Chapter 3:

Transit Signal Priority Treatments

Transit Signal Priority Overview

Transit Signal Priority (TSP) gives special treatment to buses at signalized intersections. There are two major techniques for providing TSP—**passive** and **active** treatments. The lead agency must upgrade signals to accessible pedestrian signals (APS).

Passive TSP optimizes signal timings within transit corridors so that the signal progression is set based on the average bus speed instead of the average vehicle speed. Passive TSP does not require any specialized equipment at signalized intersections; it only changes the underlying signal coordination and cycle length to favor bus progression through a corridor. Passive TSP results in transit-friendly corridors often with shorter cycle lengths and signal progression that is based on lower average travel speeds that are reflective of buses serving stops within the corridor. These signal timing treatments can also result in pedestrian benefits by shortening wait times for pedestrians crossing at intersections.

Active TSP detects a bus approaching an intersection and adjusts the signal timing to reduce the amount of time a bus spends waiting at a red light. Delays from traffic signals account for a quarter to a third of overall transit travel times. The objective of active TSP is to improve transit schedule reliability by reducing transit delays at signalized intersections while minimizing the impact to general purpose traffic operations. Active TSP works by detecting buses as they approach a signalized intersection, predicting when the bus will arrive at the intersection, and adjusting the signal timing to reduce the amount of stop delay for the bus at the intersection. TSP helps to provide faster and more reliable transit travel times through a corridor.

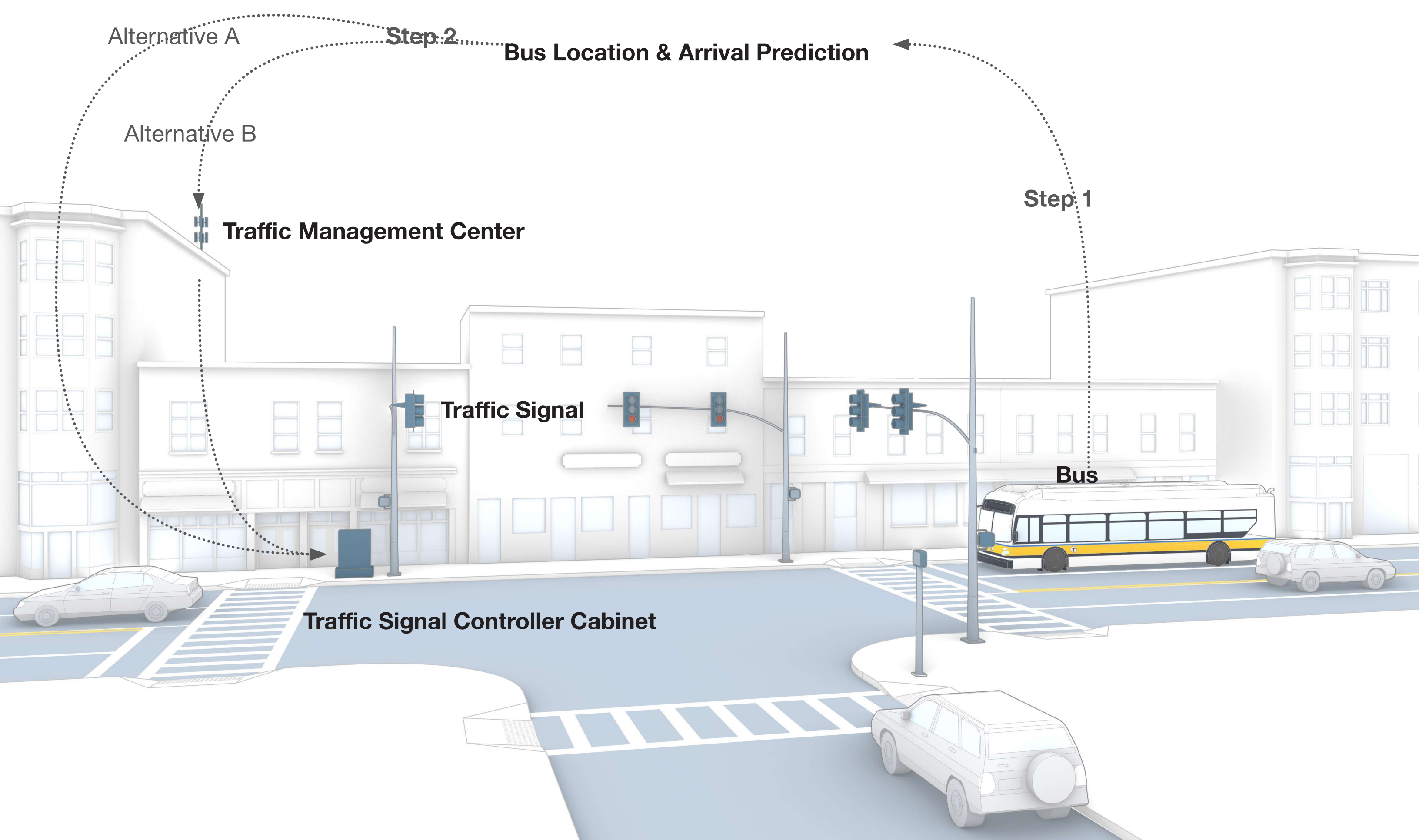
Active TSP Strategies

The figures on the following pages illustrate the five active TSP strategies available for consideration within the MBTA service area. Basic active TSP strategies include green extension and red truncation and can be implemented at any signalized intersection. More advanced TSP strategies include green reallocation, phase insertion and phase reservice. Advanced TSP strategies are typically installed in conjunction with specific bus operations (such as queue jumps) and require more advanced traffic controllers or adaptive signal timing to support the TSP operations. This chapter includes a brief description of each strategy.

How Active TSP Works

The following process outlines how Active TSP works within the MBTA service area:

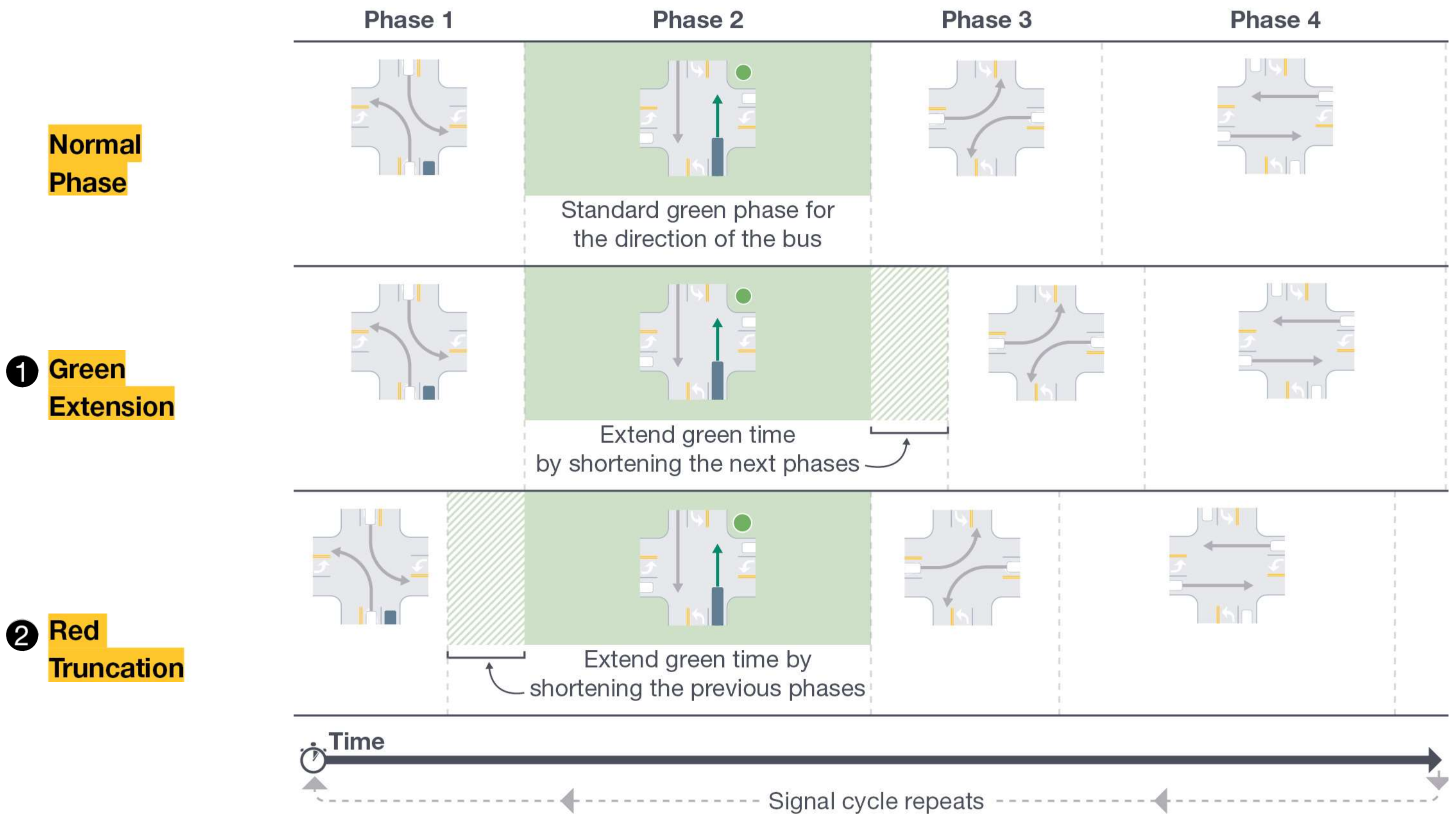
- **Step 1:** The Automatic Vehicle Locator (AVL) on board MBTA buses wirelessly transmits the bus location every 3 to 4 seconds to the MBTA's bus operations control center.
- **Step 2:** The bus location is relayed wirelessly to the transit priority request generator (PRG) in either:
    - **Alternative A:** The traffic signal cabinet where the PRG predicts bus arrival time to the intersection and submits a TSP call to the traffic signal controller within the signal cabinet.
    - **Alternative B:** A centralized traffic management center, where the PRG predicts bus arrival time to the intersection and relays the TSP request to the traffic signal controller via signal interconnect.
- **Step 3:** The traffic signal controller adjusts the signal timing to display a green indication to the bus movement as quickly as possible based on the predicted arrival and TSP strategy programmed for the intersection.



