Bus Rapid Transit For New York City

Prepared for

Transportation Alternatives

NYPIRG Straphangers Campaign

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Summary

New York City has the slowest bus service in America. NYC Transit buses travel at an average speed of 7.5 mph. On bus routes such as the M96, M23, M15, Q32, BX35 and B63, the average speed is 6 mph or less.

That buses are traveling in slow motion is obvious to everyone, especially riders, who rank it the most serious problem with bus service. Slow bus service discourages people from taking buses, especially for work trips where travel time is critical. Slow bus service contributes to very long travel times to work in New York City, as shown by the latest census.

Bus service is slow for many reasons. Traffic congestion is clearly a major factor. But other problems are just as important:

- Buses spend as much as 30% of their time waiting for passengers to board and exit.
- Increased crowding on buses due to ridership growth has lengthened delays from boarding and exiting.
- Traffic signals are not synchronized with bus speeds, so buses are delayed by red lights between bus stops.
- Drivers often have to slow down to stay on schedule even when traffic is light.
- Bus field supervisors lack the tools to prevent bus bunching.

Summary (cont.)

Bus Rapid Transit (BRT) is a promising strategy for improving bus service. By applying features used in rail service to bus service, BRT can make buses faster, more reliable and more attractive.

BRT has been applied successfully in major cities including Los Angeles and Vancouver, British Columbia as well as cities in South America, Europe and Australia. BRT has produced 15-40% increases in bus speeds and 15-150% increases in ridership.

BRT features showing the most promise for implementation in New York City include:

- More frequent service where needed.
- Bus bulbs, which bring the sidewalk out one lane so buses do not have to maneuver into and out of bus stops.
- Longer bus stops to eliminate delays as buses wait to enter the stop.
- Bus lanes with raised lane dividers or other physical means to discourage or prevent other vehicles from violating bus lanes.
- Low-floor buses that can speed boarding and exiting and encourage riders to exit through the rear door.
- Pre-boarding fare payment at selected high-volume boarding times/locations to reduce dwell time at bus stops.
- Bus traffic signal priority to help late-arriving buses catch up to schedule.
- Real-time management of buses to achieve even spacing between buses.

Summary (cont.)

BRT features applied to M15 limited stop buses on First/Second Avenue in Manhattan could dramatically improve bus service.

- One alternative, using dual bus lanes, low floor buses, raised lane dividers and pre-boarding fare payment during rush hour at six locations, would reduce bus travel times by 21-27% compared to the current limited stop service and reduce the variability of travel time by 38%. Bus riders would save 9-17 minutes for a trip from 125 Street to Houston.
- A more far-reaching set of BRT features that includes an exclusive bus lane would reduce travel times by 37-53% compared to the current limited stop service and improve reliability by 86%. Bus riders would save 16-34 minutes for a trip from 125 Street to Houston.

Achieving these improvements to bus service on Manhattan's East Side and in other congested corridors throughout the five boroughs will require close cooperation between the Department of Transportation, which controls the streets and bus stops, and New York City Transit, which operates most bus service in the city.

DOT and NYC Transit should identify key corridors for a BRT demonstration program. Candidate demonstration streets include First and Second Avenue in Manhattan and major avenues leading into commercial centers in the other boroughs, such as Flatbush Avenue in Brooklyn; Jamaica Avenue, Archer Avenue and Main Street in Queens; and Third Avenue in the Bronx.

Summary (cont.)

A DOT/NYCT demonstration program should begin with sections of several corridors that have heavy bus volumes. The demonstration project should be aimed at testing BRT features listed above. Each demonstration site should be evaluated for improvements to bus travel speeds, reliability of bus travel times and impact on other traffic. Modifications should be made as needed. Results of the demonstration program should then be used to implement BRT features on the rest of each demonstration corridor and in other locations throughout the city.

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Los Angeles Metro Rapid

Overview of Bus Rapid Transit

What is Bus Rapid Transit?

Bus Rapid Transit is a strategy for improving transit service in a cost-effective and relatively quick fashion. The strategy is simple: “Think rail, use buses.”

BRT applies to buses features that are characteristic of rail service. These include:

- A dedicated right-of-way
- Pre-boarding fare payment
- Level boarding and alighting
- Multiple door boarding and alighting
- Distinctive station designs
- High capacity vehicles
- Greater distances between stops
- Easy to understand route structure
- High frequency, all day service

Dedicated right of way and level boarding and alighting in Quito, Equador

Selection of features is based on the needs of a particular route. It is critical to analyze the particular problems that create slow and unreliable service on specific routes and select features that address those problems.

What is Bus Rapid Transit? (cont.)

BRT recognizes that a *combination of features* is required to make a real difference in bus speeds and reliability. In an integrated package, the whole becomes more than the sum of the parts.

