

APPENDIX F

EFFECTIVE SERVICE CONCEPTS

RIDERSHIP EXPERIENCE OF SERVICE CONCEPTS

This appendix describes what is known about how service concepts actually affect transit ridership among the market groups. Only those service concepts effectively implemented by other transit operators and that have raised transit ridership are discussed.

For each service concept resulting in increased ridership, the research team sought to determine the following:

- Whether increased boardings represented new riders or the same riders traveling more often,
- Who the new or more frequent riders were (by age, sex, race, income, ethnicity, and so forth),
- Whether ridership gained by the service concept represented a real net gain—or whether it came at the cost of reduced ridership on other modes or routes,
- Whether ridership was gained by providing more service or simply different service (that is, whether ridership increased per input of service), and,
- If the service concept was really linked to the increase in ridership or if larger trends—population growth, increasing immigration, migration of the elderly—were simply causing ridership increases.

Unfortunately, many transit systems had little information on how the service option affected ridership because (a) the concept had only recently been implemented, (b) the concept was implemented as part of a package of options, (c) the concept was implemented to have a long-range effect (for example, marketing targeted to school children), or (d) the system did not have the resources to conduct detailed ridership surveys.

The research team included descriptions of a few service concepts for which no ridership data existed—such as transit-supportive neighborhoods or childcare facilities—because the concepts seem so promising or because they have been widely discussed. Most have operational experience but no data on ridership effect.

The first subsection describes those concepts which make transit feasible or practical for people; the second subsection evaluates those concepts which make transit more convenient. The third subsection describes those concepts which make transit faster or more direct for users, while the fourth subsection identifies those transit concepts which make service cheaper for the user. Each of the service concepts was described in the Task 1 report.

Concepts Which Make Transit Feasible/Practical

Reverse-Commute and Feeder Routes

Reverse-commute services can be provided directly or with suburban feeder services to traditional line-haul services. Over the last two decades, several transit systems have experienced a sizable reverse-commute ridership; the **Denver RTD** is a recent example. While constructing an HOV lane, the RTD operated buses in both directions along the freeway corridor and achieved a substantial reverse-commute flow. However, the lanes were designed to be unidirectional in the peak flow and, once the construction was complete, the RTD ended the reverse-commute service—to the complaints of riders. RTD staff report that it is not financially feasible to construct another lane for the reverse-commute service, given the capital expenditure already made.

The **Santa Monica Municipal Bus Line** (The Big Blue Bus Line) also discovered a low-income reverse-commute market when attempting to meet the needs of upper income CBD commuters. At the request of stock brokers who needed to be at work in downtown Los Angeles before 6:00 AM, the bus system began early express service. While the bus only carried 15 passengers per trip in the traditional direction, it quickly gained more than 55 riders in the reverse direction. The reverse commuters are domestic workers and day laborers working in Santa Monica who are new riders for the system. The Big Blue Bus Line had to add another bus leaving downtown Los Angeles at 6:10 AM to meet the reverse-commute demand.

Another example is the **Metropolitan Suburban Bus Authority (MSBA)** serving Nassau County outside New York City (and providing commuter service to Queens, Long Island, and Suffolk County), a subsidiary of the New York MTA operated by Nassau County. The system was originally established to provide feeder services to the subways going to Queens, but during the 1980s, staff noticed that these same routes were filling up in the reverse direction as light industrial and service jobs developed on Long Island. Reverse-commute ridership was not actively developed but has simply increased with new Nassau County employment opportunities; by 1988, the number of morning peak passengers traveling east (away from the subway connection to Queens) had exceeded the CBD-bound number. By 1993, reverse-commute passengers constituted 60 percent of all MSBA ridership.

The **Suburban Mobility Authority for Regional Transportation** (SMART) in suburban Detroit introduced a planned reverse-commute service—the "Job Express Shuttle"—in late 1994. The shuttle was designed to pick up passengers from central suburban transfer hubs served by the City of Detroit DOT and transport them to suburban job centers not previously served by transit; the service was targeted to poor inner-city commuters. Some of the shuttle stations are at the end of Detroit DOT's line-haul routes. Currently, three shuttles operate on a 15-min headway, from 5:00 AM to 7:00 PM, for a \$0.50 fare; the shuttle will accept transfers and bus passes from the Detroit DOT's services. Ridership has been increasing steadily and the Job Express currently serves 400 to 500 riders per route per day (i.e., 1,200 to 1,500 daily overall). Studies show that 80 percent of riders are women, 98 percent are racial or ethnic minorities, and most are between 16 and 44 years of age. Ultimately, the shuttle is expected to serve 800 employers and 16,000 jobs within the service area.

Caltrans and the **Southern Pacific Company**, with financial support from San Francisco, San Mateo, and Santa Clara Counties, operate "CalTrain," a 47-mi-long heavy rail line between San Jose and San Francisco. They operate 52 weekday and 46 (total) weekend trains. Like many operators, CalTrain found that it had a growing number of reverse commuters. A 1989 detailed study of reverse-commute rider characteristics found significant differences between the traditional and reverse commuter: reverse commuters were younger, more likely to be male, not "quite so well off financially" and considerably less likely to have a car¹. Reverse commuters starting in San Francisco were also more likely to rate CalTrain as slower, more expensive, and less dependable than did traditional commuters².

NJ Transit, a statewide organization, has provided reverse-commute services in two major phases, the first in the 1980s when NJ Transit personnel worked with individual employers and business alliances; in the second more recent phase, personnel have focused more directly on inner-city residents.

In the first phase, NJ Transit began reverse-commute operations when Hartz Mountain Industries asked them to provide service to its new shopping mall and office complex, Harmon Meadow, located near the North Bergen park-and-ride serving New York City. Reverse peak trips on the park-and-ride service were re-routed to serve Harmon Meadow, with Hartz paying the operating subsidy. The service continues today without subsidy because fares cover the operating cost³. After the success of this route, NJ Transit implemented 13 other reverse-commute or suburb-to-suburb services between 1981 and 1989. Roughly half of these 1980s services were considered successful and remain in operation.

For example, in 1987 NJ Transit was asked to re-route an existing route (No. 1 in Newark) to stop at the River Terminal Development Corporation; the transit system agreed to do so if the River Terminal would pay approximately \$9,000 a year in additional operating costs. After just a few months

in operation, the daily ridership (46) exceeded the break-even point (42), and the system continued the service without subsidy.

On the other hand, in the same year NJ Transit was asked by United Parcel Service in the Newark area to provide them with public transportation services; UPS had difficulty in recruiting semi-skilled workers for a noon to 4:00 PM shift and felt that the absence of direct bus service was the cause. UPS projected that between 45 and 75 people would use a direct bus service if the 29 route, which intersected virtually all lines in the greater Newark area, were extended to UPS. NJ Transit modified the service as requested, adding 4.9 hr to daily service, requiring an annual subsidy of almost \$38,000 which UPS agreed to pay. Unfortunately, the service averaged only 3 riders per trip and UPS refused to continue to subsidize it after 3 months of operation, so NJ Transit discontinued service.

In analyzing all of their 1980s non-traditional commute services, NJ Transit noted that the commitment of the employer and the total travel time facing the employee were significant success factors. They concluded that costs could often be kept low enough to maintain service if unused capacity was activated and route deviations requiring little additional operation time were used. Specific examples included the high level of service they were able to provide to New Jersey work locations drawing New York employees because they had so much excess capacity in the reverse direction (given the extensive NJ Transit service to New York). They were also able to cheaply provide service to employers located close to an existing route and having shift times that matched existing bus schedules. NJ Transit calculated that any employer more than 5 mi from an existing bus service (or those with unusual shift times) required an extra driver for the new service.

NJ Transit maintains an active Business Transit Alliance program to work with employers in developing and planning new services, particularly those which employers are willing to help subsidize. In addition, in 1993, NJ Transit began a series of experimental reverse-commute routes from the inner-city to suburban employment concentrations with a CMAQ grant; these services were part of their overall Project CONNECTION. The experiment included three types of service: additional inner-city-to-suburb routes, suburban feeder routes, and suburb-to-suburb services.

The NJ Transit expansion of inner-city service has been the most successful new service concept, particularly the extension of service hours. The least successful of the services have been the routes entirely in the suburbs, particularly those operating in HOV lanes, because they did not provide frequent enough headways to be attractive. Moreover, it was difficult to adequately serve spread-out suburban locations with the resources available. The feeders to rail were only moderately successful because employees were required to make at least one and sometimes as many as three transfers.

The routes from inner-city Newark to the suburbs, begun in January of 1995, have had the best ridership response—approximately 25 passengers per vehicle trip. Staff believe that the frequent headways and direct service, coupled with connection to suburban routes, are responsible for the success in attracting inner-city riders. During the day, the service schedule is varied to address rider characteristics; the most popular trip is at 9:40 AM, geared to serve employees of two major companies with shifts beginning at 11:00 AM. The Newark services also help job seekers to travel to interviews, providing an incentive to seek suburban jobs.

NJ Transit staff believe that cooperation with suburban businesses has contributed to the success of the reverse-commute services. For example, high demand on the Newark routes has led to the addition of Sunday services to both suburban employment centers and shopping malls. This has doubled the total number of vehicle trips, including adding extra capacity on very early morning trips—even the Sunday 8:00 AM bus was operating at capacity, so a route was added at 7:00 AM. Although NJ Transit has not done studies of rider characteristics, most of the riders are assumed to be inner-city minority commuters.

Because the experimental funding will shortly run out, NJ Transit has established criteria for continuing individual services. To remain in operation, the extension of an existing route must have a 15 percent recovery ratio in the first year and a 20 percent ratio in the second. If the reverse-commute route was a new one, it must recover 20 percent of its costs in the first year, and 25 percent in the second. Some routes have failed to meet these criteria; the suburb-to-suburb ones are the most obvious, although some inner-city-to-very-low-density suburban routes have not done well either.

A well-known system of suburban reverse-commute feeder services is the "200-Series" routes operated by the **Southeastern Pennsylvania Transportation Authority (SEPTA)** (Philadelphia). SEPTA may have developed the first major express reverse-commute route more than 30 years ago—a route still in operation. The current Route 124/125 was started when a major employer expanded, locating employees to the King of Prussia/Valley Forge area. The new bus route essentially connected the two work locations of this major company. King of Prussia at that time was an outlying area but offered convenient access to major highways. The area has since developed as the major subregional center with extensive retail and employment.

Approximately 10 years ago, in response to suburban growth, SEPTA redesigned and improved this service, making it the trunk portion of a suburban network oriented to a King of Prussia transportation center. In comparison with many other express and reverse-commute routes, Route 124/125 is unparalleled. Service operates on a 10-min peak headway on the trunk portion to King of Prussia. There is a long span of service on both weekdays and weekends. Traditional transit coaches are used, though at one point articulated coaches were assigned. The major outbound boarding locations are Center City, Philadelphia, and a transit

center approximately 5 mi from downtown. In addition to providing direct service to attractions along the route, this bus route serves as a major connection between the city and suburban areas.

SEPTA's 200 series began in the mid-1980s. In September of 1986, the developer of a group of suburban business campuses approached SEPTA and asked for a new bus service to link the employers there to the nearest suburban rail station. SEPTA's original analysis showed that the route would only carry 60 percent of the ridership needed to recover the cost of operations strictly through fares. The developer and the major tenants agreed to subsidize the difference. Route 201 was heavily marketed by SEPTA and began service in March of 1988. By June, Route 201 had 186 riders—more than enough to cover operating costs. By September, the route was carrying 237 passengers and SEPTA was using the profits to subsidize the rail system⁴.

Because of the success of Route 201, SEPTA began planning more than a dozen 200-series routes between suburban rail stations and employment areas. In general, 200-series routes are only established when employers call and request them. SEPTA staff then develop a cost proposal for the requested service and require that interested parties pay for that service quarterly; the cost structure guarantees that SEPTA will break even on incremental expenses. The average cost to each employer is about \$15,000, which reflects a "credit" for the train fare paid by employees using the bus on the grounds that they would not have used the train unless the 200-series bus existed.

Most of the 200-series routes run in peak periods only, although some offer hourly service during the off-peak. Most routes carry two-thirds of their riders in the morning peak so that a significant number of riders travel only one way with the feeder bus. One route, serving AARP and the Prudential Insurance Complex, operates during non-peak hours for shift workers and for job interviewees. Routes carry from 10 to 20 passengers per daily trip.

Because the 200-series routes were a bus-to-rail service, SEPTA coordinated bus with rail schedules to make intermodal transfer as smooth as possible. For example, buses are scheduled to meet reverse-commute trains on 30-min headways; in addition, some stations have been modified so that buses come as close to the trains as possible.

Ridership peaked at 800 riders per day in 1991 and has been falling since because of lay-offs and economic downturns affecting employment. In the beginning of 1995, SEPTA had five operating 200-series routes, all serving suburban rail stations, and most significantly subsidized by private employers. One of the original routes had been canceled because of declining ridership and another had been changed to Saturday-only service. Two routes were breaking even on marginal costs and a third covered 90 percent of its operating costs.

When Sears moved from the Sears Tower in the Chicago CBD to a suburban location 35 mi away, **PACE**, the suburban

bus division of the Chicago RTA, worked with the large employer to try and retain transit ridership among the relocated workers by re-routing two routes, organizing vanpools, and providing subscription services. Roughly one third of the riders on these three services are reverse commuters, coming from Chicago to the suburban Sears work site⁵.

In Tucson, with a grant from DOT designed to promote alternatives to the private car, the city transit system, **Sun Tran**, began one reverse-commute route and one suburban extension of an existing route to serve a large aerospace firm, a major mall, and several resort hotels. Service was provided 7 days per week, on 30-min headways during morning peak periods and 15-min headways during the PM peak. Although designed to accommodate workers, the route did not provide express bus service; it took roughly 68 min to make an 11-mi-long trip.

While the extended route has exceeded its goals, its ridership has turned out to be suburban residents riding to suburban destinations—not reverse commuters. Route 16, the genuine reverse-commute route, did not do well at all; although ridership projections were in excess of 200 people daily, the route actually had only 33. Staff attribute its failure to downturns in the economy, the need for shorter headways, and public perception that transit is not reliable; they also questioned whether transit and work schedules coincided and whether the trip was simply too long.

The **Central New York RTA** (Centro) in Syracuse operates a Jobs Express that shuttles employees from Cayuga and Oswego Counties to Chrysler and Carrier plants. The routes each carry 100 passenger per day, traveling on the New York State Thruway.

Cobb Community Transit (CCT) provides feeder services to and from MARTA stations in Atlanta and DeKalb county; originally designed to take suburban residents to five suburban MARTA stations (because MARTA does not reach Cobb County), the system found itself with growing reverse-commute ridership as people learned how to use the system. CCT has an agreement with MARTA which allows it to only service rapid rail stations and which permits free transfers between the two carriers. However, an examination of their route structure makes it clear that CCT actually provides significant service in downtown Atlanta which facilitates reverse-commute activities.

CCT Route 10, which has the highest volume of reverse-commute ridership (almost 3,400 trips weekly) stops at four major MARTA stations in the city (Five Points, the Peachtree Center, the Civic Center, and the Art Center) before traveling to suburban Cobb County in closed-door operation. In Cobb County, Route 10 makes four stops, including stops at a large hotel and at a major regional shopping mall. Another CCT route stops at the Lennox Buckhead station, which is a large new employment and residential area serving as the hub of the rail network. All buses, including Route 10, operate during the peak only. Staff indicated that some reverse-commute riders had asked for the provision of direct

downtown Atlanta to Cobb County service but that the closed-door agreement with MARTA precluded such activity.

The **Broward County Mass Transit Division** has a reverse-commute route, #18, which has one of the highest number of passengers per hour of service in the system; it provides access from the largest inner-city minority neighborhood to a suburban shopping center and to a community college campus.

The fastest growing route in the **Sacramento Regional Transit District** (RT) system is one that travels from downtown on the interstate to South Natomas—the highest density area outside the CBD—and then to the Arden/Del Paso Light Rail system. This route carries 1,200 passengers a day, with almost 42 passengers per vehicle hour of service (34 percent higher than the system average). It also has a higher than average fare recovery ratio.

The **Capital Metropolitan Transportation Authority** (Austin, Texas) had several reverse-commute routes, which were not successful. Currently, they operate a suburban feeder service to and from an express bus stop in a high growth suburban area with many industrial sites. They have numerous reverse commuters on that particular route—some inner-city workers and some students traveling to a community college in the area.

The **Long Island Railway** had a reverse-commute service on its Port Jefferson line which was not successful, possibly because of the limited level of service.

APTA undertook a survey of its membership in 1992 and found that 61 percent of the 56 respondents provided some form of reverse-commute service, generally in direct response to employer/employee needs. Most respondents—86 percent—said that their programs were targeted to specific suburban employers. Sixty-three percent of the respondents reported focusing on inner-city residents; a smaller number served job training or special employment programs. Many of the respondents also reported offering more than bus or bus-to-rail connections; for example, 25 percent of respondents provided vanpools from inner cities to suburban employment concentrations.