Active TSP Strategies

There are five active TSP strategies that can be implemented within the MBTA service area. A brief description of each strategy is included below.

Figure 4: Basic TSP Strategies



Note: Signal phase diagrams are schematic only to demonstrate the functionality of TSP strategies at a high level. Exact times and phase changes will vary.

Active TSP equipment will maintain minimum pedestrian clearance times at equipped signals. Travel time benefits range based on the amount of time reallocated to the bus phase or increases to the length of the bus phase.

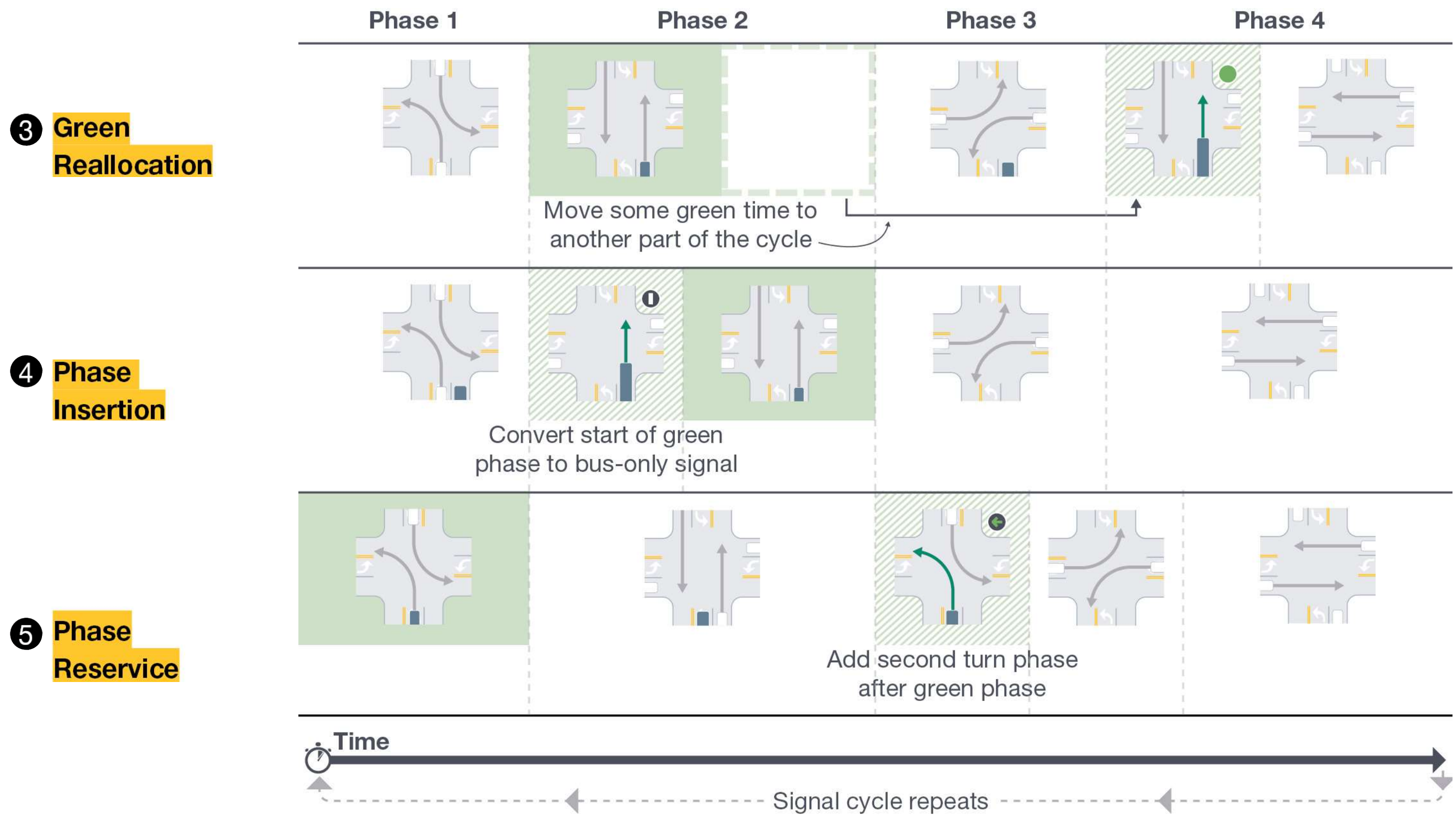
1 **Green Extension** The signal extends the green time for the bus approaching the intersection, allowing the bus to make it through the intersection without stopping.

- **When to use:** When the predicted bus arrival time is during a transition from green to yellow and red.
- **Impact on delay:** Elimination (bus doesn't stop).
- **Pedestrian considerations:** No impact. TSP operation unnoticeable to most pedestrians.

2 **Red Truncation** The signal reduces the amount of red time for a bus stopped at an intersection, by shortening the subsequent phase(s) prior to the next green. Also known as early return to green.

- **When to use:** When the predicted bus arrival time is late enough in the cycle that a green extension is not feasible, and the signal is red.
- **Impact on delay:** Reduction (bus stops for less time).
- **Pedestrian considerations:** No impact. TSP operation unnoticeable to most pedestrians.

Figure 5: Advanced TSP Strategies



3 Green Reallocation The signal moves part of the green phase to the time that coincides with the arrival of the bus. This does not affect the total time allocated to cross street traffic.

- **When to use:** If signals have advanced controllers and corridor-based adaptive signal timing.
- **Impact on delay:** Elimination (bus doesn't stop).
- **Pedestrian considerations:** Change in phase sequence may seem unpredictable to pedestrians.

4 Phase Insertion When a bus is detected at the intersection, a special bus-only phase activates before the general-purpose green phase. This enables buses to advance prior to general traffic.

- **When to use:** To support queue jumps through an intersection, or right turns from a center running bus lane, or left turns from a side running bus lane.
- **Impact on delay:** Reduction (bus advances before general traffic).
- **Pedestrian considerations:** Change in phase sequence may seem unpredictable to pedestrians.

5 Phase Reservice The signal can accommodate a green phase for bus movements—typically for left turns, right turns, or queue jumps—at two points within a given cycle, but only activates once per cycle when a bus is present.

- **When to use:** Bus movement has a left or right turn phase or a queue jump.
- **Impact on delay:** Reduction (bus stops for less time).
- **Pedestrian considerations:** Change in phase sequence may seem unpredictable to pedestrians.

Priority versus Preemption

The difference between TSP and signal preemption is that TSP modifies the normal underlying signal operations to better accommodate transit vehicle progression through the corridor, whereas preemption interrupts the normal signal operations for a responding emergency vehicle approaching the intersection. TSP calls are placed to the controller using low priority inputs, whereas emergency vehicle preemption uses high priority inputs to the controller. In the case where the emergency vehicle preemption call is placed after a TSP call has been placed, then the signal would drop the TSP call, interrupt the timing plan, and respond to the preemption call.

TSP Efficacy and Challenges

TSP is most effective and provides the most benefits to transit travel times under the following circumstances:

Flexibility in Signal Timings
TSP is effective when there is flexibility in the signal timings to extend or shorten underlying signal phases, or to add a dedicated transit phase when a bus is detected without shortening other phases below the minimum time needed to serve the pedestrian crossings. For intersections with coordinated signal timings this could mean breaking with coordination for a cycle to serve the TSP request, or increasing the cycle length so phases are not all set to the minimum time to serve pedestrian crossings so that time can be borrowed from other phases to serve the TSP request. For intersections equipped with adaptive signal timing this means having the flexibility to detect and adjust the signal phase sequence to give priority to TSP movements.

