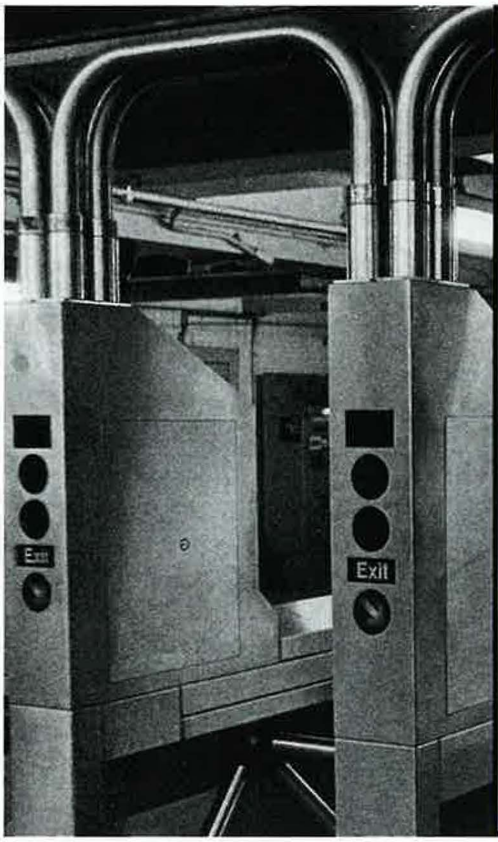

GOULD/AMERICAN FOUNDATION FOR THE BLIND

ACCESSING PUBLIC TRANSPORTATION

New Technologies Aid Persons with Sensory or Cognitive Disabilities

KATHARINE HUNTER-ZAWORSKI

The Americans with Disabilities Act of 1990 (*1*) requires that transit systems ensure effective communication with persons with disabilities, including those with sensory and cognitive impairments (*2*). The legislation has stimulated the development of a number of new technologies to help those with disabilities access public transportation systems by maximizing the independence and dignity of these passengers. A number of the new and advanced technologies are currently under development, undergoing demonstration, or in early use. When fully implemented, it is anticipated that these innovations will make the transit trip as seamless and pleasant as possible for all travelers, not just for those with disabilities.

To be successful a technology must be designed for those customers who will use it. In this case, this means not only the transit passengers, but all persons involved with the trip, such as vehicle operators, maintenance personnel, transit management, equipment manufacturers, and government officials who manage and regulate the transit industry. The particular technologies that assist transit passengers with sensory or cognitive disabilities are discussed here.

It is difficult to estimate the cost of many of the new technologies. Some are the result of extensive research projects underwritten by the federal governments of the countries in which the technology was developed. In other instances the cost has been shared among the transit agency demonstrating the technology, private companies, and government sponsors. For those technologies that are commonly available, the cost information is proprietary and is negotiated for each application.

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Trip Planning

Trip planning includes the use of transit information, route maps, fare schedules, and general or special customer information. This information can be in the form of printed materials or in alternative formats such as braille, large print, tactile maps, or audio maps and cassettes. Some of these items are described as follows.

- Tactile mapping is a combination of braille, raised symbols, and large print to transform printed maps into useful tools for those with disabilities. In Tokyo, for example, tactile maps use different textures to represent different objects, such as railroad tracks, station entrances and exits, restaurants, and newsstands. An audio signal indicates the location of the tactile map. Braille blocks embedded near a crosswalk or intersection lead blind and visually impaired travelers from one end of the crosswalk directly to the bus stop.
- Telecommunications Device for the Deaf is a device that allows messages to be sent over a telephone line by means of typed responses on a special keyboard that connects to the telephone. This technology, which is used by most transit agencies, provides visual instead of auditory messages. Some types of personal computer modems can be used for transmission.
- Hearing Aid-Compatible Telephones convert sounds into magnetic energy, enabling transit users to converse on the telephone. The telephone and the user's hearing aid must be properly equipped to be compatible. An induction coil sensitive to the telephone's magnetic energy is placed within the compatible hearing aid to

convert the energy back to sound. A t-switch allows magnification of sounds coming only from the induction coil. Amplified telephones have adjustable volume control and can amplify speech by 20 decibels, thus reducing the influence of background noise. These telephones are also compatible with a hearing aid t-switch.

