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**Electronic On-Vehicle Passenger Information
Displays (Visual and Audible)**

This TCRP Digest provides the interim results of TCRP Project A-4, "Electronic On-Vehicle Passenger Information Displays (Visual and Audible)." The project explores ways in which transit agencies and transit users can benefit from on-board audio and visual display technologies. The major focus of this project is on the information needs of passengers while on board transit vehicles. This Digest summarizes passenger information needs, agency concerns, and the current and emerging display technologies. It was prepared by Dr. Peggy Willis, King County Department of Metropolitan Services.

INTRODUCTION

Electronic audio and visual message display technologies provide opportunities to communicate customer-oriented information on board transit vehicles, and make public transportation services more convenient and user friendly. Passengers can benefit from receiving information about transportation services while on route. Transit agencies can benefit from service quality improvements that make public transportation more attractive and competitive, and from potential sources of revenue generated from the sale of advertising shown on the electronic displays.

In this study, the needs of passengers and transit agencies for electronic on-vehicle passenger information systems have been assessed. Available technologies and successful applications at transit agencies have been described. The research conducted in this study includes a literature review, a survey of transit agencies, passenger focus groups, and a survey of vendors of electronic passenger information devices.

The material contained in this digest should prove helpful to transit agency managers, general managers, maintenance managers, and others who are seeking a synthesis of information on how on-vehicle passenger information devices are being used throughout North America and Europe.

NEEDS ASSESSMENT

Information regarding new technologies for providing passenger information and their potential

applications in the transit industry has not been widely disseminated to transit agencies. In addition, little research has been done by transit agencies to determine passenger requirements for on-vehicle information or to measure reactions to on-vehicle information systems where such systems have been implemented.

Literature Review

The state of the art of electronic communication technologies is changing rapidly. New types of electronic information can be provided to passengers because of recent developments in the integration of real-time information and next-stop announcements. Developments are also being made outside the transit industry that may have potential for transfer to the transit operating environment.

In assessing advanced technologies for providing passenger information on board vehicles, U.S. transit agencies have made assumptions about basic information needs but, for the most part, have not identified passenger requirements through customer research prior to installing these systems. The researchers found few reports produced by transit agencies with electronic passenger information systems describing passenger reactions to these information systems.

Survey of Transit Agencies

A survey of North American and European transit agencies found that on-vehicle passenger information systems are currently being used mainly

to provide next-stop and connecting route information. Thirteen transit agencies with automated voice and/or electronic display systems inside the vehicle, and 13 transit agencies without such systems were interviewed. Among those with passenger information systems, eight had both audio and visual systems, three had automated voice systems, and two had information display systems.

Next-stop information and information about connecting routes at key transfer points were the most frequently provided types of information. Other information affecting transit service was provided on some systems, as was route or line number, final destination, and key destinations at the next stop. Information less likely to be provided included the names of several upcoming stops and arrival times of connecting routes. Information provided only visually included news, sports, entertainment, and advertising.

Transit agencies that currently do not have passenger information devices also expressed interest in these systems. These agencies were interested in providing information on connecting routes, key destinations, next-stop information, and arrival times of connecting routes. Emergency messages and paid advertising would also be useful. Some agencies expressed concern about the intrusiveness of audio announcements.

Light emitting diode (LED) displays and digital voice announcements were the most commonly used technologies.

Most messages were transmitted to display devices by downloading preprogrammed messages to individual vehicles rather than broadcasting the data from a remote source. However, individual coach downloading tends to be time consuming and results in less frequent updates of information and advertising. One agency used a memory card to transmit data to the information devices, which is somewhat easier to

update than downloading via hardwire connection.

Most agencies updated messages infrequently, at most only a few times per year; quite commonly systems were updated at major service reconfigurations. Few agencies updated their messages daily.

Overall, agencies with systems rated the reliability of the current passenger information systems as good to excellent. Cost estimates for purchase and installation ranged from \$2,300 to \$6,500 per vehicle. Important issues in implementing on vehicle passenger information systems identified by transit agencies included: labor and logistics issues related to installing the equipment, placement of the equipment on the vehicle, integration with other electronic systems, and ease of access for programming and maintenance.