Moderate Congestion
TSP works best for intersections with moderate levels of congestion. When congestion levels are high and queue lengths routinely spill back far in advance of the intersection, buses stuck in the queue will not be able to advance to the stop bar to take advantage of the additional time provided by TSP during one cycle. In these conditions, consider providing a dedicated transit lane for buses to bypass the queue.

Newer Technology to Support TSP Operations
The lead agency may need to upgrade traffic signal controllers to support TSP functionality at an intersection. TSP functionality may be impacted by limitations in the controller software and some legacy controller models do not support TSP at all. MBTA has developed specifications that are available on the MBTA Engineering webpage that identify the signal system requirements needed to support TSP operations.

Table 4. Implementation Considerations: Physical Corridors

Questions	Considerations
Is TSP proposed at one or at multiple signalized intersections?	▶ TSP provides a greater bus speed and reliability benefits when installed at multiple signalized intersections along a route or corridor, because of the cumulative reduction in delay.
Is existing or planned dedicated right of way available to buses (i.e., bus lane, part time bus lane, queue jump)?	▶ TSP provides greater benefits in locations where buses can take advantage of dedicated ROW approaching a signalized intersection. ▶ See Dedicated Transit Lane Treatment sheet for more details.
Are there nearside or farside bus stops?	▶ TSP provides greater benefits in locations where buses can stop at the farside of an intersection. ▶ If a stop is nearside of an intersection, look for opportunities to relocate the stop to the farside of the intersection. ▶ See treatment sheets for TSP with farside and TSP with nearside bus stops for more details.
Are there bus-bike interactions?	▶ If a corridor has a separated bike lane, TSP timings will need to consider dedicated bike phases and bike clearance times for phase adjustments. If a shared bus-bike lane is present, bike speed and volume will need to be considered when predicting bus arrival times to the intersection, since a bus with a bike traveling in front of it will be traveling slower as it approaches an intersection. ▶ Consider separate facilities for buses and bicycles if volumes warrant them.

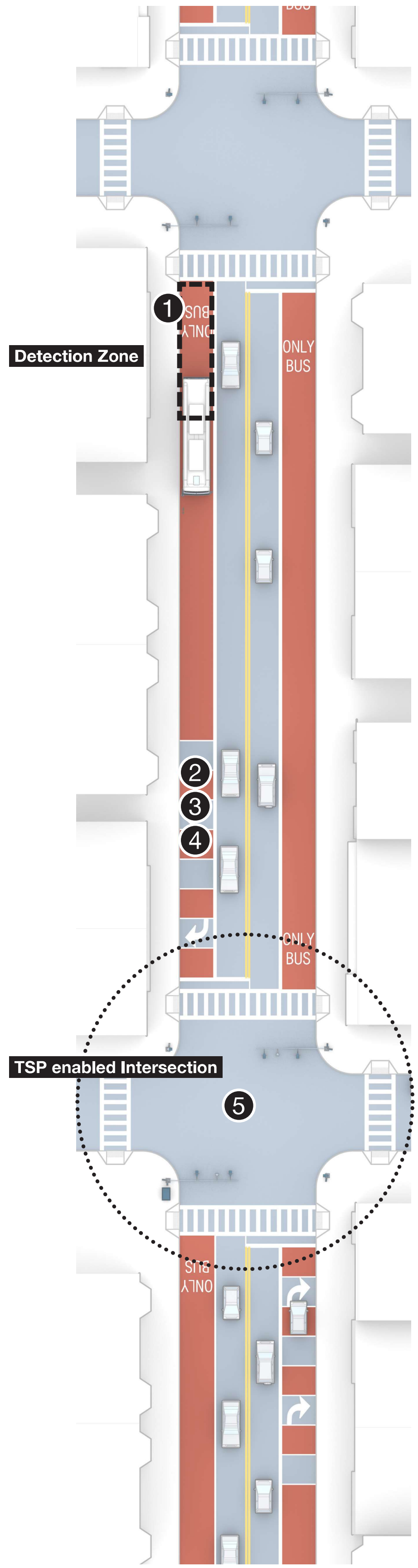
Table 5. Implementation Considerations: Transit Delay

Questions	Considerations
How much delay on average are buses experiencing at each signalized intersection within the proposed project area?	▶ If buses operate through an intersection that routinely has excessive queues that do not clear the intersection during each cycle, there are fewer opportunities to adjust the signal timings to provide TSP benefits and buses will still experience high levels of delay unless other treatments such as dedicated transit right of way are also implemented.

Table 6. Implementation Considerations: Signal Equipment Infrastructure

Questions	Considerations
What existing signal infrastructure is available to support TSP?	▶ Complete a comprehensive field inventory to identify the following: ▶ What type of controller and software versions are currently deployed at intersections? Are the existing traffic signal controllers capable of supporting TSP functionality? ▶ Does the existing signal cabinet have space available to house any additional equipment needed to support TSP? ▶ What are the current signal operations? Are signals operating with coordinated time of day plans, traffic responsive or adaptive operations? ▶ Are cycle lengths set to the minimum time to serve pedestrian crossings with no additional time allocated to any phases? If the lead agency needs to adjust the underlying cyle length, are there additional intersections that will need adjustments to maintain coordinated signal operations? ▶ See MBTA Engineering Directives site for equipment specifications for TSP.

TSP in a Dedicated Lane



TSP for buses operating in dedicated transit lanes provides the greatest benefits to transit travel times and reliability. TSP works best when buses are detected far in advance of the intersection and when predicted travel times from the detection point to the intersection are reliable. When a bus is reliably detected well in advance of an intersection, the lead agency can adjust traffic signal phasing with fewer impacts to other modes and allow buses to pass through without stopping.

Dedicated transit lanes remove general purpose vehicle congestion and queuing between the bus and the intersection. This allows for use of a wider range of detection technologies to detect the bus upstream of the intersection, and results in the most reliable travel time predictions of when the bus will pass through the TSP enabled intersection.

Benefits

- Provides greatest potential transit signal priority benefit through advanced detection and accurate travel time predictions
- Allows for use of wide range of detection technologies
- Provides transit travel time benefits throughout the whole day

Challenges

- Typically requires removal of an on-street parking lane, conversion of a general-purpose travel lane to a transit lane, or roadway widening to provide a dedicated transit lane.
- Dedicated transit lanes along curb lanes may have locations where right-turning vehicles use the transit lane. High or significantly fluctuating volumes of right-turning vehicles can degrade the accuracy of predicted transit arrival times at the intersections downstream of the right turn location.

Implementation Considerations

1. **Detection Zone** Set detection zone for the bus at the farside of the upstream intersection to the TSP enabled intersection to maximize the amount of time for the controller to respond to the TSP call.
2. **Enforcement** Ensure there is a strategy in place to prevent activities such as illegal parking, standing, or traveling in the bus lane.
3. **Turn Volume** Account for right and left turn volumes, as right-turning vehicles need to cross the bus lane to turn if the bus lane is curbside, and left turns need to cross the bus lane if it is center running.
4. **Traffic Volumes and Queueing** Use dedicated lanes where there are high vehicle volumes and where the bus is often delayed due to vehicle queuing.
5. **TSP Strategies** Can support all TSP strategies including green extension, red truncation, phase insertions (queue jump phases), phase reservice, green reallocation and transit signal optimization (adaptive corridors).

