Revolutionizing Bay Area Transit

...on a Budget

Creating a state-of-the-art rapid bus network

TRANSPORTATION
AND
LAND USE
COALITION

Working together for a sustainable
and socially just Bay Area

The Transportation and Land Use Coalition (formerly BATLUC, the Bay Area Transportation and Land Use Coalition) is a groundbreaking partnership of more than 90 groups working to maintain our region's renowned high quality of life, achieve greater social equity, and protect our natural environment. Coalition members believe that current development patterns do not have to be our destiny. Instead, the region can refocus public investment to serve and revitalize existing developed areas; design livable communities where residents of all ages can walk, bike, or take public transit; provide effective transportation alternatives; and develop affordable, transit-oriented housing that contributes to vibrant and diverse communities.

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Funders

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Executive Summary

The Bay Area faces a growing transportation crisis, including intense traffic congestion and a declining share of trips taken by public transit, bicycle and on foot. In response to this crisis, Bay Area politicians are proposing an estimated $12 billion in new transportation funding sources in the form of sales taxes and bridge toll increases. This massive transportation funding spree will largely lock in the region's investments for the next twenty years or more and determine the mobility and, in part, the growth patterns of the region for the next generation.

Too often, high-profile but exorbitantly expensive projects are treated as the magic bullet in overcoming our transportation woes. Instead, the real solutions to the crisis require making intelligent, effective use of limited transportation funding. What we need is a revolutionary approach to public transit at a price that the region can afford. Fortunately, there is hope.

In the last few years a quiet revolution has begun sweeping through the public transit world. It is driven by new technologies and innovative new practices that allow "rubber-tire" transit to very closely emulate what we love about rail, but at a much lower cost and with significantly greater flexibility.

This public transit revolution falls under the umbrella term of "Bus Rapid Transit" (BRT). BRT offers the speed, style and dignity that it will take to attract a tremendous number of new transit riders, while dramatically improving service for existing passengers.

With BRT, passengers are whisked to their destinations through the use of dedicated lanes and "smart" traffic lights. New transit stations, boarding platforms, and electronic ticketing make boarding quick and easy. And satellite-tracking systems allow transit agencies to efficiently deploy vehicles and provide real-time bus arrival and departure information with digital message boards at bus stops, online, and by phone.

State-of-the-art, low- and zero-emission buses offer smoother, more comfortable travel. One such vehicle, the Civis, uses a computerized optical-guidance system for smoother steering, enabling it to align within centimeters of a boarding platform, and allowing for ultra-fast boarding through four sets of doors.

TALC's proposal, entitled *Revolutionizing Bay Area Transit…on a Budget*, outlines a BRT network that will provide the fastest, lowest-cost way to dramatically improve the speed and quality of public transit in our region. Our vision segments BRT into three categories:

"Full-Scale" BRT on 81 miles of the region's most heavily-traveled and congested urban corridors. Full-Scale BRT utilizes dedicated bus lanes as well as a broad range of improvements and innovations in the BRT toolkit, including state-of-the-art buses and high-quality stations with boarding platforms. Top priorities for full-scale BRT include the Geary and Van Ness corridors in San Francisco and the International/Telegraph Corridor in the East Bay.

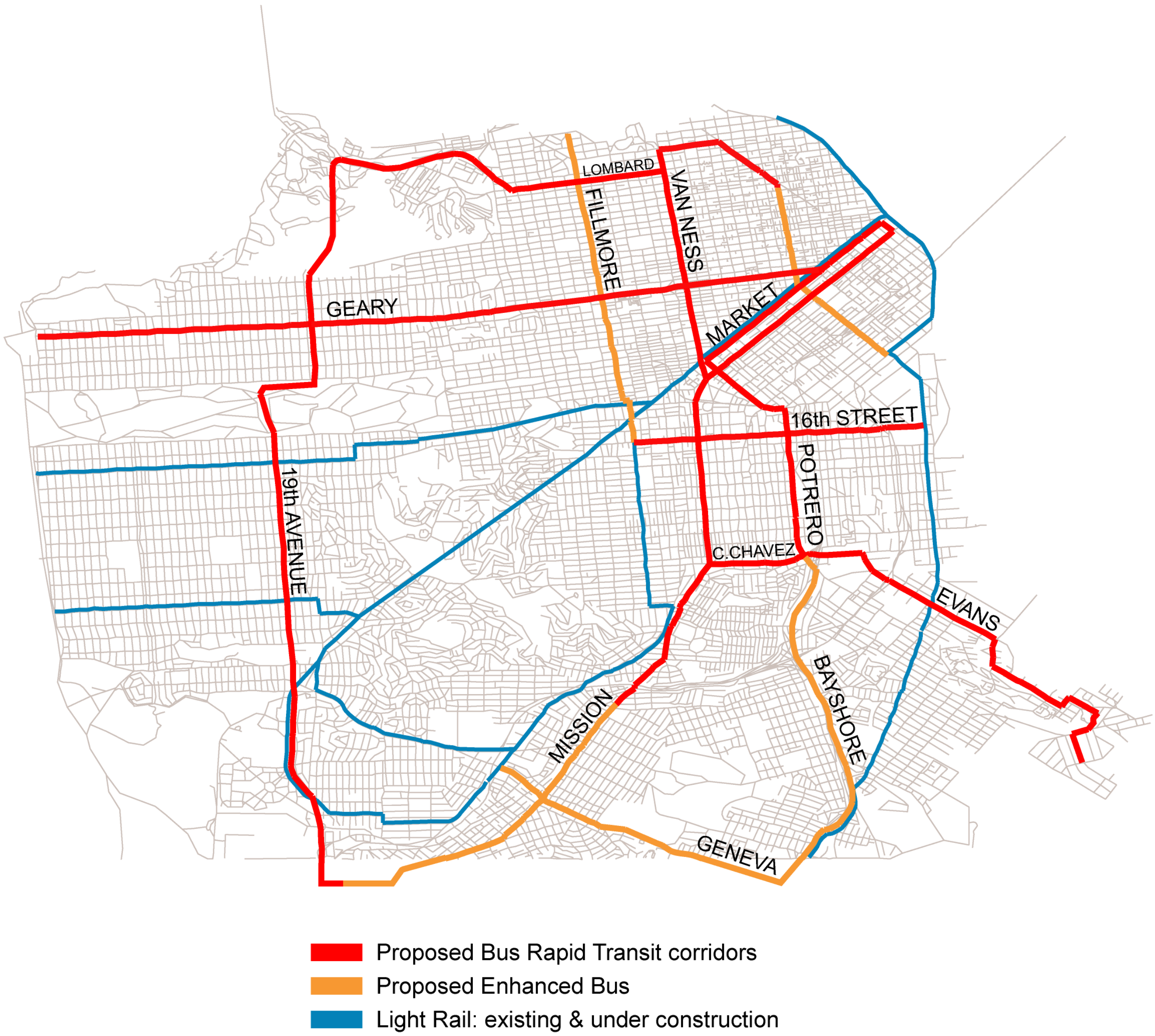
"Enhanced Bus" along 129 miles of urban and suburban corridors. Enhanced Bus applies targeted, cost-effective improvements along corridors where current ridership levels and traffic congestion do not warrant the dedicated lanes of Full-Scale BRT. While not as high-tech, these upgrades – including signal priority, low-floor vehicles, and improved bus stops – would still offer significant time savings in order to attract large numbers of new riders.

An expanded express bus network. Euro-style coaches would utilize the existing 275-mile HOV lane network. This existing infrastructure would be expanded by "optimizing" appropriate existing mixed-flow lanes on key freeways that lack HOV lanes, allowing buses to use shoulders to bypass congestion, and developing strategically located transfer hubs.

The full package of improvements in this proposal would attract a tremendous number of new riders. The authors estimate that the plan would generate at least 60,000,000 new transit trips annually. The benefits would go beyond increased transit ridership, as the proposal would offer great new transit options and opportunities for transit-oriented development, while helping to clean the air we all breathe.

Maps of Proposed BRT, Enhanced Bus, and Express Bus

Proposed San Francisco Corridors

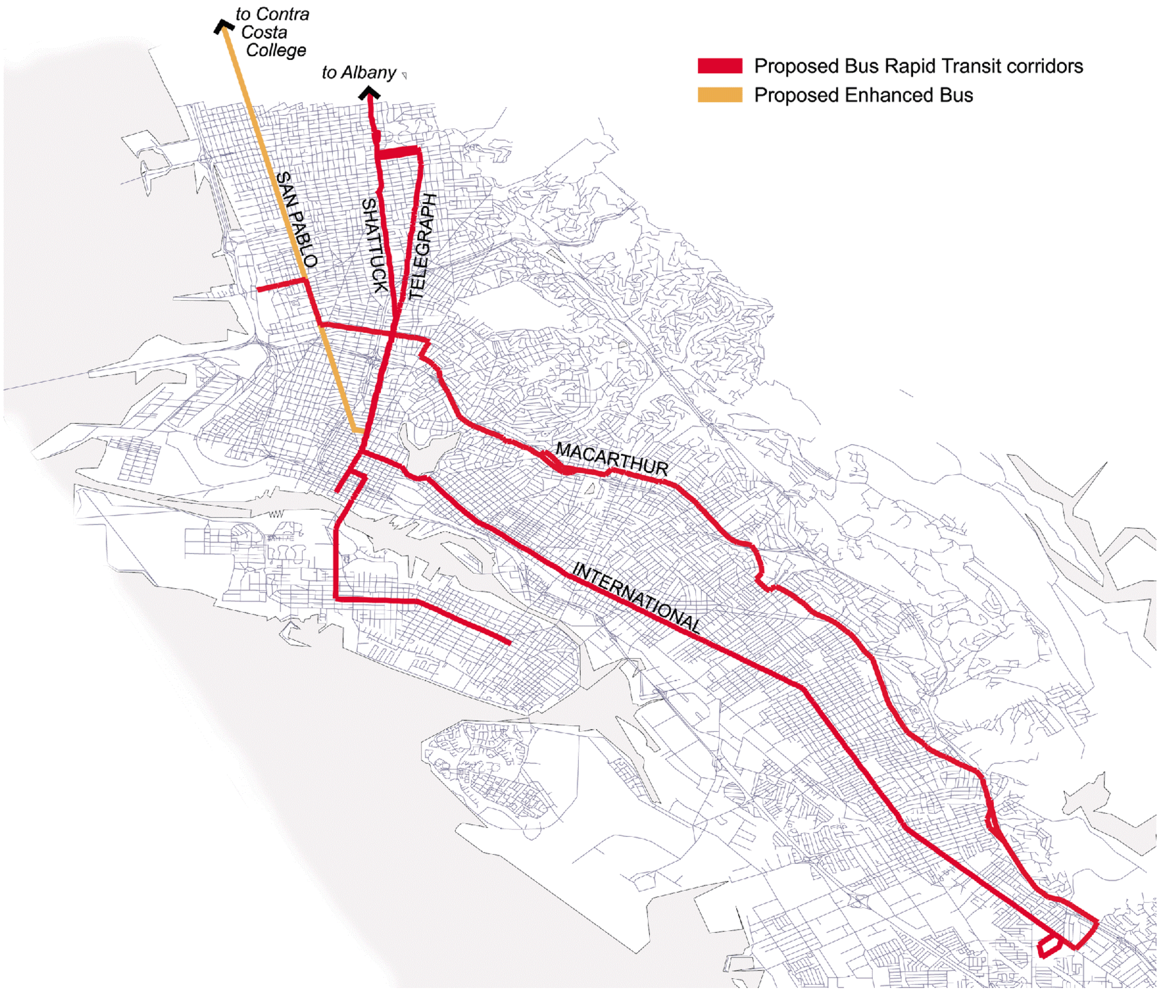


San Francisco Summary

Total BRT Corridors:	35 miles
Total Enhanced Bus:	14 miles
Total capital cost:	between $532 - $823 million

The San Francisco BRT and Enhanced Bus corridors would attract an estimated 59-81,000 new daily riders.

Proposed East Bay Corridors



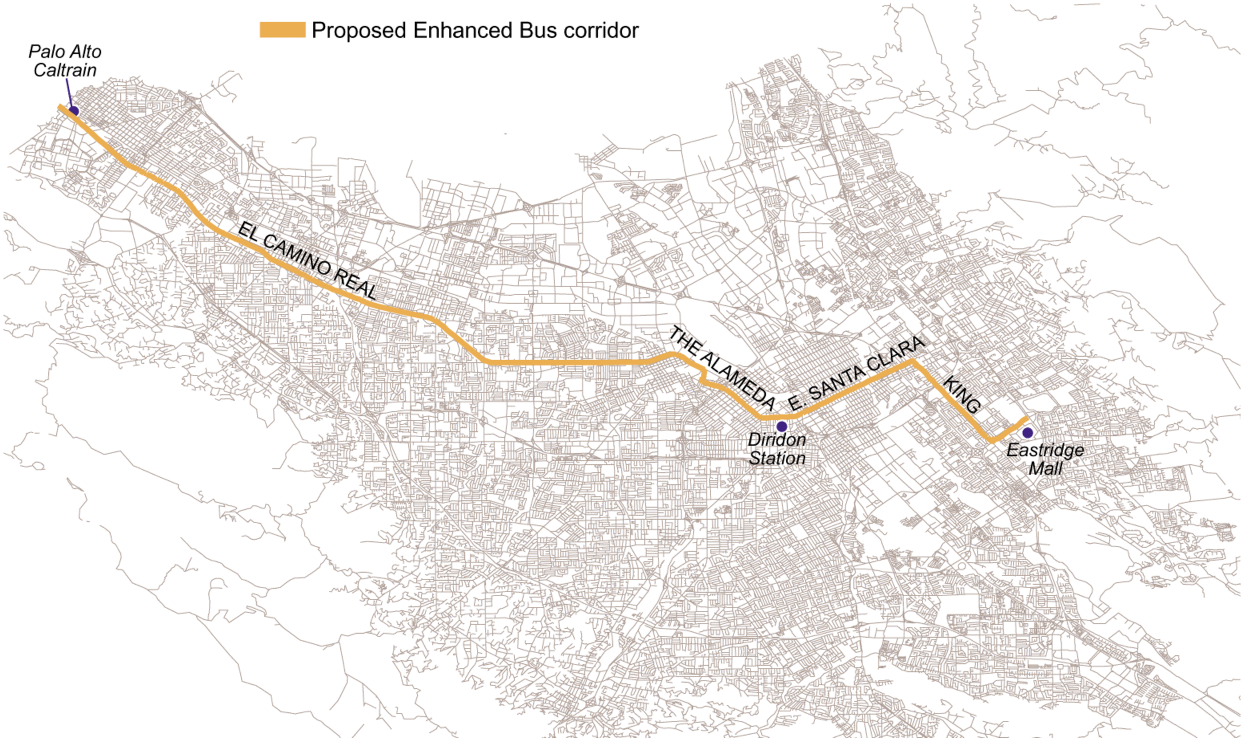
East Bay Summary

Total BRT Corridors: 46 miles
Total Enhanced Bus: 73 miles
Total capital cost: between $921 million - $1.05 billion

The East Bay BRT and Enhanced Bus corridors would attract an estimated 42,000 new daily riders.

Note: Not all Enhanced Bus Corridors are depicted in this map. See chapter 4 for additional East Bay corridors.

Proposed South Bay Corridors



South Bay Summary

Total Enhanced Bus: 42 miles
Total capital cost: $101 million

Note: Not all Enhanced Bus Corridors are depicted in this map. See chapter 4 for additional South Bay corridors.

Proposed Express Bus Network

1.0 Introduction

Pervasive traffic congestion, a declining share of trips taken by public transit, suburban sprawl, urban transit systems in decline, air quality that does not meet federal standards – these and other problems are a direct result of our existing transportation and land use planning framework. And as the number of cars on our roads skyrockets, fewer people risk walking or bicycling for legitimate safety reasons. With people spending hours commuting each day, they have less time for family and community involvement.

These outcomes result from a system that chooses transportation projects based on political popularity rather than effectiveness, and that subsidizes poorly planned sprawl development with billions in taxpayer-funded highway expansions and BART extensions. It comes as no surprise, then, that transportation repeatedly tops the list of concerns in Bay Area public opinion polls.

Why don't people use transit for more trips? Fully 70% of automobile commuters said that taking transit is not possible. Of these commuters, 42% do not use transit because it takes too much time or is not available (figure 1.1).

In response to this worsening crisis, Bay Area politicians are proposing an extraordinary number of new transportation funding sources over the next few years. This massive transportation funding spree will largely lock in the region's investments for the next twenty years, or more (the lifespan of most of these measures). To ensure these investments pay off, something needs to change.

Figure 1.1: Top 5 reasons that taking transit "is not possible"

Takes too much time	24%
No service available	18%
Irregular work hours	13%
Need car during work	13%
Transit unreliable	7%

From Commuter Profiles*, RIDES for Bay Area Commuters, Inc., September 2001*

Luckily, there is a growing clamor – indeed, a movement – to change our existing planning framework. It is time to focus this new funding on urban and regional transit systems that carry far more riders per dollar than previous investments; transit systems that would be faster and available to a greater number of people, and which could reduce automobile travel and demand for more roadways.

This report outlines a vision for urban core transportation in which public transit does not just "compete" with the automobile but in many cases beats it. It outlines a number of ways to restore dignity to urban transit, for it is a lack of dignity that keeps away many "choice" riders. This comprehensive report outlines how $2.5 billion dollars of investment will overcome the top obstacles to gaining transit riders, reducing travel times and creating new service that is affordable and effective – and will generate 200,000 new transit trips per day. TALC and its member groups will work to make these recommendations part of the upcoming expenditure plans.

The Rapid-Bus Revolution

In January 2000, after thirteen months of analysis by Coalition members, TALC published *World Class Transit for the Bay Area*. Its basic focus was to make much better use of our existing infrastructure, including use of 270 miles of HOV lanes as a backbone for a regional express-bus web. *World Class Transit* garnered significant attention and smoothed the way for MTC to model a regional express bus plan, as part of their *Transportation Blueprint for the 21st Century*. In June of 2000, MTC completed its modeling, which confirmed our projections in the report: a basic bus web would carry almost twice as many riders as new rail or highways, could be developed for one-tenth of the cost, and could be implemented in a matter of years, as opposed to the decades required for more massive infrastructure projects.

With this information MTC initiated a regional express bus expansion plan, with the first of 100 buses delivered in September 2002.[1]

But in the two years since the release of *World Class Transit*, a revolution of sorts happened in the public transit world. This revolution was precipitated by the huge cost and the lack of flexibility of rail extension projects and the simultaneous technology breakthroughs that allow “rubber-tire” transit to very closely emulate what we love about rail – but at a much lower cost and with significantly greater flexibility.[2]

Figure 1.2

Irisbus N.A.

The high-tech Civis vehicle is used in France and will soon begin service in Las Vegas.

[1] MTC and Caltrans are also studying another key recommendation of *World Class Transit:* “optimizing” our existing highways by converting a rush hour lane on eight lane highways to a “bus/carpool” lane, or using highway shoulders to let buses bypass bottlenecks.

[2] Upgrading *existing* rail lines such as Caltrain or putting trains on existing tracks such as the Altamont Commuter Express can also be cost-effective. It is really the price of *new* rail extensions that are increasingly difficult to justify.

This revolution falls under the general header of Bus Rapid Transit (BRT), and it is quickly sweeping the nation, as can be seen in chapter 2. The most impressive example of this new approach is the optically guided Civis bus, soon to begin service in Las Vegas (figure 1.2).

Figure 1.3

Irisbus N.A.

The Civis' computer-assisted steering – guided by the white stripes – enables it to align to within inches of a boarding platform for ultra-fast boarding through four sets of doors.

Instead of steel tracks at $10 million or more per mile, the Civis bus is guided by an inexpensive, computerized optical-guidance system that follows white stripes painted on the pavement (figure 1.3). With unprecedented precision, the Civis can align with station platforms, enabling ultra-fast boarding through four sets of doors. This technology also creates a smooth ride that is similar to rail. Besides its quick implementation and flexibility, BRT offers the speed, style and dignity needed to attract a tremendous number of new transit riders.

In addition to this "Full-Scale" dedicated-lane BRT there are other incredibly effective technologies and innovative new practices that enable less expensive "Enhanced Buses" to cut travel times and attract many more passengers. The success of these enhanced buses have often exceeded the expectations and projections of planners. Los Angeles started with an experiment on Ventura and Wilshire boulevards that proved so successful it is now being expanded to an additional 24 bus routes! A case study of the Los Angeles experiment is provided in chapter 3.

Chapter 4 details our recommendations for BRT and Enhanced Bus Corridors in San Francisco, the East Bay, and South Bay, while chapter 7 provides an overview of our proposals for the regional express bus system.

This report also provides a "solutions kit" in chapter 5 that describes in great detail how BRT and express buses overcome obstacles faced by existing bus systems. It also outlines how hybrid-electric vehicles and zero-emission vehicles – which are available now as prototypes – offer passengers quiet rides and cleaner air.

Seizing the Opportunity

In the next few years the public and our elected officials have an opportunity to embrace and fund the promise and innovation of BRT. If we do not, the Bay Area could easily miss out on this transit revolution and a new era of booming transit ridership.

Fortunately, key leaders are starting to seize the opportunity. State Senator Don Perata, who is spearheading a potential bridge toll increase, supports the principle of cost-effectiveness, meaning that BRT and express projects will be strong contenders for funding. Tom Ammiano, President of the San Francisco Board of Supervisors, and José Luis Moscovich, Executive Director of the San Francisco Transportation Authority, are also embracing the promise of BRT. The 2003 reauthorization of San Francisco's transportation sales tax – which is expected to raise about $1.5 billion (in 2002 dollars) – offers an opportunity to garner additional funding for BRT projects. In the East Bay, AC Transit approved the first "full-blown" BRT in the Bay Area – an 18-mile corridor from San Leandro to Berkeley that will closely resemble light rail but at one-third of the cost. This model project remains extremely underfunded and in need of support.

With this report TALC is kicking off a two-year intensive campaign to build support for and fund 210 new miles of BRT in the Bay Area. TALC will coordinate regional and county-level efforts to gain broad public support for these recommendations, to have the specific recommendations incorporated into transportation agencies' long-term planning documents, and, most importantly, to have funding appropriated during these upcoming expenditure plans.

The Bay Area is a unique tapestry of urban and dispersed land use; it demands a dynamic, flexible and cost effective transit system. We have been taking steps towards a better transportation future, but we need to pick up the pace. TALC and our Coalition partners believe that BRT and other solutions outlined here, with implementation times of 2-3 years instead of 1-2 decades, articulate a critical new component for the Bay Area's transportation system.

2.0 The Case for Bus Rapid Transit

The speed and comfort of rail – on a bus budget.

As researchers have found, the public has no preference for trains or buses *if the quality of service is the same*.[3] To this end, Bus Rapid Transit (BRT) reinvents bus service as we know it. BRT provides quick and reliable service and offers passengers greater comfort, convenience, and safety than conventional bus transit – at a lower cost to build than expensive rail lines. Most important, perhaps, a BRT line can be up and running years before a light-rail project carries its first passenger.

2.1 THE BRT RECIPE

Projects classified as BRT have included such components as smart traffic lights in Los Angeles, dedicated bus roads in Pittsburgh, and computer-guided buses in France. The term "BRT" refers to a wide range of improvements that can be made, rather than to a rigid protocol. With this flexibility communities can design BRT systems to serve their unique transportation needs and meet their financial constraints. The "menu" of BRT options includes:[4]

- ***High-Quality Buses***—To achieve a smoother and more comfortable ride, new high-tech buses use innovative designs and technology. These state-of-the-art vehicles are more like trains than buses (figure 2.1). And the use of clean-fuel buses also reduces air and noise pollution.
- ***Differentiated Right-of-Way***—To compete with the speed of automobiles, BRT service is separated from traffic congestion. These differentiated rights-of-way

Figure 2.1

Irisbus N.A.

This high-tech, articulated (extra-long) Civis bus is in use in Rouen, France.

[3] "[T]here is no evident preference for rail travel over bus when quantifiable service characteristics such as travel time and cost are equal, but a bias does arise when rail travel offers a higher quality service…[I]n order to increase ridership to public transit, the service should be designed to have favorable levels of passenger convenience. Whether it is [a] rail system or bus system should not be of great importance." Quote is from Moshe Ben-Akiva (MIT) and Takayuki Morikawa (Nagoya University), "Comparing Ridership Attraction of Rail and Bus", *Transport Policy Journal* (to be published in an upcoming issue).

[4] This list is based on "Issues in Bus Rapid Transit" by the Federal Transit Administration.

include HOV (High Occupancy Vehicle) lanes, dedicated bus-only lanes (figure 2.2), and exclusive grade-separated busways.

- ***Signal Preference at Intersections***—Smart traffic signals give buses priority at intersections and cut the time spent at red lights.
- ***Improved Traffic Management***—Adjustments to the road infrastructure reduce or eliminate delays for BRT systems that lack dedicated lanes. These adjustments include queue-jump lanes, which allow buses to skip past traffic, bus bulbs and boarding islands, which eliminate the need to merge into traffic, and relocating bus stops to the far side of intersections.

Figure 2.2

Bus-only lanes at Orlando's Lymmo BRT.

- ***Faster Passenger Boarding***—Low-floor buses and boarding platforms speed up the boarding process. To save more time, passengers use "smart" fare cards or pay prior to boarding.
- ***Improved Passenger Facilities***—Technology advances enable transit agencies to provide real-time bus arrival and departure information to passengers with electronic signs at bus stops, online, and by phone. Bus stops can provide greater comfort, convenience and security by providing lighting, informational displays to assist with trip planning, shelter, seating, security cameras, and hotline telephones.
- ***Routing Improvements***—Eliminating under-utilized stops on a BRT route can save time and differentiate BRT service from local buses.
- ***Coordination of Land Use Development***—Some BRT systems have spurred transit-oriented development along the corridors. Pedestrian- and transit-supportive streetscapes are also part of some BRT schemes.

While a dedicated-bus-lane BRT system is ideal, it is not always politically or financially feasible. BRT allows transit agencies and communities to embrace components most effective and relevant to their situation. Transit operators and municipalities may choose high-quality buses, traffic signal priority, and improved passenger facilities as a first phase of BRT. This allows them to quickly and inexpensively provide a higher level of service while they plan future improvements. Including minor traffic management improvements in this package will bring significant service improvements without the expense of creating dedicated lanes.

The Bay Area has some BRT elements scattered throughout the region. San Francisco has bus-only lanes – though these are not separated by a median and, unfortunately, are not well enforced. Muni and AC Transit provide real-time arrival and departure information for a couple of bus routes. In the East

Bay, BRT along San Pablo Avenue – featuring signal priority, limited stops, and improved station facilities – is scheduled to open in June 2003.

Although the Bay Area has taken some initial steps to implement BRT, the potential far exceeds on-the-ground accomplishments. (To their credit, AC Transit and Muni are pursuing plans that will result in new BRT corridors, with dedicated lanes, in the next several years. And a number of Bay Area transit agencies already operate successful express bus routes.)

2.2 WHY BRT MAKES DOLLARS AND SENSE

BRT (and express bus) systems build upon the key advantages of traditional bus systems: low costs, quicker implementation, adaptability, and flexibility.

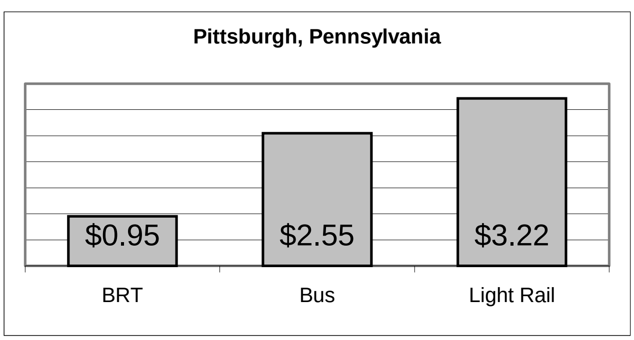
Low Costs

BRT and express bus systems are both low-cost systems, compared to other forms of transit. This is true both for capital costs (purchasing vehicles, building stations, etc.) and operations and maintenance costs (bus driver salaries, etc.).

Low operations and maintenance costs. By reducing travel times (see figure 5.17), BRT gets more use out of existing buses, resulting in lower operational costs per passenger. These costs even compare favorably to light rail. While light rail requires fewer operators per passenger, this only holds when the vehicles are full, or nearly full. During off-peak hours, BRT bus driver/passenger ratios compare favorably to light rail conductor/passenger ratios. Furthermore, light rail requires maintenance of tracks, overhead electric lines, and substations.

