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SCRTD ALTERNATE TRANSIT CORRIDOR
AND SYSTEMS TECHNICAL STUDY:

PREFERENTIAL BUS OPERATIONS ON STREETS AND FREEWAYS

Technical Memorandum on Work Package IA12V2
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The purpose of this memorandum report is to place the concept of "preferential bus operations, and generally expanded bus services, within the context of the SCRTD Technical Study of Alternative Transit Corridors and Systems. It consists of (1) a definition of the many types of preferential bus operations which are possible; (2) a review of the new bus activities of other metropolitan areas; (3) comments on preferential bus operations in the Los Angeles area; and (4) AMV conclusions at this point in the Phase I studies.

OVERVIEW

The comprehensive long-range transit plan for the Los Angeles area, adopted in 1968, contains a mixture of modes and services ranging from local bus service through express bus to rapid transit service. There are many opportunities to develop effective preferential bus operations in Los Angeles, and early action projects are possible.

Any metropolitan area considering rapid transit would include a broad range of modes of transit service, even though rapid transit is often the featured mode in the public eye. Local bus service, with a sprinkling of express bus service, is what most cities like Los Angeles begin with, and the bus element of the future system will be improved even though rapid transit is developed in a major way. There are many types of improved service possibilities. They begin with local bus and work up in quality of service toward rapid transit. Options may include

preferential treatment for buses over other traffic on streets, arterials, and freeways; 100 percent exclusive use of selected lanes by buses on streets, arterials, and freeways; exclusive use of lanes by buses mixed with carpooling automobiles; small rapid transit "people-movers" or PRT's; and interim or permanent commuter rail service.

This concept of a broad mix of services is the essence of the transit Master Plan Concept adopted in 1968. However, transit officials in the Los Angeles area have focused almost exclusively on rail rapid transit in recent years in an effort to start the rapid transit development process. These officials have not excluded development of improved bus services (which could include preferential bus operations) but, as part of the strategy toward obtaining development financing, have put forth rail rapid transit for the most public attention. Little work on a bus improvement program has taken place beyond small-scale, near-future plans.

It is a legitimate public policy question whether short-term, easier-to-implement preferential bus operations might have been or might now be given priority over, or more equal status with, the more costly rapid transit development program. A new attitude from highway officials, problems in solving air pollution, and other factors suggest a new priority for bus improvements.

What is becoming clear in the course of the Phase I work is that the SCRTD has little prospects this year of obtaining funds adequate to finance a major rapid transit program and is having difficulty in financing any rapid transit projects. Under such circumstances, a major bus improvement program may be essential even though work continues, seeking to implement a rapid transit program.

At the same time, preferential bus operations are only one element in a series of low capital cost projects that are available to cities to consider. Others include Dial-A-Bus, commuter rail, more carpooling,

more staggered work hours, restrictions on the movement of cars, elimination of free employee parking, a surcharge on parking charges, and the like. For example, the Phase 1 commuter rail study has shown that several thousand persons would use a moderately low-cost rail service in each of several corridors if the railroad companies were willing to permit the operation on their tracks. The number of riders is not great in terms of regional travel but is a start, and the amount of capital per new rider attracted is relatively favorable compared with rapid transit. If more capital were put into track and signal improvements, the better commuter service would attract more riders. At the same time, preferential bus operation on freeways serving those same corridors might also attract several thousand riders--with capital costs well below those for the lowest commuter rail cost.

DEFINITIONS

Different people in Los Angeles and across the country place different meanings upon several terms used in this memorandum to describe the various types of transit services. The following definitions are aimed at consistent interpretation of the analysis and conclusions described in this paper.

Rapid Transit

First of all, what is "rapid transit"? To most people, the phrase means the same as "rail rapid transit." However, it also includes non-rail rapid transit which operates on a fixed guideway with rubber tires or perhaps a cushion of air. The term also includes "busway rapid transit," which uses conventional or improved buses operating on their own grade-separated roadway. The term "rapid transit" is general in nature and implies a form of transit utilizing its own separate roadway or track unimpeded by other transportation movements.

No rail rapid transit service exists in the Los Angeles area today. The nearest example is the San Francisco Bay Area's BART system now going into service. The San Bernardino Busway is a slightly modified version of busway rapid transit. The new concept called PRT would be a form of rapid transit if it proves technically feasible; this concept is discussed in a separate paper. In view of the busway's rather recent acceptance as a rapid transit mode, a more complete description is included as an attachment to this report.

Preferential Bus Operations

The general subject of "preferential bus operations" includes the terms "priority bus lanes" and "exclusive bus lanes." There is a significant difference between the two latter terms, a difference which applies to streets, arterials, and freeways.

The term "priority" (or quite often the term "preferential" by itself) means less than 100 percent exclusive use by buses of a lane on a street arterial or freeway. "Exclusive" means that all other traffic is excluded from the bus lane, and under some concepts this service would approach busway rapid transit service.[1] The term "reserved" is often used to describe "exclusive," but in the past most cases have not been 100 percent for buses.

Priority treatment for buses may be obtained in several ways. One method is to allow buses to enter freeway ramps ahead of other traffic, especially at those ramps which may be closed or restricted during peak periods. Another example is to give buses priority over other traffic at signalized intersections by allowing them to make special right or left turns or to move through the intersection when traffic on its street would normally be stopped by the traffic signal. Of course, simple devices

[1] Where it is grade-separated, has reasonable access along the route to adjacent neighborhoods, etc.

can markedly improve bus service and reduce bus operating cost subsidies. These might include stronger controls and enforcement of curb parking and loading (which give the bus movement more importance than it previously had), better street surfacing and curb radii, bus passenger loading bays, and the like.