BRT also emphasizes the importance of a strong system ID to make buses attractive and easy to use. Branding BRT lines creates a distinct identity like that for subway and light rail services. Simple route structures and color coding of buses, bus stops and bus lanes can play a major role in creating a strong system image and identity.

Thus, BRT achieves:

- Speed
- Reliability
- Strong image and identity

Rouen, France. Color-coded bus lanes make the bus route clear and visible.

BRT's Effectiveness

BRT implementations on arterial streets in Los Angeles,[(8)]* Chicago,[(2)] Vancouver, British Columbia[(5)] and South and West London[(7)] have achieved:

- 15-40% increases in overall speed
- 15-150% increases in ridership
- Improved reliability

Highway HOV lanes and busways have also achieved speed and reliability improvements:

- Buses using the Gowanus Expressway high occupancy vehicle (HOV) lane in Brooklyn travel 69% faster than traffic on the general use lanes in the morning peak period. [(15)]
- In Houston, HOV lanes produced a near doubling of bus speeds, from 26 mph to 49 mph.[(18)]

*See the numbered list of sources at the end of this report.

How is BRT Different From Limited Bus Service?

Limited stop bus service in New York City uses one BRT feature: greater distances between stops. On certain routes, buses use another BRT feature: bus lanes.

But BRT offers many additional features that can further increase speed, reliability and system image. These include pre-boarding fare payment, level boarding and alighting and bus traffic signal priority.

Madison Avenue, Manhattan. Despite bus lane, limited stop service averages only 6.5 mph.

What is the Passenger Capacity of BRT?

BRT can offer substantially greater passenger capacity than current bus service.

- BRT capacity: 6,300 passengers at the peak hour
  - Based on using articulated buses and operating with 1 minute headways for the BRT service and 3 minute headways using 40’ buses for local service.
- As a comparison, the scheduled capacity of the M15 in the AM peak hour is 2,340.
  - Difference with BRT is due to less frequent service (1.5 minute headways for local and limited combined) and no use of articulated buses (40’ buses only).

BRT capacity is, however, substantially less than rail capacity.

- In New York City, actual AM peak hour loads at the CBD screen line (60th Street or the East River) were the following in 1998:
  - Lexington Avenue Express: 28,000
  - IND 53 Street tunnel: 50,000
  - Most screen line passenger counts range from 13,000 to 25,000 from 8-9 a.m.[14]

What are the Costs to Construct BRT?

- BRT on arterial streets: $0.2 to $9 million per mile for construction
  - $0.2 million per mile for the Los Angeles Phase I Metro Rapid demonstration program, covering new stations and bus traffic signal priority.[8]
  - $1.2 million per mile in San Jose, covering bus traffic signal priority, 10 queue jump lanes, 30 stations with oversized shelter canopies, benches and markers, ornamental plants and information kiosks and startup marketing.[4]
  - $9 million per mile for L.A.'s Phase II Metro Rapid program, covering roadway reconstruction, additional systems (i.e., security phones, fare vending), some parking facilities, right of way acquisition as well as stations and bus traffic signal priority.[3]
  - Construction costs for the New York Bus Lane concept (discussed below) were estimated at $8.3 million per mile by an MTA study (1997 dollars). [13]
- Busways on highways: $7-15 million/mile for busway construction.[20]
- Light rail: $20-25 million per mile.[20]
- Heavy rail (subway): $50-250 million per mile and up.[20]
  - Second Avenue subway estimated construction cost is $990 million per mile for the 63-125 Street segment (1997 dollars).[13]

BRT systems can be designed and built in a matter of months. The L.A. Phase I demonstration project was implemented in less than a year. By contrast, rail systems take years to plan, design and build.

BRT Operating Costs

- Operating costs vary widely in different cities depending on frequency of service, route characteristics and other factors. BRT can provide savings in operating costs compared to current bus service because with BRT, buses travel faster, fewer buses are required with service the same route. In practice, net operating costs often increase to expand the level of service and accommodate ridership growth.

BRT Features

BRT implementations integrate the specific features that are feasible and effective in a given situation. Each implementation can draw from features in the following areas:

- ***Fast and reliable service***. Methods include HOV lanes, bus lanes, traffic signal priority, headway-based scheduling and bus lane enforcement.
- ***Station Enhancements***. Includes distinctive station design, raised platforms and bus bulbs.
- ***Easy to board, comfortable vehicles***. Includes low-floor, articulated and distinctively marked buses.
- ***Rapid fare collection***. Includes pre-boarding fare collection and smart cards.
- ***Frequent service on well-marked routes***.

All of these features work to increase bus speeds and improve bus reliability. All of these features can also establish a distinctive image and identity for the BRT service.

More detail and examples of each feature is found in Appendix I (see separately bound companion volume).

Where Has BRT Been Implemented?

BRT has been implemented in a variety of cities in Europe and South America and Asia.