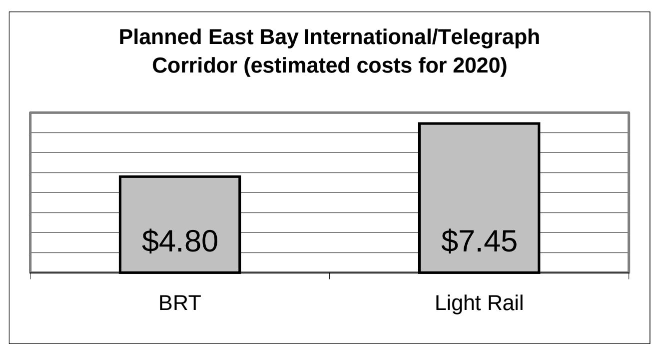
Figure 2.3

Operating and Maintenance Costs per Passenger



In Pittsburgh, Pennsylvania, the BRT system is less expensive to operate than the light rail and regular bus systems.

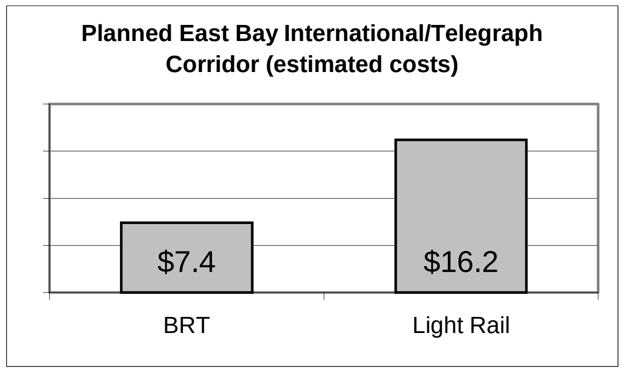
Incremental Lifecycle Cost per Boarding



AC Transit's planned BRT corridor along International/Telegraph would be less expensive to operate than a comparable light rail line, even with transit vehicles operating at five-minute frequencies. (Estimates are based on the year 2020.)

One example of BRT's low operating and maintenance costs is found in Pittsburgh, Pennsylvania, where the city's BRT busways systems are less expensive to operate than regular bus service or light rail service (figure 2.3). In the East Bay cities of Oakland, Berkeley and San Leandro, planners for AC Transit estimate that the planned BRT corridor along Telegraph Avenue and International Boulevard would be less expensive to operate than a comparable light rail line (figure 2.3).

Figure 2.4: Capital Costs per Passenger



AC Transit estimates that a comparable light rail corridor would be over twice as expensive, per passenger, to construct as BRT. (Estimates are for the year 2020.)

Lower capital costs. BRT systems have lower capital costs than other forms of transit, such as rail. This is because BRT systems do not require a specialized and more expensive infrastructure, such as tracks and overhead electrical lines.

A planning study by AC Transit for a BRT corridor along Telegraph and International Boulevard concluded that BRT would cost $350 million compared to a light rail line at $900 million. Even on a per-passenger basis, light rail would be more than twice as expensive as BRT (figure 2.4).

Quicker implementation

BRT and express bus systems can be up and running sooner than other forms of transit.

Consider the Miami-Dade Busway, a BRT project located in Miami-Dade County. After Hurricane Andrew – the costliest disaster in U.S. history – devastated this part of southern Florida, recovery efforts included plans to extend the Metrorail line from the Dadeland South station towards Florida City. However, at an estimated cost of $300 million, the project was rejected and a busway was ultimately built instead, at a cost of $59.9 million.[5] The nine-mile busway project – planning, design, and construction – was completed quickly; it took just over four years.[6] Although it is difficult to know

[5] David R. Fialkoff, P.E. *The South Miami-Dade Busway: A Transit and Highway Joint Project*, (Miami-Dade Transit Agency: 1998)
[6] David R. Fialkoff, MDTA Chief of Service and Mobility Planning. Email correspondence. 10 December 1999.

exactly how long a comparable rail line would take to build, many rail extensions have taken ten to fifteen years to complete.

Compared to BRT, express bus systems are even quicker to implement. Purchasing buses and constructing express bus stations are both quick projects. Likewise, changes in infrastructure usage, such as using shoulders or optimizing a lane, require little time to implement, other than time for legislative changes.

Incremental adaptation

Implementing in stages and upgrading over time is a significant advantage of BRT corridors and express bus systems. If funding is not available to complete a project, it can be completed in future stages. For example, short segments of exclusive BRT lanes can be built incrementally in the most critical locations, with mixed traffic operations along other parts of the route. This is the opposite of light rail, which must be fully constructed before it can be used. In addition to implementation in stages, BRT can be upgraded in phases. For example, it can begin with the quick, cheap and simple option of Enhanced Bus and proceed to more expensive, construction-intensive, or permanent phases.

An example of this is Los Angeles' Metro Rapid system, which began with two Enhanced Bus routes and is being expanded to additional routes, along with Full-Scale BRT on some corridors.

Express buses, like BRT, have the same advantages of incremental and phased implementation. For example, a new route can begin operation on freeway shoulders, the shoulder network can be expanded over time, and shoulder usage can transition to HOV lanes if, and when, they are built. Total travel time is reduced with the addition of each new segment of shoulders or HOV lanes.

The incremental nature of BRT is useful in the longer term if the original vision for the BRT system needs revision.

Flexibility and responsiveness

BRT and express buses allow transit agencies to respond to changing transportation needs in the short-, mid-, and long-term.

Because buses can use existing road infrastructure, in the short term they can be temporarily rerouted in response to construction or roadwork. BRT and express buses can switch lanes and pass each other to avoid accidents and stuck vehicles, and they can skip stops if passenger demand warrants an "express" routing.

BRT and express bus systems can adapt as land use around transit corridors changes over the years. For example, if a new development was built near a BRT or express bus corridor a spur route could be added, which would service the development but still operate primarily in the corridor. This type of direct service is impossible for a rail system to achieve without requiring passengers to transfer to a shuttle bus, or without the construction of an expensive extension.

Figure 2.5

Cambridge Systematics/AC Transit

Artist's conception of AC Transit's planned BRT system for the International/Telegraph Corridor. It is designed to be compatible with future light rail, in case it is warranted in the future.

In the long term, exclusive dedicated lanes or busways can be transitioned into rail (light or heavy) if demand justifies the cost of rail (figure 2.5). During rail construction BRT traffic could be diverted to other parallel roads. (In certain limited cases where there is no acceptable parallel right-of-way, such a conversion to rail would mean shutting down the BRT service entirely, a severe hardship for BRT passengers.)

This sort of long-term conversion is currently being considered in the Washington, D.C. area along a corridor that serves Dulles Airport. One alternative reviewed in the planning process (for the Environmental Impact Statement) involves extending BRT along the corridor and then replacing it, in stages, with an extension of their MetroRail system. The advantage of this approach is that the lower cost and shorter construction period of BRT would allow passengers to begin using the BRT extension years before a MetroRail extension could ever be completed.

2.3 WHERE ARE BRT SYSTEMS?

Figure 2.6

In Brazil, Curitiba's BRT system – with glass boarding tubes and multi-door boarding – has been compared to a "surface subway."

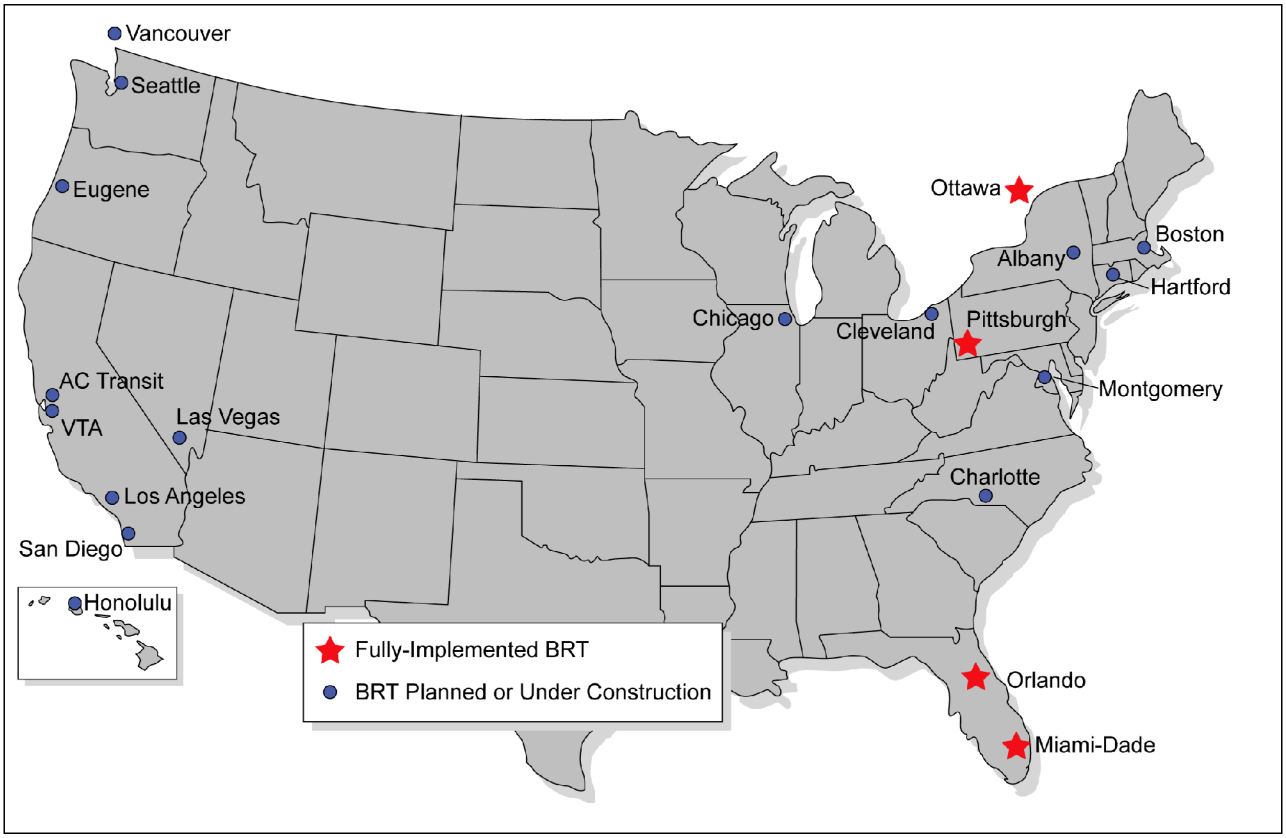
While the concept of BRT is relatively new to the American public, there are excellent examples of BRT in the U.S. and worldwide. Most modern BRT systems are based on the low-cost, high-density model developed in Curitiba, Brazil, in the 1960s (figure 2.6). With its comprehensive bus network, hierarchical system of service, innovative boarding and fare collection system, and integration of supportive land use policies, Curitiba pioneered almost every aspect of modern BRT systems. Today, more than 70% of Curitiba's commute trips are taken on its bus system, despite the high level of car ownership in the city's greater metropolitan area.

Although the planning environments of Curitiba and cities in the U.S. are widely divergent, the "menu of options" approach to BRT development outlined in section 2.1 allows transit agencies and municipalities to emulate the relevant, feasible aspects of systems from North America, South America and Europe. Figures 2.8 and 2.9 detail existing North American BRT systems, as well as BRT systems that are planned or partially implemented.

As is apparent in figure 2.7, there is a fair amount of interest in BRT in California. In Southern California, San Diego is exploring BRT and Express Bus service (which they have dubbed "flex-trolley" and "flex-train" respectively) as an alternative to expensive and less-effective light-rail extensions. In the Bay Area, the Metropolitan Transportation Commission (MTC) has made BRT and express bus programs eligible to receive funds as part of its long-term regional transit expansion policy. Furthermore, AC Transit has recently chosen "full-scale" BRT (with dedicated lanes) over light rail for the International Boulevard/Telegraph Avenue Corridor, and Muni in San Francisco has made BRT an integral part of its long-range vision.[7] These pursuits of BRT in California are discussed in chapters 3 and 4.

[7] See "A Vision for Rapid Transit in San Francisco," San Francisco Municipal Railway, February 2002.

Figure 2.7



Cities with existing BRT systems, as well as cities in the process of planning or implementing BRT

The North American interest in BRT may have stemmed from observations of the success in Curitiba and other North American cities, but it has been supported by city and county-wide initiatives. The Federal Transit Administration sponsored its BRT Demonstration Project in 1998 after recognizing that cities wanted transit system options other than rail construction (which is prohibitively expensive unless there is sufficient housing and employment density around stations) and traditional buses (which often are not able to provide desired levels of quality and service). This program provided federal matching funds for exploration of Curitiba-like bus systems in ten demonstration projects (including the Valley Transportation Authority's Route 22 line in Santa Clara county) and six participating projects (including AC Transit's San Pablo Corridor in Alameda and Contra Costa counties, and Los Angeles' Metro Rapid system).

Figure 2.8: Existing BRT systems

City	Agency	Program Name	Where	Right-of-Way	Signal Preference	Traffic Management	Boarding	Passenger Amenities
Miami-Dade, FL	Miami-Dade Transit Agency	South Miami-Dade Busway	currently 8 mile busway with 15 stops, upgrading to 19 mile system	exclusive busway in a former rail right-of-way	priority	stations at far side of intersections		large shelters with route maps, schedules, telephones
Orlando, FL	Central Florida Regional Transportation Authority	Lymmo	2.3 mile downtown circulator	exclusive lanes	pre-emption with special bus signals	AVL management	free fare	large shelters at bus stops, route information, real-time passenger info. (NextBus)
Ottawa, Canada	Ottawa-Carleton Regional Transit Commission	Ottawa Transitway	full transitway network	exclusive busway with acceleration/deceleration lanes, dedicated lanes on streets		bus bulbs (part of "fast-acting" lanes)	onboard fare collection, transfers and passes are "proof of payment" and make up 70% of ridership	stations have heating, video displays of bus departure times, transit information, hotline phones
Pittsburgh, PA	Port Authority of Allegheny County	East/South/West Busways	West Busway: 5 miles (2000), East Busway: 6.8 miles (1983), South Busway: 4.3 miles (1977)	West: exclusive busway, HOV lane; East and South: exclusive busway				stations along busways

AVL/AVM: Automatic Vehicle Location, Automatic Vehicle Monitoring

Data in both tables is from websites of the Federal Transit Administration and the agencies listed.

Figure 2.9: BRT systems that are planned or partially implemented

City	Agency	Program Name	Where	Bus Features	Right-of-Way	Signal Preference	Traffic Management	Boarding	Passenger Amenities	Other	What stage?
Albany, NY	Capital District Transportation	Best Bus Program	16 mile route from Albany to Schenectady	low floor	existing streets	priority	AVL dispatch, congestion/incident detection, loading bays, queue jumpers	smart card	electronic info display	zoning changes promoting TOD	Construction completed 12/2001
Boston, MA	Mass. Bay Transportation Authority	The Silver Line	A: Dudley station to downtown, B: South Station to Airport, C: Tunnel connection between downtown and South Station	low floor, clean fuel	dedicated lane in places	priority when late	some underground stations		real time AVL, intercom assistance, sheltered/underground stations		First phase of A opened July 2002. B: by December 2003. C: by 2010.
Charlotte, NC	Charlotte DOT	Independence Corridor BRT	I: 2.6 miles along Independence Blvd. on HOV lane, II: 3.6 mile busway, III: Explore 13.5 mile corridor	low floor, AVL with automated voice	exclusive bus lanes (converted from HOV)		queue jumpers	smart card			I: Completed 12/98, II: 2004
Chicago, IL	Chicago Transit Authority	Neighborhood Express Bus Route System	6 express routes, focusing on 18 mile Western Ave	low floor, clean fuel	dedicated lanes	priority	AVL and system control	faster fare collection	improved traveler information		Western Corridor completed 2000
Cleveland, OH	Greater Cleveland Reg. Transit Authority	Euclid Corridor Transportation Project	7.5 miles, 2 downtown transit centers, downtown transit zone	diesel-electric buses, doors on both sides	5 miles of exclusive bus lane	priority		faster fare collection	climate-controlled waiting area	encourage private investment along transit corridors	Completed 2006
Dulles Corridor, VA	Virginia Dept. of Rail and Public Transportation	Dulles Corridor BRT	22 mile Dulles Corridor I: Express Bus, II: Enhanced Express Bus, III: BRT, IVA: Rail and BRT, IVB: Rail and Feeder Bus		exclusive lanes in median					extensive high-density land development, easy to convert to rail	I: July 99, II: 2001, III: 2003, IVA: 2006, IVB: 2010

City	Agency	Program Name	Where	Bus Features	Right-of-Way	Signal Preference	Traffic Management	Boarding	Passenger Amenities	Other	What stage?
East Bay, CA	AC Transit	Rapid Bus Program	16 mile San Pablo Corridor	low floor, three doors	existing streets		bus bulbs, turnouts	smart card	AVL/AVM info at kiosks		Will open in June 2003
East Bay, CA	AC Transit		18 mile Telegraph Avenue Corridor	low floor, other features likely	dedicated lanes	priority		prepaid platform			In planning
Eugene, OR	Lane Transit District	Pilot East-West Corridor BRT	I: 10 miles from Springfield to Eugene, II: 4 miles in Eugene	possibly Civis bus, or similar	exclusive bus lanes, guided busways	priority	queue jumpers	proof-of-payment	real-time passenger info.		Environmental studies completed in 2001
Hartford, CT	Connecticut DOT	Hartford-New Britain Busway	9 miles, 12 stations, extended "express bus" service	mix of standard and articulated	busway along railroad ROW	priority		considering proof-of-payment, platforms	real-time passenger info., enclosed shelters	system of neighborhood connectors and feeders	Operations to begin mid-2003
Honolulu, HI	City and County of Honolulu Dept. of Transportation Services	CityExpress!	CityExpress!: 12.6 miles initially, plus 2 more expansions, CountyExpress!: between Waianae Coast to Alapai Transit Center	considering electric low-floor buses	freeway HOV lanes, streets. Exploring exclusive median lanes	priority for "limited stop" buses	possible queue jumpers	possible smart card	real-time passenger info. (NextBus)		CityExpress! 1999, CountyExpress! May 2000. Complete in 2010.
Las Vegas, NV	Nevada Dept. of Transportation		Las Vegas Blvd North	Civis buses(hybrid-electric)	exclusive bus lane	green light extension	boarding islands, curb realignments	possible smart card	bus shelters, enclosed bus stations		Civis buses will be deployed in December 2003
Los Angeles, CA	LA County MTA and LA DOT	Metro Rapid	I: Wilshire and Ventura routes, II: 24 additional corridors	low floor, CNG	streets, one busway in Phase II	priority	Metro stops separate from local stops	off-vehicle fare collection	real time passenger info.	headway-based schedules (unique for MTA)	Phase I opened in March 2000. Phase II underway.
Montgomery County, MD	Montgomery County Dept. of Public Works and Trans.	Veirs Mill Road Bus Priority Project	6 miles on major arterial		rerouting on uncongested parallel streets; shoulders	early green	queue jumpers, computer-aided dispatch	working toward smart card	enlarged shelters with real time passenger info.		development
San Diego, CA	Metropolitan Transportation Development Board			low floor, large doors, smooth ride	HOV lanes, possibly dedicated lanes/busway	priority		prepaid		van shuttles from homes to transit stations	in planning
Santa Clara County, CA	VTA	Line 22 Rapid Transit Corridor	27 miles along "Line 22" connecting 6 cities	low floor, articulated		priority	queue jumpers, bus bulbs	prepayment (ticket machines)			
Seattle, WA	Sound Transit	ST Express	network of 18 new routes that connect urban centers. Linked to LRT, commuter trains, and existing bus	low floor, reclining seats, overhead racks, reading lights	HOV lanes, other "priority" lanes				operates 24/7, coordinated multi-modal transfers		1996: Sound Move Plan, 1999: began operation, 2006: full implementation
Vancouver, Canada	Greater Vancouver Transportation Authority	B-Line Rapid Bus	11 mile route, 14 stops. Connects CBD with University of BC and Skytrain. Planning another corridor from Vancouver to Richmond City Centre	low floor, articulated, on-board automatic stop announcements	bus lanes (peak period, peak direction)	priority when late	queue jumpers	proof-of-payment	unified marketing/image, real-time passenger info. (NextBus)		first line opened September 1996, another in 2000. Two more planned

3.0 Case Study: *Learning from Los Angeles' Metro Rapid*

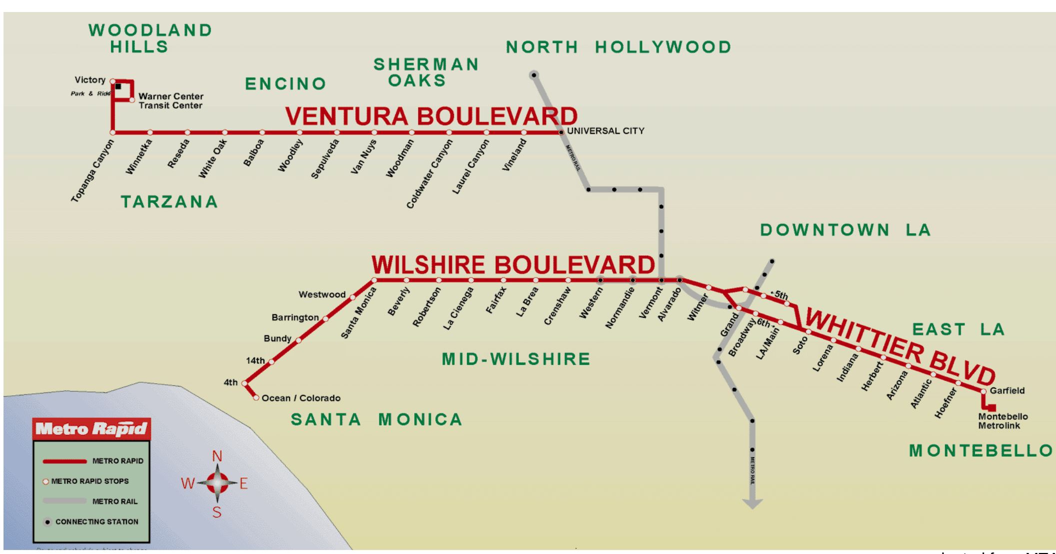
The highly successful implementation of the first phase of Los Angeles' Metro Rapid system is an illustrative BRT case study for the Bay Area. This chapter describes the Metro Rapid system and details the success it has earned in its first few years of operation.

L.A. Metro Rapid: Phase One

The Metro Rapid bus demonstration project was created in 1998 through a partnership of Los Angeles' Metropolitan Transportation Authority (MTA) and the Los Angeles Department of Transportation (LADOT). Conceived as a way to extend the Metro subway system, Metro Rapid was envisioned to eventually become a system that would reach throughout the Los Angeles metropolitan area. Its creators recognized the importance of testing the relatively new technology employed by this BRT system, and consequently decided to design and construct the Metro Rapid system in distinct phases. This would give the public an immediate improvement in service followed by a steady stream of incremental improvements and expansions.

Phase I upgraded the 26-mile Wilshire-Whittier Boulevard Corridor and the 16-mile Ventura Boulevard Corridor, as shown in figure 3.1. Aside from the station upgrades, these rapid bus improvements were up and running in nine months, with the full implementation of Phase I achieved in June of 2000.

Figure 3.1



adapted from MTA

Map of the two Metro Rapid BRT routes (shown in red): Wilshire/Whittier and Ventura.

As described earlier in this report, one of the main benefits of BRT is its flexibility in solving the problems common to traditional bus systems. The strategies that Los Angeles pursued from the BRT menu of options capitalized on this advantage, picking and choosing improvements that could be most effectively implemented in their particular environment.

To differentiate this improved bus service from the existing local service along the transit corridors, the Metro Rapid buses and bus stations were both redesigned. The buses were new low-floor CNG-powered vehicles with a distinctive red and white design (figure 3.2). A matching color scheme was translated into the station design, shown in figure 3.3.

Figure 3.2

MTA

Metro Rapid buses are low-floor and CNG-powered, and have a distinctive design.

Figure 3.3

MTA

Metro Rapid stations are bright, airy and well-lit at night.

The Metro Rapid bus stations are not the grungy benches that dominate so many traditional bus stops. These new stations are truly designed for the heavy passenger movement and frequent, rapid service that characterize BRT – consequently, there are no benches at all. Instead, the stations offer bright, airy shelters with excellent lighting and overhead protection from the elements without the usual visual barriers. There is very little opportunity for graffiti or vandalism, and the cost of maintaining the shelters is covered by advertising revenues generated by the sale of space on Metro Rapid kiosk signs (figure 3.4), which display important information about the bus route. Additionally, an electronic sign in the station displays real-time predictions of when the next bus will arrive. The overall Metro Rapid station design complements a variety of sidewalk widths and streetscapes, while still providing the customer with a smooth transition (both physically and visually)

Figure 3.4

MTA

Metro Rapid kiosks display route information.

between the station and the bus itself.

The stations are distinguished from the local and limited bus lines not only by design, but also by placement. They do not replace existing bus stops, but were erected on new sites. Metro Rapid stations are spaced further apart than the existing bus stops, but with no more than one mile between stations. Along the 26-mile Wilshire-Whittier Corridor, 32 Metro Rapid stations were constructed, and along the 16-mile Ventura Corridor, there were 15 built. The broader spacing was expected to raise concerns with riders, but the overall response to this change has been positive, since the decrease in the number of stops along the route shortens the Metro Rapid's travel time along the corridor. Passengers are also given free transfers to local service, if the more widely-separated Metro Rapid stations do not put them close enough to their destination.

An effort was also made to construct these new stations on the far side of intersections. Traditional buses tend to use the near side of intersections, so that passenger loading and unloading can take place while the bus is waiting at a red light. The signal prioritization system that was installed has meant that buses rarely need to stop for a traffic light, so placing the stops on the far side of the intersection is actually more efficient.

Los Angeles chose to engineer its own signal prioritization system for Metro Rapid. Each vehicle is equipped with a transponder, which is tracked by a series of loop detectors installed under the pavement along the Metro Rapid corridors. The information from the loop detectors is transmitted to a central control center, which can then track how fast each bus is traveling and how far away it is from a leading or lagging bus. Based on this information, traffic signals can be instructed to hold a green light for up to ten seconds, or to change a red light up to ten seconds early.

It was relatively inexpensive to build this type of signal prioritization scheme, since the traffic signals along these corridors were already “smart” signals that have the capability of adjusting their signal patterns according to information sent to them from a central control center. It was simply a matter of altering the signals to assure that every signalized intersection (216 in total) gave priority to the Metro Rapid vehicles. In places where “smart” traffic signals are not already installed, it would be more expensive to implement such a system.

Overall, the Metro Rapid system has been successful at reducing bus delay at traffic signals, with minimal impact on cross traffic along the corridor. It also eliminated the need for other more expensive BRT options such as bus bulbs and queue-jump lanes because buses already received priority through signalization.

The same information that guides the signal prioritization process is also used to maintain the time between arriving buses. The Metro Rapid system does not publish timetables, since the bus frequencies are supposed to be high enough that customers would not need to use them anyways. With this method of operation, it is important that buses arrive regularly and that there is no “bunching” of buses. Currently, peak-hour travel has resulted in buses that arrive every two minutes or so, but there is still a demand for more frequent and more reliable service by some customers.

The coordination of Metro Rapid with land use planning is a BRT principle that has not yet been fully embraced in Los Angeles. The City's general plan intends to focus future growth around transit station areas, and the Transportation Element of the plan includes a number of transit-priority streets. However, this has not directly been coordinated with Phase I of the Metro Rapid transit corridor.

Metro Rapid: A Success Story

Metro Rapid capital improvements in the two corridors cost just $8.2 million[8], in addition to the ninety low-floor buses that were purchased out of regular bus replacement funds. These capital costs were split almost evenly between the construction of new transit stations (at a price of $4.0 million, or an average of $60,000 per station) and the signal prioritization upgrades (which cost approximately $20,000 per intersection). The Los Angeles area was fortunate to already have modern traffic signals, a centralized control center, and "loop detectors" in the road, and these costs will be higher in those parts of the Bay Area that need to upgrade their traffic control systems. (Such upgrades could run as high as $1 million per mile, which is still very low compared to the per-mile costs of BART and light rail systems.)

In short, the low cost of construction and the short time it took to make the Metro Rapid plan a reality must be seen as a success. For perspective, the same $8.2 million that built 42 miles of transit infrastructure for Metro Rapid would have bought a mere 251 feet of the BART extension to SFO (in total an 8.7-mile, $1.5 billion project).

