Before transit services can be provided, a myriad of capital items are required. These capital items required for public transit service consist of vehicles, vehicle maintenance facilities, passenger amenities such as shelters and benches, and computer equipment. Indeed, many capital elements will be required to maintain and potentially expand EDCTA services over the coming years, as discussed below.

VEHICLE ALTERNATIVES

The size and types of EDCTA's fleet was presented in Table 26 in Chapter 3. In summary, EDCTA currently has 16 wheelchair-accessible cutaway vans, 2 low-floor minivans, 13 10-year/350,000-mile medium/heavy-duty transit coaches, 1 replica trolley bus and 9 non-revenue vehicles. All of the revenue vehicles (with the exception of three commuter buses) will have reached the end of their useful lives (as presented in Table 26 in Chapter 3) during the short-range planning period. Based on EDCTA's selection of the service alternatives presented in the previous chapter, a Capital Plan will be presented in a subsequent step of this study that will identify an appropriate vehicle acquisition schedule. If vehicles are required for casino service, all costs would be assumed to be borne by the casino.

In Fiscal Year 2002-03 dollars, the following prices are assumed for each type of bus currently used for the various services provided by EDCTA:

- Dial-A-Ride, Local Deviated Fixed Route and Rural Route – $65,000
- Commuter – $250,000

The design life for the deviated fixed-route and Dial-A-Ride buses are 5-years/150,000 miles. The design lives for the Commuter buses are 10-years/350,000 miles. These estimates do not assume the vehicles will use alternative fuel nor is a low-floor design assumed. The additional cost per bus for the former is assumed to be $35,000, and $30,000 for the latter.

In total, the current EDCTA service plan requires 23 buses – a peak of three local deviated fixed-route buses, four Dial-A-Ride vans, eleven commuter buses and five buses for the contracted services. This equates to an overall fleet spare ratio of 52.2 percent. However, this figure is somewhat misleading, since several buses are used for more than one service. For example, the Ford Eldorado minibuses are used for contracted special services, local deviated fixed-route services and Dial-A-Ride services. In addition, several buses are currently "moth-balled," awaiting formal disposal.

Alternative Fuels

To reduce pollution from mobile sources, the United States Environmental Protection Agency (EPA) has adopted a variety of regulations as required by the Clean Air Act Amendments (CAAA) of 1990. In addition, the California Air Resources Board (CARB) recently adopted a transit bus fleet rule that requires transit agencies to significantly reduce the tailpipe emissions of their fleet by 2015. Agencies are allowed to opt for either a "diesel path" or "alternative fuel path" to provide flexibility in determining their optimal fleet mix. In general, the requirements include:

- An in-use fleet average requirement for oxides of nitrogen (NOx) that will encourage the retirement of the oldest, dirtiest diesel buses. This requires a minimum active fleet average of 4.8 grams per brake horsepower-hour (g/bhp-hr) of NOx. This requirement is the same for either path (diesel or alternative fuel).

- A particulate matter (PM) retrofit requirement, with an emphasis on the dirtiest buses, to reduce diesel PM emissions. This requires that an after-treatment device that demonstrates 85 percent conversion efficiency be installed on engines that meet specified requirements. This requirement is the same for either path.

- Low-sulfur diesel fuel must be used by all transit agencies by July 1, 2006 (this deadline was July 1, 2002 for agencies operating 20 or more urban buses). Low-sulfur diesel will reduce PM, though it is projected to cost an additional five to ten cents more per gallon. Use of low-sulfur fuel is required for both paths, though it is more important for agencies choosing the diesel path since most existing after-treatment technologies require low-sulfur fuel to operate efficiently and reliably.

- Large transit agencies (greater than 200 urban buses) who choose the diesel path are required to procure three zero-emission buses by July 1, 2003, and use them in service for a minimum of one year.

- Beginning in 2008, large transit agencies that choose the diesel path must ensure that at least 15 percent of its annual bus purchases are zero-emission buses. This requirement is delayed until 2010 for agencies that choose the alternative fuel path.