Exclusive bus lanes may be effected on present or future freeways or streets. In Los Angeles (as in most cities), it is doubtful that an existing freeway lane would be given over to exclusive bus operations. Such a decision is politically difficult and often not technically supportable (in the sense of providing maximum travel time benefits to the maximum number of people). It is believed that no American city has yet done this, with the exception of the application of reverse peak direction running (such as on the New Jersey approaches to the Lincoln Tunnel in New York, the Southeast Expressway in Boston, and in the San Francisco area).

If they are shown to be technically desirable, exclusive bus operations may be put into effect on new freeway construction and on existing or future streets in the Los Angeles area. The San Bernardino Busway/Freeway project comes close to having an exclusive bus lane in new freeway construction, though a limited separation exists here between the bus lanes and the regular roadway (permanent rubber cones). Regarding streets, many arterials or local distribution streets are not operating at capacity in the peak period, and it may be possible to match a desired bus travel path with streets having excess capacity.

The terms "saturation bus system" and "grid saturation with buses" have been used in Los Angeles and elsewhere without any firm, agreed-upon definition. They clearly suggest a substantial increase in the number of routes and the quality of service, and they usually mean much more crosstown service and point-to-point express or semi-express routes between residential areas and travel points other than downtown. It is a conceptual description of a level and style of greatly improved bus

service and not unlike the new concept of substitute rapid transit service described as "Personal Rapid Transit" (PRT). PRT, described in a separate paper, is in its pure form a grid pattern of grade-separated (e.g., aerial structure) lines with direct origin-to-destination routing via small "personal" vehicles. PRT probably would offer a much higher level of service, if proved feasible, but at a much higher capital cost than saturation bus service.

RECENT EXAMPLES

There is growing realization that the basic qualities and inherent advantages of transit systems have not been fully exploited and that, with improved application, they could offer much better service than they do at present. New approaches to bus service are important to this change. This section of the memorandum examines current and planned action bus programs aimed at improving public transportation capabilities through application of current and innovative bus technologies. This overview deals primarily with activities outside the Los Angeles area but begins with a discussion of the San Bernardino Busway.

San Bernardino Busway

The San Bernardino Busway offers the highest type of public transportation service in the Los Angeles area. It is built on a restricted highway/railroad right-of-way, which presently imposes certain limitations on the types of bus operations which may be provided on it (in the sense of the ideal "rapid transit" service). The primary limitation is the amount of bus access between the local street system or freeway lanes and the exclusive busway lane in the median strip. Ultimately, this rapid transit facility may be unable to attract the full potential transit market which exists in that corridor because of access limitations. The facility may also have less capacity than the full market potential would require, but this subject is addressed in a separate paper being prepared in

Phase I. The attached busway paper further explains some of the issues in defining and analyzing alternative approaches to busway design and operation.

Shirley Highway, Northern Virginia/Washington, D. C.

This project provides exclusive bus lanes on the Shirley Highway (I-95) in Northern Virginia. The facility was originally a four-lane freeway; reconstruction called for an eight-lane freeway with four lanes each way and two reversible lanes in the median. The 1959 regional plan called for preferential express buses on the widened freeway. Then, in 1964, express bus service was considered for the reversible lanes--although not for the exclusive operation which is being tested at present. This led to the redesign of three interchanges to allow exclusive bus access to the reversible lanes. In 1968, an FHWA-funded ($200,000) feasibility study was begun, entitled "Feasibility Study of Bus Rapid Transit in the Shirley Highway Corridor."

In September 1969, as a result of an interim recommendation of the feasibility study, that portion of I-95 where construction of the reversible lanes had been completed began operation as exclusive bus lanes during the morning peak period. This section covered a distance of 4.8 miles. Time savings approximated 12 to 18 minutes per bus. In March 1970, the feasibility study was completed. It recommended construction of a temporary busway for the remaining 4 miles to Washington. The recommendation was incorporated into two ongoing construction projects; the first portion of temporary bus lane (1.5 miles) was opened in September 1970. At the point where the temporary bus lane begins, a slip ramp was constructed so that an additional 50 buses could gain access to the reserved lane. The remaining portion of the temporary lane was opened to a new Potomac River bridge on April 5, 1971, which provided a total saving of 30 minutes over automobiles.

In addition to construction of the $2.8 million temporary bus lane (funded by the Interstate program), this demonstration project includes UMTA-

funded ($4.6 million) work on three main elements: (1) assistance in developing a critical path to ensure timely changes in bus routing during construction; (2) development of additional bus service; and (3) monitoring of vehicle and person flows to determine public response to the improved transit service. Circulation of buses in downtown Washington, D.C., is being improved to take advantage of the exclusive lane across the new bridge. The project also includes the provision of fringe parking lots and bus shelters. This UMTA-funded demonstration began on June 14, 1971, with the addition of 30 new buses. Additional buses were added--20 buses in February 1972, 10 buses in June 1972, and 16 buses in September 1972.

Since September 1969, ridership has increased from 1,900 to 8,100 passengers (325 percent) during the morning peak period at a survey point midway along the exclusive bus lane. Approximately 30,000 bus passenger trips are made on some portion of the busway during a workday.

