NATIONAL COOPERATIVE TRANSIT RESEARCH & DEVELOPMENT PROGRAM



# 7 Synthesis of Transit Practice

# Passenger Information Systems for Transit Transfer Facilities

TRANSPORTATION RESEARCH BOARD

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### *Transportation Research Record 1106*

page 225
The second sentence in the abstract should read as follows:

> In the past, a uniform set of geometric design standards for these types of roads was not available in Canada.

page 227
The last item in the bullet list in column 1 should read as follows:

> One-lane, two-way resource development roads for ADTs up to 100 vpd.

pages 229–232
The figure captions should read as follows:

| | |
|---|---|
| FIGURE 1 | Cross-section elements for two-lane, low-volume earth and gravel roads. |
| FIGURE 2 | Cross-section elements for two-lane, low-volume surfaced roads. |
| FIGURE 3 | Cross-section elements for one-lane, two-way low-volume roads. |
| FIGURE 4 | Cross-section elements for one-lane, one-way low-volume roads. |
| FIGURE 5 | Roadway width versus design speeds of various road agencies (ADT < 50). |
| FIGURE 6 | Roadway width versus design speeds of various road agencies (ADT 50 to 100). |
| FIGURE 7 | Roadway width versus design speeds of various road agencies (ADT 100 to 150). |
| FIGURE 8 | Roadway width versus design speeds of various road agencies (ADT 150 to 200). |

### *NCTRP Synthesis of Transit Practice 7*

pages 22 and 23
The captions for Figures 11 and 12 have been transposed.

### *NCHRP Synthesis of Highway Practice 128*

page ii
The subject area Bituminous Materials and Mixes (31) is incorrect; it should be Transportation Safety (51). (This is also incorrect in the 1988 TRB Publications Catalog, p. 24.)

### *NCHRP Report 298*

page 93, Section 14.2, Definitions
The last three items in column 1 and the first in column 2 should read as follows:

$S$ = Shape factor of one layer of a bearing

$$= \frac{\text{Loaded Area}}{\text{Effective Area Free to Bulge}}$$

$$= \frac{LW}{2h_{ri}\,(L + W)} \text{ for rectangular bearings}$$

$$= \frac{D}{4h_{ri}} \text{ for circular bearings}$$

page 94
In the third paragraph, last sentence, the reference to "Section 25.9.1" should read "Section 25.7.1."

NATIONAL COOPERATIVE TRANSIT RESEARCH & DEVELOPMENT PROGRAM

## 7 Synthesis of Transit Practice

# Passenger Information Systems for Transit Transfer Facilities

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*Subject Areas*
Structures Design and Performance
Human Factors
Operations and Traffic Control

*Mode*
Public Transit

TRANSPORTATION RESEARCH BOARD
National Research Council
Washington, D.C. October 1985

## NATIONAL COOPERATIVE TRANSIT RESEARCH & DEVELOPMENT PROGRAM

Administrators, engineers, and many others in the transit industry are faced with a multitude of complex problems that range between local, regional, and national in their prevalence. How they might be solved is open to a variety of approaches; however, it is an established fact that a highly effective approach to problems of widespread commonality is one in which operating agencies join cooperatively to support, both in financial and other participatory respects, systematic research that is well designed, practically oriented, and carried out by highly competent researchers. As problems grow rapidly in number and escalate in complexity, the value of an orderly, high-quality cooperative endeavor likewise escalates.

Recognizing this in light of the many needs of the transit industry at large, the Urban Mass Transportation Administration, U.S. Department of Transportation, got under way in 1980 the National Cooperative Transit Research & Development Program (NCTRP). This is an objective national program that provides a mechanism by which UMTA's principal client groups across the nation can join cooperatively in an attempt to solve near-term public transportation problems through applied research, development, test, and evaluation. The client groups thereby have a channel through which they can directly influence a portion of UMTA's annual activities in transit technology development and deployment. Although present funding of the NCTRP is entirely from UMTA's Section 6 funds, the planning leading to inception of the Program envisioned that UMTA's client groups would join ultimately in providing additional support, thereby enabling the Program to address a large number of problems each year.

The NCTRP operates by means of agreements between UMTA as the sponsor and (1) the National Research Council as the Primary Technical Contractor (PTC) responsible for administrative and technical services, (2) the American Public Transit Association, responsible for operation of a Technical Steering Group (TSG) comprised of representatives of transit operators, local government officials, State DOT officials, and officials from UMTA's Office of Technical Assistance, and (3) the Urban Consortium for Technology Initiatives/Public Technology, Inc., responsible for providing the local government officials for the Technical Steering Group.

Research Programs for the NCTRP are developed annually by the Technical Steering Group, which identifies key problems, ranks them in order of priority, and establishes programs of projects for UMTA approval. Once approved, they are referred to the National Research Council for acceptance and administration through the Transportation Research Board.

Research projects addressing the problems referred from UMTA are defined by panels of experts established by the Board to provide technical guidance and counsel in the problem areas. The projects are advertised widely for proposals, and qualified agencies are selected on the basis of research plans offering the greatest probabilities of success. The research is carried out by these agencies under contract to the National Research Council, and administration and surveillance of the contract work are the responsibilities of the National Research Council and Board.

The needs for transit research are many, and the National Cooperative Transit Research & Development Program is a mechanism for deriving timely solutions for transportation problems of mutual concern to many responsible groups. In doing so, the Program operates complementary to, rather than as a substitute for or duplicate of, other transit research programs.

### NCTRP SYNTHESIS 7

Project 60-1 FY 1982 (Topic TS-8)
ISSN 0732-1856
ISBN 0-309-04008-6
Library of Congress Catalog Card No. 85-51730

**Price: $7.60**

### NOTICE

The project that is the subject of this report was a part of the National Cooperative Transit Research & Development Program conducted by the Transportation Research Board with the approval of the Governing Board of the National Research Council. Such approval reflects the Governing Board's judgment that the program concerned is of national importance and appropriate with respect to both the purposes and resources of the National Research Council.

The members of the technical committee selected to monitor this project and to review this report were chosen for recognized scholarly competence and with due consideration for the balance of disciplines appropriate to the project. The opinions and conclusions expressed or implied are those of the research agency that performed the research, and, while they have been accepted as appropriate by the technical committee, they are not necessarily those of the Transportation Research Board, the National Research Council, or the Urban Mass Transportation Administration, U.S. Department of Transportation.

Each report is reviewed and accepted for publication by the technical committee according to procedures established and monitored by the Transportation Research Board Executive Committee and the Governing Board of the National Research Council.

The National Research Council was established by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and of advising the Federal Government. The Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in the conduct of their services to the government, the public, and the scientific and engineering communities. It is administered jointly by both Academies and the Institute of Medicine. The National Academy of Engineering and the Institute of Medicine were established in 1964 and 1970, respectively, under the charter of the National Academy of Sciences.

The Transportation Research Board evolved in 1974 from the Highway Research Board, which was established in 1920. The TRB incorporates all former HRB activities and also performs additional functions under a broader scope involving all modes of transportation and the interactions of transportation with society.

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*Published reports of the*

**NATIONAL COOPERATIVE TRANSIT RESEARCH & DEVELOPMENT PROGRAM**

*are available from:*

Transportation Research Board
National Research Council
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Printed in the United States of America

## PREFACE

A vast storehouse of information exists on nearly every subject of concern to the transit industry. Much of this information has resulted from both research and the successful application of solutions to the problems faced by practitioners in their daily work. Because previously there has been no systematic means for compiling such useful information and making it available to the entire transit community, the Urban Mass Transportation Administration of the U.S. Department of Transportation has, through the mechanism of the National Cooperative Transit Research & Development Program, authorized the Transportation Research Board to undertake a series of studies to search out and synthesize useful knowledge from all available sources and to prepare documented reports on current practices in the subject areas of concern.

This synthesis series reports on various practices, making specific recommendations where appropriate but without the detailed directions usually found in handbooks or design manuals. Nonetheless, these documents can serve similar purposes, for each is a compendium of the best knowledge available on measures found to be successful in resolving specific problems. The extent to which these reports are useful will be tempered by the user's knowledge and experience in the particular problem area.

## FOREWORD

*By Staff*
*Transportation Research Board*

This synthesis will be useful to planners, designers, and others in the transit industry concerned with design of transit transfer facilities and communication with transit passengers. Information is presented on communication principles and on various means of communicating with transit passengers.

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Administrators, engineers, and researchers are continually faced with problems on which much information exists, either in the form of reports or in terms of undocumented experience and practice. Unfortunately, this information often is scattered and unevaluated, and, as a consequence, in seeking solutions, full information on what has been learned about a problem frequently is not assembled. Costly research findings may go unused, valuable experience may be overlooked, and full consideration may not be given to the available methods of solving or alleviating the problem. In an effort to correct this situation, NCTRP Project 60-1, carried out by the Transportation Research Board as the research agency, has the objective of reporting on common transit problems and synthesizing available information. The synthesis reports from this endeavor constitute an NCTRP publication series in which various forms of relevant information are assembled into single, concise documents pertaining to specific problems or sets of closely related problems.

Availability of passenger information encourages use of transit and is especially important at transfer points because these are often the initial points of entry into the public transportation network. This report of the Transportation Research Board describes the information aids used to communicate with passengers and gives general guidance on the factors that are important when designing a program of information aids.

To develop this synthesis in a comprehensive manner and to ensure inclusion of significant knowledge, the Board analyzed available information assembled from numerous sources, including a large number of public transportation agencies. A topic panel of experts in the subject area was established to guide the researcher in organizing and evaluating the collected data, and to review the final synthesis report.

This synthesis is an immediately useful document that records practices that were acceptable within the limitations of the knowledge available at the time of its preparation. As the processes of advancement continue, new knowledge can be expected to be added to that now at hand.

# CONTENTS

**ACKNOWLEDGMENTS**

This synthesis was completed by the Transportation Research Board under the supervision of Damian J. Kulash, Assistant Director for Special Projects. The Principal Investigators responsible for conduct of the synthesis were Thomas L. Copas and Herbert A. Pennock, Special Projects Engineers. This synthesis was edited by Anne S. Brennan.

Special appreciation is expressed to John J. Fruin, Massapequa, New York, who was responsible for the collection of data and the preparation of the report.

Valuable assistance in the preparation of this synthesis was provided by the Topic Panel, consisting of Charles F. Arndt, Superintendent, Facilities and Equipment Planning, Chicago Transit Authority; S. Lee Carlson, Architect, Skidmore, Owings & Merrill; Lester A. Hoel, Chairman, Department of Civil Engineering, University of Virginia; Lana L. Nelson, Senior Manager, Customer Services, Tri-County Metropolitan Transportation District of Oregon; Harold I. Wright, Consultant, Transit Graphics; and Liaison Member Bert Arrillaga, Chief, Pricing Policy Group, Urban Mass Transportation Administration.

W. Campbell Graeub, Engineer of Public Transportation, of the Transportation Research Board, assisted the Project 60-1 Staff and the Topic Panel.

Information on current practice was provided by many transit agencies. Their cooperation and assistance were most helpful.

# PASSENGER INFORMATION SYSTEMS FOR TRANSIT TRANSFER FACILITIES

**SUMMARY** A passenger information program that gives a clear understanding of available transit services, including connections, frequency of service, and costs, will encourage use of transit. Passenger information at transit transfer points, such as bus stops, transit stations, and multi-modal terminals, is especially important because the transfer facility is the initial point of entry into the public transportation network. A well-designed information system in a large transfer facility will promote rapid passenger processing, minimize crowding, and enhance safety and security.

There are four categories of information aids used to communicate with transit passengers. Visual communication includes directional and destinational signing, route-map and timetable displays, and video screening of departure and arrival times. Oral communication involves telephone information services, operating personnel, and other passengers. Distributed information includes route maps, timetables, brochures, and newsletters. Automatic passenger interactive systems are being increasingly used in transfer facilities; these include electric guidance maps and computer-generated trip information.

A comprehensive passenger information program must be carefully planned and consistently managed to project a favorable public image and to maximize communication effectiveness. The selection of all facets of information aids should be an integral part of transit system planning and operation. It should be an early consideration in the design of transfer facilities and is an important consideration in the selection of route structures, transfer options, and schedules. A passenger information program will consist of establishing goals, identifying user needs, selecting information aids to meet the needs, establishing design and service standards, evaluating alternatives, and selecting the final program.

Transfer facilities differ in their need for information aids; the types and numbers of aids needed depend on the size and complexity of the facility. An on-street bus stop serving a single route may need only an identifying logo and a route marker, whereas a multi-modal, multi-route facility would require a full range of aids, possibly including special personnel. Transfer facilities can be classified according to a number of factors, such as volume of passengers, number of routes, number of needs, and physical configuration. The synthesis has identified five general classification levels.

The factors that are important in designing information aids are rehearsal, where a passenger learns something about the service before using it; simplicity of the message content; consistency of presentation, design, and terminology; continuity, in progressively presenting multiple bits of information; and use of repetition to reinforce the presentation of information.

Areas where research is needed include standardization of transit signing, cost-effectiveness of changeable message signing, automatic passenger interactive information systems, national geocoding system, and transit sign materials and supports.

CHAPTER ONE

# INTRODUCTION

## IMPORTANCE OF PASSENGER INFORMATION

The use of public transportation is dependent on a clear understanding of all of its available services. Transit trips are encouraged where there is knowledge and confidence about connections to a prospective destination, frequency of services, and trip costs. Conversely, the lack of this information discourages trips by public transit, particularly by non-peak-period passengers, areas visitors, and other types of infrequent or new users.

The availability of easily understood trip information fosters positive attitudes towards transit and creates favorable perceptions of its efficiency and security. A comprehensive, well-designed and fully integrated program incorporating all the various types of information aids assures passengers that their transportation needs can be efficiently accommodated by public transit.

Transit agencies should view passenger information programs as part of the total marketing effort, with positive benefits both in terms of increasing ridership and improved public recognition of the value of transit services. In the current economic and political climate, the projection of a positive image to infrequent users and even nonusers of transit has become important because of all systems require financial support from taxes, bond issues, and other public sources.

## PASSENGER INFORMATION AT TRANSFER FACILITIES

Communication of essential trip information at transfer points, such as bus stops, transit stations, and multi-modal transportation terminals, is especially important. The transfer facility is the initial point of entry into the public transportation network, and therefore the first introduction of the passenger to both its physical facilities and services. Transfer facilities are also the connecting links of the transit network; their number and location determine both the range of trip opportunities that can be served and the utility of the system. In large transfer facilities, information aids promote rapid passenger processing and orderly pedestrian movement. This minimizes passenger crowding and delays and enhances passenger safety and security.

## RESPONSIBILITY FOR PASSENGER INFORMATION

Communication of transit information to the general public, both passengers and nonpassengers, is an important responsibility requiring a comprehensive and well-coordinated management approach. Although a range of different passenger information techniques are described in this synthesis, some would not be directly applied at transfer facilities. An example of those that would not be directly applied would be public service announcements via the broadcast or print media. However, it is emphasized that all forms of passenger information are in fact complementary, with each contributing to the passenger's general familiarity and understanding of the transit system and services. It is therefore necessary that the development, design, and application of all passenger information, in whatever form, be carefully coordinated. This requires that management responsibility for this function be clearly defined and established in every transit agency.