Latin America	Europe	Asia
Belo Horizonte	Bradford	Akita
Bogota	Claremont Ferrand	Ankara
Campinas	Eindhoven	Fukuoka
Curitiba	Essen	Gifu
Goiania	Ipswich	Istanbul
Porto Alegre	Leeds	Kanazuwa
Quito	Nancy	Kunming
Recife	Rouen	Miyazaki
Sao Paulo		Nagaoka
		Nagoya
		Nigata
		Taipei

U.S. Examples of BRT Applications

A federal demonstration program is assessing the effects of BRT projects in a dozen U.S. cities. Several other cities are also members of the federal BRT consortium.

Los Angeles Metro Rapid BRT

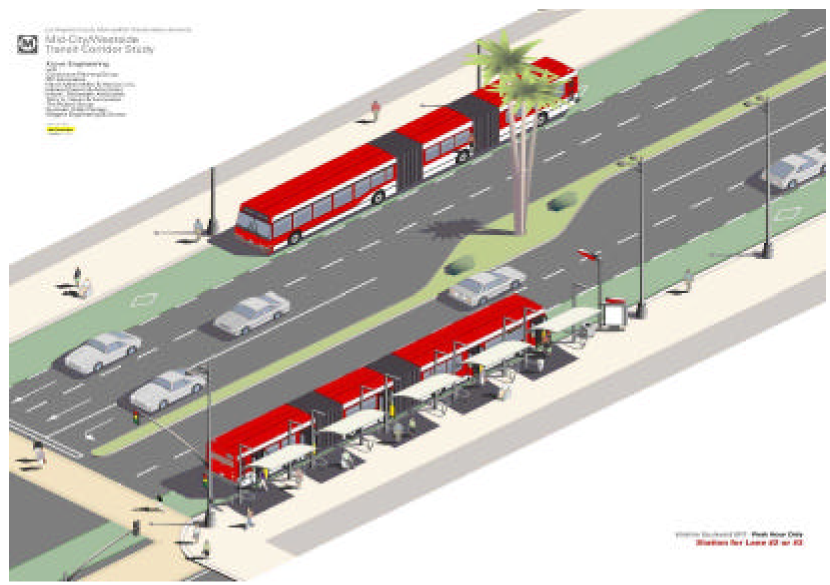
Los Angeles' Metro Rapid Program began as a demonstration project on two major bus routes. It was so successful that it is now being expanded county-wide.

- Phase I (current implementation)
  - Simple route layout; all buses operate to the same terminals
  - 3-10 minute headways at peak; 10-12 minutes off-peak
  - Headway-based schedules
  - Stops spaced at average of 0.8 miles
  - Low-floor buses
  - Color-coded buses and stations
  - Bus traffic signal priority (for buses running "late")

- Phase I results[8]
  - Speeds increased 23-29%
    - From 11 mph to 15 mph on Wilshire/Whittier route
    - From 15 mph to 20 mph on Ventura Blvd. route
  - Ridership increased 25-30%
    - From 63,500 to 84,100 weekday riders on Wilshire/Whittier route and from 10,800 to 13,650 on the Ventura route.
    - 1/3 of ridership increase are new riders; 1/3 are current riders riding more often; and 1/3 switched from another route.

Los Angeles Metro Rapid BRT

- Costs
  - Phase I: $200,000 per mile for stations and bus signal priority. Total capital cost of $8.3 million. Incremental operating cost is $10-12 million per year for additional vehicle hours, additional field support, enhanced vehicle maintenance, station maintenance and repair, customer service and marketing.[8]
  - Phase II: $9 million per mile for roadway reconstruction, additional systems (i.e., security phones, fare vending), some parking facilities, right of way acquisition as well as stations and bus traffic signal priority. Cost is $16 million per mile including expanded bus storage and maintenance facility and new articulated vehicles.[3]
- Next phase will expand county-wide to form a network of two dozen Metro Rapid routes. Six additional routes are approved and funded.
- Expanded system will include:
  - Exclusive lanes
  - Articulated buses
  - Multiple door boarding and alighting
  - Pre-boarding fare payment
  - Feeder network



London BusPlus BRT

London Bus Initiative (“BusPlus”) announced in August 2001:[1]

- 27 bus routes initially and 70 routes total, serving 2.2 million passengers annually
- £200 million initiative ($350 million)
- Includes:
  - Bus traffic signal priority
  - Real-time bus arrival information at stops
  - Enforcement of bus lane restrictions
  - New bus shelter with improved information maps and timetables [24]
- Agreements are currently being announced with various London Boroughs for coordinated enforcement of bus lanes, bays and routes

Implementing BRT in New York City

Why BRT Makes Sense for NYC

Bus Rapid Transit works for bus routes with high ridership and chronic travel delays. New York City has these kinds of routes in abundance.

Why BRT Makes Sense for NYC (cont.)