During the first week in September 1972, an additional 16 UMTA-funded buses were put into service. The total number of UMTA project buses is now 76. On October 2, 1972, a fringe parking lot for 410 vehicles was opened.

Reverse-Direction Bus Lanes/Freeways

New Jersey. The first major lane of this type was established on I-495 in Northern New Jersey in December 1970. The lane extends 2.5 miles from the New Jersey Turnpike to the Lincoln Tunnel. During morning peak hours, the outbound median lane is made available to inbound buses. Because of differing traffic conditions, no provision has been made for a similar process in the evening. Morning outbound traffic is alerted to the reverse flow by 80 directional signals placed directly over the outbound lanes, by traffic posts placed every 40 feet to designate the reversed lane, and by 50 changeable traffic signs. The project is funded through a $500,000 grant under the Urban Corridor Demonstration Program. In addition, the New Jersey Turnpike Authority provided needed

bus access ramps from the turnpike to the reserved lane at a cost of $134,000. Prior to the opening on December 18, 1970, 30,000 printed notices were distributed to motorists using this particular highway facility to inform them about the reverse-lane operation. Over 800 buses carrying approximately 35,000 commuters (21,000 of them carried in the peak hour) are now saving an average of 15 minutes each by completing the former 25-minute trip in 10 minutes. Thus, it is estimated that an annual savings of 2 million person-hours of commuter travel time will be realized. Data obtained by the New Jersey Department of Transportation show that 82 percent of the people riding through the tunnel during the morning peak hour are now carried by bus.

Boston. A reverse-direction bus lane on the Southeast Expressway in Boston was put into operation in May 1971. The 8.5-mile bus lane was in operation from 7 to 9 a.m. and from 4 to 7 p.m. Two State maintenance crews needed 1 hour and 15 minutes to place cones and change signing for the operation at a cost of $2,700 per week. There were 80 buses using the lane, carrying 3,500 passengers during each peak period. Bus service was increased to handle the increased demand. In the first year of operation, bus passengers increased 14 percent in the morning peak period. Some buses from Providence (Rhode Island), which formerly used the Massachusetts Turnpike as part of their route, used the bus lane. Bus patrons were saving up to 15 minutes in travel time during the morning peak period. The project received favorable press coverage but was discontinued in October 1971 for the winter. Decreasing hours of daylight and snow and ice conditions in the winter months caused concern for the safety of crews setting traffic cones on this unlighted freeway. The exclusive bus lane operation was resumed from April to November 1972 in the morning rush hours only. Deletion of the afternoon operation (time saving of only 5 minutes) was made because of an unfavorable cost-benefit ratio. Service was discontinued again in mid-November 1972 for safety and weather reasons, but this service is expected to be reinstated in April 1973.

San Francisco. A reverse-direction bus lane in the San Francisco area was implemented in September 1972 on Route 101 north of the Golden Gate Bridge. The lane operates in the evening peak period. An 80-20 directional split of traffic permits the closing of two of the four lanes in the non-peak direction without existing traffic being delayed. One closed lane acts as a buffer between opposing directions of travel. Implementation of this same plan in the morning peak period is awaiting completion of a current roadway construction project.

The Golden Gate Bridge District has been providing expanded bus service in this corridor since January 1972. New buses are in use with financing from the UMTA capital grant program. Before the Golden Gate Bridge District started running the bus service to San Francisco, around 4,100 passengers journeyed by bus to work in this corridor. That figure increased 50 percent--to about 6,000--after the new buses were in use for a few months. The number of bus commuters continued to rise and reached 6,700 when the reverse-direction lane was inaugurated in September 1972. As of November 1972, the number of bus commuters was 7,050.

New York. On the Long Island Expressway in New York City, a reverse-direction exclusive bus lane for Manhattan-bound buses was set up on October 26, 1971, in the morning rush hours. Located on the two miles of expressway from the Brooklyn-Queens Expressway to the Queens-Midtown Tunnel, this project is monitored by the New York City Department of Traffic. Over 160 private and Transit Authority buses originating in Queens are directed through a cut in the median barrier onto the special lane. These buses, running at 80 percent capacity and carrying about 6,500 people, are averaging 3.5 minutes on the two miles to the tunnel. Traffic traveling the same distance in the three westbound regular lanes averages 18 minutes. Traffic in the remaining eastbound lanes is not being delayed despite the loss of a lane.

Oakland Bay Bridge, San Francisco, California

An exclusive bypass lane for buses has been provided through the toll plaza of the San Francisco-Oakland Bay Bridge. At the east end of the bridge, nine westbound freeway lanes merge into six lanes in the bridge approach area and, after passing through 16 toll collection lanes, merge again into five lanes across the bridge. One of the toll collection lanes is reserved for buses starting 1,200 feet east of the toll plaza and extending 1,600 feet to the west.

The exclusive bus lane began operation on April 15, 1970, for westbound buses in the morning commuter period. About 500 buses use the facility during the peak three-hour period (approximately 300 during the peak hour). Buses do not stop to pay tolls at each crossing; instead, the bus companies pay a lump sum each month based on the number of scheduled runs. In addition, the toll bridge authority has reduced the tolls for buses from $1.00 to 50¢, resulting in a $110,000 annual saving by the bus companies. Time savings for users of AC Transit buses using the bypass lane have been estimated at 5 to 15 minutes in the morning peak.