• Facsimile Equipment has become a familiar part of everyday life. One advantage for those for whom typing is difficult is that it is not required for using this equipment as it is for telecommunications devices for the deaf. Another advantage is the personal format that can be used (2).

• "Smart" Traveler Systems are part of intelligent vehicle-highway systems. These systems provide opportunities for transit agencies to convey travel and trip-planning information to potential transit customers. A smart traveler system operates like a travel agent for public transportation, providing potential customers with a number of modal choice options, routes, schedules, and prices for the different options for traveling between two points.

Although most smart traveler systems are designed for the general public, systems that assist persons with disabilities to plan a trip either on fixed route or paratransit systems have been developed. Computer-assisted reservation and scheduling systems help both paratransit operators and users, and many of these technologies also coordinate other procedures such as pickup and drop-off and any intermodal transfers.

• Handyline and BusLine. Handyline, used by B.C. Transit in Vancouver, British Columbia, Canada, is a fully automated telephone information system using microcomputers. Customers can call a computer and request, reserve, and receive immediate confirmation for a ride. In Victoria, British Columbia, Busline provides general transit information and a geocoded bus route network data base includes information on each link in the system. A geographic information system (GIS) is also being developed for integration into the BusLine system.

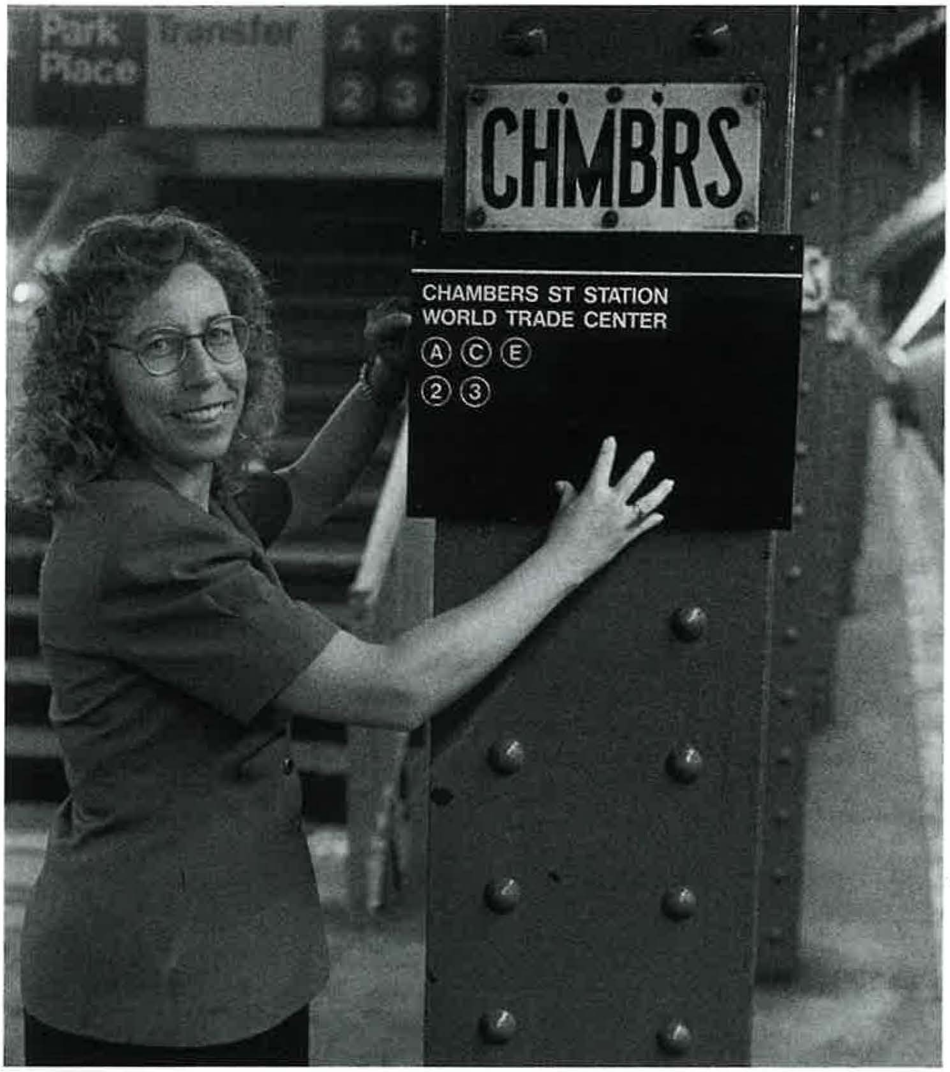
Other technologies are also available with a wide spectrum of scheduling and dispatch options. Typically the more sophisticated the system, the more expensive it is. In some jurisdictions the implementation of smart traveler technologies has required the cooperation of independent agencies and providers. The coordination of these agencies is a major difficulty in putting the smart systems to use.