Figure 3.5: The success of Metro Rapid[9]

	Initial Phase	Second Phase
Cost per mile	$195,000	$310,000
Total cost	$8.2 million	$110.5 million
Ridership increase	40% *between June 2000 - summer 2002*	
Scope of system	2 lines, 42 miles	24 lines, 356 miles
Completion time	9 months	5 years (by 2008)

Despite its low capital costs, the MTA and its riders are now reaping the rewards from rapid bus improvements that were made to the corridors, with a reduction in travel time and an increase in ridership. Before Metro Rapid, the average MTA bus speeds had declined by 13% since the early 1980s. The new Metro Rapid, however, operates on average 25% faster than traditional

[8] Operating and capital cost: www.fta.dot.gov/brt/lamrdp/occ.html
[9] From MTA's *Scoop*, September 2002, www.mta.net/press/stakeholders/scoop.htm

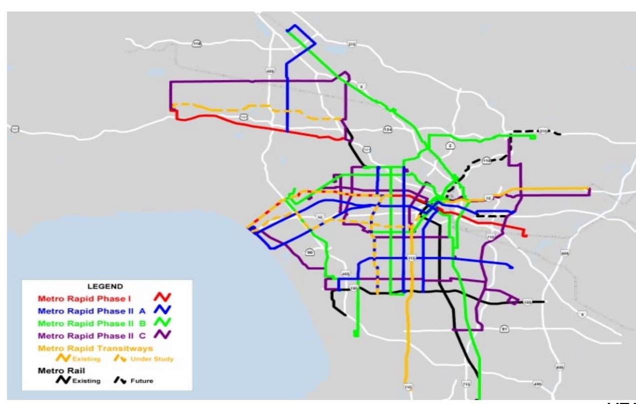
MTA bus service, achieving average speeds of between 14 and 30 mph. It is interesting to note that the bus system of Curitiba, Brazil (the most celebrated example of BRT) averages 13.8 mph. The time saved by Metro Rapid is due in part to the signal prioritization system (accounting for an estimated one-third of the total time savings) and in part to its improved operational efficiency and its reduction in the number of stops along the corridor.

The number of passengers traveling by bus along the two transit corridors increased significantly because of the new Metro Rapid bus system and its link to the newly-opened Metro subway system—the 25% reduction in travel time resulted in a 25% ridership increase after the first ninety days of service. After more buses were added to the corridors, patronage continued to increase. As of February 2002, MTA had measured an overall 42% increase in ridership along the Wilshire-Whittier Corridor and a 38% increase in ridership along the Ventura Corridor.[10] The Wilshire Corridor carried nearly 70,000 daily bus passengers prior to the inception of Metro Rapid service, so the increase in ridership caused by Metro Rapid may not be such a surprise. However, the Ventura Corridor carried fewer than 11,000 daily bus passengers prior to Metro Rapid, and yet it still achieved nearly the same percentage increase in ridership as the Wilshire Corridor. Thus, Metro Rapid adds further proof that BRT can attract significant numbers of new passengers, something that is usually only associated with expensive new rail projects.

Looking to the future: what will LA do next?

The immediate success of Metro Rapid's Phase I program has catalyzed plans to expand the network, as part of Phase II. Over the next five years, an additional 24 Metro Rapid corridors will be created (figure 3.6), further reducing rapid bus travel times on surface streets and potentially benefiting over 500,000 daily riders. The MTA has an ambitious timeline and plans to open two new corridors every six months, with the first two additions scheduled to open in December 2002.

Figure 3.6



MTA

Over the next five years, MTA will be expanding Metro Rapid to 24 additional corridors, increasing the network to nearly 400 miles.

[10] Rex Gephart, Metro Rapid Program Manager, presentation at Alameda County Congestion Management Agency, February 8, 2002.

The MTA also plans to introduce prepaid boarding and exclusive right-of-way in at least one corridor and is considering introducing high capacity, low-floor articulated buses, and boarding and alighting through multiple doors.

There are also distant plans for a Metro Rapid Phase III that would include exclusive rights-of-way along key transit corridors, including the Exposition Boulevard and the Burbank-Chandler corridors, along with the Wilshire-Whittier Corridor that was included in Phase I.

Lessons for a Rapid Bus System in the Bay Area

There are at least three important lessons that can be gleaned from the start of the Metro Rapid system in Los Angeles:

- **Providing better service, even along a bus line, *can* increase ridership.** Metro Rapid was designed to be faster, cleaner, and easier to use than the local buses running along the same corridors, and the traveling public took notice.
- **Providing better service *can* be implemented inexpensively.** Metro Rapid increased transit ridership in the Wilshire-Whittier Corridor by building a rapid bus system for a fraction of what light or heavy rail would have cost. The transit service improvements did not have to be drastic to draw new riders, they just had to provide a similar experience.
- **Incremental adaptation *can* provide immediate results and allow new technology to be tested.** Metro Rapid was able to deliver better service to its customers within nine months, which resulted in an immediate improvement in the public perception of bus service, and increased support for additional Metro Rapid projects and improvements.

These lessons have already been taken to heart in parts of the Bay Area. In the East Bay, AC Transit has already implemented several of the Metro Rapid improvements on its own San Pablo Corridor in the East Bay. The 72 and 72L currently employ low-floor articulated buses that are decorated with a unique color scheme (different from the rest of AC Transit's fleet). Buses with an even more state-of-the-art design will arrive for testing in October of 2002. AC Transit also plans to redesign bus stop locations in a manner similar to Metro Rapid's spacing, and will hopefully achieve similar travel time reductions. The full project is scheduled to begin operation in July 2003.

Both AC Transit and San Francisco's Muni are working with the local information technology firm NextBus to provide online and onsite information technology to allow transit passengers to track the arrivals and departures of buses all along transit corridors. This would also allow the buses to achieve better operational efficiency, something that has contributed to Metro Rapid's remarkable time savings.

Despite these movements in the right direction, transit agencies in the Bay Area have not fully capitalized on the potential of BRT. The next chapter presents recommendations for how a truly comprehensive advanced bus system could be built in the Bay Area.

4.0 A Vision for the Bay Area: *BRT and Enhanced Bus Recommendations*

In this chapter we turn our focus to the nine-county Bay Area and take a closer look at how and where new BRT and Enhanced Bus service could best be implemented.

Our vision calls for Full-Scale BRT along heavily-traveled non-freeway corridors and Enhanced Bus along moderate-volume non-freeway corridors. Additionally, chapter 7 details our recommendations for express bus service.

Full-Scale BRT

Full-scale BRT employs a full range of service and infrastructure upgrades. The common denominator on these proposed Full-Scale BRT projects is that they would utilize exclusive lanes (i.e. lanes restricted to BRT vehicles), except in certain limited areas where physical constraints, such as limited street width, would make such lanes impossible. Full-Scale BRT routes would operate at least as frequently as BART. Our cost estimates include sufficient vehicles to provide service every five minutes (every two minutes along Geary), and service could be operated 24 hours a day.

Enhanced Bus

Enhanced Bus would implement some of the lower-cost BRT options on corridors where lower ridership or road conditions (such as narrow road width) do not warrant implementing Full-Scale BRT in the near future. Enhanced Bus would be a major upgrade over traditional bus service. It would be most analogous to Los Angeles' Metro Rapid system which, using signal priority, low-floor vehicles, and improved stations and route configuration, cut travel times by 25% and increased ridership by 40% in just two years. Enhanced Bus would include some of the Full-Scale BRT features – without exclusive lanes – with an emphasis on signal priority, vehicle tracking systems, and improved stations. Enhanced Bus service would operate as frequently as Full-Scale BRT (every five minutes) in San Francisco and every 7.5 to 15 minutes in the East Bay and South Bay.

A 210-Mile Full-Scale BRT and Enhanced Bus Network

There are hundreds of transit corridors in the Bay Area. While it would be ideal to turn all of these into BRT corridors, doing so is financially infeasible. Thus, it is important to determine which corridors would be most likely to succeed as BRT and to prioritize them for upgrades.

We believe that those most likely to succeed are high-ridership corridors that pass through areas of high residential and employment densities with a significant number of destinations along the corridor.

TALC identified 22 corridors as priorities for Full-Scale BRT and Enhanced Bus upgrades. The corridors – in San Francisco, the East Bay, and South Bay – are described on the following pages. Eighteen major bus routes that currently traverse these corridors carry over 375,000 daily riders – approximately 30% of all daily transit trips in the entire Bay Area!

It is important to note that the 22 corridors identified in this report should be considered a first phase. There are likely other corridors – with slightly lower ridership than the ones selected, or which travel through slightly less-dense areas – that deserve to become Full-Scale BRT or Enhanced Bus corridors. However, like Los Angeles – which had great success with two Enhanced Bus routes, and is now planning nearly 360 additional miles of Enhanced Bus routes – corridors in the Bay Area with lower ridership could be upgraded to Enhanced Bus or Full-Scale BRT as part of a future phase.

The result of TALC's analysis is a proposal for a 210-mile BRT and Enhanced Bus network. It would be comprised of 81 miles of Full-Scale BRT and 129 miles of Enhanced Bus improvements. The details of each corridor are described in the following pages, and are depicted in the maps beginning on page 3.

Figure 4.1

Las Vegas Review-Journal

High-tech vehicles, such as the Civis pictured above, would be implemented onFull-Scale BRT Corridors.

The characteristics of the BRT and Enhanced Bus improvements are described in chapter 5. However, it is worth noting that the cost estimates for each of the corridors includes the purchase of sufficient vehicles to allow for five-minute headways along BRT corridors and between 7.5 minutes and 15 minutes on Enhanced Bus corridors in the East Bay and South Bay.

Costs and Ridership

We estimate that the capital cost of implementing the 210 miles of Full-Scale BRT and Enhanced Bus improvements proposed in this report would range between \$1.6 and \$2 billion. (See Appendix I for additional cost information.) The corridors would attract an enormous number of new riders, generating as many as 122,000 new daily transit trips in San Francisco and the East Bay.

The operating costs for these BRT projects are complex to calculate, as they involve knowing the current and future vehicle speeds, the time saved from faster boarding times and other parameters. Compared to traditional bus service, BRT would likely cost more to operate. However, it is quite likely that the *net* operating cost (operating costs less revenues from passenger fares) could decrease. Faster travel times allow the same number of buses and drivers to make more trips per day, thereby carrying a greater number of passengers, increasing revenues from passenger fares and thus decreasing overall costs. (For further information and examples, see “Schedule improvements” on page 69.)

4.1 SAN FRANCISCO RECOMMENDATIONS

In February 2002, Muni released its report *A Vision for Rapid Transit in San Francisco.* Muni’s report contains recommendations for a mix of BRT, “Transit Preferential Treatments” (which we call Enhanced Bus), and light rail on corridors throughout the city. The report recommends that on three corridors BRT would be the final phase, on three others it would be an intermediate phase succeeded by light rail, and on an additional three corridors light rail is proposed in lieu of BRT.

In contrast, our guiding principle is that rapid transit service should be implemented as broadly as possible, and as soon as possible, so as to serve the greatest number of people. Given light rail’s steep cost, each mile that is constructed depletes funding that could otherwise be used to create at least 2-3 miles of Full-Scale BRT or 15+ miles of Enhanced Bus. Therefore, we recommend that Full-Scale BRT and Enhanced Bus be first implemented on all nine of our recommended corridors. Once the BRT/Enhanced Bus network is in place, a conversion to light rail might be justified if future analysis shows that cost and ridership projections warrant such an upgrade. In these corridors, bus improvements could be designed to be as compatible as possible with future light rail service to minimize transition costs.

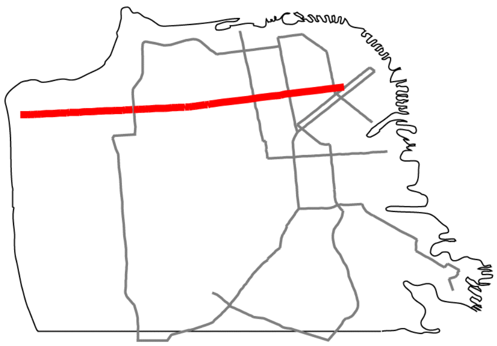
By first implementing BRT improvements on all of the recommended corridors the greatest number of passengers will benefit from rapid transit service.

It is important to note that Full-Scale BRT and Enhanced Bus would not replace existing local bus service, as there would still be passengers who would need the closely-spaced stops that local buses make. Los Angeles’ Metro Rapid bus service is an instructive example. There, the new service has been extremely popular and many passengers switched from local buses to the Metro Rapid vehicles. Local service in the corridor has been maintained for those who need it.

Several of the dedicated lanes that are recommended for San Francisco would also benefit other agencies’ bus routes, namely SamTrans and Golden Gate Transit. (For example, SamTrans uses Mission Street and Golden Gate Transit uses Lombard and Van Ness.) Of course, the corridors could also be used by any Muni buses that travel along even a portion of a given corridor.

TALC's Proposed San Francisco Corridors

Proposed Corridors		Capital Cost *$millions*	New Daily Riders *in 2020*
Tier 1	Geary	92-156	12,000-22,300
	Van Ness	29-47	4,200
Tier 2	Market	27-42	2,600
	Mission	82-123	12,000-14,100
	Lombard/Bay /Columbus/Stockton/4th	57-87	10,500-11,800
	Potrero/Bayshore/Geneva	50-66	6,100
	Evans/Cesar Chavez	58-91	3,200-7,100
	19th Avenue	96-153	3,700-7,400
	Fillmore/16th Street	40-57	5,100
	San Francisco Total	$532M - $823M	59,400-80,700

GEARY BRT CORRIDOR	Existing Corridor Service
 **Corridor length:** 6.1 miles **Cost:** $92-156 million **New Daily Riders:** 12,000-22,300 *See Appendix I for detailed information.*	• Lines 38/38X, 38L-Geary 46,906 Average Daily Riders • Line 1-California 28,794 Average Daily Riders • Line 2-Clement 6,865 Average Daily Riders • Line 4-Sutter 4,716 Average Daily Riders

TALC has identified Geary Boulevard as a top priority BRT corridor in San Francisco, and one of the top priorities in the Bay Area, given its high volume of passengers and low per-passenger cost.

The 38 and 38L-Geary lines are the most heavily traveled in the Muni system with nearly 47,000 riders per weekday. The 1-California, 2-Clement and 4-Sutter carry an additional 40,000 riders in the Geary Corridor. Improvements along Geary Boulevard that significantly increase the corridor's capacity would attract many new riders.

Our cost estimates of $92-156 million include sufficient vehicles to allow for 2-minute headways (i.e. buses would stop at a given station every two minutes), as opposed to five-minute headways on the other San Francisco corridors that we have proposed.

Some physical improvements have already been made along parts of the Geary Corridor, such as exclusive bus lanes along part of the route. However, lack of enforcement has allowed vehicles to double-park, obstructing the bus lanes and slowing transit. Physically separating the BRT lanes with a curb or barrier is one element that would physically deter private vehicles from obstructing public transit. Adequate street space exists west of Van Ness for these improvements.

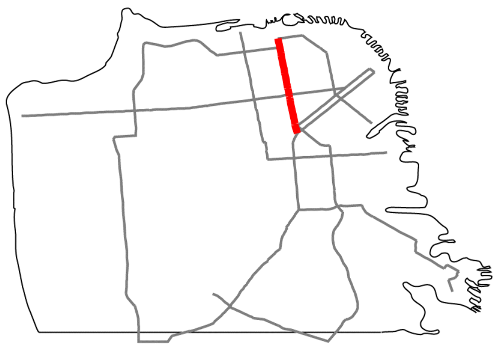
Currently, Geary is one-way between Market Street and Van Ness, which means that east-bound buses are required to divert onto O'Farrell Street. One option would be to consolidate BRT operation on Geary. The benefits would be a potentially lower capital cost (construction along one street instead of two) and less confusion for passengers unfamiliar with the system. However, putting in dedicated BRT lanes would entail the elimination of one parking lane or one travel lane, which would likely generate community opposition.

In parts of the Western Addition and Laurel Heights, the center travel lanes dip below street level, allowing vehicles to bypass certain intersections; the outer lanes remain at street level. Many of these “underpasses” are three lanes wide in each direction, and one lane could be converted to a dedicated BRT lane. However, some stretches are two lanes in each direction and traffic volume is heavy. In these areas the alternatives are either to operate BRT at street level without a dedicated lane or to widen the underpass at great expense. Further study would be needed to determine if the latter alternative is warranted.

In the Richmond District, segments of Geary Boulevard are two lanes in each direction with diagonal parking along the sides of the street. One potential way to add dedicated BRT lanes here would be to convert diagonal parking to parallel parking. Although this would mean fewer parking spaces, it would add enough right-of-way for a dedicated lane, as currently the right-hand travel lane is very wide.

For the near future, BRT in the Geary Corridor could achieve many of the benefits of running Muni Metro under and along Geary, but at a far lower cost and with a much shorter timeline. Ultimately, Geary is the top candidate for a new light rail line, but this should only be done once BRT is implemented throughout the city.

VAN NESS BRT CORRIDOR



Corridor length: 2.2 miles
Cost: $29-47 million
New Daily Riders: 4,200

See Appendix I for detailed information.

Existing Corridor Service

- Line 47-Van Ness
  6,753 Average Daily Riders
- Line 49-Van Ness/Mission
  9,740* Average Daily Riders

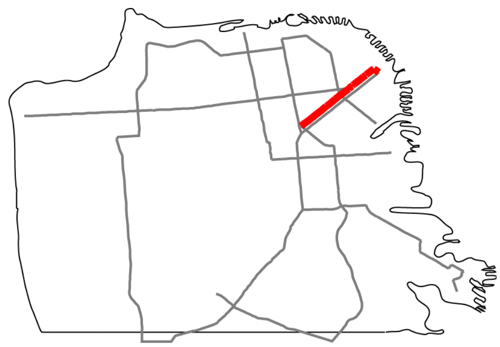
** Total daily ridership for line 49 is 19,480. We have allocated half of it to the Van Ness Corridor, and half to the Mission Corridor.*

The Van Ness Avenue Corridor borders offices, government buildings and high-density housing. In addition to Muni bus lines, the street is also used by Golden Gate Transit buses that head south from Marin and Sonoma counties.

TALC has identified Van Ness – along with Geary – as a top-priority BRT project. BRT on Van Ness Avenue would entail a relatively low per-passenger cost on a corridor that often suffers from significant traffic congestion.

A primary north-south corridor, Van Ness has enough right-of-way for exclusive BRT lanes between Fort Mason and Mission Street. BRT lanes adjacent to mixed-flow lanes could be introduced along the edges or along the existing center median. Caltrans has final say over reconfiguration of Van Ness as the thoroughfare is designated a state highway. However, community groups, voters, and elected officials who understand the benefits of BRT can encourage Caltrans to approve BRT plans for Van Ness.

MARKET STREET BRT CORRIDOR



Corridor length: 2.0 miles
Cost: $27-42 million
New Daily Riders: 2,600

See Appendix I for detailed information.

Existing Corridor Service

- Numerous bus routes travel on Market Street, including the 2, 5, 6, 7, 9, 21, 26, 31, 38/38L, 66, and 71/71L.
- We estimate that approximately 10,000 daily bus trips are made which begin and end on Market Street.

Over a quarter of all Muni weekday riders travel on a portion of Market Street. The corridor serves high-density downtown employment destinations, the Transbay and Ferry terminals, shopping and entertainment destinations, as well as housing – all within walking distance of Market Street.

We have listed Market Street at the top of our “Tier Two” San Francisco BRT project list because it would cut travel times for a huge number of passengers – not just the 10,000 we cite as the primary ridership, but riders on all of the lines listed in the chart above.

Market Street currently has boarding islands for routes that travel in the middle of the street and bus bulbs for routes in the side lane. Nevertheless, auto congestion causes delays for existing transit routes. One option that has been suggested is to close Market Street to automobile traffic in the most delay-prone portion (such as between 5th and Embarcadero). This would allow for unrestricted transit and bicycle travel, but would be difficult to achieve politically. If Market Street were designated as transit-only then the parallel stretch of Mission Street would not need a dedicated BRT lane, as all transit vehicles on Mission could be permanently rerouted to Market.

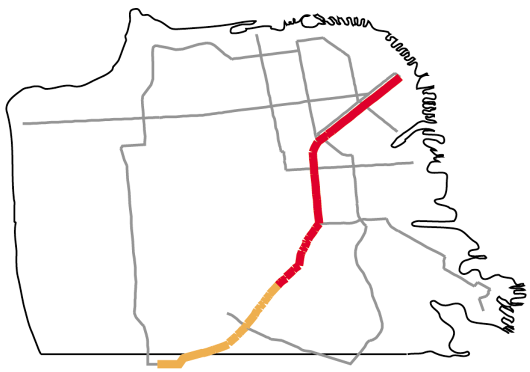
Without designating portions of Market as transit-only there are few remaining alternatives for dedicated lanes. The center lanes could be designated as transit-only – however BRT vehicles would be unable to pass slower-moving F-line trolley cars which already travel in this lane. In other words, transit vehicles would start delaying each other under this scenario.

The San Francisco County Transportation Authority has undertaken a Market Street Study – between the Ferry Building and Octavia Street – that should be completed in early 2003. The study’s primary goals are to reduce transit travel time and increase reliability, and to improve safety for pedestrians and bicyclists.

The study will investigate a number of short- and mid-term solutions. The vehicle and transit projects being studied include: creating exclusive transit lanes, employing new bus boarding arrangements, prioritizing transit at traffic signals, instituting a proof-of-payment system on buses, increasing parking enforcement, and re-striping traffic lanes.

The Market Street Study's recommendations should be carefully considered, as they will offer a potential plan to increase the street's ability to carry a greater number of people quickly and safely to their destinations.

MISSION
BRT/ENHANCED BUS CORRIDOR



Corridor length: 8.3 miles
Cost: $82-123 million
New Daily Riders: 12,000-14,100

See Appendix I for detailed information.

Existing Corridor Service

- Line 14/14L-Mission
  43,362 Average Daily Riders
- Line 49-Van Ness/Mission
  9,740 Average Daily Riders
- Line 26-Valencia
  6,287 Average Daily Riders
- Line 67-Bernal Heights
  3,269 Average Daily Riders

** Total daily ridership for line 49 is 19,480. We have allocated half of it to the Van Ness Corridor, and half to the Mission Corridor.*

The 14/14L-Mission line, with 43,000 riders, has the second highest ridership for any individual bus line in the Muni system.

The Mission Corridor serves neighborhoods with a high percentage of low-income and transit-dependent people. It is for this reason, in particular, that we have put this project towards the top of the “Tier Two” list of San Francisco projects.

Mission Street already has a number of bus bulbs and some signal priority. The street is currently configured with two travel lanes in each direction. One option would be to convert one lane in each direction to a dedicated BRT lane, with appropriate provisions for delivery vehicles (such as dedicated parking spots) and strictly enforced bans on double parking. With these improvements, the Mission Corridor could more effectively transport a greater number of people than it does today. We do not recommend dedicated lanes at this time in the southern part of the corridor (depicted by the yellow line in the map), as buses are not delayed much here by traffic congestion.

Unless portions of Market Street are made transit-only (see the previous section about the Market Street Corridor), it would make sense for the SOMA segment of Mission Street to have dedicated BRT lanes. This is because Mission is a very high-ridership corridor and connects directly with the Transbay Terminal.

At its southern end, the corridor connects with the Daly City BART station and the 19th Avenue BRT Corridor.

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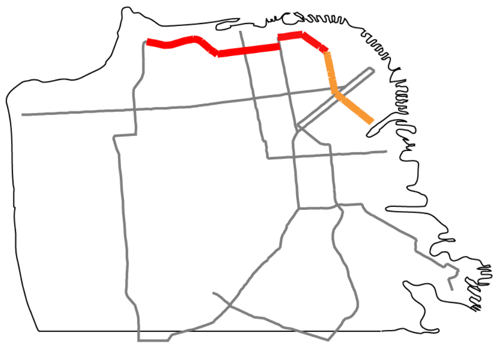
LOMBARD, BAY, COLUMBUS, STOCKTON, 4TH STREET BRT/ENHANCED BUS CORRIDOR



Corridor length: 5.6 miles
Cost: $57-87 million
New Daily Riders: 10,500-11,800

See Appendix I for detailed information.

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Existing Corridor Service

- Line 30-Columbus/Stockton
26,428 Average Daily Riders
- Line 45-Union-Stockton
19,344 Average Daily Riders
- Line 30X-Stockton
2,468 Average Daily Riders
- Line 41-Union
3,561 Average Daily Riders

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Serving heavily populated areas of the city including downtown, Chinatown, North Beach and SOMA, Muni buses (lines 30 and 45) navigate these routes congested with pedestrians, bicyclists and automobiles. The relatively narrow streets can become clogged at any time because these areas are both popular and densely populated.

We recommend Full-Scale BRT along Columbus, Bay, Lombard, and Doyle – dedicated lanes on the latter two streets would require permission from Caltrans as they are part of Highway 101. Along the 1.8-mile north-south stretch of Stockton and 4th Street, we recommend implementing Enhanced Bus (depicted by the yellow line in the map).

We are not recommending dedicated lanes along Stockton and 4th because plans call for putting the Central Subway along this route; furthermore, Stockton is narrow and congested and could not easily tolerate the conversion of lanes to dedicated BRT operation. Although Full-Scale BRT would be more cost effective than the Central Subway project, the Central Subway is supposed to receive the bulk of its funding from federal sources (according to MTC's *Regional Transit Expansion Policy*). Therefore, it would not significantly draw funding away from San Francisco BRT projects. In contrast, Enhanced Bus improvements along Stockton and 4th Street (including traffic signal priority, improved buses, stations, and pre-paid boarding systems) would be relatively quick and comparatively inexpensive improvements that could offer significant service improvements until the Central Subway opens.

Currently, the 30-Columbus/Stockton route travels west on North Point. Using Bay instead of North Point is worthy of further investigation as Bay Street has four lanes while North Point has only three. West of North Point, the 30 line traverses Chestnut. However, our suggestion is to run along Lombard, which has six lanes.

The Lombard/Doyle portion of the corridor would connect with the Van Ness Corridor, which would allow express buses from Marin and Sonoma counties to more quickly access parts of downtown San Francisco.

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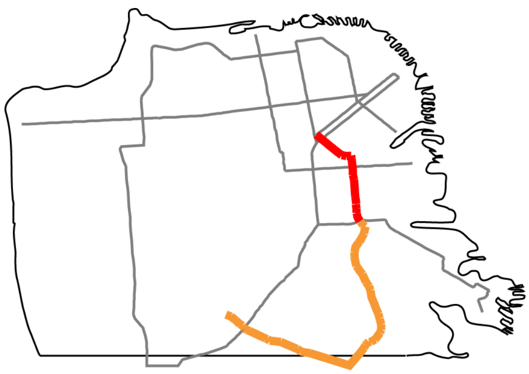
POTRERO, BAYSHORE, GENEVA BRT/ENHANCED BUS CORRIDOR



Corridor length: 8.2 miles
Cost: $50-66 million
New Daily Riders: 6,100

See Appendix I for detailed information.

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Existing Corridor Service

- Line 9-San Bruno
18,461 Average Daily Riders
- Lines 9X/9AX/9BX-San Bruno Express
12,814 Average Daily Riders

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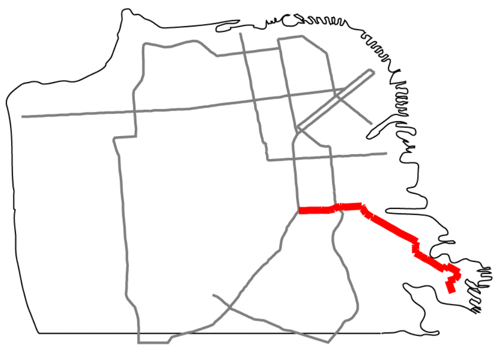
The 9-San Bruno routes serve over 30,000 daily riders. The corridor passes through residential neighborhoods, such as the Mission, and numerous commercial and industrial employment areas.

Currently, route 9 switches over from Bayshore Boulevard to San Bruno Avenue at the Silver Avenue intersection. Rerouting the corridor to remain entirely on Bayshore Boulevard is worthy of further investigation because Bayshore (unlike San Bruno) has sufficient width to accommodate dedicated BRT lanes in a future phase.

We do not recommend dedicated lanes at this time south of Cesar Chavez – i.e. along Bayshore or Geneva (depicted by the yellow line in the map) – as buses are not delayed much by traffic congestion along either street.

In Visitacion Valley, the corridor connects with the future Third Street light rail line (now under construction) and the Bayshore Caltrain station. Our recommendation is that the corridor should be extended west along Geneva Avenue to connect with the Mission BRT Corridor and with BART and Muni Metro at the Balboa Park Station. Ultimately, Muni would like to upgrade Geneva to light rail, as this would allow the agency to better interconnect its light rail lines. However, Muni considers this a second ‘tier’ project; thus, it will likely be many years before light rail ever operates on Geneva. In contrast, Enhanced Bus improvements will upgrade service along Geneva long before trains would roll along that street. Particular attention should be given to designing Geneva Enhanced Bus improvements to be as compatible as possible with future light rail service so as to minimize these potential future costs.