In December 1971, this program was extended to include (1) reserved lanes on both sides of the toll plaza, (2) three reserved toll booths, (3) the addition of carpools with three or more occupants to the reserved lanes, and (4) the elimination of tolls for carpools in the reserved lanes. Results of a survey conducted one week after this plan went into effect showed that, in the morning peak period, (1) automobile occupancy increased from 1.33 to 1.45 persons per vehicle; (2) bus ridership was virtually unaffected; and (3) while the number of vehicles did not significantly change, 2,350 more people were carried in them.

In the latest proposal, tolls for buses crossing the bridge will be reduced from 50¢ to 10¢ per round trip. This latest toll reduction--the fourth in six years--will become effective within the next few months.

Another change has been the fare structure for carpools. The existing toll-free fare structure for carpools in the morning peak was changed to a minimum charge of $1.00 per month per carpool. Carpools without the monthly passes may use the special lanes but must pay the normal toll. This change was instituted because of a provision in the original bondholder agreements that no vehicles would cross toll-free.

East-West Transitway, Milwaukee, Wisconsin

A study completed in June 1971 concluded that a bus rapid transit system is most appropriate for I-94 in Milwaukee. The study was an outgrowth of recommendations made in 1963 by the Southeastern Wisconsin Regional Planning Commission. Study costs were shared jointly by the Federal Highway Administration, the Urban Mass Transportation Administration, the Wisconsin Department of Transportation, and Milwaukee County.

The recommended bus rapid transit system, employing turbine-powered buses, will offer fast service to compete with the private automobile. The comfortable new buses, providing adequate seating for all passengers and a speed capability of 70 miles an hour, will travel on freeways with other traffic until they reach the point toward the center of the city where travel speeds on the freeway normally drop due to rush-hour congestion. Here the transit vehicles will move onto their own transitway (a grade-separated bus roadway) for the rest of the trip through the congested area.

The proposed transitway is an eight-mile, two-lane, grade-separated roadway. Within the transitway corridor, transportation planners have forecasted a growth of 100 percent for auto travel and 270 percent for transit travel by 1990. The transitway is expected to cost $40 million. Another $60 million will be required for stations, buses, and parking lots.

PATways, Pittsburgh, Pennsylvania

Two exclusive bus highways (PATways) are planned as part of the Early-Action Program in Pittsburgh. The two facilities will be grade-separated and will total 12 miles in length. Ramps will be provided to permit intermediate trips and line-haul trips to the downtown area. Design and construction of these PATways are being funded by capital grants from UMTA. Pending litigation against the Early-Action Program must be resolved, but implementation of minor aspects of the program is continuing in the interim.

An initial $8.7 million capital grant was made by UMTA to the Port Authority of Allegheny County in June 1970. A $60 million grant followed in August 1971. The grants will assist in the design and construction of PATways and other transit improvement projects in the greater Pittsburgh area.

All riders will benefit from the reliable travel time and shortened trip times resulting from operation on exclusive and grade-separated rights-of-way. Most PATway passengers will have single vehicle service from stops near their homes to stops downtown or otherwise close to their destinations. PATway ramps will not only provide entry at major suburban points, but will also enable certain routes to utilize the PATway for intermediate portions of their journey.

Crosstown Expressway, Chicago, Illinois

FHWA has approved participation with Interstate highway funds in the additional right-of-way and construction costs for a mass transit (highway) facility within a portion of the Crosstown Expressway (I-494). The transit portion of the project will include a two-lane, two-way bus roadway with access only at major interchanges. Sufficient clearance will be allowed at structures for rail transit vehicles should a future conversion to rail transit occur. Preliminary costs for the Crosstown Busway

are estimated at $97 million. Volumes along much of the route will range from 30,000 to 40,000 persons per day, with a peak-hour demand at 15 percent of the daily total.

Reserved Lanes for Buses and Carpools

In 1971, a study jointly funded by OST, FHWA, and UMTA was conducted on an existing freeway in Cleveland to determine the feasibility of reserving one or more lanes for the exclusive use of buses and carpools during normal weekday peak periods. The study concentrated on an investigation of total passenger time expended under various operational conditions. It also included an investigation of such items as mode choice analysis, safety implications, user cost analysis, legislation affecting such a traffic operations scheme, enforcement required, and needed public relations and informational programs. The concept of reserving an urban freeway lane for the exclusive use of buses and carpool vehicles during commuting hours was found to be basically sound. The study determined that reserved lane operation would result in a reduction in the total number of vehicles required to serve a given level of travel demand when sufficient numbers of commuters shift from low- to high-occupancy vehicles and from low-occupancy cars into buses.

The Florida Department of Transportation and the Dade County Metropolitan Transit Authority have jointly submitted a proposal to the FHWA and UMTA for a project involving construction of a lane on I-95 in Miami for use by buses and carpools. Included in the proposal are fringe parking, interim improvements to bus flow on city streets, and express commuter bus service.

Urban Corridor Demonstration Program

The Urban Corridor Demonstration Program is a joint Federal program of the Federal Highway Administration, Urban Mass Transportation Administration, and the Office of the Secretary of Transportation. The

basic purpose of this program is to test and demonstrate the concerted use of available tools, including the use of public transportation, in attacking the problem of peak-hour congestion in urban radial corridors. Eight metropolitan areas have been selected to implement proposed urban corridor demonstration projects. These projects are outlined below.

