Los Angeles County
Metropolitan Transportation
Authority
One Gateway Plaza
3rd Floor Board Room
Los Angeles, CA

File #: 2018-0305, **File Type:** Informational Report **Agenda Number:** 55.

AD HOC CUSTOMER EXPERIENCE COMMITTEE
JUNE 21, 2018

SUBJECT: ACTIONS TO MITIGATE SEVERELY CONGESTED BUS CORRIDORS

ACTION: RECEIVE AND FILE

RECOMMENDATION

RECEIVE AND FILE report identifying examples of actions available to mitigate the effects of severe bus congestion.

ISSUE

As part of the NextGen Bus Study, staff has developed a tool that allows us to identify the impacts of traffic congestion on bus speeds. This report identifies the severity of congestion along a sample bus corridor (Vermont Av.) and identifies examples of mitigating actions to reduce the impact on bus speeds.

DISCUSSION

Vermont Av. was chosen as an example corridor because it has been studied in detail for upgrade to Bus Rapid Transit (BRT) and possible future rail operation. The corridor is currently served by a Local bus (Line 204) and a Rapid bus (Line 754). Service is operated over a 12.5 mile segment from Vermont and 120th St. on the southern end to Sunset Bl. at the northern end (Figure 1).

Rapid Line 754 has 24 stops, and Local service on Line 204 serves 68 stops. Rapid service averages about 11.5 mph during peak periods compared with 9.0 mph on Local service. The Rapid is 28% faster than the local requiring an average of 65 minutes to complete a peak period trip while the local takes an average of 84 minutes. The Rapid has about a 32% advantage during off peak periods averaging 56 minutes per trip instead of 73 minutes.

Much of the speed advantage of the Rapid bus can be attributed to serving 44 fewer stops per trip as well as some time savings as a result of signal priority. Only buses equipped with devices that broadcast their presence to the city’s traffic signals receive this priority treatment. Starting June 2018, All Door Boarding will be implemented on Line 754, reducing bus stop dwell times by allowing customers with valid TAP cards to board at any door.

Figure 1: Vermont Ave. Studied BRT Proposal

The Vermont Av. bus service is the most productive in the system with Line 754 averaging 80.1 boardings per revenue service hour on an average weekday (18,422 daily boardings), and Line 204 averaging 75.3 boardings per revenue service hour (20,843 daily boardings).

Vermont Av. buses are subjected to severe congestion over much of the service day. The severity of congestion is measured by a Travel Time Index (TTI) which reflects the ratio of travel time for a given time period with travel time during uncongested time periods. A ratio greater than 1.25 is indicative of significant congestion (the bus is taking 25% longer to make the trip than it would without congestion being present). A ratio exceeding 1.50 is indicative of severe congestion. Line 204 experiences severe congestion throughout the day with a TTI averaging 1.55 during the AM Peak period increasing to 1.67 by midday and 1.75 during the PM Peak. Rapid Line 754 experiences TTI's averaging 1.43 to 1.54 during the same time periods. It is less affected by traffic than the Local bus line because it does not make as many stops that require buses to merge in and out of the congested traffic flow.

Congestion Mitigations

The 12.5 mile Vermont Av. corridor exhibits three different street profiles: 1) Starting from the southern end, the first 2.5 miles from 120th St. to about 88th St. provides 3 traffic lanes and a parking lane in each direction separated by a wide median which itself could contain 2 travel lanes; 2) The following 2.5 miles from 88th St. to Gage Av. retains the 3 traffic lanes plus a parking lane in each direction, but the median narrows considerably such that it can no longer contain even one traffic lane; and 3) The northern 7.5 miles from Gage Av. to Sunset Bl. only allows for two traffic lanes and a parking lane in each direction with virtually no median. Thus, the street becomes narrower and more congested as it passes through areas of increasing density.

A study of ways to upgrade Vermont Av. to Bus Rapid Transit (BRT) has been underway for the past few years. A number of mitigations benefitting bus movement have been identified in that study. This report will provide examples of these and others along with their applicability.

A. **Stop Location** - Generally it is preferable to locate bus stops on the far side of intersections so that the traffic signal only affects bus movement once, upon arrival, and can create gaps in the traffic flow allowing the bus to merge back into traffic more easily. There are times when this is not possible such as when an abutting property owner objects, when two lines cannot share a single stop because there is not enough space, a desirable transfer location (such as a rail station) is located near side, or there isn't enough linear space. On Vermont Av. 76% of Rapid Line 754 stops and 44% of Line 204 stops are located far side.