Getting To and From Transit Facilities

Bus Stop and Transit Station Access

The regulations issued by the U.S. Department of Transportation on September 6, 1991 (49 CFR Part 37), are clear on the responsibilities for accessible bus stops and transit stations. A number of papers and handbooks provide guidance for design and construction of these facilities (3,4). The provisions of the regulations on detectable warnings are currently under review by U.S. DOT and the U.S. Architectural and Transportation Barriers and Compliance Board (Access Board) and a final rule is anticipated.

Tactile paths and visual signs can assist persons with visual impairments to locate stops at a station terminal. Public address announcements, "talking" bus stops, and "talking buses" are additional ways to direct travelers to their correct



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Elga Joffee, Chair of American Foundation for the Blind's Americans with Disabilities Act Consulting Group, displays braille and large print platform sign in New York City subway system.

vehicles. Tactile signs containing raised letters or characters enable visually impaired persons to read signs in transit systems such as route and fare information at bus stops, information kiosks, or customer service centers. Tactile paths are textured surfaces designed to be detectable by foot or cane and distinct from the surrounding ground area. Some textured surfaces may also have distinct colors so that they can be detectable by persons with low vision (*5*).

Electronic Speech Information Equipment

Electronic speech information equipment was developed in England to enable visually impaired travelers to locate a bus stop, activate audible route and schedule information, and be alerted to the arrival of a given bus. The three components of the system are a digital speech unit, a unit that reads the route numbers of approaching buses, and a microcomputer that coordinates the other two components. The procedure involves mounting a low-power radio transmitter by the road. The bus, which is equipped with a small receiver, picks up the signal as it approaches and responds by transmitting a signal back that is encoded with the bus route number. A microprocessor at the bus stop interprets this signal. When a button at the bus stop is activated, a message announces the approaching bus number, schedule information, and the arrival time of the next bus. The box to which the button is attached emits a "click" approximately every second so that the button can be located. This clicking sound also helps to identify the bus stop (*6*).

Auditory Pathways

Auditory pathways incorporate a system of speakers positioned throughout the desired path. Customers can activate the system by such means as a signaling device, a button that is depressed when entering a station, or a motion detector to activate the speaker as they enter the area.

Route Cards

Route cards are low-technology signaling devices. These cards, which are designed with large letters or numbers, identify the desired route and are held by the passenger so that the driver of an approaching bus can see them.

Verbal Landmark Systems

A pocket-sized receiver and a transmitter keep travelers with visual or cognitive impairments, reading disabilities, or language barriers informed of their location or provide travel information. When an individual wearing a receiver enters the field of transmission, information is transmitted through the receiver's speaker. Information can be provided about building entrances and directories, elevators and stairways, restrooms, office entrances, cultural and sports facilities, mass transit vehicles, public transit stops, and retail stores.

Talking Buses

Digital speech is used to announce destinations, stopping points, and intersections. Automatic messages can be programmed to be activated by opening the bus door, by pole transmitters along the route, or by other automatic vehicle locator devices. For a manual message, an operator can depress a number-coded entry key. Current technology allows for simultaneous broadcast by interfacing digital speech with a visual display (*3*).

Fare Collection

New technologies are facilitating the collection of fares. For persons with disabilities, off-vehicle fare collection is the easiest method, and includes the use of passes, prepaid fares, some smart card applications, and fare boxes that are located at the bus stops or transit stations.