## PASSENGER INFORMATION NEEDS

The potential users of transit information in both rider and nonrider categories have different needs. The primary need of all prospective riders is to be able to determine if transit provides a reasonable connection between a planned trip origin and destination. Initially this requires some general knowledge about area geography and the places served by transit and, then, more specific details about the routes serving these places (including the times that services are available, service frequency, and fares). On the next level is the need to locate the transfer facility nearest the trip origin and destination and to accurately identify the transit vehicles and transfer points needed to complete the trip.

In larger multi-route and multi-modal transportation terminals, the communication of information is complicated by the greater number of services and their physical separation, at times on different building levels. This requires added directional information to negotiate the transfer facility itself. Underground transit stations can cause additional passenger orientation and information problems because the relationship with local street-level features and landmarks is obscured.

Nonriding users of transit information include system operating personnel and those who depend on the availability of public transportation for business or other reasons but do not use it. Transit operating personnel may require specialized information aids, such as directional and gate identification signing in multi-modal transfer facilities. Information directed at other nonrider categories and the general public includes vehicle and transit facility identification, and any transit-related communications in the broadcast and print media. Rider and nonrider categories using passenger information, and passenger information needs, are identified in Chapter 2.

## TYPES OF PASSENGER INFORMATION

There are four general categories of information aids used to communicate with transit passengers: (a) visual communication (signs), (b) oral communication, (c) distributed information (print media), and (d) automatic passenger interactive. Special information aids for sight- and hearing-impaired passengers in these categories are discussed separately. As noted previously, not every form of passenger information would be provided at transfer points, but each type of information is linked with the other and contributes to a fuller understanding of the transit system, its services, and public benefit. The information categories outlined below are discussed in greater detail in the following sections of the synthesis.

### Visual Communication

Directional and destinational signing, route map and timetable displays, video screening of departure and arrival times, and other forms of visual aids are the most common form of information associated with transit transfer facilities. At the bus-stop level, signing could include local guide signs leading passengers to the stop; stop identification by a system logo; and route number, route map, and schedule displays. In larger multi-route and sometimes multi-level transfer facilities, signing needs become more complex as the number of passenger "decision points" and orientation problems increase.

### Oral Communication

The person-to-person exchange of information through telephone information services, operating personnel, and other passengers is heavily relied on by many transit riders, especially those who have difficulties understanding area geography, route maps, timetables, and directional signing. The dependence on oral information may be due to language barriers, psychological and/or physical disabilities, or simply unfamiliarity with an area and its transit network. Misleading and confusing signs can also result in a need for oral information by otherwise knowledgeable riders. Frequent changes in schedules and routes have increased the importance and use of telephone information services by all transit users.

In a more general sense, oral communication of information to prospective riders includes the use of the broadcast media, such as commercial and public service radio and television and cable television, for transit programming and special announcements about services.

### Distributed Information

Printed route maps, timetables, brochures, and newsletters are useful information aids that can be given to prospective riders. Distributed information has the advantage of providing riders with a permanent reference. It can also supply valuable introductory information to new or occasional riders (such as the names and relative locations of local geographic features and landmarks, transit route structure, and street names), which they can subsequently make use of if additional information is required from other sources. Introductory information of this type ("rehearsal") can reduce the length of telephone information inquiries, questioning of operating personnel, and other information aid requirements.

### Automatic Passenger Interactive

Self-help devices, with which the passenger can automatically determine directional or trip information without the assistance of others, are being increasingly employed in transfer facilities. A simple example in use in the Paris Metro subway for many years is an electrical circuit board with light bulbs arranged in the shape of the Metro system map. A keyboard is provided listing the system stations. When the passenger presses the destination station on the keyboard, the correct route to that station lights up. The advent of compact, high-capacity, and less expensive computer technology is leading to the development of more sophisticated interactive systems, which are described in later sections of the synthesis.

## SPECIAL INFORMATION AIDS FOR THE HANDICAPPED

There has been limited use of transit information aids for the handicapped because of the wide variety of mental and physical impairments that can be involved, the high cost of system-wide application of special information facilities for these passengers, and their small numbers. However, approaching the development of information aids from the viewpoint of the handicapped gives useful insights into the problems of others, and will result in designs that are more easily understood and used. For example, larger-than-normal lettering on signs to assist the sight-impaired rider increases sign legibility for the general population. The future development of computer-based user-interactive information aids also opens up possibilities of developing systems that can better meet the special needs of the handicapped, as well as other transit riders.

CHAPTER TWO

# INFORMATION PROGRAM PLANNING AND MANAGEMENT

The development of a comprehensive passenger information program is a systematic process requiring the active and continuing involvement of transit management. Good information programs must be carefully planned and consistently managed to project the most favorable public image and to maximize communications effectiveness. Staff assigned to this function should be knowledgeable in transit operations, graphic design, communications, and marketing. In some instances outside consultants may also be employed to supplement the skills of the agency staff. The selection of the types, numbers, and quality of information aids provided should be an integral and on-going part of all transit system planning and operations, and not a separate or piecemeal effort.

As an example, when planning new facilities it is a poor practice to leave the design and placement of directional signs as one of the last decisions after finalization of facility plans. The close examination of passenger orientation, pedestrian movement patterns, and sight lines, which are associated with development of signing, will also provide valuable insights into the functioning of the transfer facility. This type of functional review can highlight plan deficiencies, such as pedestrian traffic conflicts, confused pathway directions, and blind spots. Early identification of these deficiencies can result in plan changes to improve facility operations, safety, and security.

Similarly, passenger information needs and the design of information aids must be an early consideration in developing transit route structures, transfer options, and schedules. Complex route structures that are difficult to depict and describe on route maps and other information aids are also confusing to passengers, and will cause continuing communications difficulties for telephone information agents and others. Passenger information should also be an important first consideration in existing facilities when changes in fares, services, station or route names, or facility operations are necessary.

## STEPS IN PLANNING PROCESS

Information program development follows the classic process of: (a) determining program goals and objectives; (b) identifying user needs; (c) selecting the types of information aids that can best meet these needs; (d) establishing design and service standards for preliminary alternatives; (e) evaluating alternatives; and (f) selecting and implementing the final program.

### Goals and Objectives

The primary program objective is the communication of useful transit information to passengers and the general public. Other objectives include program integration, economy, and attractive graphic design. Although graphic design is important, it should be recognized as being secondary to the communications objective. This is noted because some graphics specialists have concentrated heavily on the development of lettering styles, graphic symbols, and other minor details without fully addressing the more important issue of effective communication with users of an information aid.

Integration is defined as the careful coordination of all information components, the use of standardized and consistent nomenclature, and modular design of components to ensure adaptability to a range of different applications. Economy is the total life-cycle cost of the information component related to its effectiveness. For signs it would include factors such as first costs, useful life, maintainability, vandal resistance, and adaptability to changing needs.

### Identification of User Needs

As noted in the introduction, the users of transit information can include both riders and nonriders. Table 1 identifies the various categories that could be considered in the development of a comprehensive information program. For riders, their characteristics and the complexity of the transit system and specific transfer facility would determine information requirements and priorities. A transfer facility that attracts many tourists and foreign-language passengers or other types of special or infrequent users naturally requires a wider range of information aids, and may require staffing by information personnel. Similarly, the directional signing for an underground station may be more complicated than an elevated station that is in full view of easily recognized landmarks.

The types of information needed by passengers is summarized as follows:

- Area geography, topographical barriers, major highways, place names, street numbering systems;
- Places served by transit;
- Proximity of transit transfer facility to trip origin and destination (walking distances, transfers);
- Route numbers, transfer points, station names, cross streets at stops, house numbering;
- Hours that service is available;
- Schedules (headways, waiting time);
- Travel distance, total travel time, time between stops;
- Fares, free transfer privileges, riding rules, special rates;
- Special services, facilities for the handicapped, architectural barriers, language barriers;

TABLE 1

CATEGORIES OF TRANSIT INFORMATION USERS

| Riders | Nonriders |
|---|---|
| Regular Riders | Transit Employees<br>o Regular operators<br>o Unfamiliar operators (temporary replacements) |
| New Riders | |
| Special Riders<br>o Handicapped<br>o Foreign language<br>o Tourists<br>o Students<br>o Conventions | Elected Representatives<br>Employers<br>Retail Merchants |
| | Real Estate Developers and Agents |
| | Special Event Planners |

• Identification of stops, stations, external markers, guide signs to transfer facilities;

• Routes serving the stop or transfer facility;

• Directional signing within transfer facilities for various locations (transfer points, routes, platforms, gates, vehicles, services) and for various types of users (ticket holders, visitors, employees, first class, etc.);

• Vehicle identification signs, route numbers, and names;

• Supplementary information assistance en route (on-board route maps, station assistance telephones, transit personnel, other riders);

• Information center telephone numbers.

#### Selection of Information Aids

The four general categories of information aids (visual, oral, distributed, and automatic passenger interactive) were identified in Chapter 1 and are discussed in greater detail in Chapters 4 through 6. The following is a list of information aids in each of these categories (asterisks identify aids in use in transit transfer facilities). Priority ratings, relating user needs to the relative effectiveness of alternatives in meeting program goals and objectives, can assist in the selection process.

1. Visual Communication (signs)
   a. external station or stop identification;*
   b. local guide signs;*
   c. internal directional signing;*
   d. route map and schedule displays;*
   e. you-are-here maps, directories, local community orientation and facility guide maps;*
   f. video displays of schedules, routes, gate assignments;*
   g. teletypewriter.*
2. Oral Communication
   a. telephone information (operator assisted, manual or computer-assisted data retrieval);
   b. passenger assistance telephones;*
   c. special information personnel, information agents, patron assistance aides;*
   d. transit system operating personnel—drivers, station agents, police;*
   e. public address system (recorded, real-time announcements);*
   f. two-way closed-circuit television;*
   g. commercial and public service television and radio and cable television programming;
   h. other passengers;
   i. transit agency speakers bureau.
3. Distributed Information (print)
   a. route maps and timetables;*
   b. rider kits, brochures;
   c. media advertising, press releases;
   d. newsletters and flyers;
   e. information displays;*
   f. mobile information center;
   g. telephone directory listing, maps, schedules.
4. Passenger Interactive
   a. telephone—computer automated voice (e.g., Teleride), recorded voice, geocoded digital phone input (future);
   b. electric light push-button route map;*
   c. computerized trip planner;*
   d. touch-sensitive CRT/computerized map display.*

#### Information Aids for the Handicapped

Special aids that have been proposed for the visually and hearing impaired include: auditory maps and schedules, tactile maps, texturized floor surfaces, Braille bus schedules, and teletype or TTY systems (discussed in Chapter 7).

Auditory maps and schedules, in the form of cassette tapes, provide the blind with recorded instructions for specific movement pathways (for example from a bus stop to a subway station) and can also provide schedules and other information. Recorded tapes have the advantage that they can easily be duplicated, and can provide more user-specific information for planned or repetitive trips at less expense than Braille maps, schedules, and signs.

Tactile maps, in essence a Braille-like map, are printed with raised symbols by a process known as thermaform. Maps of the Washington Metro (WMATA) and Southeastern Pennsylvania Transportation Authority (SEPTA) transit systems are available in this form.

Texturized floor surface, distinct from the surrounding area and detectable by foot or cane, can be used to provide directional or safety information to the blind. Texturized surfaces are also distinct in color to aid the visually impaired. The edges of transit platforms have been marked in this manner for safety reasons. Texturized surfaces could also be used to mark "tactile paths" as a directional aid for the blind in transfer facilities.

#### Establishment of Standards

Standards for design and performance are also based on attainment of the program goals of communication, integration, economy, and attractive graphic design. The communications effectiveness of signs is dependent on lettering style, letter height and viewing distance, hierarchies of lettering for different levels of information, sign color combinations, lighting, sign placement, mounting height, and the method of mounting. Standardization of sign materials, modular design, and coordination with other information aids relates to the integration objective. Sign durability, maintainability, and vandal resistance would be cost considerations.

Consultants have also been used to develop design and performance standards, most often in the form of a manual of guidelines for transit facility signing. The manual of guidelines ensures consistent and coordinated design. A good manual provides guidelines not only for graphic design, but for dealing with a wide variety of different environmental settings and passenger orientation and information problems. Manuals that concentrate mostly on lettering styles are of limited value. Besides guidelines for signs, a comprehensive information and marketing program can include the design of logos, corporate letterhead, the colors and marking of transit fleet vehicles, uniforms of operating personnel, and other public image elements.

#### Evaluating Alternatives

Different sign designs for new transit systems have been evaluated by presenting mock-ups of the signs to an audience comprising a cross section of prospective users, and then surveying the audience for their opinions. Both the actual signs and photographic slides of the signs in typical settings have been used for this purpose. In existing settings, trial designs have been installed in the actual setting to determine communications effectiveness. Alternative bus stop sign designs have been installed on different bus routes, and passenger opinions on the different routes compared. Field trials of this type have the advantage that user problems, and problems with materials or the sign mounting, are more likely to be identified before a more costly system-wide installation.

#### Program Implementation

Information program effectiveness can benefit from a separate marketing and public relations effort for the introduction of each major program component or innovative passenger assistance aid. Staged development can provide additional opportunities for media coverage to promote public awareness of available passenger information assistance.

### TRANSFER FACILITY CLASSIFICATIONS

Passenger information program management, including allocation of resources and evaluation of program effectiveness, has been aided in one transit agency by classifying different levels of transfer facilities and relating these classifications to information aid requirements. In addition, this agency maintains a computer-based inventory of the information aids at each transfer point, which can be used for program management purposes.

Typically, information needs expand and become more complex as passenger volumes, the number of different services, and physical size of a transfer facility increase. A street bus stop serving a single route may need only an identifying logo and route marker, whereas a multi-modal, multi-route transfer facility will require the full range of information aids, potentially including special personnel for this purpose.

The New York City Port Authority Bus Terminal is a complex facility of this type (Figure 1). The terminal serves 35 inter-city and suburban bus carriers, operating out of 235 bus berths, on 3 different building levels, and in 5 separate bus loading areas. This 7-story terminal interfaces with the New York City subway system and surface bus routes on its lower level, and has an 1100-car parking garage on its 3 upper levels. On a typical weekday 180,000 passengers and 6,300 buses use the terminal.

Passenger information elements at this busy terminal include directional signing for ticket-selling areas and bus-loading gates, 3 passenger information windows, patron assistance telephones at many locations, a public address system with both recorded and spot announcements, video display of gate arrival/departure information in its 2 inter-city bus concourses, and a telephone information center employing 71 agents. The terminal management is experimenting with a two-way television communication system allowing passengers and information agents to both see and hear each other, and is considering an automated self-help information center to provide patrons with video screen and hard-copy information about the terminal's 100 most heavily used destinations.

Despite the magnitude of the information effort at this terminal, passengers still experience problems using it because of the size and physical complexity of the building and the large number of bus services, some of which serve the same destination but load from different gates. This terminal is classified as a *level 5* transfer facility in the categories described in the following section. Table 2 gives the relative use of information aids in the various transfer facility classifications.