B. **Dwell Time Reduction** - On some high demand bus lines it is possible to achieve significant time savings by converting to all door boarding. All door boarding allows customers with valid TAP cards to board at any door, increasing the flow into and through the bus. This feature will be implemented on Rapid Line 754 starting June 2018.

C. **Exclusive Lanes** - Exclusive lanes (Figure 2) free buses from interaction with other traffic (except at intersections). They are most beneficial if they add to the street capacity rather than sacrificing lanes from an already congested street. This may be accomplished through street widening, or where a sufficiently wide median exists, by adding lanes within the median.

Figure 2: Example of Exclusive Median Bus Lanes

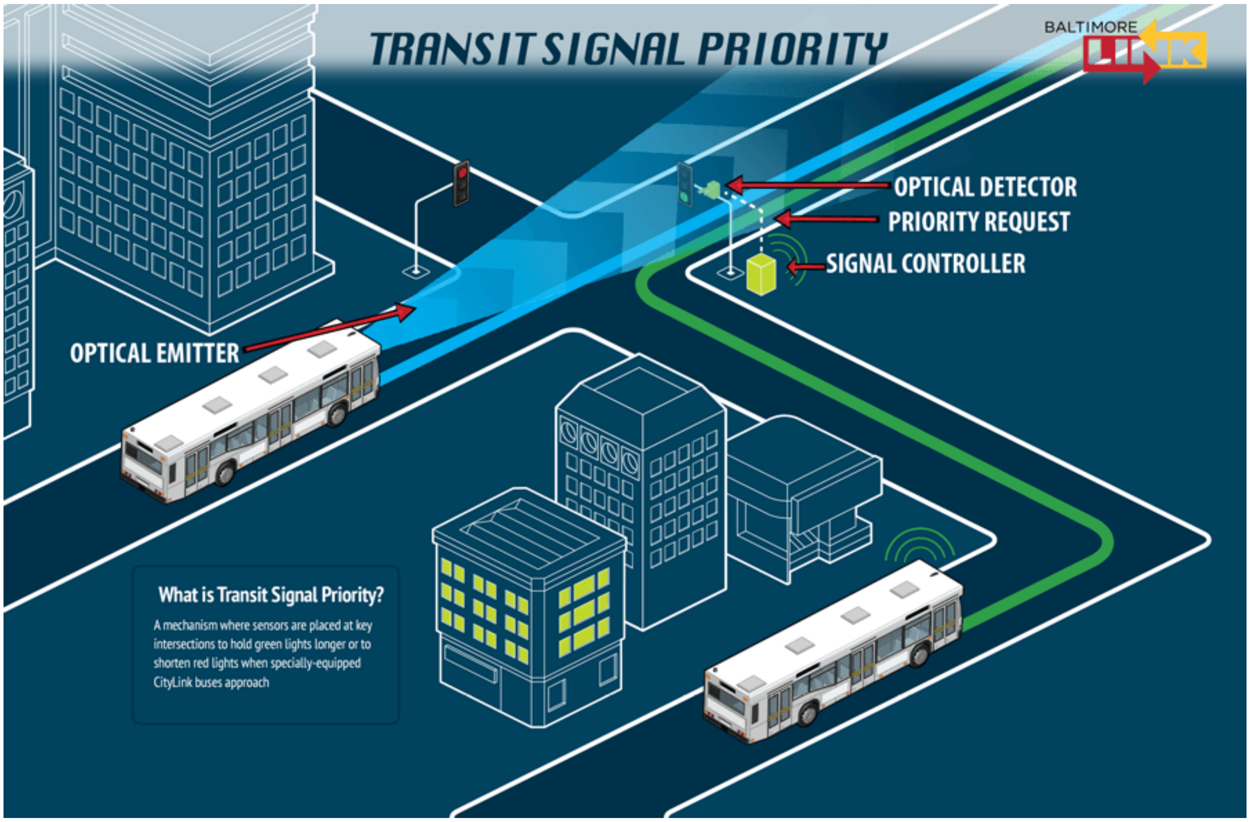
Providing passenger stops may prove difficult if there is little space remaining after adding lanes to the median. Where space permits side platforms, this is ideal because standard buses can be employed. If there is only space for a center platform, then buses must either cross over to the opposite lane to serve each station or they must be equipped with left side doors. The Harbor Transitway Green Line station is an example of a center platform station requiring buses to cross over to serve the station and then cross back to continue on the transitway. The BRT implemented on Euclid Av. in Cleveland employs center platforms served by buses with left side doors (the buses also have right side doors because some operation is in street rather than on the exclusive guideway).