Both paths provide approximately the same NOx emission reductions over the lifetime of the fleet rule, though the alternative fuel path will provide greater PM reductions. A number of reporting requirements were also imposed as part of this rule.

In order to develop a working concept of the different alternative fuels, their advantages and disadvantages, and their potential application for the EDCTA fleet, the following review of the five relatively common alternative fuels is presented below.

Methanol

Most of the methanol used commercially in the United States is manufactured from natural gas, making it economical to use. The tailpipe emissions of methanol are generally considered to be about half as reactive as an equal mass of emissions from gasoline or diesel fuel, promoting its use to reduce ozone in urban areas, such as Los Angeles.

By volume, methanol has slightly more than half the energy content of diesel fuel and slightly more than half the energy content of gasoline. Due to the above characteristics, a methanol engine will consume a little over twice the volume of fuel per mile of service, as compared to a diesel engine.

Transit authorities in Los Angeles and Seattle have over recent years retired their methanol programs due to the fuel's highly corrosive properties. After spending $102 million since 1989 on methanol buses, Los Angeles County transit officials declared their methanol anti-pollution program a failure. Authorities from the Metropolitan Transportation Authority (MTA) cited that the buses are prone to costly mechanical repairs. Officials of the Seattle Metro eliminated their methanol demonstration program after a trial period of five years. Test results of the program indicated that severe engine malfunctions were experienced on the buses at 60,000 and 70,000 miles, largely attributed to the corrosive nature of the fuel.

Ethanol

While not being as corrosive as methanol, the major use of ethanol is currently limited as an octane additive and oxygenate for gasoline. According to Information Update, (Detroit Diesel Corporation, February 1992), the cost of ethanol is almost twice as much as that of methanol, making its use limited as a motor vehicle fuel. Aside from the fuel's economic drawbacks, ethanol produces lower carbon monoxide (CO) emission rates than gasoline, has a higher energy density than methanol, and has a lower toxicity than either methanol or gasoline.

Compressed Natural Gas (CNG)

The strength of CNG as an alternative fuel for transit buses is that it is generally less expensive per unit of energy than gasoline or diesel fuels, although the gap in price has closed considerably over the past two years. The fuel also has the potential to reduce NOx emissions and PM when compared to diesel. However, CNG engines still emit higher concentrations of HC and CO than recent diesel engines – two greenhouse gases that contribute to global warming.

Many people – both inside and outside the transit industry – perceive CNG as the future fuel of choice. Others see CNG as a stop-gap measure that can be used to reduce vehicle emissions until other technologies (hydrogen fuel-cell or combustion-electric hybrid) are developed further. Indeed, the decision to pursue CNG comes down to the underlying goals of the agency considering alternative fuels, the local politics, the financial resources of the agency, and the commitment of decision-makers.

Historically, the weakness of CNG is its difficult storage requirements. CNG is stored in high pressure cylinders at pressures up to 3,000 pounds per square inch. The high weight, volume, and cost of the storage tanks for CNG have been a barrier to its commercialization as an alternative fuel. The recent development of lighter aluminum tanks, however, has reduced this disadvantage to some degree.

The advantages of a CNG bus are no visible pollution and quieter operation. The problems encountered with CNG include the inconsistent quality of local CNG supplies, limited range of CNG vehicles, and continued industry concerns regarding reliability.

According to a 1996 Department of Energy report, a CNG bus costs between $35,000 to $50,000 more than a comparable diesel bus. This is due to the higher cost of the engine itself and the higher cost of the fuel tanks. In addition, a CNG refueling facility for EDCTA's fleet would cost between $600,000 and $2,000,000 depending upon the ultimate capacity of the facility (economies of scale might be realized if a fueling facility could be shared with other CNG vehicle users). Also, as there is no natural gas pipeline in the vicinity, this option would require trucking CNG to an EDCTA facility, at very substantial cost. Additional costs would be incurred to upgrade the new maintenance facility (discussed below) with required safety features and to provide emergency response equipment and training.