EVANS, CESAR CHAVEZ BRT CORRIDOR	**Existing Corridor Service**
 **Corridor length:** 4.3 miles **Cost:** $58-91 million **New Daily Riders:** 3,200-7,100 *See Appendix I for detailed information.*	• Line 19-Polk (along Evans to Cesar Chavez) 12,690 Average Daily Riders • Line 44-O'Shaughnessy 15,338 Average Daily Riders

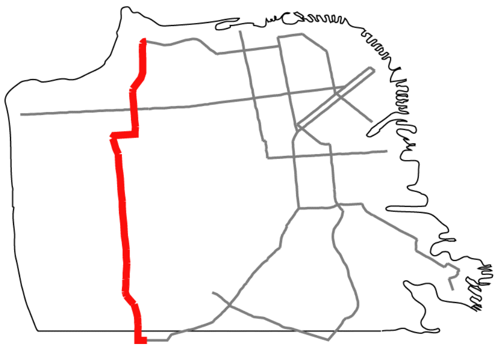
In the coming years, Bayview-Hunters Point is anticipating new commercial and entertainment development at the site of the former Hunters Point Naval Shipyard, with the potential to generate 10,000 new trips per day.

The Evans/Cesar Chavez Corridor that we are proposing combines the 19-Polk's southern leg in Bayview/Hunters Point with the 44 O'Shaughnessy's east-west connections to the Third Street, San Bruno/Bayshore, and Mission corridors. (It is important to reiterate that local service, such as the 44-O'Shaughnessy, would still be maintained under this proposal.)

We are proposing that the corridor travel east-west on Cesar Chavez as it has sufficient width to allow for dedicated BRT lanes, unlike the narrow Silver Avenue on which line 44 runs. Furthermore, Cesar Chavez is currently underserved by transit. Any of the vehicles operating in this corridor could potentially continue three blocks north on Mission so as to connect with the 24th Street BART station.

This corridor passes through low-income and transit-dependent neighborhoods. However, traffic congestion is not as great an issue along Evans. Therefore, we recommend further study to determine if dedicated BRT lanes are warranted, or if Enhanced Bus – or some hybrid of the two – would be a better fit along Evans.

19TH AVENUE BRT CORRIDOR



Corridor length: 7.2 miles
Cost: $96-153 million
New Daily Riders: 3,700-7,400

See Appendix I for detailed information.

Existing Corridor Service

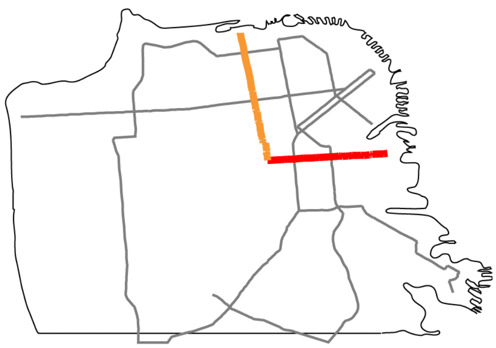
- Line 28/28L-19th Avenue
  14,447 Average Daily Riders
- Line 29-Sunset
  14,490 Average Daily Riders

As the primary north-south artery in the western half of the city, lines 28/28L on 19th Avenue serve 14,400 riders. Running parallel on Sunset, line 29 serves another 14,500 riders. Both routes serve western portions of the city with lower residential density but high levels of traffic. Implementing BRT could help improve the throughput of the entire western portion of San Francisco.

Along 19th Avenue, dedicated BRT lanes would help release public transit from traffic congestion. However, before lanes are converted to BRT service, further study is needed to ensure that the net result would be improved travel times for everyone in the corridor. If it is found that net travel times (for all people traveling in the corridor) would increase, one compromise would be to convert one lane to an HOV lane – instead of to a dedicated BRT lane – which would be open to carpools, vanpools, and buses. (Caltrans would have to approve of such a change as 19th Avenue is also designated as Highway 1.) HOV or BRT lanes would also help residents of north- and west-San Francisco, Marin and Sonoma counties better reach the San Francisco International Airport and the Peninsula via transit, as the lanes would be open to express buses and private carriers such as the Marin Airporter.

The 19th Avenue BRT Corridor connects at its southern terminus with the Daly City BART station and the Mission Corridor.

FILLMORE, 16TH STREET BRT/ENHANCED BUS CORRIDOR



Corridor length: 5.2 miles
Cost: $40-57 million
New Daily Riders: 5,100

See Appendix I for detailed information.

Existing Corridor Service

- Line 22-Fillmore
  24,491 Average Daily Riders

The 22-Fillmore is one of the major crosstown routes outside the downtown central business district. It connects several residential neighborhoods to Market Street, the Fillmore commercial district and future development along Mission Bay.

The three-mile stretch of Fillmore is constrained to only one lane in each direction, and therefore we recommend Enhanced Bus improvements (depicted by the north-south yellow line in the map) without dedicated BRT lanes. Nonetheless, improvements such as signal priority, bus bulbs, and improved vehicles and station stops along Fillmore Street would reduce travel times for tens of thousands of passengers daily. (As part of a pilot project, the 22-Fillmore was the first bus line to employ real-time passenger information systems, informing passengers of the estimated arrival times of the next two buses.)

On 16th Street there is adequate width to implement exclusive BRT lanes and we have recommended Full-Scale BRT for this street (depicted by the east-west red line in the map).

4.2 EAST BAY RECOMMENDATIONS

Plans are underway at AC Transit to implement Full-Scale BRT along Telegraph/International – the agency's busiest transit corridor (see the following page). AC Transit is also well into its preparations to bring Enhanced Bus service to San Pablo Avenue by June 2003, which it has dubbed 'Rapid Bus' service (see page 47). The agency would like to implement Enhanced Bus improvements along additional corridors, which it has set forth in its new *Strategic Vision*, which was released in September 2002, and which are part of this proposal. These Enhanced Bus improvements are the quickest, lowest-cost way to significantly upgrade existing service and attract new riders.

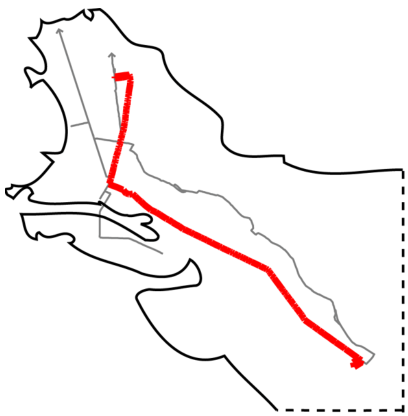
We do not recommend that the Full-Scale BRT and Enhanced Bus projects in the East Bay should replace existing local bus service. This is because even with rapid transit service there would still be passengers needing local routes' closer-spaced stops. Thus, we recommend maintaining local buses as "background" service, although the number of buses providing this local service might be able to be scaled back.

Two key components are required in order for these BRT and Enhanced Bus corridors to be realized. Funding is absolutely critical. Also necessary is the assistance of the thirteen cities in the AC Transit District to allow traffic signal adjustments to be made, so as to enable signal priority for buses.

Several of the corridors below are depicted in the maps on page 3.

Proposed Corridors	**Capital Cost *$millions***	**New Daily Riders**
Telegraph/Intl./East 14th BRT Corridor	350	11,300
Shattuck/Alameda BRT Corridor	126	5,500
MacArthur BRT Corridor	213-337	5,000
San Pablo Enhanced Bus	10	2,700
Foothill/MacArthur Enhanced Bus *(first phase, prior to Full-Scale MacArthur BRT)*	41	5,300
MacArthur/Airport Enhanced Bus	38	3,700
Shattuck/Alameda Enhanced Bus *(first phase, prior to Full-Scale Shattuck/Alameda BRT)*	30	3,900
College/University Enhanced Bus	20	2,100
Hesperian Enhanced Bus	20	1,700
6th Street/Hollis Enhanced Bus	17	5,000
Sacramento/Market Enhanced Bus	23	2,800
Mission/Outer East 14th Enhanced Bus	33	1,750
East Bay Total	$921M - $1,045M	41,550

TELEGRAPH, INTERNATIONAL, EAST 14TH BRT CORRIDOR



Corridor length: 18 miles

Cost: $350 million
New Daily Riders: 11,300

Cost and ridership from AC Transit.

Existing Corridor Service

- Line 82/82L
  23,464 Average Daily Riders
- Line 40/40L/43
  21,303 Average Daily Riders

This 18-mile corridor runs from downtown Berkeley, through Oakland, to San Leandro, passing such major destinations as the University of California at Berkeley, Oakland's City Center, Laney College, and the Bay Fair Mall. Stretching down Telegraph Avenue and then along International Boulevard/ East 14th, this corridor is the busiest in the AC Transit system, carrying nearly one-fifth of all AC Transit riders. The corridor passes along International Boulevard through Oakland's San Antonio and Fruitvale districts, and along Telegraph through the Temescal district, all of which have high concentrations of low-income and transit-dependent residents.

In July 2001, AC Transit chose Full-Scale BRT over light rail as the preferred option for the Telegraph/International/East 14th Corridor. As envisioned, the BRT service will be virtually identical to light rail service, but will cost $350 million instead of $900 million for light rail.

TALC has identified this corridor as a top priority for funding as this project would promote "transportation justice" along AC Transit's heaviest-traveled bus routes in neighborhoods that are heavily transit-dependent. This project would create the first full-blown BRT line on the West Coast, and demonstrate to the Bay Area the benefits of investing in efficient, cost-effective transit.

The project already has $40 million in committed funding, and is part of MTC's *Regional Transit Expansion Policy*. This BRT corridor should be prioritized for funding from the proposed bridge toll increase (see chapter 1). It is a good candidate for this funding due to its cost-effectiveness, transit-dependent passengers, and its connections with BART stations.

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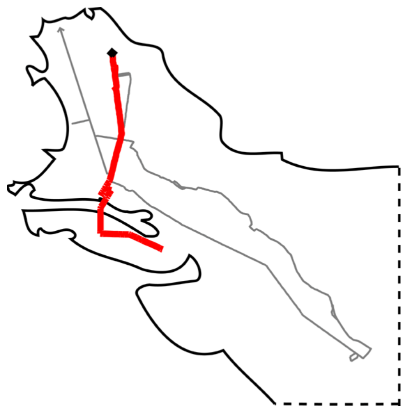
SHATTUCK, ALAMEDA BRT CORRIDOR



Corridor length: 12 miles

Cost: $126 million
New Daily Riders: 5,500

Cost and ridership from AC Transit.

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Existing Corridor Service

- Line 51/51A/51M
18,136 Average Daily Riders
- Line 40/40L/43
21,303 Average Daily Riders

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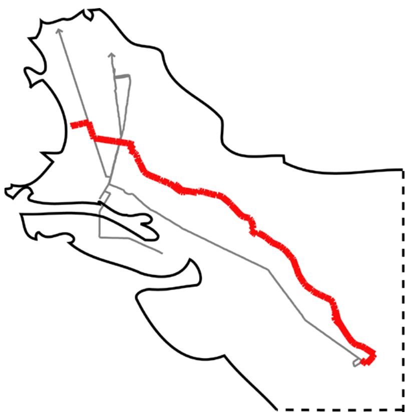
This corridor connects Oakland, Berkeley, Albany and the city of Alameda. Heading south from Albany, the route travels along Shattuck Avenue through downtown Berkeley, then on Telegraph Avenue to downtown Oakland, and on to Alameda. This corridor combines elements of the current 51 and 43 bus routes.

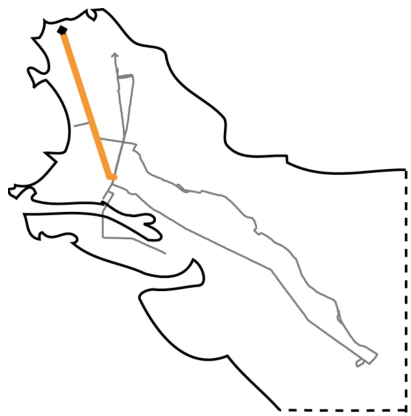
AC Transit estimates that this project would take four to six years to implement, including separate bus lanes and other enhancements. This corridor would achieve some cost savings by overlapping on Telegraph Avenue with the Telegraph/International/East 14th BRT Corridor.

MACARTHUR BRT CORRIDOR	Existing Corridor Service
 **Corridor length:** 15.9 miles **Cost:** $213-337 million **New Daily Riders:** 5,000 *Estimates by TALC, see Appendix I for more details.*	• Lines 57/57C, 58/58X 19,501 Average Daily Riders

This 16-mile corridor runs from the Emeryville Amtrak station, along 40th Street and MacArthur Boulevard to the Grand Lake District. It continues on MacArthur to the Bay Fair BART station.

This corridor passes such destinations as: shopping centers in Emeryville (including the East Bay Bridge Shopping Center), Kaiser Medical Center, Highland Hospital, Mills College, Eastmont Town Center, and the Bay Fair Mall. Many portions of the corridor pass through or border on low-income and transit-dependent neighborhoods.

TALC is recommending Enhanced Bus service as a first phase along this corridor and as a spur from the corridor – along 73rd Avenue – to the Oakland Airport. (This is discussed further in the section “Additional East Bay Enhanced Bus Corridors”.)

SAN PABLO ENHANCED BUS CORRIDOR	**Existing Corridor Service**
	• Line 72/72L/73 13,000 Average Daily Riders
Corridor length: 16 miles **Cost:** $10 million **New Daily Riders:** 2,700 *Cost and ridership from AC Transit.*	

AC Transit is scheduled to begin Enhanced Bus service (which it calls "Rapid Bus") in this corridor – which will extend from downtown Oakland to Contra Costa College in San Pablo – by June 2003.

When completed, the project will include: new vehicles, traffic signal priority, a reconfiguration of the existing stops, a passenger information system at all Rapid Bus shelters with real-time bus arrival predictions (provided by NextBus), and a distinctive design for the buses and stops. The stops are being reconfigured to be, on average, just under two-thirds of a mile apart from each other.

The new buses will be low-floor, 40- and 60-foot coaches with an extra set of doors to help reduce the time that buses must spend dropping off and picking up passengers. The buses also are quieter than AC Transit's standard buses and are the winner of the European Bus of the Year Award for 2003. Despite these benefits the new buses cost about the same price as standard buses.

This project has required the cooperation and approval of multiple agencies and governments because the corridor passes through seven cities, two counties, and part of the route is a state highway. Although this complexity increased the project's timeline, the result will be a significant improvement for many East Bay transit passengers.

ADDITIONAL EAST BAY ENHANCED BUS CORRIDORS

TALC has identified eight additional corridors for upgrades to Enhanced Bus service.[11] Although these project are not included in the maps on page 3, TALC believes they should also be prioritized for funding. Two of these corridors – Foothill/MacArthur and Shattuck/Alameda – would be first-phase rapid transit projects prior to the implementation of Full-Scale BRT.

Foothill/MacArthur

This corridor serves neighborhoods with a high percentage of low-income and transit-dependent residents. This project should be prioritized because of the “transportation justice” benefits that it would offer to transit-dependent passengers. The second phase for this corridor – discussed previously – would be an upgrade to Full-Scale BRT.

Cost: $41 million New Daily Riders: 5,300 Cost/New Rider: $3.80

MacArthur/Oakland Airport

Providing more frequent service and real-time bus arrival information is important for passengers heading to the Oakland Airport. Significant improvements could be made in as little as two years. This project could help build ridership for the planned rail connection the airport, but could offer improved service years before the rail extension would carry its first passenger.

Cost: $38 million New Daily Riders: 3,700 Cost/New Rider: $2.19

Shattuck/Alameda

This corridor combines the current Line 43 north of Oakland with a southern extension across Alameda from downtown. It would serve Albany, Berkeley, Oakland, and Alameda. The second phase for this corridor – discussed previously – would be an upgrade to Full-Scale BRT.

Cost: $30 million New Daily Riders: 3,900 Cost/New Rider: $2.03

College Avenue/University

This project would begin with more frequent service, and culminate in full Enhanced Bus improvements to the corridor.

Cost: $20 million New Daily Riders: 2,100 Cost/New Rider: $2.11

[11] Cost and ridership estimates are from AC Transit’s *Strategic Vision*, September 2002. Ridership figures have been converted by TALC from ‘annual new riders’ to ‘daily new riders’.

Hesperian

Increased frequencies have already been approved along Hesperian in Hayward and San Leandro. This project would upgrade the corridor beyond frequency improvements to full Enhanced Bus service.

Cost: $20 million New Daily Riders: 1,700 Cost/New Rider: $2.24

6th Street/Hollis

This corridor is developing with new businesses and housing, particularly in Emeryville. There is currently no direct north-south service running the full length of the corridor and Enhanced Bus service is expected generate a large increase in ridership.

Cost: $17 million New Daily Riders: 5,000 Cost/New Rider: $2.51

Sacramento/Market

It would take an estimated two to four years to fully implement Enhanced Bus service along this corridor once funding is secured.

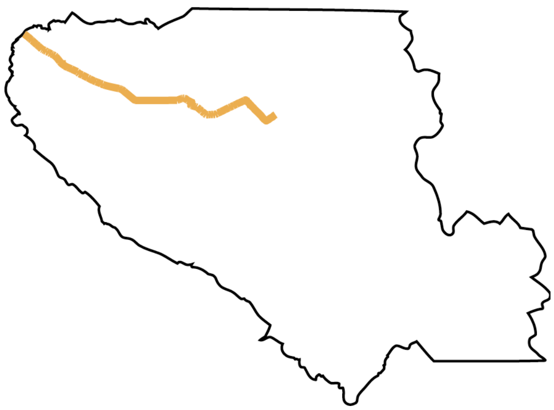
Cost: $23 million New Daily Riders: 2,800 Cost/New Rider: $2.78

Mission/Outer East 14th

This project, serving Oakland, San Leandro and Hayward, would take two to four years to implement, assuming that funding can be secured.

Cost: $33 million New Daily Riders: 1,750 Cost/New Rider: $4.64

4.3 SOUTH BAY RECOMMENDATIONS

EASTRIDGE TO MENLO PARK/ EL CAMINO REAL ENHANCED BUS CORRIDOR	**Existing Corridor Service**
 **Corridor length:** 27 miles **Cost:** $32.5 million *Cost from VTA.*	• Line 22 24,705 Average Daily Riders • Line 300 3,187 Average Daily Riders

This corridor is Santa Clara County's bus "backbone". The principal bus route in the corridor is Line 22, and with nearly 25,000 daily riders, one out of every seven VTA passenger trips is taken on this route every day. This 27-mile corridor covers a large portion of Santa Clara County, stretching from the Eastridge Shopping Center in East San Jose, through downtown San Jose, and along El Camino Real between Santa Clara, Sunnyvale, Los Altos, Palo Alto, and across the San Mateo county line into Menlo Park.

This corridor is a "rapid transit" project that VTA is undertaking. VTA estimates that, when completed, the project improvements will result in at least a 25% time savings for passengers. Ultimately, the project is supposed to include the following components: traffic signal priority; queue-jump lanes at certain congested intersections; bus bulbs at stops with high passenger volumes; low-emission, low-floor articulated vehicles; Automatic Vehicle Location systems (which are supposed to be introduced throughout VTA's entire fleet) with real-time information signs at certain stops; and pre-paid ticket machines at certain high-volume stations. The new rapid buses will make fewer stops than the current Line 22 buses which stop 157 times from the beginning of the route to the end.

Some improvements have already been made as part of this project. Queue-jump lanes have been installed along El Camino Real at Page Mill Road and Arastradero Road in Palo Alto. Furthermore, 40 new low-floor, low-emission articulated buses are being delivered to VTA around the time that this report is being printed.

Originally, the project was supposed to have been fully operational by late 2001. However, with recent drops in sales tax revenues, this project now appears to be fairly low on VTA's list of priority projects, with the BART extension to San Jose receiving far more attention. VTA plans to make the Palo Alto-Mountain View segment the first phase to receive signal priority. VTA does not yet have funding for signal priority in San Jose and improved station stops are also delayed. Estimates are that it will be an additional 18-24 months for the core part of the project to be operational.

VTA should prioritize this project – a crucial lifeline for tens of thousands of transit riders – given that the entire project cost is less than 1% of the cost of the BART extension.

ADDITIONAL SOUTH BAY ENHANCED BUS CORRIDORS

In addition to the El Camino Real/line-22 Enhanced Bus Corridor, there are two other corridors that VTA should prioritize for upgrades to Enhanced Bus service. Enhanced Bus on Stevens Creek Boulevard is a $30 million project that is supposed to receive funding from the 2000 Measure A sales tax. The second is Enhanced Bus from Monterey Highway in downtown San Jose to Guadalupe light rail, a project which would help build ridership for the future Downtown East Valley light rail extension. This $38 million bus project is also supposed to receive funding from Measure A. These projects should not be shunted aside to pay for the BART extension to San Jose as these low-cost improvements would benefit thousands of daily riders.

5.0 Transit Solutions: *How BRT and Express Buses Solve Transit Problems*

In the past, rail has been cleaner, faster, and more efficient than bus systems. BRT allows buses to closely emulate the best features of rail, but at a much lower cost and with significantly greater flexibility. The following scenario encapsulates some of the many features in the BRT “toolkit” that make it such an attractive transit alternative:

On your way to work you decide to take the new BRT route you’ve been hearing so much about. When you arrive at the bus stop a digital sign informs you that the next bus will arrive in five minutes – enough time to pop into the corner café. Sipping your coffee under the bus stop’s sheltering canopy, you prepay your fare at one of the ticket machines. A sleek vehicle pulls up right when expected and you’re impressed by how the ticketing system speeds up the boarding process. Looking out the window from your comfortable seat, you watch as the bus flies by rush-hour traffic in its own lane. Pulling away from the curb, ahead of automobile traffic, the vehicle’s clean-fuel engine emits far less noise and pollution than older buses. As you walk into your office you realize that BRT got you to work faster than driving and you decide to ride it to work again tomorrow.

BRT, and express buses, offer speed, style and dignity – qualities more often associated with rail or automobiles. This chapter explores the specific solutions that BRT and express buses offer and explodes the myth that bus service can only be slow, unreliable, dirty and polluting.

This chapter is meant as a toolkit, allowing transit agencies and communities to choose the BRT components that will be most effective and applicable to their situation. The following table groups the many technologies and innovations that BRT and express buses offer into seven major categories.

Solutions in the BRT/express bus “toolkit”:	page
BRT offers comfortable, high-tech vehicles	54
Clean-air buses slash pollution	57
BRT and express bus systems cut travel times, and move faster than cars	58
Technology allows for on-time schedules and minimizes waiting time	66
Frequent service and improved routing cuts the need to transfer	69
Comfortable, secure and stylish stations and bus stops improve the quality of service	72
BRT and express buses, like rail, can support transit-oriented development	75

Problem: Buses are unappealing
Solution: BRT offers comfortable, high-tech vehicles

Major advances in bus technology have been made in the last decade, resulting in much improved passenger comfort and amenities, and significantly lower impacts on the environment. Additional bus design advances continue to be made in Europe, and offer great potential for application in the United States.

Modern exterior designs

Sleek new exteriors (figure 5.1) are the first obvious differentiation between traditional buses and specialty express buses or BRT. The buses currently in use on BRT routes are designed to resemble rail vehicles in style and length. High capacity double- and triple-length buses are available, with loading/unloading doors available on both sides of the vehicles. Attractive, easy-to-board buses are now a standard offering of vehicle suppliers – the BRT projects in Las Vegas and Eugene, Oregon both plan to employ the European "Civis" bus shown in figure 1.2. The Civis system is already in use in two French cities: Clermont-Ferrand and Rouen. Other companies – such as Bombardier, Van Hool and Mercedes – also produce sleek, attractive, high-tech vehicles.

Figure 5.1

Bombardier

This vehicle in Nancy, France can operate as a self-powered bus, as a trolley with overhead electric wires, or as a guided "train" by using a groove in the pavement.

Express buses have also differentiated themselves from traditional bus service by making use of Euro-style touring coaches (figure 6.1).

Improved interiors

Improved BRT vehicles are designed for in-city transit, with better standing room, padded seats, air conditioning, and extra-large windows to connect passengers with their surroundings (figure 5.2).

Figure 5.2

Irisbus N.A.

BRT buses can resemble light rail or subway vehicles.

Technology improvements have also allowed lower floors and wider wheelbases to become characteristic of BRT vehicles. Low floors (figure 5.3) facilitate boarding for elderly and physically challenged passengers who have trouble navigating the steep entrance steps to traditional buses, and also enable wheelchairs, strollers and carts to roll onboard from boarding platforms. Wider wheelbases further stabilize the bus and provide a smoother ride.

Figure 5.3

Josh Apte

Boarding a typical bus, with three steps, is slow and difficult for the elderly and people with disabilities.

L.A. MTA

Low-floor buses have only one step, and their simple ramps allow people in wheelchairs to board faster.

Irisbus N.A.

When combined with a boarding platform, low-floor buses are as easy to board as a BART train.

Ultra-comfortable express buses, which are designed for longer-distance commutes, ride as well as luxury automobiles. These luxurious buses feature: air conditioning, high-backed airline style seating (with foot rests and personal trays), reading lights, power ports for laptop computers, video players and monitors, headphone plug-ins at every seat for music, bicycle racks, luggage racks, storage space under the bus, and a wheelchair lift for ADA compliance.

High-tech innovations

Advancements in bus technology extend beyond improvements in passenger comfort. The European “Civis” bus uses a computerized optical guidance system (figure 5.4) to create a smoother trip for riders and to reduce the road width required for operation. With unprecedented precision, Civis buses can also align to within two inches of a curb or boarding platform, eliminating the need for wheelchair ramps. This system also has a hands-free interface, allowing drivers to control the speed of the bus without having to steer when traveling along a specially-designed busway. The University of California is also developing a magnetic guidance system, based on its “smart” snow plow technology, which would have the same benefits as the Civis system.

Figure 5.4

Irisbus N.A.

In Rouen, France, a high-tech BRT vehicle with a computerized optical guidance system can steer itself via the painted white stripe. This allows for a smoother ride and precision alignment with boarding platforms, making the travel experience comparable to BART.

The flexibility of these new buses further allows them to adapt to complex urban environments. The Bombardier-built vehicle (figure 5.1) in use in Nancy, France, is capable of operating as a bus (self-powered on pavement), as a streetcar (powered by overhead cables on pavement) or as a guided “rail” vehicle (using either power source on a guided pathway). This dexterity allows BRT vehicles to use existing transit infrastructure, operating alongside existing modes when appropriate and operating on surface streets or dedicated busways when necessary.

Problem:	Dirty diesel buses pollute the air
Solution:	Clean-air buses slash pollution

Clean-air buses are readily available. Very-low emission buses powered by **compressed natural gas** (CNG) are in use in several California cities. Zero-emission **electric buses** have operated for decades in San Francisco, Seattle, Dayton, Ohio, and Vancouver. State-of-the-art **hybrid-electric buses**, with better fuel economy than conventional diesel buses, are in revenue service in Orange County (figure 5.5), Portland, and New Zealand. Hybrid-electrics produce much lower hydrocarbon and carbon monoxide emissions than conventional diesel buses, reducing particulate matter by 90 percent and nitrogen oxide emissions by 50 percent.[12]

Figure 5.5

General Motors

Orange County currently has hybrid-electric buses in revenue service.

Designline

This hybrid-electric in Christchurch, New Zealand is stylish and ultra-low emission.

Electric **fuel-cell buses** are the wave of the future. Powered by natural gas or hydrogen, they reduce tailpipe emissions to simply water vapor and heat, and do so without the inefficiency of batteries or the expense of installing overhead wires. These are already in use as prototypes for pilot projects (figure 5.6), and will likely be in widespread use within the next ten years. (Fuel cells generate electricity by combining hydrogen with oxygen from the air, without combustion.)

Figure 5.6

AC Transit

A fuel-cell demonstration bus owned by AC Transit. VTA will acquire three fuel cell buses in 2004.

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[12] General Motors, “Tri-Met Becomes First Transit System in Pacific Northwest To Put Hybrid-Electric Bus Into Commercial Service,” April 9, 2002.

Problem: Buses are slow
Solution: BRT moves faster than automobile traffic

One of rail transit's greatest advantages is its dedicated right of way – it can navigate independently of traffic congestion. Conversely, buses typically operate on surface streets. While this allows bus systems much broader coverage of an urban area, it also limits travel speeds to that of the rest of the traffic on the roads. Including the dead time that buses experience accelerating, decelerating, and loading/unloading passengers, it is impossible for buses to achieve travel times that come close to those of automobiles. Transit has been further impacted by the Bay Area's increasingly congested roads, making the question of delay a priority to transit operators. Recognizing that bus delay results from three main problem areas (bus stops, intersections, and the roads themselves), BRT and express bus systems are designed to eradicate many of the problems traditional buses face, and allow buses to achieve travel times on par with, or better than, automobiles.

Uncongested rights-of-way

Allowing buses to avoid traffic congestion is a priority in BRT and express bus system design. Recognizing the time, space and financial constraints on transportation projects, a variety of options are available to create less congested rights-of-way for bus use.

Figure 5.7

Buses use reversible-flow HOV lanes in Houston, Texas and, on average, travel twice as fast as adjacent non-HOV lanes.