New York City bus ridership is very high:

- 34 bus routes have 20,000 or more passengers on an average weekday.
- An additional 52 routes have 10,000 to 20,000 passengers on an weekday.
- Even weekend ridership is substantial—37 bus routes have at least 10,000 passengers per average weekend day. (10)

But buses are slow:

- New York City Transit buses average 7.5 mph. Buses in Manhattan and the Bronx average 6.6 mph.(11)
- Speeds are worsening. Average speeds declined 8% from 1996 to 2001 in Manhattan and the Bronx and 4% in the other three boroughs. (11)
- A NYC Transit analysis estimated that bus running times are up to 85% longer during peak hours than when traffic is flowing freely. (12)

Slow bus speeds are a very important deterrent to bus ridership, particularly for work trips. In a survey of bus riders, 51% said "how long the trip will take" is a serious problem with bus service and a major reason to take a different form of transportation. (16)

Slowest NYC Bus Routes

	Route	Speed	2001 Avg. Weekday Ridership
Brooklyn	B63	6.0	14,432
	B41	6.3	43,420
	B52	6.5	14,260
	B43	6.6	13,120
	B35	6.7	39,792
Bronx	BX35	5.9	10,767
	BX15	6.6	20,567
	BX19	6.6	35,889
	BX13	6.7	8,619
	BX4	6.8	17,715
Manhattan	M96	4.3	16,303
	M16	4.6	8,370
	M6	4.7	7,582
	M23	4.7	20,877
	M86	4.8	31,600

	Route	Speed	2001 Avg. Weekday Ridership
Queens	Q32	5.6	14,488
	Q56	7.6	10,346
	Q24	8.0	11,502
	Q58	8.0	23,517
	Q54	8.3	13,121
Staten Island	S42	8.5	2,218
	S48/98	10.6	8,311
	S59	11.5	4,397
	S53	11.9	7,525
	S46/96	12.2	7,749

Average noontime speed on weekdays. Routes with relatively light ridership omitted from list (Bx32 with 5100 average weekday riders; M30 with 2300 average weekday riders; M22 with 3200 average weekday riders; and S42 with 2200 average weekday riders.)

Source: New York City Transit, 2000 Bus Route Profiles.

Steps Already Taken in NYC

NYC DOT and NYC Transit have attempted to speed buses with a network of bus lanes and limited stop service on high-ridership routes. These steps help, but not enough.

- Installation of dual peak-hour bus lanes in the early 1980s reduced bus travel time on Madison Avenue by 40% and reduced the variation in travel time by 59%.[17] Still, bus lanes and bus stops are often blocked and the current scheduled speed is currently only 6.5 mph for Madison Avenue limited stop buses.
- Despite the combination of limited stop service and bus priority lanes on First and Second Avenue in Manhattan, average speeds for limited stop service are below 9 mph.

Selecting the Best Routes for BRT in NYC

Application of BRT features should focus on:

- Locations with heavy bus ridership and low speeds.
- Express bus routes, especially operating on highways with HOV lanes.
- Airport service to Midtown and Downtown Manhattan.

Locations with heavy bus ridership and low speeds offer the most immediate opportunity to apply BRT principles. Top candidates include:

- First/Second Avenue corridor in Manhattan (M15 route)
- Archer Avenue/Jamaica Avenue in Queens (numerous routes serving the Jamaica employment and retail center and E,F,J,Z subway stations)
- Flatbush Avenue and Livingston and Fulton Streets in and approaching Downtown Brooklyn (numerous bus and subway routes serving downtown Brooklyn)
- Third Avenue in the Bronx (Bx55 limited stop, Bx15 and parts of Bx41 and Bx21 local buses)

BRT Features to Apply to NYC

While the specific combination of features should be tailored to each location or corridor, the following features are most widely applicable to heavily traveled streets in NYC:

- More frequent service where needed.
- Bus bulbs, which bring the sidewalk out one lane so buses do not have to maneuver into and out of bus stops.
- Longer bus stops to eliminate delays as buses wait to enter the stop.
- Bus lanes with raised lane dividers or other physical means to discourage or prevent other vehicles from violating bus lanes.
- Low-floor buses that can encourage riders to exit through the rear door. (NYC Transit currently operates 255 low-floor buses and has 325 additional low-floor buses on order.)
- Pre-boarding fare payment at selected high-volume boarding times/locations to reduce dwell time at bus stops.
- Traffic signals that give buses priority to help them stay on schedule.
- Headway-based scheduling to achieve even spacing between buses while letting buses travel as fast as prevailing conditions allow.

Alternatives for First and Second Avenue in Manhattan

How BRT Can Work on First/Second Avenue

First and Second Avenues in Manhattan provide a prime opportunity to showcase the benefits of BRT in New York City.

- With 65,000 passengers a day, the M15 has the highest ridership of any bus route in New York City.[10]
- Operates both local and limited stop service
- Scheduled headways are 1.5 minutes at rush hour—although service gaps can produce 15 minute waits for a limited stop bus
- Average weekday noontime speed is 5.3 mph on the M15 local.[9] Between Houston and 126 Street, the limited stop bus averages 6 mph on Second Avenue and 8-9 mph on First Avenue.