Shared Bus-bike Lanes

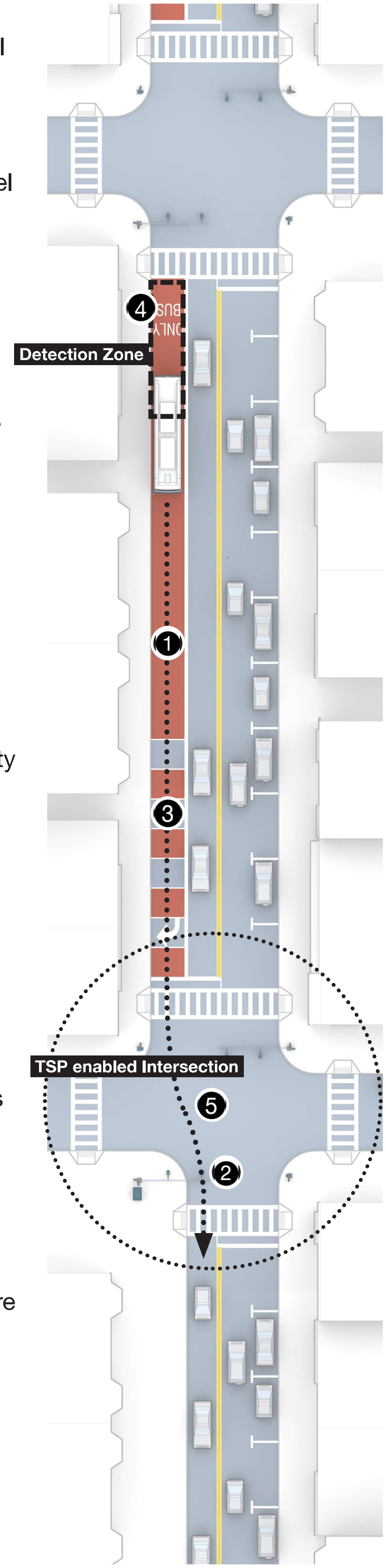
- Consider current and future bicycle volumes along the corridor.
- Where possible, accommodate bicyclists separate from the bus lane; otherwise, consider shared bus-bike facilities (such as bus-bike lanes) and additional bike accommodations (such as bike boxes) at intersections.
- Consider grade changes to reduce the speed differential between buses and bikes. Prioritize separate bike lanes for steep uphill segments where possible.
- Consider the volume and frequency of bicycles in the shared lane and how bus speeds may vary from the detection point to the intersection depending on whether leading or following a bicycle.
- Likely will not get the full benefit of accurate bus predictions compared to a dedicated transit lane since bus travel times will vary if a bicyclist is present.

Peak Period Only

- Likely to provide similar benefits to full-time, dedicated bus lanes during peak periods.
- Likely to provide similar benefits to TSP in General Purpose Lane during off-peak periods.

TSP in a Queue Jump Lane

Queue jumps reduce transit delays at intersections by allowing buses to bypass queues at signalized intersections and travel through the intersection ahead of general purpose traffic. Buses can bypass the front of the queue and will get a head start at the beginning of the next signal cycle using a dedicated bus lane or shared turn pocket with low volumes of turning vehicles. A phase insertion strategy may be used to provide a transit-only signal phase when a bus is detected so that the bus can travel through the intersection into receiving general purpose lanes ahead of general traffic.



Benefits

- Provides travel time savings by routing buses around queues at congested intersections ahead of other traffic.
- Provides more reliable travel times in locations where a dedicated transit lane ends and buses merge downstream of the intersection with general purpose traffic.
- Can implement at intersections with a right turn pocket, but not necessarily space for a dedicated bus lane.

Challenges

- Requires a long enough dedicated ROW in advance of an intersection to enable a bus to pass the queues that typically occur at a signalized intersection.
- Requires a dedicated ROW for merging back into the main travel lane.
- Requires upstream bus detection to ensure that a bus isn't going to miss the priority phase and miss the signal.
- Could require dedicated ROW or farside bus stop.

Implementation Considerations

1. **Dedicated Lanes** Implement a dedicated transit, shared bus-bike, or left or right turn lane that is long enough so that a bus can enter the lane from the back of the queue to wait at the stop bar. Ideally, the queue jump lane should be longer than the queue 90% of the time.
2. **Signal Indications** May require a dedicated signal head to indicate when the bus can travel through the intersection ahead of general purpose traffic. The signal head can either be transit specific or optically programmed/louvered, making it visible only to bus operations or to both lanes.
3. **Turn Volume** If the queue jump is from a shared turn lane, the volume of turning vehicles should be low enough to avoid significant queues. The dedicated transit phase will need to be of sufficient length for the bus to clear the intersection before the adjacent through traffic receives a green phase.
4. **Detection Zone** Setting upstream detection zones within the dedicated or shared lane can alert the signal that a transit vehicle is approaching and try to accommodate it. Also, a post intersection detection check out zone can end the transit phase more quickly, reducing the disruption of normal signal operations.
5. **TSP Strategies** Typically implemented with a phase insertion for the dedicated transit signal phase. The lead agency can also combine with a phase reservice to minimize the amount of stop delay for the buses by activating the transit signal phase at more than one point in a cycle.

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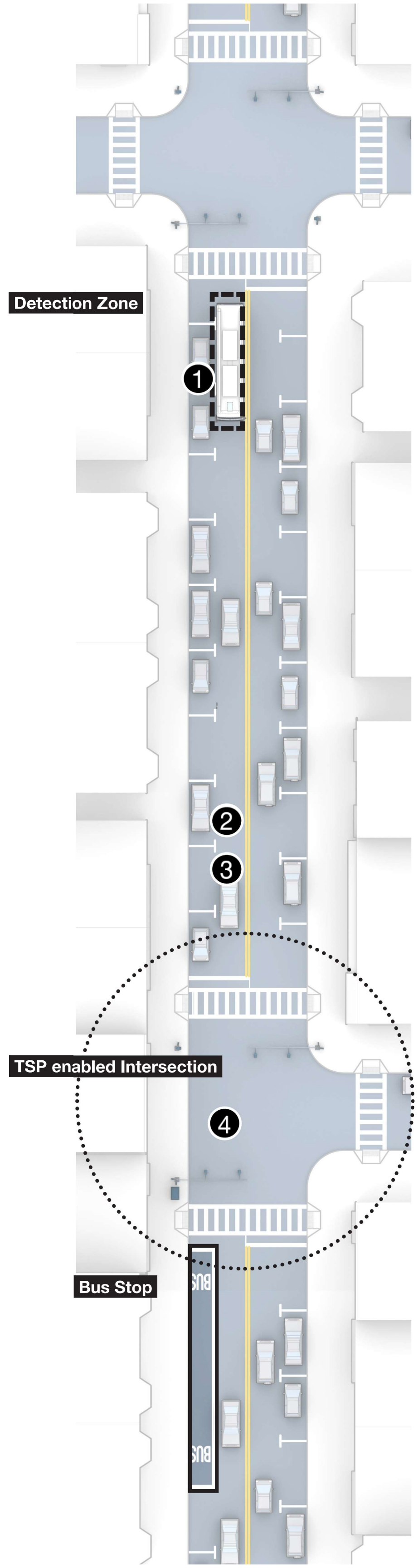
Mixed Traffic, Farside Stop

Adding TSP to an intersection where buses operate in general purpose traffic lanes with other vehicles can improve transit travel times by reducing stop delays. This treatment works best when buses are detected far in advance of the intersection and when there are reliable, predictable travel times between the detection point and the intersection. This reliability is important, as it means that it's possible to adjust the traffic signal phase with fewer impacts to other modes.

Farside bus stop locations allow buses to receive the greatest potential benefits from TSP. With a farside bus stop, buses are detected detected well in advance of the intersection, the travel time between the detection point and the intersection is not interrupted by a stop location, and buses can pass through the intersection without stopping.



Benefits

- Provides the greatest potential benefit to transit travel times since the bus stop is not within the detection zone of the TSP intersection
- Possible to implement without changes to roadway channelization
- Maximizes the time allowed for a controller to respond to a TSP call

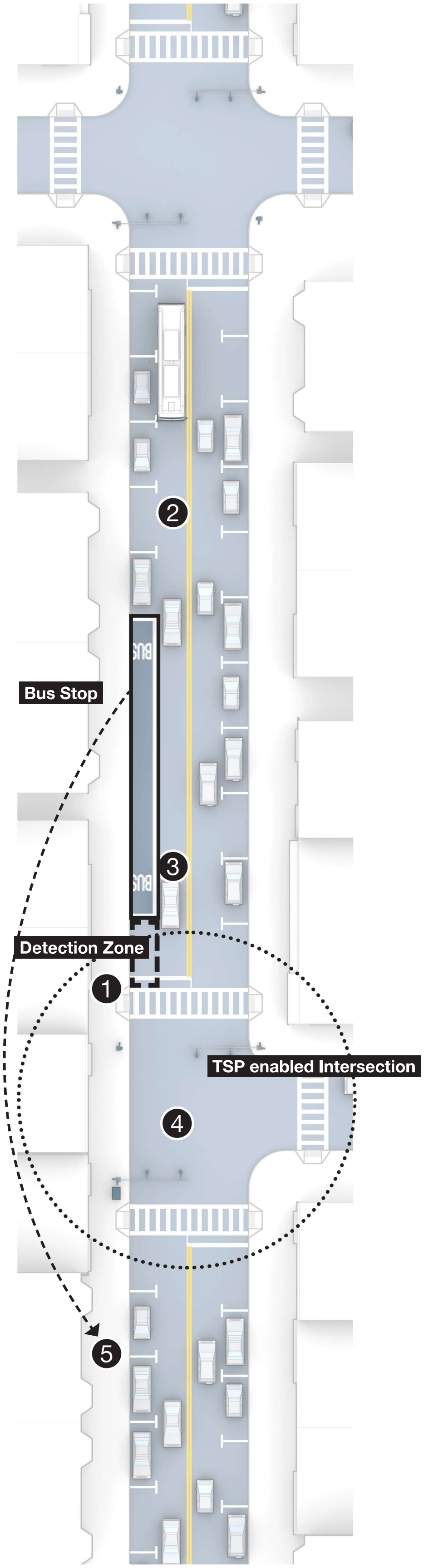
Challenges

- Accuracy of predicting bus arrivals at the intersection is compromised when there are heavy traffic volumes in the general purpose traffic lane or highly variable traffic conditions throughout the day.