#### Classification Factors

The factors considered in determining transfer facility classifications include the following:

- volume of passenger activity;
- number of interfacing routes;
- number of different interfacing modes;
- physical configuration—number of berths, platforms, and building levels;
- investment in physical facilities;
- transit center type—community, regional;
- joint development, commercial uses of transfer facility.

#### Transfer Facility Classifications

*Level 1*

The simplest form of transfer facility, typically a local stop serving a single transit mode. For buses, it would consist of an on-street curb loading area, serving one to two routes. For rail transit, it would be a station with a grade-level platform. Capital investment could include a passenger shelter.

*Level 2*

For buses, an on-street turnout serving two or more routes, with loading bays separated from moving traffic lanes. For rail transit, a passenger-car level, raised platform station, which


FIGURE 1 The Port Authority Bus Terminal in midtown Manhattan is an example of a level 5 transfer facility. It occupies one and a half square blocks, houses five separate bus loading areas on three different building levels, and has direct grade separated access to the Lincoln Tunnel. (Photo courtesy Port Authority of New York and New Jersey.)

could include some auto parking and vehicle interface facilities. Capital investment could include a passenger shelter, or waiting room, and auto parking area.

*Level 3*

For buses, an off-street turnout and loading platforms serving multiple routes. For rail transit it would be an at-grade but raised-platform station, with a possible pedestrian overpass or underpass, auto parking, and bus transfer facilities. Capital investment, in addition to platforms, parking, and pedestrian grade separation, could include waiting room and ticket-selling areas and minor concession spaces.

*Level 4*

An urban grade-separated multi-modal transit facility with exclusive bus access provisions and elevated or subway rail access. Large station parking areas and a level 2 or 3 bus-transfer facility could be included in a rail station. Multi-level construction, adjacent parking areas and auxiliary tranfer facilities, ticketing and other passenger processing facilities, escalators, and circulation elements would involve a major capital investment. This level facility could be incorporated into a major activity center with joint development by others.

*Level 5*

Major center-city, regional, grade-separated, multi-modal, multi-level bus or rail-transfer facility. Investment in pedestrian circulation elements, waiting room, ticket selling and other passenger processing facilities, and concession spaces could exceed $100 million in current costs. Joint development with others likely. (Examples include the Port Authority Bus Terminal in New York, the Pennsylvania Railroad Station in New York, and the San Francisco Trans-Bay Bus Terminal in San Francisco.)

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## EXAMPLE OF PRACTICE

### Transfer Facility Class and Information Elements

Tri-Met of Portland, Oregon is an example of a transit property that has recognized the need for varying levels of information at different classes of transfer facilities. In Portland, four

TABLE 2

USE OF INFORMATION AIDS IN TRANSIT TRANSFER FACILITIES

| Information Aid | Level of Facility 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Station or Stop Identification Sign | * | * | * | * | * |
| Route Map and Schedule Display Signs | * | * | * | * | * |
| Internal Directional Signing | | | * | * | * |
| System Map, You-Are-Here Map Displays, and Directories | | | * | * | * |
| Public Address System | | | * | * | * |
| Information Center - Map and Schedule Display Rack | | | + | * | * |
| Video Display of Schedules, etc. | | | + | * | * |
| Staffed Information Desk | | | + | + | + |
| Changeable Message Signs | | | + | + | + |
| Passenger Assistance Telephones | | | + | + | + |
| Local Pedestrian Guide Signs | | | + | + | + |
| Automatic Computer Trip Planner | | | + | + | + |
| Information Aids for the Handicapped | | | + | + | + |
| Touch-Sensitive CRT Computer | | | | o | o |
| Two-Way Television Connection to an Information Center | | | | | o |

* Commonly used

+ Used by some agencies

o Under development

levels of information are provided, depending on the location of the stop and the complexity of the transfer point. The basic level, which comprises the majority of the stops in the Tri-Met system, carries only a modular bus stop identification sign. Depending on individual stop requirements, the following sticker components are added: route number, with "to" and "via" information; fare zone designation; service frequency; bus zone (no parking); handicapped accessibility; and system logo.

At the second level, stops with shelters, a schematic system map with downtown inset and system information (such as fares, self-service fare collection, fare zones, and bus riding rules) is added. At major transfer points, Tri-Met's third level, an information display showing timetables, route maps, area map, and site map is provided. In Portland's downtown pedestrian mall, the focal point of the system, each of the 31 bus shelters on the mall contains a video display of the schedule of the next 3 buses serving that stop. In addition, there are four trip-planning kiosks on the mall, equipped with a video screen and a keyboard, to answer route and schedule inquiries automatically. Light rail facilities under development by Tri-Met will follow the same passenger information programming.

Source: *On Street Information* (APTA) and *The Way to Go* (U.S. DOT).

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CHAPTER THREE

# THE COMMUNICATIONS OBJECTIVE

Communications effectiveness has been stressed as the primary objective in developing information aids, and particularly signs. Ideally, the information presented to passengers should be simple, quickly assimilated and retained, and easy to apply. An in-house study of passenger information problems at the Port Authority Bus Terminal in New York City included observations and interviews of lost or confused travelers, analysis of tape recordings of patron information inquiries, and the evaluation of the effectiveness of directional signs and other information aids. The study concluded that the communication of information to passengers, by signs or other means, was similar to a learning process. The study also found that the factors or principles known to improve human learning, and specifically short-term memory, provided useful guidelines for developing information programs and designing information aids. These factors are: (a) rehearsal, (b) simplicity, (c) consistency, (d) continuity, and (e) repetition.

## REHEARSAL

Behavioral research has shown that the retention of information is significantly improved when there has been some prior introduction to the subject matter presented. Similarly, studies of passenger inquiries in transfer facilities and to telephone information centers show that communication is more difficult when patrons lack even basic knowledge of the transit system or its facilities. A simple form of rehearsal can occur when prospective passengers learn about transit services through the media, either by news events or marketing efforts. This introductory information provides a basic familiarity with transit services that the prospective passenger can build on and use to obtain more specific supporting information when needed. The rehearsal helps confirm and reinforce subsequent, more detailed communications. In transfer facilities the rehearsal principle is applied by providing system maps, "you-are-here" plans, and directories at strategic locations, such as near entrances and critical decision points (Figure 2).

## SIMPLICITY

Communication is enhanced where the message content is simple and direct, using easily understood and familiar terms. Station, route, and other names should be those in common use and, where possible, should provide orientation, direction, and location information. In transfer facilities, common terms, such as first floor or second floor, provide better orientation and more useful information than passenger concourse, plaza level, or mezzanine, where the passenger has no means of differentiating levels. Transit jargon, which may have little meaning to passengers, should also be avoided.

## CONSISTENCY

Uniform methods of presentation, design, and terminology facilitate communication. Behavioral research has established that wayfinding through an environmental setting involves a process called "cognitive mapping," in which the wayfinder draws on past experiences for orientation, direction, and movement within a new setting. Unusual or unexpected plan configurations, nonuniform design of signs, or variations in terminology contrary to expectations can confuse and disorient passengers. Consistency with all other forms of passenger communication, written and oral, in terminology and methods of presentation, is also necessary.

## CONTINUITY

A progressive build-up of "bits" of information, from the simple to the more complex, communicates better than the simultaneous presentation of multiple bits of information. A sequence or series of visual cues or signs, without gaps, provides continuing confirmation to users that they are on the "right track." Numbering and lettering systems that gradually increase or decrease as passengers follow a path of movement provide continuity and convey a clear directional message. Station identification signing (Figure 3), which can be viewed by passengers en route and compared with on-board route maps or pocket maps, and "trail-blazer" guide signs, such as those displaying a logo and directional arrow, are other examples of the continuity principle and also of the principle of repetition discussed below.

## REPETITION

Repetition is a classic form of learning. The repetitive and redundant presentation of information, potentially by several different means, helps to confirm and reinforce passenger trip information. For signing, it would not mean repeating the same verbal message on a single sign. Instead it would mean using the same presentation format and sequential messages on successive signs to lead passengers. Repetition can take other forms. The Massachusetts Bay Transportation Authority (MBTA)

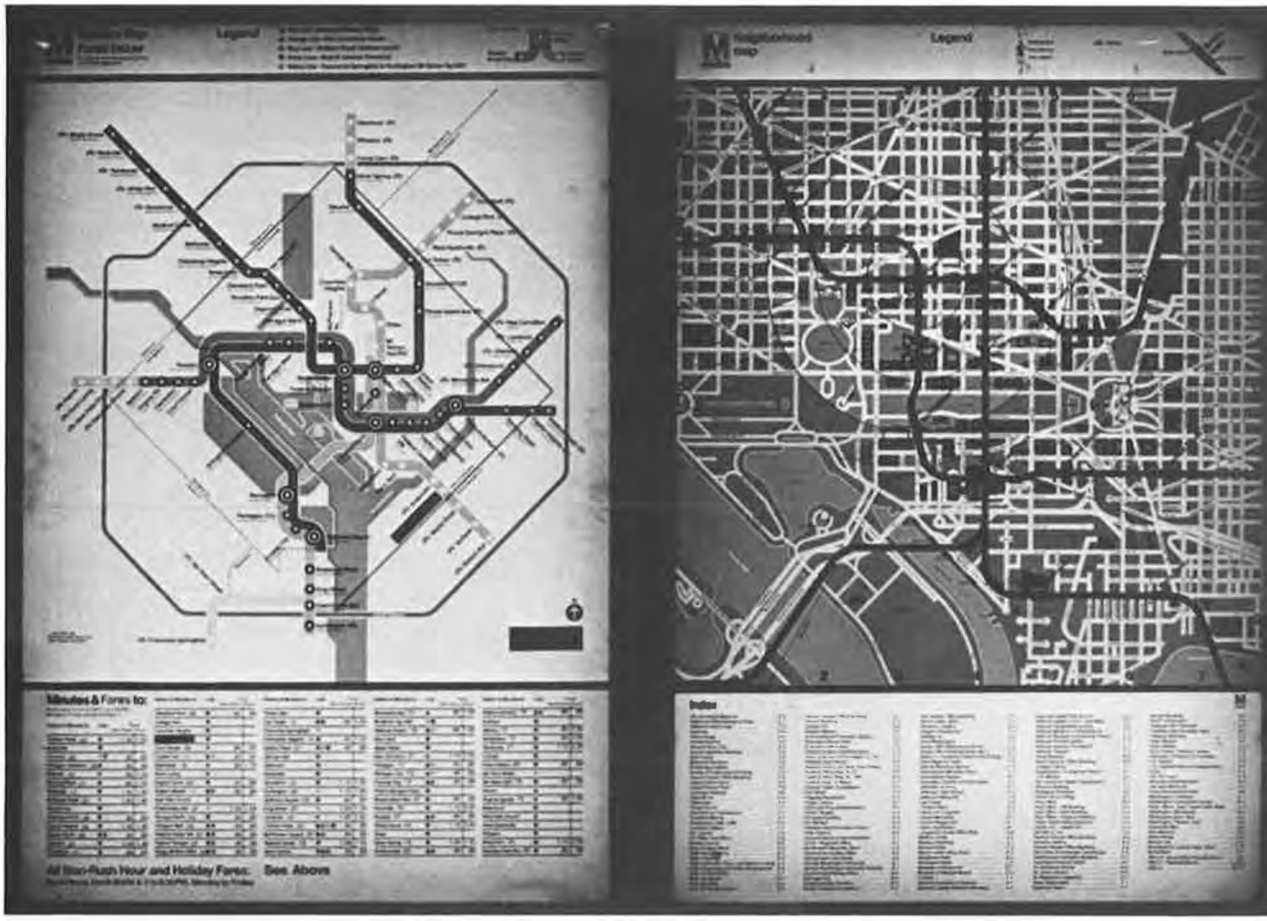


FIGURE 2 System maps, you-are-here plans, and directories are rehearsal elements that introduce passengers to the terminology used on signs, route maps, and timetables and provide basic knowledge for use in oral communications.


FIGURE 3 Station identification signing follows the continuity and repetition principles of communication, allowing passengers to confirm direction en-route by comparison with on-board route maps, or pocketmaps. (WMATA photo by Paul Myatt.)

makes use of the repetition principle by naming its routes by color (such as "green line") and repeating the same color on maps and signs for each route. The more complex New York City subway transit system has also been using route color codes on maps and signs but, because of the large number of different lines, it is forced to use alphabetical and numeric designations, rather than color, for route names. Many New York passengers are unaware of the significance of the different colors because of the absence of the redundant type of color code reinforcement used by the MBTA. In addition to redundant color coding, different geometric shapes have been used to enhance the recognition of a sign and its message. An outstanding example of the use of color, shape, and words to convey the same message is the highway stop sign. Many transit agencies have used a consistent presentation format, distinctive sign shapes, colors, and symbols for transit stop identification.

CHAPTER FOUR

# VISUAL COMMUNICATION—SIGNS

Signs are a primary means of communicating information to passengers at transfer facilities. At the bus-stop level, signs identify the transfer point and provide passengers with basic route and schedule information. As the transfer facility becomes more complex (Level 3 and above), internal directional signing, emergency egress, and other types of building signs become necessary. Transfer facilities generally require more directional signing than most building types because the number of "decision points" (changes in direction, platform and vehicle choices) are greater, and the visual environment (architectural setting) is usually more complex and potentially disorienting. The principles of communication discussed in Chapter 3 are directly applicable to the design of signs.

## TYPES OF SIGNS

The types of signs that may be used in a transfer facility include: (a) identification, (b) directional, (c) instructional, (d) regulatory, (e) emergency and security, and (f) advertising. All the various types of signs used in a transit system and in its transfer facilities should be designed for coordination of type faces, terminology, color coding, symbols, sign shapes, and a hierarchy of letter size related to the importance of the information presented. Modular designs with standardized components and hardware, which can be combined to develop different sign types and sizes, and mounting options help provide coordinated and economical signs. The modular design also provides the ability to meet different information needs and, most importantly, changes in these needs. The latter is especially useful for new facilities where message content may be subject to change after sign contracts are awarded.

### Identification Signs

Included in this category are: (a) system identification by the transit agency name, logo, or corporate symbol; (b) mode (rail, bus, ferry)—by words or pictogram; (c) station or stop—street, place, or district name; (d) route—name and/or number; and (e) vehicle—route and/or terminal point. In larger facilities identification signing may be required for passenger services such as ticket selling, rest rooms, facilities for the handicapped, baggage check rooms, police, and concession spaces. Symbols, logos, color codes, and distinctive sign shapes are often used in combination on identification signs to enhance their effectiveness (repetition principle) (Figure 4). At Level 1 and 2 transfer facilities, limited route map and schedule information may be combined with stop identification signing, typically in a modular format that allows a display of several routes. The New York City and Central Ohio Transit Authorities are using simple modular pole-mounted timetable and route map displays that can be easily modified (Figures 5 and 6).

### Directional Signs

This category includes external guide signs located within a few blocks' radius of stops and stations, and internal signing within larger (Level 3 to 5) transfer facilities. Directional signs are typically located at pathway decision points where a passenger must make choices, such as a horizontal change in direction, or a vertical level change. Identification signs in series, in the form of logos or symbols with the inclusion of directional arrows ("trail blazers"), are sometimes used very effectively to convey directional information. These guide signs communicate well because they follow the learning principles of simplicity, consistency, continuity, and repetition. You-are-here maps and other forms of directories can provide useful directional information and are valuable as "rehearsal" elements. They familiarize passengers with general facility configurations, the scale of distances, and relative locations.