Although the term "reverse commute" often conveys the image of poor inner-city workers traveling to suburban jobs, professionals and managers are often riders as well. For example, a TMA representing a group of employers has been responsible for several feeder projects in the Princeton, New Jersey, area which serve largely high-income workers coming from New York and Philadelphia.

The **Greater Princeton TMA (GPTMA)** was formed in 1984 as a non-profit corporation whose goal was to initiate traffic reduction programs in the growing Princeton employment concentrations. Within a few years, several major firms relocated from Manhattan and wanted to keep their Manhattan employees; in 1987, Merrill Lynch initiated and paid for a shuttle to transport employees 5 to 7 mi from the rail station on the New York and Philadelphia line. When First Boston and American Reinsurance relocated

from Manhattan, they too tried to start their own shuttle services; the developer of the employment complex, the Forrestal Center, in which they were located suggested developing one shuttle service for all three firms.

GPTMA was asked to administer and broker the service; it received an UMTA/FTA Entrepreneurial Service Grant for planning expenses. Once the service was planned, GPTMA requested proposals for service and awarded the contract to a local limousine company. (Staff report that, because of proximity to Atlantic City, many private carriers in the area have excess capacity.) The local public transit operator, NJ Transit did not bid on the service because smaller, non-diesel vehicles were specified and because union requirements kept its operating costs higher.

The current service has been operating successfully since October of 1990, with an average daily ridership of 75. The shuttle meets trains during morning and evening peak periods (7–9:30 AM, 4–6:30 PM); the employee pays nothing while each business pays \$104,000/year in operational expenses plus 10 percent administrative fees (GPTMA member firms pay 8 percent). GPTMA is responsible for scheduling and coordinating buses with train service and for providing ridership and marketing information.

GPTMA staff attribute the success of the shuttle to several factors: the long history of shuttle service by Merrill Lynch before the coordinated service was begun, the willingness of employers to pay all associated costs in order to retain high-level white collar and executive employees, and the developer's use of the service as a marketing tool in attracting other employers to the area.

Another shuttle service in a suburban center close to the Princeton Forrestal Center has also been successful. The Route 1 "Carnegie" corridor in Mercer County is an employment concentration located near but not at a commuter rail station along a high-speed line serving New York, Newark, and Philadelphia. The area has both residential and campus-style office parks, which are part of the rapid office growth in Princeton; it is 1.4 mi from the Princeton Junction commuter rail station.

The area's developer began a shuttle service in 1988, the **Carnegie Haul**, to enhance the attractiveness of the Carnegie Center in West Windsor Township; the developer originally paid all of the costs and the service was free to employers. The shuttle runs from 6 to 10 AM and from 3 to 8 PM on a 25-min headway, meeting all outbound trains. Employees ride free, but local residents pay. A clustered campus-style office park, the center consists of 20 buildings with an average of six bus stops per run with no more than $\frac{1}{5}$ mi between stops. The Carnegie Center also includes 550 medium-density residential units which generate traditional suburb-to-center city commuter rail ridership to New York and Philadelphia; residential ridership accounts for nearly 60 percent of the total daily ridership on the Carnegie Haul. The residential ridership has a 6:30 to 7:30 peak and the reverse-commute feeder has a 7:45 to 8:45 peak—the same bus can service both residential and office locations.

A 1991 study by Marchwinski and Fittante⁶ found that about 20 percent of the Carnegie Haul riders came from New York City. Of the remaining riders another 20 percent came from Newark, a little more than 7 percent came from Philadelphia, and an equal number came from Princeton. In total, roughly 75 percent of riders were reverse commuters traveling an average of 28.5 mi. When asked how they would make the trip if the shuttle were discontinued, almost 40 percent said they would come to work in a car (as a driver or passenger), and 19 percent said they would take a train or taxi. No one said that they would not make the trip without the shuttle service.

Another shuttle service was organized in the Middletown/Homdel area of Monmouth County, New Jersey, to serve several separate AT & T facilities in a rural suburban area, the furthest of which is 7.5 mi from the North Jersey Coast Line, a 66.7-mi-long rail route with direct service to New York City. The AT & T shuttle connects to the Middletown rail station, approximately 40 mi from New York City. However, Marchwinski and Fittante found that more than 80 percent of the AT & T shuttle riders came from further south of the work site and not from New York; the average trip was 14.4 mi. When asked what mode they would use if the shuttle were discontinued, 10 percent said that they would no longer make the trip while more than 40 percent said that they would drive.

Feeder Routes

The **Potomac and Rappahannock Transportation Commission** (PRTC) in Prince William County, Virginia, near Washington, DC, operates OmniLink shuttles on five routes serving three stops on the Virginia Railway Express (VRE), largely taking commuters to the DC area (25 to 30 mi away). OmniLink's services are coordinated with train schedules, although riders may flag the bus down anywhere along the route. Having a VRE ticket allows a person to ride OmniLink for free. The service began in December of 1994 with an average of 100 trips per day; by August of 1994, there were almost 350 daily trips.

Many riders commuting to Alexandria, Virginia; Crystal City in Arlington, Virginia; or Washington, DC, have been encouraged to use VRE by the availability of the feeder service. Twenty-nine percent of OmniLink riders are going to work; almost 26 percent are going shopping, 15 percent are going to the doctor, and 11 percent are making social or recreational trips. Staff report that approximately 32 percent of OmniLink riders to the three VRE stations are new VRE riders. OmniLink riders are very different from overall VRE riders. The typical VRE rider is male (60 percent) and has a very high income: almost half have household incomes above \$75,000 while 22 percent have incomes above \$100,000. A December 1995 study found that the typical OmniLink rider, however, is female (61 percent), under 45 (79 percent), and fairly poor—64 percent have incomes below \$25,000. Many of those using the shuttle formerly

made the trip by car—21 percent drove alone, 29 percent were car passengers, and 22.3 percent had used a taxi for the trip.

In 1991, the **Metro North Railroad** (suburban New York City) began providing a rail feeder service, the Hudson Rail Link, to suburban commuter rail stations offering service to New York City. Five shuttles currently operate on fixed routes during peak hours throughout the communities near the rail stations, feeding the stations; two routes are offered in the off-peak. Service is provided from 5:45 AM to 11:45 PM, every 15 min during the peak, every hour off-peak; fares range from \$0.25 off-peak to \$1.25 in the peak.

Average daily ridership is about 1,000 trips per day—an 11 percent increase between 1993 and 1994, and a 5 percent increase between 1994 and 1995; ridership is highest in winter months when it is more difficult to reach the station by other means. Ridership at the two stations served by the Rail Link increased by a third from 1991 to 1993, or 300 new rail passengers. Rail Link riders are very different from the typical Bronx transit user; roughly 71 percent of the riders have incomes over \$50,000 (47 percent have incomes above \$75,000). About two-thirds of Link riders are women and 41 percent are over 45 years old (18 percent are over 55).

The **Norwalk Transit District**, in conjunction with the Connecticut DOT, recently began feeder service between the Greenwich rail station and downtown Greenwich, from 7:42 AM to 9:00 AM and from 3:56 PM to 6:19 PM each weekday. The service carries between 88 and 106 trips per day. The Transit District also began two feeder routes from the South Norwalk train station and the Merritt 7/South Wilton employment corridor (with more than 13,000 employees). Although the services were free for the first 6 months, ridership in May of 1995 was only 63 passenger trips per day. The lower ridership is attributed to the long travel time and the indirect routing to northern employment concentrations⁷.

In 1991, Shore Line East Commuter rail service was established between New Haven and Old Saybrook, Connecticut; **Connecticut Transit** initiated the Commuter Connection Shuttle service to connect the New Haven downtown with Union Station served by the new commuter rail service. The feeder service operates when the Shore Line East trains run, from roughly 6:30 AM to 10:00 AM and between 3:00 PM and 9:00 PM. Riders can pay by adding a small surcharge to their monthly rail commuter ticket. Daily ridership is about 440 riders⁸. This is one of the most effective feeder services operated by Connecticut Transit, probably because the schedules are so well coordinated with those of the rail system and there is an integrated fare system.

The **Connecticut DOT (ConnDOT)** began feeder services from Stamford's Metro North Rail station, served by more than 140 trains each work day, to downtown Stamford. The service operates from 6:15 AM to 9:37 AM and from 2:48 AM to 7:27 PM carrying about 140 passengers per day. ConnDOT is considering adding shuttle services to the South End employment corridor and modifying existing local bus

routes to serve these locations⁹. No ridership data are available on either of the ConnDOT feeders described here.

The **Lehigh and Northampton Transportation Authority (PA)** instituted a shuttle service allowing passengers to transfer to the core service at transit centers throughout the system; system ridership increased by 8 percent¹⁰. The **Dallas Area Rapid Transit District (DART)** operates a network of fixed-route feeders to regional buses and rail; ridership has increased steadily on these services at 7 to 8 percent a year¹¹.

Many transit systems provide feeder services for special and sporting events. The Boston **Massachusetts Bay Transportation Authority (MBTA)** runs very successful feeder services from rapid rail stations to the Patriots games; while it took time to develop the market, they now experience high ridership. The MBTA has also had a high ridership response to large special events; when SAIL BOSTON brought tall ships to the harbor, the system ran a massive shuttle service from the revamped South Station to the waterfront, carrying 2 million riders per day.

Service to Large Employers, Schools, and Universities

PACE, the suburban bus division of the Chicago RTA, operates nine subscription services for Sears' employees under contract to private operators. Sears relocated from the Sears Tower in downtown Chicago to the Hoffman Estates, a suburban development 35 mi from the Chicago CBD. PACE worked closely with Sears to attract approximately 25 percent of the workers who had previously used transit; the subscription services were one of three alternatives offered employees (the other two were vanpools and new fixed routes). The subscription services provide nearly 200,000 annual rides; they are open to the general public, although geared to Sears' needs, and fares are set to equal 60 percent of the cost of service. PACE will not begin a subscription service until there are 30 passengers. Most of the subscription bus riders drive their cars to the origin of their routes and pay \$88 per month bus fare; the average commute is 47 mi one way.

Community Transit (serving Snohomish County, north of Seattle) operates 11 customized routes serving Boeing, the largest employer in the county; while open to the general public, the routes are scheduled to meet Boeing shifts and needs. These routes carried 264,000 riders in 1994 or about 5 percent of all system riders. However daily ridership has been dropping drastically—almost 29 percent between 1993 and 1995—because of dramatic personnel changes and layoffs at Boeing in the last 3 years.

Several privately run shuttles operate to and from the **New Haven Union Station** connecting with the Shore Line East Commuter rail service initiated in 1991. Two hospital complexes (Yale/New Haven and St. Raphael's) each operate

feeder services for their staff, carrying 57,000 and 20,800 annual riders, respectively. In addition, Yale University operates two shuttles with an annual ridership of almost 41,000, while the Maritime Center at Long Wharf also operates a shuttle to Union Station¹². Plans are underway for additional private shuttle services.

The **Santa Monica Municipal Bus Line** (The Big Blue Bus Line) introduced commuter services between Santa Monica and El Segundo, an area where large aerospace firms, including TRW and Hughes, are located. With funding from the air quality district, the transit system carefully constructed routes and purchased four 30-ft-long buses with reclining seats and TVs. Although the buses can carry 25 passengers on the 45-min 20-mi trip, they are carrying 10 riders per trip.

Many transit systems have found local universities to be fertile ground for increasing ridership. **Community Transit** (north of Seattle) is one of two transit systems serving the University of Washington through its U-PASS program which began in 1991 (described in a subsequent section). Campus-based ridership is now an important part of CT's service; it carries the largest number of riders per vehicle hour (31.8 compared to a system average of 21.8). In 1995, CT had almost 2,500 boardings per day on its university based routes, or a 7 percent increase since 1993. Overall, this is slightly more than 12 percent of the system's daily boardings.

In 1990, the **Champaign-Urbana Mass Transit District** (MTD) decided to focus a series of services at University of Illinois students. The system began with a shuttle from a remote parking facility to the main campus; other routes were quickly added to provide frequent service for short trips around campus. Today the MTD operates the Quad route from 7:30 AM to 5:30 PM, Monday to Friday with a 5-min headway, the Scamp route to new buildings on the edge of campus on a 20-min headway over the same period, and a parking shuttle on 5-min headways over a slightly longer day. Finally, the MTD operates the Illini campus circulator which operates from 7:00 AM to 2:00 AM on 15-min headways during the day with shorter headways—largely for security reasons—at night.

Before 1990, the MTD had less than 3 million annual passengers; after it began service to the university, annual ridership grew to 8.5 million passengers in 1995. The average number of riders carried per hour of service rose from 41 (right after the change) to 53 six years later. In 1995, the campus services accounted for 35 percent of all MTD riders; weekday services to the community accounted for 45 percent, while the remaining ridership was on the weekend and evening services. Weather has a differential effect on ridership; in bad weather, ridership on the community services goes down because most trips are discretionary; however, university ridership goes up in bad weather because the trips are not discretionary and people unable to drive, walk, or bike also use the bus.

Students pay a mandatory \$18 fee each semester—this permits them to access transit service simply by showing an

ID. The university subsidizes 80 percent of the cost of a semester transportation pass for both faculty and staff; this allowed the university to eliminate more than 1,000 parking spaces and postpone \$5 million of parking garage construction. The MTD ridership push was helped by the university first raising parking fees by 30 percent in 1989 and by an additional 24 percent in 1990.

In 1989, the **Capital Metropolitan Transportation Authority** in Austin, Texas, took over a fare-free system formerly run by the University of Texas, Austin, for its students; at that time, the university was carrying more passengers per day than the city system—roughly 40,000 boardings daily when the university was in session. The university's system, which began as a local circulator serving fraternity houses near campus, had grown exponentially and served apartment concentrations and student housing complexes more than 10 mi from campus—it paralleled the city system at several points. Although students were supposed to show a student ID to use the system, drivers generally did not ask for proof of student status; as a result, Capital Metro felt that it was losing substantial ridership to the university's system. Today, the city runs the original routes and also develops shuttles, vanpools, and circulators to serve campus needs.

The **Sacramento Regional Transit District** (RT) provides several services connecting the light rail system and California State University; special routes also operate through campus and connect nearby apartment complexes to the campus. The university's student association developed a special student pass which allows students to ride without paying a fare when showing a picture ID. Since the initiation of this pass, whose costs are subsidized by the student association, ridership on campus routes has increased 300 percent—to account for roughly 7 percent of total RT ridership.

The **Santa Monica Municipal Bus Line** (The Big Blue Bus Line) carries a substantial percent of its total ridership—13 percent—to the University of California, Los Angeles. After the 1994 earthquake, the Santa Monica Community College paid the bus line to provide shuttle service from a remote parking lot to the college; the shuttle carries 800 passengers per day.

The **Central New York RTA** (Centro) in Syracuse recently took over on-campus services for the State University of New York at Oswego; under contract to the university it provides fare-free services to all students holding a valid ID. In addition, Centro has provided on-campus service to Syracuse University for more than 20 years. Together, the two university services account for more than 20 percent of total system ridership; moreover, the route with the fastest growth is a new one linking a regional shopping mall, which has substantial parking, with Syracuse University. The route, begun in 1992 to address the university's growing parking shortage, is the fastest growing and has the highest ridership in the system.

The **Port Authority of Allegheny County** (Pittsburgh) recently arranged direct service from two neighborhoods to the University of Pittsburgh campus; the university pays PAT a flat fee of \$4,000 per week. The university is the largest employer in the area as well as a large student trip attractor. Students and others access the system by showing a picture ID. The service has been successful and PAT hopes to expand it to other universities.

VIA Metropolitan Transit (VIA) in San Antonio, Texas, recently implemented a series of circulator routes connecting large apartment complexes—previously unserved by transit—with both the University of Texas campus and the UT Medical School complex; the routes also serve some firms which hire students for part-time work. The routes are all fairly short; the average trip length is less than 3 mi. Buses run every 30 min in the peak and once per hour off-peak.

PalmTran in West Palm Beach, Florida, is restructuring its entire route network to attract the kindergarten through 12th grade student market. Routes will be redirected so that 46 out of 49 grade, middle, high, and vocational schools will be on one or more bus lines; there will be 32 new routes and more than 2,200 new stops. Surveillance cameras with sound will be mounted on all 143 buses in the system to reassure both students and their parents. To create an incentive for older students to ride transit, PalmTran will offer a \$10 monthly pass (the current student fare is \$0.50 a ride or \$18.50 for a pass). The new network is expected to be in place for the 1996-97 school year.