Implementation Considerations

1. **Detection Zone** Set detection zone for the bus at the farside of the upstream intersection to the TSP enabled intersection to maximize the amount of time for the controller to respond to the TSP call.
2. **Traffic Volumes** Heavy traffic volumes in the shared lane with buses will likely impact the ability to accurately predict bus arrivals at the intersection, especially if the traffic volumes are highly variable throughout the day.
3. **Queueing** If queuing in advance of the intersection is excessive, and the intersection regularly experiences cycle failure where upstream queues do not clear the intersection, adding TSP will provide little benefit to transit. Consider providing a dedicated transit lane in these situations so that the bus can bypass queues as it approaches the intersection.
4. **TSP Strategies** Typically implemented with both green extension and red truncation TSP strategies. There is a higher probability of receiving a green extension when there is a longer detection area in advance of the intersection.

Mixed Traffic, Nearside Stop



TSP is possible at intersections with nearside bus stops, but the proximity of the bus stop to the intersection will limit some of the benefits of TSP due to a shorter detection zone. Implementation of TSP at these locations may require additional programming of the traffic signal controller.

Benefits

- Provides low to moderate transit travel time improvements.

Challenges

- Accuracy of predicting bus arrivals at the intersection will be limited based on the shorter detection zone between the bus stop and the intersection.
- With a shorter detection zone, the controller will have limited call reaction time, which may limit the TSP strategies the lead agency can implement.
- May require additional controller programming to delay the TSP request once a bus is detected at the bus stop to account for dwell time.
- May require additional hardware and/or programming of the buses for the API feed to provide “door open/door closed” status ensuring TSP requests are only placed after the bus serves the stop.

Implementation Considerations

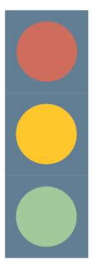
1. **Detection Zone** Set detection zone for the bus just beyond the head of the bus stop in advance of the intersection, or use the bus stop as the detection point with delay timer in the controller, or door open/door closed status in the API feed.
2. **Traffic Volumes** Heavy traffic volumes in the shared lane may cause delays to buses trying to reach the nearside stop and then delay buses clearing the intersection. If right turns are allowed in front of the bus stop, the bus may not be able to pull forward directly after serving the stop, which may further disrupt predictions.
3. **Queueing** If queuing in advance of the intersection is excessive and the intersection regularly experiences cycle failure where upstream queues do not clear the intersection, adding TSP will provide little benefit to transit. Provide a transit lane in these situations.
4. **TSP Strategies** Typically implemented with both green extension and red truncation TSP strategies. Higher probability of receiving a red truncation treatment given short detection zone in advance of the intersection.
5. **Bus Stop Relocation** Having the bus stop close to and on the nearside of the intersection can reduce the benefits of TSP. Therefore, consider relocating the bus stop to the farside of the intersection, or relocate nearside bus stops to mid-block to allow for a longer detection zone in advance of the intersection.

Transit Signal Heads and Phasing

This section provides guidance on the types of signal heads and signal phasing that municipalities can use to support transit operations for typical scenarios. MBTA prefers to use transit signal heads for locations where buses are operating in dedicated ROW, and standard signal heads for locations where the buses operate in general purpose or shared lanes with other vehicles.

The MBTA uses transit signal heads with a horizontal red bar as the red indication, white triangle as the yellow indication and a vertical white bar as the green indication. A standard signal head included in the MUTCD (Manual of Uniform Traffic Control Devices) can include red, yellow, green ball indications or dedicated turn arrow indications. In cases where buses are receiving a phase ahead of adjacent travel lanes, there should be an optically programmable signal head which only is visible from the bus travel lane. Municipalities can use optically programmable signal heads to target visibility of the head to the travel lane to avoid confusion from other drivers trying to advance through the intersection during a dedicated bus phase.

Transit Signal Head



Standard Signal Head

Optically Programmable Signal Head

The MUTCD requires that signalized through movements have a minimum of two primary signal heads for the through movement. In some situations the primary signal heads for the through movements are used for the bus movements at the intersection. For other situations, an additional head is recommended for the bus movement. The following section includes illustrations of eleven scenarios with bus operations at signalized intersections with the guidance on the signal heads for each scenario, unique operational considerations, and complementary Active TSP strategies that municipalities could use for the illustrated conditions.

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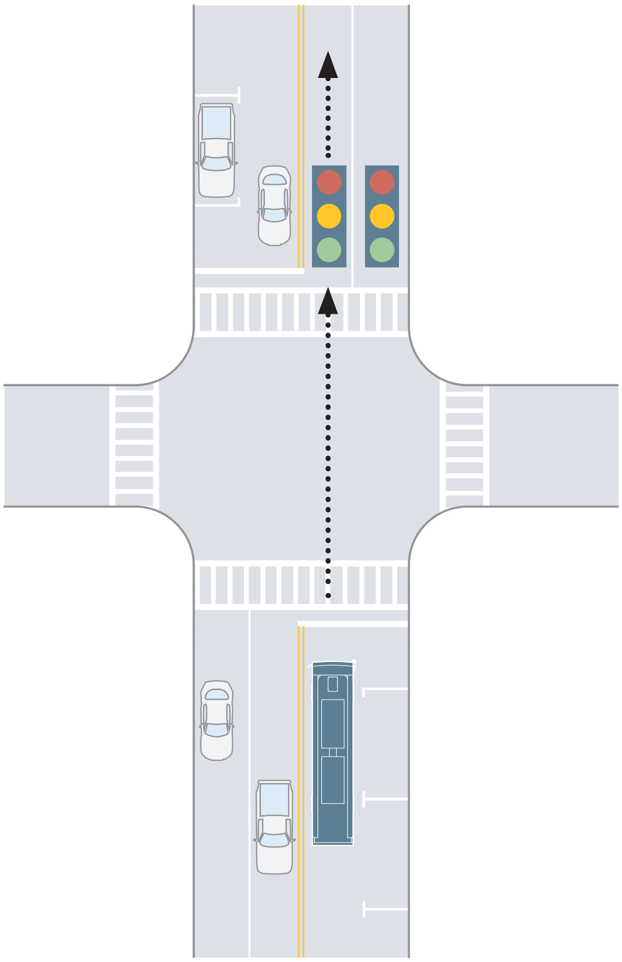
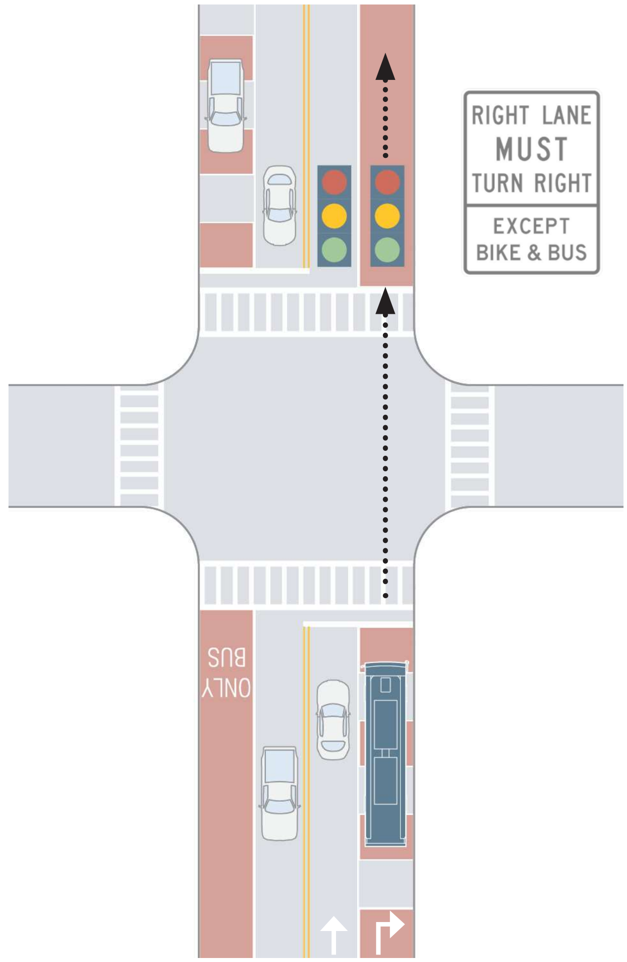




1 Bus Operating in Mixed Traffic Traveling through the Intersection

Signal Heads

No special signal heads needed for bus movements

Operational Considerations

- No special signal phasing required to support bus operations.
- Mixed traffic operation provides no operational benefit to buses approaching an intersection. The benefits of active TSP strategies are affected by underlying traffic volumes and queue lengths approaching the intersection.