Behavioral studies have shown that the you-are-here facility plan must be positioned with the top of the plan oriented towards the direction ahead (for example, south at top when south is directly ahead), or else the plan will disorient and confuse the user. This means that different you-are-here plans have to be made for the same facility if the floor plan and its facing location vary from the direction ahead.

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**EXAMPLE OF PRACTICE**

**Washington Metro Street Signs**

The Washington Metropolitan Area Transit Authority (WMATA) has installed guide signs to help pedestrians find the nearest Metro subway station. The guides, specifically designed and located for those on foot, have the characteristic reflective white message on a green background scheme used for street identification signs. Each shows the Metro logo, points to the nearest staion, gives the station name, number of blocks to it, and the color code of the transit lines serving it (Figure 7). The guide signs assist the many visitors to Washington, D.C., as well as area residents using the Metro in unfamiliar areas.

Source: *Passenger Transport* 9/26/83.

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FIGURE 4 Southern California Rapid Transit District bus stop identification and modular bus route sign. (Photos courtesy of SCRTD.)

### Instructional Signing

Passengers in transfer facilities may require information on fares, transfers, facilities for the handicapped, and security and emergency procedures. Instructional messages should be kept as short and as simple as possible and the hierarchy of sign size and lettering height should be kept at a smaller scale than identification and directional signs.

### Regulatory Signing

Traffic signs, safety warnings, no-smoking signs, and similar restrictive rules and regulations are included in this category. The Manual on Uniform Traffic Control Devices should be strictly followed for highway signing. Local ordinances, building codes, and legal practice may control the wording and design considerations for other types of regulatory signs.

### Emergency Signing

The marking of exits and evacuation routes is required by most building codes. These codes specify minimum letter sizes, sign color, and lighting requirements.

### Advertising Signs

Advertising can be an important source of revenues to help fund desirable improvements, such as bus shelter programs or the installation of changeable message signs (with an alternative advertising message). However, because advertising is designed to attract the attention of passengers through the use of letter size, color, lighting, message content, and other means, it can significantly detract from the effectiveness of information signing. Advertising should not be combined with directional signing because passengers seeking directional aid will tend to ignore a combination sign as a source of information. Transit agency control of the placement and design of all advertising to limit visual competition and conflicts with passenger information aids is necessary, and should be covered in all advertising agreements. This would include rights of approval of advertising, removal of unacceptable advertising, and/or contract termination.

## ELEMENTS OF SIGNING

Signing effectiveness, in terms of communication with passengers and in meeting transit system management objectives, depends on four elements: (a) the *user* of the information presented; (b) the *setting* or architectural context in which the sign is located; (c) the *message* conveyed by both the wording of the sign and the setting in which it appears; and (d) *sign hardware,* or the type of sign used, materials, method of mounting, and associated cost.

Signs should always be designed for the total population of users including: those who are unfamiliar with the transfer facility plan, place names, and compass directions; those who have a mental or physical handicap; and those who have possible language barriers. Consideration must also be given to human factors, such as sign legibility (related to type style, letter height, and viewing distance), normal viewing angles, and user interpretation of symbols and color codes.

The architectural setting is the primary "message" given to passengers in transfer facilities because of the overwhelming scale of this visual background in relation to signs, and because of the equally strong influence of the pedestrians and vehicles moving within it. For example, a stairway or escalator provides a powerful visual statement of a level change and movement direction; this can frequently cause confusion if nearby signs contain conflicting information about other pathway choices. Confusing architectural settings typically need more signs to explain them, but even then these signs often prove to be ineffective. Ideally, signs should complement and reinforce architecturally defined movement pathways, and not be the primary means of passenger orientation. This is why directional information needs must be an early input in transfer facility planning.

Sign messages should follow the communications principles

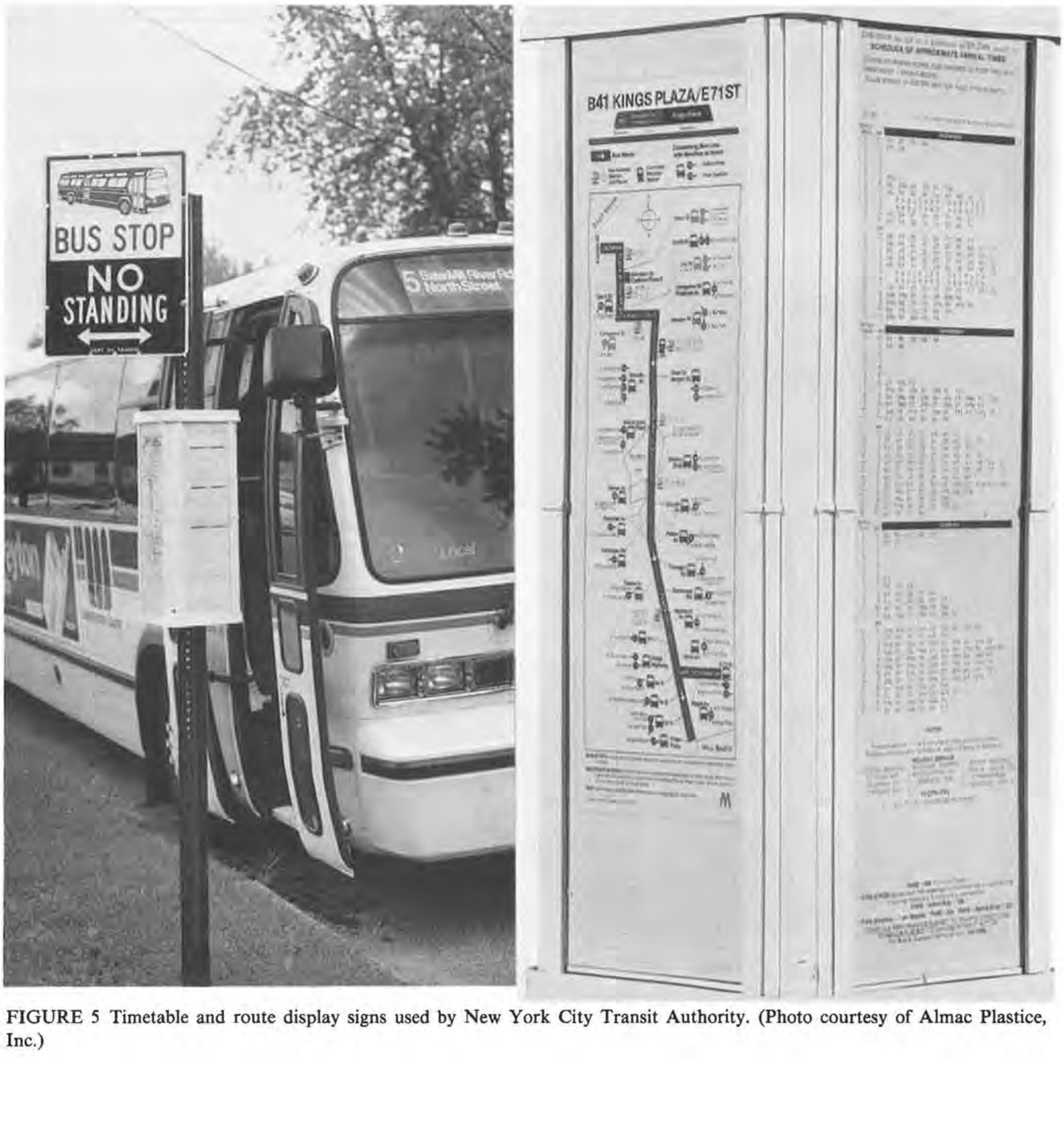



FIGURE 5 Timetable and route display signs used by New York City Transit Authority. (Photo courtesy of Almac Plastice, Inc.)


FIGURE 6 Timetable and route map display cylinder used at bus stops by the Central Ohio Transit Authority. (Photo courtesy of Trans Ad Corp.)


FIGURE 7 WMATA guide sign.

discussed in Chapter 3. Symbol signs, color codes, the placement of directional arrows, and the use of innovative or atypical designs should be tested by experimental trials when possible to ensure that they are not ambiguous or confusing.

Sign hardward must be adaptable to different weather conditions, mounting options, panel sizes, and other variations likely to be encountered in a diversified transit system. Consistent modular design of sign components and materials is not only more economical but can enhance the recognition of information signs, an important factor in ensuring their effectiveness.

#### Human Factors

A sign must be designed so that it can be readily identified by the user within what is likely to be a visually cluttered and confusing background environment. This characteristic is called the "target value" of the sign. In transportation facilities where there may be visual competition from advertising and tenant signing, directional signing should be distinctive, using plain design and simple color combinations with good color contrast, to give it an "official" appearance that will stand out and not be confused with other types of signs.

Lighting can increase sign target value and legibility if it is designed not to produce glare or shadows on the sign face. Because of the inherent economies, ambient light sources should be considered in locating a sign. Where ambient light is inadequate, spotlighting may become necessary. Backlighting or internal lighting of signs can also increase legibility, but these signs must first be evaluated for optical effects such as "halation," which causes a blurring or merging of letters. Halation effects are more pronounced with smaller sized letters. Internally lighted signs are usually the most expensive in both first costs and subsequent costs of re-lamping. When internally lighted signs are used, trials with alternative letter and background colors and lighting arrangements are advised. The perception of sign colors can be affected where sodium vapor or other colored lighting is used.

Letter height and style are important human factors design considerations, with larger letters and more legible type faces naturally increasing sign target value and readability. Letter heights are typically related to viewing distance, but in some cases oversized letters and giant "super-graphics" may be used for greater emphasis or design impact. Letter height determines sign panel size and cost. Sign panel dimensions can become a significant limiting factor where there are low ceilings or other space restrictions. Letter sizes may also be established by a design hierarchy, with larger letters on signs that are more important and used more frequently.

Lowercase lettering with initial caps has been found to be easier to read than all capital letters in user tests and usually provides a more attractive message format. The Helvetica type face, an open, sans-serif style lettering originally developed by the famous Bauhaus graphics design group, is widely used in transportation facilities. Based on human factors studies, the minimum letter height recommended for the majority of viewers under good lighting conditions is 0.035 in. for each foot of viewing distance [0.035 in. per vft (3 mm per vm)] and double that [0.070 in. per vft (6 mm per vm)] for the general population under a wider range of lighting conditions. Oversized letters [0.10 in. per vft (8 mm per vm) and above] are often employed by graphic designers for greater visual impact, or to establish a hierarchy of information based on a range of letter heights.

There are practical limits to the effective viewing distance of signs in transfer facilities. Guidelines in one transit agency graphics manual suggest that additional confirmatory signing may be needed every 75 ft (23 m) along a pedestrian pathway. Observations of lost and confused passengers in a large transportation terminal indicated that most were "short-sighted," or looked for directional guidance within a very narrow range of viewing angles and distances.

Colors, and particularly color contrast, are another determinant of sign legibility. Letter recognition experiments have shown that the high contrast combination of black letters on a yellow background was legible at three times the distance of a low-contrast combination of green lettering on a red background. Combinations of white lettering on a blue or black background (or vice versa) are common in transit facility signing, but other high-contrast letter and background color combinations can be equally effective. Color consistency should be controlled by matching colors against a standard reference system, such as the Munsell rating system, which uses paint chip samples, or the Pantone Matching System used for offset printing inks. The Munsell system designates color by a numerical notation signifying degrees of hue, value, and chroma.

Where color codes are used, there is a practical limit of about 10 colors that can be differentiated by the general population. Excluding black and white, the most commonly used colors are the three primary colors red, yellow, and blue; the secondary green; and less frequently, the secondaries orange and brown. The dedicated use of red for danger and yellow for caution may further limit choices in some applications. Color coding can cause difficulties for the estimated 8 percent of the population who are subject to color confusion, and the 0.3 percent who are color blind. Verbal reinforcement of color codes, as previously discussed with the Boston MBTA example, can assist those who are confused by colors.

Sign placement is determined by passenger lines of sight and the normal field of human vision. The general cone of human vision is about 60 degrees, but a smaller cone of 20 to 40 degrees is recommended for optimum word recognition (Fig. 8). Of course the human line of sight and viewing angle can be expanded by the movement of the head, but the primary zone of recognition is straight ahead along the path of pedestrian movement. Eye levels for the general population range from 56 in. (1420 mm) for the 5th percentile (5 percent are less than this) adult female population to 69 in. (1750 mm) for the 95th percentile adult male population. The recommended minimum clearance for overhead signs is 7 ft 6 in. (2.29 m). Eye levels for seated persons measured from the chair seat range from 28.1 in. (714 mm) for the 5th percentile adult female population to 33.9 in. (861 mm) for the 95th percentile adult male population. The seated eye height dimension is of interest in the placement of on-board signing inside transit vehicles, and also exterior station identification signing that would be viewed from vehicles by seated passengers.

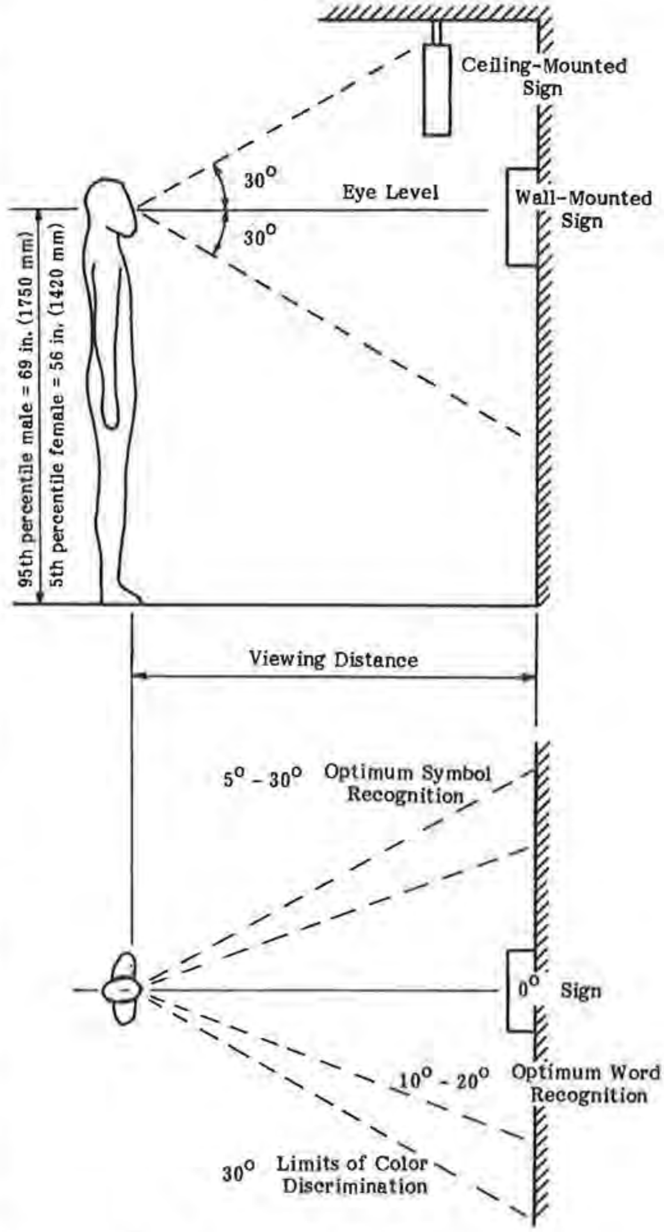



FIGURE 8 Sign placement—visual angles.