In a 1996 Department of Energy report, Pierce Transit (Tacoma, Washington) estimated that CNG engines are about 20 percent less efficient than diesel engines on a per gallon equivalency which reduces the range of CNG buses. Typically, buses smaller than 35 feet in length are unable to accommodate enough fuel tanks to operate a full urban cycle service day without refueling.

The issue of reliability is surrounded by diverging viewpoints. In the same 1996 Department of Energy report, Pierce Transit noted no large difference in reliability between CNG- and diesel-powered buses. The main problem they encountered in the beginning of their CNG program was difficulty with the fuel control system – a problem they note has been resolved for the most part by advances in the technology and continued training of maintenance staff. Indeed, CNG technology is still saddled somewhat with the reliability problems that surfaced in the late 1980s when it was still very much in its infancy – especially when dual-fuel technology was still the state-of-the-art. The technology truly has come a long way since then, and reliability is seemingly much better.

However, in a 1999 report the Contra Costa County Transit Authority (CCCTA) noted that engine manufacturers encounter CNG-related warranty claims that are between 50 percent and 250 percent higher than their diesel counterparts. This may be a particular problem for agencies like EDCTA who are not located close to a CNG engine warranty provider. CCCTA also cited experience by BC Transit in British Columbia, Canada. BC Transit started a two year comparison of 25 1996 New Flyer CNG-powered buses and 25 1996 New Flyer diesel-powered buses, all with Detroit Diesel engines. Results for the CNG fleet were as follows: the roadcall rate was 4½ times higher, parts and labor costs were 132 percent higher, and overall maintenance costs were 61 percent higher. CCCTA has chosen to pursue "clean diesel" technology.

Liquefied Natural Gas (LNG)

LNG has only recently received attention as an alternative fuel. The potential advantages of the fuel lie in its economic considerations, where the fuel's processing costs are much less than that of the other gaseous fuels. LNG also has a greater potential to reduce NOx and HC emissions when compared to diesel and gasoline fuels. Currently, the biggest obstacles facing LNG are the lack of availability and its storage and handling facility requirements.

Liquefied Petroleum Gas (LPG)

The advantages and disadvantages of LPG (commonly referred to as propane) are similar to those of natural gas. The advantage of LPG is that gasoline engines can be easily converted, due to its high heating and high octane characteristics. LPG is also well established in its transit fleet applications. According to Alternative Transportation Fuel in the United States (R.F. Webb Corp., June 1989), approximately 350,000 LPG transit vehicles were in operation in the United States. In 1995, the Department of Transportation estimated over 750,000 LPG transit vehicles would be in operation by year 2000.

The disadvantages of the fuel is in the engine performance of transit vehicles using the fuel. According to the above citation, the conversion of a gasoline engine to LPG will usually cause a 10 to 15 percent power loss.

Hybrid Electric

An emerging vehicle propulsion technology that has recently gained national interest are hybrid electric systems. Under this arrangement, battery-powered electric motors drive the wheels; the batteries are charged using a small internal combustion engine (diesel-, gasoline- or alternative-fueled) to power an electric generator. This arrangement provides near-zero emissions, as the engine operates within a very narrow and efficient operating range.

According to a recent report in Metro Magazine[6], operating costs for a hybrid electric system are typically lower in comparison to conventional diesel- or CNG powered arrangements due to greater fuel economy and reduced break wear (the batteries are also charged through regenerative breaking, which tends to slow the vehicle while it recoups energy). In addition, hybrid electric buses provide better acceleration and quieter operation than conventional internal combustion engine propulsion systems. Another benefit of hybrid electric technologies is that it does not require a large infrastructure investment that is required for CNG or LNG technologies. However, the cost of a full-size heavy-duty hybrid electric vehicle is currently between $80,000 and $100,000 greater than a comparable conventionally-powered vehicle. In addition, conventional sealed-gel lead acid battery systems typically last only two to three years, and replacement units cost on the order of $10,000 to $15,000. Better battery technology currently

[6] Pages 84 - 87, January 2003.

exists that could extend battery life (i.e., nickel metal hydride), but this technology currently costs several times that of lead-acid batteries.