One BRT solution is to provide **bus-only lanes** (figure 2.2) along major corridors, in order to separate the BRT vehicles from regular automobile traffic. Appropriate pavement striping and signage designating bus-only traffic can reduce travel times on surface streets and improve schedule reliability. However, proper enforcement of bus priority lanes is required. An alternative to paint and signs is to use a median barrier, such as a low curb; this approach does not depend on traffic police to enforce the separation. A bus-only lane is justified when bus passenger volumes exceed the auto capacity of a street lane, such as on Mission and Geary Streets in downtown San Francisco. Bus-only lanes work best when on-street parking is restricted during peak hours.

HOV lanes (also known as "diamond" lanes or carpool lanes) have also become a popular option for establishing both BRT and express bus rights-of-way. While the application for BRT is limited (since BRT typically travels on city streets rather than freeways), express buses can fly by rush hour traffic in the less-congested “diamond” lanes. Transit agencies in Pittsburgh, Honolulu, Houston (figure 5.7), Seattle, San Diego, and San Juan, Puerto Rico have all implemented express bus or BRT service along freeway HOV lanes. Similarly, contra-flow bus lanes are used in the approach to New York City’s Lincoln Tunnel. The Bay Area currently has 275 miles of bus/carpool lanes, which are already used by transit operators such as AC Transit and Dumbarton Express, and there are plans to construct 148 more miles.

Allowing express buses to use paved **freeway shoulders** is another option that gives buses an advantage when operating in rush hour traffic. Metro Transit in Minneapolis/St. Paul operates buses along HOV lanes as well as on 146 miles of shoulders. Shoulder operation in the Minneapolis area offers bus passengers a significant time advantage, while maintaining the safety of all highway users with simple operational rules: buses may not travel more than 15 mph faster than adjacent traffic, and may not exceed 35 mph on the shoulders. There have not been any injury accidents in over a decade of operation.

In Ottawa, Canada, buses operate on the shoulders of portions of Highway 417. Although the shoulders are narrower than regular travel lanes, the buses are able to travel at full speed (approximately 60 miles per hour), giving them a significant time advantage over cars in adjacent lanes. While we are not recommending that this dramatic difference in speed be adopted in the Bay Area, it is important to note that such speeds are used elsewhere. The buses in Ottawa exit and re-enter the highway in bus-only lanes along the sides of exit- and on-ramps, and drop-off and pick-up passengers at the end of these ramps.

TALC’s proposals for lane optimization and the use of shoulders by express buses is now being studied by MTC as part of its *2002 HOV Lane Master Plan Update*. The Bay Area could reap significant benefits from putting freeway shoulders to use for express buses in areas where HOV lanes are not currently available, resulting in a comprehensive regional bus web that would allow transit passengers to travel faster than commuters who drive alone[13]. The Federal Highway Administration – which gave approval to Minneapolis – would likely give approval if Caltrans decided to allow shoulder operation on select Bay Area freeways. This is a plausible scenario, as Caltrans has become more receptive to innovative transit solutions under the leadership of Jeff Morales.

[13] A vision for a potential regional bus web was originally outlined in “World Class Transit for the Bay Area,” published by the Bay Area Transportation and Land Use Coalition in January 2000.

Figure 5.8

Port Authority of Allegheny County

Passengers on Pittsburgh's East Busway save an average of 35 minutes.

A high-end BRT solution is to provide **exclusive busways** along major corridors, allowing buses to operate with complete independence of automobile traffic. Separate rights-of-way (when used exclusively by buses) provide the greatest potential for time savings, service reliability, and increased safety when compared to bus lanes or conventional operations on surface streets; however, finding money and suitable space for such busways is often difficult, though not impossible. Land for exclusive busways can be found in unexpected places. Pittsburgh's MLK, Jr. East Busway (figure 5.8), which has been operating since 1983, was constructed on right-of-way adjacent to a freight railroad line, which became available when the railroad reduced its operations. Oregon's Lane Transit District plans to build a semi-exclusive busway in the median of Franklin Boulevard between downtown Eugene and downtown Springfield (figure 5.9).

Figure 5.9

Lane County Transit District

Eugene, Oregon plans to introduce BRT…

Lane County Transit District

…in the median of a major arterial.

Construction costs for bus-only lanes and exclusive busways range between $3 million to $20 million per mile, depending on the degree of street reconstruction and right-of-way purchase required. These expenses are a fraction of typical light rail construction costs, and unlike light rail, short segments of exclusive busway lanes can be built incrementally in the most critical locations, with mixed-traffic operations in other parts of the rapid bus route. A direct comparison between the costs of rail and BRT is addressed in section 2.2.

Priority at intersections

Often, providing less congested rights-of-way for BRT and express bus systems only partially solves the problem of interaction between buses and normal traffic. Reducing bus delay at intersections can further improve the speed and reliability of buses on surface streets.

The simplest way to improve bus priority at intersections is to install **signal priority devices** that recognize an approaching bus and alter normal signal operation to give preference to the bus when appropriate. These devices can be designed to meet any number of local concerns. Honolulu's CityExpress! gives priority to limited-stop buses but not to normal routes, while cities like Vancouver and Boston only allow buses to alter signal behavior when they are running behind schedule. While most BRT programs are planning to implement signal priority devices that are triggered automatically using special sensors, AVL technology, or a tie-in to a centralized control center, others allow drivers to trigger the signal prioritization themselves.

In San Francisco, Muni uses several types of signal priority systems along several routes. Electric trolley buses along Mission Street currently receive signal priority at nine intersections from electro-mechanical devices in the overhead lines. These devices will soon be upgraded to an infrared system and added at an additional 17-30 intersections (depending on funding) along Mission Street and Geary Boulevard. Once equipped with infrared emitters, electric trolley buses as well as articulated (double-length) buses will be able to receive signal priority at these intersections. Embedded electromagnetic wires (known as "inductive loops") are used along the F light-rail line, and at several intersections along the J, K, and N light rail lines. These signal priority systems are an excellent start, but funds are needed so that prioritization can be expanded city-wide.

By 2004, the S.F. Department of Parking and Traffic (DPT) plans to have installed advanced traffic signal controllers, vehicle detectors, and cameras to monitor road conditions in eight areas: South of Market, 19th Avenue/Park Presidio/Lombard, Bush Street, Ocean Avenue, Doyle Drive, Oak and Fell streets, Central Freeway/Octavia Boulevard, and Third Street.

Another simple measure that can reduce bus delay is to **relocate bus stops** to the far side of intersections. Locating bus stops immediately before an intersection has the benefit of allowing the bus to load and unload during the "dead" time it spends waiting for the light to turn; when buses are given signal priority, this benefit becomes a detriment, forcing the bus to vie for curb space with vehicles trying to make a right-hand turn. Transit operators in Miami-Dade have found that by placing bus stops at the far side of an intersection, buses can fly through the intersection, stop for passenger loading, and then merge into traffic unhindered.

Figure 5.10

Lane County Transit District

Buses in a queue-jump get a green light before other lanes.

A more aggressive method to avoid bus delay at intersections is the **queue-jump lane** (figure 5.10). A "queue jumper" gives rapid buses their own lanes at intersections, with a traffic signal that turns green a few seconds ahead of the other signals. This allows the bus to proceed ahead of other traffic, contributing to improved traffic flow. These bypass lanes can speed up bus service by 30 to 60 seconds at a typical signalized intersection.

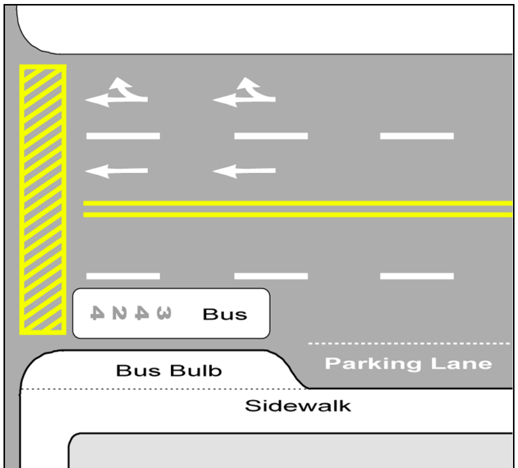
In most cases, queue-jump construction ranges from $200,000 to $500,000 per intersection. Queue jumpers are particularly applicable along major roadways where lower-passenger volumes, a lack of financial resources, or available right-of-way width precludes continuous exclusive busway/HOV lanes. Bus queue jumpers have been installed in Santa Clara County, California; Charlotte, North Carolina; Albany, New York; and Montgomery County, Maryland. Queue jumps are also planned for the BRT and express bus systems being constructed in Honolulu, Vancouver, and Eugene, Oregon.

Reduction of dead time at bus stops

BRT introduces infrastructure and technology to reduce the overall time spent at bus stations. One way this is accomplished is by reducing the number of stops along a route. Letting local buses serve more localized needs, BRT and express buses provide **"limited-stop" service** at major intersections. For example, a local route that stops every quarter-mile could be complemented by a limited-stop BRT or express bus service that stops every mile. This allows passengers traveling longer distances to receive more appropriate service, and also reduces overall bus stop delay.

Installation of **"bus bulbs"** on busy surface bus routes is another way to reduce the amount of time spent by buses pulling into and out of bus stops (figure 5.11). A bus bulb is an extension of the sidewalk, the width of a curbside-parking lane, out to the edge of a street travel lane. Bus bulbs eliminate the need for buses to maneuver into and out of stops, thus saving time and awkward traffic movements. Unlike buses that have pulled over to a conventional bus stop, buses stopped at a bus bulb do not have to wait for "breaks" in auto traffic since they are already in the travel lane, thus reducing travel times further. In addition to the time-saving benefits, bus bulbs are pedestrian- and passenger-friendly as they allow space for passenger facilities (shelters, benches, etc.) along narrow sidewalks, and in areas with high foot-traffic they allow pedestrians to walk past without being impeded by passengers waiting on the sidewalk.

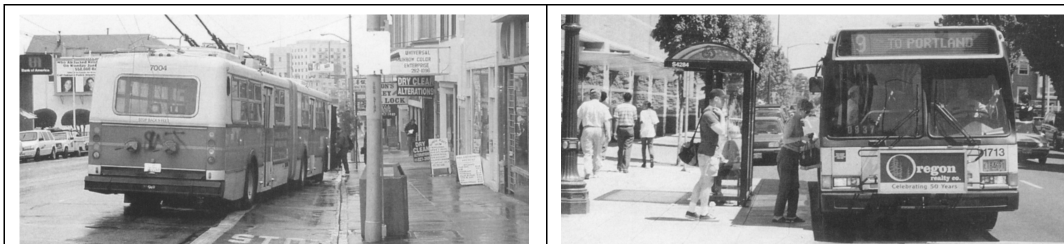
Figure 5.11



Installing bus bulbs on busy routes reduces the time buses spend merging.

While the casual observer might assume that bus bulbs slow down other vehicles in the travel lane, a recent study of bus bulbs discovered that the reverse is true.[14] Researchers did a before-and-after comparison of bus bulbs installed along Mission Street in San Francisco. They discovered that prior to the installation of the bulbs, buses would only pull halfway into the parking lane, thereby blocking the right-hand travel lane (figure 5.12). Bus drivers would do this to ensure that they would be able to pull back into traffic after picking up passengers. However, not only does this block the travel lane, but it slows down the boarding process by forcing passengers to walk out into the street to meet the bus. After the installation of bus bulbs, vehicle and transit travel times along Mission Street were *both* improved – a win-win situation.

Figure 5.12



Without bus bulbs, buses still block traffic.

With bus bulbs, buses don't need to pull over, the loading process is faster, and bus <u>and</u> car travel times are improved.

Bus bulbs are in use in San Francisco, Oakland (where they were constructed at 14th and Broadway in spring 2002), Portland, Seattle and Vancouver. Construction costs vary between \$15,000 and \$55,000, depending on the amenities installed, the need to relocate utilities and install

[14] Kay Fitzpatrick, et al, "Guidelines for the Use of Bus Bulbs", *ITE Journal*, May 2002, which summarizes "Evaluation of Bus Bulbs", *TCRP Report 65*, Transportation Research Board, 2001. Photos from *ITE Journal*.

drainage infrastructure, and whether the bulb is a retrofit or part of a comprehensive street rehabilitation program.[15]

A third way to reduce delay at BRT or express bus stops is to provide a better connection between bus and bus stop with **boarding platforms**. When combined with more accessible bus designs (vehicles with low-floors, multi-door boarding and high-precision curb alignment for easy wheelchair access), boarding platforms can provide a seamless transfer between land and vehicle. These platforms can have an even greater impact on the dead time spent at bus stops when combined with an advanced fare collection system.

Prepaid boarding, proof-of-payment, and the new “smart card” systems all improve upon more traditional on-board fare collection systems. For BRT or express bus systems that use boarding platforms, **prepaid boarding systems** simply require fares to be paid upon entering the platform. The regional bus system in Curitiba, Brazil utilizes prepaid “boarding tubes” on many routes with turnstiles staffed by fare collectors (figure 5.13).

Figure 5.13

City of Curitiba

Passengers pay an attendant when they enter any of Curitiba’s many BRT boarding tubes.

City of Curitiba

When a bus pulls up, the glass doors slide open, ramps fold down, and passengers board through any door.

Proof-of-payment systems are another way to eliminate the need for the bus driver to collect fares during boarding, but the transit agency must then use fare inspectors to spot-check buses for fare evaders. This method does not have to be used exclusively of onboard collection to impact day-to-day boarding times. Ottawa’s bus drivers still collect fares onboard, but transfers and passes make up 70% of the city’s total daily ridership, greatly reducing the dead time caused by onboard fare collection. Proof-of-payment systems are currently in use in San Francisco, Los Angeles and Vancouver, and are used on all new light rail systems in North America which opened in the 1980s and 1990s.[16] The Telegraph Avenue/International Corridor BRT project currently under development by AC Transit also plans to utilize prepaid

[15] Fitzpatrick et al.
[16] Federal Transit Administration, *BRT Reference Guide*, www.fta.dot.gov/brt/guide/fare.html.

boarding at station platforms. In a different twist, Orlando's Lymmo system avoids both on-board fare collection and the need for inspectors by eliminating the bus fare altogether.

Figure 5.14

MTC

The Translink system is being introduced in the Bay Area to simplify payment and transfers for passengers.

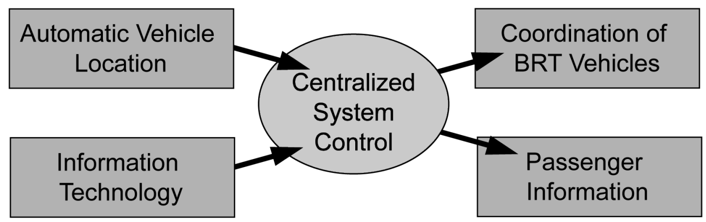
New **"smart card" fare collection systems** (figure 5.14) – such as the Translink system being implemented in the Bay Area – not only speed the process of collecting fares, but also make it simpler for passengers to transfer between buses or modes. These cards act as electronic tickets, either swiped or scanned for fare payment. Systems, such as Translink, with smart chips only need to be waved near the scanning device. These cards eliminate the need to carry extra bills or to fumble for change upon entering a bus, which causes delay.

By allowing the bus driver to focus on operating the vehicle rather than enforcing fare policies and making change for riders, these three improved methods of fare collection can be safer than traditional means, as well as substantially quicker. And frequent random inspections with sufficiently high fines can keep fare evasion at acceptably low levels. The payback of these systems is the ability to reduce dead time at stops, enabling transit agencies to operate more frequent service along very high-ridership corridors.

Problem:	Buses are unreliable and confusing
Solution:	Technology permits on-time schedules, minimizing waits

The same improvements that allow BRT and express buses to reduce travel times also make these systems inherently more reliable than traditional buses, since they are able to avoid the delay associated with traffic congestion. In normal traffic flow (which typically peaks during rush hours), travel times along the same route can vary by time of day. By using designated rights-of-way, BRT and express buses avoid this variation and keep more reliable travel times throughout the day. Aside from this advantage, BRT and express bus operators have utilized recent advances in vehicle tracking and information technology that allow greater synchronization of buses within the system and improved passenger information systems. Figure 5.15 shows how these technologies work together to provide a higher level of service.

Figure 5.15



Technology can improve both coordination and efficiency of vehicles, as well as keep passengers better informed about their trip.

Coordination of BRT Vehicles

Automatic Vehicle Location (AVL) systems allow real-time bus tracking, which can be used in several ways to improve the reliability of BRT and express bus service. Using a centralized control facility, transit dispatchers can monitor the location of each bus in the system and issue directions to the drivers in response to changing circumstances.

An important part of providing direct, convenient BRT or express bus service are **timed transfers** to minimize waiting times between connections. The arrival and departure of transit vehicles that have large numbers of transfers or that are along a common or continuing route should be scheduled and then coordinated with the use of AVL to occur simultaneously or within a short layover period. Buses can be held at transfer points when a second bus is reasonably close to arrival, reducing the time passengers would spend waiting for a transfer vehicle. Timed transfers could be done with bus-to-bus transfers, and also with transfers between buses and other transit modes. Timed transfers are most important for service that is infrequent (such as late-night service that only operates once every 30 or 60 minutes). When service is frequent (every 10 minutes, or better), timed transfers become less important, as waiting times are minimized.

The high number of transit operators in the Bay Area, combined with the absence of an effective means of regional coordination, makes schedule coordination difficult. However, agencies can still work together to surmount these obstacles. For example, a multi-agency committee in central and eastern Contra Costa County – including County Connection, AC Transit, WestCAT, Tri Delta Transit, LAVTA, BART and the Contra Costa Transportation Authority – has begun planning for an integrated express bus service.[17] The proposed multi-agency service would have a common bus-stop identity and design, to help passengers perceive the service as part of a single system.

A centralized control facility also allows BRT and express bus operators to **maintain proper headways** between vehicles on the same route, avoiding bus "bunching". When the control center observes one bus closely following another, it can direct the trailing bus to hold at another station, restoring the desired headways between buses.

AVL is also useful because it gives transit dispatchers much more accurate bus departure and arrival information. With real-time bus location information readily available, BRT and express bus operators must then look at how to convey this information to the riding public.

Improved passenger information

Traditional bus systems have typically offered many layers of confusion to prospective riders. System maps are often complex, inconsistent, and illegible, with no distinction between local feeders and more regionally significant routes. Bus schedules often change drastically over the course of a day, with headways that can range from two minutes to an hour, or more. Buses sometimes end service at odd hours, leaving the unfamiliar rider stranded. On top of these information problems, there is no guarantee that the buses are actually adhering to the posted schedule. Even the riders who are familiar with the schedule can only gauge whether or not the bus is running on time by the number of angry passengers standing at the bus stop with their arms crossed.

Strategies to improve passenger information are an integral part of BRT and express bus systems currently under design in North America. There has been a concerted effort to market BRT lines differently than traditional bus systems, and more like their rail counterparts. Cities like Boston, Los Angeles, Vancouver, and Eugene have created new identities for their BRT projects, with **unified coloring and design and stylized route maps** that resemble those of subway systems. Many other BRT systems combine this "streamlining" with improved information at the bus stops themselves – Miami-Dade Transit Agency, for instance, provides route maps and schedules, and has installed a telephone-based information system at each bus stop on its South Miami-Dade Busway.

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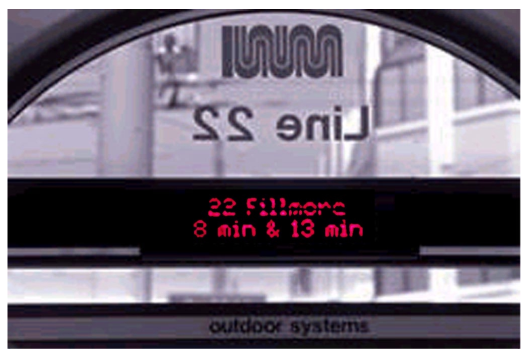
[17] DSK Associates, "Contra Costa Express Bus Study", September 13, 2001, prepared for Contra Costa Transportation Authority and Bus Transit Coordinating Committee.

Through this improved marketing, BRT and express bus operators hope to accommodate the needs of new riders, and attract them to become regular riders. Consequently, they have also improved passenger information systems, so they **provide more information to potential riders**, eliminating uncertainty and confusion about first-time trips. Websites such as those developed as part of the BRT and express bus systems in Ottawa and Houston cater to first-time riders, encouraging them to call a special hotline with any questions that were not addressed on the site. In this way, customers can become comfortable with the bus system from home or work before using it for the first time.

The Internet has been useful for relaying information about routes and schedules, but it can be combined with AVL technology and wireless communication capabilities to greatly improve the experience of waiting for the bus. Systems such as NextBus provide **real-time predictions of bus arrival times** that can be accessed via the Internet, by wireless phone or handheld mobile device, or at digital message boards at bus stops. By accessing this information remotely, riders have the option of timing their journey to the bus stop to coincide with the predicted arrival time. Even without access to a wireless phone or the Internet, if a passenger reaches the bus stop and is informed that the next bus will arrive in eleven minutes, there would be time to run an errand or buy a snack.

Figure 5.16



A NextBus display at a Muni bus stop.

NextBus technology is currently used in the Bay Area by Muni on its Metro light rail lines and its 22-Fillmore bus route (figure 5.16), by AC Transit on its San Pablo corridor, and by Emeryville's Emery-Go-Round. Muni signed a $9.6 million contract to outfit all Muni vehicles with NextBus equipment by 2007.[18] Ottawa has instituted a similar "dial-a-station" system for its bus stops, where each stop has a four-digit phone number that provides arrival and departure information. Other systems utilize different technology, including a tracking system for Los Angeles' Metro Rapid (developed in-house) which uses inexpensive loop detectors embedded in the roadway.

AVL and improved passenger information systems have made BRT and express bus systems more reliable and less confusing. Even though amenities like NextBus have reduced the amount of time a rider will have to spent waiting at a bus stop, another trait of BRT and express bus systems is to make waiting more pleasant by improving the quality of passenger facilities. (For more information on improved passenger facilities see page 72.)

[18] Lizette Wilson, "Get on the bus," San Francisco Business Times, January 18, 2002.

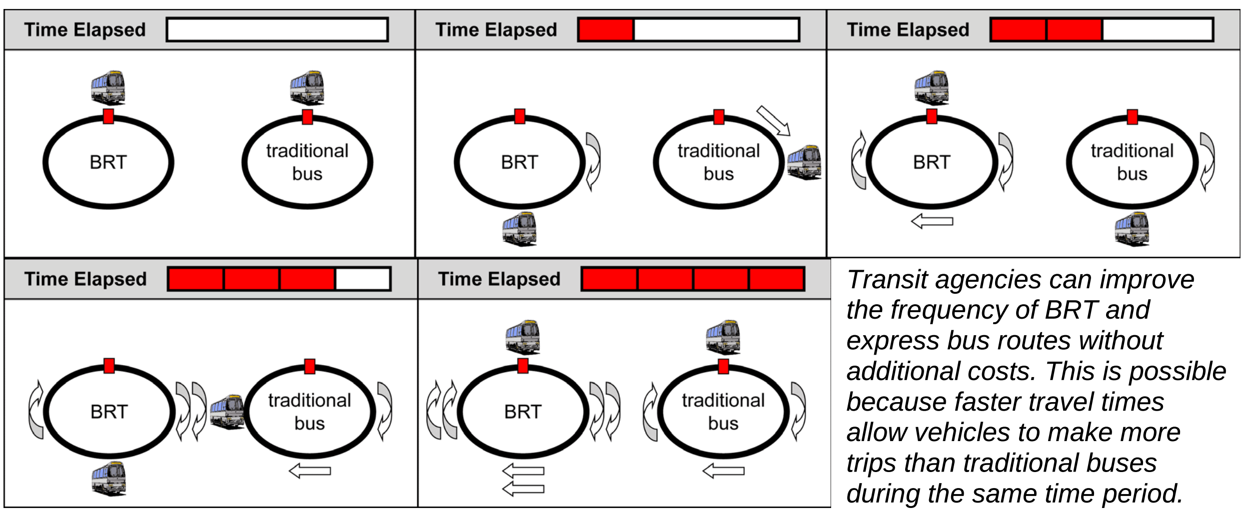
Problem:	Buses run infrequently and require multiple transfers
Solution:	BRT provides more frequent service

In order to provide more convenient service for transit riders, another aspect of BRT and express bus development is a close look at *when* and *where* the service is most needed.

Schedule improvements

As a result of faster travel times, Charlotte DOT has been able to increase the frequency of service on their Independence Corridor BRT project, which currently runs buses along a 2.4 mile stretch of HOV lane, and uses a queue jump lane to give the buses priority when merging back into normal traffic. During evening rush hour, this queue jump lane normally saves between 10 and 15 minutes of travel time, and the use of the express lane saves between 2 and 4 minutes. (This is illustrated conceptually in figure 5.17.) As a result of this overall time savings, ridership increased 55% on the route, and each BRT route using the lane has been able to add an additional peak-hour trip without increasing the total number of buses in the fleet.[19]

Figure 5.17



Transit agencies can improve the frequency of BRT and express bus routes without additional costs. This is possible because faster travel times allow vehicles to make more trips than traditional buses during the same time period.

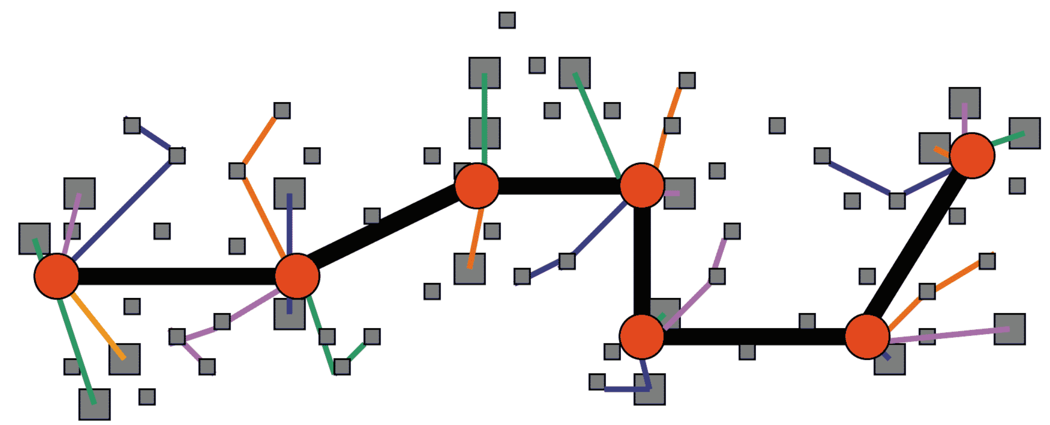
Aside from more frequent service, in the best case scenario rapid bus service should operate 24 hours a day, 7 days a week. While this can be skeleton service at minimum headways (typically every 30 or 60 minutes), it is important to provide a basic level of service, particularly for those whose jobs are outside of regular 9 to 5 hours.

[19] This information, and more data about the Charlotte Independence Corridor project, can be found in the documentation of the FTA Demonstration Projects.

Routing improvements

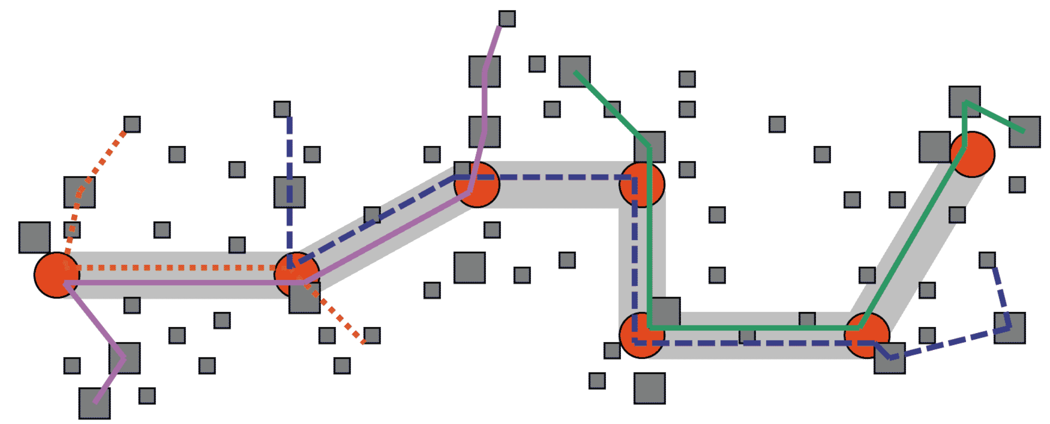
The implementation of BRT along well-traveled routes can allow for a system redesign that improves mobility throughout the service area. System redesign can include a switch from a feeder network (figure 5.18) to an integrated corridor approach (figure 5.19) allowing easier, integrated access to BRT corridors and reducing the number of transfers required.

Figure 5.18



In the real world, passengers travel between a diverse array of origins and destinations. The typical transit model serves these travel patterns with feeder service – i.e. buses (denoted in the diagram by the colored lines). This feeder service delivers passengers to a main bus or rail line (denoted by the heavy black line). The problem with this model is that most trips require two transfers.