Smart Cards

The financial, security, operational, strategic, and accounting requirements of smart cards and electronic fare-collection technologies are described in a Transportation Research Circular (*7*). Smart cards come in various forms. One version has a magnetic strip and another an embedded microchip. The most significant difference between the two cards is cost. The card with the magnetic strip costs approximately 6 cents. The one with the small computer chip costs about $6, but is capable of holding considerably more information and is reprogrammable or reusable. Another type of smart card has a radio frequency device attached and the user passes by a radio frequency receiver at an entrance gate to the transit facility.

Fahrsmart System

The Fahrsmart system, used in Germany, is a cashless payment system. Passengers enter their cards in readers on entering and exiting the vehicle. All transactions are stored in an on-board processor and read into a central computer at night. Fares are calculated at the end of each accounting period and the most favorable rate is deducted from the customer's bank account.

Navigating the System

Visual Signs

Transit agencies need signs that are consistent and uniform in design and easily located and accessible. Print information should be legible, using symbols, pictographs, and large print. Incorporating standard symbols in signs is beneficial to persons with and without disabilities. Other items to be considered for standardization are architectural design features, lighting, emergency alarm systems, icons, color coding, and priority seating (*3*).

Electronic Information Systems

Electronic information systems for customer or passenger information are being developed at a prodigious rate. In general these systems provide real-time traveler information, advertising, public announcements, and emergency and general travel information. Types of transit customer information systems in use include visual-only systems, audio-only systems, and a combination of both. Some systems provide information on fixed schedules, whereas other more advanced systems provide real-time information by either telephone line or radio signal, based on automatic vehicle location (AVL) systems. The advantage of a real-time system is its ability to provide more accurate scheduling information, and information or instructions in the event of a breakdown or accident.

An example of a real-time system is a readerboard/audio system on board the vehicle that uses a radio signal from a transit control center to update passenger information or display advertisements. Customer information systems under development include flat panel liquid crystal displays (LCD), flip-dot and fiber optic displays, new development in light-emitting diodes (LED), and improvements in design for travelers with disabilities.

System Descriptions

• *San Diego, California.* The Rapid Transit District is currently using a video display on board its vehicles and a multipurpose information terminal at strategic positions in the system. The system is accessible to persons with disabilities and is multilingual. The display is one step beyond a normal cathode ray tube in that it accepts touchscreen inputs to make the system interactive. The information available includes timetables, route maps of various lines, and advertisements. A graphic picture of the route is displayed to which road networks and landmarks can be added. The onboard displays offer the same features.

• *St. Saulve, France.* LED readerboards using single or multiple colors are used. LED is a pea-sized electronic device that emits light when a current is applied. Unlike light bulbs, which produce illumination by white-hot filaments, readerboards use a two-dimensional array of LEDs to display letters, numbers, or symbols. They can also provide some animation, depending on system capabilities. A user receives information from a LED display panel at stops and on board the vehicle. Bus route, destination, schedule, and delay information is provided at bus stops. Messages about the next stop and transfers are displayed on board the vehicles. All information is real time based on an AVL system. Similar technologies have been installed in Sweden.

• *Montreal, Quebec, Canada.* A system developed and installed uses LED readerboards and speakers to provide visual and audible (through digitized voice) information. The name of the next stop is displayed and announced as the vehicle leaves a stop. Between stops general information, news, and advertising can be presented, including any real-time information such as public and emergency news. The information is sent by radio wave from a control center. This communication system pairs auditory and visual information on a network that enables

LEVINE/WASHINGTON METROPOLITAN TRANSIT AUTHORITY

Travelers with disabilities will not be only ones to benefit from new technologies designed to improve accessibility of public transportation; some innovations will make travel easier for all transit customers.

Low-floor buses such as Orion II enable persons with disabilities, parents with small children, and the elderly to board vehicle more easily.

transit authorities to deliver specific, rapidly updated messages. Three high-intensity panels display images and text. The hardware can also digitize, store, and replay specific audio messages.

• *Rotterdam and Utrecht, The Netherlands.* A system based on vehicle tagging (VETAG) for AVLs is linked to vehicle tagging, which provides AVL information. VETAG information provides real-time adjustments to timetables and is presented visually by LED readerboard and audibly by digitized voice on a speaker. Timetable and next-stop information is also provided.