D. Peak Period Lanes - Peak period lanes (Figure 3) restrict use to only buses at specified times of the day (though other vehicles may encroach at intersections in order to make right turns). They provide a tradeoff because when limited to buses, the capacity of the street for other vehicles is reduced. Peak period lanes are limited to times of greatest congestion, and often require added enforcement to keep them clear of other vehicles. An example of this mitigation is the exclusive bus lanes on Wilshire Bl. during peak periods.

Figure 3: Example of Peak Period Bus Lane

E. Transit Signal Priority - Signal priorities can take several forms depending on the physical characteristics of the location (Figure 4) Key to its functioning is bus detection**.**

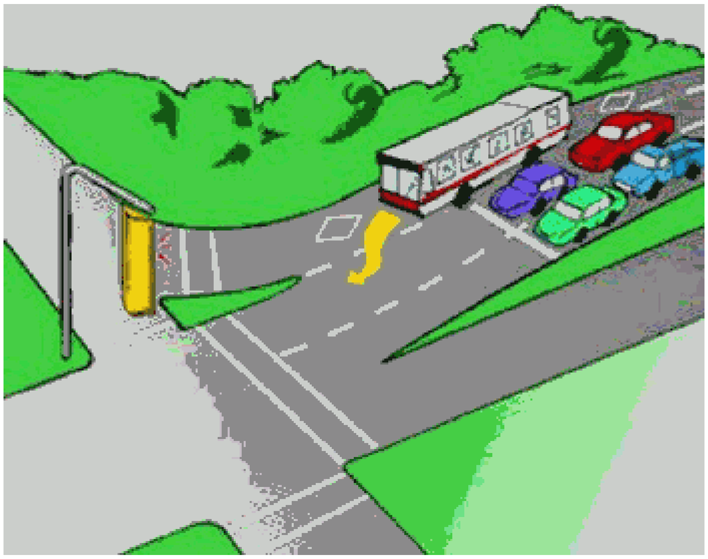
Figure 4: Example Transit Signal Priority Elements



If buses are equipped with an emitter that can be decoded by the city's signal system, then signals can be programmed to provide extended green indications, or advance green in the instance when the signal is red upon approach. Of course, adjusting the signal timing can have adverse consequences for cross streets, so signal priority works best in a corridor with few major cross streets. It is also of greater benefit if any bus stop associated with the intersection is located on the far side so that the bus's behavior is not affected by the signal twice.

F. Queue Jumps - The queue jump is an alternative form of transit signal priority that provides a dedicated curb lane for buses and an advance green when buses are detected in the curb lane (Figure 5).

Figure 5: Example of Bus Queue Jump



The dedicated bus lane at intersections can be readily provided when a parking lane is available without reducing street capacity. Whether through the use of an emitter or other sensing technology, the presence of a bus tells the traffic signal to provide a few seconds of advance green for buses so that they may “jump” ahead of other traffic.

G. **Curb Extensions** - These are often used to shorten the length of a crosswalk while making the pedestrians more visible to vehicle drivers. They are also a treatment for extending a bus stop out to the bus (Figure 6).

Figure 6: Example Bus Stop Curb Extension

This allows the bus to serve the stop from a moving lane making it easy to merge back into the traffic flow because the bus never left the flow. It also creates more sidewalk space for the bus stop and any associated street furniture. Since the bus remains in a moving lane when serving a bus stop it adversely impacts the flow of other traffic, but then our interest here is the bus and not the other traffic.

H. **Passenger Islands** - There may be occasions when the design of an intersection prevents a bus from serving the curb, or an extended curb. A median bus lane is one instance. Another would be where channelization separates right turning vehicles from the through traffic flow (Figure 7).

Figure 7: Example Bus Passenger Island

In the top center of Figure 7 there is an example of a passenger island serving buses continuing on the street exiting the illustration to the lower left. Without this treatment there would be no place to provide a bus stop for this line's passengers anywhere within the immediate vicinity of the intersection. An example exists within downtown Los Angeles at Pico Bl. Northbound Hill St. continues directly across Pico Bl. while a left diverging Olive St. originates at this intersection. Several Metro and Muni buses serve a passenger island for Olive St. passengers.