Figure 5.19



With a BRT corridor (using either a dedicated lane or a busway) a main "trunk" route travels from end-to-end, picking up passengers at stations along the line. In addition to the trunk line, local routes (the colored lines) can pick up passengers close to their origins, enter the corridor for part of the trip, and then exit to serve various destinations, as is the case in Ottawa, Canada. The advantage of this model is that most trips can be completed with at most one transfer. (The corridor is denoted by the thick gray line.)

Local feeder routes can make timed transfers with BRT routes. Additionally such local routes can pick up passengers in a neighborhood or business district and then directly enter the BRT corridor (figure 5.19) for quick, limited-stop service. This reduces the need for passengers to make bus-to-bus or inter-modal transfers and provides a seamless transit experience. This has been the successful model adopted in Ottawa, Canada.

In Ottawa an exclusive bus-only roadway, known as the Transitway (figure 5.20), was opened in 1983 and formed the backbone of a BRT network. Today the Transitway, operated by OC Transpo, has 35 stations and is over 25 miles long – including operations along a limited length of freeway shoulders.[20] OC Transpo operates “trunk line” BRT routes which only travel on the Transitway, local feeder routes that connect to Transitway stations, as well as express routes which pick up passengers at local stops and then enter the Transitway for a quick trip to the downtown area.

Figure 5.20

Ottawa’s Transitway is a separate roadway for BRT vehicles. It includes stations, terminals, and other passenger facilities typically associated with a rail system.

As a testament to the successful design of its route structure, OC Transpo now carries about 335,000 passengers per day – at least 200,000 of whom travel on the Transitway for some portion of their trip.[21] Even though greater Ottawa is made up largely of low-density suburbs, the Transitway model makes transit so convenient that nearly 75% of peak-hour trips to downtown Ottawa are made on transit.[22] After nearly two decades of Transitway operation, which has witnessed steadily increasing ridership, OC Transpo now also operates one light rail line. However, taxpayers still express strong support (about 90%) for the Transitway, and the system recovers a solid 55% of its operating costs from passenger fares – which is particularly impressive given that Canadian transit agencies receive no federal funding.

[20] Joel Koffman, OC Transpo
[21] Koffman.
[22] Robert Cervero, *The Transit Metropolis: A Global Inquiry* (Washington, D.C.: Island Press, 1998).

Problem: Bus stops are unappealing
Solution: BRT stations and stops are comfortable and secure

By revisiting bus users' needs, BRT and express bus operators have improved upon the typical "bench on the side of the road" design of traditional bus stops. Paying attention to issues such as safety, aesthetics, comfort, and convenience, cities such as Los Angeles, Seattle, Vancouver, Pittsburgh, and Ottawa have made a concerted effort to improve the experience of waiting for the bus for their BRT and express bus passengers.

Improved bus station design

The main improvement in bus stop design that distinguishes BRT and express bus service from more traditional bus service is the attention paid to **passenger convenience**. The real-time bus arrival signage, the provision of detailed system map and schedule information, and the introduction of modern fare collection systems were described in earlier sections, but they all work together to provide as efficient an experience as possible at the bus stop. The idea behind these amenities is to give passengers as many options as possible, and to take up as little of their time as necessary.

Figure 5.21

Port Authority of Allegheny County

Shelters along Pittsburgh, Pennsylvania's West Busway are designed to overhang the bus so as to protect passengers from the elements.

Another aspect of rapid bus stops that differentiates them from traditional bus service is the attention to **passenger comfort**. BRT and express bus transit operators provide appropriate seating, lighting, and protection from the elements that match the quality and comfort of modern light rail systems. While weather concerns may not be as significant, given the Bay Area's temperate climate, cities such as Boston and Ottawa provide enclosed, heated waiting areas for their BRT passengers. On Pittsburgh's West Busway, the shelters are designed so that when the bus pulls up the right-hand side of the vehicle is covered by the overhanging canopy (figure 5.21). This design allows passengers to board and alight without being exposed to rain or snow.

Another aspect of traditional bus stops that BRT and express bus operators have looked to improve upon is the issue of **passenger safety**. Safety and security have been improved through station designs that emphasize visibility and excellent lighting, accessible transit employees and security officers, hotline telephones, and security cameras in stations and onboard vehicles.

Figure 5.22

Steve Price

Orlando's Lymmo BRT system offers attractive stations with shelter, seating and informational displays.

BRT stations should also be designed with more appealing **aesthetics**. Although buses and bus stations are typically not considered to be as engaging as rail vehicles and stations, improving upon the general appearance of the bus stops helps to dispel negative public perceptions about bus transit. Besides keeping the passenger waiting areas and the buses clean, the addition of distinguishing decor and artwork can be used to make the public spaces more comfortable and inviting. To attract riders, Orlando's Lymmo service (figure 5.22) provides appealing bus shelters and paints its vehicles with artistic themes that change monthly.

Regional transfer hubs.

Station design for BRT and express bus systems must embrace the principles of more appealing bus stop design (convenience, comfort, safety and aesthetics) but at a larger scale. Mimicking more "prestigious" subway stations, cities such as Seattle have moved certain BRT stations underground (figure 5.23).

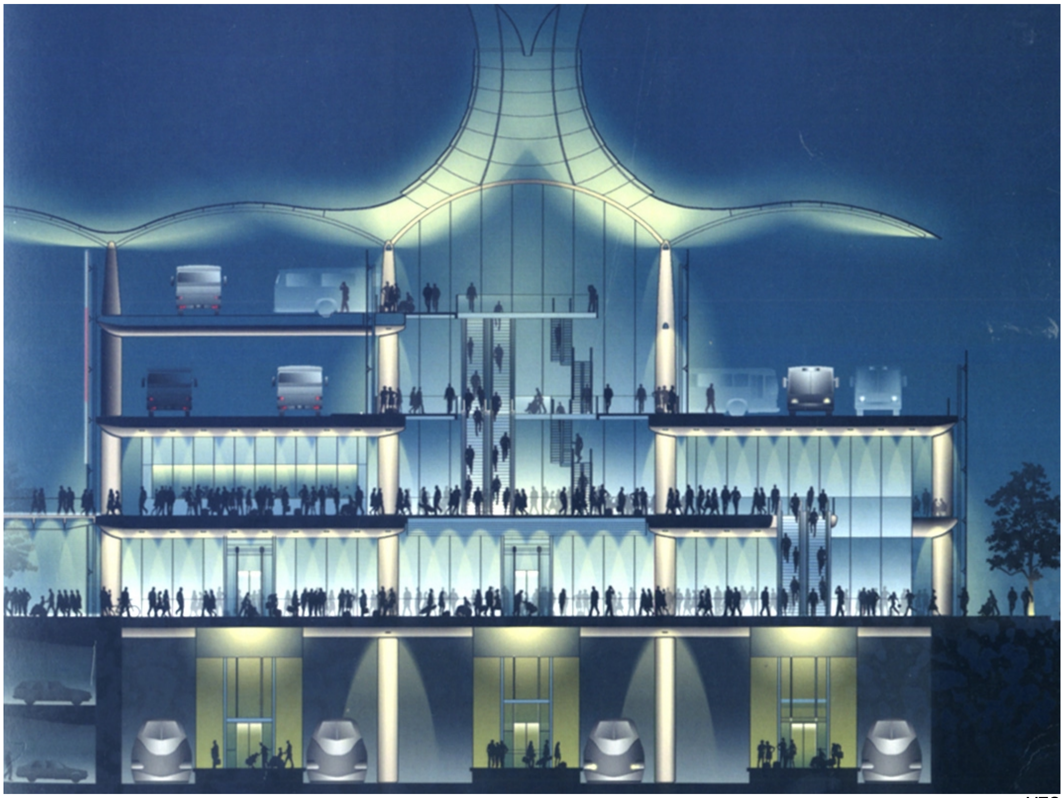
Figure 5.23

King County Metro

Open, airy, and colorful, some of Seattle's downtown bus stations are located underground.

These centers should include such amenities as telephones, restrooms, and drinking fountains. More importantly, transit facilities are part of a larger community, and improvements to these transit facilities should benefit the community at large. Integrated facilities of a transit center include those features not directly related to the transfer process or the center's environment, including shopping and services (such as cafes and dry cleaners), child care, and community centers. This type of "transit-oriented development" offers the exciting possibility of attractive, well-designed, small-scale stations that can create convenient neighborhoods that help reduce the distance that residents and employees must drive.

Figure 5.24



MTC

The plans for a new Transbay Terminal envision convenient transfers between multiple bus agencies, Caltrain, and potentially high-speed rail. The terminal would integrate space for retail and services, and would include housing and hotel space nearby.

Problem: Buses cannot promote smart growth
Solution: BRT supports transit-oriented development

One of the most common arguments for rail over BRT or express buses is the perception that rail is more likely to encourage transit-oriented development. While laying track to support a rail system is perceived as a commitment to "smart" development along the corridor, traditional bus routes are rightly perceived as being less permanent and their development effects minimal and dispersed.

In contrast to traditional buses, BRT (and express buses, when built with permanent infrastructure such as transfer hubs and neighborhood stations) shares three of rail's characteristics that make trains more amenable to transit-oriented development: high ridership levels, a limited number of stations, and infrastructure permanence. There are two other ingredients – necessary for rail, BRT, and express buses alike – which are vital to achieving transit-oriented development that supports livable, walkable, and convenient neighborhoods: appropriate design and supportive land use policies.

High levels of ridership

There are abundant examples which illustrate how BRT and express bus corridors attract and carry high levels of passengers (express buses in New York/New Jersey, BRT in Los Angeles, Pittsburgh, Ottawa and Curitiba, Brazil). In this regard, there is not a significant difference from rail systems. As a Transportation Research Board report states: "[T]here is no reason to think that attractiveness to development is inherent in a specific mode [BRT, light rail, etc.]. As long as the number of riders is equal, there should be equivalent development potential."[23]

A limited number of stations

Like rail, BRT and express buses typically run on regionally-significant corridors, with fewer, nicer stops spaced out along the route. Instead of being dispersed along an entire corridor, development or redevelopment can be focused at these stations, stops, or transfer hubs, resulting in a complementary concentration of passengers, housing, stores, and office space.

Pittsburgh's MLK, Jr. East Busway is an example of this type of focused development. Since it was opened in 1983 there have been 54 developments along the East Busway with a total value of $302 million. Of these, 42 developments (with 58% of the value, or $176 million) are clustered within a six-minute walk (1,500 foot radius) of a busway station. As a report by a Port

[23] Allen D. Biehler, "Exclusive Busways Versus Light Rail Transit: A Comparison of New Fixed-Guideway Systems", in *Light Rail Transit, New System Successes at Affordable Prices*, Special Report 221 (Washington, D.C.: Transportation Research Board, 1989).

Authority of Allegheny County transit planner concludes: "Many of the communities located along the busway have experienced disinvestment and population loss… Additionally, there are no local or regional land use policies directing development to transit guideways. Given these conditions, the scale of development which occurred along the busway is truly interesting. Pittsburgh's experience shows that communities with a busway can be as attractive to developers as communities with rail transit lines."[24]

Infrastructure permanence

BRT systems that include permanent infrastructure (such as exclusive lanes and stations) give developers confidence that there will a steady stream of people at BRT stops for years to come, making these desirable places to build transit-oriented development. This was the conclusion reached by AC Transit as part of a recent study evaluating BRT and light rail alternatives for a high-ridership corridor in the East Bay: "Both BRT and LRT [light rail] have a large fixed infrastructure component that helps attract development. Bus systems that have little or no fixed infrastructure do not appear to have the same development potential."[25]

The same logic should largely apply to express bus systems. HOV lanes, transfer hubs, and neighborhood express bus stations are all long-term infrastructure elements that can reassure developers that express bus service will be a permanent presence, making the construction of transit-oriented development more likely.

Figure 5.25

bikestation.org

Long Beach, California has excellent multi-modal access to transit at its downtown Transit Mall bus and light rail hub. Adjacent to the Transit Mall is the Long Beach Bikestation (above) which provides a range of bike services, including valet parking, repairs, and rentals, along with a café and electric car rentals.

Appropriate station design

When done right, BRT and express bus stations and hubs offer an alternative to investments in giant BART parking lots. Because BRT and express buses traverse multiple routes and pick up passengers in local areas, they serve more stations and stops than rail and come closer to people's homes. The increased number of transit "nodes," makes it more convenient to walk, bike, take local transit, or get dropped off at BRT and express bus stops and stations, thereby

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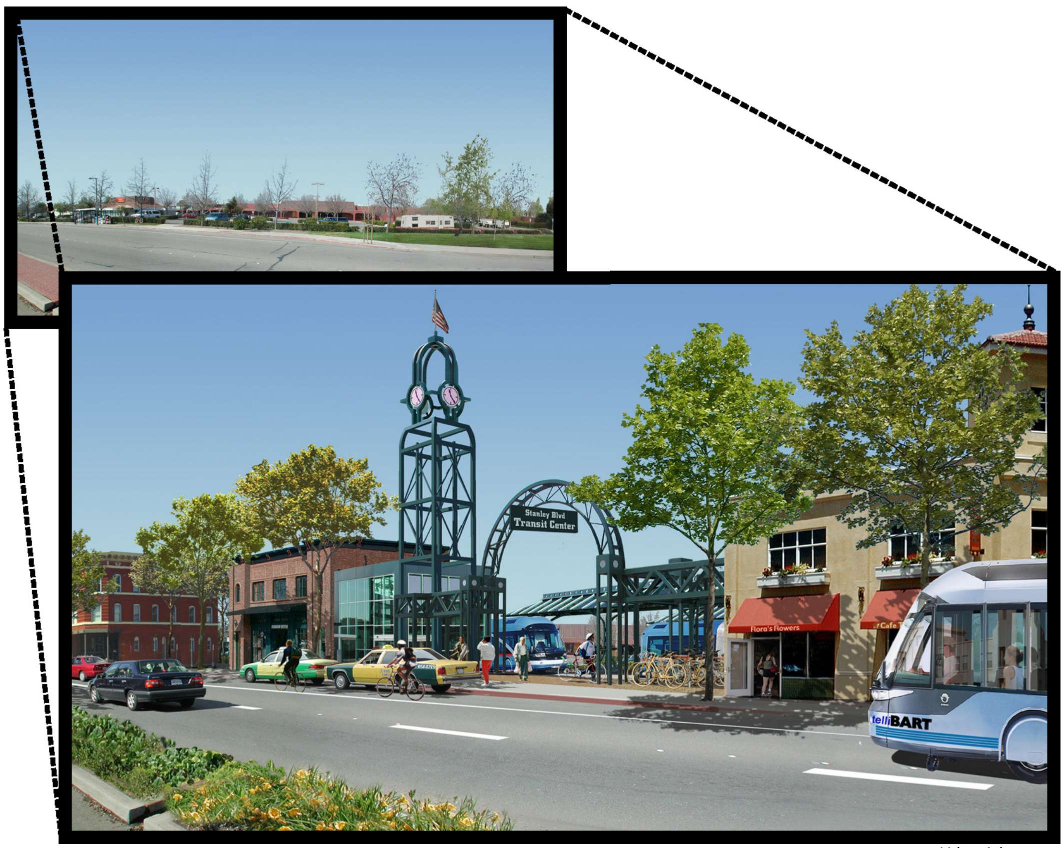
[24] David E. Wohlwill. "Development Along A Busway: A Case Study of Development Along the Martin Luther King, Jr. East Busway in Pittsburgh, Pennsylvania", (June 1996).
[25] AC Transit Staff, "Berkeley-Oakland-San Leandro Major Investment Study: The Development Potential of Light Rail and Bus Rapid Transit", (2001).

drastically slashing the amount of parking required at each station (in urban areas there is no parking needed at all). This, in turn, allows for appropriately-scaled, higher-density development around stations – such as housing, office space and neighborhood stores.

This type of transit-oriented development can create convenient neighborhood centers (figure 5.26) that help reduce the distance that residents and employees must drive. It is also a positive factor in the eyes of the Federal Transit Administration when evaluating which transit projects should receive federal funding.

Figure 5.26



UrbanAdvantage

A new express bus hub, as pictured in this artist's conception, could transform this vacant strip mall (top) into an attractive, livable community (bottom). Such transit hubs would create convenient neighborhood centers with adjoining stores, cafés and office space.

Supportive land use policies

Even if the four previous criteria are met, transit-oriented development doesn't simply spring into place. It needs to be supported with land use policies, including appropriate zoning regulations and smart growth incentives. As AC Transit staff concluded during a recent study evaluating BRT and light rail alternatives for an East Bay corridor: "In summary, the literature indicates that transit alone won't create development – there need[s] to be additional governmental investments and coordinated transportation and land use policies in place. In addition, there is evidence that bus-based rapid transit systems can direct development in a way similar to that observed for the more common light rail systems."[26]

While BRT and trains are both capable of promoting development near transit, it is important to keep in mind the distinction between developments that are *oriented* to transit and developments that are simply *adjacent* to transit. Isolated apartment or office buildings that are adjacent to a train or bus station, but which are surrounded by large parking lots and located far from stores, restaurants, schools, and other services, may succeed at increasing the use of transit for work trips, but will be unlikely to increase usage for all other types of trips. In short, BRT and express buses – like trains – are capable of promoting transit-oriented development, but – just like trains – need to be implemented in concert with transit-supportive land use policies.

There are numerous ways of devising supportive land use policies, the details of which go beyond the scope of this report. For more information on this subject, the following resources may prove helpful:

- Greenbelt Alliance's *Smart Infill* report, available at www.greenbelt.org or by calling (415) 398-3730.
- The California Futures Network: www.calfutures.org or 415-395-9333.
- The California Center for Land Recycling: www.cclr.org.
- The *Bay Area Housing Crisis Report Card* by the Non-Profit Housing Association of Northern California and Greenbelt Alliance, available at www.nonprofithousing.org.

[26] AC Transit Staff, ibid.

6.0 What Are Express Buses?

Express bus service is a form of Bus Rapid Transit, but it has a more specialized function.

One defining characteristic express routes typically include is at least one long segment along which the bus makes no stops. For example, many AC Transit Transbay buses pick up passengers along major local roads in the East Bay and then travel on freeways directly to the Transbay Terminal in San Francisco.

Another characteristic: express bus passengers generally travel from a limited number of origin points to even fewer destination points – with the buses sometimes serving a single destination, such as the Transbay Terminal or a particular employment center. In contrast, BRT routes tend to serve passengers with numerous combinations of origin and destination points along an entire corridor.

Figure 6.1

Josh Apte

Tri Delta Transit operates "Delta Express" service using Euro-style luxury coaches.

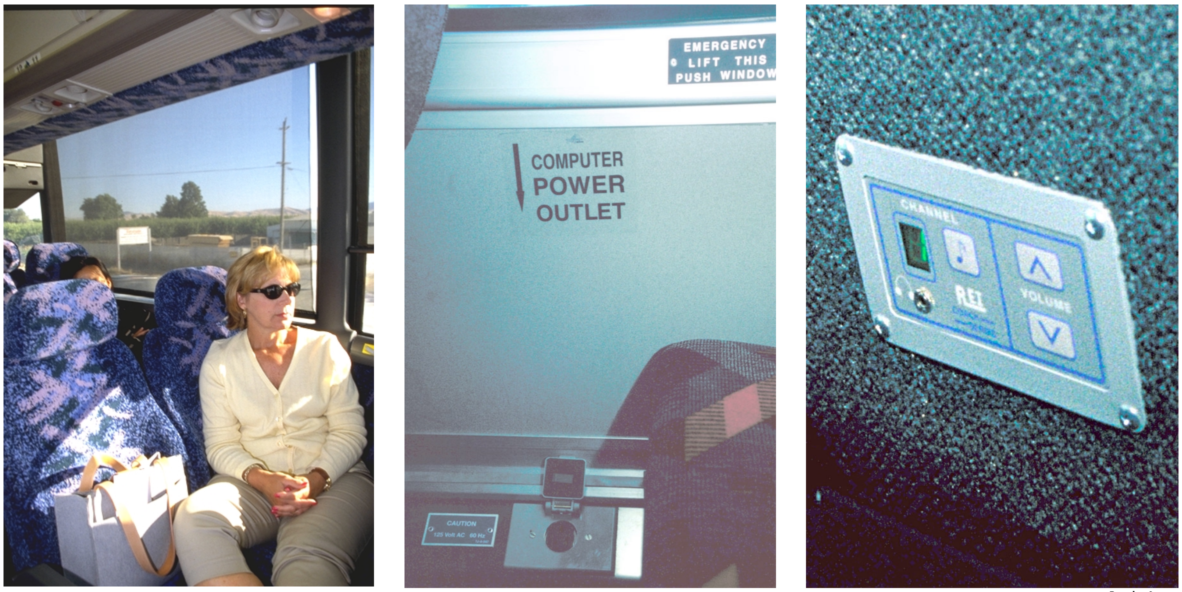
Express buses can share many of the same features discussed previously for BRT. Like BRT, express bus service may include:

- ***High-Quality Buses***—Euro-style luxury coaches designed for longer trips – such as ones used by Tri Delta Transit (figure 6.1) – feature padded, reclining, high-back seats; luggage storage; tray tables; music consoles at every seat; and optional movies or news on overhead screens. (figure 6.2)
- ***Differentiated Right-of-Way***—Express buses can rival or beat automobile travel times through the use of rights-of-way that are separate from congestion and regular traffic. Most often, express buses use HOV (High Occupancy Vehicle) lanes, also known as diamond lanes.
- ***Signal Preference at Intersections***—Express buses benefit from traffic signal priority systems put in place for their BRT cousins. For example, Golden Gate Transit buses traveling on Lombard and Van Ness streets in

San Francisco could receive the same signal priority as Muni BRT vehicles.

- ***Faster Passenger Boarding***—To cut delays, fare collection strategies, such as monthly passes or “smart-cards”, allow prepaid boarding.

Figure 6.2



Josh Apte

Some of the features in use in express bus luxury coaches (left to right): padded, reclining, high-back seats; computer power port; music console.

- ***Improved Passenger Facilities***—Transfer hubs can offer convenience and security. Examples include services and shopping (dry cleaners, coffee shops and florists), passenger information displays, seating, security cameras, and hotline telephones. Real-time arrival and departure information can be provided on electronic signs, as described in chapter 5.
- ***Routing and Transit Network Development***—Like their BRT cousins, express bus routes have fewer stops than traditional bus routes, are designed to connect with BRT and other transit modes, and can offer timed transfers at transfer hubs.

Express Bus Operations/Maintenance and Capital Costs

Low capital, operations, and maintenance costs are characteristic of express bus systems. In the 2000 *Bay Area Transportation Blueprint* report by MTC, eight of the ten most cost-effective projects were all express bus projects. These express bus projects had an average cost of $2.55 per new rider. In contrast, the most cost-effective rail project ranked 23rd on the list, with an average cost of $11.27 per new rider.

WHERE ARE EXPRESS BUSES?

There are abundant examples of effective express bus service here in the Bay Area, and in cities across the U.S. While the components of the service vary – high-quality vehicles, high-end passenger facilities, signal priority, etc. – most use HOV lanes and serve passengers traveling longer distances than on traditional bus routes.

Bay Area Examples

Several transit agencies in the Bay Area operate express bus service that uses HOV lanes for at least a portion of the route:

- ***AC Transit's*** service between the East Bay and San Francisco's Transbay Terminal includes 38 routes, and in 1998 began taking advantage of new HOV lanes along I-80. Transbay ridership increased 50% in 1997 as a result of a six-day BART strike. Since then it has maintained those levels and continued to rise, reaching nearly 15,000 passengers per day in late 2000. AC Transit now uses high-quality, comfortable coaches along several of its longer-distance routes.
- ***Golden Gate Transit*** has sixteen commuter bus routes that utilize HOV lanes along Highway 101 in Marin County. The northernmost routes, which can use the full extent of the existing HOV lanes, save an average of fourteen minutes in travel time compared to single-occupant cars traveling in adjacent lanes.
- ***LAVTA*** (the Livermore Amador Valley Transit Authority) operates subscription express service (called *Prime Time*) from Livermore/ Pleasanton to Lockheed Martin and Intel in Silicon Valley and to employment destinations in Walnut Creek and Pleasant Hill. These buses use I-680 HOV lanes for part of the route. LAVTA has cut costs by using employer-based drivers, which allows the bus to be parked at the driver's worksite during the workday. This strategy has cut expenses and pollution, and allows the service to operate without any subsidy from LAVTA.
- ***Dumbarton Express*** operates two routes across the Dumbarton Bridge between the Union City BART station and Menlo Park and Palo Alto destinations. Dumbarton Express buses utilize a two-mile HOV lane to bypass traffic at the Dumbarton toll plaza, saving an average of 16 minutes with each westbound morning trip.
- ***Tri-Delta Transit*** – which serves the eastern Contra Costa cities of Antioch, Pittsburg, and Brentwood – offers its *Delta Express* subscription express bus service. Service on luxury coaches is provided to Lawrence Livermore and Sandia Labs in Livermore and to the Hacienda Business Park in Pleasanton. Future service may be extended to Silicon Valley.
- ***VTA*** (the Valley Transportation Authority) operates seven express bus routes in Silicon Valley which use HOV lanes on 101, I-280, 85, and 237. However, these routes only operate during peak-period weekday commute hours, with each route making only between two and six

roundtrips per day. (The number of daily trips on some of these routes was reduced in July 2002 as a result of budget deficits.) As of 2000, these routes had about 1,000 daily riders.

- ***Vallejo Transit*** operates two express bus routes from Solano County (the 80 and 90/91) that serve the El Cerrito Del Norte BART station in Contra Costa County and utilize HOV lanes on I-80. Both routes offer trips throughout the day, although the 80 has no Sunday service and the 90/91 has no weekend service at all.
- ***County Connection*** operates five routes that use HOV lanes on I-680 in Contra Costa County. Bus drivers have the choice of entering the HOV lanes if traffic congestion warrants it. Three of these routes operate only during peak-period weekday commute hours. The other two operate both during peak-period commute hours and midday, but during the midday buses depart only once per hour.
- There are other “express” routes in the Bay Area which have limited stops and serve passengers traveling longer distances, but which do not benefit from the use of HOV lanes. These include VTA’s 140 and 180 routes from the Fremont BART station to Santa Clara County and SamTrans routes BX and KX which serve the San Francisco airport. SamTrans operates an additional eight express routes in San Mateo County which do not use HOV lanes and run only during peak-period weekday commute hours. Fairfield-Suisun Transit operates the 40 Solano BART Express from Vacaville and Fairfield along I-680 to the Pleasant Hill BART station in Contra Costa County during peak-period weekday commute hours.

Most of these Bay Area routes are generally designed to serve daily commute trips between the transit agency’s suburban service area and the concentrated job markets in San Francisco and the South Bay. However, as decentralized job centers continue to develop all over the Bay Area, it will become increasingly difficult for local transit agencies to independently serve the ongoing dispersion of their commute trip demands.

Other Examples

- ***New York/New Jersey***—A single, bus-only highway lane, begun in 1970, takes Manhattan-bound buses from the New Jersey Turnpike to the Lincoln Tunnel, carrying 24,000 passengers per hour during peak periods.[27] Regular highway lanes only carry, on average, between 2,000 and 2,200 passengers per hour. The high capacities of the Lincoln Tunnel bus lane are possible because express buses from a number of different routes all funnel into the bus-only lane.

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[27] A staggering 52% of all morning commuters travel through the Lincoln Tunnel on this one lane. According to a 1998 survey, from 6:00 to 10:00 a.m. 115,200 people traveled through the Lincoln Tunnel, of which 60,200 were carried on the bus-only lane. 1998 peak flow statistics from Jerry Quelch, Senior Transportation Planner, Port Authority of New York and New Jersey (October, 1999).

- ***Houston*** has about 100 miles of reversible-flow HOV lanes. These are utilized by 34 express bus routes. These buses comprise three percent of the volume of *vehicles* but carry 38% of all *people* in the HOV lanes – a daily total of 45,670 person trips.[28]
- ***Seattle***—In operation since 1999, "SoundTransit Express" is a network of regional express bus routes utilizing the nearly 200 miles of HOV lanes in the greater Seattle area. As of 2002, ST Express ridership was 22,000 daily trips on 17 routes.
- In ***Honolulu***, "CityExpress!" buses use a reversible-flow HOV lane along the H-1 freeway to cut their travel times. Off the freeway, these buses utilize other BRT options, including traffic signal priority.

[28] Texas Transportation Institute, "Houston High Occupancy Vehicle Lane Operations Summary," March 2002, as provided by Nader Mirjamali, Metropolitan Transit Authority of Harris County, Texas.

7.0 A Bay Area Express Bus Web

TALC's proposed express bus network offers a way to attract suburban riders with fast, convenient, comfortable service. Best of all, it can be fully implemented at a fraction of the cost of new BART extensions – and years before the first passengers would ride a new BART line.