In 1989, **Transfort**, the transit system operated by the City of Fort Collins, Colorado, decided to focus new services on students at Colorado State University; before that time no special efforts had been made for this large trip attractor. As the result of a marketing study, Transfort restructured city service, added two new routes to the campus, and rescheduled buses to better meet campus schedules; within 1 year, system ridership was up dramatically while CSU ridership alone increased 300 percent. Currently, the university has no special pass system, although Transfort is trying to get the university to institute a mandatory pre-paid pass (that is, the cost of the pass would be part of the mandatory student fee)¹³.

Guaranteed-Ride-Home Programs

Houston Metro recently implemented a GRH to provide a "security blanket" for suburban park-and-ride users without mid-day service access. The program allows a rider up to three emergency rides each year. Metro contracts with private taxi companies to provide rides to either the park-and-ride lot or the site of the emergency. In January of 1996, 76 rides were provided at an average cost of \$28.87 (including a 6 percent discount provided by the taxi operators).

The **Boulder Department of Transportation** provides a guaranteed-ride-home program to riders holding its EcoPass (described in a subsequent section); passholders are entitled

to unlimited GRH service anywhere within a 100-mi one-way distance. The DOT contracts with taxis for service in case of emergency or if the rider missed the last bus of the day.

Virginia Railway Express (VRE) has a guaranteed-ride-home program called "Special Delivery." In case of illness or emergency in the family, the rider calls VRE's Special Delivery operator, who arranges for a taxi or sedan service to pick up the rider at the office and take them to where they need to go. VRE reimburses the rider for 90 percent of the pre-approved fare, up to \$100 per trip. The program allows for three rides per year at 90 percent; if an individual must use the service more often, additional rides are reimbursed at 50 percent.

Studies have found that guaranteed-ride-home programs do affect employee transportation decisions. A 1992 study at the Warner Center in the West San Fernando Valley (Los Angeles) found that more than 59 percent of employees surveyed said that a GRH was important when deciding whether to use an alternative to driving alone¹⁴. Elizabeth Burn's evaluation of 525 worksites in Phoenix shows that a guaranteed-ride-home program is positively linked to a small reduction in single-occupant vehicle use¹⁵. Guiliano, Hwang, and Wachs also found a positive relationship between guaranteed-ride-home programs and reduced single-occupant vehicle use in the Southern California area¹⁶. However, changes in driving alone do not always, or even usually, translate into increased transit ridership.

Travel/Mobility Training

Travel training programs for people with disabilities have been a major part of many social service agency agendas; until recently transit operators themselves have had minimal involvement (sometimes, but not always, offering free or reduced cost passes for trainers and students). The requirements of the Americans with Disabilities Act (ADA) are a serious incentive for transit operators to either conduct travel training programs themselves (often contracting with social service agencies to do training) or to work more cooperatively with the agencies actually doing such training.

In 1991, the Community Forum in Phoenix, in cooperation with the **Regional Public Transit Authority (RPTA)**, conducted travel training for 89 people in wheelchairs, using trainers who were themselves in wheelchairs. Without any change in service, schedules, or fares, ridership of fixed-route accessible buses by people in wheelchairs went up more than 75 percent on the route in question after the training was over.

In 1994 and 1995, **Capital Metro** in Austin, Texas, worked with the Center for Independent Living to travel train 180 people with various disabilities. The center undertook the training; Capital Metro tracked the effect on paratransit and transit ridership. A year after training, 170 of the 180 trained users were still using fixed-route services for at least some of their trips. Almost 29 percent became frequent users, riding regular buses 7 or more times per week. An additional

34 percent rode fixed-route transit 1 to 3 times per week. The Center also surveyed 100 of the 200 people who had been trained between 1990 and 1993, 85 percent still made at least one trip per week on fixed-route transit. The effect on paratransit ridership was clear.

In the last 5 years, Project ACTION of Easter Seals, funded by the US DOT, has supported more than a dozen local demonstration projects of various travel training programs for people with various disabilities. In many cases, the major goal of participating transit systems was to induce (or even require) people with disabilities to use fixed-route transit instead of substantially more expensive ADA-complementary paratransit.

Ironically, like the Austin system, few were able to show much diversion from paratransit; however, all of these programs increased fixed-route ridership by people with disabilities, often substantially¹⁷. Reno, Baltimore, and Columbus, as well as the systems discussed in this section, gained riders. These findings suggest that a market exists among people who have disabilities but either do not qualify for, or do not totally depend on, paratransit; when appropriately travel trained, they will become regular fixed-route transit users.

This may be confirmed by a recent TCRP project which surveyed 724 people with disabilities in six communities, finding that an average of 69 percent had used regular fixed-route transit, including roughly 58 percent of those in wheelchairs and 66 percent of those with sensory disabilities. The frequency of use was not high, but roughly 13 percent of the surveyed people with disabilities had used fixed-route service more than 100 times in the previous year and roughly 20 percent had done so between 10 and 100 times¹⁸.

The **Miami Valley Regional Transit Authority** in Dayton, Ohio, has a full-time in-house staff person who trains both individuals and small groups—about 180 people per year. As a result, there has been a significant increase in wheelchair boardings on fixed route; there are roughly 2,000 boardings each month or a 40 percent increase over pre-training ridership. The **Sacramento Regional Transit District** has long had an active travel training and travel facilitation program for people with disabilities. SRTD trains about 400 people per year and studies show that about 80 percent continue to use fixed-route service after 1 year¹⁹.

The **Greater Bridgeport Transit District's** travel training program found that more than 80 percent of all those trained were still using fixed-route service 1 year after training, each person making an average of six one-way trips per week. In the first years of the program, training was focused on people with disabilities; in the third year, a group of 50 seniors attending a daily meal program requested training²⁰.

Marketing and Advertising

The **Broward County Mass Transit Division** (BCt, Pompano Beach, Florida) has maintained a 4 percent steady

increase in annual transit ridership, despite fare increases, because of the heavy promotion of the system. Since 1988, they have had a substantial increase in the number of people with disabilities using the system, largely because fixed-route service is better and more reliable than the paratransit services. Today, roughly 28 percent of the agency's riders are either people with disabilities or the elderly. The BCt has made special marketing efforts for these kind of travelers; for example, they revised the transit guide, color coding routes for use by those with developmental disabilities, non-readers, and those who cannot see small print.

The **Santa Monica Municipal Bus Line** (the Big Blue Bus Line) has experienced ridership increases among Hispanics; it attributes this to its marketing efforts with the Catholic Church. **Foothill Transit** (Los Angeles) estimates that between 20 and 30 percent of its ridership is Spanish-speaking; as a result they have developed their communications campaigns to appeal to current and prospective Hispanic riders. Their marketing efforts include bilingual versions of most printed materials and publicity efforts in media serving the Hispanic community. Although they have no direct way to know the effect of these programs, Foothill Transit believes that these efforts account for some of the growth in Hispanic system ridership.

Calgary Transit conducted a 1994 telephone survey with current transit riders; they found that rider security concerns might be affecting ridership, especially among those riding at night. In response, the system improved lighting at several bus stops and rescheduled cleaning crews at C-Train stations, to give customers an additional feeling of safety²¹.

Concepts Which Make Transit More Convenient

Route Deviation

There are several different kinds of route deviation services—the bus can (a) deviate anywhere along the route, (b) deviate only to pre-arranged stops (e.g., senior centers and hospitals), (c) deviate along some parts of the route but not in others, or (d) have fixed stops but deviate anywhere in between stops. Many systems make little distinction between flex-routes—covered in the section below—and these services.

A small system which allows deviations anywhere along the route is the **Grays Harbor Transportation Authority** of Hoquiam, Washington. The system offers several kinds of route deviation; first, there is one major route which serves all the small towns of the county allowing deviation on request. In addition, three "satellite" routes serve areas away from the major route. These satellite routes meet the major route at scheduled stops as well as providing service to a passenger ferry. The system has been in effect for almost 20 years.

Jefferson Transit in Port Townsend, Washington, provides route deviation anywhere along a 40-mi one-way route

connecting small areas in the Puget Sound. Riders must call and request service 15 min before desired pick-up, or, they request a deviation upon boarding. In essence, all of the 21,000 trips taken per year are deviations.

Another small community, also in the Northwest, is Newport, Oregon; **Central Coast Connections** offers three routes in Lincoln County, a 992-sq mi area with 40,000 people. The buses will deviate up to $\frac{3}{4}$ mi from the regular route when passengers call in advance, request the service when boarding, or flag the bus down along the route. Although the system has few deviations—roughly five per week—there have been some complaints from the general ridership about the delays associated with route deviation. The system has noted a very small decrease in paratransit ridership by people in wheelchairs, although elderly riders have continued to depend on paratransit.

Several slightly larger communities also have tried route deviation. **Rural Transit**, operating in two rural counties near Bloomington, Indiana (population 128,000), operates a route every other day from which the bus is permitted to deviate only $\frac{3}{4}$ mi. The route serves largely the elderly for shopping, meals, and medical trips but it does have a drop-off in Bloomington. Ridership increased steadily in the first year of operation and then stabilized at around 2,200 riders. When deviations are requested, the bus may be 10 to 15 min late and this has occasioned some customer complaints.

CityLink in Abilene, Texas, a 108-sq mi community of 106,000 people has ten fixed routes, nine of which will deviate to either specific places or to destinations requested by a rider. Riders must call to request the service 30 min before boarding but riders also appear to be allowed to request deviations as they board. The system officials report that most deviation requests come from those using wheelchairs; as more users become familiar with the service and the riders become regular, it has become easier to accommodate the deviations. Moreover, many elderly people and those with disabilities who were pre-ADA paratransit users but not recertified as ADA-eligible have switched to the fixed-route service. On the other hand, while the route deviation service is substantially cheaper than providing paratransit services, it is still difficult to operate well and the city is considering either ending it or reducing it.

Another Texas community with roughly the same population, **Wichita Falls**, also offers a system where all routes will deviate upon request. The city has five fixed routes and no paratransit service; all buses will deviate up to two blocks from the fixed route—but only for those who qualify. Riders must call a day in advance to request service, although same day requests will be honored, if possible. The choice of route deviation was consciously made to deal with the paratransit requirements of the ADA. In 1994, of the roughly 120,000 system boardings, more than 4 percent were deviations requested by the elderly and those with disabilities—this reflects a 900 percent increase in ridership by these groups in the 2 years of service.

Ashtabula County Transportation in Ashtabula, Ohio, a city of 22,000 people (in a county of roughly 100,000) operates two point-deviation services in the city; each will deviate one or two blocks to serve specific locations upon request. The hourly "Uptown" route serves shopping centers as well as buildings that house many seniors; the "Harbor East West" route serves residential towers, pharmacies, and medical clinics. The two routes meet at the city center and are timed so that passengers may transfer between the two. The system was adopted in 1992 specifically to replace a previous demand-responsive system. In 1994, roughly 10 percent of the system's 60,000 to 70,000 annual boardings were riders requesting deviations.

Marble Valley Regional Transit in Rutland, Vermont, offers one fixed route in a rural area of central Vermont. The overall goal of the service is to divert paratransit-eligible riders to fixed-route service; the bus will deviate $\frac{3}{4}$ mi off the fixed route. Elderly riders constitute most of the route's total ridership—system officials feel that roughly 20 percent of the system's annual ridership of 24,000 consists of people requesting a deviation to one of the allowable sites. Officials are pleased with the existing service—originally there were three routes with deviation and this service has been reduced to one route.

The **Cheyenne Transit Program** in Cheyenne, Wyoming, has four flexible routes which allow deviation anywhere; they are considering adding more. The buses are permitted to deviate from the route as long as they arrive and leave the scheduled stops on time—in essence a checkpoint service. In general, the purpose is to pick up and drop off people with disabilities rather than to serve origins and destinations off the route. The service was implemented in May of 1994 to both provide more cost-effective transit service and to do so while meeting the ADA mandates. Currently, the system serves anyone requesting a deviation, although it may be restricted to those ADA-eligible in the future. As with several other services, the deviations have occasioned complaints from other riders who have been delayed.

Rides Mass Transit in Rosiclare, Illinois, in a county with less than 100,000 people, offers what they call quadrant checkpoint deviation. There is a scheduled "fast-track residential route" which operates in four quadrants of the city of Harrisburg; the bus is in each quadrant every 15 min, thus covering the city once each hour. The vehicle travels along a published route, stopping at fixed points but deviating to provide door-to-door service as requested. Riders can only request deviations during the time the bus is in their quadrant; as a result they may have to wait for up to 1 hr for service. This service has evolved from an older demand-responsive system operated by the city. Ridership response has been very positive, and the system is considering adding another vehicle so 30-min service will be available. Although previous demand-responsive users complained when the system switched to this mode of operation, most riders are now very happy with service and ridership has increased more than 13 percent in 1 year.

Route Extension and Optional Stops

The essence of this concept is that the part of route operating in low-density or low-demand areas can be made optional—the bus will not run the route unless requested in advance or by a rider on board the vehicle. The **San Diego Transit System** installed a solar-powered cellular call box at a remote bus stop on a non-productive route leading to Lake Poway, a recreational facility. The bus will not continue to the lake unless a specific request is made. Ridership on the route increased threefold in the first few months of the call box service.

For the 12-month period beginning in July of 1994, there were 1,285 requests for service to the lake and 485 requests from the lake. Today, there are roughly 35 calls per month from the fare box and an equivalent number of on-board requests for the route extension. As a result, the system reduced the number of vehicle trips to the lake by 67 percent and saved approximately \$3,500 per year. Most riders are young people attracted by specific recreational events.

The **King County Department of Metropolitan Services (METRO)** in Seattle is testing a new service concept designed to address people's security concerns. Passengers riding at night are allowed to request a stop anywhere along the route.

Service Routes and Community Buses

The best known U.S. service route experience is that of **Madison Mobility** in Madison, Wisconsin, the first community to explicitly adopt the Swedish version of service routes. Over time, the system has significantly changed the service. Beginning in 1992, the Madison Metro Transit System provided service routes in areas not well served by transit and then found themselves also required to provide even more complementary paratransit. Recently, the system reduced the complementary paratransit area to the minimum required, promoted travel training, and begun to apply trip-by-trip eligibility standards. Moreover, they have largely substituted service routes for other traditional services. As a result, they have gone from two to six passengers per hour on the service routes and have reduced their need to subcontract with taxi operators for paratransit services by \$300,000 annually.

Madison Mobility has eight service routes, which operate weekdays only, from 7 AM to 6 PM in the community of just under one-quarter of a million. The routes will deviate but only for passengers with disabilities who make the request in advance. All travelers pay the basic system fare of \$0.50, with some discounts available.

The **Monmouth County DOT** in Freehold, New Jersey, operates the Shuttle, a network of service routes in addition to operating a fixed-route and paratransit service. The DOT carefully analyzed the patterns of paratransit ridership in determining the routing and scheduling of the service routes.

The buses travel a 50-min route with a 2-hr headway, week days only; the schedule is such that three routes provide three round trips per day while the other two provide five trips a day.

The shuttle is available to the general public, although most riders are elderly or those with disabilities. Passengers can board anywhere along the routes, which serve malls, libraries, shopping centers, hospitals, and business areas. The vehicles are routed so that transfers between various routes are possible. Currently, the shuttle carries 20,000 passenger trips per year at a cost of roughly \$22 per vehicle hour, substantially less than the paratransit service. Ridership has been steadily increasing; although the system had no data on the number of ADA-eligible riders diverted from paratransit, they believe that they are diverting those travelers and saving money.

The **Broward County Mass Transit Division (BCt)** in Pompano Beach, Florida, initiated a series of community buses as part of an overall route restructuring plan. The BCt ended service to several trailer parks, but paired this with the development of community bus services in conjunction with local municipalities. In 1990, one municipality took part as a trial; today, six different systems participate.

Each participating municipality routes the community bus to provide local services to senior centers, malls, grocery stores, and so forth and to act as feeder or shuttle to regionwide bus services. Most operate on a 90-min loop. The BCt helps each city conduct research and design and develop its own routes and schedules. The BCt leases the vehicles to the municipalities for \$10 a year and provides \$18,000 per year to maintain each vehicle; the cities pay for drivers and insurance—at an estimated annual cost of \$50,000 to \$75,000 (although most cities keep costs down by hiring part-time and retired drivers and operating on a restricted schedule). Five of the six systems are fare-free; the remaining city charges \$0.25.

BCt has not collected detailed ridership information on the six community bus routes, although it has been higher than that on the traditional fixed route it replaced. Several cities have recently asked to be part of the program. There has been no assessment of the ADA implications of the services.

The **Boulder DOT**, in conjunction with the Denver RTD, began operating "The HOP" in 1994; the HOP has provided Monday through Friday service along a two-way loop, operating on a 10-min headway from 7 AM to 7 PM, serving 43 stops. The DOT is testing an extended service, funded by student and merchant organizations; now Saturday service is available from 9 AM to 10:30 PM, while Thursday and Friday service has been extended to 10:30 PM.