FINANCIAL IMPACT

There is no budgetary or financial impact from the presentation of the information in this report. Application of the mitigation techniques could result in potential capital investments, which would likely be mitigated by increased speed and reliability resulting in decreased operating cost.

NEXT STEPS

Staff will identify the five most heavily congested bus corridors within the network, including specific congestion hot spots and root causes. We will then develop potential solutions to each hot spot and present a speed and reliability action plan to the Board within 6 months.

Prepared by: Dana Woodbury, Manager Transportation Planning (213) 922-4207
Gary Spivack, Deputy Executive Officer (213) 418-3432
Conan Cheung, Senior Executive Officer, Service Development (213) 418-3034

Reviewed by: James T. Gallagher, Chief Operations Officer (213) 418-3108

Phillip A. Washington
Chief Executive Officer

Bus Congestion Mitigation Strategies

June 2018

Metro

Example Congested Corridor

- Vermont Ave among Top 20 Congested
- Under study for BRT improvements

- 12.5 mile Corridor
  Local – 68 stops – 84 min – TTI 1.75 (peak)
  Rapid – 24 stops – 65 min – TTI 1.54 (peak)

  Corridor Profile (South to North)

  2.5 mi   1 parking / 3 travel lanes
            wide median
  2.5 mi   1 parking / 3 travel lanes
            thin or no median
  7.5 mi   1 parking / 2 travel lanes
            no median

Metro

Reduce Stop Dwell Times

All Door Boarding and Far Side Stops

- All Door Boarding
  - Currently on Orange and Silver Lines
  - Line 754 (Vermont) in June 2018
  - Line 720 (Wilshire) in Oct 2018

- Far Side Bus Stops
  - On Vermont Ave:
    Rapid 76% far-side
    Local 44% far-side

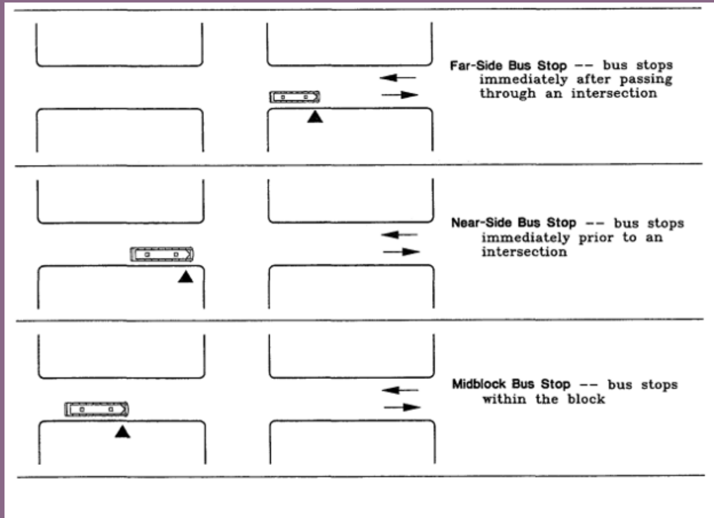


Figure 1. Example of Far-Side, Near-Side, and Midblock Stops.

Metro

Reduce Stop Dwell Times

Curb Extensions

- Buses can serve a stop from a moving lane so that merging with the traffic flow is not necessary

- Creates more sidewalk space for the bus stop and associated street furniture

- Forces traffic to wait behind the bus, or try to pass it, so the treatment is most useful at lower demand stops where the bus does not dwell long

Metro

Reduce Running Time

Bus Only Lanes

- Bus Lanes use exclusively or at limited times such as peak periods
- Curb vs. Median
- Added enforcement often required to keep lanes clear during restricted periods