The express bus network that TALC is proposing has three key components:

Luxurious vehicles and expanded service. The network would employ luxurious coaches designed for long-haul trips and would quickly introduce new buses in order to increase the capacity and frequency of existing service. Nowadays some existing express bus routes only operate for limited hours during peak commute periods. One of the objectives of instituting a true express bus network would be to offer frequent service during peak periods, as well as consistent service throughout the day and during nights and weekends. This would allow the network to serve a broad range of passengers and not just those heading to 9-5 jobs. Partial funding to operate these extended hours could be obtained from the $1 bridge toll increase that is expected in 2004 as well as from sales tax authorizations that are expected in the next few years.[29]

A high-speed network. TALC's proposal would make express bus travel times competitive with automobiles by leveraging the Bay Area's existing highway infrastructure into a broad, high-speed network. The region has an extensive infrastructure for express bus service: 275 miles of existing HOV lanes (with an additional 144 miles planned). The network would be expanded and gaps would be closed through innovative approaches that would squeeze the maximum capacity out of our existing freeways without needing to undertake costly widening projects. These approaches include "optimizing" existing mixed-flow lanes, when appropriate, along key freeways that lack HOV lanes and allowing express buses to use freeway shoulders.

Thanks to recommendations by TALC, MTC is now studying both of these approaches as part of its *2002 HOV Lane Master Plan Update*. Governor Davis and MTC should appoint a blue ribbon commission to look at the plan's recommendations, since these are incredibly cost-effective ways to offer the fastest congestion relief.

As part of the network, on the local portion of their trips, express buses would take advantage of traffic signal priority already installed along Full-Scale BRT and Enhanced Bus corridors (see chapter 4).

Strategically-located transfer hubs. The network would employ strategically-located transfer hubs with timed transfers between connecting

[29] MTC initiated a regional express bus expansion plan, with the first of 100 buses delivered in September 2002. However, this doesn't include sufficient funding to operate the buses.

routes. The hubs, as well as local stations and stops, would offer a high degree of comfort and convenience, and would be intended to integrate with nearby transit-oriented development.

The chapter ends with an in-depth look at TALC's proposal for express bus service in the Tri-Valley as an alternative to a costly and ineffective BART extension along the I-580 median.

Express Bus Web Summary

Total Capital cost:	$541 million
Total annual operating cost:	$74 million
New daily riders:	76,000

A note about ridership estimates

The ridership estimates in this section are extremely conservative as they do not include the ridership increases that would result from our recommendations for a high-speed network (section 7.1) and transfer hub system (section 7.2). Although these recommendations would likely result in tens of thousands of new riders, we are only able to quantify the benefits for the initial service and frequency increases that we recommend in section 7.1.

7.1 ADD NEW BUSES, EXPAND SERVICE HOURS AND INCREASE FREQUENCY

New express buses should be introduced to increase both the number of express bus routes, as well as the frequency of service. This would lead to increased express bus ridership.

These capacity increases could be implemented relatively quickly and inexpensively. Two recent studies – the *Bay Crossings Study*, sponsored by MTC, and the *Contra Costa Express Bus Study*, sponsored by the Contra Costa Transportation Authority and other transit agencies – point to places where such investments could yield significant ridership increases. These opportunities include increased service on the Bay Bridge, new service on the Hayward-San Mateo Bridge, and additional service to and from Contra Costa County. Additionally, we have included recommendations for expanded service to and from Marin, Napa, San Mateo, Santa Clara and Solano counties.

Increase express bus service on the Bay Bridge

AC Transit currently has 38 Transbay express buses that cross the Bay Bridge to San Francisco. As of October 2000, these routes carried approximately 14,900 weekday passengers.

Under this proposal, changes would be made to 31 of these routes (figure 7.1). These changes would include: increases in the frequency of service (during the morning peak commute period, the afternoon peak commute period, the off-peak period, and night service), service that would operate later into the evening and night, and new routing. (The G-line would be split into two routes, with the GA serving the stretch north of Dwight, and the GB serving San Pablo Avenue between Dwight and 40th Street).

This increased service on the Bay Bridge would entail a capital cost of $57.8 million, and would cost $19.5 million per year to operate. It is estimated that these service increases would more than double express bus ridership across the Bay Bridge, resulting in 43,400 daily passengers – compared to 19,800 daily passengers if these service changes were not implemented.[30]

Capital cost (103 luxury coaches): $57.8 million
Annual operating cost: $19.5 million
New daily riders: 43,400

[30] Cost and ridership estimates are from MTC's *Bay Crossings Study* and ridership totals are for the year 2025.The cost of purchasing express buses includes spare buses, a 10% contingency allowance, and a 20% project delivery cost.

Figure 7.1: Increased Bay Bridge express bus service

Boldface type indicates the *new* frequency of service or final departure time. For example, 30➢**15** means that four buses per hour – instead of two – would stop at any given bus stop (i.e., a 15-minute headway, instead of the current 30-minute headway).

Line	AM Peak Frequency *(minutes)*	Off-Peak Frequency *(minutes)*	PM Peak Frequency *(minutes)*	Night Frequency *(minutes)*	Last PM Trip
A	*The A-line currently provides "night-owl" service every 60 minutes after midnight.*				
B	30➢**15**	--	30➢**12**	--	6:30➢**7:00**
BX	30➢**15**	--	30➢**12**	--	6:00➢**7:00**
C	20➢**15**	90➢**30**	20➢**12**	60➢**30**	11:00➢**11:59**
CB	30➢**15**	--	30➢**12**	--	8:00
E	30➢**20**	--	20➢**15**	--	7:30
F	30➢**20**	30	30➢**15**	30	11:59
FS	30➢**20**	--	30➢**15**	--	6:45
G	*The G-line would be split into GA and GB.*				
GA	20➢**15**	*none currently*➢15	20➢**12**	*none currently*➢**30**	7:00➢**11:59**
GB	20➢**15**	*none currently*➢15	20➢**12**	*none currently*➢**30**	7:00➢**11:59**
H	20➢**15**	--	20➢**15**	--	7:00
HX	60➢**30**	--	40➢**30**	--	6:00➢**7:00**
K	30➢**15**	--	30➢**15**	--	6:30➢**7:00**
KH	30➢**15**	--	30➢**15**	--	6:30➢**7:00**
L	20➢**15**	--	20➢**15**	--	7:45
LA	15➢**10**	*none currently*➢**15**	15➢**7.5**	*none currently*➢**30**	7:00➢**11:59**
LB	20➢**15**	--	20➢**15**	--	6:00➢**7:00**
LC	20➢**15**	--	20➢**15**	--	7:15
LD	30➢**20**	--	30➢**15**	--	6:15
N	--	--	--	30	11:59
NL	30➢**15**	30➢**15**	30➢**15**	--	7:00
NG	30➢**20**	--	20➢**15**	--	7:00
NF	30➢**20**	--	15	--	6:45
NH	15➢**20**	--	15	--	7:00
NV	60➢**30**	--	60➢**15**	--	6:15
O	15	45➢**30**	15	60	11:59
OX	15	--	15	--	8:00
OX1	30	--	60➢**30**	--	5:00
P	30➢**15**	--	10➢**7.5**	--	7:30
RCV	20	--	20	--	7:00
S	30➢**20**	--	30➢**15**	--	6:15➢**7:00**
SA	30➢**20**	--	30➢**15**	--	6:45➢**7:00**
SB	30➢**15**	*none currently*➢**15**	30➢**15**	*none currently*➢**30**	6:30➢**11:59**
V	20➢**15**	--	15	--	7:30
W	15	--	15	--	7:00
WA	20➢**15**	--	30➢**20**	--	6:00
Y	30➢**15**	--	30➢**20**	--	6:00
Z	15	--	20	--	*reverse commute*

These changes in express bus service are based on MTC's Bay Crossings Study.

Add express bus service to the Hayward-San Mateo Bridge

There is virtually no existing bus service across the Hayward-San Mateo Bridge. The only transit service that is currently available is provided by an employer shuttle from the Hayward BART station, which makes four round-trips per day with limited stops in Foster City.

This report proposes adding three express bus routes to the Hayward-San Mateo Bridge to provide service between the East Bay and Peninsula destinations (figure 7.2). Route ORA1 would serve a potential mixed-use development at Bay Meadows and terminate at Oracle in Redwood City; route FC2 would serve destinations in the northern end of Foster City; and route SFO3 would serve the San Francisco airport via the hotels along Old Bayshore Highway in Millbrae. In order for any of these routes to have the time savings to attract sufficient ridership, they would need a preferred right-of-way on the newly-widened San Mateo Bridge. With Caltrans' permission, this could be accomplished by allowing express buses to access the shoulder lane (see section 7.2b on page 94).

AC Transit plans to implement what will be a first phase of this service in March 2003. The service would run from the Castro Valley and Hayward BART stations to Foster City and the Hillsdale Caltrain station. Ridership would be significantly improved if these express buses were allowed to use the shoulder lane on the bridge, which would significantly reduce their travel time. Although this new service will be a step in the right direction, the operating funds that AC Transit has for this project (a $2 million, three-year CMAQ grant) will only be sufficient to cover service during peak hours with 30-minute headways.

The three routes TALC is proposing would entail a capital cost of $11.2 million, and would cost $6.4 million per year to operate. This new service would attract an estimated 6,200 daily express bus passengers.[31]

Capital cost (20 luxury coaches): $11.2 million
Annual operating cost: $6.4 million
New daily riders: 6,200

Figure 7.2: New Hayward-San Mateo Bridge express bus service

Line	AM Peak Frequency *(minutes)*	Off-Peak Frequency *(minutes)*	PM Peak Frequency *(minutes)*	Night Frequency *(minutes)*	Last Trip
ORA1	15	30	15	30	12:30 AM
FC2	30	30	30	30	11:30 PM
SFO3	15	30	15	30	*hourly after 12:30 AM*

These additions in express bus service are based on MTC's Bay Crossings Study.

[31] Cost and ridership estimates are from MTC's *Bay Crossings Study* and ridership totals are for the year 2025.The cost of purchasing express buses includes spare buses, a 10% contingency allowance, and a 20% project delivery cost.

Increase Contra Costa County express bus service

The Contra Costa County transportation sales tax expenditure plan is being developed in 2002-2003, with a vote on reauthorization expected in 2004. The sales tax offers a significant opportunity to secure funding for new express bus service that is both intra- and inter-county.

TALC has identified a number of promising express bus service expansions (figure 7.3) that should be considered for inclusion in the expenditure plan.

In addition to the purchase of new vehicles for this service, the construction of HOV access ramps would allow the express buses to quickly enter the HOV system, further reducing travel times. The *Contra Costa Express Bus Study* identified 20 candidate locations for HOV ramps. TALC recommends further study to ensure that these HOV ramps would be cost-effective projects.

Capital cost (101 luxury coaches): $40.5 million
Capital cost (20 HOV access ramps): $84 million
Annual operating cost: $13.3 million
New daily riders: 25,000[32]

Figure 7.3: New and expanded Contra Costa County service

Route	Description
New service in the I-80 Corridor	
Martinez to Del Norte BART	Expand existing service to 30 min. frequency during peak hours. The route would include a stop at the Hercules Transit Center.
Martinez to San Francisco	Add new service with 15 min. frequency during peak hours. The route would travel via Hercules, Berkeley and Emeryville.
Vallejo to Del Norte BART	Expand existing service to 10 min. frequency during peak hours, 20 min. midday, and 60 min. during evenings. Add service on Sundays (60 min. frequency).
Vallejo to Emeryville/Berkeley	Add new service with 15 min. frequency during peak hours. The route would travel via Hercules, the Richmond Parkway, and Emeryville.
Hercules to San Francisco	Add new service with 15 min. frequency during peak hours. The route would include a stop at the Richmond Parkway Transit Center.
New service in the I-680 Corridor	
Fairfield to Dublin/Pleasanton BART	Would expand existing service beyond the Dublin/Pleasanton BART station to Bishop Ranch, Hacienda Business Park and the ACE station in Pleasanton.
Vallejo to Concord	Add new service with 15 min. frequency during peak hours. Route would include stops at the Sun Valley Mall/Diablo Valley College and the Concord BART station.
Martinez to Dublin/Pleasanton BART	Add new service with 15 min. frequency during peak hours, 20 min. midday, and 60 min. during evenings. Would include stops at the Sun Valley Mall, Pleasant Hill and Walnut Creek BART stations, Danville, and San Ramon.
New service in far east Contra Costa County	
Antioch (Hillcrest) to Lawrence Livermore Lab	Expand existing *Delta Express* subscription service to 30 min. frequency during peak hours.
Antioch (Hillcrest) to	Add new service with 30 min. frequency during peak and midday

[32] Cost and ridership information is from a presentation to the Toll Bridge Advisory Committee on the *Contra Costa County Express Bus Service Plan* in October 2002.

Route	Description
Dublin/Pleasanton BART	periods and 60 min. during evenings. Route would travel through Brentwood and Livermore, and stop at the Pleasanton ACE station.
Discovery Bay to Pleasanton	Add new service with 30 min. frequency during peak hours. Would travel through Brentwood and stop at the Pleasanton ACE station.
New service in central Contra Costa County	
Brentwood to Walnut Creek/Hacienda	Add new service with 30 min. frequency during peak hours. Route would include stops in Antioch, Pittsburg, Clayton/Concord, Walnut Creek BART, Bishop Ranch, Dublin/Pleasanton BART, and the Hacienda Business Park.
Antioch (Hillcrest) to Baypoint BART	Expand existing service to 15 min. frequency during peak hours, 20 min. midday, and 60 min. during evenings. The route would include stops at Railroad, Loveridge, and County East Mall.
Brentwood/Oakley to Baypoint BART	Add new service with 15 min. frequency during peak hours.
Antioch to Walnut Creek	Expand existing service to 15 min. frequency during peak hours. Route would include stops at the Walnut Creek BART station and the Shadelands Business Park.
Antioch to downtown Concord	Add new service with 15 min. frequency during peak hours. Route would also include a stop at the Concord BART station.

These additions in express bus service are based on the Contra Costa County Express Bus Service Plan*.*

Increase Marin County express bus service

Marin County will be developing a transportation sales tax expenditure plan that will likely culminate in a vote on reauthorization in 2004. The sales tax offers an opportunity to fund additional express bus service. TALC has identified several existing express bus routes that would benefit from service expansions (figure 7.4).

Capital cost (11 luxury coaches): $5.8 million
Annual operating cost: $6.0 million
New daily riders: 1,400[33]

Figure 7.4: Marin County express bus service expansions

Route	Description
Richmond to San Rafael	Expand existing service to 15 min. frequency during peak hours, 30 min. during weekday off-peak periods, and 60 min. during weekends.
Sonoma to Marin	Expand existing service to 15 min. frequency during peak hours. (If the new Sonoma-Marin Rail begins operation this express bus service may no longer be needed.)

These additions in express bus service are based on information from the Golden Gate Bridge Highway & Transportation District.

[33] Cost and ridership information is from a presentation to the Toll Bridge Advisory Committee by the Golden Gate Bridge Highway & Transportation District in October 2002.

Increase Napa County express bus service

We have included three projects for Napa County from our 2000 *World Class Transit* report which we believe may benefit from additional funding.

INCREASE EXPRESS BUS SERVICE TO BART LINK/VALLEJO FERRY

This project provides improved connections to regional transit. Express bus service will connect to BART Link and Ferry Terminal in Vallejo via Route 29. Service will increase from eight to fifteen round trips per day, helping Napa Valley Transit increase its 30% farebox recovery ratio—which is already an excellent figure for rural/suburban transit.

Capital cost (1 luxury coach): $450,000
Total annual operating cost: $150,000

EXPRESS BUS SERVICE TO SAN RAFAEL AND SAN FRANCISCO

Express bus service should be started to the San Rafael Transit Center and San Francisco Transbay Terminal via the Golden Gate Bridge. This could provide zero or one-transfer transit for Napa residents to most activity centers in the Bay Area. Reverse service could be marketed to tourists interested in attending wineries in Napa.

Capital cost (4 luxury coaches): $1.8 million
Total annual operating cost: $375,000

NEW EXPRESS BUS SERVICE BETWEEN FAIRFIELD AND NAPA

There are no transit alternatives in this corridor to serve growing commute and recreational travel. New express bus service is intended to primarily serve commuters between Napa and Solano Counties, and would operate between Fairfield and Napa on 60 minute headways via Route 12.

Capital cost: $1.05 million
Total annual operating cost: $278,000

Increase San Mateo County express bus service

We have included one project for San Mateo County from our 2000 *World Class Transit* report which we believe may benefit from additional funding.

The definition of this project is to expand express bus service throughout the Peninsula to improve the following service areas: South San Mateo/northern Santa Clara County to Millbrae BART; Redwood City to Palo Alto/Sunnyvale; and Central San Mateo County to Millbrae BART.

Bus improvements are intended to better serve Silicon Valley and San Francisco employment markets. Bus service provides more flexibility in serving employment centers east of US 101. The express bus system is compatible with existing or planned rail improvements, as it attracts new riders that otherwise would have too many transfers.

Capital cost: $31.3 million
Total annual operating cost: $18.0 million

Increase Santa Clara County express bus service

We have included two projects for Santa Clara County from our 2000 *World Class Transit* report which we believe may benefit from additional funding.

EXPRESS BUSES TO SILICON VALLEY FROM THE TRI-VALLEY

Currently the only bus service provided in the corridor is by LAVTA from Livermore to Lockheed Martin and Intel in Sunnyvale and by SMART from San Joaquin County to the Tri-Valley and Silicon Valley. New express bus service should be introduced from the Tri-Valley to northern Santa Clara County, San Jose, and other parts of Silicon Valley. Stops would be strategically located to provide connections to park-and-ride lots, the BART station and key employment centers in Fremont, Milpitas, San Jose and Silicon Valley. LAVTA could operate service every 30 minutes during peak periods and every 60 minutes off-peak (more frequent service would be provided to BART).

Capital cost (21 luxury coaches): $9.5 million
Total annual operating cost: $6.2 million

EXPANDED TRI-VALLEY/SILICON VALLEY SUBSCRIPTION EXPRESS BUS

Subscription buses have the advantage of providing the most direct type of transit service to the destination end of a commute trip. LAVTA operates two subscription buses from the Tri-Valley to Lockheed Martin, one to Intel, and two from the Pleasanton BART Station to Walnut Creek. The service (called “Primetime”) utilizes refurbished Golden Gate Transit buses and trains and pays employees from Lockheed and Intel to drive the buses.

The next increment of service involves refurbishing 12 additional buses ($5,000 each to purchase and $40,000 each to refurbish) to operate to destinations in Santa Clara County (IBM, Stanford, etc.). Additional new buses to further expand service will cost approximately $260,000 each.

Capital cost: $540,000
Total annual operating cost: None – will cover all costs if successful

Increase Solano County express bus service

We have included one project for Solano County from our 2000 *World Class Transit* report which we believe may benefit from additional funding.

SERVICE WITHIN SOLANO COUNTY AND TO SACRAMENTO

STA has proposed an ambitious program of intercity buses that will build ridership over time, particularly as HOV lanes in the area are completed. Sacramento service will aid commutes to the state’s capital. (Service from Sacramento to Vallejo would operate at nine-minute frequencies during peak periods, and 60 minutes at midday.) The capital and operating costs are divided almost evenly between the intercity and Sacramento service.

Capital cost (39 luxury coaches): $17.5 million
Net annual operating cost: $3.92 million

7.2 DEVELOP A HIGH-SPEED NETWORK FOR EXPRESS BUSES

Quickly putting new express buses into service (as described in the previous section) would increase ridership, but this is only a first step. Even with 275 miles of bus/carpool lanes and plans to build 144 more miles, key gaps in the high-speed network will still remain. However, rather than constructing expensive new lanes, there are three strategies that offer an inexpensive and quick way to allow express buses to achieve travel times that are competitive with automobiles. These strategies include: using existing, and planned, HOV lanes; using highway shoulders when necessary; and strategically converting certain segments of mixed-flow lanes to HOV lanes. These strategies are all depicted in the map on page 6.

7.2a: *Utilize existing (and planned) bus/carpool lanes.*

By using faster-moving HOV lanes, express buses can get a jump on low-occupancy automobile traffic. Furthermore, as congestion increases and more bus/carpool lanes are completed, traveling via the bus web will often be faster than driving. The map on page 6 shows the Bay Area's existing network of bus/HOV lanes, as well as future HOV lanes that MTC has listed in their latest *Regional Transportation Plan* and their *Transportation Blueprint for the 21st Century*. Since these lanes are already "on the books," they would incur no additional expense to the public or to the overseeing transit agencies. Nevertheless, these construction plans should be reevaluated to determine whether more cost-effective measures – such as "optimize-a-lane" (see section 7.2c) – would be more appropriate. This could free up funds for such purposes as purchasing additional express buses.

In order to assure that express buses continue to achieve faster travel times than regular traffic, traffic speeds and performance on existing bus/carpool lanes must be diligently monitored. If bus/carpool lanes that allow two-person carpools become saturated with vehicles, it may become necessary to require carpools to have a minimum occupancy of three people.

Capital cost: negligible

7.2b: *Operate Express Buses on highway shoulders when necessary to avoid mixed-flow congestion.*

Another way to provide a time advantage for express buses is to give them the right to skirt traffic congestion by traveling on paved highway shoulders.

As noted earlier in this report (see "Uncongested rights-of-way" on page 58), Minneapolis/St. Paul and Ottawa, Canada have had great success in allowing buses to travel on highway shoulders. These cities have different speed limits and requirements for buses using the shoulders. Caltrans and the California Highway Patrol can offer valuable advice in helping to determine what operational parameters would be appropriate for future shoulder usage in the Bay Area.

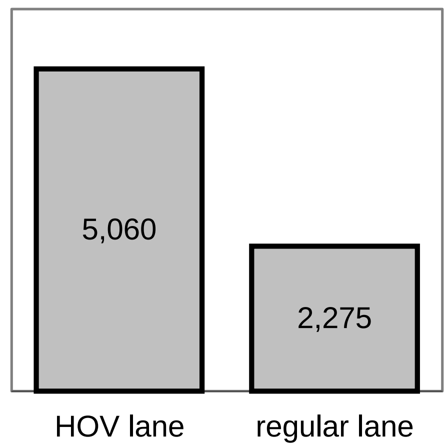
MTC is currently studying the possibility of allowing express buses to use shoulders on segments of Bay Area freeways as part of its *2002 HOV Lane Master Plan Update*. The segments identified in the map on page 6 should be evaluated to determine which shoulders would be appropriate (from both an operational and safety standpoint) to carry express buses.

Capital cost: negligible

7.2c: Expand existing HOV network by strategically converting certain mixed-flow lanes to HOV lanes ("optimize-a-lane").

The third strategy for inexpensively and quickly expanding the HOV network is to convert certain mixed-flow lanes to bus/carpool lanes during peak hours. This strategy, known as "lane optimization" has the potential to speed up buses, carpools, as well as traffic in adjacent lanes.

Figure 7.5:
HOV lanes carry more <u>people</u>



During morning commutes, the west-bound I-80 HOV lane carries over twice as many people as the adjacent lane.

Source: Caltrans measurements at Ashby Avenue interchange, May 2001.

Lane optimization is a virtually free alternative made possible through the strategic conversion of one existing mixed-flow lane (in each direction) to an HOV lane serving buses and carpools. Lane optimization would require no modifications other than some paint and new signs. By carrying high-occupancy vehicles, an optimized lane has the potential to better utilize existing infrastructure by moving a greater number of *people* in the same lane (see figure 7.5). Attracting many more people into carpools and buses could also free up space in the adjacent lanes for people who still need to drive solo: resulting in a win-win situation.

The locations where lane optimization should be studied further are shown in the map on page 6 and meet the following preliminary selection criteria:

- the freeway is already four lanes wide in each direction;
- there are no planned HOV lanes for these freeway segments.

These locations that TALC has identified as potential candidates for lane optimization should be evaluated to determine which ones have the potential to increase the total throughput of *people* (not vehicles) along the freeway corridor. Although this strategy has been perceived as facing political opposition, MTC is currently studying lane optimization throughout the Bay Area as part of its *2002 HOV Lane Master Plan Update*.

Capital cost: negligible

7.3 EMPLOY TRANSFER HUBS FOR EASY PASSENGER TRANSFERS

The strategy detailed in the previous section explains how to give regional express buses priority on the Bay Area's highway network so that they can travel at speeds competitive with automobiles. The strategy in this section explores how to best accommodate the *passengers* who use the Regional Express Bus Web.

For those passengers who will need to combine two bus routes, a system of transfer hubs should be implemented to offer comfortable waiting areas and timed transfers on many routes. A transit hub is any location at which multiple routes or modes of public transportation intersect and that provides access for pedestrians to transfer from one mode or route to the next. By creating inexpensive transfer hubs, it would be possible for many commuters to go door-to-door with no more than one transfer. For example, a commuter from Solano County would be able to travel directly by express bus to San Francisco, Napa, or Oakland, or with one simple connection could reach San Rafael.

Well-designed transfer hubs can dramatically improve the efficiency and attractiveness of transit service. These facilities would serve buses operating throughout the day, and could include real-time information kiosks to display up-to-the-minute arrival time information based on information from satellite tracking systems. These facilities could be designed to be compact and low-cost, but sited so that they could co-locate with transit-oriented development, such as housing or retail. Having development located in close proximity would also reduce the need for transfers because for some passengers their destination would be the transfer hub. Newsstands and cafés could round out the list of passenger amenities, along with restrooms, telephones, and maps.

The following transfer points are recommended to serve the Regional Express Bus Web (see figures 7.6 and 7.7 and the map on page 6). They were selected for:

- their proximity to the highways on the Regional Bus Web,
- their use of existing infrastructure when possible, and
- their connectivity with local bus routes and other transit modes.

Obviously, any time a bus must spend traveling between the highway network and the transfer point is time that could be spent on the network itself and should therefore be minimized. With cost in mind as well as time, existing terminals or transfer points should be used for the new Express Bus Transfer Hubs in order to reduce the capital infrastructure costs and the overall implementation time. Finally, integration with other transit modes allows passengers to easily transfer to ferries or trains, so as to best meet their travel needs.

TALC found that BART and Caltrain stations provided good sites for transfer hubs because of their intermodal connectivity and their park-and-ride lots. When these facilities were not available, we selected transfer hubs already in use by other transit agencies (such as the Vallejo Ferry terminal), or paved lots located close to the highway (such as the proposed Ralston Avenue transfer hub).

Planning the location of regional transfer hubs is a complex and detailed undertaking and, unfortunately, has typically been done only by counties or municipalities, but not at the regional level. Transfer hubs need to be part of a regional system that includes a full hierarchy of transit modes: from rail and ferry, to express bus, BRT, local feeder buses, and shuttle service. The list of hubs in this report should be considered a starting point for a true regional planning process.

Transfer Hub Costs. We assume an average construction cost of $10 million per transfer hub. Even though some sites, such as the El Cerrito del Norte BART station, already have extensive bus facilities, we still assume that these costs would be incurred, as they could be used to provide nicer facilities or increase capacity.

Capital cost: $280 million

Figure 7.6: Existing Transit Hubs or Transfer Points

These transfer hubs are listed alphabetically by county, and then by name. (The transfer hubs are also depicted on the map on page 6.)