The route was designed around three major trip generators: a shopping center to the east, the Boulder business district to the west, and the University of Colorado campus and its adjacent shopping area to the south. The HOP uses decorated 22-passenger accessible vehicles; with three buses running in each direction, Boulder does not publish a schedule,

knowing that a 10-min headway is realistic. The fare is \$0.25, although many people use the ECO-PASS.

The City of Boulder hoped to have 2,000 riders per day; ridership has gone as high as 5,100 and the city predicts that 1996 daily ridership will be 4,300 people (or 1.1 million riders annually)—roughly system capacity. More than 57 percent of all riders are university students; most are not making commuter trips but using the service for shopping, running errands, and lunchtime travel. Twenty-six percent report going to work, 36 percent report going to school, and 35 percent report going shopping. Forty-five percent of riders are men, and 50 percent of all riders are under 24 (roughly 70 percent are under 34).

The system is operating near capacity; part of the success of the service is because of the ECO-PASS (discussed in another section). Surveys show that riders are happy with the frequent and reliable service; 16 percent said that their trips would have been made driving alone if the HOP did not exist while 49 percent of all riders said that the HOP had significantly reduced the number of drive-alone trips they regularly made. There is substantial public demand for additional services.

A service route network in **Madison County**, Illinois, was used to replace off-peak and local services formerly provided by the Bi-State Development Corporation in St. Louis—the service routes cost roughly one-fourth of what the Bi-State service had. Paratransit trips declined by 42 percent when the routes were implemented. Madison County encouraged this diversion by offering travel training and by special marketing and service efforts²².

A case study of Madison County's 16-route network found that it was linked to a reversal in the general decline in transit ridership seen over the last decade and diverted some paratransit riders. Unfortunately, the decline in paratransit ridership has not led to a drop in the cost of paratransit service, in part, because the service routes are diverting the least expensive type of traveler with disabilities so that the number of paratransit trips per hour have dropped 44 percent²³. Again, however, this experience suggests a substantial market among people with disabilities for fixed-route transit service.

TCRP Project B-1 identified 12 North American systems providing service routes in 1993 (out of 309 systems which responded to a survey); the 5 not described in this section are **Pecos Trails Transit** in Roswell, New Mexico, the **Minneapolis-St. Paul Regional Transit Board**, **Lakeland Area Mass Transit District** in Lakeland, Florida, and two Canadian services in Ontario²⁴.

U.S. examples of service routes in operation longer than 6 months are scarce; therefore, Canadian experiences are of interest. The **Toronto Transit Commission (TTC)** operates five community bus services in addition to a network of increasingly more accessible bus routes and trams, as well as a subway. The community bus routes are focused on areas where there are high concentrations of the elderly and people with disabilities. The routes serve local community

destinations—shopping, recreation, and medical—and as feeders to other TTC services, particularly accessible subway stations. The buses operate on a fixed schedule making hourly loops around local areas; the buses run from 9:30 AM to 5:30 PM on weekdays only. The bus may be flagged down anywhere along the route, anyone may ride, and the fare is equal to that on all TTC services.

Ridership has generally stabilized on the community bus routes, with most passengers being over 65. In an on-board survey in 1991 of the first, experimental route, there were one or two passengers in wheelchairs per day. Most users report themselves very happy with the service; there have been continuing requests for longer hours of service as well as weekend service.

TTC began the community bus system with one experimental service; they wanted to see if they could provide an alternative to paratransit for travelers designated as only being able to "use transit with difficulty." The service was a success, diverting several riders from paratransit services and the system was expanded. In 1995, almost 30 percent of the riders on one of the five community bus routes were eligible for paratransit; the least successful service had only 18 percent of its passengers eligible for paratransit services. The first community bus service, which operates 8 hr per day, carries approximately 12 passengers per hour, of whom 3.6 per hour, on average, are eligible for paratransit services. The service considered the least successful carries 5 passengers per hour, of whom less than one-half per hour are eligible for paratransit.

OC Transpo in Ottawa, Ontario, operates three "communibuses." The services are provided in addition to the fixed-route network as a way to improve accessibility for the elderly and those with disabilities. The communibus uses a small low-floor vehicle which has two wheelchair securement areas; it can seat 20 passengers. The routes serve areas where seniors live, as well as hospitals, senior centers, malls, and community facilities; they are designed to come as close to the door of each place as possible.

The services began in May 1992 with accessibility plans calling for the addition of two new routes in each of the next 3 years. Two of the three current communibuses operate on a 1-hr schedule, the third on a 70-min schedule. All three use just one bus and provide service from 8:30 AM to 4:30 PM, Monday through Friday.

The first route, #306, operates on an hourly schedule, although it began with a 30-min headway. The route continues to display increased ridership despite the reduction in service; in 1992, it began with approximately 1,400 trips per month but by August of 1995 it was carrying more than 4,000 monthly trips. Of the 121 average daily trips, 25 (or 21 percent) are taken by people registered for special transit services; and 4 per day are in wheelchairs. Of the total number of daily trips, 8 percent were diverted from cars, 74 percent from regular buses, and 5 percent from the special transit service.

Of all trips on route #306, 13 percent would not have been made without the communibus, almost 30 percent are made by people who have trouble using regular buses (although apparently many had done so), and almost two thirds of the trips are made by people over 55 (28 percent by people over 75). In other words, the route is both diverting riders with disabilities from the special transit service—and increasing total ridership among people with disabilities and the elderly.

The second route, #356, carries 208 daily passengers, with 2 per day using wheelchairs. Almost 26 percent of all trips are made by people registered for the special paratransit system, more than 40 percent of all trips are made by people who have trouble with regular buses, 24 percent of all trips are made by those over 75, and almost 7 percent of all trips would not have been made without the communibus. Roughly 11 percent of all trips—or 23 per day—are diverted from paratransit.

The third route, #316, is the least successful; it carries 95 trips per day of which 14 (15 percent), are made by people registered for special transit service. Almost all of the trips are made by those over 55, a third are made by people who have trouble with regular buses, and about 8 percent would not have been made without the communibus. This route also illustrates some of the problems inherent in providing this type of service; in 1995 the headway had to be increased to 70 min simply to accommodate the delays created by riders.

BC Transit in Vancouver, British Columbia, operates the "handyRoute," a door-to-door service which parallels the fixed-route services. It runs for 12 km in residential neighborhoods, serving destinations of interest to the elderly and those with disabilities. It was begun as an experiment designed to divert riders from the more expensive paratransit service; the specific route was chosen after four possible routes were evaluated for their potential in reducing paratransit use among eligible riders. Currently, there are plans to replace traditional, large bus service in several low-density or low-ridership areas with service routes focused on destinations of interest to those with disabilities.

Unlike other service and community bus systems in North America, handyRoute service is limited to only those who are elderly or have disabilities; this has kept ridership levels fairly low. The service is averaging two trips per hour—which is double the productivity of the special paratransit system; this is roughly 9,000 trips annually. The route operates on a 90-min headway, from 9:30 AM to 5:00 PM, Monday through Friday. It connects with other accessible routes in the community at three sites.

Neighborhood and Downtown Circulators/Loops

The **Phoenix Transit System** has operated a downtown circulator called the DASH since 1990. The service was originally funded by downtown merchants and an air quality

management grant. In the first 2 years of service the system was fare-free and operated on a 10-min headway on a loop through the downtown and to the state capitol. Ridership peaked at 650,000 per year. In July of 1992, funding was ended and a \$0.25 fare was instituted; ridership declined. As ridership declined, the system cut back service and ridership fell again. In March of 1995, the system reduced service still further, only providing service to the capitol during lunch; overall ridership fell from a high of 1,500 riders per day to less than 600, with more than 70 percent traveling at lunch.

VIA Metropolitan Transit (VIA) in San Antonio, Texas, operates several trolleys on downtown streets; each route is a 30-min one-way directional loop. Together, the trolley routes serve all the major hotels and tourist attractions. The services were originally free and carried 12,000 passengers per day; a fare was instituted and then raised twice to its current level—\$0.50. The services now carry only 8,000 daily riders, more than 70 percent of whom are tourists.

The **Greater Richmond Transit Company (VA)** operated a fare-free downtown trolley for 18 months beginning in early 1993; the service ran from 11:30 AM to 2:30 PM. In the first year of service, the trolley carried 250,000 passengers; in July of 1994, GRTC imposed a \$0.25 fare and ridership dropped in half. The system then cut service, doubling headways from 6 to 12 min and ridership dropped again because the lunchtime crowd abandoned the system. The service was eliminated in July of 1995.

The **Charlotte Department of Transportation** created a City Loop designed to provide inner-city transportation; two vehicles ran the loop in opposite directions for 18 months. Although the route carried roughly 8 passengers per vehicle hour, the Charlotte DOT did not believe that they were new transit riders and discontinued the service.

The **Grand Rapids Area Transit Authority (GRATA)** began two new suburban circulators in March of 1995 using 14 passenger minibuses; the routes are designed to serve various users making local trips as well as linking with regional bus routes. Both routes have two shuttles, each vehicle moving in the opposite direction; it takes approximately 1 hr to complete the loop in either direction. Route 15 serves Kenwood, a rapidly growing suburban employment center, containing two malls, the airport, and city hall. Although it originally started slowly, the route grew rapidly—carrying about 700 trips per week by May of 1995.

The second route, Route 11, serves two suburban communities southwest of Grand Rapids with service to four major shopping areas and a mix of residential and commercial locations. Route 11 began with and maintained fairly high patronage—about 850 passengers per week. No information is available about rider characteristics²⁵.

Long Beach Transit (Southern California) recently implemented a downtown circulator service which now has 1.3 million new boardings a year and which is well used by people with disabilities²⁶.

*Public Demand-Responsive Service,
Taxi Substitution, Jitneys*

In the last two decades, several small, demand-responsive services have been open to the public, many in California. TCRP Project B-1 found 90 systems in the United States which claimed to provide general public paratransit; however the researchers felt that most of those were not public systems but specialized services in rural areas²⁷.

With tightening budgets and the coming of the ADA, those systems which did provide general demand-responsive services have either stopped or sharply reduced services. The problem is that most transit systems have never been able to carry more than two to four travelers per hour which makes these services extremely expensive, even when they are substituting for low-volume fixed routes. However, experts maintain that the technology now exists at a price which would allow even small systems to effectively and efficiently provide demand-responsive services²⁸. For example, the **Los Angeles Department of Transportation** recently completed a "Smart Shuttle" feasibility study which evaluated the use of advanced transportation technologies in establishing a flexible demand-responsive system. Unfortunately, very few demand-responsive systems have yet adopted such technology.

Some smaller communities have decided that it may be cost-effective to provide traditional dial-a-ride without sophisticated technology. While demand-responsive services are an expensive complement to existing fixed-route services, it may be cheaper to provide only general public paratransit than to provide fixed-route and ADA-mandated paratransit. The ADA regulations clearly exempt non-fixed-route services from the need to provide paratransit service at the level demanded by the ADA; in particular, the general public system is allowed to have capacity constraints*. Therefore, if a community can meet its total transit demands with only one system, it may be able to save substantially.

The **Phoenix Transit System** has had considerable experience with general public demand-responsive services. For almost a decade, the system offered a weekday service in the northern end of the Phoenix area where traditional service was poor or non-existent. Under contract with private transit operators, mini-vans provided service in a 130-sq mi area; riders just called the carrier for taxi-like service, paying the ordinary base fare. Over time, the area became more densely settled, and Phoenix Transit was able to provide fixed-route service Monday through Saturday; so the dial-a-ride service was discontinued. Phoenix Transit does not provide any service on Sundays. Using accessible vans bought by the system, the private contractor provides dial-a-ride services in a nine-zone service area on Sundays.

The base fare is \$2.40 with a surcharge of \$1.20 for each additional zone. The average trip is two or more zones. Aver-

age Sunday or holiday ridership is about 475 people; roughly one-fourth are people traveling between transfer points for one of the seven other dial-a-ride services operated in the region (almost all the large cities in the region offer such a service including Tempe, Scottsdale, Mesa, and Glendale).

Tidewater Regional Transit District (TRT) in Norfolk, Virginia, provides general public dial-a-ride, although only in a 25-sq mi area of its almost 1,100-sq mi service area. Tidewater provides the Maxi-Ride service in five defined service areas, each with one bus. Although the service is generally demand responsive, the bus is timed to be at a transfer point, where riders can transfer to fixed-route services. Each of the five services operates from 6:00 AM to 7:00 PM, arriving at the timed transfer point once an hour. Requests for service can be phoned directly to the bus through a cellular phone, from 1 to 2 hr before travel. The fare is \$2.20 or twice the fixed-route fare.

TRT has found that the general public demand-responsive service costs roughly \$23 per hour while fixed-route service costs almost \$35 per hour. Ridership has fluctuated substantially over the years but has remained stable since 1993. Maxi-Ride carried 78,372 riders in FY93 and 79,655 in FY94. Staff believe that more than 50 percent of all riders are using the system as a feeder to the fixed-route service, rather than as community-based travel. Maxi-Ride productivity in FY94 was 3.5 passengers per hour.

The **Bis-Man Transit Board** in Bismarck, North Dakota, serves a 12-sq mi area with almost 76,000 residents. It has operated a demand-responsive door-to-door service for two communities surrounding Bismarck since 1990; anyone may ride, although riders who are elderly or who have disabilities are eligible for reduced fares. The service is available 7 days per week, 24 hr per day. The fare is \$1.25 in town, \$2.00 between towns; 24-hr advance reservations are required. The service carries between 450 and 550 trips per day in the summer and 650 and 700 per day in winter; total annual ridership is approximately 143,000.

The **Sweetwater Transit Authority Resources (STAR)**, in Rock Springs, Wyoming, serves a county of 45,000 over 10,400 sq mi, operating a demand-responsive service to all eight cities in the region. STAR carried more than 100,000 one-way passenger trips in 1995. The service costs between \$29.10 and \$31.91 per vehicle hour and carries an average of 5.74 passengers per vehicle hour. Between 1993 and 1994, ridership increased from 6,288 to 8,537 per month, or 35 percent annually.

The **Portage Area Regional Transportation Authority (PARTA)**, of Kent, Ohio, operates demand-responsive services in the rural parts of its service area. It allows anyone to ride but requires at least a 24-hr advance reservation; reservations up to 21 days are accepted. The system makes a serious effort to group passengers on a shared ride basis. PARTA also has contracts with social service agencies to provide services to their own clients. Although actual ridership data are not available, the system says that ridership is increasing.

* The system would have to buy accessible vehicles for all vehicles large enough to seat more than eight passengers; moreover they would be required to provide equivalent services to their passengers with and without handicaps

Community Transit of Sisseton, South Dakota, operates a paratransit system which serves special schools, medical facilities, stores, and even casinos in an area of under 30,000 people. Anyone may ride, although the system was originally devised for the elderly; 24-hr advance reservations are required although the system will attempt to do real-time dispatching if possible. The previous system attempted to serve employment trips but had very low ridership. Currently, Community Transit carries 94,000 one-way trips annually.

Ozark Regional Transit in Springdale, Arkansas, provides a curb-to-curb public dial-a-ride service to four counties, covering almost 3,000 sq mi and 241,069 people; service is provided within zones through which the bus circulates. The basic demand-responsive service has been in effect since 1973 but has been changed to respond to new demands. Eligible riders may request door-to-door service. The system operates at four to five trips per vehicle hour, fairly high for such services. All riders must request service the day before travel, although same-day medical trips will be accommodated and subscription trips may be requested; most are during the morning peaks. Ridership has been increasing rapidly; between 50 and 100 people each month request certification for door-to-door service. Staff believe that 70 percent of all system riders are either elderly or have disabilities.

The **Metropolitan Transportation Authority** (Houston Metro) has developed a jitney-like service—"FasTrak"—initially designed to complement the fixed-route system along heavily traveled corridors; eventually it may be used to replace unproductive services. FasTrak vehicles are owned and operated by private entrepreneurs who shuttle along Metro's regular bus routes within designated service areas; riders may flag the FasTrak vehicles anywhere along existing routes and they may be dropped off anywhere within ¼ mi of the route. FasTrak vehicles accept no pre-arranged trips in order not to compete with regular taxis. Metro pays each operator \$25 per day for each vehicle fielded; the operators set their own fares—which must be published and posted; the operator keeps all the fares and must provide service at least 6 hr per day.

The FasTrak service began in mid-1995 with about 1,600 daily riders in the Westheimer corridor; it stabilized at 1,200 to 1,400 riders per day, or roughly 35 trips per vehicle shift, when Metro was forced to terminate service because the original contractor was not making a profit. MetroService is now in the final stages of contract negotiation with another contractor for service designed to be re-introduced in April of this year. If the FasTrak service is successfully re-introduced, it will allow Metro to trim some peak service; in the second phase, Metro plans to eliminate service in several corridors.