Note: BRT is not a substitute for a Second Avenue Subway. BRT can, however, improve transit service relatively quickly and offer East Side transit users an attractive alternative to being sardined on Lexington Avenue trains.

Problem Definition:
What Causes Delay on the M15?

M15 buses spend 35% to 50% of their time not in motion. The amount of time that buses are stopped, and their average speeds, depends on the time of day, direction, crowding, traffic and how the bus operator drives the bus.

What are the specific causes of delay?

- Extensive dwell times while boarding passengers. May be due to large number of people boarding (especially after gap in service), crowding on the bus that makes boarding of new passengers difficult, especially when riders are both exiting and boarding through the front door, and use of the wheelchair lift.
  – Observed dwell times of up to 1 minute 44 seconds due to many customers boarding and crowding on bus.
  – Observed dwell times of 2:20 to 4:35 for wheelchair boarding/exiting.
- Heavy traffic that delays buses trying to leave bus stops and re-enter the traffic flow.
- Heavy traffic that delays buses trying to pass other vehicles that are stopped at the curb or waiting to make a right turn.
- General traffic congestion between bus stops, resulting in bus hitting multiple red lights between bus stops.

Goals for BRT on First/Second Avenue

Goals for BRT implementation in this corridor should be:

- Make the bus stops work better
  - Most important source of delay
  - Reduce dwell time at bus stops
  - Reduce or eliminate delay in exiting bus stops
- Identify the combination of BRT features that keeps bus stops clear and keeps other vehicles out of bus lanes
  - A demonstration program can be used to determine which combination of features keeps motorists, truckers and taxi drivers from blocking bus stops and violating bus lanes.
- Move toward real-time management of bus operations
  - Buses should be able to go faster when traffic is light. The gaps between buses should be kept as equal as possible to minimize bus bunching and distribute passengers evenly among all buses. These goals can be achieved through headway-based schedules and real-time management of bus operations.
- Build process that strengthens interagency cooperation
  - Close cooperation between New York City Transit and the NYC Department of Transportation is essential to implementing BRT. The process should help to strengthen this relationship by identifying mutual interests and achieving successes that the agencies can then build on.

BRT Alternatives for First/Second Avenue

- The following three BRT alternatives focus on First and Second Avenue between 125 Street and Houston. Alternatives would be modified for First Avenue below 14 Street and possibly above 96 Street. New BRT service would replace the current M15 limited stop service.
- The alternatives include a basic plan that could be implemented in 9-12 months and a full-scale dedicated BRT lane. Costs, implementation timeline and impact on general traffic are greater with the full-scale dedicated BRT lane than the other two alternatives.
- Effectiveness of each concept in reducing bus running times and improving reliability are estimated based on detailed observations of the M15 Limited Stop service.
  - Observations involved timing each discrete event, e.g., time in motion, passenger boarding and exiting, merging back into traffic, stopped at red lights at bus stops, stopped at red lights not at bus stops, etc.
  - Overall time savings and reliability improvements are based on assumptions about the time savings for each phase. Overall estimated improvements appear reasonable given experience in other cities, but of course are subject to testing in actual practice along this corridor.
  - Observations were conducted in Spring 2002.
- Additional details about each alternative including modeling results are in Appendixes II and III (see separately bound companion volume).