Active TSP Strategies

- Green Extension
- Red Truncation
- Green Reallocation

2 Bus Operating in a Shared Bus Lane with Right Turns with the Bus Traveling through the Intersection

Signal Heads

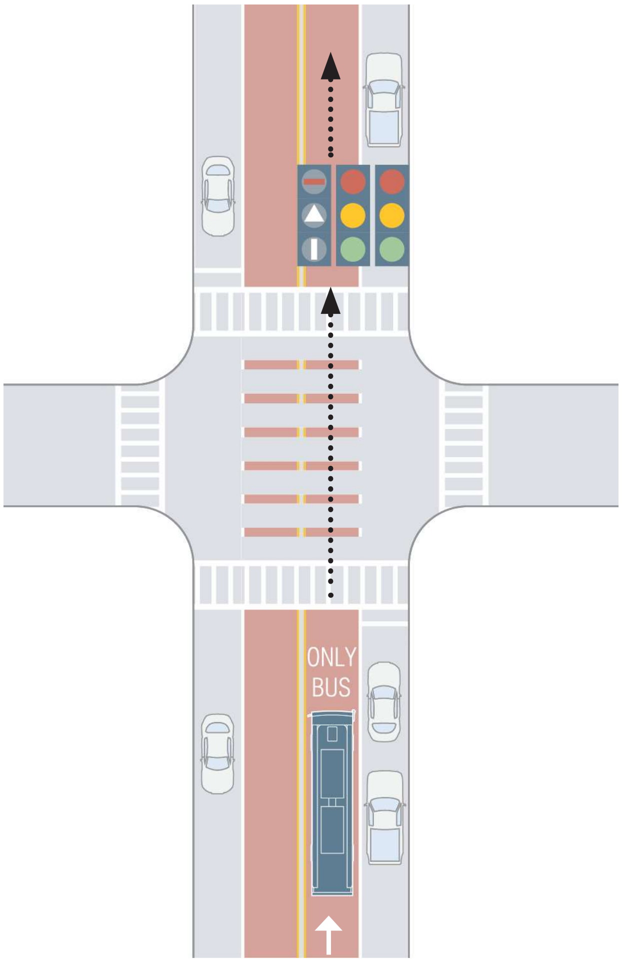
No special signal heads needed for bus movements

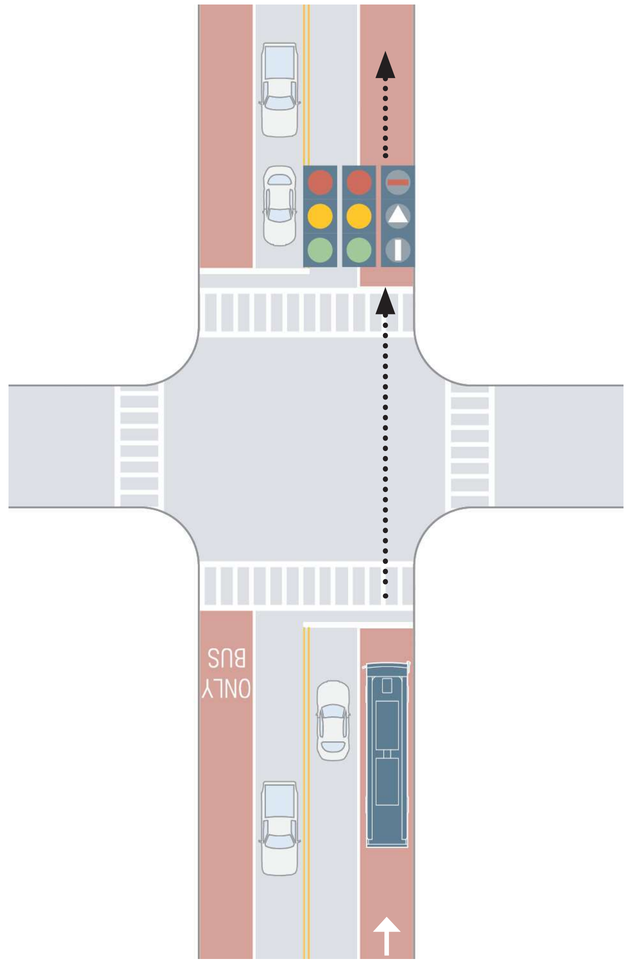
Operational Considerations

- No special signal phasing required to support bus operations.
- Include supplemental signing to reinforce shared operations (i.e modified R3-7 sign).
- The operational benefits to buses of shared lanes depends on the volumes of right turning vehicles and pedestrian volumes crossing the intersection. If the volume of right turning vehicles is high and those turning vehicles must yield to a high number of pedestrians crossing the side street, then queues will develop in the shared lane and limit the benefits of the shared lane and active TSP strategies at the intersection.

Active TSP Strategies

- Green Extension
- Red Truncation
- Green Reallocation





❸ Bus Operating in Center-running Bus Lane Traveling through the Intersection

Signal Heads
Use dedicated transit signal for bus movements

Operational Considerations

- No special signal phasing required to support bus operations.

Active TSP Strategies

- Green Extension
- Red Truncation
- Green Reallocation

❹ Bus Operating in Curbside Bus Lane Traveling through the Intersection

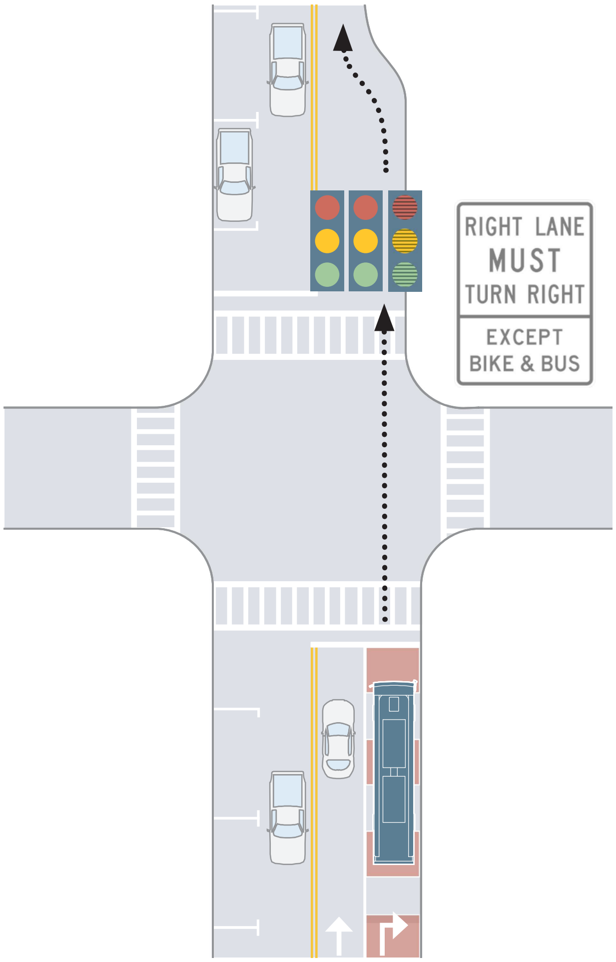
Signal Heads
Use dedicated transit signal for bus movements

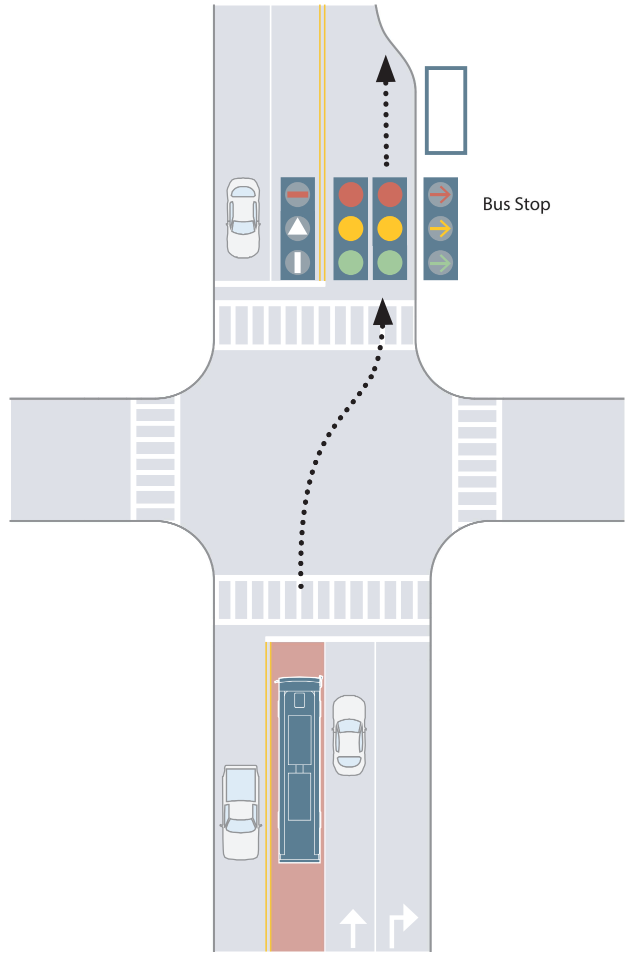
Operational Considerations

- No special signal phasing required to support bus operations.