Directional signs should be located at all decision points and with the clearest possible relationship to the pedestrian pathway and the next immediate destination referenced on the sign. In cases where this destination, or the next decision point, is not clearly visible within the context of the sign, such as at the end of a long and winding passageway, additional confirming directional signs should be provided.

### The Setting

The background environment in which a sign is placed, and not the sign itself, is the predominant visual message presented to passengers. Studies of passenger wayfinding have shown that orientation and pathway choice is enhanced where there is visual access to points ahead in the sequence of passenger movement, where decision points are clearly differentiated by architectural treatment, where there are recognizable relationships to landmarks or special architectural features, and where there is a minimum of visual confusion and background clutter in the passenger's field of view.

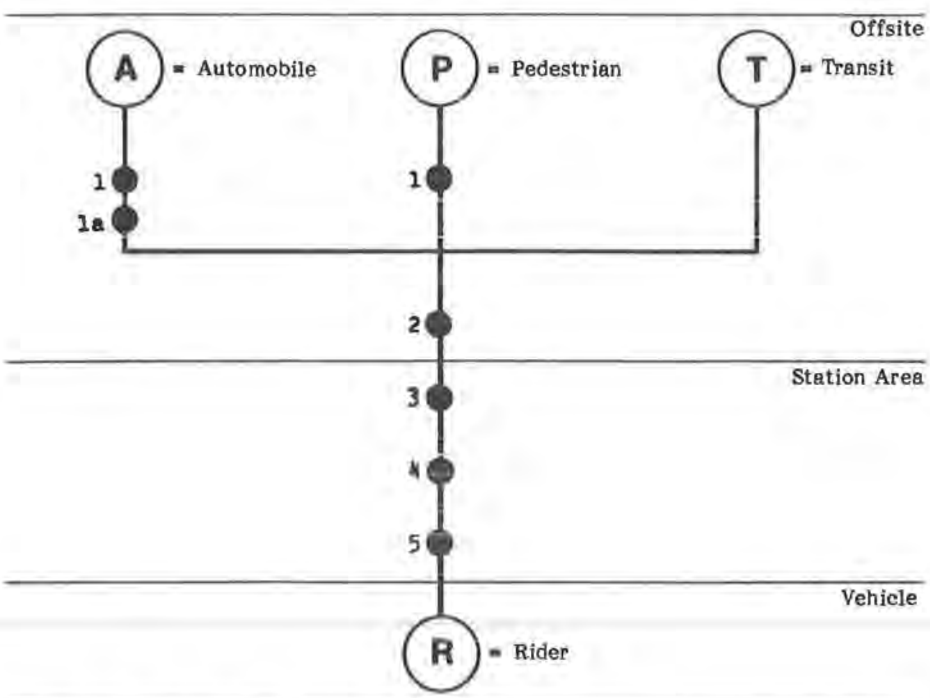
An example of the problems that can sometimes be caused by architectural treatment is stairs and escalators that are walled in, reducing their visibility. When these elements can be readily seen by passengers they signal a level-change decision point that naturally attracts the passenger. Well-designed directional signing can then complement, confirm, and support this visual statement. When these pathway elements are walled in, the level-change statement is lost and more complex signing, which is often less effective, becomes necessary.

Signing underground transit stations is more complicated because of the loss of relationships with surface elements. In deep stations a wrong pathway decision at the train platform level can result in a passenger exiting the station many blocks away from the intended surface destination.

The features that architecturally distinguish pedestrian pathways are:

- the clarity of decision points;
- the directness of the pathway between decision points;
- visual access (sight lines) to decision points ahead;
- relationships to landmarks and distinctive design elements;
- the definition of the edges of the pathway (a train platform is well defined, a wide passenger concourse may not be);
- pathway length and width (excessively long or wide paths add to orientation problems);
- and, the logic of the sequence of events along the pathway (purchase ticket, use turnstile, escalator, etc.).

A schematic "decision tree" diagram is useful in determining locations where signs will be needed and what types of signs they should be. Figure 9 shows a decision diagram for a commuter rail line "ingress sequence."




1. Transit decision
1a. Parking and drop-off decision
2. Station name
3. Fare options decision
4. Direction of travel decision
5. Platform decisions and confirmations

FIGURE 9 Example decision tree—commuter ingress sequence (adapted from SEPTA Design Standards: Part III. Graphics).

TABLE 3

COMMUNICATIONS AND SIGN DESIGN

| Principle | Explanation | Application | |
|---|---|---|---|
| Rehearsal | Introductory overview of plans, place names, and codes. | Don't | - assume that the user knows plan, place names, color codes, keys to alphabetic number series, pictograms. |
| | | Do | - use directories, you-are-here maps, models, and keys to all codes at points of entry; establish relationships to landmarks. |
| Simplicity | Familiar terms, brevity, fewer bits of information. | Don't | - use multiple messages on the same sign, jargon, unfamiliar or ambiguous place names, "unrehearsed" coding or symbols. |
| | | Do | - use short, common terms; place names showing locations (e. g., street or floor); room numbers keyed to floor and building sector coding; only "rehearsed" symbols and place names. |
| Consistency | Uniform design format and terminology. | Don't | - mix sign types (advertising, information, or directions); nor vary color, shape, or letters within the same sign category. |
| | | Do | - establish distinctive, uniform design within categories, control signs of others, maintain consistent use of terms. |
| Continuity | Progressive series of coordinated and complementary information. | Don't | - leave gaps in signing or treat one sign as an entity unrelated to others. |
| | | Do | - sign all decision points, reaffirm messages in sign sequences, use progressive alphabetic and numeric series. |
| Repetition | Confirmation and reinforcement of information by repetition of signs and architectural elements. | Don't | - rely on single signs in long, circuitous, multi-level, variable space networks. |
| | | Do | - reconfirm messages periodically, repeat architectural elements, use linked series of trail-blazer symbol signs and logos along routes. |

### The Message

The communications principles of Chapter 3 apply to the messages presented on signs. Table 3 summarizes these principles and provides some "do's" and "don'ts" in designing signs and their messages. Consistency of terminology, grammar, and writing style are important in avoiding confusion and ambiguity. Wherever possible, multiple names for the same station should be avoided. Some general criteria for message formulation are:

- brevity, a minimum of words and punctuation consistent with comprehension;
- avoid redundancy in written message, but repeat color codes, symbols, and sign shape to reinforce message;
- message should be positive, decisive, and active in tone, rather than passive or negative;
- different places and things should have clearly differentiated, instead of similar, terminology;
- "to" should not be used as the first word on a sign, or used redundantly with a directional arrow, such as "To Exit" (arrow) or "To Stairs."

Symbolic messages (in the form of symbol signs, pictograms, or logos) can be used effectively for directional, regulatory, emergency egress, and identification signing if the symbolic message is easily recognized and understood. The advantages of good symbol signs are that they can quickly communicate without excess verbiage and they can be understood by those with language barriers or literacy problems. Behavioral scientists believe that symbol signs stimulate visual thinking. As an illustration, the graphic curve symbol on a highway sign is simple, unambiguous, and more quickly understandable than the words "sharp right turn ahead."

Usually pictogram symbol signs in the appropriate context, such as a graphic representation of a bus, airplane, and ferry, or the figures of a man or woman for rest room signing, are correctly interpreted. However, some symbol signs have proved so abstract that the intended message is ambiguous and confusing. In one study of the legibility of these signs, graphic symbols of a man and woman framed in a rectangle combined with up and down arrows to portray an elevator was interpreted as a directional sign for rest rooms. Abstract symbol signs of this type, which are based on an arbitrary or assigned code of meaning, depend on some form of rehearsal for users. Rehearsal can take the form of a directory introducing the symbol, use of some supporting verbal message, redundant cueing by color code or sign shape, or common use over time. The context of a symbol sign is considered critical to the interpretation of its meaning; for example, a symbolic highway sign would have little meaning in a passenger terminal concourse.

Innovative or unusual symbol signs should be tested for interpretation by representative groups of uses before wide application. The best symbol signs have a good conceptual base for the object or idea to be presented; are used only in a context in which the sign makes good sense; concentrate on one idea or message and not several; are "rehearsed" by some means when the symbol is not in common use; employ good graphic technique (color, drafting); and are used consistently for the same message. Figure 10 shows a series of symbol signs recommended for use by the U.S. Department of Transportation.


FIGURE 10 Symbol signs—U.S. Department of Transportation (Northeast Corridor Design Manual).

Directional arrows are a form of symbol sign that must be carefully and consistently applied to avoid misleading passengers. As with the other forms of symbol signs, their context can be critical in their interpretation, particularly when they are used near a multiple decision point or strong directional statement such as an escalator or stair. Passengers often misinterpret arrows at these locations. One agency has adopted the guidelines given in Table 4 for the use of directional arrows, constraints on use, and placement locations on signs.

### Hardware

The method of mounting a sign is important in determining its cost and overall effectiveness. In Level 1 facilities, mounting hardware should be flexible enough to take advantage of existing utility or traffic light standards where their location is compatible with the intended sign placement. Modular hardware that is flexible and adaptable to different sign configurations and mounting options, and also future changes, is desirable. Outdoor signs require consideration of wind forces, weather exposure, and greater possibilities for vandalism.

Where there is conventional beam and column construction, the full range of sign mounts is possible. This includes signs fixed to brackets or flush-mounted on ceilings, walls, and columns, or used as free-standing units on "A" frames, pedestal mounts, or pylons (Figure 11). In transit stations with high vaulted ceilings, and walls separated from the passenger platform, only free-standing signs or information pylons may be feasible. The mounting method may also limit the utility of a sign. Because of the smaller usable surface, pylons limit letter size and message length (Figure 12). Signs mounted on brackets fixed to ceilings, walls, and columns can have messages on both sides if desired, whereas a flat mount on a wall or column has only one usable sign face.

Materials commonly used for signs in transit applications include: (a) porcelain enamel on steel or aluminum, (b) painted aluminum, (c) fiberglass, (d) acrylics and polycarbonates, and (e) adhesive plastic films overlaid on a metal, wood, or plastic sign panel base.

Porcelain enamel on steel or aluminum sheet provides a smooth, glossy finish with long life and durability. It is neutral to cleaning solvents and resistant to fading and color changes. The metal sign panel is adaptable to a wide range of mounting options and fastenings by bolts and rivets. Sign faces must be silk-screened or frisket-brushed and each printing of one or two colors must be separately fired for the porcelainized finish, increasing the cost of multiple colors. To reduce costs, porcelainized signs have been produced with a common basic design, with plastic add-on decals then applied to the sign for other variable information. The glass-like finish of a porcelainized sign will crack or craze if hit.

Painted aluminum signs using heat-cured paints have a lower first cost than procelainized signs, are similar in hardware adaptability, and are only slightly less durable. Painted aluminum is commonly used for highway signing. The sheet aluminum surface of the sign must be degreased, cleaned, and primed to ensure adherence of the background color and lettering, which is silk-screened on the sign face. The heat-cured paints are baked on, as compared to the firing required for porcelainized signs.

Fiberglass signs have high reproduction quality and flexibility of application, are durable and resistant to cleaning chemicals, and are relatively economical. The message to be embedded in the fiberglass is printed on paper by either a silk-screen or offset process, and there are no color limitations except that special inks are required. Ultraviolet inhibitor is routinely added to prevent color fading. The sign material may be made transparent, translucent, or opaque. Duplicates of the original paper sign messages for fiberglass signs can be stored, making replacement quicker and cheaper. Fiberglass and plastics may experience weather exposure problems in outdoor applications where there are extreme changes in temperatures and climate.

Acrylics and polycarbonates are plastics that are available in a variety of colors and varying degrees of transparency. Plastics have a low resistance to scratching but control of colors is reliable. Use of these signs in transit applications is limited.

Plastic film is suitable for the self-adhesive application of numbers, letters, symbols, and logotypes. It has a limited life, but is economical and adaptable to change. Adhesive plastic decals can be custom-made or purchased from available stock, with some suppliers providing pre-spaced and pre-cut messages for easier application.

## OPERATIONAL SIGNING

Operational or changeable message signing is available in a number of different formats depending on the desired application. A simple blackboard mounted near a station agent's booth can provide passengers with useful information about changes in service. Advances in computer and electronic display technology have resulted in more sophisticated changeable message signs with rapidly increasing capacity to store and display programmed messages, and to keyboard in and display current on-line information. The display of current route arrival and departure information can play an important role in crowd management and safety in larger bus and railroad stations, particularly when service delays have caused accumulations of passengers and when platform changes may become necessary. Current arrival and departure information and gate assignments shown on video screens or changeable message signs control crowding by reducing concentrations of passengers around information booths and platform entrances, and by promoting more orderly crowd movement to platforms when trains or buses become available. In addition to this practice at most airports, New York's Pennsylvania Railroad Station uses Solari "split-flap" changeable message signs in this manner.

### Split-Flap Panel

This type of display is one of the earlier forms of automatically changeable message signing used in transportation facilities.

TABLE 4

SEPTA'S USE OF DIRECTIONAL ARROWS ON SIGNS[a]

| Arrow Orientation | Connotation | Use Constraint[b] | Placement Constraint |
|---|---|---|---|
| 1. → | To the right | | To the right of legend only. |
| 2. ↗ | Half right or half right up | Not to mean to the right and then up. | To the right of legend only. |
| 3. ↑ | Straight ahead Straight up ahead | | Normally placed to the left of legend. |
| 4. ↖ | Half left or half left up | Not to mean to the left and then up. | To the left of legend only. |
| 5. ← | To the left | | To the left of legend only. |
| 6. ↙ | Half left down | Not to mean to the left and then down. | To the left of legend only. |
| 7. ↓ | Down | | Normally placed to the left of legend. |
| 8. ↘ | Half right down | Not to mean to the right and then down. | To the right of legend only. |

[a] Adapted from SEPTA Design Standards; Part III, Graphics.

[b] The limitations on the use of orientations 2, 4, 6, and 8 are to reduce the ambiguity implicit in 45° angled orientations. The criterion to apply in these cases is one of visibility; the stairway should be visible and to the diagonal direction indicated or the diagonal fork should be visible or nearby when these orientations are to be used. Otherwise two separate appropriately located signs are required.


FIGURE 11 Example of sign mounting options (adapted in part from MBTA Manual of Guidelines and Standards).

Split-flap signs form messages by the positioning of a series of rotating flaps, each of which contains a printed segment of a number or letter. Electronics controls position each panel segment in the stationary configuration required to produce the desired message. The panels are made of plastic or aluminum. Split-flap panel signs are more legible than most signs employing matrix-generated characters because of the better graphic quality of numbers and letters. The length of the message on split-flat is limited because "scrolling," or the moving of letters that is possible with lighted display signs, is not practical.