Transit Hub Location	Connections with other transit service/Notes
Bayfair BART Station (Alameda County	BART, AC Transit
Dublin/Pleasanton BART Station (Alameda County)	BART, Amtrak feeder bus, County Connection, LAVTA Wheels, Modesto MAX, San Joaquin Regional Transit
MacArthur BART Station (Alameda County)	BART, AC Transit, Emery-Go-Round
Richmond BART/Multimodal Center (Alameda County)	The Richmond Center was built as part of the original BART system in 1972. The center is near downtown Richmond and serves as the northern terminus of BART, as well as an access point to AC transit bus routes and Amtrak's Capitol Corridor service. The center utilizes a central underground concourse, which provides direct access to both BART and Amtrak without crossing tracks. The center is also easily accessible by bicycle with bicycle stalls in view of a station attendant. Recent improvements to circulation and bus bays allow smooth flow of vehicles and provide a safe pedestrian movement. Parking areas are situated outside of the transit flow patterns and good pedestrian connections are made between parking areas and the station.
El Cerrito del Norte BART Station (Contra Costa County)	BART, Vallejo Transit, AC Transit, WestCAT, Golden Gate Transit

Transit Hub Location	Connections with other transit service/Notes
Pittsburg/Bay Point BART Station (Contra Costa County)	BART, Tri-Delta Transit
Pleasant Hill BART Station (Contra Costa County)	BART, Benicia Transit, County Connection, Fairfield/Suison, LAVTA Wheels
San Ramon Transit Center (Contra Costa County)	County Connection
San Rafael Transit Center (Marin County)	 Golden Gate Transit
Transbay Terminal (San Francisco County)	The Transbay Terminal, originally built in the 1930s as the San Francisco terminus of the Key System, serves as a major center for Muni, AC Transit, Golden Gate Transit, SamTrans and Greyhound. Service is provided for downtown San Francisco and to the rest of the region. The Transbay Terminal has a number of positive attributes that set it apart from other regional transit centers. It is located only a few blocks from downtown San Francisco and is thus close to shopping and eating establishments. Unfortunately, the terminal is old, dirty, and confusing, with poor signage and dark areas that are a security problem at night. A number of the operators accept inter-operator transfers, but the relocation of Golden Gate Transit and SamTrans from inside the terminal to poorly marked areas outside of the facility has created an obstacle to physical integration between operators. Many travelers simply get lost. The situation will be dramatically improved with the construction of a new Transbay Terminal (see picture on page 74). This project will allow for much better transfers between AC Transit, Muni, Golden Gate Transit, SamTrans and Greyhound routes, as well as with a future Caltrain downtown extension. (The terminal will still be at least a five-minute walk from the Ferry Terminal, and alternatives to bridge this gap should be investigated.) This project is one of a limited number of projects that are included as part of MTC's *Regional Transit Expansion Policy*.
Colma BART Station (San Mateo County)	BART, SamTrans
Hillsdale Caltrain Station (San Mateo County)	Caltrain, SamTrans
Millbrae Caltrain Station (San Mateo County)	Caltrain, soon-to-open BART service, SamTrans

Transit Hub Location	Connections with other transit service/Notes
Cottle VTA Light Rail Station (Santa Clara County)	 The Cottle VTA light rail station is across the street from a park-and-ride lot and office development. The lot could potentially be used for express bus service.
Diridon Station, San Jose (Santa Clara County)	This station, located west of downtown San Jose, first opened in 1935 and was renovated in 1994. Presently it serves two commuter trains (Caltrain and ACE), Amtrak inter-city trains, as well as extensive bus service. The bus terminal is located on the east side of the main depot, and the train platforms are on the west side. Despite its distance from downtown and major commercial and retail activity, the station serves as a major transit center. The location of the San Jose Arena only a block away greatly improved the connection between transportation and surrounding land use. Future plans for the VTA light rail include an extension from downtown to the Diridon Station.
Mountain View Caltrain Station (Santa Clara County)	  This downtown Mountain View location has Caltrain, VTA bus and light rail service, and is in close proximity to transit-oriented housing.
Palo Alto Caltrain Station (Santa Clara County)	Caltrain, VTA buses, Dumbarton Express, and SamTrans. This station would also be a stop for the El Camino Real BRT service proposed in this report.
Vallejo Ferry Terminal (Solano County)	Vallejo Transit, Napa Vine Transit, Benicia Transit

Figure 7.7: Proposed New Transfer Hubs

These transfer hubs are listed alphabetically by county, and then by name. (The transfer hubs are also depicted on the map on page 6.)

Transit Hub Location	Other transit service/Notes
14th & Jefferson, Oakland (Alameda County)	Could potentially be located in a vacant lot at 14th and Jefferson, close to I-980. This site is close to the 12th Street BART station and several AC Transit routes.
Dumbarton Bridge (Alameda County)	Could potentially be located in a parking lot at 5869 Jarvis Road if property owners are interested in a joint development, or at a nearby park and ride lot. Site is in adjacent to Dumbarton Express service.
Greenville Road (Alameda County)	Potential sites exist near the Greenville Road interchange off of I-580. Tri-Delta Transit, Wheels, and could also potentially serve existing Amtrak feeder buses Modesto MAX, and San Joaquin Regional Transit.
University Avenue, Berkeley (Alameda County)	Could potentially be located in a parking lot next to Spenger's Fish Grotto at the University Avenue exit off of I-80. This site is along the University/Alameda BRT Corridor proposed in this report, and is adjacent to existing AC Transit and Amtrak Capitol Corridor service.
Ralston Avenue (San Mateo County)	Could be located at this existing SamTrans park and ride lot.
DeAnza College (Santa Clara Co.)	 DeAnza College is located along highway 85, near I-280. There is existing VTA bus service to the college, and the college appears to have ample amounts of excess parking space which could be used for a mixed-use transfer station development if DeAnza College is interested.
Great Mall (Santa Clara County)	Could potentially be located in a parking lot adjacent to the Great Mall and to VTA Light Rail. Also a proposed stop for the BART extension to San Jose.

Transit Hub Location	Other transit service/Notes	
Oakridge Mall (Santa Clara County)		Could potentially be located in a parking lot adjacent to the Oakridge Mall and to the VTA light rail station.
Story and King (Santa Clara County)		This potential site is mostly vacant, with excess space in its parking lot for a potential express bus station. This site is also along the El Camino Real BRT Corridor proposed in this report and adjacent to existing VTA bus routes.
Winchester Boulevard (Santa Clara County)		This potential site is adjacent to a future Vasona Junction VTA light rail station, and is very close to the intersection of highways 17 and 85.

7.4 AN EXPRESS BUS SYSTEM INSTEAD OF BART IN THE TRI-VALLEY

This section makes the case that an express bus system is the best transit solution for the Tri-Valley cities of Livermore, Dublin, and Pleasanton. An express bus system would provide rapid, comfortable service, at a low cost, and could be up and running quickly.

The alternative, extending rail from the Dublin/Pleasanton BART station to Livermore would be a tremendous waste of scarce transportation funds, given the enormous cost and low ridership such an extension would generate. A rail extension also would not carry a single passenger for at least 10 to 15 years.

Extending BART to Livermore along the I-580 median would cost a staggering $760 million (excluding the costs of operating the extension), but would generate a mere 3,390 new daily transit trips in 2020.[34] A diesel train alternative to the BART extension, dubbed tBART, would cost half as much ($380 million), but would generate less than half the ridership (1,380 trips).

In September 2002, the I-580 Corridor Study Policy Advisory Committee – following a July vote by the Livermore City Council – rejected an alternative route which would have extended rail to downtown Livermore. Although this route would have been more expensive, at least it had Smart Growth potential, unlike the chosen route which will operate in the I-580 median.

The proposal, which we have dubbed intelliBART, offers a better alternative: high-tech express bus service operating on the median of I-580 (or on new HOV lanes), which could begin service in one to two years, move passengers more quickly to their destinations and do this at a truly affordable price.

IntelliBART offers the greatest short-term benefits: a direct link to the BART system, as well as improved mobility along local streets and roads in Livermore and the Tri-Valley. It also offers long-term benefits in the form of more livable, walkable and convenient neighborhoods. This is directly attributable to the fact that intelliBART would offer more transit stops and stations than tBART or a BART extension, and these hubs could serve as a backbone for Smart Growth and transit-oriented development – particularly in Livermore. IntelliBART offers numerous other advantages; it would: be up and running much sooner than any other form of transit, carry passengers faster and more frequently, cost a fraction of tBART or a BART extension, be flexible and upgradeable, and offer clean air benefits.

The intelliBART proposal builds on the express bus alternative studied as part of the joint BART/Alameda County Congestion Management Agency I-580 Corridor Study. However, the intelliBART proposal dramatically cuts the implementation time of the study's express bus plan; offers passengers a

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[34] *Draft Final Report: I-580 BART to Livermore Study*, June 27, 2002, from www.580corridor.com

superior travel experience in high-tech, BART-like rubber-tire vehicles; and provides faster travel along more local routes.

With a construction cost of between $35 and $65 million (depending on the type of vehicle chosen) and only one or two years for startup, intelliBART is the solution that will meet the needs of Livermore and the Tri-Valley.

The intelliBART Alternative

IntelliBART would serve two broad markets: the 30,000 commuters who traverse the Altamont Pass on a daily basis, and the 155,000 residents of Livermore, Pleasanton and Dublin. IntelliBART would use sleek, high-tech rubber-tire vehicles; special priority on I-580 to carry passengers comfortably and quickly to BART; and new traffic signal systems, communications technology and route reconfiguration to cut travel times along local streets.

Figure 7.8

Josh Apte

Luxurious coaches, such as this one used by Tri Delta Transit, feature padded, reclining, high-back seats; luggage storage; tray tables and music and video entertainment.

Luxurious – coaches could be used (see figure 7.8). These vehicles, intended for longer-distance commutes, typically feature padded, reclining seats; tray tables; power ports for laptop computers and music and video entertainment.

A high-speed backbone: express service along I-580

The heart of the intelliBART proposal is simple: enable intelliBART vehicles to zip past traffic on I-580. The vehicles would depart frequently and would originate in both downtown Livermore and at a Greenville Road Transit Center. The intelliBART system would allow passengers to make reliable, timed transfers to BART trains at the Dublin/Pleasanton BART station. Passengers continuing on to employment destinations difficult to reach via BART, such as office parks in San Ramon and Walnut Creek, could connect to existing and newly proposed express bus service to these areas.

Ultimately, schedule reliability and quick travel times would be ensured through the use of HOV (carpool) lanes on I-580 and a special HOV connector ramp to the Dublin/Pleasanton BART station. Although Caltrans does not expect to open HOV lanes on I-580 before 2009 (assuming a typically lengthy study, design and construction timetable), there are a number of creative ways to ensure that intelliBART will still be able to move faster than regular I-580 traffic far sooner than 2009. These include: phasing the HOV lanes, optimizing an existing lane and installing a connector ramp.

Phasing the HOV lanes. A single, reversible-direction HOV lane in the median strip would be less costly and time consuming than building two HOV lanes. This would enable HOV facilities to open sooner and would allow for time savings in the direction of rush-hour traffic.

Optimizing an existing lane. This is a virtually free alternative made possible through the strategic conversion of one existing mixed-flow lane (in each direction) to an HOV lane serving intelliBART, other buses and two-person carpools. Lane optimization would require no modifications other than some paint and new signs. By carrying high-occupancy vehicles, an optimized lane would better utilize existing I-580 infrastructure by moving a greater number of *people* in the same lane. Attracting many more people into intelliBART, carpools and buses, could free up space in the other three lanes for people who still need to drive solo.

Lane optimization would bring back the HOV lanes that used to be on I-580 about thirty years ago. Although traffic was light then and the lanes were not really needed at the time, afternoon congestion on I-580 between Hopyard and El Charro increased 4200% between 1992 and 2000 – a key reason to reinstate the HOV lanes. Although lane optimization has previously been perceived as facing political opposition, the Metropolitan Transportation Commission is currently studying this alternative as part of its *2002 HOV Lane Master Plan Update*.

Install a connector ramp. A reversible-flow ramp would allow intelliBART to directly access the Dublin/Pleasanton BART station in the morning without having to merge across multiple lanes. In the afternoon, the ramp would change direction, allowing intelliBART to enter the HOV lane heading eastbound. This concept – originally developed by Korve Engineering for Shea Homes Northern California as part of their transit package for the proposed North Livermore development – is estimated to cost $18 million.

Greenville Road Transit Center

There is a critical need to get Central Valley commuters off of the Tri-Valley's local streets and freeways. Approximately 28% of drivers coming over the Altamont Pass are headed to Silicon Valley.[35] Expanded Altamont Commuter Express (ACE) train service would do the most to help get these commuters onto transit, and the low capital cost of intelliBART would free up funding for an expansion of ACE service above the eight round-trip trains per day that are already planned.

For commuters not headed to Silicon Valley, intelliBART service from a Greenville Road Transit Center would allow them to connect directly to the Dublin/Pleasanton BART station (figure 7.9). The station site, on land that is currently owned by BART, would include an air-conditioned pre-paid boarding area, electronic signs showing real-time arrival information for the next intelliBART vehicle, bicycle and pedestrian access paths, bicycle racks and lockers, restrooms, telephones and comfortable seating.

Upon arrival at the Greenville Center, passengers would purchase BART tickets at convenient ticket machines and pass through BART fare gates in

[35] San Joaquin Partnership Altamont Pass Commuter Survey, October 2000.

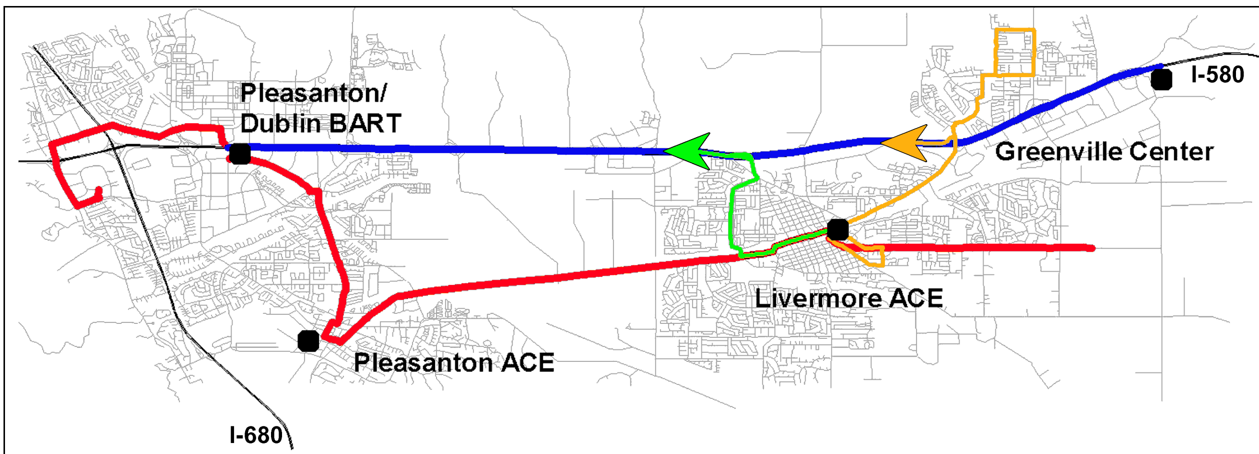
order to board intelliBART. In this way, intelliBART riders would not have to fumble for change while boarding and would already be in the BART system so that they would not need to stop to purchase tickets at the Dublin/Pleasanton BART station. To further speed the boarding process, intelliBART vehicles would have low floors matching the height of the boarding platform and multiple wide doors. Thus, boarding intelliBART would be as quick and easy as boarding BART. IntelliBART vehicles would depart the Greenville Center every 10 to 15 minutes, offering a direct, express trip to the Dublin/Pleasanton BART station that would be timed to connect with BART trains.

The Greenville station would also be a transfer point for Tri Delta, MAX (Modesto Area Express), SMART (San Joaquin Regional Transit District), and Greyhound passengers. The station would include a 750-space parking garage. This modest size would be made possible by increased Central Valley express bus and ACE service and potential future intelliBART service over the Altamont Pass.

Tri-Valley express service

IntelliBART would offer similar benefits to Tri-Valley residents, with vehicles traveling along local routes (see map below) to collect passengers near their homes, and entering the I-580 HOV facilities for a direct express trip to BART. The service would operate along the local transit agency's (Wheels) three highest-ridership routes – the 10, 11 and 12/12X, which currently carry about 70% of all Wheels passengers. Local intelliBART service would travel faster and more frequently than current Wheels service, and would boast greatly improved stations and stops and real-time passenger information systems.

Figure 7.9



IntelliBART would operate along I-580 to the Dublin/Pleasanton BART station. Direct, express service would operate along the blue line using HOV facilities and connect to the BART station. The green and orange arrows indicate where local routes enter the HOV system and proceed directly to BART. All local service on the orange, green and red lines would benefit from technological and infrastructure changes which would slash travel times by 20 - 25%.

Faster Travel

IntelliBART service would utilize new technology and a reconfiguration of transit stops in order to slash travel times on local streets by 20 - 25%.

New technology. Traffic signal priority is a cost-effective way to ensure the efficient movement of intelliBART and Wheels buses on local streets without them frequently getting stuck at red lights. (For example, the popular #10 buses, which carry over half of all Wheels riders, encounter 43 traffic lights along the route.) A signal priority system would better manage the overall flow of traffic and speed transit service along congested and traffic signal-laden local streets, such as Stanley Boulevard, Santa Rita Road and the western portion of Dublin Boulevard.

A typical signal priority configuration – made possible through the use of smart traffic signals, transponders on transit vehicles and satellite tracking systems – extends the duration of the green light for an approaching transit vehicle. A signal priority system is possible now that Dublin, Livermore and Pleasanton are changing to the same type of traffic signal controller and I-580 Smart Corridor Project funds are available for the installation of transponders in transit vehicles.

Transit stop reconfiguration. IntelliBART would also travel faster due to greater spacing between stops, although local service with more closely spaced stops could still be maintained. This approach has been highly successful in other cities, such as Los Angeles, given that most passengers prefer shorter transit times even if it means walking or traveling a bit further to reach a transit stop.

More Frequent Service

Reducing travel times on local streets by 20 - 25% would also enable intelliBART service to run more frequently without any increase in operating costs. This increased frequency would reduce waiting times and thereby help attract new passengers. (See "Faster, more frequent service" on page 9 for specific frequencies along each route.)

Improved Passenger Facilities and Information Systems

Upgraded stops and stations. IntelliBART "super stops" (see "Improved bus station design" on page 72 for a description) and additional developer-funded transit stations (discussed and pictured on the following page), would offer a more comfortable and convenient passenger experience – an additional lure to attract new riders.

Passenger information systems. The satellite tracking system mentioned above would also be used to keep passengers apprised of the exact arrival time of the next intelliBART. With the system, the Tri-Valley would join the ranks of San Francisco, Emeryville and Santa Barbara, who already provide real-time information to passengers at transit stops and stations, as well as via Internet browsers and web-enabled wireless devices. This would benefit both transit-dependent passengers and upper-income "choice" riders, as both groups would be able to minimize their wait times.

Building Smart Growth potential

IntelliBART offers an alternative to giant, but perennially-full BART parking lots. Because intelliBART would traverse multiple routes, it would serve more stations and stops than tBART or a BART extension, coming closer to people's homes. The increased number of transit nodes, combined with the greater ease of walking or biking to intelliBART, would greatly reduce the amount of parking required at each station. This, in turn, would allow for moderately higher-density development around stations – such as housing, office space and neighborhood stores.

This type of "transit-oriented development" can create convenient neighborhoods that help reduce the distance that residents and employees must drive. It is also a positive factor in the eyes of the Federal Transit Administration when evaluating which transit projects should receive federal funding.

In short, intelliBART offers the exciting possibility of attractive, well-designed, smaller-scale stations instead of a giant 5,000-space parking lot on the eastern edge of Livermore (surrounding a tBART or BART station), which would do little to meet the city's Smart Growth goals.

Advantages of intelliBART

IntelliBART offers numerous benefits to the Tri-Valley and I-580 commuters; it would: be up and running much sooner than any other form of transit, carry passengers faster and more frequently, be more accessible and serve a broader market than the rail alternatives being considered, cost a fraction of tBART or a BART extension, be flexible and upgradeable, and help address the Tri-Valley's air quality concerns.

Ready sooner. IntelliBART could be in operation many years before tBART or a BART extension would ever carry a single passenger. Extending BART or building tBART would require the creation of totally new infrastructure (tracks, stations, bridges for road crossings, signals, etc.), which would entail many years of design and engineering, environmental review, and construction. Furthermore, both rail projects would be contingent on securing hundreds of millions of dollars in funding, which is a distant future prospect.

IntelliBART also has the advantage of being incrementally upgradeable. TBART or a BART extension would both be unusable until the entire project was completed. Even worse, they would cause horrible congestion and delays during their years of construction. Individual components of the intelliBART system, on the other hand, would each offer benefits and time savings to passengers. For example, intelliBART vehicles could switch from a single, reversible-flow lane to dual HOV lanes (once they are available) and ultimately take advantage of a connector ramp to the Dublin/Pleasanton BART station once it is built.

Faster, more frequent service. IntelliBART would always travel faster than rush hour traffic on I-580 due to the use of HOV lanes. And through such options as lane optimization and phasing, HOV lanes could be available very quickly.

Once HOV facilities are available, the travel time for the intelliBART blue line would be nearly the same as for tBART. Similarly, peak period travel time from downtown Livermore to the Dublin/Pleasanton BART station would be reduced from the current 27 minutes on Wheels Route 12X to about 17 minutes on the intelliBART green line (see map, page 5). A signal priority system and transit stop reconfiguration would result in a 20 - 25% time savings along local portions of intelliBART routes.

During the peak periods of morning and afternoon commutes, intelliBART service would run every 10-15 minutes between the Greenville Road Transit Center and the Dublin/Pleasanton BART station, every 15 minutes along the green and orange express routes and every 20 minutes along the red and orange local routes. During off-peak hours, nights and weekends, intelliBART service would run every 15 to 30 minutes. All of these frequencies match or exceed current Wheels service and likely BART or tBART frequencies.

More accessible = broader market. IntelliBART would be easily accessible to a greater number of people than tBART or a BART extension. This is because intelliBART would operate along multiple routes and would have many more transit stations and stops than either of the two rail options. IntelliBART would directly serve commuters heading over the Altamont Pass, while additional routes operating through Livermore, Dublin and Pleasanton would pass closer to more residences and businesses, offering a more “fine-grained” service that would be within easy walking distance of a greater number of people’s homes and employment destinations.

In contrast, a tBART or BART extension along I-580 to Greenville Road would not serve Livermore residents well as it would require them to go out of their way to reach it. Likewise, BART or tBART service through downtown Livermore would offer slower service to Central Valley commuters as it would force them to travel a 25% longer (12 miles instead of 9.5 miles) and considerably slower route, and would bring thousands of cars towards the already congested downtown.

Most cost-effective. IntelliBART is by far the most cost-effective transportation option available to serve the I-580 Corridor and the Tri-Valley. A BART extension in the I-580 median would cost $760 million, a tBART extension $380 million, and intelliBART $50 million. On the basis of cost per new rider, the BART and tBART extensions could be two times, or more, as expensive as intelliBART – with costs dropping for intelliBART if bus-centered transit-oriented development is implemented.

Flexible and upgradeable. IntelliBART’s inherent flexibility would allow it to more easily serve whatever new developments may occur in the Tri-Valley. And, unlike tBART, which would require ripping up the rail tracks to lay down BART tracks, at enormous expense, intelliBART would not preclude a future BART upgrade.

Cleaner air. According to the Bay Area Air Quality Management District, Livermore exceeds national ozone standards more than any other Bay Area city. While some of these air quality problems are due to upwind pollution sources, intelliBART would still help address the Tri-Valley's air quality problems. Unlike tBART or a BART extension, which would only operate along one route and serve *either* Central Valley commuters or Livermore commuters, intelliBART would operate along multiple routes, thereby taking single-occupancy cars off of the stretch of I-580 between the Greenville Road Transit Center and the Dublin/Pleasanton BART station *as well as* from the commute along local roads between Livermore and the BART station. IntelliBART vehicles – which could begin service with low-emission hybrid-electric engines – could later be upgraded to zero-emission hydrogen fuel cell power as the technology (which is now available in prototype form) becomes more readily available over the next five to ten years

Appendix I: BRT/Enhanced Bus Cost and Ridership Details

A note about costs

The best, and most in-depth, local BRT cost estimate comes from the studies that AC Transit has done for the International/Telegraph BRT Corridor. The project's comprehensive cost estimate of $19.4 million per mile includes stations, communication systems (radio system, Automatic Vehicle Location system, operations control center, etc.), environmental mitigation, sidewalk improvements, signage and lane striping. However, this is a conservative (high-end) estimate because it also includes new traffic signals and controllers at every intersection, new concrete pavement along the entire length of the BRT lanes, and an entire set of new articulated, low-floor, clean-diesel buses to operate along the route (with a five-minute frequency). Most likely, not all of the traffic signals will need to be replaced, the existing pavement may be useable for BRT, and the agency may use some existing buses instead of buying all new ones.

Based on AC Transit's figures, the estimated costs for the Full-Scale BRT corridors we are recommending range between $13.4 and $21.2 million per mile. The $13.4 million cost assumes that existing pavement could be used (saving $6 million per mile). The $21.2 million cost would repave the transit lanes with smooth, long-lasting concrete pavement and upgrade from standard low-floor articulated buses to sleek, high-tech, hybrid-electric Civis vehicles or their equivalent (see Figure 4.1), at $1.2 million each.[36]

For the Enhanced Bus corridors that we are recommending, we estimate a cost of $3.6 million per mile. This is a conservative (high-end) estimate, because it includes upgraded traffic signals and controllers at all intersections; sufficient new, high-quality, articulated buses to operate along the corridor at 5-minute intervals; and sidewalk-side stations and platforms with ticket vending machines and validators.[37]

[36] AC Transit calculates a $1.1 million per mile bus cost, which assumes an operating speed of 16 mph, 5-minute headways, and $522,500 per vehicle (including transponders and a 15% allowance for spare vehicles). Civis vehicles (at $1.39 million per vehicle, including transponders and a 15% spare allowance) would add an additional $1.8 million per mile to the project cost.

[37] These estimates are based on AC Transit's figures: $140,000 for traffic signals and controllers per intersection (we assume up to 10 intersections per mile will need to be upgraded), $1.1 million per mile for new vehicles, and $280,000 per station (including platforms and ticket machines). We assume stations will be located every half-mile, on average, on both sides of the street.

San Francisco Corridors

Tier	Proposed Corridors	Existing Routes in Corridor	Current Daily Ridership on Core Corridor Routes	Current Daily Ridership on Non-Core Routes	Corridor Length (miles)	Capital Cost *$millions*	Total Daily Corridor Ridership, with BRT (in 2020)	Total Daily BRT Riders (in 2020)	Capital Cost per BRT Rider	Net New Transit Riders (in 2020)	Capital Cost per Net New Transit Rider
Tier One	Geary	38/38L	46,906			†					
		1		28,794							
		2		6,865							
		4		4,716							
	Geary subtotal		46,906	40,375	6.1	$92-156	63,800-118,700	29,300-54,600	$0.46-$1.44	12,000-22,300	$1.12-$3.51
	Van Ness	47	6,753								
		49 ††	9,740								
	Van Ness subtotal		16,493	-	2.2	$29-47	22,400	10,300	$0.77-$1.22	4,200	$1.90-$3.00
	Tier One Totals:		63,399	40,375	8.3	$122-203	86,200-141,100	39,600-64,900	$0.51-$1.38	16,200-26,500	$1.24-$3.38
Tier Two	Market †††	numerous routes	(est.) 10,000								
	Market subtotal		10,000	-	2.0	$27-42	13,600	6,300	$1.15-$1.82	2,600	$2.78-$4.40
	Mission	14/14L	43,362								
		49 ††	9,740								
		26		6,287							
		67		3,269							
	Mission subtotal		53,102	9,556	8.3	$82-123	69,300-81,800	30,300-35,800	$0.62-$1.10	12,000-14,100	$1.57-$2.77
	Lombard/Bay/ Columbus/ Stockton/4th	30	26,428								
		45	19,344								
		30X		2,468							
		41		3,561							
	Lombard/Bay... subtotal		45,772	6,029	5.6	$57-87	60,000-68,000	26,400-29,900	$0.52-$0.89	10,500-11,800	$1.31-$2.24
	Potrero/Bayshore/ Geneva	9	18,461								
		9X, 9AX, 9BX	12,814								
	Potrero/Bayshore/Geneva subtotal		31,275	-	8.2	$50-66	39,100	16,100	$0.84-$1.11	6,100	$2.22-$2.94
	Evans/Cesar Chavez	19	12,690								
		44		15,338							
	Evans/Cesar Chavez subtotal		12,690	15,338	4.3	$58-91	17,300-38,100	7,900-17,500	$0.89-$3.12	3,200-7,100	$2.19-$7.69
	19th Ave	28/28L	14,447								
		29		14,490							
	19th Ave subtotal		14,447	14,490	7.2	$96-153	19,600-39,400	9,000-18,100	$1.44-$4.58	3,700-7,400	$3.52-$11.14
	Fillmore/16th Street	22	24,491								
	Fillmore/16th Street subtotal		24,491	-	5.2	$40-57	31,200	13,200	$0.82-$1.17	5,100	$2.13-$3.04
	Tier Two Totals:		191,777	45,413	40.8	$411-620	250,100-311,200	109,200-136,900	$0.81-$1.53	43,200-54,200	$2.04-$3.88
	San Francisco Totals:		255,176	85,788	49.1	$532-823	336,300-452,300	148,800-201,800	$0.71-$1.49	59,400-80,700	$1.78-$3.74

† The Geary capital costs include sufficient new buses for 2-minute headways, instead of 5-minute headways, as on all other corridors.

†† Total current daily ridership for route 49 is 19,480. It is allocated 50/50 in the table between the Van Ness and Mission corridors.

††† Ridership along Market Street is much higher than 10,000; this is an estimate of the number of riders whose trips begin and end on Market Street.

Appendix II: BRT Resources

The contacts below are for BRT and express bus projects mentioned in the report.

Federal Transit Administration

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www.actransit.org/onthehorizon/mis.wu

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www.allaboutsilverline.com

Curitiba, Brazil

www.curitiba.pr.gov.br/pmc/ingles/index.html

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Eugene-Springfield, Oregon

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Mr. Stefano Viggiano
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www.ltd.org/brt1.html

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www.oahutrans2k.com

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www.mta.net/metro_transit/rapid_bus/metro_rapid.htm

NOTE: MTA is responsible for Metro Rapid service and the DoT is responsible for signal priority.

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www.co.miami-dade.fl.us/transit/metrobus/busway.htm

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www.ridegold.com/eastbusway/index.asp OR /westbusway/index.asp

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