Metro

Reduce Running Time

Transit Signal Priority

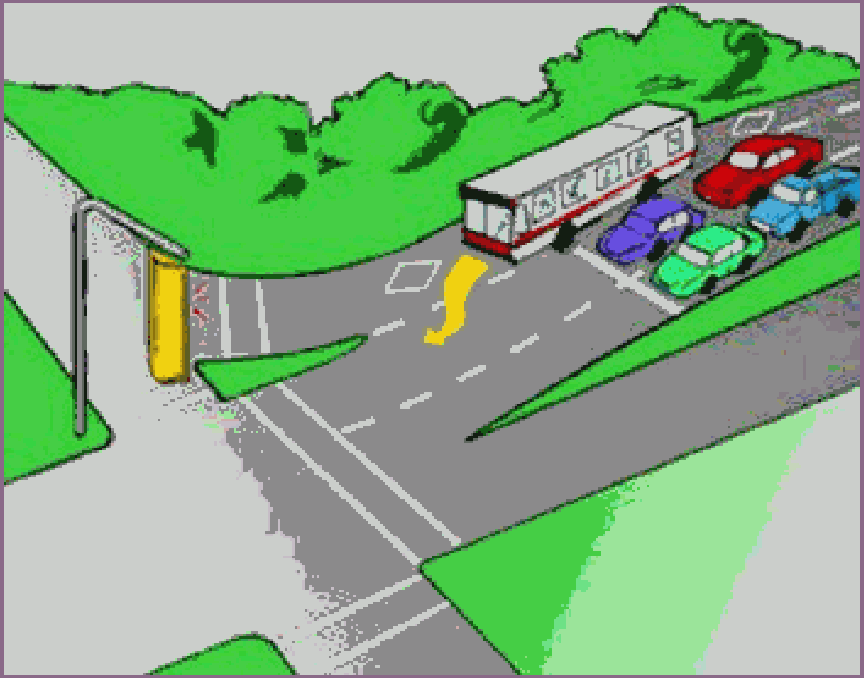
- Buses must be equipped with emitter to signal presence
- Each signalized intersection must have appropriate hardware
- Prioritization strategy must balance wider bus bandwith against adverse cross street traffic impacts
- Works best with far-side stop locations so that bus doesn't trigger signal multiple times

Metro

Reduce Running Time

Queue Jumps

- Buses must be equipped with emitter to signal presence
- A curb lane is reserved for buses near a signalized intersection with the stop line moved back so that right turning vehicles do not block buses
- When buses are present the traffic signal will provide a few seconds of advance green so that buses may get in front of other traffic



Metro

Vermont Ave – Weekdays

Preliminary List of Mitigations

Segment NORTHBOUND	Severe Congestion	Applicable Mitigations
120th to Green Line		
Green Line to 92nd	AM - 754	1 - Bus Stop Location 2 - Dwell Time 3 - Exclusive Lanes 5 - Transit Signal Priority
92nd to Manchester	AM - 754 PM - 754	
Manchester to 54th	AM - 204,754 Mid - 754 PM - 204,754	1 - Bus Stop Location 2 - Dwell Time 4 – Peak Period Lanes 5 - Transit Signal Priority 7 - Curb Extensions
54th to Slauson	AM - 204,754 Mid - 754 PM - 204,754	
Slauson to Exposition	AM - 204 Mid - 754 PM - 204	1 - Bus Stop Location 2 - Dwell Time 5 - Transit Signal Priority 6 - Queue Jumps 7 - Curb Extensions
Exposition to Adams	AM - 204,754 Mid - 754 PM - 204,754	
Adams to Wilshire	AM - 204,754 Mid - 204,754 PM - 204,754	
Wilshire to Monroe	Mid - 754 PM - 754	
Monroe to Santa Monica	AM - 754 Mid - 754 PM - 754	
Santa Monica to Sunset	AM - 754 Mid - 754 PM - 754	

Segment SOUTHBOUND	Severe Congestion	Applicable Mitigations
Sunset to Santa Monica	Mid - 204,754 PM - 204,754	1 - Bus Stop Location 2 - Dwell Time 5 - Transit Signal Priority 6 - Queue Jumps 7 - Curb Extensions
Santa Monica to Monroe	Mid - 754 PM - 204,754	
Monroe to Wilshire	Mid - 754 PM - 204,754	
Wilshire to Adams	Mid - 754 PM - 204,754	
Adama to Exposition	AM - 754 Mid - 754 PM - 754	
Exposition to Slauson	Mid - 754 PM - 754	
Slauson to 54th	Mid - 754 PM - 754	1 - Bus Stop Location 2 - Dwell Time 4 – Peak Period Lanes 5 - Transit Signal Priority 7 - Curb Extensions
54th to Manchester	AM - 754 Mid - 754 PM - 754	
Manchester to 92nd		
92nd to Green Line		
Green Line to 120th		

Metro

Next Steps

- Conduct detailed analysis of congestion "Hot Spots" on 5 severely congested corridors and identify specific solutions
- Consider systemwide application of specific strategies as part of NextGen Bus study
- Work with local communities to implement identified actions

Metro

Metro