A 1992 study described the private jitneys which carry roughly 500,000 per day in the **Miami** area, or roughly 24 percent of the number of riders carried by Metrobus. An Urban Mobility Corporation study concluded that the jitneys had developed their own markets and were not diverting existing riders from the bus system. Many drivers are Haitian, Cuban, or Dominican immigrants who target services to

their own communities; there is substantial evidence that riders prefer to travel with people who speak their language and are known in their respective communities²⁹. When Hurricane Andrew destroyed many buses and disabled a host of transit services, the 400 jitneys in the area were pressed into "legal" and even traditional transit services.

Smaller Transit Vehicles

The **Port Authority of Allegheny County** (Pittsburgh) initiated a 1-year demonstration of the effect of using smaller transit vehicles in older neighborhoods. PAT substituted 24-passenger vehicles for the larger 40-ft-long coaches on six non-productive routes, each of which fed into a main trunk line at two transfer points. After the experiment began PAT reduced service to 1-hr headways; despite that, ridership on the routes in question more than doubled.

The British also have solid evidence that using smaller vehicles can increase ridership. After privatization of transit, many private bus companies began running small vehicles along routes formerly served by full-size and even doubledecker buses. Ridership increases were substantial but it was not initially clear that the increases were because of vehicle size because the private companies also offered different headways, and so forth. However, ridership grew so rapidly that the bus operators replaced the smaller vehicles with full-size coaches—and ridership dropped, sometimes substantially. It became clear that small vehicles were simply more attractive to riders like the elderly, those carrying shopping and packages, and those accompanied by young children, particularly in strollers or prams.

Concepts Which Make Transit Faster or More Direct

HOV Lanes, Express Buses, Park-and-Ride

High-occupancy vehicle (HOV) lanes give priority to buses, making them faster than adjacent lanes of auto traffic. HOV lanes are often served by express buses, that is, buses which make limited or no stops before reaching their final destination. Both HOV lanes and express buses are often served by park-and-ride facilities. The actual effect on net system ridership of any of these services is not fully known; that is, these services may simply divert riders from existing routes.

For example, a study of the HOV lanes on **Minnesota's I-395**, which opened in fall 1992, found that in the morning peak (1) the use of the adjacent park-and-ride lots increased more than 200 percent, (2) the number of person trips on the corridor increased 57 percent—most were in the HOV lane, and (3) transit ridership went up 126 percent. But the study also found that person trips decreased 41 percent on adjacent routes and that transit increase might be the result of improvements in feeder bus services (rather than the

HOV lane itself) and might have come at the expense of other transit routes in the area. The study concluded that, "... [C]hanges in ridership should be evaluated on a service area basis rather than a linear corridor basis."³⁰

Even when there is positive effect on transit, that effect may be diluted because HOV lanes also serve car and vanpools. For example, **Community Transit** (near Seattle) found that express ridership dropped significantly in 1992 when the definition of carpool for HOV lane use dropped from 3 to 2 passengers per car. At the same time, however, CT's express commuter services along I-5 to downtown Seattle are the most successful in the system, because this is one area where transit can be competitive with the private car.

The I-66 HOV facility inside the Capital Beltway had a similar experience. In March of 1995, the definition of a carpool was changed from three to two riders as a 1-year test. The **Virginia DOT** (VDOT) evaluated the test and found that transit ridership in the lane dropped by 23 percent in the AM peak period or 3 percent daily. During the same year, other regional in-bound buses slightly increased transit ridership as did the commuter rail line, although total transit ridership in the I-66 corridor remained the same. It seems clear that the substantial drop in the HOV lane was because of the increasingly preferential treatment of small carpools, especially because congestion went up only very slightly on I-66 and accidents actually went down significantly.

The **Denver RTD** recently completed HOV lanes on I-25 and US 36, which provide suburb to suburb service as well as service to downtown. HOV lanes have decreased transit travel time by 20 min in the peak, 7 min in the off peak, and up to 20 min in bad weather. While ridership on the express buses using the HOV lanes was initially encouraged by free fares, ridership has been high even after fares were introduced; the express lane on US 36 is credited with increasing bus ridership by 38 percent and park-and-ride use by a comparable amount. The new ridership is not from among groups generally more likely to use transit—HOV riders tend to be high-income managerial professionals.

The **Charlotte Department of Transportation**, in conjunction with Rockhill, South Carolina, and the states of North and South Carolina, implemented a limited stop service between Rockhill, a suburban bedroom community, and "uptown" Charlotte, in the morning and evening peaks. The objective was to have 200 passengers per day; today the route carries 150 on four vehicle trips and the numbers are growing. The Charlotte DOT has decided to keep the service and considers that it keeps more than 100 cars out of the city each day.

The **Santa Monica Municipal Bus Line** (the Big Blue Bus Line) provides a significant amount of express or freeway service from the city of Santa Monica into downtown Los Angeles during peak hours, carrying roughly 2,000 riders per day.

Foothill Transit, serving the San Gabriel Valley portion of the Los Angeles region, has implemented several produc-

tive express services. In fact, express commuter ridership accounts for more than half of total system ridership and has been growing; total boardings on express routes rose 88 percent between FY92-93, when coupled with a 67 percent increase in revenue vehicle hours and a 59 percent increase in vehicle miles.

Two Foothill express routes are the most effective in the system; one operates on the freeway directly to downtown Los Angeles, the second links more distant areas. In 1991, Foothill Transit implemented Route 690 providing peak-period service between Montclair and Pasadena—the first commuter express bus service in the network not focused on downtown Los Angeles.

The **Harris County Metropolitan Transit Authority** (Houston Metro), in conjunction with the Texas DOT and the City of Houston, operates an express bus serving a park-and-ride lot for the annual Houston Livestock Show and Rodeo, one of the largest livestock exhibitions in the world. Nearly two million spectators attend in a 2-week period; because most arrive at the Rodeo grounds 60 to 90 min before opening and leave together at closing time, the event causes every road and freeway in the area to come to a standstill. Moreover there are only 14,000 parking places at the Astrodome, the actual site of the rodeo performances. By 1987, the average spectator could wait several hours in traffic to get into the Astrodome area.

In 1988, the Rodeo Express was initiated on a trial basis to shuttle patrons to and from a single remote parking lot at an underutilized mall parking lot a few miles from the Astrodome; the fare was \$0.50 and the Rodeo agreed to pay Metro for all costs incurred. Because football and baseball shuttles had never attracted more than 500 people (the Astrodome is where the Oilers and Astros play), the organizers were uncertain of the response. By the end of the first year, the shuttle was averaging 2,500 patrons daily. Between 1988 and 1995 the shuttle experienced dramatic increases in ridership; in 1991 it was carrying just under 10,000 passengers per day and in 1995 it carried an average of 17,000 trips per day—or about 16 percent of those attending the Rodeo. There are now six separate park-and-ride lots throughout the city; with a \$2.00 fare the service pays 77 percent of its full cost with the Rodeo subsidizing most of the rest³¹.

The **Greater Cleveland Regional Transit Authority** (GCRTA) also recently began park-and-ride service to a new sports and entertainment complex which opened in April 1994. The Gateway Center is ¼ mi from the main intermodal transfer hub of the system's buses and rapid transit and is connected by a \$11 million walkway. At the April 4, 1994, opening of the ballpark at Gateway, the express buses carried 18,000 people or 44 percent of those attending the Cleveland Indian's game—double the original projections. In the 9 months of service in 1994, the express buses provided 830,000 passenger trips to the Gateway Complex³².

A Georgia Institute of Technology study of **MARTA's** (Atlanta) special events ridership found that special events

riders were very different from daily riders; for example, only 19 percent of those using transit to attend basketball games were regular transit riders. Special events riders were wealthier than regular riders—nearly half earned more than \$35,000 yearly compared to under one-third of regular riders. Special events riders were more likely to be white males than were regular riders (33 percent versus 15 percent) and more likely to be white females (50 percent of concert goers, for example, versus 12.5 percent of regular transit users). The study concluded that special events create new and different markets for transit operators³³.

The addition of parking facilities can also increase commuter ridership. Another Georgia Institute of Technology study found that suburban transit riders were especially sensitive to the supply of park-and-ride lots; middle- and high-income suburban workers were not likely to use shuttle or feeder buses if they could not drive to the station or stop³⁴. METRA, the commuter rail system serving downtown Chicago, increased transit ridership when new parking was added at selected stations, although the effect varied with distance. At METRA stations within 25 mi of downtown Chicago, between 12 and 16 percent of new parkers were former drive-alone commuters; at stations further from Chicago, between 39 and 100 percent of new parkers were former car drivers³⁵.

However, the **Broward County Mass Transit Division** operates a park-and-ride shuttle which has the lowest number of passengers per mile in the system—rarely more than 6 or 8 passengers per vehicle trip. However there is only one trip run in the morning and one in the afternoon so the limited frequency may constrain ridership below what it would be in the face of more service.

Route Restructuring

Surveys conducted by transit agencies reveal that people are dissatisfied with routes and frequencies, service during evenings, the number of transfers, and the long waits for transfer connections. To better serve existing and new markets, systems can restructure their routes, services, and schedules. These service concepts can include providing more direct routing by eliminating branches, connecting radial routes to eliminate the need to transfer at terminals and delivering patrons closer to their CBD destination, eliminating routes that are too close, and duplicating routes to provide more frequent service on route segments where vehicles are overloaded. It can also provide more consistency in both the span of service and clock headways so that schedules are easier to remember.

Transit agencies can restructure existing service to provide more frequent and reliable service as well as to introduce less traditional modes for areas where traditional service does not exist or must be withdrawn. Route restructuring responds to the fact that land use in American

cities is constantly changing: people are mobile, jobs are flexible, and neighborhoods are buffeted by social shifts. But transit routes remain stable over long periods requiring travelers to adapt to them. This rigidity may prevent transit agencies from better serving several potential groups of riders, including those living in older residential neighborhoods where density may be increasing.

The suburbanization of employment is often associated with very-low-density development but it may also result in some very-high-density suburban nodes. Although route restructuring is normally directed to routes serving downtown, suburban nodes can also be the focus because these centers are increasing their share of commercial activity. The "new" routes can include through connections to suburban centers without transferring, which allows members of low-income households to reach a wider selection of public services. For example, the **Hartford DOT** has been restructuring service to deal with the fact that more than 40 percent of system riders no longer have a CBD destination and that ridership on express buses from the suburbs to the CBD has been falling by 3 percent or more each year for close to a decade. Instead they have been redirecting existing radial routes to reach suburban shopping malls and large retirement communities.

In addition to removing redundant or ineffective services, route restructuring as a concept implies providing a package of new or better targeted services—although most have been tried individually by systems for years. The most common individual service concepts are interlining, developing new or modified crosstown service or suburb-to-suburb service, initiating timed transfers, and constructing suburban transit/transfer stations—all discussed in this subsection.

Route restructuring can also include implementing feeder services, express routes, park-and-ride facilities, downtown and neighborhood circulators, and reverse-commute services, all of which are discussed in other sections of this report. In the following subsections, the ridership response to individual service changes which systems have implemented and the ridership experiences of systems which have implemented whole sets of these changes either throughout their service area or in one section are described.

Individual Service Options

The **Capital Metropolitan Transit Authority** in Austin, Texas, implemented a cross-town route in 1992; it travels through large population centers, including a high concentration of university student housing and high-technology employment; the middle of the route has low-income housing projects and several retail areas. The service has experienced continuing growth and is a stable route within the system although detailed ridership data are not available. At the same time, Capital Metro has not been successful with other suburb-to-suburb routes.

The **Boston Massachusetts Bay Transportation Authority** (MBTA) added three limited-stop crosstown routes to better serve students, visitors, and staff at several hospitals and medical complexes as well as local universities. Although the services were not designed to actually improve ridership, but rather to provide better services for existing riders, one-third of the 7,500 daily riders are new.

The **Charlotte Department of Transportation** (Charlotte, NC) recently added a crosstown route which was designed to better connect the northern side of the city without requiring travelers to go through the traditional core of the city to go from northwest to northeast (where the university is located). The route is considered effective because it already carries more than 13 passengers per vehicle hour.

The **Capital Area Transportation Authority** (Lansing, Michigan) has created a system of interlined routes by renumbering buses as they pass through the downtown area and continue on. This has allowed 25 percent of riders to travel through downtown without transferring.

Foothill Transit, serving the San Gabriel Valley portion of the Los Angeles region, began operation in December of 1988 by taking over and restructuring services formerly provided by the regional carrier, SCRTD, now the Los Angeles MTA. Foothill began new express services and routes to areas not formerly served and reorganized service to connect with the transit operators serving nearby Riverside and San Bernardino counties at a suburban transfer center. In fact, the system is developing a network of eight timed transfer centers. Foothill's ridership has increased each year since 1988; between 1992 and 1994, ridership rose from 6.9 million passenger trips annually to 11.1 million—or almost 61 percent in 3 years, with the average number of passengers per vehicle hour ranging from 27.2 to 28.0.

In 1993 and 1994 the **Central New York RTA** (Centro) in Syracuse, New York, took over a bankrupt private bus operator providing service among three small nearby cities—in essence suburb-to-suburb travel. Centro changed the service from local to express, modified schedules, and integrated the services with their own, allowing for better connections. Ridership has increased more than 30 percent on the routes in question. In response to the move of a large employer from the CBD to the suburbs, Centro also developed a new crosstown route providing service to employees at that major employment site (without any subsidy from the employer). One bus carries 35 to 40 riders and travels directly between two suburban areas without requiring riders to go through downtown.

A 1993 study of transit operators with 50 or more vehicles found that roughly two-thirds reported having some kind of timed transfer or transit center service. Ninety percent of the largest transit systems (those with more than 350 vehicles) used timed transfers. Most of the systems had seen substantial ridership increases within 1 year after implementing such services; **Painesville, Ohio**, had a 40 percent increase in system ridership. Transit ridership went up substantially in the

two areas of **AC Transit** (Oakland) where multidirectional transit stations were implemented in 1989. In fact, the system showed a 4 percent increase in overall system ridership between 1989 and 1991 entirely because of the 32 percent increase in ridership in one and the 7 percent increase in the other transfer station³⁶.

Suburb-to-suburb and cross-town services, interlining, and suburban transit stations operate in several other communities, including **Dallas, Marin County, Denver, Santa Clarita (CA), Westchester County (NY), Allentown (PA), Granite City (WI), Columbus (OH), and San Diego**³⁷.

System Restructuring

One of the earliest comprehensive system restructuring efforts was undertaken by **Tri-Met** in Portland; they have also provided the most carefully documented case studies of restructuring^{38 39}. The system evaluated the consequences of changes in service level, travel cost, and market size at the system, sector, and route level as well as the effect of 81 service-level and 5 fare changes on ridership. The analyses found that there were wide variations in the effect of service and cost changes and that ridership in different sectors and on different routes responded differently to similar changes in the level of service provided. Routes traversing the medium-density suburbs and the central city had the highest response given the percentage change in service.

In addition, Portland found that the effects of variables were not independent. Feedback relationships were identified between transit ridership, service level, fare, gasoline prices, and employment. In addition, the effects of the route restructuring were not instantaneous; ridership increased in some suburban services in the first 5 months while it took 8 to 10 months for urban service changes.

Suburban bus service in the Westside sector of Portland was restructured in June 1979. The new system included four regional routes and eight community routes focused on transit centers in Beaverton and Cedar Hills. Community service within the Westside was significantly increased and service to downtown Portland was increased and travel time decreased. An additional 8,400 riders per day were achieved through this service change. Most of the gain resulted from increased service or was accounted for by the gasoline shortage that occurred 3 months after the service change.

Off-peak, non-work trips increased by 68 percent, however. This was unexpected and created a new market for transit in suburban Portland. Monitoring performance by route has enabled Tri-Met to gradually improve performance. During the initial year, ridership was at 20.11 passengers per vehicle hour. Tri-Met had provided too much service, so they have been gradually reducing service hours to improve service effectiveness. As they have done so, ridership per vehicle hour increased to 26.7 (1982), 27.4 (1985), and 40.8 (1989).

In 1994, the **Sacramento Regional Transit District** (RT) reoriented and restructured service in its South Sector. RT used Census data to screen several sectors and chose to focus on the South Sector because both population and the number of households were increasing. In addition, this segment linked the downtown where governmental and commercial employment is concentrated with the emerging health services complex on the southern margin. A shopping mall that serves as a timed-transfer center, as well as the university hospital, are in this sector.

RT replaced non-productive service with through-routes by combining the most productive segments of existing routes. Streets with heavy traffic which had not previously been served were combined into through-routes with frequent service to major attractors. At the same time, RT abandoned routes which did not meet minimum performance criteria. Finally, RT added a major shopping mall as a transit center for many of the revised routes. Overall, seven routes were substantially changed; however, RT selectively added and deleted service so that the net hours of revenue service remained the same.

The changes generated increased ridership; overall, ridership was 12 percent higher on the restructured routes. However, when controlling for the level of service, ridership per hour increased 1.3 percent on all the restructured routes.