Cincinnati. This project involves improvements in bus service on arterial routes, through traffic engineering improvements, and bus turnouts. The project calls for a permanent park-and-ride parking lot at the suburban end of the corridor. Other aspects of the project involve increased transit service and park-and-ride spaces in shopping center parking lots obtained at no cost to the project.

Dallas. This project is being coordinated with an ongoing corridor traffic surveillance and control project. The UCDP techniques focus on improving bus service through park-and-ride facilities, increased service frequency and coverage for selected areas, and some limited preferential bus treatments. Arrangements are well under way for the park-and-ride lots at freeway-adjacent locations. The freeway surveillance and control elements are installed and operating on the North Central Freeway, and the local agency is seeking bids on the corridor control system elements. Data collection capability is excellent because of the existing automated surveillance system. Since different transit service is being provided to distinct subareas of the corridor, an excellent opportunity exists to determine the relationship between transit level of service and transit patronage.

Dayton. The major element of the Dayton UCDP plan is an exclusive roadway for buses and carpools along an existing rail right-of-way. Express transit service is planned and incorporated with new collection and distribution systems in the outlying areas and the CBD. The plan represents a major opportunity to test a high-quality bus transit system. However, implementation has not yet begun and is being complicated by

local controversy regarding the busway vis-a-vis other alternative transit improvement concepts.

Louisville. This project can be characterized as a variety of bus operation improvement techniques on existing arterial streets to provide improved service to existing patrons and to attract new ones. In addition, many traffic engineering spot improvements are planned to eliminate bottlenecks and improve the general level of traffic service in the corridor. A special feature of the project to be intensively evaluated is the wrong-way operation of buses on one-way streets.

Minneapolis. This project is unique; it will test concept feasibility of express bus service on a metered freeway (with preferential bus entries at the metered ramps). Significant bus service improvements include express operation and outlying collection-distribution services and facilities. The experiment will be phased to permit evaluation of bus service improvements with and without the freeway ramp metering. The new bus services are partially implemented; the traffic control center is under construction; and the field components of the freeway control system are being installed. Priority metering could be operational as early as Fall 1973.

New York. This project contains more individual improvement concepts than any of the others, but the improvements appear well interrelated to form an integrated program. Included in the demonstration are an exclusive bus lane on I-495, freeway surveillance and control with preferential bus treatment, park-and-ride facilities, improved CBD bus service, an automated bus identification system, road and interchange reconstruction on Route 3, and an intensive transit information and marketing effort. This program presents the opportunity to evaluate the the impact of a comprehensive "package" of improvements. Several individual elements of the program can also be evaluated in detail because of project phasing. For example, the exclusive bus lane was implemented about two years ago, and evaluations have already been conducted.

Philadelphia. This project represents a conglomeration of improvements which are not closely interrelated. Elements of the plan include CBD parking pricing modifications; spot improvements on surface arterials to eliminate bottlenecks; physical improvements in a rail transit lane; renovation of a dilapidated rail transit station; and various improvements in transit shelters, terminals, and parking facilities.

Washington, D.C. This project on the heavily congested South Capitol Street corridor is comprised of a variety of bus operations improvements and traffic operations and roadway improvements to preferentially and generally improve level of service in the corridor. Included will be fringe parking facilities, a public information program, and expanded bus service for the Anacostia area. The existing free fringe parking at the South Capitol Street Bridge will be expanded. New free fringe parking areas will be established near the Indian Head Highway in the vicinity of Palmer Road and at Eastover Shopping Center.

Reserved Lanes on City Streets for Buses

Reserved lanes for transit vehicles on city arterials and surface streets are now in use in a number of areas in the United States and abroad. Usually, the "reservation" permits a limited number of other vehicles in the lane; therefore, there are few cases of 100 percent exclusive use. In essence, reserved transit lanes are used to separate traffic and, through separation, facilitate the movement of all vehicles. Thus, the concept is not merely one of serving transit since, when properly applied, it speeds automobile and other vehicular movement as well. A lane may be reserved during peak hours only or may be kept free of vehicular traffic other than buses during the entire day. Analysis of the experience in several urban areas of reserved lanes on city streets indicates the following general conclusions:

- Reserved transit lanes in most communities have been justified and established only in core areas or

on major traffic arteries immediately adjacent to the core.

- In larger urban cores, at least 30 buses per hour should use the reserved lane in the peak-hour period.
- Transit lanes will not work if there is inadequate capacity in the remaining lanes to accommodate other vehicular traffic.
- Public acceptance and cooperation, together with support by city traffic officials and police, are basic prerequisites for successful reserved transit lane operation.

Most reserved lanes in operation are curb lanes, with buses moving in the direction of traffic flow. However, in some cases, buses move against the main flow of traffic.

The following are examples of reserved lanes on city streets. Baltimore and Dallas have reserved bus lanes in the direction of traffic flow, whereas San Juan and Louisville represent a condition where buses move against the main stream of traffic flow. Houston has exclusive curb lanes on both sides of a two-way street.

Baltimore. Reserved lanes for buses presently are in effect on eight streets over a total distance of 51 blocks. The longest stretch extends 18 blocks, whereas the shortest stretch is three blocks long. The remaining six transit lane areas range in length from four to six blocks.

The criterion for the designation of reserved lanes in Baltimore is based on the following formula established by the Department of Transit and Traffic:

> When the number of transit riders carried in one lane in a particular artery equals the number of occupants in automobiles in an adjoining traffic lane, then the bus (or transit rider) is entitled to the exclusive use of the first lane.