• *London, England.* A passenger information system for use at bus stops has been developed by London Transport. Information is presented about the route, destination, and time until arrival of the next three buses at a single-route stop, or the next seven buses at a multiroute stop. Signs, which are currently being installed, will eventually be placed at 4,000 stops (about a quarter of the total number). The signs are currently three-line red LED based on 5-millimeter LEDs in a 5 X 7 matrix. Other color LEDs and matrix configurations are under development, along with a possible LCD flat panel display. Also under development is an audio version (*8*).

Technologies Under Development

Some technologies that have been developed for other applications are being considered for transit applications.

• Automatic speech recognition systems (ASR) involve data entry into computers by voice recognition. The hearing person speaks into a microphone connected to a computer, which acts as an interpreter and converts the speech to text. ASR is a rapidly evolving technology that is still in its infancy in transportation applications. Currently the computer interprets only 30 to 40 words per minute, which is not close to the speed of real-time speech recognition. The system works on a matching principle whereby the pattern produced by the sounds is matched with a pattern for particular sounds and phrases. When a sound is made that closely approximates a pattern, the corresponding word is chosen. The person who speaks into the device must be registered with the computer. Only after repeated use can the registered voice pattern be recognized. Technology is available to connect ASR devices with TDDs. This holds the potential for improved distribution of transit information.

• Radio frequency fare cards, previously described, can make fare payment easier and eliminate the need to handle the card or any other fare device.

• GIS and AVL technologies: GIS include geocoding of city streets, facilities, and services. In Portland, Oregon, the GIS system also includes all the addresses for paratransit service customers. This application has permitted detailed planning and route structuring for the paratransit operations.

AVL technologies are based on signposts, vehicle tagging and receivers, or global positioning systems (GPS). AVL systems permit the real-time monitoring of transit vehicle location. The technology is linked to automatic bus stop announcements. It is anticipated that in the near future AVL information will be directly input to advanced traveler information systems, bus stop information kiosks, and general passenger information systems. Demonstration projects of these technologies are under way at several transit agencies around the country. No integrated GPS/GIS systems are in operation at this time, but demonstration projects are planned for the near future. A number of configurations of AVL, GPS, and GIS technologies are being tested

Future Concepts

Many of the transit technologies under development will facilitate travel for everyone. Low-floor buses and light rail vehicles make vehicle access simpler and faster for travelers, including parents with small children, the elderly, and persons with disabilities. Improvements in fare collection both on and off the vehicle will simplify some of the vehicle operators' responsibilities and provide tighter management and fiscal controls for the operating agency. All transit customers, including transit operators and management, will benefit from the integration of GIS/AVL and real-time information systems at stations and bus stops and on board transit vehicles.

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MPOs and State DOTS *continued from page 9*

the planning process to deal realistically with environmental protection and land development will require close relationships with federal, state, and local regulatory agencies. Incorporating MTIP into STIP will require close relationships with the governor and the SDOT. In complex urban areas, where there is more than one MPO or SDOT, constructive relationships with each of those organizations will be needed.

8. *Retooling the staff.* Like SDOTs, MPOs may need to be restaffed to meet new needs. Because MPOs have been meeting federal planning requirements under previous laws, their need to retool may not be as great as that of SDOTs. Nevertheless, most MPOs will probably find staffing needs in activities such as air quality planning, intermodal and financial planning, and public involvement.

Sources of Help

DOT, TRB, and the Surface Transportation Policy Project (STPP) are all aware of the fundamental changes called for by ISTEA, and they are trying to be helpful. For example, DOT is funding several research projects and conferences to assess MPO and SDOT capacities to perform ISTEA tasks and to identify best practices. TRB has initiated a task force on intermodal planning. STPP has established a Partner State Program to help expand the public involvement processes in SDOTs and strengthen the relationships between SDOTs and MPOs. (See related article in this issue of *TR News.*)

It is too early to report results from these efforts, but they can be expected in the next year or two as the reauthorization of ISTEA nears. Meanwhile, keep improvising, and share experiences.

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