Areas of functional guidelines for electronic passenger information systems, obtained from the literature review and interviews with transit agencies, are listed in Table 1.

Passenger Focus Groups

Two focus group discussions were held to gather additional information on passenger needs. These discussions indicated that attention to both transportation messages and entertainment may enhance customer experiences while on vehicles. Focus group participants were especially interested in next-stop, route number and name, and other transportation information, as well as entertainment (trivia and humor), time of day, and traffic updates.

Focus group participants expressed reservations about the intrusion of audio systems and advertising. They preferred that announcements reinforce key information—such as the next stop—to make passengers pay attention. Some mentioned that essential information should be both audible and visual.

Focus group participants viewed advertising announcements negatively, but were more accepting of visual advertisements.

SYNTHESIS OF TECHNOLOGIES

Technology advances have resulted in a wide range of message display systems. Those currently used in the transit industry include flip dot displays, liquid crystal displays (LCDs), light emitting diode (LED) displays, and television monitors.

Selection of a display or announcement system depends primarily on the type of information to be supplied to the passenger, and the format (audio or visual) in which the information is to be provided. Factors that determine the choice of a display include character size, color, and style; requirements for symbols or graphics; ambient lighting conditions; and viewing distances. In the transit environment, attention must also be given to shock and vibration. As with any electronic system, it is important to ensure that the display or announcement system is not adversely affected by radio frequency interference or electromagnetic interference (RFI/EMI). Passenger information systems should be compatible with the electronic environment on the vehicle and capable of being integrated with other on-board systems.

To reduce driver responsibility in operating the passenger information devices, automatic message triggering is needed. If messages are triggered automatically, the vehicle's location must be provided electronically at the time the message is to be triggered. This can be achieved through interface with automated vehicle location (AVL) systems or a preprogrammed route, often augmented with door openings, odometer readings, and time elapsed between stops. Date and time of day may also be used to trigger announcements

These **Digests** are issued in the interest of providing an early awareness of the research results emanating from projects in the TCRP. By making these results known as they are developed, it is hoped that the potential users of the research findings will be encouraged toward their early implementation. Persons wanting to pursue the project subject matter in greater depth may do so through contact with the Cooperative Research Programs Staff, Transportation Research Board, 2101 Constitution Ave., N.W., Washington, DC 20418

TABLE 1 Areas of functional guidelines for electronic passenger information systems

PASSENGER REQUIREMENTS	<ul style="list-style-type: none"> - high quality acoustics - visibility from all seats - limited number of messages
PHYSICAL CHARACTERISTICS	<ul style="list-style-type: none"> - large enough to be seen - small enough to be out of passengers' way
VISUAL FEATURES	<ul style="list-style-type: none"> - readability in all light conditions - multiple colors, graphics, and animation for advertising
DRIVER REQUIREMENTS	<ul style="list-style-type: none"> - automatic ambient noise volume adjustment - no driver participation required to operate - driver ability to turn device on and off
EMERGENCY INFORMATION	<ul style="list-style-type: none"> - capability for driver or operations control to override system with emergency information
MESSAGES	<ul style="list-style-type: none"> - announcements of where vehicle is and where it is going - sufficient memory capacity to accommodate information and advertising
REAL-TIME INFORMATION	<ul style="list-style-type: none"> - capability for use in schedule, connecting-route messages
MESSAGE PROGRAMMING AND DISPATCH	<ul style="list-style-type: none"> - simple programming of messages - capability to update frequently changed messages from a remote location - capability to target messages to individual displays - capability to purge messages automatically
OPERATION	<ul style="list-style-type: none"> - capability to accommodate changes in bus routing - capability to function with different kinds of vehicle location systems
SUPPLIER	<ul style="list-style-type: none"> - technical support, training, and instructions
INSTALLATION	<ul style="list-style-type: none"> - minimum wiring and retrofit - adequate electrical supply in device or on vehicle
STANDARDS/MODULARITY	<ul style="list-style-type: none"> - adherence to SAE J1708 and 1578 hardware, software, and communications standards - interoperability with other systems - expandability as system requirements change
MAINTENANCE	<ul style="list-style-type: none"> - reliable equipment - easy access for diagnosis, repair, or replacement
COST	<ul style="list-style-type: none"> - complete cost estimates including retrofit, maintenance, ongoing support - capability of advertising to cover costs and provide revenue

automatically. Manual operation by the vehicle driver is used when automated systems are not available.