There has been no enforcement directed at penalizing motorists who drive or stop in the reserved lanes, nor have right turns been prohibited. The reserved transit lane areas are prominently posted with signs reading "Buses Only," and the hours of restriction are shown. All buses use the reserved lanes, including express buses in areas where they make local stops. In areas where express buses do not stop, they pull into the second lane from the curb so as not to be delayed by the local buses.

Local transit management has been better able to maintain schedules; however, there has not been sufficient improvement as a result of the reserved lanes to significantly reduce running time.

Dallas. Reserved lanes operate on two principal streets in downtown Dallas. One is on Commerce Street, an eastbound, one-way thoroughfare which is divided into five traffic lanes. The right curb lane is reserved for transit use between 7:00 and 9:00 a.m. and 4:30 and 6:00 p.m. for a distance of nine blocks. Right turns have been eliminated at two intersections within this nine-block distance.

The second transit lane has been established on Elm Street, a one-way westbound thoroughfare which is divided into five traffic lanes. The right curb lane has been reserved solely for transit buses during the same three and one-half hours daily, for a distance of about five blocks. During those hours, right turns are restricted at all intersections.

The Dallas experience has shown that transit lanes are effective in speeding the movement of transit vehicles in the downtown area when kept clear of other traffic, although there has been difficulty in enforcement. Tests made of the "before and after" running time of buses in the transit lane areas indicate an increase in speed during the morning rush hour of from 5 to 10 percent and generally between 10 and 20 percent in the afternoon rush hour. This means an average saving over the affected street segments of about one-half minute in the morning rush

and three-quarters of a minute average running time reduction in the p.m. rush hour period.

San Juan. The first stage of a reverse-direction exclusive bus lane system became effective in San Juan, Puerto Rico, in May 1971. Initially, this system has had apparent success both in improving bus service and in alleviating traffic congestion; it is described here in some detail because of the special interest it has aroused.

This service was part of an immediate-action demonstration program designed to provide a short-term solution to improved operation of the existing public transportation system before a planned fixed-guideway transit system was introduced. Although a draft proposal for federal funding assistance was submitted to the Urban Mass Transportation Administration in March 1971, the local Policy Committee decided to proceed with the experimental exclusive lanes before receiving UMTA support. Public transit patronage had been declining in the San Juan urbanized area, whereas automobile ownership and usage had been increasing --thus placing added burden on the narrow streets and limited highway facilities.

This first phase was established on three major streets in a corridor about four miles long from the old City of San Juan through the central business district and beyond the Hato Rey area. The second stage is expected to extend the exclusive lanes another two miles to the vicinity of the University of Puerto Rico (Rio Piedros).

One curb lane on each of the three streets, moving in the opposite direction to the one-way flow, has been set aside for exclusive use of buses. White and yellow lines are used to delineate the two directions of travel. In addition, several other traffic improvements were necessary (such as modification of the existing traffic pattern, construction of new facilities, changes in garbage collection methods, modification or installation of traffic signals, and changes in bus routes).

Preliminary analysis of the operation, based on 42 days' experience, showed a reduction of over 20 minutes in average travel time over the entire Old San Juan-Rio Piedros route, including the portion which extends beyond the exclusive lanes. This route is scheduled for 55 minutes running time; however, during peak periods, runs on this route had been taking as long as one hour and twenty minutes. Between 1,800 and 2,000 buses move through the demonstration corridor daily.

A survey of results of the first 42 days of operation indicated that revenues increased by $146,000 for the period (or $3,450 per day). Although there was a net decline in the total number of passengers, there was a net increase in the number traveling a longer distance and thus paying the higher (25¢) fare (rather than the 10¢ fare).

Financing of the second phase of this project is now under study. This phase will involve reconstruction of the existing roadway to increase the length of the exclusive bus lanes, purchase new buses, and construct a new bus terminal.

Louisville. Another project of this type was initiated in Louisville, Kentucky, on October 19, 1971. Express bus service here utilizes reverse-direction bus lanes on one-way streets. The rush-hour lanes link the southern part of the city with downtown. The trip on these lanes takes 15 minutes during rush hours--a 25 percent time advantage for the bus rider over other traffic. A free 175-vehicle park-and-ride lot has been opened in conjunction with the bus lanes.

Houston. In October 1971, exclusive curb lanes were created along 3,000 feet on both sides of the main business street in downtown Houston. This is the only two-way street in the large downtown area. It is six lanes wide, and each curb lane is restricted 100 percent to buses from 7 a.m. to 6 p.m. each weekday. No taxis, truck or post office collections, or right-turning vehicles are allowed in this 10-block central section. While the distance is short, it has reduced trip running time by

3 to 5 minutes, depending on the time of day; this reduction is 5 to 10 percent of the total trip time. Service reliability has increased, also. This innovation has proved self-policing, with an initial schedule of 55 buses per hour each direction in the peak period and about 40 buses each way during a mid-day hour. It has been proposed that bus routes which have been using other streets be selectively reassigned to the exclusive lanes. When the City Council authorized this bus lane, it also gave general authority to the traffic engineer to install priority bus lanes elsewhere when he and the transit interests believe such installation to be warranted.