Hybrid electric propulsion systems are currently being tested at several large transit programs, most notably at New York City Transit. This agency has been testing 10 pre-production 40-foot hybrid electric buses since 1999, with generally positive results. New York City Transit currently has another 325 Orion VII hybrids on order. Other agencies currently testing hybrid technologies include Sunline Transit in Thousand Palms (California), the Los Angeles County Metropolitan Transportation Authority, the Orange County Transportation Authority, Omnitrans in San Bernardino, TriMet in Portland (Oregon), King County Metro Transit in Seattle, the Southeastern Pennsylvania Transportation Authority in Philadelphia, and New Jersey Transit.

Full electric vehicles and hydrogen-powered buses are two other emerging technologies that are being tested by several transit agencies, although many experts consider these technologies to be on the leading edge of current understanding. Considerable research is still necessary regarding the life cycle costs and benefits of these technologies before they should be considered as viable options for small transit agencies.

Diesel Fuel

Diesel-fueled engines have traditionally dominated the transit vehicle marketplace with their fuel efficiency and durability. From an air quality perspective, diesel engines have very low tailpipe emissions of CO and other organic gases. The concern from an air quality perspective, however, has been the emission rates of NOx and PM.

Due to increasing environmental pressure to reduce the above emissions, the Environmental Protection Agency, working in concert with the American Public Transit Association, has developed stringent NOx and PM regulations. The final Clean Air Amendments permit the use of clean diesel in urban buses, provided that the clean diesel engines meet the PM standards imposed by the CAAA. In partial response to the 1990 CAAA amendments for cleaner burning fuels and the continued development of the previously mentioned alternative fuels, the traditional diesel fuel engine has made great strides toward evolving with a cleaner burning particulate trap and catalytic converter technology.

Since the CAAA imposed regulations, diesel engine manufacturers have been successful in lowering NOx and PM tailpipe emissions by employing in-cylinder control techniques. Similarly important is that manufacturers have maintained the fuel's economy.

Summary

Barring conversion to alternative fuels, a number of steps can be taken to substantially reduce the air quality impacts of diesel-fueled transit buses. Various transit systems have been successful in reducing PM emissions through the application of "clean-diesel" technology. The utilization of a low sulphur fuel has proven to reduce the average annual PM emissions of a transit coach from 935 pounds to 260-300 pounds – roughly a 70 percent reduction. In addition, installation of an electronically-controlled fuel injection system and specially-designed transmission has dropped emission levels by 120 pounds of PM annually, for a total reduction in emissions of 87 percent. This technology is currently in use on EDCTA's fleet of 1997 and newer buses, all of which use either the Ford-Navistar Powerstroke or Cummins B- and C-Series diesel engines.

The California Air Resources Board has determined that the EDCTA buses meet the definition of urban diesel buses. As such, and due in large part to the unavailability of CNG in the area, EDCTA is pursuing the "diesel path" to addressing CARB requirements. The impact on EDCTA is that the fleet will be required to use ultra-low sulphur diesel fuel. As this fuel is not currently available in the Placerville / El Dorado area, this in turn will require that a fueling facility be installed at the EDCTA administration/maintenance facility.

Nonetheless, EDCTA should remain open to the ideas of alternative fuels. However, the agency would have a greater impact on local air quality through the purchase of new diesel equipment with "clean-diesel" standards that meet CARB requirements. To pursue this route, EDCTA would replace the worst-polluting vehicles from the existing fleet as they are due for retirement. If a natural gas infrastructure is implemented and as more research is completed, EDCTA should continue to investigate alternative fuel options.

IMPROVEMENTS TO EDCTA ADMINISTRATION/MAINTENANCE CENTER

As a relatively new facility, the EDCTA Administration/Maintenance Center is relatively well-suited to the needs of the transit system. A review of the various functions, based on the analysis presented in this document, indicates the following:

- ❑ While in the long-run the expansion of services will be accompanied by an appropriate increase in administrative staff positions, there appears to be adequate overall space and flexibility in the administration building to provide office space with only minor changes in interior walls.
- ❑ The existing three maintenance bays should be adequate for the foreseeable future.
- ❑ There appears to be adequate space to accommodate the growth in transit fleet.
- ❑ As discussed above, a fueling facility needs to be installed on-site in order to provide the low-sulphur diesel fuel required by CARB regulations. This facility is estimated to cost on the order of $50,000.