Active TSP Strategies

- Green Extension
- Red Truncation
- Green Reallocation





5 Queue Jump from a Shared Right Turn Lane

Signal Heads

Use optically programmed signal head for the queue jump lane

Operational Considerations

- Requires a dedicated phase for the queue jump.
- Include supplemental signing to reinforce shared operations (i.e modified R3-7 sign).
- Right turns allowed to make the permissive right turn during the queue jump phase. Best used where right turn volumes and pedestrian crossing volumes are low so that buses are not stuck behind a queue of right turning vehicles yielding to pedestrians.
- Use in locations where a shared bus lane ends and buses need to merge back into mixed traffic.

Active TSP Strategies

- Phase Insertion
- Phase Insertion with Phase Reservice

6 Queue Jump from a Center-running Bus Lane

Signal Heads

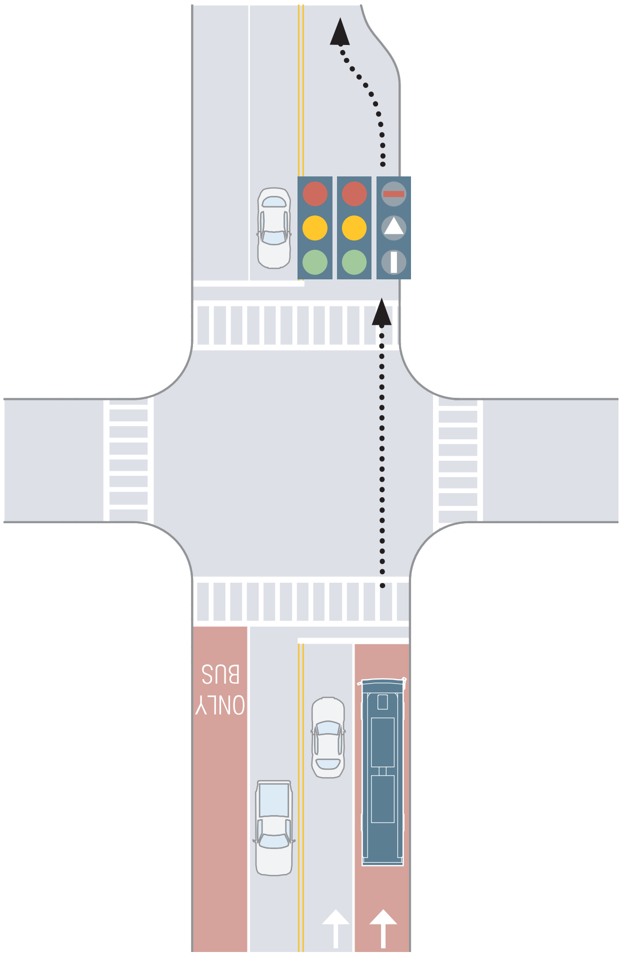
Use transit signal head for the bus lane

Operational Considerations

- Requires a dedicated phase for the queue jump.
- Use in locations where a dedicated bus lane ends and buses need to merge back into mixed traffic.

Active TSP Strategies

- Phase Insertion
- Phase Insertion with Phase Reservice



❼ Queue Jump from a Curbside Bus Lane

Signal Heads

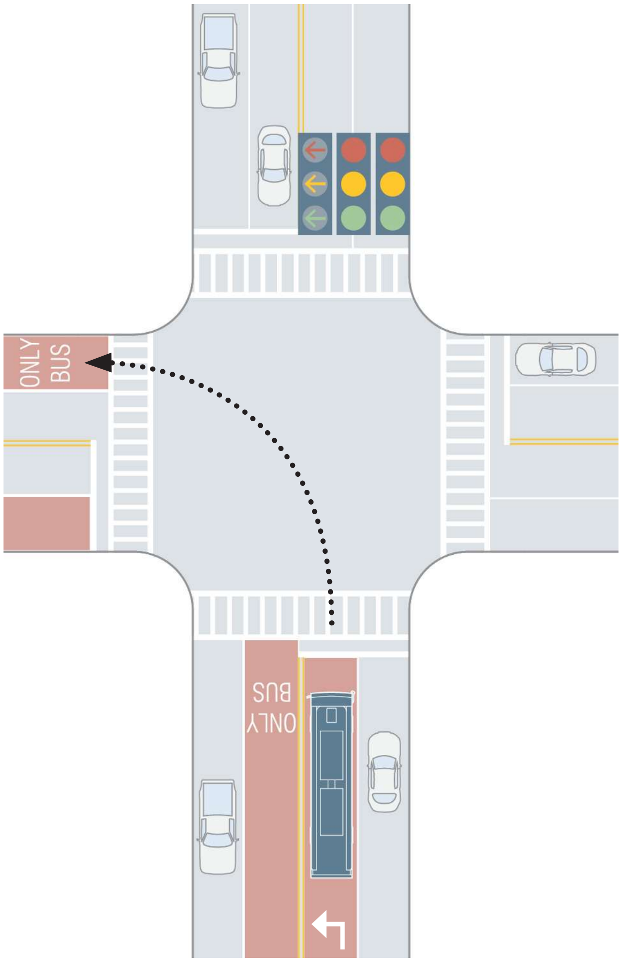
Use transit signal head for the bus lane

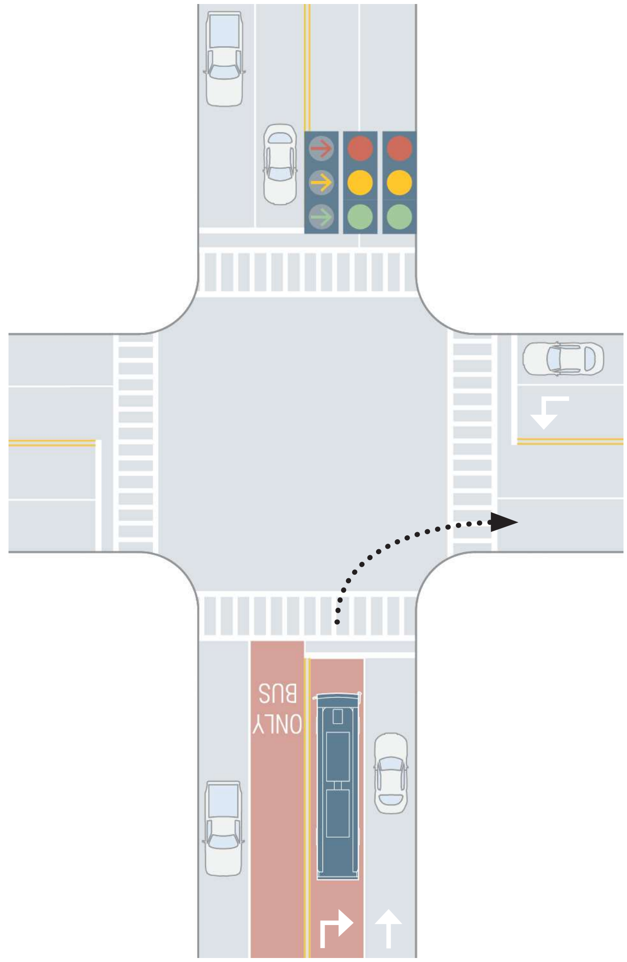
Operational Considerations

- Requires a dedicated phase for the queue jump.
- Use in locations where a dedicated bus lane ends and buses need to merge back into mixed traffic.

Active TSP Strategies

- Phase Insertion
- Phase Insertion with Phase Reservice





8 Bus Left Turn from a Center-running Bus Lane

Signal Heads
Use standard left turn arrow signal head for the bus lane

Operational Considerations

- Include a standard protected left turn phase for the bus movement.
- Use in locations where the transit route turns from the main road to the cross street.