#### Magnetic Flip-Dot

These signs use a series of rotating disks arranged in a matrix. Letters and numbers are formed by magnetically alternating the black and fluorescent colored sides of the disks (Figure 13). These signs have fewer moving parts than the split-flap type, but the graphic quality is not as good.

#### Light-Emitting Diode (LED)

LED displays generate graphic characters by turning individual lights (LEDs) in a matrix on or off. LED displays can present a long-running message by scrolling. The graphic quality of display characters is dependent on the fineness of the matrix employed.

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**EXAMPLE OF PRACTICE**

**Miami's Electronic Information System**

The Miami automated people-mover system uses an integrated electronic vehicle and station information display to show vehicle destinations, emergency procedure instructions, and advertising messages. Each vehicle is equipped with light-emitting diode (LED) display units mounted above the vehicle doors. Controlled by the vehicle's on-board computer, the units can display both letter and graphic messages. The LED displays in each station are identical to those on the vehicles, with the exception that they can also be programmed by computer keyboard at the station.

Source: *Passenger Transport* 8/29/83.

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**EXAMPLE OF PRACTICE**

**NYCTA Annunciator Signs**

The New York City Transit Authority has installed electronic LED changeable message "annunciator" signs at a number of its subway stations and plans to have 336 eventually in place as part of a $3.8-million passenger information systems program. The signs announce the arrival and direction of incoming trains. They also scroll other information such as safety messages ("Caution—Don't Stand Near Platform Edges") and helpful advice ("Avoid Delay—Purchase Tokens in Advance"). The annunciator signs are installed in off-hour waiting areas where approaching trains are not easily visible and where passengers are more secure.

Source: *New York Times.*

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**Television**

Video displays are becoming an increasingly common means of communicating transit information (Figure 14). The finer television screen matrix allows for the display of higher graphic quality characters, and offers possibilities for color displays of symbols, logos, and color-coded information. As the technology and costs of large thin-screen video displays improve, there will be wider applications of television screen signs in transfer facilities.

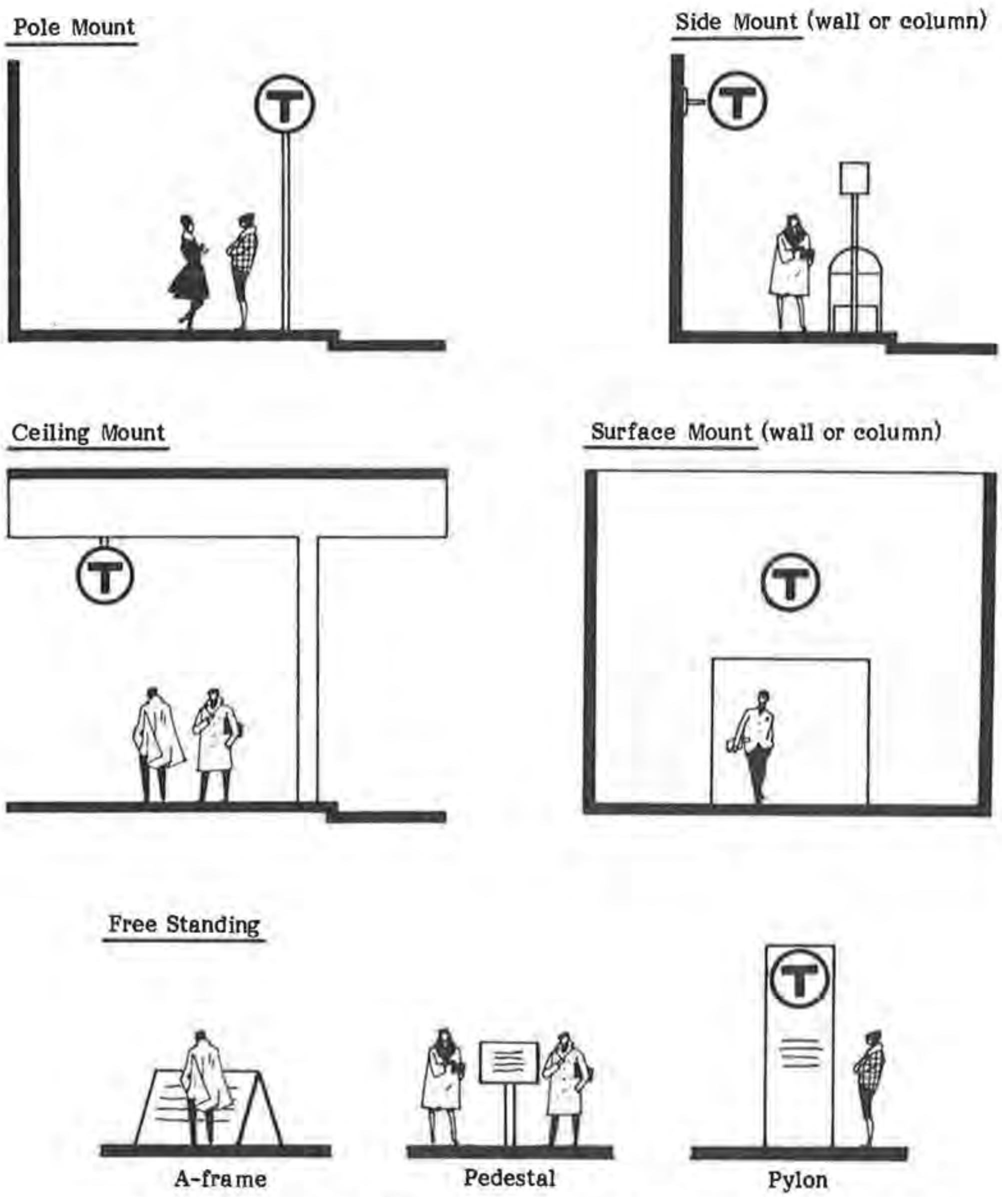


FIGURE 12 In transfer facilities that do not have conventional beam and column construction, information pylons or other free-standing signs may be required. This limits message size and length. (WMATA photo by Phil Portlock.)


FIGURE 13 Flip dot changeable message sign at the Inverness, Scotland railroad station. (Photo courtesy of Vultron, Inc.)

FIGURE 14 Video displays of bus departures and arrivals in use at the New York Port Authority Bus Terminal. (Photo courtesy Port Authority of New York and New Jersey.)

## SIGN MAINTENANCE

Periodic inspection of signs is necessary to determine if the sign is still in place, the message remains legible, the sign has maintained its structural integrity, and the message is still accurate. Exterior signs facing west and south may age faster because of prevailing wind directions and sun exposure. Rusting and oxidation of metal panels and sign hardware can affect the structural integrity of a sign, potentially resulting in a failure during high winds.

Sign maintenance can be facilitated by a written record of each sign by location, message, dates of fabrication and installation, type of sign materials and mounting hardware, colors, exposure conditions, and other relevant notes that could affect sign durability and maintenance. Computerized sign inventories containing these data can significantly assist sign maintenance programming.

CHAPTER FIVE

# ORAL COMMUNICATION

Many passengers rely heavily on oral information because of their inability to understand and use other types of information aids, and because of the need for the reassurance of person-to-person communication. Oral information can be communicated to passengers in transfer facilities by passenger assistance telephones connected to a centralized information center, by recorded and on-line public address announcements, and, in larger Level 3 to 5 facilities, by strategically stationed information staff. Passengers frequently rely on oral communication with transit operating personnel and other riders, even where other information aids are provided.

The primary means of providing oral information in the majority of transit agencies is the centralized telephone information center. A telephone center is usually less expensive than on-site personnel because fewer employees are needed. In part this is because the presence of on-site personnel may generate assistance requests from passengers who want only to confirm what they already know, but who would not call a telephone center for the same confirmation.

In a broader sense, oral communication of passenger information includes presentations by transit agency speakers bureaus, and the use of the radio and television media for transit-related broadcasts and spot announcements.

## ORAL INFORMATION IN TRANSFER FACILITIES

Public address systems are commonly used in Level 3 to 5 transfer facilities to announce departures and arrivals, changes in service, and for communication in potential emergencies. Departures and arrivals and other repetitive announcements are often recorded, but can be interrupted for current information. Problems encountered with public address systems include uneven sound distribution caused by inadequate numbers of amplifiers or amplifiers that are not properly located, and too loud or otherwise unintelligible announcements caused by poor microphone technique or improper tuning and volume adjustments. Public address systems in transit stations and large terminals should always be on a separate emergency standby electrical circuit, or have the capability of operating off standby batteries, so that the system will be operable during a power failure and other emergencies.

Special information staff may be utilized in larger Level 3 to 5 transfer facilities to provide directional information within the facility, trip and fare information, and other types of traveler aid (Figure 15). Experience has shown that prominently located staffed information desks will generate many non-transit-related inquiries, and also inquiries that could be readily accommodated by less costly means. Temporary information staff is often used in transfer facilities to assist passengers when a new service is instituted, or when there are significant changes in existing services, special events, or other unusual situations.

Recognizing the dependence of many passengers on personal communication, the Port Authority of New York and New Jersey has been experimenting with a two-way closed-circuit TV passenger assistance system in its huge midtown bus terminal. A recent expansion of this terminal into a site across the street from the main building prompted the use of the experimental two-way television. The TV, which connects to a centralized telephone information center, enables telephone agents to better interpret passenger problems and to communicate more effectively.

Telephone information can play an important role in the functioning of transfer facilities. At the bus-stop level, the use of a nearby public telephone can help passengers confirm a trip itinerary (transfer points, schedules, and waiting times). In the major transfer facility, such as a subway station or multi-modal interface, in-house telephones connecting to an information center can provide directional information within the facility itself. This is reassuring to passengers who otherwise might be apprehensive about becoming lost in crowded and unfamiliar surroundings.

The Port Authority Trans-Hudson (PATH) transit system in the New York-New Jersey metropolitan area provides passenger assistance phones in its stations. A color-coded PATH system map is displayed at each telephone installation for ready reference by the caller. The map display assists in the communication between the information agent and the caller. The phones can also be used for other forms of passenger assistance, such as turnstile problems, reporting accidents, or for security purposes.

## TELEPHONE INFORMATION CENTERS

The centralized telephone information center is commonly used by transit operators as part of their passenger communications program and overall monitoring strategy. As noted above, it can also be used to supplement other information aids in transfer facilities. Telephone information has several advantages over printed media such as timetables and maps:


FIGURE 15 Special information aides may be required for changes in service, special events, or during construction as shown in this photo. (Photo courtesy Port Authority of New York and New Jersey.)

- It is readily available to all.
- It reduces apprehension about using transit because informed assistance is obtainable if needed.
- Adjustments can be quickly made for changes in schedules and routes.
- The needs of individual callers, including those with language barriers or disabilities, can be addressed.
- It provides feedback to system management about transit consumer problems and service requirements.

In the typical telephone information center, agents answer inquiries about schedules, routes, and fares for a prospective transit trip. In transfer facilities additional directional information may be provided to those having orientation difficulties or requiring other types of assistance. Very often there is some type of communication difficulty, and the agent must assist the caller until the inquiry is mutually understood. The agent provides the information by consulting street and route maps, schedules, headway sheets, or other indexed data to respond to the inquiry.

#### Telephone Information Personnel

Good communication skills and a knowledge of the transit system and local geography are important for information agents. Typically, agents undergo intensive training to reach the level of skill required to provide the required trip information quickly. The agent's job is naturally more difficult in larger transit systems and service areas, particularly where there are interconnecting urban and suburban services.

Virtually all transit properties staff telephone information centers with their own personnel. However, the Chicago Regional Transportation Authority recently established a region-wide telephone information service that is contracted out to an independent vendor. Under the terms of this five-year agreement, the vendor is responsibile for all phases of the operation of the information center and a proportion of equipment costs.

#### Personnel Requirements

The American Public Transit Association (APTA) Telephone Information report, one of its consumer information handbook series, provides some data on the personnel requirements and costs of these services. Obviously the complexity of the transit system and the size of its service area affects the time spent with each caller and, therefore, the number of personnel required. In the APTA study, call volumes for a typical transit agency were found to average 1 to 2 customer inquiries per 100 passengers carried. For new transit service, calls may initially be as high as 20 calls per 100 passengers, and gradually decline. Higher levels of calls are also experienced if there are service or fare changes, special events, or abnormal weather.

Information agents usually can process an average of 20 to 40 calls per hour. In addition to system complexity, call productivity depends on agent experience and the types of trip data retrieval facilities provided. The length of a call can vary from 10 seconds up to 10 minutes where there is a communication problem, difficulties retrieving a street address or other needed trip data, or a complicated trip involving several transfers. WMATA reports that 80 percent of the calls are 3 minutes or less.

#### Telephone Information Center

The unit costs of handling telephone inquiries can vary considerably, depending on the quality of service provided. Costs may range from as little as $0.14 to more than $1 per call. However, from a transit marketing standpoint, a single call may generate many revenue-producing rides, thereby providing good return on the telephone information center investment. A market research study of the Washington, D.C. center found that approximately 80 percent of those who called for telephone information completed their trips, and that about 67 percent would not have used transit for the trip if the information service were not available. From these results, it was estimated that there was a 30 percent return on the investment in the information center.

#### Monitoring Performance

It is important to monitor call volumes to determine daily and hourly variations and information agent productivity. Typically, where there are 10 or more work stations, automatic call distributors (ACDs) are used to control incoming telephone traffic and record system performance data. The ACD system directs an incoming call to the first available agent. If all agents are busy, the call is routed to a holding queue and answered on a first-in, first-out sequence by the next available agent. While holding, a caller receives a message indicating that the call will be answered shortly and is requested to organize the trip itinerary before the agent comes on the line. This message can also provide commonly asked-for information. The ACD system is a valuable source of performance data because it can record incoming call volumes, waiting times, individual agent service times, and the number of "lost" calls (or those calls ended before reaching an agent). The ability to monitor system performance has been found to improve the quality and consistency of the information provided and to maintain agent productivity at high levels.

#### Information Retrieval

In addition to the normal communication problems involved in dealing with the general public, telephone agents have to quickly access a large amount of geographic, route, schedule, and fare data. Typically these data have been contained in tab-indexed, quick-reference files. Larger area maps may be wall mounted, requiring the agent to leave the work station. All these data must be kept up-to-date to reflect service changes. Various means have been developed to improve data retrieval times. For example, routes, maps, and schedules have been stored on microfiche. In one microfiche retrieval system, the agent enters the route number and trip direction and time of travel, and the schedule appears on the screen within four seconds. However, some difficulties have been experienced with microfiche retrieval systems relating to the inefficiency of updating data files, difficulties in handling more complex trips, ability to store only black and white and not color-coded route maps, and equipment problems.

#### Automated Information Directory System (AIDS)

The Washington Metropolitan Area Transit Authority (WMATA) uses AIDS, a computerized data base that can generate detailed trip information. WMATA's objectives in instituting AIDS were to: increase the productivity of agents by increasing trip data retrieval speeds, increase the reliability and consistency of information provided, reduce agent training times, improve ability to rapidly incorporate service changes in the data bank, increase agent job satisfaction, and expand the capability to monitor the performance of the information center.