The **Orange County Transportation Authority** (OCTA) (California) began the implementation of a comprehensive set of bus service changes in October 1995. The changes were the result of a comprehensive bus system improvement project which recognized the substantial changes in both population and county development patterns. OCTA adopted a three-tier transit strategy as the permanent framework for providing service.

In the first or base tier, OCTA will operate a grid system of base routes in the areas with high transit use and high population and employment densities. In the second or connector tier, OCTA will use bus routes to link the first tier to the rest of the county, together providing countywide coverage. In the third or support tier, OCTA will offer a "family" of transit support services, including neighborhood circulator routes, express routes on the freeways, shuttle bus routes for Metrolink users, and other less traditional transit services.

New service plans were developed by area of the county. All service plans provide for

- Consistent headways on all routes to reduce passenger wait times, increase passenger convenience, and improve transfer connections;
- Consistent spans of service to ensure that users make roundtrips and to provide a service that is easy to understand;
- Restructured routes and new routes to reduce transfer requirements and times to reduce delays because of circuitous routing and to add service to underserved areas; and

- Upgrading of transit service, including expanding community and express routes, and late evening services to attract commuters and other discretionary users.

Many of the new community circulator routes will be operated with smaller buses.

Unfortunately, OCTA was affected by the county's financial problems and has not been able to implement all the plans. OCTA did eliminate some routes, create several new routes, alter headways to make them more consistent, and put smaller buses into service on lower volume routes. Three new feeder lines were added to serve the newly opened Inland Empire/Orange County Commuter Rail Line, which opened on October 2, 1995. In addition, trips were extended on some existing routes to serve the new stations.

Ridership response to these changes has been high. Ridership was up 8 percent in October of 1995 over the same month in 1994; the November 1995 tally was 10 percent higher than the comparable month in 1994. Some of the increases were part of a general trend toward increased ridership in the area, but the route changes, combined with increased marketing efforts, and the feeder routes to the commuter rail, are credited with attracting the remainder of the new riders.

The **Niagara Frontier Transit Authority** (Buffalo, New York) began a major system restructuring in 1993 designed to simplify the system by eliminating deviations and focusing instead on major transit corridors, while retaining the same amount of service. Included in the restructuring program were six new suburban transit centers, a renewed emphasis on express services from the suburbs to the traditional core (the most successful aspect of the prior network), and reverse-commute services. The reverse-commute routes have been the most successful of the restructured routes so far, with both ridership and passenger miles gradually increasing. Among the least successful new routes are weekend services to suburban shopping malls.

Community Transit (serving Snohomish County, north of Seattle) began a program of local route restructuring in 1992. This involved adjustments to individual routes and schedules and changes in the fundamental orientation of the network. In the South County network, CT abolished two routes and changed most of the remaining routes. In particular, CT established a South County Transit Center west of Highway 99, which eliminated the need to transfer at the Lynwood center for riders traveling to Highway 99 destinations. In 1993, CT began restructuring the North County network; CT eliminated two routes, added two routes, and expanded several more. These changes resulted in a 5 percent increase in overall ridership and an even greater effect on several routes. Ridership response on the two new routes was high and doubled between 1993 and 1994.

The **Phoenix Transit System**, operated by the Regional Public Transportation Authority, operated a grid system which left major segments of the community, including

major employment concentrations, unserved. To address this problem, in March of 1994, the system introduced a Color Line Service designed to serve major employment centers and destinations, such as the airport and Arizona State University (the fifth largest employer in the state). The most productive segments of existing routes were taken, realigned along major transportation corridors, and linked; headways were reduced significantly. As a result, most riders no longer need to transfer and can reach destinations formerly inaccessible by transit. Although ridership has been high on the Color Lines, it has been matched by a roughly equal decline in the older routes on the grid system.

Tidewater Regional Transit in Norfolk, Virginia, introduced a timed-transfer system in multiple phases from 1989 to 1991. All routes and schedules were revised from a radial network to a system of 13 multiple hubs and spokes designed to facilitate transfers, because more than 40 percent of all trips require a transfer, more than half outside the downtown area. From two to six routes meet at one location; there are no transfer fares and no elaborate facilities because passengers do not have to wait long for their connecting bus. As part of the guaranteed connection program, drivers are authorized to wait up to 2 min for the other buses due at the transfer point. TRT has been losing ridership over the last 10 years, largely because it is so heavily influenced by tourism and the actions of the U.S. Navy. However, riders are very satisfied with the Direct Transfer Bus system and it may have helped stem the decline in ridership.

The **City of Los Angeles Department of Transportation** (LA DOT) is undertaking a major study of restructuring bus services in the Westchester, Lennox, Watts, Inglewood area they call "Mid-Cities" which includes Los Angeles International Airport. The LA DOT is attempting to review the existing fixed-route system to make it more responsive to the needs of people in the area. The current bus network is largely a grid system which requires people to transfer at least once to complete trips.

In the past few years, the LA DOT implemented DASH circulator systems and a new limited-stop diagonal service to minimize transfers. At the same time, several buses were rerouted to facilitate access to the new Green line rail system; this move was widely seen as reducing the quality of bus service in the area.

King County Transit (Seattle) recently adopted a 6-year transportation plan which includes a restructuring of existing transit routes. Restructuring will begin with one of nine service areas in September of 1996; four additional areas will undergo restructuring in 1997 and the final four will be done in 1998. The overall goal of the restructuring efforts is to better serve suburban job centers.

Light Rail

In July of 1993, the **Bi-State Development Agency** in St. Louis opened MetroLink. In July of 1993—before all the stations were in operation—the system was carrying just over

44,000 trips per weekday and more than 50,000 trips per weekend day. Much of the weekend traffic is attributable to two specific trip attractors—Busch Stadium (where the Cardinals play) and the Casino Queen, a new riverboat gambling establishment. While there are no figures available on diversion from other transit, bus ridership also went up 36 percent in the 12 months after the rail system opened (from 125,000 to 169,000 trips per month). There are reports that, since MetroLink opened, business has also increased at St. Louis Center (a large shopping center) and Union Station (a festival mall).

The **Sacramento Regional Transit District** (RT) opened its light rail system in April of 1987; it became fully operational with two segments in 1988. The system is organized to provide timed transfers between modes. Ridership grew quickly; in FY89, the system carried 16.7 million trips per year but ridership increased more than 26 percent to 21 million trips by FY93. Since 1993, however, light rail ridership increases have come at the expense of bus patronage. During 1995, light rail ridership was increasing at 3.1 percent per month while ridership on RT buses was dropping 2 percent overall per month. In the summer of 1995, RT introduced a bus to parallel the Orange Vail Citrus Heights light rail route during peak hours; it has a travel time 15 min less than the light rail system.

RT also recently added two new light rail stations which have contributed to the monthly ridership increases. Two stations were added to the Folsom line, one at 39th Street and one at 48th Street. The 39th Street Station is on the northern fringe of the University of California Medical center; there is also additional hospital construction in the area. The station includes a turning loop for a free shuttle bus which serves the medical center. Although ridership increased substantially when these stations were opened, ridership on the buses serving the same area fell.

The **Niagara Frontier Transportation Authority** (NFTA, Buffalo, NY) has had a 6.5-mi light rail line since 1985 with a barrier-free self-service honor system. Although the system was carrying 30,000 passengers per day in its initial year of operation, ridership has fallen to 27,000 daily. In 1993, NFTA began implementing an 18 month long route restructuring to create greater ridership in several transportation corridors, including the rail corridor.

Heavy and Commuter Rail

The **MBTA** has been experiencing substantial ridership gains on its commuter rail services—gains not achieved at the expense of bus ridership. Commuter rail travel has been growing at about 8 percent per year for the last 3 years; system personnel believe this is because of a shift of population to the suburbs, but suburbs served by rail where residents prefer rail to bus. The MBTA is adding two new commuter rail lines; the 1994 extension of the Framingham line to Worcester, a previously unserved city west of Boston, immediately attracted 150 to 200 daily riders.

Today with limited service (six trips per day) the Framingham line carries 800 passenger trips—who must all be new transit riders by definition. The Middleborough-Plymouth line (scheduled for completion this year) is expected to serve just over 6,000 daily trips with slightly less than half being new transit riders. At the same time, MBTA is resisting pressure for more rail lines because express bus service is more convenient in many places than rail allowing travel to Boston's core without making riders transfer.

In October of 1995, the **Southern California Regional Rail Authority (SCRRA)** opened a 49-mi suburb-to-suburb commuter rail link, dubbed the Inland Empire/Orange County Line; it parallels the US 55 and 91 freeways in Riverside County and then travels south along US 5 to Irvine. In the first month of operation, there were 650 trips per day; in March of 1996 there were roughly 1,000 trips per day. Surveys indicate that 70 percent of the rail system's riders were previously drive-alone commuters.

In 1994, the **Chicago Transit Authority (CTA)** opened the Orange Line in the Southwest corridor of the service area, connecting the downtown Loop with Midway Airport. The new line connects with other CTA lines and provides 40 percent faster service than the express buses formerly serving the area—when the line opened, the routes were restructured to reduce duplication and to encourage transfer to the rail system. In October 1994, the line had 37,500 trips per weekday.

A May 1995 on-board survey found that 27 percent of all Orange Line riders were Hispanic, 13 percent were Black, and 55 percent were White. Fifty-nine percent of riders were women. Roughly one-third of all riders made more than \$50,000 per year while 37 percent made under \$30,000 annually; at the same time, only 11 percent of riders had no vehicle available for the trip while more than half of all riders had two or more vehicles available. The bulk of riders were younger than 34; only 8 percent were over 55 while 20 percent were under 18. Of those riders under 18 years of age, 52 percent were Hispanic while 19 percent were Black. Those younger than 18 were significantly more likely to use the Line five or more times per week⁴⁰.

The May 1995 on-board survey also showed that most riders came from households with four or more members; 29 percent came from households with five or more members. More than 56 percent of all riders were commuting to work while 15 percent were going to school; only 3 percent were going shopping and 4 percent were going to the airport. Many of those using the Line to shop were older (over 55) and had very low incomes.

When the line opened in 1994, many rail riders were former bus passengers—65 percent were diverted from the express buses formerly serving the area—but the new line clearly diverted non-transit users. Roughly 11 percent of the remaining riders drove for the trips in question before the opening of the Orange Line. The 1995 survey showed that 54 percent of riders had made the same trip before the Orange Line; of those, 26 percent were former car drivers or passen-

gers while an additional 4 percent had previously taken a taxi. Most diverted riders had previously taken either a CTA or PACE bus (62 percent) or another rapid rail line (12 percent) or the METRA commuter rail line (2 percent).

Most of the auto users diverted were White (66 percent), male (53 percent), and under 34 years of age; two thirds made more than \$30,000 and more than one-third made more than \$50,000. More than 90 percent of those diverted to the Orange Line had one or more cars available for the trip; one out of four diverted passengers had three or more cars available for the trip.

In 1989, the **Tri-County Commuter Rail Authority (Tri-Rail)** opened a 66-mi commuter rail system in southeast Florida (Broward, Dade, and Palm Beach counties). In March of 1991, when an on-board survey was undertaken, Tri-Rail operated 15 stations, running 20 trains each weekday and 18 trains on Saturday. In September of 1991, the system carried an average of 6,700 trips per day. The on-board survey showed that the average weekday rider was White, between 23 and 34, and making between \$20,000 and \$40,000; almost all riders were new to mass transit and traveling an average of 34 mi⁴¹. Thus rail passengers were substantially different from bus riders in the area—who were largely female, often elderly, with low income and making much shorter average trips.

An interesting feature of Tri-Rail is that, unlike other commuter rail systems, it does not go to a traditional downtown (Miami); rather it serves employment and residential markets along the long rail corridor. As a result, almost one in five trips is not a work trip and is made in the off-peak.

The **Long Island Railroad**, now managed by the New York MTA, has been losing ridership at 1 percent per year. However several individual services have gained ridership because the system was able to significantly reduce travel time. In 1987, the Ronconcomo Line, at the eastern edge of the LIRR service area, was electrified; this reduced travel time to New York City to 60 min (from 90 min) and eliminated the need to transfer at Jamaica Station. These changes resulted in a tremendous increase in ridership on this one line. The railroad is purchasing dual-mode trains (diesel and electric) in order to cut time and the required Jamaica Station transfer on the Port Jefferson line.

METRA, the commuter rail system serving downtown Chicago, increased transit ridership substantially between 1983 and 1993. Ridership increased almost 29 percent or roughly 60,000 trips per day. Ridership increases were highest among those living farthest from the Chicago CBD; ridership among those boarding at stations 30 mi or more from central Chicago increased almost 74 percent while ridership increased "only" 44 percent among those living within 10 mi of the CBD. Most riders accessed METRA by driving alone (55 percent) or being dropped off (13 percent); less than 5 percent transferred from another transit mode. Of course, the further away from the CBD a rider boarded, the more likely he or she was to drive alone to the station; more than 70 percent of those living more than 30

mi away did so. The further away someone lived from the CBD, the more likely he or she also was to get to the station by bus⁴².

Low-Floor Buses

There are many stories both in North America and in Europe of the ability of low-floor buses in regular fixed-route service to increase ridership among many kinds of riders^{43 44}; in Europe, for example, some systems report a belief in increased ridership by women with small children and baby carriages⁴⁵. The UK researchers documenting the British experience with low-floor buses note that one of the major reasons for implementing such vehicles is to increase ridership by the elderly and those with disabilities⁴⁶. However, the actual effect of low-floor buses on ridership has been far harder to document.

Calgary Transit tested 22-passenger low-floor buses on a downtown shuttle route. A survey of passengers indicated a 19 percent increase in ridership and a 95 percent customer satisfaction score.

A TCRP study reported anecdotal stories of greater use of low-floor buses by those with disabilities in **Ann Arbor, Michigan**, but noted that these assertions could not be supported by either decreased paratransit ridership or increased fixed-route ridership. However the Ann Arbor Transit Authority was only operating 10 low-floor buses at the time of the study and, because they were unsure of the operational implications, they were not widely advertising the services or taking any steps to encourage diversion from paratransit⁴⁷.

Concepts Which Make Transit Cheaper for the Rider

Fare Incentives

Pricing is an important tool for distinguishing among markets of users. By establishing fare categories, transit systems can respond to the fact that different market niches (e.g., commuters, students, immigrants, and older people) have different responses to the cost of transit service. This opens the door for marketing strategies which respond to transit's highly segmented market.

There has long been substantial discussion of the effect on transit ridership of reducing fares and making fares easier to pay. A 1991 APTA study found that transit's fare elasticity—or people's responsiveness to changes in the price of a transit trip—was fairly low: -0.40; this means that for every 1 percent increase in the price of transit there would be a 0.4 percent decrease in the number of rides purchased. It also means that increasing fares will lead to higher total revenues, because fares will go up faster than ridership will go down. The study also found that elasticities varied by city size and

by peak and off peak. Transit riders in areas under one million were more responsive to fare changes as were peak-period riders⁴⁸.

The elasticities computed in the APTA study should, in theory, also apply to reductions in fares designed to increase ridership; that is decreasing fares by 10 percent should increase ridership on average by 4 percent. However, almost all of the 52 systems which APTA studied had raised fares; it is not clear if rider response really would be the same to decreases in fares—they may move faster or slower. Moreover, if the elasticity figures were correct, the transit system would actually lose money although it increased ridership, simply because ridership would not increase as fast as fares would drop. In addition, one would expect different kinds of riders to have different responses to price incentives; the challenge of using fare incentives is to target the right price to the right passenger.

That larger cities have fairly low fare elasticities may explain why the **Massachusetts Bay Transportation Authority** (Boston) reported no effect on ridership from their 20 percent increase in fare in September of 1991 (the basic fare went from \$0.50 to \$0.60). However, other factors are at work. The **Broward County Mass Transit Division** also raised fares in April 1995 without reducing ridership; in fact there was a 14 percent increase in youth ridership and a 4 percent systemwide increase. Broward County attributes this, in part, to the aggressive marketing of monthly and weekly passes; the passes are widely available and may be purchased by government employees as a payroll deduction. **Community Transit** also raised fares in 1991 but ridership continued to grow.

On the other hand, the **Hartford DOT** has increased fares four times since 1991; each increase has had an adverse effect on ridership. The first fare increase in 1991 generated the most noticeable drop in ridership. Likewise, the **Capital Area Transportation Authority** (Lansing, MI) has increased fares twice since 1991, resulting in an annual ridership loss of 8 percent.

A 1995 study of deep discounting of multi-ride tickets—that is giving a substantial reduction on the purchase of ten or more tickets—found that 30 transit systems had adopted this approach in just the last 8 years. Although local experience varied, the study concluded that "... it is generally accepted that an effective Deep Discount plan can raise revenue by 15 to 20 percent without losing riders, and it has sometimes built ridership by a few percent."⁴⁹ The authors of the study concluded that infrequent riders rode more once they purchased multi-tickets even though they were less sensitive to price discounts than regular riders.