Active TSP Strategies

- Green Extension
- Red Truncation
- Phase Reservice

9 Bus Right Turn from a Center-running Bus Lane

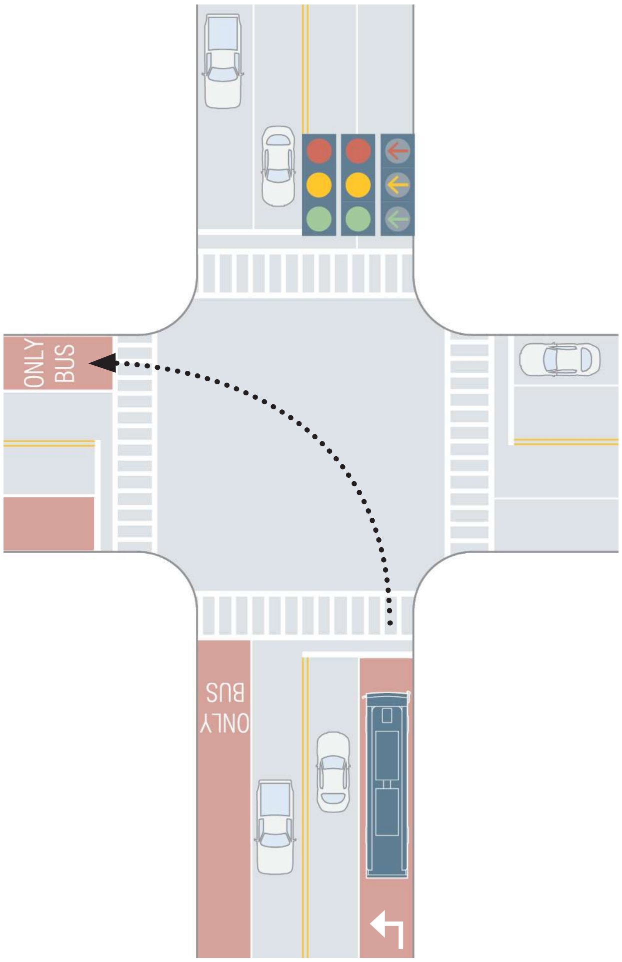
Signal Heads
Use standard turn arrow signal head for the bus lane

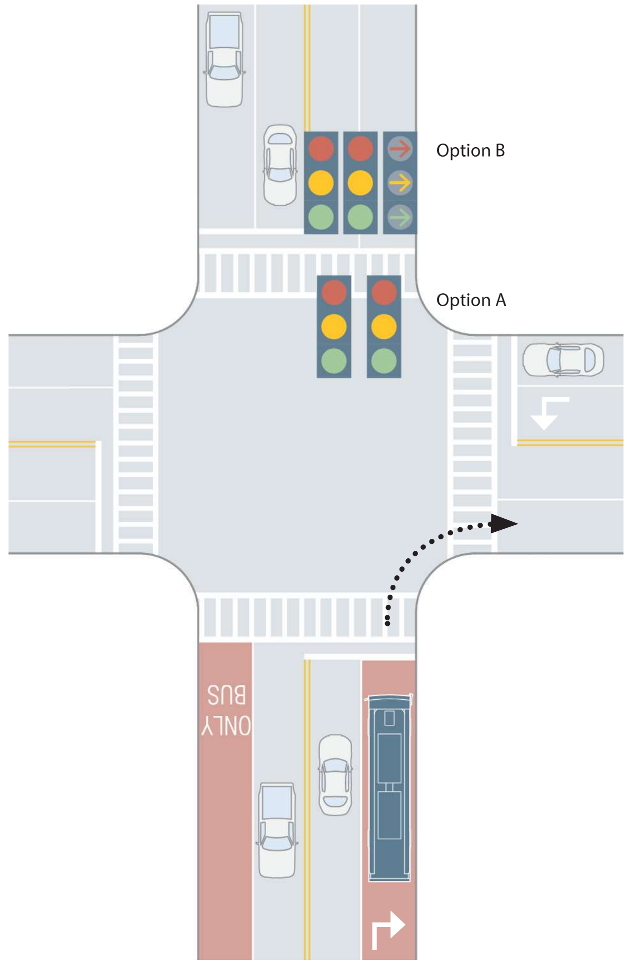
Operational Considerations

- Requires a dedicated phase for a protected turn isolated from other movements at the intersection.
- Use in locations where the transit route turns and there is significant queuing in the adjacent general purpose lanes that restrict the ability for buses to merge into the right turn lane in advance of the intersection.

Active TSP Strategies

- Phase Insertion
- Phase Insertion with Phase Reservice





10 Bus Left Turn from a Curbside Bus Lane

Signal Heads

Use standard turn arrow signal head for the bus lane

Operational Considerations

- Requires a dedicated phase for a protected turn isolated from other movements at the intersection.
- Use in locations where the transit route turns and there is significant queuing in the adjacent general purpose traffic lanes that restrict the ability for buses to merge into the right turn lane in advance of the intersection.

Active TSP Strategies

- Phase Insertion
- Phase Insertion with Phase Reservice

11 Bus Right Turn from a Curbside Bus Lane

Signal Heads

Use either standard signal head for the bus lane
Or
Use standard right turn arrow signal head for the bus lane

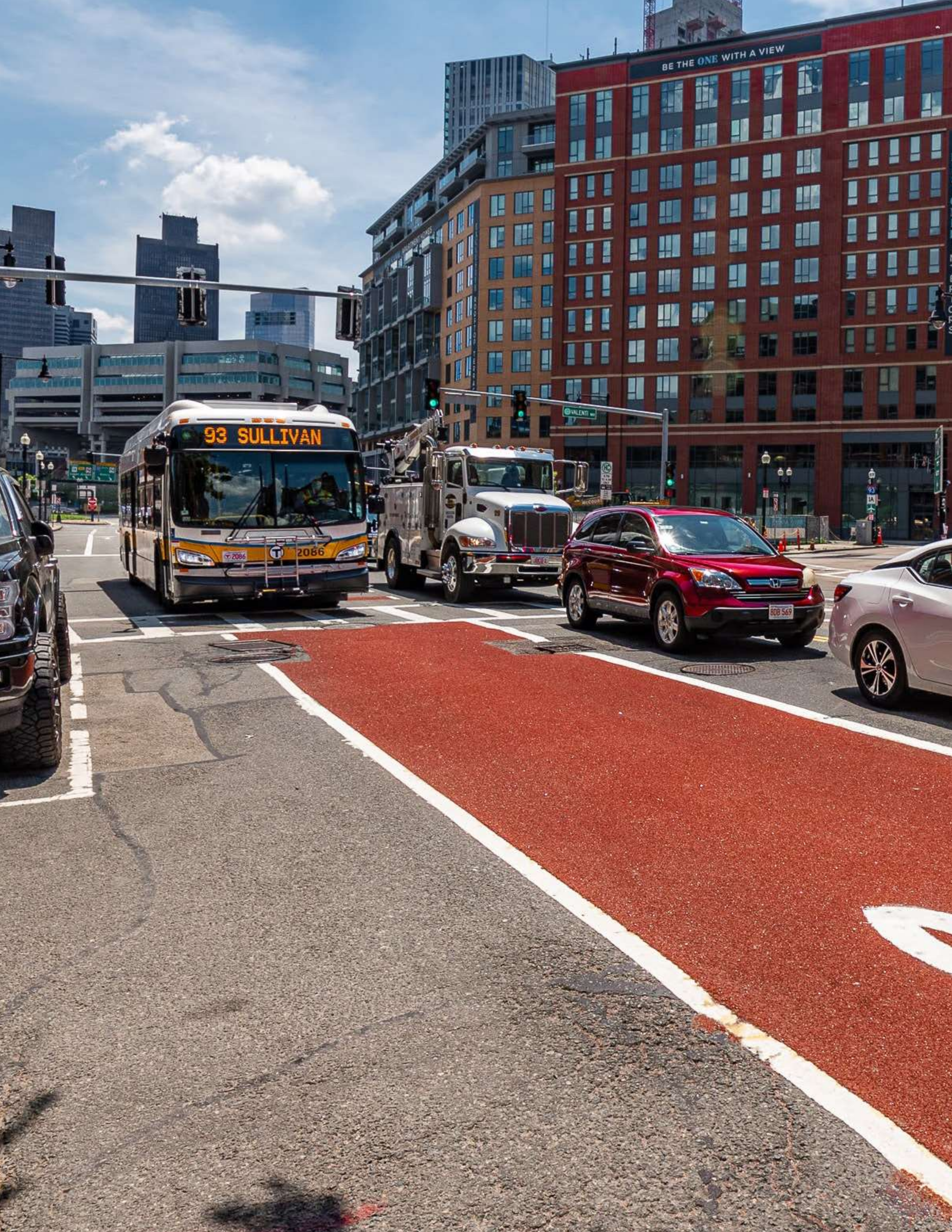
Operational Considerations

- No special signal phasing required to support bus operations. Can operate as a permissive right turn with buses yielding to pedestrians for locations with moderate to low pedestrian volumes.
- Alternatively provide a protected right turn phase to allow the bus to make the right turn ahead of the pedestrian crossing for locations with high pedestrian volumes.

Active TSP Strategies

- Green Extension
- Red Truncation

  Or
- Phase Insertion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