Features in All Three Alternatives

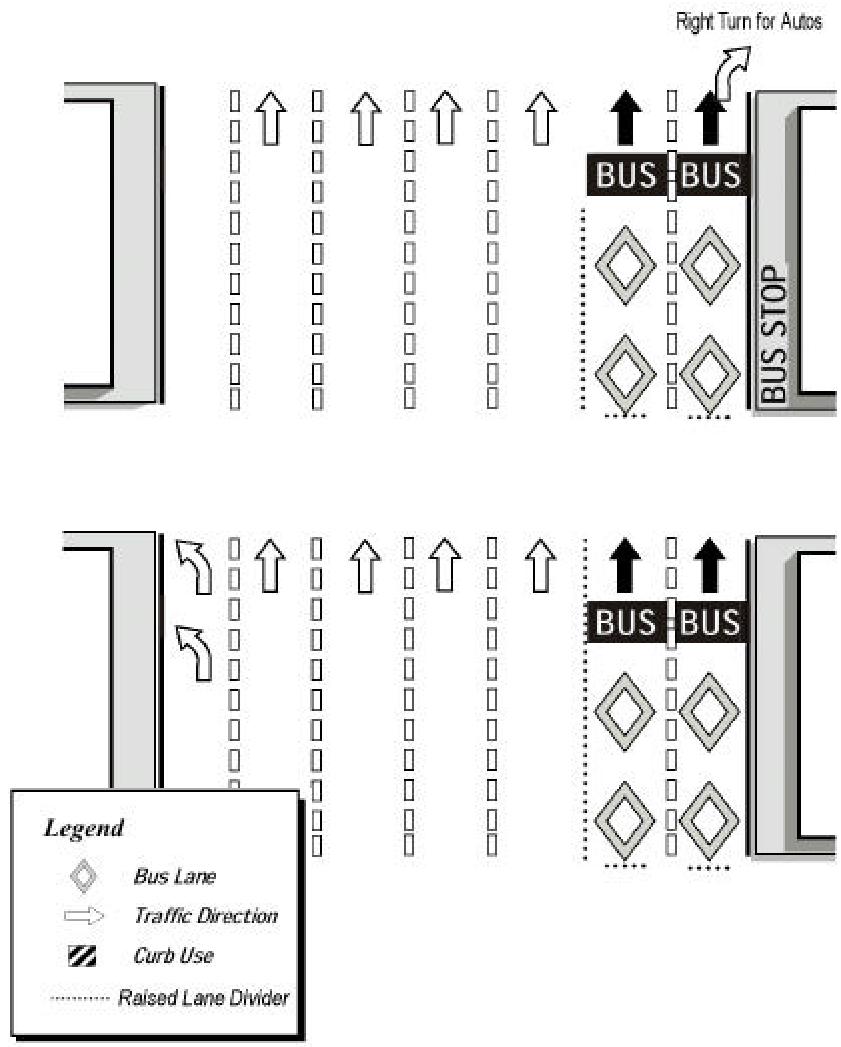
Following features are part of all three alternatives presented below.

- Use low floor buses to speed boarding and exiting.
- Increase service frequency.
- Automatic vehicle location (AVL) and headway-based schedules (phased in when available).
- Eliminate four limited stops at minor cross-streets; buses stop at major cross-streets only.
- Lengthen bus stops where buses must currently wait for other buses to leave the stop.
- Clearly mark both Limited and Local buses.
- Once AVL is implemented, install “next bus” signs at major stops.

In addition, somewhat different approaches are used in each concept for pre-boarding fare payment.

Alternative A - Enhanced Limited Service

- Summary: Dual bus lanes on First and Second Avenue with package of other BRT features that can be implemented within 9-12 months.



Alternative A - Features

- Install dual bus lanes (as on Madison Avenue) with general traffic permitted to turn right from the curb lane. Off-peak goods deliveries in curb lane permitted.
- Install raised lane dividers between lanes and at the entry to bus lanes to discourage cars, trucks and taxis from using bus lane as a through lane.
- Implement pre-boarding fare payment during peak periods at six high-ridership locations. Use transit staff to control entry.
- Features common to all three alternatives: low floor buses; increased service frequency; automatic vehicle location and headway-based operations; eliminate limited stops at minor cross-streets; lengthen bus stops where needed; and clearly mark both Limited and Local buses.

Alternative A - Benefits

Speed Improvements

- 21-27% reduced travel time
- 9-17 minute time savings for a trip on Second Avenue from 125 Street to Houston during the morning rush hour.