Foreign Experience

Following the American experience with reserved lanes for buses, many European cities have instituted reserved lanes. Several cities in England, France, Germany, Belgium, the Netherlands, and Switzerland have implemented reserved lane plans. In many cases, these lanes run counter to the traffic flow on one-way streets and offset the adverse effect of changes to one-way operation on public transportation when adjustments in routes had caused loss of patronage.

Several cities in the Netherlands have developed unique solutions to problems of congestion at street intersections. In one instance, the bus receives an advance green signal over other traffic so that it may precede other traffic into the next street section. In another situation, buses turn left on a special phase from a right-hand traffic lane in order to avoid cross-traffic lanes on the approach street. In a third case, the stop line for buses in the reserved lane is approximately a yard and a half ahead of other traffic so that buses can merge into the main road more easily.

London. The Greater London Council has reserved lanes for buses on five streets in London and has approved one other. Nine additional sites are in various stages of final investigation, and many others have been suggested as possible suitable locations.

Taxis are permitted to use bus lanes in London, according to the policy of the Greater London Council. However, individual decisions may be made for each location to permit non-London Transport coaches and/or bicycles to use the bus lane where considered appropriate.

A counter-flow lane was implemented on the Tottenham High Road in April 1970. This lane is part of a traffic management plan operating as a Bus Demonstration Project of the Department of Environment. Since part of Tottenham High Road had been converted to one-way traffic flow to alleviate congestion, buses were required to follow a more circuitous route on the southbound portion of the trip. The reserved lane in the reverse direction was implemented to avoid the extra mileage and to keep buses on the existing route, which was felt to provide better access to certain activity centers.

Bus flows vary from 60 to 100 per hour over the length of the reserved lane. Surveys conducted by London Transport indicate time savings of 2 minutes, 24 seconds in the morning peak and 1 minute, 12 seconds in the evening peak over the more circuitous route. Bus occupancy has increased since the reserved lane went into effect; however, some of this increase is attributed to opening of the Victoria Line.

The reserved lane is separated from the three other traffic lanes by a narrow strip so that commercial vehicles may stop to load and unload goods acruss the bus lane for businesses fronting on the lane. Initially, there was some concern for the safety of persons crossing the bus lane for this purpose, but no incidents have occurred from this cause.

The Department of Environment is sponsoring a number of bus demonstration projects in other parts of England as well. These include bus lanes in Darby, Manchester, Reading, Stockton, and Gateshead. Traffic signal preemption is being tested in Southampton. Several of these involve counter-flow lanes on one-way streets to enable buses to retain existing routes. These plans are designed not only to improve bus

reliability but to mesh with current traffic management and control planning. Each experiment is being carefully monitored so that plan effectiveness can be evaluated in terms of improved bus reliability and traffic flow, increased patronage, and better accessibility to town centers.

Urban Traffic Control System/Bus Priority System, Washington, D. C.

A computerized traffic control system is being installed at 112 signalized intersections in downtown Washington. The computer will be supplied with information on the flow of vehicles by electromagnetic sensors. It will also receive information on the presence of buses in the traffic. About 500 buses will be equipped with special transmitters to activate detectors in the pavement at selected intersections. The computer will use this additional information to optimize the flow of persons throughout the controlled network by regulating the timing of traffic signals. The urban traffic control system development is being funded by FHWA, with UMTA funding the bus priority system portion of this research.

The installation of vehicle-loop detectors and bus detectors and the connection of the traffic signal controllers to the central control unit have been completed. Testing of control strategies has begun, and system operation is expected to start in 1973.

Washington was selected as the system site because of its heavy downtown traffic congestion and because of the attention that will be focused on it in the nation's Capital. This project is not designed especially for Washington but is an experiment which will be available to all cities should it succeed there. The objective is to develop a workable system to control traffic signals and give bus priority by digital computer.

NEW HIGHWAY ASSISTANCE FOR TRANSIT

Highway agencies across the country have new attitudes and policies toward bus transit service assistance. There may be even greater changes in the near future as pressure mounts at state and federal legislative levels.

Quite clearly, the California Division of Highways (soon to be the Department of Transportation) is ready to help provide for preferential bus operations and such facilities as park-and-ride lots. The Division of Highways and the Federal Highway Administration are participating in bus (including busway) financing; the San Bernardino Busway is an example of that participation. SCRTD is discussing this matter on city street preferential treatment with the Los Angeles Department of Traffic. The Department has, for example, conducted research on means of giving buses priority over cars at signalized intersections.

Highway agencies generally believe that the most successful freeway bus plan will be one where buses use selected freeways mixed with private vehicles under metered freeway surveillance and control. That is, they see the most feasible plan for preferential or express bus service to be where freeway traffic is controlled so as to maintain free flow in the peak periods (for example, at 50 miles per hour) and thereby increase the speed of all traffic, including any buses assigned to that route. Freeway metering is practiced now on several routes in Los Angeles and is being expanded to others (such as the Golden State Freeway). Buses could then maintain a more reliable schedule and provide faster service. With this type of bus operation, the Division of Highways would no doubt be willing to consider construction of bus stops, transfer facilities, and parking lots along the freeways using highway right-of-way not presently needed or acquiring new land as required. In addition, CDH might well build special bus ramps or bypass lanes on existing ramps for buses if these were shown to be needed.[1]

[1] The Division of Highways is currently implementing a scheme for metering both the Golden State and Hollywood Freeways. They appear willing to entertain proposals for preferential bus operations on these facilities.