Survey of Vendors

Although most products currently available can provide nearly any type of passenger information, vendors' experiences depended on the specific information requirements of the transit agencies. Visual displays were most frequently used for providing messages. Audio announcements were used mainly for next-stop information and emergency messages. European vendors were likely to produce systems that provided information in both visual and audio formats; American vendors tended to specialize in one format.

Vendors who have placed their information devices on the interior of transit vehicles most commonly have used LED technology for visual displays and digital recording technology to provide audio messages.

The means of transmitting messages to the devices depended on the type of information provided. Downloading information to individual devices, typically through hardwire connection or memory card, was used for next-stop and routine transit service announcements. Transmission from a remote source—most frequently through radio transmission via FM signal—was used most often for entertainment, advertisements, and emergency messages. While vendors can provide systems that transmit messages using either technique, most have experience primarily with one or the other. Most vendors who participated in this study transmit

information by downloading to individual devices.

Messages can be prepared by the transit agency or the vendor. In practice, the transit agency was typically responsible for recording and programming transit messages, whereas vendor involvement usually occurred only with entertainment and advertising messages.

Information devices produced by these vendors were developed with broad interface capabilities, and were able to communicate with many other electronic systems. However, these vendors' experiences in interfacing their devices with other on-board electronic systems were limited. Most products supplied by American vendors adhered to Society of Automotive Engineers (SAE) J1708 standards for product interface. European products were developed to a different set of standards, which varied by country.

CONCLUSIONS

Information Needs

Comparisons of passenger and transit agency information needs are provided in Table 2. The data indicate transit agencies with information devices and those without such devices agree on which devices are useful. Agencies without these devices reported that information on vehicle arrival times and paid advertising would be useful. Passengers generally reported agreement with transit agencies but would also like information about upcoming stops; other information affecting transit service—

including route and schedule changes; time of day; and trivia or joke of the day.

Technological Capabilities

For the most part, technology is ahead of applications in the transit industry. Few agencies have made full use of display capabilities to provide advanced passenger information, such as real-time information or frequent information updates.

Greater integration of passenger information devices with other electronic devices, including AVL systems, is required to reduce vehicle driver involvement in the operation of the information devices.

Greater flexibility in the types of announcements that can be made and in the frequency with which such announcements are updated could be achieved 1) through transmission of data to all devices from a remote source or 2) through the use of memory cards for transmitting data. These technology options are currently underutilized in the transit industry.

FUTURE RESEARCH

Subsequent research on this project will investigate advertising revenue sources, identify disparities and overlaps between available technologies and transit agency and passenger needs, perform a cost and revenue analysis, and prepare a set of guidelines to assist agencies in selecting appropriate technologies. This project is scheduled to be completed in December 1995.

TABLE 2 On-vehicle electronic passenger information system needs

	PASSENGER INFORMATION NEEDS*		AGENCY INFORMATION NEEDS			
			HAVE SYSTEM** n=13		DON'T HAVE *** n=13	
	VISUAL	AUDIBLE	VISUAL	AUDIBLE	VISUAL	AUDIBLE
ROUTE NAME/NUMBER	X	X				
NEXT-STOP INFORMATION	X	X	X	X	X	X
KEY DESTINATIONS NEXT STOP	X	X		X	X	X
UPCOMING THREE STOPS	X	X				
CONNECTING ROUTES	X	X	X	X	X	X
VEHICLE ARRIVAL TIMES	X	X			X	
OTHER INFORMATION AFFECTING TRANSIT SERVICE (traffic, route/schedule changes)	X	X	X	X		
EMERGENCY MESSAGES				X	X	X
TIME OF DAY	X	X				
TRIVIA, JOKE OF DAY	X					
PAID ADVERTISING					X	

* Information desired by focus group participants.

** Inclusion based on five or more transit agencies surveyed that have the devices.

*** Inclusion based on five or more transit agencies surveyed that do not have the devices, but consider such information "very useful."