As proof of this interesting observation, Oram and Stark evaluated the **San Francisco Bay Area Commuter Check Program**; commuter checks are bought by employers and given to employees as a tax-free benefit which they redeem when buying tickets and passes. Checks are available in two denominations: \$20 and \$30. Their survey of 239 employers found that roughly a third of employee respondents

increased their use of transit for work and occasionally nonwork trips; the average increase was 3.24 transit trips per week per check recipient. While these data show that the fare subsidies had substantial effects on traveler behavior, there was no correlation between the size of the subsidy and travel behavior—that is, those getting the smaller subsidy were actually more likely to use transit more often than were those getting the larger subsidy (35 percent versus 30 percent) even when controlling for location in the community (as a proxy for transit access)⁵⁰.

The authors conclude that infrequent users could substantially increase their use of transit while those very dependant on the mode already could not travel much more regardless of the subsidy. If true, these observations suggest that enrollment in a subsidy program may have a greater effect on increasing transit use than does the actual amount of the subsidy. For example, a 1994 study by Charles River Associates of New York City's fare subsidy voucher found that the number of new trips per \$15 of subsidy fell after employees began to receive more than \$15 of subsidy⁵¹.

The **Champaign-Urbana Mass Transit District (MTD)** increased base fares from \$0.50 to \$0.75 in August of 1992; at the same time, MTD introduced discount tokens at \$0.50 apiece if bought in lots of ten. Both ridership and revenue went up, probably indicating that people sensitive to fare increases simply bought discount tokens and even those not sensitive used transit more once they bought the tokens.

The **Denver RTD** and the **Boulder DOT** have developed individual ECO-PASS programs, an employer-based pass begun by Boulder and then taken regionwide by the RTD. Companies must enroll all their employees to use the pass program which provides unlimited access to bus and light rail service at a cost of \$40 to \$45 per year per employee. Pass holders also have unlimited use of a guaranteed-ride-home program with a 100-mi one-way limit. The price of the pass is based on the pricing structure in the area concerned; Denver is the most expensive while outlying areas with limited transit service are the cheapest. Currently, 25,000 students at the University of Colorado use their IDs to obtain the ECO-PASS which is subsidized by the university. An additional 15,000 workers use the pass provided by the Denver RTD.

When a new company joins the program, transit ridership at that location increases from 50 to 400 percent. Overall, in the 6 years since its inception, ridership associated with pass use has increased 161 percent. Although the success of the program has been attributed to environmental awareness as well as the parking problems of the participating employers, the pass itself is attractive to several riders. The DOT staff report that employers often indicate their participation as an incentive in job advertisements.

The **Washington Metropolitan Area Transit Authority (WMATA)** in Washington, D.C., created a workplace transit benefit program they call MetroPool. MetroPool is designed to be used by corporations, federal and military agencies, nonprofit organizations, and businesses. It encourages

employers to make transit vouchers available to employees at work. Employers can purchase Metrocheks in preset denominations and distribute them monthly to their employees who use public transit. A Metrochek is a commuting card created for the workplace. It looks and works like a Metrorail farecard and is accepted by 49 different transit systems in the Washington area, including commuter trains, Metrorail, Metrobus, and qualified commuter bus and vanpool systems.

The **University of Washington** (Seattle) developed a special commuter program in conjunction with **Seattle Metro** and **Community Transit (CT)**; in 1991, the university implemented a package of transit and ridesharing options tied to a U-PASS. The U-PASS was offered to students at a substantial discount (initially \$20 per quarter for students and \$27 for faculty and staff) and allowed ridership on various transit modes. The program included increased transit services, ridesharing matching, guaranteed rides home, and merchant discounts; campus parking rates were also raised 50 percent (from \$24 to \$36 per month). Within 2 years, roughly 80 percent of the 50,000 people on campus had bought a pass.

Between 1991 and 1993, total campus ridership on Seattle Metro's services grew almost three million trips per year, or 60 percent. Community Transit reported an immediate 22 percent increase in ridership on its weekday routes to campus. Overall CT has almost 2,500 campus-based boardings each day—roughly 12 percent of all daily boardings in the system. Ridership has been increasing steadily; between 1993 and 1995, university boardings grew almost 7 percent. CT's university services have the highest number of passengers per hour in the system—31.8 compared to the system average of 21.8.

Doing away with transit fares to increase ridership is a topic which constantly engages the public's interest. The **Capital Metropolitan Transportation Authority** in Austin, Texas, is one of the largest systems to ever introduce a totally fare-free system; begun in 1989, the free fare remained in force for 18 months. It was ended prematurely because of substantial problems with homeless people, vandalism, and increased crime aboard the vehicles; the School District formally requested that Capital Metro end the policy because it was encouraging truancy. Ridership did increase remarkably—from 70,000 to 130,000 boardings daily. Capital Metro did not return to their former fare policy when they returned to a paying system; they sharply reduced the price of discount passes and instituted a flat \$0.50 cash fare.

The Austin system has no data on the type of rider attracted by the free service. They feel that the actual number of riders did not go up substantially; rather they think that current riders simply rode more frequently. Anecdotal stories, however, report decreased ridership by regular commuters who were upset by vehicle crowding, the rowdiness of groups of teenagers, and the security problems possibly posed by large numbers of homeless people who were riding.

In January of 1994, Capital Metro also introduced a reduced weekend rate of \$0.25 for a 6-month demonstration period; the fare was targeted at large families and was designed to increase weekend ridership. The system did increase ridership, which was maintained after the end of the special fare trial period.

The **Greater Bridgeport Transit District (GBTD)** provides fixed-route and paratransit services to the Connecticut communities of Bridgeport, Fairfield, Stratford, and Turnbull, with a combined population of 276,509. In 1993, GBTD adopted a promotional campaign that included free fares on fixed-route service and a substantial fare increase on para-transit. This month-long campaign was so successful that the free-fare program was extended through 1993 and 1994. Ridership increases have been significant.

The **Port Authority of Allegheny County** (Pittsburgh) offers barrier-free entry at all three rail stations in the downtown area as well as free entry to the bus system. The "Three Stops for Free" program is well utilized by people working and shopping in downtown, and it has been a great selling point for the convention and tourist trade. As a result, all trains operate at full capacity in the core.

PAT also has a special Summer Pass Program for summer school students paid for by the City of Pittsburgh; although the program was targeted at teenagers, the actual ridership response has been from 8- and 9-year-olds. In the first year of the program, Summer Pass holders made 95,000 trips; in 1994, they made 225,000.

The **King County Department of Metropolitan Services** (Metro) in Seattle allows all transit services in the downtown area to be boarded for free until 7:00 PM. Originally designed to reduce dwell time, the free ride concept has been modified to eliminate the problem of homeless people riding at night—now service is no longer free after 7:00 PM.

Several transit systems which implemented fare-free trials were successful in increasing overall transit ridership, including the **Worcester Regional Transit Authority**, the **Riverside (CA) Transit System**, the **Santa Cruz (CA) Transit System**, and the **Hillsborough Area Regional Transit (HART)**⁵².

The **Niagara Frontier Transportation Authority** (Buffalo, NY) reports that 30 percent of their ridership are public school students in grades 8 through 12. About one-third of the students use a student pass which has a picture ID; these passes are purchased from the transit system by the school district and are valid only during school hours and rides from home to school and back again.

Several transit systems offer free fares to those in wheelchairs or certified as eligible for complementary paratransit in order to increase use of accessible vehicles and to reduce paratransit demand. **Bridgeport, Connecticut**, adopted free fares on fixed-route services for those with disabilities at the same time they increased paratransit fares and introduced a comprehensive travel training program. This program significantly affected ridership on paratransit service

and fixed-route service—decreasing the former and increasing the latter.

Before the fare incentive, paratransit ridership had been increasing 30 to 40 percent each year; after the program was implemented, ridership grew only 9 percent annually. Fixedroute service, which had been declining steadily for the 3 years before the fare incentive program, grew 5 percent immediately after the fare program. Overall, free travel on the fixed-route system was responsible for shifting approximately 6,300 trips from paratransit to fixed route; 5 percent of those shifted had never before used fixed-route services.

Most of the travelers who shifted to fixed route had previously been eligible for a half-price fare of \$0.40⁵³. Before the program, reduced fare rides were fairly constant (between 37,000 and 39,000 per month); immediately after the program began, the number of reduced- and free-fare rides (that is, by seniors and those with disabilities) rose by more than 7,100 per month (in May of 1994, the system carried 49,000 free-and reduced-fare rides)⁵⁴.

Capital Metro in Austin, Texas, retained free fares for those with disabilities when it abandoned its systemwide free-fare policy; as a result, the system had more than 5,000 wheelchair boardings per month in 1993 (which is roughly equivalent to what systems 8 to 10 times bigger are experiencing⁵⁵).

Several systems have important ridership from among 12- to 17-year-olds directly linked to pass programs. The **New Orleans Regional Transit Authority** reports that this student population is its most successful market segment, possibly because the school district buys and distributes student passes. The Tucson Unified School District also buys transit passes for its students to ride **SUNTRAN**; students account for 15 percent of all pass users. **Centro**, the Syracuse system, provides 80 percent of all bus service to junior and senior high schools; the local Board of Education issues passes to students which are only valid on school routes, during school hours. Centro is reimbursed for the number of passes distributed.

Facilitating Transfers

Many systems charge an additional fee for riders transferring from one route or transit mode to another. This reduces the attractiveness of transit to those who need to link several trips. A previous section discussed how transit systems can eliminate transfers (by various route restructuring concepts) and facilitate transfers (by timed and/or guaranteed transfers and developing suburban transit centers). For those transfers that remain, some pricing options may also encourage ridership.

The **Capital Metropolitan Transportation Authority** (Austin, Texas) has targeted working parents with its new transfer policy. The policy was designed in response to an increase in "chaining of trips" where riders leave the bus to drop off children at daycare, go grocery shopping, or do other

errands before reaching their destination. The transfer policy allows riders to reboard and continue travel on the same route. Time for reboarding was increased to 3 hr on weekdays and 4 hr on weekends. Transfers are free if requested when the fare is paid. This change was made 18 months ago; during that time there has been a 3 percent growth in ridership.

Tidewater Regional Transit also has offered a "stop and go" transfer for many years. The increase in trip chaining activity is evident in the increased sales of this transfer. As part of an upgrading of its on-board fare collection system, the **Delaware Administration for Regional Transit (DART)** in Wilmington, Delaware, introduced a transfer that is the equivalent of a 90-min systemwide bus pass. The target market for this transfer consists of residents of the urban core who make short trips. With the new transfer policy, they can complete a round trip in the allotted time.

Subsidized Vanpools

The **Harris County Metropolitan Transit Authority** (Houston Metro) coordinates the private operation of vanpools throughout Harris County by providing matching subsidies for their operations. Currently, Metro has 104 vans in service, with an average monthly ridership of 40,737. Metro contracts out van operation and maintenance to several private providers; by advertising and marketing the program and subsidizing roughly three-fourths of the costs, the system reports 39,000 passenger trips per month as transit trips. Service is largely provided from one suburb to another; less than 10 percent of the vanpools go downtown, in large measure, because the core transit service is very good. Much of the ridership is traveling to or from medical centers—25 percent of all vans are serving just one suburban medical complex. Most riders are workers but there are a few students vanpooling as well. Most riders are believed to be former car drivers or passengers.

The **Capital Metropolitan Transportation Authority** (Austin, Texas) markets and subsidizes a vanpool program; they currently support 100 vanpools (4 outside the service area) by contracting with VPSI, a private firm, for the vehicles, maintenance, and insurance. The vanpools provide almost 400,000 annual passenger trips. Riders within the system's service area pay \$10 each per month while those not in the service area pay by the mile or an average of \$120 per month; Capital Metro subsidizes all additional costs. Riders may also purchase "insurance" for a guaranteed-ride-home program; for \$5 per year they are eligible for up to four rides home per year, provided by a taxi operator under contract to Capital Metro.

The Austin system organizes roughly 3 new vanpools each month; they expect to have more than 200 by the end of the century. They currently have 90 people on a vanpool waiting list. In general, the system will not organize a vanpool until there are at least seven to eight guaranteed riders.

Community Transit (north of Seattle) operates a vanpool system which accounts for almost 4 percent of annual ridership. CT's program leases vans to qualified commuter groups with an origin or destination in Snohomish County; currently 142 vans are in operation (3 of which are lift-equipped). More than 80 percent of the vanpools travel to major employment centers in the county, carrying just over 200,000 trips per year. Ridership has increased 74 percent between 1991-94.

PACE, the suburban bus division of Chicago's Regional Transportation Authority, has a vanpool incentive program to serve the needs of small groups of workers. The vanpool program, VIP, provides passenger vans to 5 to 15 people who pay the operating costs; in 1995 there were 172 vans running with more than 90 percent in suburb-to-suburb operation. The fares vary according to distance and the number of passengers, but they have been covering more than 100 percent of operating costs. Recently the vanpool program has been expanded to serve workers with disabilities living outside the ADA paratransit service area; in 1995, there were 20 "ADvAntage" vans in operation.

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APPENDIX G

ATTRIBUTES SOUGHT BY VARIOUS MARKET GROUPS

INTRODUCTION

This appendix describes how various transit service concepts might provide the service attributes sought by various market niches. Service concepts are matched to actual/potential market segments and to individual service environments.

SERVICE CONCEPTS MATCHED TO TRANSIT MARKETS

Prior analyses performed for this project made clear that different market niches use transit more than average (when controlling for income) in different service environments. While some market niches are important markets for operators in most or all service environments, others are only more likely to use transit in a few service environments. For example, women, Blacks, and Hispanics created transit markets in almost all of the 14 service environments; older workers (over 65) are only a transit market in a few service environments. This analysis, then, assumes that any given service concept would meet the needs of potential markets in some service environment and not in others; the following tables attempt to match concepts and the market niche they might serve to various service environments.

Table G-1 is concerned with those service concepts that make transit feasible or practical; overall, these options work

best in medium- or high-density service areas of at least 500,000 people. Some options, such as joint development and transit-supportive neighborhoods, probably only create transit markets in high-density areas over one million. Some options, such as travel training or marketing, could work in any size community.

Table G-2 focuses on those service concepts that make transit convenient; most of these options work best in low-to medium-density service environments under 500,000. Some, such as smaller transit vehicles, can work in larger service environments although they seem better suited to smaller ones. Smartcards and other sophisticated fare paying mechanisms probably only make sense in very large service environments.

Table G-3 matches those transit service concepts that make transit faster or more direct with various market niches. These concepts are the most effective in creating transit markets in medium- to high-density areas over 500,000 and often over one million. Some concepts, such as route restructuring, are so broad that various elements (e.g., suburb-to-suburb service, interlining, and cross-town routes) could be used in any service environment to attract certain transit markets.

Table G-4 covers transit service concepts that make transit cheaper. These are the only set of concepts that can create transit markets in all service environments, regardless of size or density.