IMPROVED MISSOURI FLAT TRANSFER CENTER

The attractiveness, convenience, and safety provided at transfer centers is a key element in both the public's perception of a transit service as well as the attractiveness of the service to the passengers. Other than the quality of the buses, the transfer center is what both the riding and the non-riding public see and use on a day-in/day-out basis. The quality of the transfer center is particularly important to EDCTA, as the local deviated fixed-route services are operated relatively infrequently (hourly headways are operated on the Hangtown Shuttle; all other services are operated at a lower frequency).

At present, the Prospector Plaza transfer center provides the minimum necessary to be considered adequate, and does little to improve the image of the service in the community or to attract discretionary riders. In addition, buses are often delayed entering and exiting the shopping center parking lot. Finally, this facility does not provide a convenient driver restroom.

To address these deficiencies, one option would be to move the transfer site immediately outside Prospector Plaza along Missouri Flat Road. Another option would be to improve the existing bus stop adjacent to Wal-Mart into a small transfer center.

In recent years, many similar transit systems have improved transfer facilities into extensive (and expensive) staffed off-street transit centers, with capital costs in the range of several million dollars apiece. Regional examples include the transit centers provided by the Redding Area Bus Authority in Redding, as well as the Lodi Grapevine system in Lodi. Because the EDCTA route structure does not provide a high level of transfers at a single central location, and in light of financial realities, an expensive full transit center is not appropriate for the region. However, there are a number of more modest improvements that merit consideration:

- For both passenger convenience and security, adequate lighting should be provided, including lighting within the passenger shelters. While EDCTA does not operate evening services, a substantial proportion of existing riders use the system during hours of darkness during the winter months.

- A driver restroom should be provided. To minimize vandalism and associated costs, this restroom would only be accessible using a key provided to the drivers.

- A modest amount of seating should be provided with both shade and wind protection.

- A payphone and bike rack should also be provided.

A key requirement of the site will be efficient transit travel paths to and from the site for all routes. This effectively requires a traffic signal wherever a left-turn movement onto Missouri Flat Road would be required. In addition, it is beneficial if the site is within convenient walking distance of a major activity center, such as a commercial center.

Optimally, land for this facility can be provided either within existing public right-of-way or by purchase or long-term lease from adjacent property owners. The cost of this facility will be impacted by the potential land cost, utility costs (particularly the need to provide water and sewer), and the possible need to construct a retaining wall along the bottom of the fill slope.

Another potential option would be to move the transfer point between the deviated fixed routes to Placerville Station on Mosquito Road. While this is an attractive facility, moving all of the routes to this location would add roughly 7.8 miles to the length of the El Dorado, Cameron Park / Diamond Springs and CRC routes. To provide equivalent frequency of service on these routes would require the operation of at least one and possibly two additional buses, which would in turn substantially increase EDCTA's operating costs. In light of the existing passenger travel patterns, a transit center in the western portion of Placerville along Missouri Flat Road is instead the economical choice.

A focused study will be needed to identify the optimal site along Missouri Flat Road, focusing on sites near Prospector Plaza and near Wal-Mart. This study should consider land availability, transit ingress and egress, pedestrian access, site amenities, and impacts on operations due to traffic queues from nearby traffic signals and on route running times. The study should also consider the final design for the reconstructed US 50 / Missouri Flat Road interchange. It is estimated that this study will cost on the order of $8,000.

OTHER PASSENGER AMENITIES

The "street furniture" provided by the transit system is a key determinant of the system's attractiveness to both passengers and community residents. In addition, they increase the physical presence of the transit system in the community. Bus benches and shelters can play a large role in improving the overall image of a transit system, and in improving the convenience of transit as a travel mode. More importantly, shelter is vital to those waiting for buses in harsh weather conditions. In addition, passengers could benefit by installing passenger amenities at major bus stops, particularly adjacent to regional shopping centers, medical facilities and social service agency facilities.