Reliability Improvements

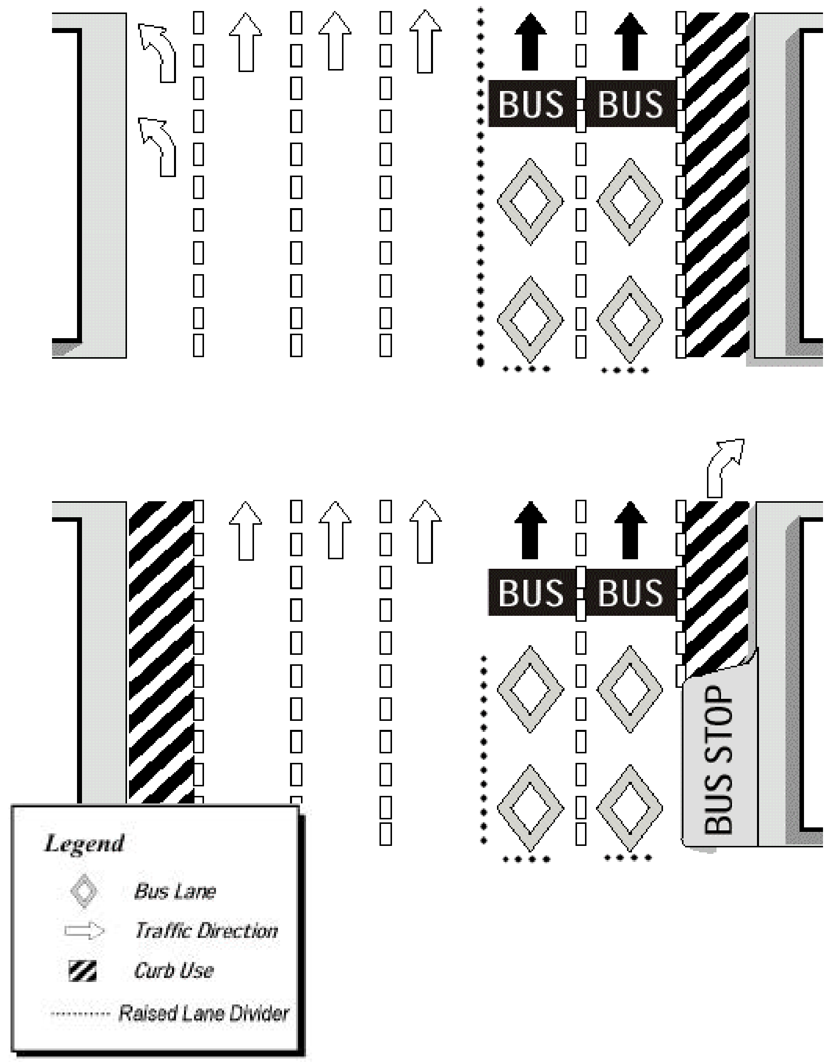
- 38% less variation in running times

Expanded Capacity

- Can re-invest improved speeds to reduce headways between buses

Alternative B - New York Bus Lane with Enhancements

- Summary: New York Bus Lane concept proposed by NYCT staff and studied in the Second Avenue DEIS, combined with other BRT features. Most features can be implemented within approximately 2 years and others can be added subsequently.
  - Likely to have somewhat greater impact on general traffic than Alternative A but impacts can be mitigated through traffic signal retiming and other steps.



Alternative B - Features

New York Bus Lane concept:

- Right curb lane reserved for goods deliveries, taxi pickups/drop-offs, metered parking.
- Dual bus lanes are in the second and third lanes.
- Bus stops are built out into the delivery lane so that curb is adjacent to a bus lane.
- Install raised lane dividers between lanes and at the entry to bus lanes to discourage cars, trucks and taxis from using bus lane as a through lane.
- Right turns allowed from delivery lane.

Additional features:

- Camera enforcement of bus lanes.
- Traffic signal priority or queue jumpers for late buses.
- Pre-boarding fare payment during peak periods at six high-ridership locations. Use transit staff to control entry.
- Features common to all three alternatives: low floor buses; increased service frequency; automatic vehicle location and headway-based operations; eliminate limited stops at minor cross-streets; lengthen bus stops where needed; and clearly mark both Limited and Local buses.

Alternative B - Benefits

Speed Improvements

- 26-38% reduced travel time
- 11-24 minute time savings for a trip on Second Avenue from 125 Street to Houston during the morning rush hour.

Reliability Improvements

- 62% less variation in running times

Expanded Capacity

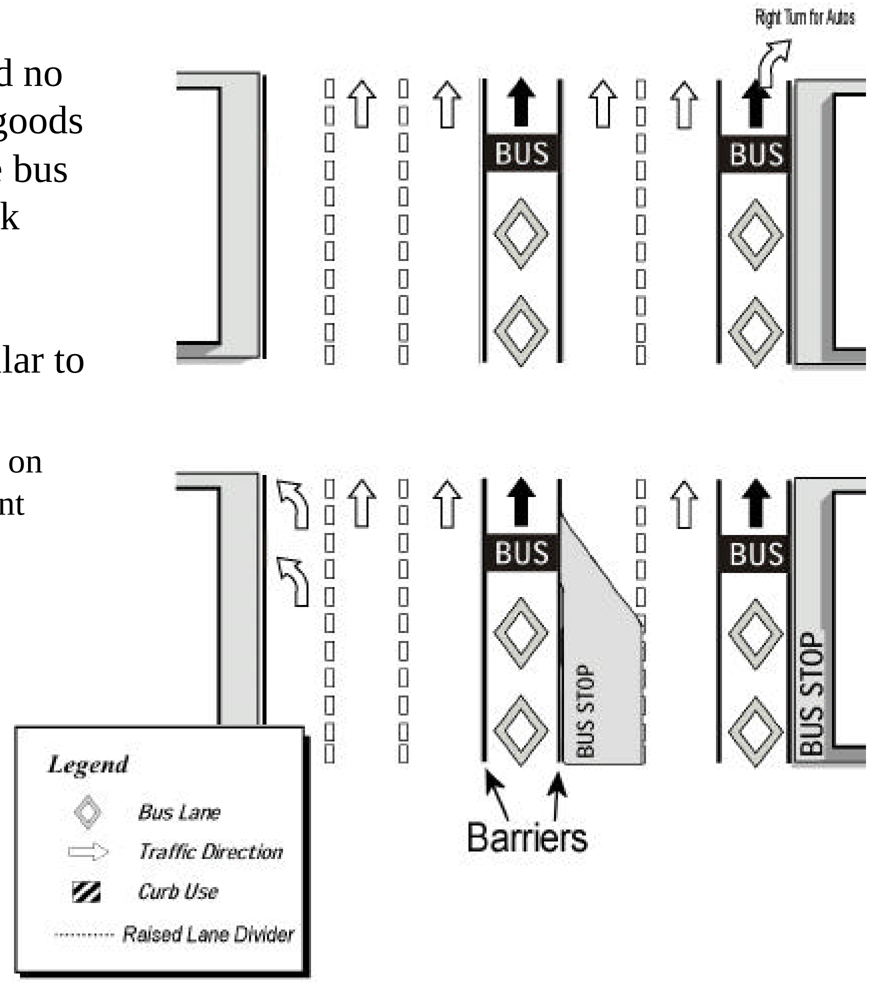
- Can re-invest improved speeds to reduce headways between buses