With AIDS the agent enters trip data from the caller's inquiry into the computer terminal keyboard; the computer accesses the geographical and transit service data base (street addresses, routes, schedules, fares) and optimizes the caller's stated trip parameters (travel time, transfers, walking distances, or others) through comparison of alternative routings. After processing by the computer, typically in four seconds or less, the trip alternatives are displayed on the agent's video screen above the keyboard for presentation to the caller.

WMATA has realized other benefits from AIDS that were not originally anticipated:

- standardized timetable data developed for AIDS has improved the scheduling department's ability to quickly access, evaluate, and improve service schedules;
- the AIDS data base and performance statistics have been used as a resource to evaluate route effectiveness by the planning department;
- the bus-stop department has used AIDS to determine what types of signing and other information should be displayed at different transfer points; and
- the data base has been used to estimate the number of passenger route-miles provided in WMATA's various political jurisdictions.

### AUTOMATIC TELEPHONE ANSWERING SYSTEMS

In addition to using automatic call distributors, transit agencies have augmented their regular telephone information services with automated call-answering systems providing either recorded or computer-synthesized voice information. The objectives of automation are to reduce the cost of providing telephone information and to improve its reliability and availability by reducing the number of calls lost because of busy signals or long hold times. Examples are the Teleride system, which uses a computer-generated voice, and the recorded message system used by Tri-Met of Portland, Oregon.

#### Computer Voice

Teleride is an automated telephone answering system, employed in a number of U.S. and Canadian cities, that utilizes a computer and voice synthesizer to provide callers with current service information at the bus-stop level. The system is based on the premise that a large proportion of information calls are about current schedule information and the status of service. With Teleride, each bus stop is assigned a different telephone number. These telephone numbers are shown on route maps that are widely distributed in the service area (Figure 16). When the caller dials the stop number, a computer-generated voice announces the schedules of the next two arriving buses at the time of the call and for that stop. Other currently relevant service information can be inserted by computer input when needed. A typical call is answered within 10 to 15 seconds, usually without waiting, and at much less cost than an agent-assisted call. Teleride has been found to be the most effective in increasing off-peak ridership because these passengers are usually reluctant to use transit because of the uncertainty of waiting.

#### Recorded Messages

Portland Tri-Met has developed an automatic telephone answering system utilizing recorded messages that callers access using a different telephone number for each bus route. A separate tape recorder is necessary for each of Portland's 65 routes. The system enables up to 10 callers to access the same tape at the same time. The tape messages are relatively long because information is provided about an entire route, rather than at the bus-stop level. Also the recorded message cannot be quickly changed to provide current information about delays or other problems. Portland also provides agent-assisted information, but at reduced staffing levels, on the assumption that the tape-recorded route information satisfies a significant proportion of call demand.

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**EXAMPLE OF PRACTICE**

**SCRTD Telephone Information Center**

The Southern California Rapid Transit District (SCRTD) telephone information center is an example of a large transit consumer marketing effort. The SCRTD service area extends up to 90 miles north and south, and 50 miles east and west in the Los Angeles Metropolitan area. Within the district, more than 200 SCRTD bus routes and 2400 buses serve 185 different communities and cities. On an average day the SCRTD telephone information center receives 10,000 to 13,000 calls. SCRTD employs 85 information agents working in 3 shifts, 24 hours day, 365 days a year, to meet this demand. Despite this large number of personnel, approximately 30 to 40 percent of all peak-period calls are lost, or ended by the caller, before reaching an agent. However, during these periods more than 800 calls are completed. SCRTD recently conducted an experimental evaluation of a computerized customer information system to improve its performance rate. This system uses a computerized data bank to retrieve more rapidly the trip data required by agents, and is also capable of developing computer generated trip itineraries based on the caller's origin and destination.

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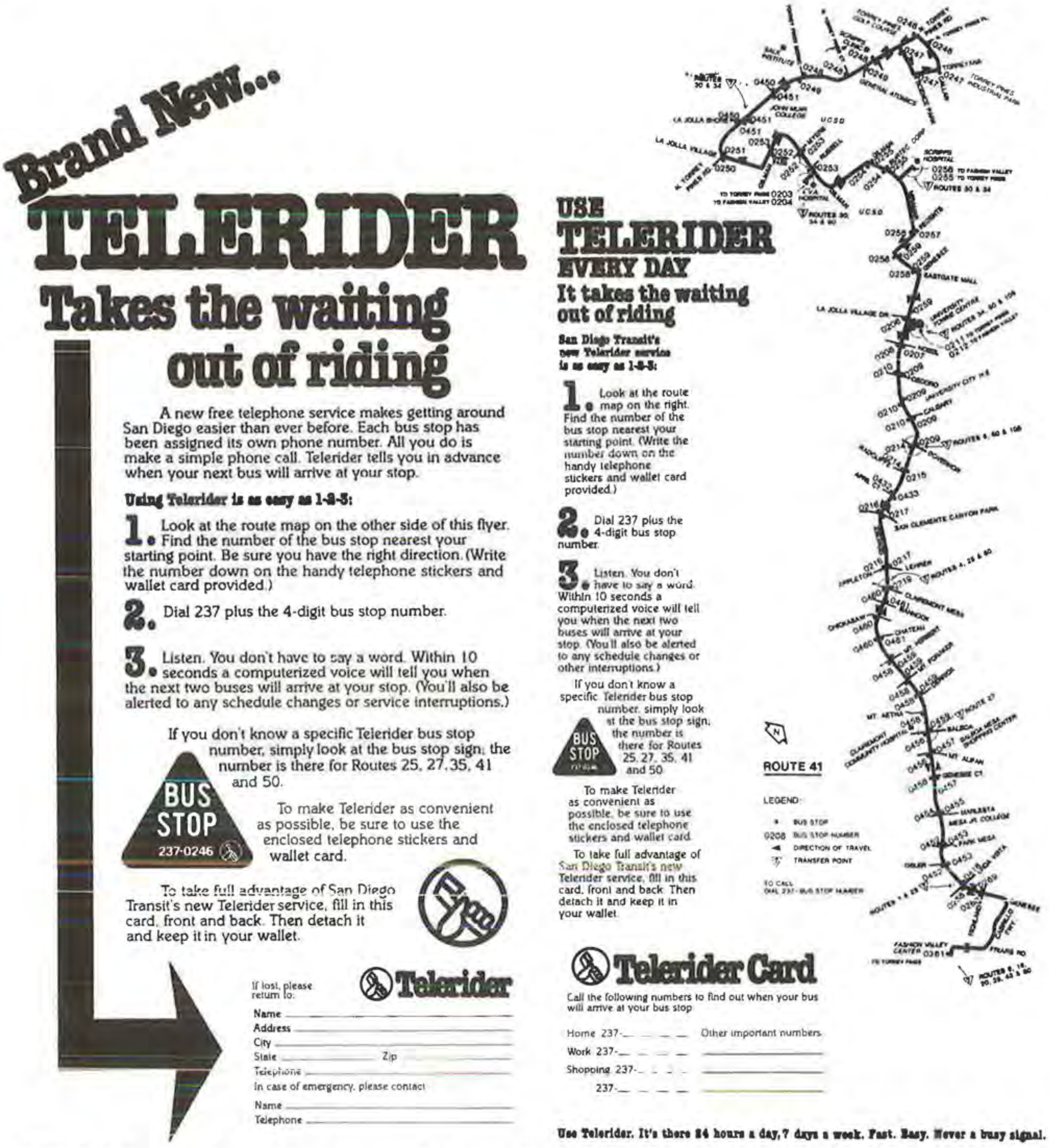


FIGURE 16 Brochure that explains how to use San Diego's Telerider (former name of Teleride).

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### EXAMPLE OF PRACTICE

#### Denver Cable TV Program

The Regional Transportation District (RTD) of Denver, Colorado introduced a 30-minute videotape production, "Catching the Ride," as part of its communication and marketing program. Produced by the RTD public affairs department, the show presents viewers with trip information and background on agency operations and policies. Each bimonthly show features some of the most interesting places served by RTD. Shown on local cable TV networks, the program reaches a wide audience that might otherwise not use the transit system because of unfamiliarity with routes and services.

Source: *Passenger Transport* 1/30/84.

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CHAPTER SIX

# DISTRIBUTED INFORMATION

The distribution and/or display of maps, schedules, brochures, newsletters, and other forms of printed information is an important passenger communication and transit marketing tool. A study of the public's knowledge of transit services and the use of information aids in a major midwestern city concluded that the majority of those surveyed did not have a good geographical knowledge of the city in which they lived, had a poor understanding of its transit network, and tended to overestimate transit travel times and distances.

Printed system and route maps displayed at transfer facilities and distributed by other means can help passengers overcome this knowledge gap by familiarizing them with route and place names, transfer points, and geographical relationships and by providing a permanent reference that can be used during a transit trip. They also can assist in communications with telephone information centers, transit operating personnel, and other riders.

The display of system and route maps in transfer facilities and on-board transit vehicles initially helps passengers in selecting a trip itinerary, and then provides continuing confirmation of the itinerary at successive transfer points en route. This follows the continuity and repetition principles of communication discussed in Chapter 3.

Newsletters, brochures, publicity releases, advertising, and other forms of printed communication provide prospective passengers with valuable introductory information about existing and new transit services and thus increase ridership by reducing trip uncertainties.

## TYPES OF DISTRIBUTED INFORMATION

The most common forms of distributed information are system maps, route maps, and timetables. System-wide maps should be designed to provide more generalized information with a minimum level of detail to give prospective riders a good overview of the transit network and its services. System maps should be considered a promotional and marketing aid to encourage new riders at the first level, or introductory phase of communication; more specific "navigational" information should be shown on the detailed route map.

Timetable information plays a lesser role than route maps in most transfer facilities. However, it is important for passengers to know the hours of service so that they can avoid becoming stranded. The availability of current real-time arrival and departure information creates positive perceptions of service and, in larger Level 4 and 5 transfer facilities, improves facility function by controlling pedestrian movement and crowding. As discussed previously, Tri-Met of Portland, Oregon provides, a video display of the scheduled departure times of the next three buses at each of 31 bus shelters in its downtown pedestrian mall. In addition, Tri-Met has four trip-planning kiosks on the mall, each equipped with a video screen and a keyboard by which route and schedule inquiries can be entered and answered automatically. A large-scale map of the mall, showing the bus routes serving it and hours of service, is also displayed in these kiosks.

Newsletters and press releases are secondary types of distributed information that typically do not provide specific trip information, but are used to inform passengers of planned changes in service, system improvements, special events, ridership promotions, and other types of transit "news." Although basically a form of marketing, they also help increase the general knowledge of the transit system and therefore benefit the overall passenger communication process.

### Methods of Distribution

Route maps, timetables, newsletters, and brochures can be provided to prospective riders via "Welcome Wagon," door-to-door, direct mail, and telemarketing promotions directed at new residents or in areas where new services are being instituted, and in response to mail or telephone requests to the transit agency. Distribution at transfer facilities can be done by station personnel, by means of strategically located information display racks, or at staffed information centers. The inclusion of transit maps and timetables in local telephone books has proven to be an effective method of providing this information. Many transit agencies distribute newsletters and special notices to riders explaining the causes of unusual service delays, or informing riders of changes in service or of improvements in equipment and facilities. These notices can be placed on transit vehicle seats or in display racks, and/or distributed by personnel at transfer points.

## MAP DISPLAYS AT TRANSFER FACILITIES

The display of route maps at transfer facilities and on transit vehicles provides an important orientation function: familiarizing passengers with route nomenclature and the names and relative locations of the places served. When riding, the sequence of station names or street stops encountered helps the passenger confirm that the proper route and direction have been selected. Where route maps are available, information inquires of transfer facility personnel can be reduced; or if the inquiries are made, they can be more clearly presented and the transfer facility personnel can respond to them more quickly. This minimizes passenger confusion and the time spent on inquiries—fostering rider good will and confidence. For this same reason, system maps should be conveniently displayed near passenger assistance telephones and, when possible, at public telephones located near transit stops.

At the bus-stop or Level 1 transfer point, only a simple pole-mounted strip map of the routes serving the stop may be presented in conjunction with system logo and route identification signing. Limited headway and other service information may also be presented. Where there is a bus shelter or small station facility, a larger system map would be added. In larger multimodal facilities, the route names, numbers, color codes, and symbols used on system and route maps should be coordinated with, and incorporated into, facility signing to facilitate passenger transfers.

## DEVELOPMENT OF SYSTEM AND ROUTE MAPS

The primary purpose of all transit maps is to help the passenger identify the specific routes and transfer locations needed to efficiently complete the intended trip. The inclusion of timetable information on these maps enables the passenger to determine the times that services are available and to estimate waiting times. "Time points," or the average travel times between stops shown on a route map, can also help users to better understand transit trip times and distances.

Fundamentally, the system and route map consists of a street layout, to provide a geographic base, with the superimposition of the transit system route or network of routes. In actual practice, the development of a route map can be very complicated, requiring the determination of the proper balance of geographic detail, transit information, graphic treatment, and other considerations necessary to make it easily understood by the public.

For example, development of the current New York City subway system map, which evolved over many years of trials of different concepts, was complicated by the size of the system and its many different branch lines. Maps following a strict geographic scale were found to be unsatisfactory because of the confluence of so many of the major subway lines in the small area of Manhattan. There is also little room for street detail because of the size of the system. From the standpoint of graphic treatment, schematic maps were found to be the best for portraying individual routes and transfer locations, but the lack of geographic references (rivers, parks, bridges) was found to confuse the public. The present map is a combination of the two design types, with one side consisting of a general system map using a recognizable but distorted geographic scale to provide sufficient space for both route and locational information, and the other side containing more detailed strip maps of the various branch lines.

The development of a system or route map that will be understood by the public is done in an organized sequence of stages. The first step is to establish the relative priorities of the information to be presented. Primary bits of information, such as route names and numbers, should be listed as one group and secondary classifications, such as street names, points of interest, etc., as others. Each information group should be consistently used on the map. The relative importance of each type of information to the user determines the visual weight of the linework, typefaces, symbols, and colors used to identify it. As illustrations, route names and numbers should clearly stand out from other secondary information, and a railroad station should receive more emphasis than local points of interest. The assembly of the preliminary map should begin only after agreement on information priorities and related graphic codes, and on whether the map is a general system map to be used for introductory passenger information and marketing purposes or as a route map with more specific geographic and transit service detail.

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### EXAMPLE OF PRACTICE

#### COTA Computer-Generated Route Maps

The Central Ohio Transit Authority (COTA) is using computer-generated graphics to produce route maps. The method allows faster and less expensive map up-dates as new services are added and existing routes revised. The computer data base allows instant printouts of individual routes or segments of routes; maps of local, express, or crosstown routes; or other variations. These maps are used in graphic layouts supplied to the printer (Figure 17).

Source: *Passenger Transport* 6/6/83.

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## FACTORS CONSIDERED

The general areas that must be considered in the development of system and route maps include: (a) graphic design, (b) the level of detail and relative priorities of transit and any other supplementary information that will be shown on the map, (c) printing, and (d) distribution. The factors that are included in each of these areas are outlined below.