Adequate shelters and benches are particularly important in attracting ridership among the non-transit-dependent population – those that have a car available as an alternative to the bus for their trip. Preference should be given to locations with a high proportion of elderly or disabled passengers and areas with a high number of daily boardings. Many regional transit agencies have had benches provided by advertising firms at no cost to the agency. Lighting and safety issues are equally important along major highways. Consideration of evening service should include an analysis of lighting needs at designated bus stops. This could range from overhead street lighting to a low power light to illuminate the passenger waiting area.

The cost of modern glass and steel shelters averages $5,000 to $8,000 (including installation) for most areas, and appropriate transit benches range from $350 for a recycled plastic bench to $550 for a vinyl-clad "stretched" steel bench. Maintenance and repair of vandalism to bus benches and shelter is a very minor cost since they are designed to be very resistant to vandalism. As a result, cleaning and maintenance costs are minor. EDCTA has made great strides over the past five years in implementing additional passenger facilities. A total of seven shelters are currently provided in the local deviated fixed-route service area.

Bicycle/Pedestrian Facilities

At one end of their trip or the other, virtually all transit passengers also travel on foot or on bicycle as part of their transit trip. A key element of a successful transit system, therefore, is a convenient system of sidewalks and bikeways serving the transit stops. EDCTA should continue to work with the planning and public works departments of El Dorado County and the other jurisdictions in the region to review construction plans and schedule priorities for pedestrian and bicycle improvements to best coordinate with transit passengers' needs.

ADVANCED PUBLIC TRANSIT SYSTEM TECHNOLOGIES

Recent advances in communication and communication technologies have impacted all segments of modern society, and have found new applications in the transit industry. These technologies have come to be known as Advanced Public Transportation Systems (APTS). For purposes of the EDCTA environment, there are three promising technologies within the APTS umbrella that have been developed over recent years: Automatic Vehicle Location (AVL) systems, Demand Responsive Dispatching (DRD) capabilities, and Automated Transit Information (ATI) systems.

Automatic Vehicle Location (AVL)

Originally developed in the trucking and package delivery industries, AVL has increasingly found application within transit services. AVL employs in-vehicle transponders and a central geographic mapping system using geopositioning satellites to locate, track and monitor vehicles. The central computer system automatically or manually (by the dispatcher) polls one or more vehicles. The polled vehicle transmits the longitudinal and latitudinal coordinates, time/date and other information if available (such as riders on board, etcetera) back to the central computer. The dispatcher knows the vehicle's location based on triangulation of the signals received from the global positioning satellites. A computer screen in the dispatch office displays a map indicating vehicle location, with an accuracy of plus or minus fifty feet. This map can also display direction of travel, on-time status (a different color for vehicles operating behind schedule, for example), and potentially the number of passengers on board.

Early transit AVL systems relied on electronic "signposts," consisting of monitors placed throughout a transit system that could detect and report to the center computer the passage of a specific vehicle. Between signposts, vehicle location could only be estimated based upon the schedule. This strategy proved to be cumbersome (as route changes would require modifications of the signposts), and not adequate for demand-response services. Later systems attempted to use LORAN-C radio receivers; this system, however, is often susceptible to electromagnetic interference. In recent years, however, the development of relatively low-cost Global Positioning System (GPS) technologies using satellite triangulation to identify location has largely replaced these other technologies.

