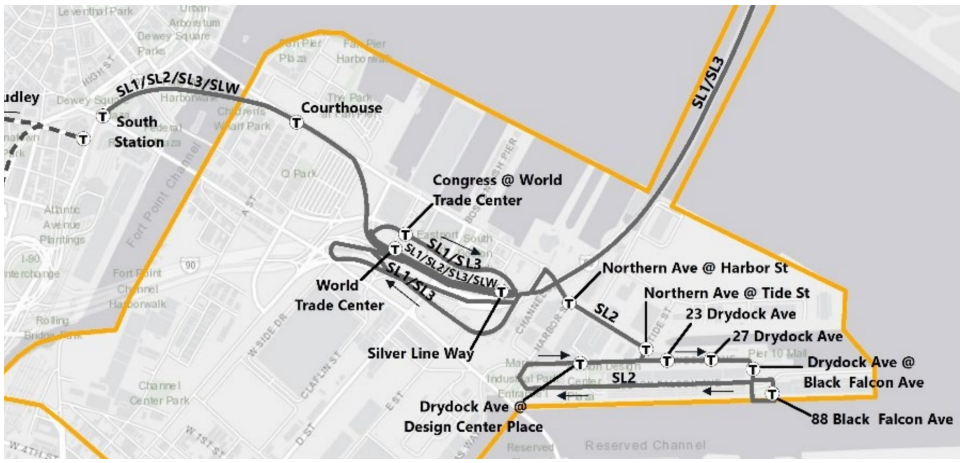
Exploring Near-term Improvement Ideas in South Boston
Silver Line: Deployment of Five New Buses

The MBTA Silver Line is a bus rapid transit system that consists of five different routes. South Station serves as a point of transfer for the Red Line and the SL1, SL2, SL3, and Silver Line Way (SLW) routes. SL1 terminates at Logan Airport, SL2 at Design Center, SL3 at Chelsea, and SLW at Silver Line Way station. The SL4 and SL5 routes terminate at Dudley Square. The other end of SL4 is a surface bus station near South Station, and the other end of SL5 is at Downtown Crossing.



The current SL3 route is new as of April 2018[1], and it services the Chelsea area and also connects to the Blue Line Airport Station. The bus uses dedicated bus lanes throughout the Chelsea leg of its trip.

For this report, we look at how we can deploy five new buses (one diesel/hybrid[2], four battery electric[3]) on the waterfront routes (SL1, SL2, SL3, SLW). The diesel/hybrid bus is an extended range bus that has less idling time when stopped and will reduce greenhouse emissions. This bus is able to use battery power travel in the tunnel between South Station and Silver Line Way without using the wire that the rest of the current hybrid fleet uses. Once this bus returns to street level, it switches back to diesel mode and recharges its batteries while driving on diesel power. If this bus proves to be effective, the MBTA will consider ordering more of the model. The electric buses need more charging infrastructure, but they are zero-emission.

[1] https://www.mbta.com/projects/silver-line-3-chelsea-sl3
[2] https://www.mbta.com/news/2018-09-26/first-extended-range-hybrid-bus-joins-mbta-silver-line-fleet
[3] https://www.greencarcongress.com/2019/01/20190108-mbta.html

To decide how to deploy the new buses, we can look at ridership and the bus frequency schedule[4] from 2018 on the waterfront lines.

Route	Daily		Core Trunk Routes AM Peak Hour		Core Trunk Routes PM Peak Hour	
	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound
SL1	4,229	4,148	242	403	309	212
SL2	3,335	3,111	163	997	775	210
SL3	2,447	2,485	206	276	297	193
SLW	1,006	1,134	71	252	242	113
Total	**10,822**	**10,751**	**682**	**1,928**	**1,623**	**728**