Note: A New York Bus Lane concept was evaluated in the Second Avenue subway Draft Environmental Impact Statement. The DEIS concluded that the New York Bus Lane would:

- improve travel time 15-20%
- increase ridership 48%
- cost $40 million for lane construction, plus $13 million cost for purchase of 31 additional articulated buses to handle the ridership increase.(13)

Alternative C - Dedicated BRT Lane

- Summary: Rail-like design with dedicated lane for BRT service and no conflicts with turning vehicles or goods deliveries. This concept moves the bus bulbs and one of the two New York Bus Lanes into the middle of the avenue to create a dedicated lane. Construction time is probably similar to Concept B (two-plus years).
  - Likely to have significant impacts on other traffic and restricts movement between right and left sides of the avenue.



Alternative C - Dedicated Lane

Dedicated BRT lane in the center lane:

- Barriers prevent cars and other vehicles from entering dedicated lane.
- Stops for the BRT service are built on islands next to the BRT lane.
- Right two lanes for local buses, goods deliveries, right turns and pickup/drop-off.
- Left three lanes are for through traffic, goods deliveries, left turns and pickup/drop-off.
- Cars and other vehicles cannot move across the avenue once vehicles enter the avenue. Thus, at the time they turn onto the avenue, motorists must decide whether they will eventually make a right turn (and enter the right lanes) or a left turn (and enter the left lanes).

Alternative C - Other Features

- Use low-floor articulated buses for BRT service.
- Use guideway technology so buses “dock” at the curb at BRT stations, allowing wheelchair users to board easily.
- BRT stations use pre-boarding fare payment and level boarding/alighting on 24/7 basis.
- Features common to all three alternatives: low floor buses; increased service frequency; automatic vehicle location and headway-based operations; eliminate limited stops at minor cross-streets; lengthen bus stops where needed; and clearly mark both Limited and Local buses.

Alternative C - Benefits

Speed Improvements

- 37-53% reduced travel time
- 16-34 minute time savings for a trip on Second Avenue from 125 Street to Houston during the morning rush hour.

Reliability Improvements

- 86% less variation in running times

Expanded Capacity

- Approximately 150% greater capacity than current M15 service

Summary of Features for Alternatives

Alternative A	Alternative B	Alternative C
Dual bus lanes	Dual bus lane with bus bulbs and curb lane reserved for deliveries, parking, right turns	Center dedicated bus lane and island bus stations
Raised lane dividers	Raised lane dividers	
Staffed pre-boarding fare payment at 6 locations, peak times only	Staffed pre-boarding fare payment at 6 locations, peak times only	Pre-boarding fare payment 24/7
	Bus traffic signal priority	Low-floor articulated buses for BRT service
	Camera enforcement of bus lanes	Guideway technology so buses "dock" at stations

Features common to all three alternatives: low floor buses; increased service frequency; automatic vehicle location and headway-based operations; eliminate limited stops at minor cross-streets; lengthen bus stops where needed; and clearly mark both Limited and Local buses.

Summary of Benefits

	Current Conditions	Alternative A	Alternative B	Alternative C
Travel time*	43-64 min.	34-47 min.	32-40 min.	27-30 min.
Time savings (min.)**	--	9-17 min.	11-24 min.	16-34 min.
Time savings (%)**	--	21-27%	26-38%	37-53%
Reliability improvement	--	38%	62%	86%

* Range of travel times during morning rush hour for the M15 limited stop bus from 125 Street to Houston on Second Avenue.See Appendix III for detailed modeling results.

**Time savings for best and worse cases.

Conclusion

- BRT features applied to New York City can substantially increase the quality of bus service by increasing bus speeds, improving bus reliability and expanding passenger capacity. BRT can be implemented in a reasonable time frame and at a reasonable cost.
- Several effective and realistic options are available for major corridors such as First and Second Avenue in Manhattan. A demonstration program should be implemented to test BRT features on a section of Second Avenue. Results of the demonstration program should be used to implement BRT features throughout First and Second Avenue on the East Side and Upper East Side.
- BRT features should also be tested and implemented in other congested, high-volume corridors. Selection of features should be tailored to each location's traffic characteristics and bus operating needs.

Sources

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