TABLE G-1 Service concepts: feasible/practical

	BY SERVICE ENVIRONMENT	
	WORK TRIPS	NON-WORK TRIPS
REVERSE COMMUTE		
FEEDER ROUTES		
500,000 - 1 MILLION 1 MILLION PLUS	▶ MEDIUM DENSITY HIGH DENSITY	
	<ul style="list-style-type: none"> • Women • People with out Cars • People with Household Incomes <\$15,000 • Blacks • Hispanics • Asians • College and Graduate School Education • People 17-29 • People with High School Degree • Immigrants 	<ul style="list-style-type: none"> • People with Household Incomes <\$15,000 • Women • College and Graduate Education
SERVICE TO LARGE EMPLOYERS / UNIVERSITIES		
500,000 - 1 MILLION 1 MILLION PLUS	▶ MEDIUM DENSITY HIGH DENSITY	
	<ul style="list-style-type: none"> • Women • People without Cars • People with Household Incomes <\$15,000 • Blacks • Hispanics • Asians • College and Graduate School Education • People 17-29 • People with High School Degree • Immigrants 	<ul style="list-style-type: none"> • People 17-29 • College and Graduate School Education
GUARANTEED RIDE HOME		
CHILDCARE FACILITIES		
CONCIERGE SERVICES		
500,000 - 1 MILLION 1 MILLION PLUS	▶ MEDIUM DENSITY HIGH DENSITY	
	<ul style="list-style-type: none"> • Women • College and Graduate School Education • People with Household Incomes <\$15,000 	
TRAVEL TRAINING		
TRANSIT FAMILIARIZATION PROGRAMS		
ALL SERVICE ENVIRON- MENTS	▶ ALL DENSITIES	
		<ul style="list-style-type: none"> • People 65+ • People without Cars

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TABLE G-1 (continued)

		BY SERVICE ENVIRONMENT	
		WORK TRIPS	NON-WORK TRIPS
MARKETING AND ADVERTISING			
500,000 - 1 MILLION 1 MILLION PLUS	▶	LOW DENSITY MEDIUM DENSITY HIGH DENSITY	
		<ul style="list-style-type: none"> • People without Cars • People with Household Incomes <\$15,000 • People 17-29 • People with High School Degree • Immigrants 	<ul style="list-style-type: none"> • People 65+ • People without Cars • People with House Hold Incomes <\$15,000 • People 17-29 • People with High School Degree • Immigrants
JOINT DEVELOPMENT			
TRANSIT SUPPORTIVE NEIGHBORHOODS			
1 MILLION PLUS	▶	MEDIUM DENSITY HIGH DENSITY	
		<ul style="list-style-type: none"> • Women • People without Cars • People with Household Incomes <\$15,000 • Blacks • Asians • Hispanics • College and Graduate School Education • People 17-29 • People with High School Degree • Immigrants 	<ul style="list-style-type: none"> • Women • People without Cars • People with Household Incomes <\$15,000 • Blacks • Asians • Hispanics • College and Graduate School Education • People 17-29 • People with High School Degree • Immigrants

* A *Transit Market* = a market niche matched to specific service environments

TABLE G-2 Service concepts: more convenient

		BY SERVICE ENVIRONMENT	
		WORK TRIPS	NON-WORK TRIPS
ROUTE DEVIATION			
FLEX ROUTES			
ROUTE EXTENSION			
LATE NIGHT / REQUEST STOP			
50,000 - 200,000 200,000 - 500,000	▶	VERY LOW DENSITY LOW DENSITY	
		<ul style="list-style-type: none"> • Women • People without Cars • People with Household Incomes <\$15,000 • Blacks • Hispanics • Asians • College and Graduate School Education • People 17-29 • People with High School Degree • People 65+ 	<ul style="list-style-type: none"> • Women • People without Cars • People with Household Incomes <\$15,000
ROUTE EXTENSION			
LATE NIGHT / REQUEST STOP			
50,000 - 200,000 200,000 - 500,000	▶	VERY LOW DENSITY LOW DENSITY	
		<ul style="list-style-type: none"> • Women • People 65+ 	<ul style="list-style-type: none"> • Women • People without Cars • People with Household Incomes <\$15,000 • Blacks • Hispanics • Asians • People 65+
DOWNTOWN LOOPS/CIRCULATORS			
NEIGHBORHOODS LOOPS/CIRCULATORS			
200-500,000 500-1 MILLION 1 MILLION PLUS	▶	MEDIUM DENSITY HIGH DENSITY	
		<ul style="list-style-type: none"> • Women • People without Cars • People with Household Incomes <\$15,000 • Blacks • Hispanics • Asians • College and Graduate School Education • People 17-29 • People with High School Degree • People 65+ 	<ul style="list-style-type: none"> • Women • People without Cars • People with Household Incomes <\$15,000 • Blacks • Hispanics • Asians • College and Graduate School Education • People 17-29 • People with High School Degree • People 65+

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TABLE G-2 (continued)

		BY SERVICE ENVIRONMENT	
		WORK TRIPS	NON-WORK TRIPS
DOWNTOWN LOOPS / CIRCULATORS			
NEIGHBORHOODS LOOPS/CIRCULATORS			
500-1 MILLION 1 MILLION PLUS	▶	Low DENSITY MEDIUM DENSITY	<ul style="list-style-type: none"> • People 65+ • Women • People without Cars • People with Household Incomes <\$15,000 • College and Graduate School Education
SMALLER TRANSIT VEHICLES			
50,000 - 200,000 200,000 - 500,000 500,000-1 MILLION	▶	Low DENSITY MEDIUM DENSITY	<ul style="list-style-type: none"> • College and Graduate School Education • College and Graduate School Education • Women • People 65+
SMARTCARDS / FAREBOXES			
500,000-1 MILLION 1 MILLION PLUS	▶	MEDIUM DENSITY HIGH DENSITY	<ul style="list-style-type: none"> • College and Graduate School Education

* A *Transit Market* = a market niche matched to specific service environments

TABLE G-3 Service concepts: faster and more direct

		By SERVICE ENVIRONMENT	
		WORK TRIPS	NON-WORK TRIPS
HOV LANES			
EXPRESS / LIMITED STOP SERVICE			
COMMUTER RAIL			
500,000 - 1 MILLION 1 MILLION PLUS	▶	MEDIUM DENSITY HIGH DENSITY	
		<ul style="list-style-type: none"> • College and Graduate School Education • Immigrants • Women 	
PRIORITY BUS TRAFFIC			
500,000 - 1 MILLION 1 MILLION PLUS	▶	MEDIUM DENSITY HIGH DENSITY	
		<ul style="list-style-type: none"> • Women • College and Graduate School Education • Immigrants • People 65+ 	<ul style="list-style-type: none"> • People 65+ • College and Graduate School
FACILITATING TRANSFERS			
SUBURBAN TRANSIT CENTERS			
200-500,000 500,000 - 1 MILLION 1 MILLION PLUS	▶	LOW DENSITY MEDIUM DENSITY HIGH DENSITY	
		<ul style="list-style-type: none"> • People without Cars • People with Household Incomes < \$15,000 • Blacks • Hispanics • Asians • People with High School Degrees • Immigrants 	<ul style="list-style-type: none"> • People without Cars • People with Household Incomes < \$15,000 • People 65+
ROUTE RESTRUCTURING			
200-500,000 500,000 - 1 MILLION 1 MILLION PLUS	▶	LOW DENSITY MEDIUM DENSITY HIGH DENSITY	
		<ul style="list-style-type: none"> • Women • People without Cars • People with Household Incomes < \$15,000 • College and Graduate School Education • Immigrants • People 17-29 • People with High School Degrees 	<ul style="list-style-type: none"> • Women • People without Cars • People with Household Incomes < \$15,000 • People 65+

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TABLE G-3 (continued)

		BY SERVICE ENVIRONMENT	
		WORK TRIPS	NON-WORK TRIPS
LIGHT RAIL			
1 MILLION PLUS	▶	HIGH DENSITY	
		<ul style="list-style-type: none"> • College and Graduate School Education 	
LOW FLOOR BUSES			
ALL SERVICE ENVIRONMENTS	▶	ALL DENSITIES	
		<ul style="list-style-type: none"> • Women • College and Graduate School Education • People 65+ 	<ul style="list-style-type: none"> • People 65+ • Women

* A *Transit Market* = a market niche matched to specific service environments

TABLE G-4 Service concepts: cheaper

		BY SERVICE ENVIRONMENT	
		WORK TRIPS	NON-WORK TRIPS
FARE INCENTIVES			
TRANSFER POLICIES			
ALL SERVICE ENVIRONMENTS	▶	ALL DENSITIES	
		<ul style="list-style-type: none"> • People without Cars • People with Household Incomes < \$15,000 • Blacks • Hispanics • Asians • Immigrants 	<ul style="list-style-type: none"> • People without Cars • People with Household Incomes < \$15,000 • Blacks • Hispanics • Asians • Immigrants • People 17-29 • People 65+
VANPOOL / CARPOOL SUBSIDY			
ALL SERVICE ENVIRONMENTS	▶	ALL DENSITIES	
		<ul style="list-style-type: none"> • People with Household Incomes < \$15,000 • People without Cars • Blacks • Hispanics • Asians • College and Graduate School Education • People 17-29 • People with High School Degrees • Immigrants 	<ul style="list-style-type: none"> • People with Household Incomes < \$15,000 • People without Cars • Blacks • Hispanics • Asians • College and Graduate School Education • People 17-29 • People with High School Degrees • Immigrants

* A *Transit Market* = a market niche matched to specific service environments

APPENDIX H

GLOSSARY

Concierge Service: services provided at transit facilities for the convenience of the traveller. Services include car maintenance, dry cleaning, diaper service, food/drinks, transit travel assistance, etc.

Dedicated Busways/Tunnels: capital improvements designed to speed transit through congested areas. Facilities can either bypass or integrate with other transportation.

Demand-Responsive Service: a shared-ride community-oriented service where a vehicle can pick up passengers and deliver them to a local destination as requested; it has no fixed-route or schedule. Dial-a-ride is a synonym. Although often provided to elderly and disabled passengers, it can and has been offered to the general public (see general public dial-a-ride below).

Downtown Loops/Circulators: routes that travel within a CBD, often during peak commute and lunch hours. Smaller vehicles are often used, to differentiate from regular transit buses.

Express Service: connects residential areas with activity centers using high-speed facilities, e.g., a freeway, turnpike, or busway with limited stops at each end for collection and distribution. (See limited service below.)

Facilitating Transfers: networks of suburban transit centers, flexible transfer policies, coordinated transfer points, and capital improvements designed to simplify transferring between vehicles and services.

Fare Incentives: policies and passes offered by the transit system in order to gain and maintain regular ridership. Includes recreation, school, university, and employee passes, as well as free rides for riders who are elderly or have disabilities. Free/reduced fare trips can encourage those who are elderly or have disabilities to use fixed-route transit instead of paratransit. Some systems dedicate downtown areas as "free ride zones."

Feeder Service: service that picks up and delivers passengers to a rail station, transit center, park-and-ride terminal, or other transfer facility. Can be used to connect suburban employment concentrations to rail and regional bus facilities.

Flex-Routes: one transit vehicle provides several types of service, switching between paratransit, deviating fixed-route,

express route, and local fixed-route services, depending on density of service area, peak hours, and demand. Can serve cross sections of market by different service, while maintaining same driver and vehicle.

General Public Dial-A-Ride: demand-responsive service available to the general public as well as those who are elderly or have disabilities. (See demand-responsive service and "smart" demand-responsive transportation.)

Guaranteed Ride Home: service that provides emergency transportation for people who usually use transit or carpools/vanpools but must return home and do not have other transportation available. Service can be provided by taxis or company vans.

HOV Lanes: separate lanes provided for high-occupancy (two or more passengers) vehicles, including transit as well as personal vehicles. HOV lanes vary from curbside lanes and movable directional barriers to separate median lanes for sole HOV use. Busways are a form of HOV lanes, provided solely for the use of transit vehicles; no private vehicles are allowed. Designed to encourage carpooling through potential bypassing of single-occupant vehicle (SOV) traffic.

Joint Development: transit, commercial, and mixed-use facilities built together to increase transit use and building revenues.

Limited Service: higher speed arterial service serving only selected stops during certain periods of the day. Unlike express service, there is no significant portion using an exclusive right-of way. *Skip-stop service* is a synonym. (See express service.)

Low-Floor Buses: Forty-foot transit coaches having no steps and no impediments between the front and rear doors. Floor level is typically no more than 15 inches from the ground. Ramps may be used for access from curbs to floor level.

Neighborhood Circulators: often smaller transit vehicles that circulate on secondary routes through residential areas and serve shopping, recreation, and possibly work destinations. The routes may connect to major fixed-route service as well or operate as isolated localized service. The main intention is to bring transit as close as possible to potential riders.

Park-and-Ride Facilities: suburban facilities for commuters travelling from suburbs. Service is often provided during peak hours on express routes into downtown areas.

Priority Bus Traffic: timing of signals as well as bypasses and ramps designed to get buses through traffic faster than automobiles.

Request-a-Stop: often a late-night service, allowing passengers to board/disembark anywhere along a route, not just scheduled stops. Designed for passenger safety, to reduce walking distances late at night.

Reverse Commute: transportation provided to accommodate central city workers travelling to suburban employment concentrations. Can be a change in schedule or route to accommodate suburban work sites or a feeder service from regional bus and rail service.

Route Deviation: vehicles deviate from a route to pick up or drop off passengers. Routes may be fixed or based on checkpoints and windows of service time. Buses may provide service for all passengers or solely for passengers who are elderly or have disabilities and are registered with agency.

Route Extension: optional continuation of a route into low-density and low-demand areas. Riders can either request service upon boarding or from a remote stop by advance reservation. Optional extensions optimize efficiency by reducing or eliminating unproductive trips. Combined with route turn back, it operates as a flexible routing option for low-density areas. (See route turn back.)

Route Restructuring: major changes in the route network, schedules, stops, and modes of service in response to changing travel requirements. Variations or components are as follows:

- **Crosstown Route:** a nonradial bus route that does not enter the CBD. Provides service to commercial and industrial centers in the suburbs; normally provides connections with regional bus and rail services.
- **Interlining:** use of the same vehicle on more than one route without requiring passengers to transfer. Joins the ends of radial routes to travel through the downtown instead of having vehicles turn back or lay over in the downtown. *Through* or *interlocking routes* are used as synonyms. Designed to serve different markets during peak and off-peak periods.
- **Route Extension:** the continuation of a fixed route into previously unserved (often suburban) areas, in place of introducing a separate route. Makes more efficient use of existing services to reach new markets.

- **Route Streamlining:** changes designed to eliminate unproductive branches and route duplication. When change reduces travel time and improves alignment of service on arterial streets, it improves service for commuters, especially for those residing in medium-density areas where routes may reflect previous demand.

Route Turnback: changes designed to shorten the length of a route during off-peak periods. *Short turn* is a synonym. It allows more service to be provided in high- and medium-density areas without the additional cost of maintaining service in lower density areas. (See route extension.)

Small Bus: a bus 28 feet or less in length.

Smart Cards/Fare Boxes: application of technology to fare-box payments that "senses" fare cards from a distance without having to physically read them. Designed to speed up and facilitate the boarding/fare payment process. Software can also collect more accurate ridership and fare data.

Smart Demand-Responsive Transportation: Dial-a-ride shuttles that operate with the assistance of technology; software for vehicle location, dispatch, and scheduling allows for immediate demand-responsive service.

Suburban Transit Centers: Multiple facilities for transfers provided in suburban areas, eliminating the need to travel into downtown areas to transfer between routes. Used in conjunction with suburb-to-suburb links (see below).

Suburb-to-Suburb Links: provides service between outlying areas without traveling through the CBD. Service between areas can be provided by express routes or local service.

Taxi Substitution: taxis used to replace bus service when not feasible in an area. Useful in low-density, low-demand areas where fixed-route service is not efficient.

Timed Transfer: a location where two or more routes come together at the same time to facilitate the transfer of passengers. A short layover may be provided at the timed transfer location to enhance connections. Timed transfers have allowed the restructuring of suburban services into hub-and-spoke networks. *Pulse transfer* is a synonym. Provides a wider range of destinations for suburban travelers.

Transfer Policies: extended transfer times and multi-mode transfers used as incentives for passengers. Allows for trip linking instead of making multiple trips.

Transit Familiarization: programs designed to familiarize potential riders with experiences that will be encour-

tered in riding transit vehicles, such as boarding and alighting, fare payment, requesting stops, and route travel. Designed to encourage riders unfamiliar with transit to travel, once accustomed to what will be encountered while traveling.

Transit-Supportive Neighborhoods: cooperative development of transit and supporting commercial/public facilities in neighborhood areas. Designed to develop a "transit area" for the community's use.

Travel Training: a training program designed to teach people, generally those with mental or visual disabilities, how to ride a bus or train. Can be quite lengthy and complex, depending on the disability of the riders.

Vanpool/Buspool: where a group of individuals organize to share all or part of the cost of operating the vehicle. When there are more than 15 passengers, it is normally called a buspool. Generally marketed to commuters employed at a single destination.

The **Transportation Research Board** is a unit of the National Research Council, which serves the National Academy of Sciences and the National Academy of Engineering. The Board's mission is to promote innovation and progress in transportation by stimulating and conducting research, facilitating the dissemination of information, and encouraging the implementation of research results. The Board's varied activities annually draw on approximately 4,000 engineers, scientists, and other transportation researchers and practitioners from the public and private sectors and academia, all of whom contribute their expertise in the public interest. The program is supported by state transportation departments, federal agencies including the component administrations of the U.S. Department of Transportation, and other organizations and individuals interested in the development of transportation.

The National Academy of Sciences is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. Upon the authority of the charter granted to it by the Congress in 1863, the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. Dr. Bruce M. Alberts is president of the National Academy of Sciences.

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The National Research Council was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purpose of furthering knowledge and advising the federal government. Functioning in accordance with general policies determined by the Academy, the Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. The Council is administered jointly by both the Academies and the Institute of Medicine. Dr. Bruce M. Alberts and Dr. William A. Wulf are chairman and vice chairman, respectively, of the National Research Council.

Abbreviations used without definitions in TRB publications:

AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
IEEE	Institute of Electrical and Electronics Engineers
ITE	Institute of Transportation Engineers
NCHRP	National Cooperative Highway Research Program
NCTRP	National Cooperative Transit Research and Development Program
NHTSA	National Highway Traffic Safety Administration
SAE	Society of Automotive Engineers
TCRP	Transit Cooperative Research Program
TRB	Transportation Research Board
U.S.DOT	United States Department of Transportation