Route	Origin	Destination	Scheduled Peak Hour Travel Times	Peak Hour Frequencies	Off-Peak Frequencies
SL1	South Station	Logan Airport	AM Inbound: 23 mins AM Outbound: 14 mins PM Inbound: 27 mins PM Outbound: 19 mins	AM Peak: 7.5 mins PM Peak: 10 mins	9-12 mins
SL2	South Station	Design Center	AM Inbound: 9 mins AM Outbound: 14 mins PM Inbound: 15 mins PM Outbound: 10 mins	5 mins	9-15 mins
SL3	South Station	Chelsea Station	AM Inbound: 24 mins AM Outbound: 22 mins PM Inbound: 27 mins PM Outbound: 27 mins	10 mins	12-15 mins
SLW	South Station	Silver Line Way	AM Inbound: 6 mins AM Outbound: 7 mins PM Inbound: 6 mins PM Outbound: 7 mins	10 mins*	Varies*

We can calculate approximate average ridership per trip for each route during peak hours by calculating how many buses travel in each direction during that hour and dividing the number of passengers by that figure.

Route	AM Inbound	AM Outbound	PM Inbound	PM Outbound	Capacity[5]
SL1	30.25	50.38	51.50	35.33	38/53
SL2	08.15	49.85	38.75	10.50	47/66
SL3	34.33	46.00	49.50	31.17	47/66
SLW	11.83	42.00	40.33	18.83	47/66

[4] MBTA Spring 2018 Load Profiles (April 1 to June 23, 2018) and MBTA Spring 2018 Schedule Sheets
[5] Seated/Policy Capacity of the buses on each route

The red cells indicate route-peak time pairs where the average ridership is extremely close to policy capacity. The yellow cells indicate times when the average ridership is within 80% to 120% of the seated capacity, and the green cells indicate times when the average ridership is reasonably below seated capacity.

Of course, this is not a perfect metric because not all the riders are riding from route end to end. There may be certain segments on the route that are much nearer capacity than other segments on the route.

To alleviate the load on SL1 during peak hours, we can allocate three new buses to the SL1 route and one each to the SL2 and SL3 routes. Because all these routes also service the SLW pathway, the new buses will also help with fewer people on that route. Given route trip travel times, we assume the additional SL1 buses will be able to make only one round trip each during peak hours in both the morning and afternoon. The same goes for the SL3 bus. Conservatively, the additional SL2 bus can add about two round trips in the morning and two in the afternoons.

We recalculate the average ridership during peak hours again with these updated bus trip numbers. Although the new buses have higher capacity than the ones currently use on the SL1, we use the existing capacity numbers for simplicity without overestimating capacity.

Route	AM Inbound	AM Outbound	PM Inbound	PM Outbound	Capacity
SL1	22.00	36.36	34.33	23.56	38/53
SL2	07.41	45.32	35.23	09.55	47/66
SL3	29.43	39.43	42.43	27.57	47/66
SLW	11.83	42.00	40.33	18.83	47/66

The cells are again colored with the same red-yellow-green schema defined previously. By deploying the buses in this manner, we manage to bring the SL1 trips to a lower utilization percentage of its total capacity, making the experience more pleasant for the riders. The increased service frequency and available capacity across all three routes and the SL1 particularly may also incentivize workers in South Boston to consider the Silver Line as a commuting option.

Currently, only 6% of commuters to South Boston take a bus, including the Silver Line[6]. (24% take the commuter rail and 21% take the subway, and it is unclear how any multimodal transit riders are calculated in these statistics.) The majority (76%) of these commuters live in Suffolk, Middlesex, and Norfolk counties. The Silver Line is connected to South Station, which is a hub for the commuter rail lines, so even if workers do not live in Boston, they can consider the commuter rail / Silver Line as a route to get to work. The goal would be for this option to become more appealing than driving.

During off-peak hours, the buses do not seem to reach capacity as much, and a better way of increasing quality of service is to increase the trip frequency. That is a separate decision and issue, as the additional buses are not required to increase frequency during off-peak hours, but they can replace current buses on those trips because the new buses are more environmentally friendly.

The extended range hybrid buses can have positive effects on the Silver Line system due to their ability to service the current routes while not requiring the overhead wires in the tunnel portion of the trip. If the fleet moves to these buses, the MBTA would have to spend less resources on the maintenance of the charging system. If the electric buses also prove viable, having more of those would also reduce greenhouse gases as the MBTA improves its coverage and service by expanding bus routes and refining bus trips beyond just the Silver Line.

[6] Supplemental South Boston Technical Data