### Graphic Design

- Use the services of a designer experienced in transit practice when possible.
- Design to fold to pocket size.
- Use geographically correct base map; distort scale only if necessary.
- Show map scale in miles and kilometers when true scale is used.
- Show compass points (or north arrow) for orientation.
- Control level of detail to reduce clutter, yet provide all necessary information.
- Use a single clear typeface, minimum 8 point type.
- Use colors with high contrast to distinguish routes, services, landmarks, points of interest, etc., but keep the number of different colors to a minimum.
- Use legend and consistent standardized symbols and logos.
- Use terminology, color codes, and symbols consistent with transfer facility signing and other information aids.
- Do not include extraneous information or advertisements, particularly on the primary map side.

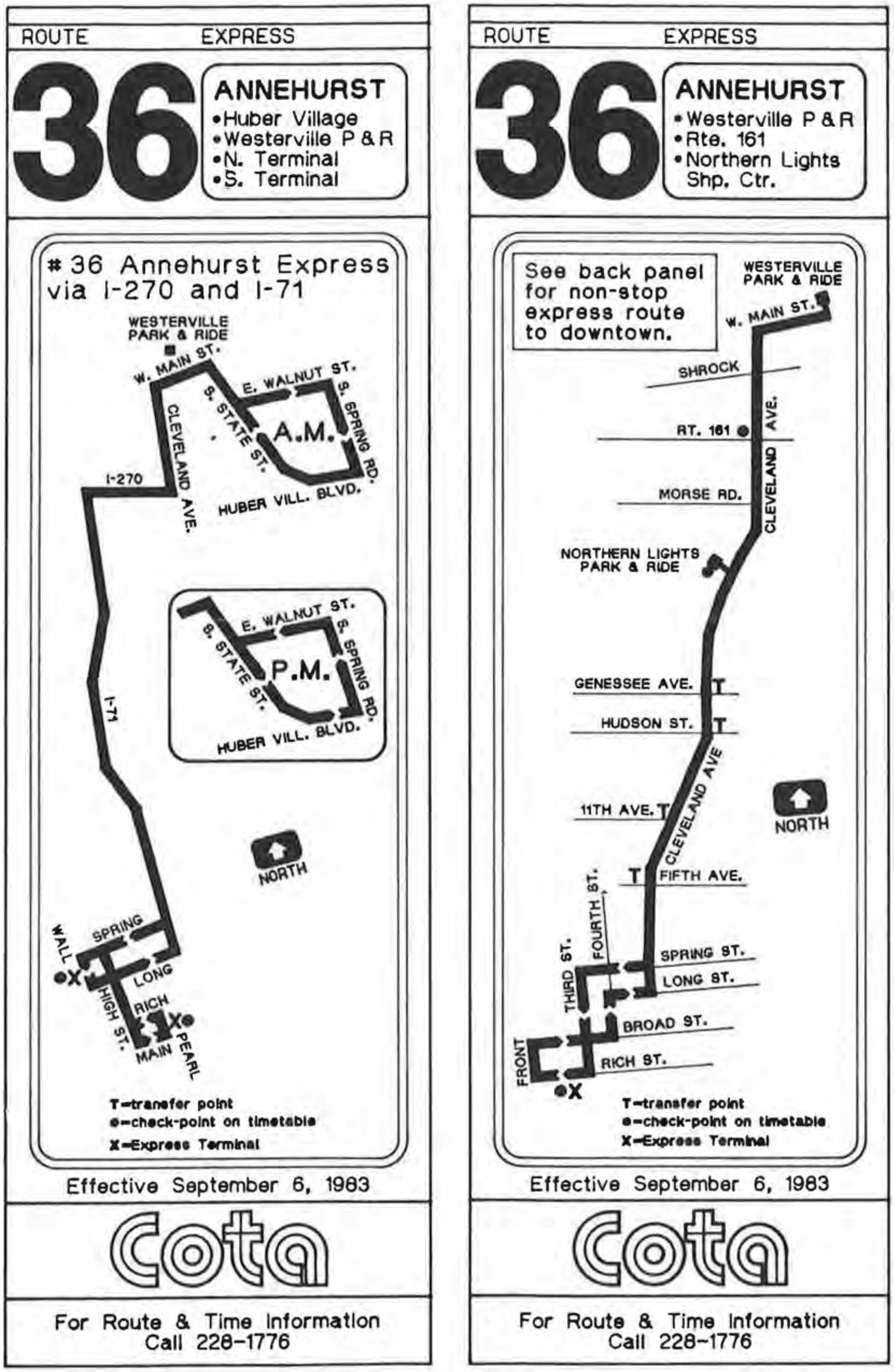


FIGURE 17 Computer-generated route maps (Central Ohio Transit Authority).

### Transit Information

- Use solid lines to designate routes.
- Identify all route names and numbers and transfer points.
- Include insets to show enlarged detail or transfer facilities and complex route intersections.
- Identify landmarks, topographical features, major highways, and cross streets.
- Show interfaces with other modes, suburban routes, and other transit networks.
- Show effective date of map.
- Use directional arrows where applicable.

### Supplementary Information

- Provide hours of service and schedule information in tabular form or as headways; show time points or intermediate travel times along route.
- Provide ticket, fare, and free-transfer information.
- Provide street and major activity center index coordinated with routes and alphanumeric map grid.
- List system telephone information number; also numbers of other connecting systems and emergency or other services.
- Include lost-and-found and transit agency address.
- Provide accessibility information for the handicapped.
- Include multi-lingual instructions and special maps where applicable.

### Printing

- Consult printer experienced in map printing before design and selection of paper size, paper stock, colors, etc.
- Use standard paper sizes and stock.
- Have written agreement as to ownership of print masters and reprinting costs.

### Distribution

- In response to mail and telephone requests.
- Schedule racks at transfer facilities.
- Welcome Wagon, new-rider kits, door-to-door, direct mail, and telemarketing promotions.
- Mobile information centers at large traffic generators or special events.
- Station agents and other transit system personnel.
- Local telephone book listing of maps and timetables.
- Local chamber of commerce, employers, and real estate agencies.
- Transit agency speaker's bureau presentations.

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### EXAMPLE OF PRACTICE

#### Tucson New-Rider Kit

Sun Tran, of Tucson, Arizona, has developed a new-rider kit to introduce first-time users to the system and to help others plan their trips more effectively. The kit is a brochure type of folder containing a Sun Tran system map, rider's guide, and schedules. The schedules indicate where and when to board buses and the guide answers basic user questions.

Personal trip planners at Sun Tran's Telephone Information Center will also modify the kit to include information that best meets specific passenger needs. The kits are mailed in answer to telephone requests and are also distributed at local community and group presentations.

Source: *Passenger Transport* 3/5/84.

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### EXAMPLE OF PRACTICE

#### Toronto's Mobile Information Center

The Toronto Transit Commission (TTC) "Info-Bus" is a mobile information and display center used to provide transit information to the public at a wide range of community locations and at special events in Toronto, Ontario, Canada. TTC converted an aging surplus bus into the Info Center by refinishing it and installing changeable photographic display panels and audiovisual equipment. An interactive TTC system map allows Info-Bus visitors to plan their trips by transit. A full range of information is also available on the bus including a system rider's guide, pocket schedules, and tourist brochures. The bus is stationed prominently at the Canadian National Exposition, an annual event that attracts many tourists to Toronto.

Source: *Passenger Transport* 8/22/83.

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CHAPTER SEVEN

# AUTOMATIC PASSENGER INTERACTIVE COMMUNICATION

The increasing cost of providing operator-assisted telephone information, combined with the rapid development of reliable and low-cost computer technology, has led to the development of automatic systems in which the user interacts directly with a computerized information data base. The Teleride system discussed in Chapter 5 is one example of this emerging technology. Other examples are described in following sections. A key development in the expanded use of automatic information systems in transportation will be the establishment of a uniform national standard geocoding system, which would be universally applicable to any urban area.

## TELETYPE

Teletypewriter (TTY) is primarily a means of communicating with hearing-impaired passengers, but could be expanded to other uses as well. WMATA (Washington, D.C.), MARTA (Atlanta, Georgia), and Tri-Met (Portland, Oregon) have installed TTY units in their telephone information centers. The units consist of a typewriter-like keyboard with a small viewing screen that can be attached to any standard telephone. A high-pitched noise is triggered when the telephone rings to indicate an incoming TTY call. The information agent on the receiving end of the call places the receiver of the phone on the TTY cradle. Next, the transmitted message automatically appears on the screen or a printout, and the response is typed with the message simultaneously appearing on the caller's unit. The caller must have access to a TTY unit, which currently costs about $500.

Although TTY is not now a fully automatic information system, the alphanumeric input used by the system could be coupled with a computer to access the large information data bases being developed by a number of transit properties. This could result in TTY inquires being answered directly by the computer. For example, inputs such as place names, cross streets, and time of day could generate outputs such as route numbers, stop locations, and schedules.

## TOUCH-SENSITIVE CRTs

This system accesses a computerized data base via input from a touch-sensitive CRT terminal. The information displayed on the CRT is organized in a hierarchy ranging from the general to the specific. Typically the CRT screen lists a number of general choices at first, with the user selecting one option from the list. The next list of choices in the information hierarchy is then displayed, with the user touching the CRT and making a series of subtopic selections from progressive displays until all the desired information is displayed. The user has the option of "backtracking" if other information branches need to be explored. Printers can be coupled with the CRT/computer interface to provide a printed, "hard-copy" output to the user. The system has the capability of providing multilingual directional and schedule information in transfer facilities.

## AUTOMATED PASSENGER ROUTE INFORMATION

Paris, France and Hamburg, Germany are experimenting with automated information systems for transit routing. In both systems a passenger using a machine connected to a central computer can punch in the origin and destination of a trip and the computer will select a routing and provide a printed copy. In the Paris system, the user may select a trip that is the fastest, involves the least walking, uses the subway only, or uses buses only. In Hamburg, users may also gain access to the system by telephone. To use the Hamburg system by telephone, the user must first look up the four-digit codes for the trip origin and destination. The user then calls a telephone number that reaches the computer; in response to requests from the computer (which uses a synthesized voice), the caller dials the codes for the trip origin and destination, day of the week, and desired departure or arrival time. The computer then determines how the trip can be made and gives this information to the caller, including transfer location and times and trip fares.

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### EXAMPLE OF PRACTICE

#### Automatic Passenger Information Machines in Germany

The German National Railway System has installed an automated passenger information system at many of its major stations. For a small fee, passengers can obtain itinerary and schedule information by keying in their origin and destination using three-digit location codes. Computer-generated trip information is printed on tri-lingual forms, which are retained by the passenger. The information output includes departure times and locations, train types, arrival times, transfers, and fares.

Source: Diewald et al.—*Assessment of Transit Passenger Information Systems,* UMTA (June 1983).

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## NATIONAL GEOCODING SYSTEM

A prospective development that would accelerate the wider implementation of automatic information systems would be the institution of a national geocoding system. Geocoding is simply the development of a grid or zone system as a means of indexing a geographical area. The most commonly used type of geocoding for transportation information is the alphanumeric index on many local street and highway maps. On a national scale there are many different geocodes, such as the census tract employed by the U.S. Census Bureau, and the zip codes used by the Post Office. However, these systems are not useable for transportation information purposes.

There is a need for a standardized regional grid system that would be uniformly applicable to any urban area in the United States. With this grid system in place, street names and numbers would be a secondary rather than primary information parameter. Because the same basic geocode grid on the regional level could be used in all cities, travelers could quickly locate a destination anywhere in the country by knowing the national and regional geocode index. With the geocode coupled to a local trip information data base, passengers could use digital telephones to input origin and destination codes and receive computer-synthesized-voice trip information (as in the Hamburg system noted above).

The national geocode system would be similar to the longitude and latitudes used by navigators, but at the regional level the indexing codes would be the same for every metropolitan area. The lowest level grid would be a 100-meter (305-ft) square. Area geocodes would be carried into local street and highway signing, and the identification of bus stops and transit stations. Geocoding would allow the description of transit routes in indexing terms, which would indicate the direction and places served by the route.

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### EXAMPLE OF PRACTICE

#### Private Geocoding Effort

Since 1980, Geographic Data Technology (GDT) of Lebanon, New Hampshire has been encoding geographic information on U.S. cities in its mainframe computer. Based on U.S. Census Bureau maps, GDT is recording 300 bits of geographic data for each city block, including street names, address ranges, latitude and longitude, and zip code boundaries. GDT is selling access to sections of the data base to trucking companies, for developing optimum routes, and to other commercial interests who are relating consumer market demographics to geographic location. There is also the potential for on-line use of the data base to reduce the amount of wasted truck mileage resulting from drivers who become lost.

Source: *In Cider* computer magazine, Sept. 1984, p. 17.

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CHAPTER EIGHT

# RESEARCH NEEDS

The potential research needs identified as a result of this synthesis study include:

- National standards and guidelines for transit industry signing;
- Relative costs and effectiveness of changeable message signing;
- Relative costs and effectiveness of automatic, user interactive information systems, projected developments and staging of technology;
- Study of national geocoding system for transportation; and
- Transit sign materials and supports.

A transit industry workshop seminar on passenger information could validate the need for research in these areas as well as identify other potential research.

## STANDARDIZATION OF TRANSIT SIGNING

Most of the major transit agencies in the United States have developed their own graphics manuals for the design and application of signing and other information aids. However, there are variations in the guidelines, and there is no national standardization analogous to the successful Uniform Manual on Traffic Control Devices as used country-wide for highway signing. The Air Transportation Association of America has recently developed standard guidelines for airport signing. Benefits that could occur from similar efforts to standardize transit signing include:

- Improved graphic design and wider recognition of the importance of information aids in transit facilities;

• Better communication with passengers, and particularly for visitors and tourists using transit systems in different cities;

• Accelerated evolution of information aid research and development, owing to the establishment of a larger, consolidated national market, rather than one fragmented along local lines; and

• Reduced cost of information aids owing to a larger market base.

### CHANGEABLE MESSAGE SIGNING

Changeable message signing has the advantage that it can provide current system information. Developments in display technology, combined with advances in computer technology, are increasing the capabilities of changeable message signing and reducing costs. Establishment of the relative costs and effectiveness of the various types of changeable message signs would help increase their use in transfer facilities.

### AUTOMATIC PASSENGER INTERACTIVE INFORMATION SYSTEMS

The prospects that automatic information systems can reduce the high costs of operator-assisted telephone information, improve the ability to meet peak demands, and potentially benefit passengers with disabilities warrants further research. Objectives would be to identify systems that are best suited to future needs and to develop staging plans that would bring these systems on line.

### NATIONAL GEOCODING SYSTEM

A national geocoding system would enable the widespread introduction of automatic trip information technology. Initial research efforts would be directed at establishing grid system rationale and indexing methods that could be learned and applied by the general public. The research would establish grid requirements for major cities in the United States and examine numerical, alphabetical, and alphanumeric coding methods.

### TRANSIT SIGN MATERIALS AND SUPPORTS

Although there is considerable documentation of experience with highway signing materials exposed to a range of climatic conditions, the record of transit agency experience in this area is limited. Transit signs are typically different from highway signs in terms of the types of materials used, adaptability to changes on the sign, and other factors. The research would identify the types of materials, mounting hardware, and methods of support that are most suitable for transit applications under a range of exposures to temperature, wind, and vandalism conditions.

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