AVL technologies open up a range of additional services and benefits. The Americans with Disabilities Act requires transit systems to provide voice announcements prior to major transit stops, to allow the visually impaired to more easily use transit services. Drivers, who are often more than busy coping with traffic congestion, find it difficult to consistently provide these announcements. With AVL, vehicle location and direction of travel can be used to trigger a computer processor on a transit vehicle to automatically make a synthesized announcement, and also potentially to display a message inside the vehicle. An important benefit in larger urban systems is the ability for drivers to trigger a silent alarm which automatically dispatches police to a bus. The response time to criminal activity on a bus is greatly reduced. Pre-emption of traffic signals to allow quick passage for transit vehicles is also possible. Tying the GPS system into the traffic signal's computer can trigger an extended green indication for buses approaching a signal. This option could potentially be used for all buses, or be limited to those buses operating behind schedule or those carrying relatively high passenger loads. The ability to identify vehicle location in "real time" is critical to the success of any advanced technology transit service, particularly if demand-response service is to be provided.

Demand Responsive Dispatching (DRD)

DRD technologies uses the computing speed of modern computers to match incoming ride requests with available vehicle capacity to most efficiently assign vehicles to serve passenger requests. This can be a very demanding computing task, as the number of potential combinations of passengers assignments to even a small fleet of vehicles can be extremely large: the computer must assess the time required under each potential assignment within a few seconds, taking into consideration the travel time impacts on passengers already aboard the vehicles, as well as the potential for transfers.

Since the demand is constantly changing with new ride requests and rides being completed, the system must readjust the optimum utilization of the fleet of vehicles continually. How the system knows to assign a ride request to a particular vehicle is based on several factors. These include vehicle location, vehicle load, vehicle destination and caller location and destination. The system may also consider specific needs of the current passengers if the system is programmed to do so. Ride requests can be generated from a number of sources, including phone requests (either using a human operator or through a voice mail system), a "touch pad" at specific transit stops, or specialized touch pads at important trip generators (such as casinos or lodging properties).

A variety of software packages have been developed to allow "real-time" dispatching to varying degrees . With names such as "EasyTrips," "Dispatch-A-Ride," "Rides Unlimited," and "Quick-Route™," many of these systems have been designed for demand response systems for elderly persons and persons with disabilities.

Data is commonly relayed to the driver via radio frequency communications to a liquid crystal display text screen mounted next to the dashboard, commonly called mobile data terminals (MDTs). This data is continually updated to display the driver's next several pickup and delivery points. If MDTs are implemented, EDCTA officials should ensure the existing dispatch program can communicate appropriately with these units.

Automated Transit Information (ATI)

Once AVL and DRD technologies are put in place, it is a relatively straightforward process to automatically provide passengers with "real-time" information regarding transit services. Provided with vehicle location, vehicle travel speed, and the passenger's desired service point, a computer can readily estimate the number of minutes before service is actually provided. This information can be disseminated in a number of ways:

- Automated phone systems can be used to provide information. Transit passengers in the Ottawa, Ontario area, for example, can call Ottawa-Carlton Transit, punch in their bus stop number and desired route, and be provided with the next several service times at their stop.

- Video terminals placed in transit terminals and shopping malls are also used to provide "real time" arrival and departure times in Halifax, Nova Scotia and Broward County, Florida. A similar system is currently installed at various locations around Anaheim, California (including the Anaheim Stadium and the Hilton) providing real-time traffic congestion information. Overseas, real-time information is already widely provided in Stockholm, Sweden, and Osnabruck, Germany.

Potential Applications for EDCTA

A number of factors indicate that the innovations in transit technologies have a high potential for successful application at EDCTA:

- The complexity of the local transit services makes efficient connections between services very important. The availability of AVL would be a great help to dispatchers in directing efficient connections between various EDCTA services. The importance of this information may well grow in the future, as increasing congestion along the transit routes reduces schedule reliability.

- With the aging of the population, demand for demand response services is likely to grow. Implementation of AVL technology into the EDCTA's existing DRD program would be extremely useful in maximizing the efficiency of demand-response services, particularly with regard to service to the more outlying portions of the EDCTA service area.

At present, experience at other similar-sized transit services indicates that EDCTA's current services are near the "critical mass" at which APTS technologies can be cost-effective. As the system grows in response to growth in the community, or as the cost and dependability of these technologies improves, EDCTA should carefully consider an investment in APTS systems as a means of improving service quality while also increasing service effectiveness.