The SCRTD will want to consider not only low-cost bus projects such as priority lanes on existing streets, but also those more expensive bus improvements, including transit busways, which might be funded by highways. The Federal Highway Administration encourages and finances the development of bus lanes and separate busways in road construction, and separate bus-only roads on new right-of-way not physically related to highways may be added to the Federal-aid primary and secondary road systems, even though limited to selected vehicles (buses, or perhaps buses and trucks, or buses and carpool automobiles). In this latter instance, Federal highway funds would be received.

DEVELOPMENT IMPACT

One factor which may be important to the various affected parties is the relationship between development patterns (for example, concentrated development compared with dispersed development) and the type of public transportation provided in the Los Angeles area.

The question of concentrated development is one of the more important public policy questions existing in the Los Angeles area today. The following points demonstrate the effect on transit actions of this question.

- If it becomes clear that public policy will <u>discourage</u> concentrated development and <u>encourage</u> greater dispersal, there may be reason to avoid a major rapid transit program and substitute, instead, a major expansion of preferential bus operations to saturate the urban area with service.
- However, if concentrated development is to be <u>encouraged</u>, then a major amount of rapid transit facilities is probably essential to full realization of that policy.
- A limited amount of rapid transit construction (for example, a relatively short section in the Wilshire Corridor) would do little to encourage a policy of concentrated development.

However, the interaction of development and transit is not this simple. For example, consider the following. The Phase I rapid transit search by the consultant team is using future land use information which assumes a continuation of present trends. In most cases, the data do not reflect a substantial change from past and present desires toward either a very high concentration pattern or a much more dispersed development pattern. Certain points of intense concentration--such as the CBD--are reflected in the transit planning assumptions, but these represent much less than the full impact of a series of major concentration points.

In this respect, the transit recommendations which result from the current consultant studies will be based upon conservative estimates of the potential future patronage and needs of the traveling public. The value and benefit of building a major rapid transit program may well be understated from this process, but it is considered the most realistic basis for investing public funds of this magnitude. If rapid transit is built on a large scale, it may create more extensive concentration points than presently assumed in the above land use information, regardless of public policy toward development patterns. The speed with which a complete system is installed will determine the extent to which land patterns will be affected by rapid transit. The greatest impact will not be felt until the major part of a large rapid transit system is committed to construction because most private investors will not risk decisions on the commitment of only one or two legs of the system.

Given the natural and manmade factors existing in Los Angeles, it seems clear that residential development will continue to spread out much as before--whether or not major concentration points occur--and that most people will continue to live in the same housing densities as in the past. At the same time, despite official public development policy, the concentration points for commercial developers may or may not occur, depending on how much rapid transit is provided and what its scheduling will be or depending on how much transit improvement emphasis will be placed on preferential bus operations.

CONCLUSIONS

There are advocates of a total "bus saturation" approach to public transportation who are opposed to dependence on rapid transit as the main basis for creating an improved transit system. It is AMV's opinion that any comprehensive transportation plan for Los Angeles will have large amounts of preferential bus operations, whether or not rail or other forms of rapid transit exist. There are many opportunities for these bus improvements; funding will probably be relatively easy, and full support of the Division of Highways is likely.

However, in mode choice and travel time terms, preferential bus operations cannot match the passenger attractiveness of rapid transit. Fewer people will ride on public transit in the future if Los Angeles relies primarily on bus operations than if it proceeds with a logical rapid transit program that is integrated with a proper mix of preferential bus operations.

Detailed studies would probably show that operating costs of a bus saturation approach to public transit would be less favorable than costs of a comprehensive, integrated rapid transit and bus program. Of course, reliance on preferential bus operations would have a much lower capital cost; only a complete study would show how total costs--that is, annual capital costs plus annual operating costs--would compare.

The essential question--not answered in this memorandum--is, "How much travel does Los Angeles want to attract to transit?" All of the potential from rapid transit? Two-thirds of that amount? One-third?

In any event, the service which preferential bus operations would provide would not attract nearly so many passengers as the comprehensive Master Plan Concept of 1968--at least not until the preferential bus concept was expanded to include a very extensive amount of busway construction. In that case, close adherence to the earlier definitions would mean

that many busways in a preferential bus operation equalled rapid transit; that the region had, in fact, gone to a rapid transit program of some indeterminate value. Of course, if policy specified a large number of busways rather than rail rapid transit, there would then be a need to determine how many reasonably priced busways could be built in the Los Angeles area at a total cost below that of a fixed guideway rapid transit system of the rail type. That determination will be treated in part in the current consultant studies.

RECOMMENDATIONS

Developing some preferential bus operations, including parking lots and other features, appears logical in the near future and should be encouraged. This would provide better service even if it is less than the improvement from rapid transit. It can be provided much sooner and at lower cost. However, in no way should it be considered a substitute for rapid transit. It will be assumed that parallel development of both preferential bus and rapid transit would be best.

However, the most logical and beneficial beginning focus for preferential bus operations should follow from the decision process that concludes Phase I of the current technical study. Findings of Phase I will undoubtedly indicate that, due to financial or related constraints, a start on rapid transit construction is not imminent in some of the high priority corridors. In one or more of these corridors, detailed plans for preferential bus operations should be developed without further delay. While not fulfilling the need for rapid transit, an immediate investment in preferential bus operations will be a low-cost way to provide a meaningful alternative to the automobile for many commuters. In other words, preferential bus operations could be started in those areas which cannot afford to wait much longer for rapid transit.