

# 4 Intersections

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# Multimodal Intersections

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Intersections are locations where modes come together, and where the most conflicts and crashes occur on the roadway. People who travel on Boston’s streets should feel safe and comfortable, and experience a minimal amount of delay during all trips regardless of whether they are made on foot, by bicycle, via transit, or in an automobile. Intersection designs must address three basic needs:

**Safety** – the most important objective of intersection design is the safety of all users.

**Convenience** – intersections should be convenient to access and comfortable for all users.

**Minimal Delay** – users should not be unduly delayed when moving through intersections.

Intersection safety is of paramount concern in the City of Boston. Intersection design should carefully balance the safety needs of all users, and should recognize that non-motorized users are more vulnerable and suffer far greater injuries in the event of a crash.

Intersections should be functional and easy to navigate, and designed with intuitive geometry and clear regulatory and wayfinding instructions through signage, pavement markings, and signalization. Also, designs should reflect users’ desired travel paths as seamlessly as possible.

Traditional policies, both written and unwritten, have focused primarily on reducing motor vehicle delay, which offers benefits of reducing vehicle emissions and fuel consumption; however, these policies prioritized motorists over other users. Moving forward, intersection design in Boston will equally address the safety, comfort, and convenience of all modes.

The design of multimodal intersections will include the following considerations:

- ▶ The safety of all users will be the priority of intersection design.
- ▶ Decisions regarding intersection design will not be made solely on the delay to individual legs or movements occurring for short periods of time.
- ▶ Automatic pedestrian phases—not requiring pushbutton activation—should be used wherever feasible.
- ▶ Generally, concurrent pedestrian phases will be provided for the full length of the corresponding vehicle phase when feasible.

Different design elements of the roadway environment impact the basic needs described above. Unfortunately, several elements that improve conditions for one mode can have the effect of reducing the quality of service for other modes. Multimodal Level of Service (LOS), also termed “quality of service,” provides a set of tools that can be used to measure how well intersections perform for various modes. In the context of intersections, the following pages illustrate the elements that matter most to each mode, as well as a discussion of the tradeoffs faced with trying to balance the needs of safety, convenience, and minimal delay for all users.



# Pedestrian Experience

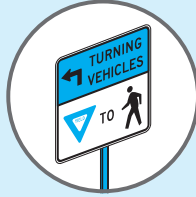
The primary needs of pedestrians at intersections include:

## Safety



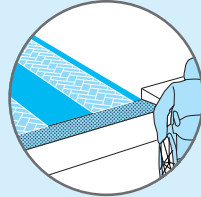
Lower motor vehicle speeds:

- ▶ Narrower motor vehicle lane widths
- ▶ Reduced turning radii
- ▶ Traffic calming measures



Less exposure to conflicts:

- ▶ Dedicated space
- ▶ Shorter crossing distances
- ▶ Improved sight lines and visibility
- ▶ Crossing islands where appropriate
- ▶ Appropriate signal timing and crossing treatments



Accessible crossings:

- ▶ American's with Disabilities Act (ADA) compliant curb ramps that prevent ponding of precipitation
- ▶ ADA compliant crosswalks
- ▶ Accessible pedestrian signals that inform users when signals have been activated

## Convenience



Comfortable and inviting spaces:

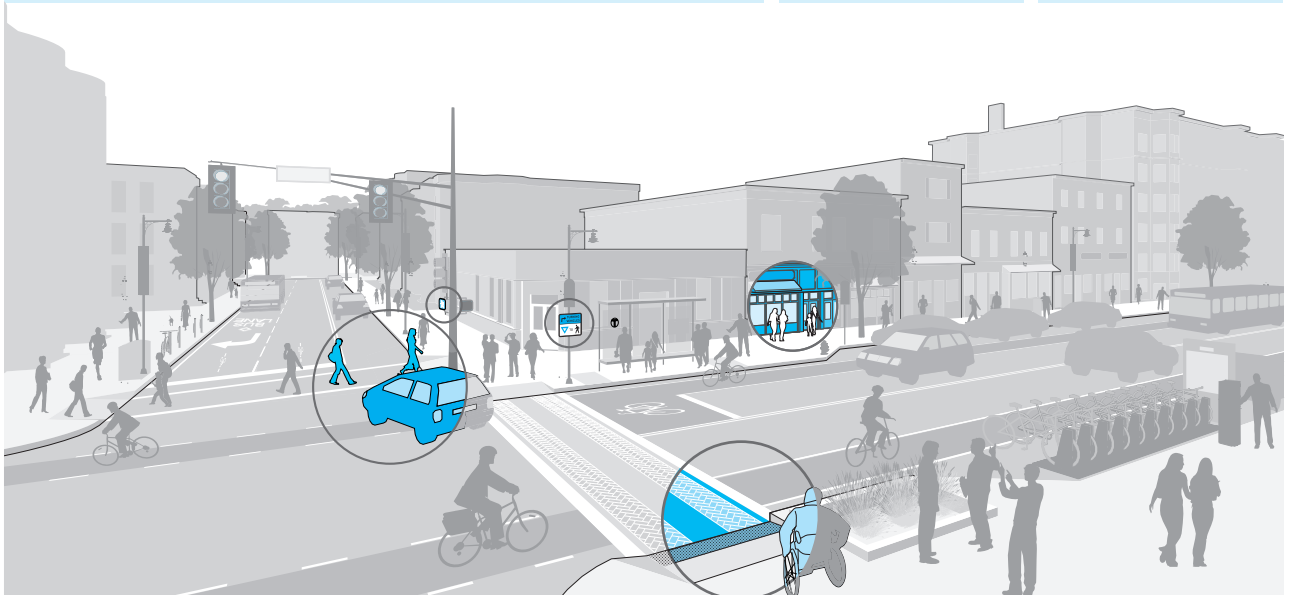
- ▶ Appropriate sidewalk widths for pedestrian volumes
- ▶ Crossings that reflect pedestrian desire lines
- ▶ Buildings that front the street
- ▶ Transparent store fronts
- ▶ Street trees
- ▶ Amenities such as benches, recycling and trash receptacles, public art, street cafés, etc.

## Minimal Delay



Frequent opportunities to cross:

- ▶ Appropriate traffic controls (i.e., signage vs. signalization)
- ▶ Pre-timed pedestrian signals for every cycle
- ▶ Responsive pushbuttons where applicable
- ▶ Direct routes across complex intersections

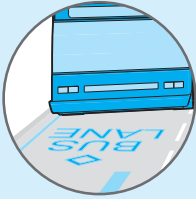




# Transit User Experience

The primary needs of transit users at intersections include:

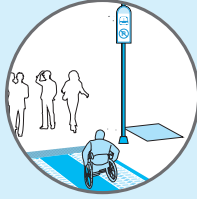
## Safety



Good pedestrian and bicycle accommodations (see previous sections)

Less exposure to conflicts:

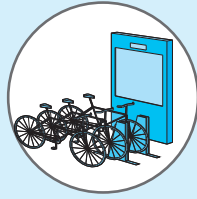
- ▶ Bus bulbs (Curb extensions at bus stops)
- ▶ Transit-only lanes
- ▶ Far-side bus stops



Accessible transit stops:

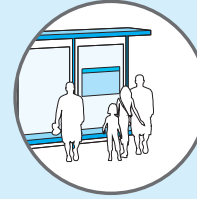
- ▶ ADA compliant landing zones at all doors
- ▶ Appropriate sidewalk widths for pedestrian volumes
- ▶ Well-lit transit stops

## Convenience



Connections to other modes:

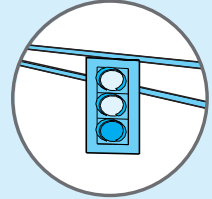
- ▶ Good pedestrian and bicycle accommodations
- ▶ Bicycle share stations
- ▶ Wayfinding signage



Comfortable transit stop locations:

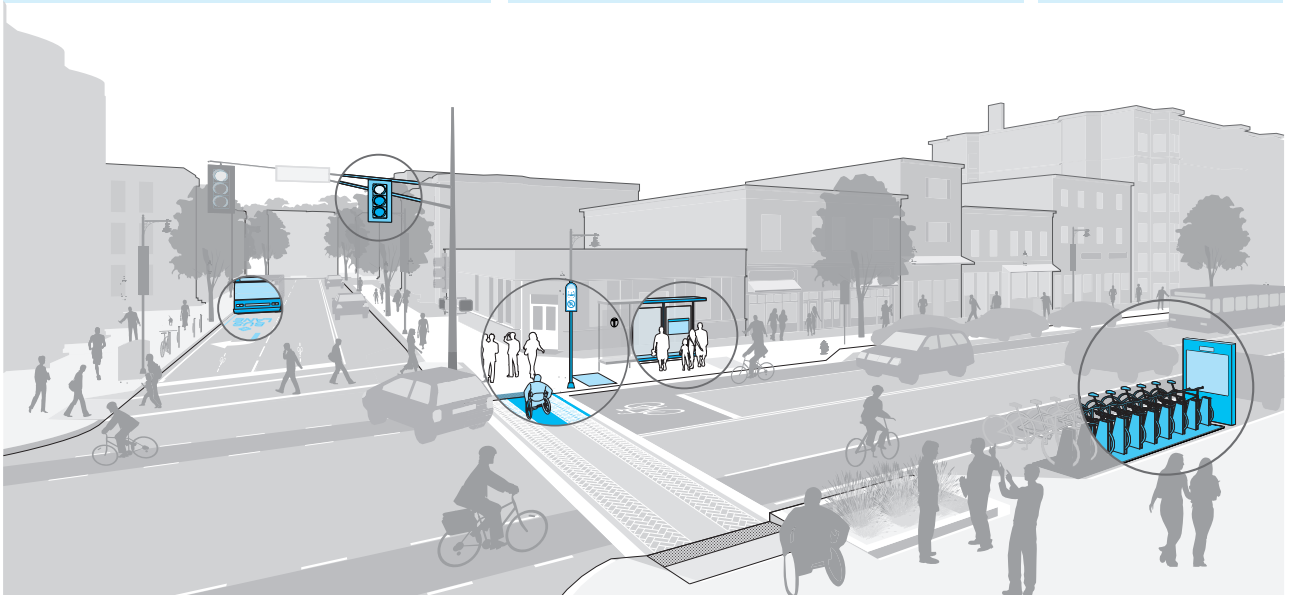
- ▶ Transit shelters
- ▶ Recycling and trash receptacles
- ▶ Route information
- ▶ Storage space for snow during winter

## Minimal Delay



Minimal delay in service:

- ▶ Frequent headways
- ▶ Signal priority
- ▶ Queue jump lanes
- ▶ Off-bus fare collection



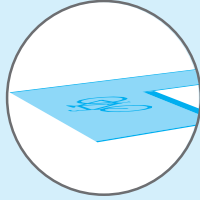
# Bicyclist Experience

The primary needs of bicyclists at intersections include:

## Safety



- Lower motor vehicle speeds:
- ▶ Narrower motor vehicle lane widths
  - ▶ Reduced turning radii
  - ▶ Traffic calming measures

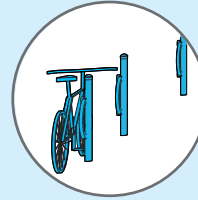


- Less exposure to conflicts:
- ▶ Dedicated space
  - ▶ Shorter crossing distances
  - ▶ Signal design that accommodates bicycle speeds
  - ▶ Signal design that reduces conflicts with other modes



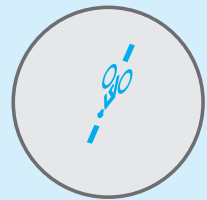
- Degree of separation:
- ▶ Intersection treatments for separate bicycle crossings
  - ▶ Bicycle lanes
  - ▶ Buffered bicycle lanes
  - ▶ Cycle tracks

## Convenience

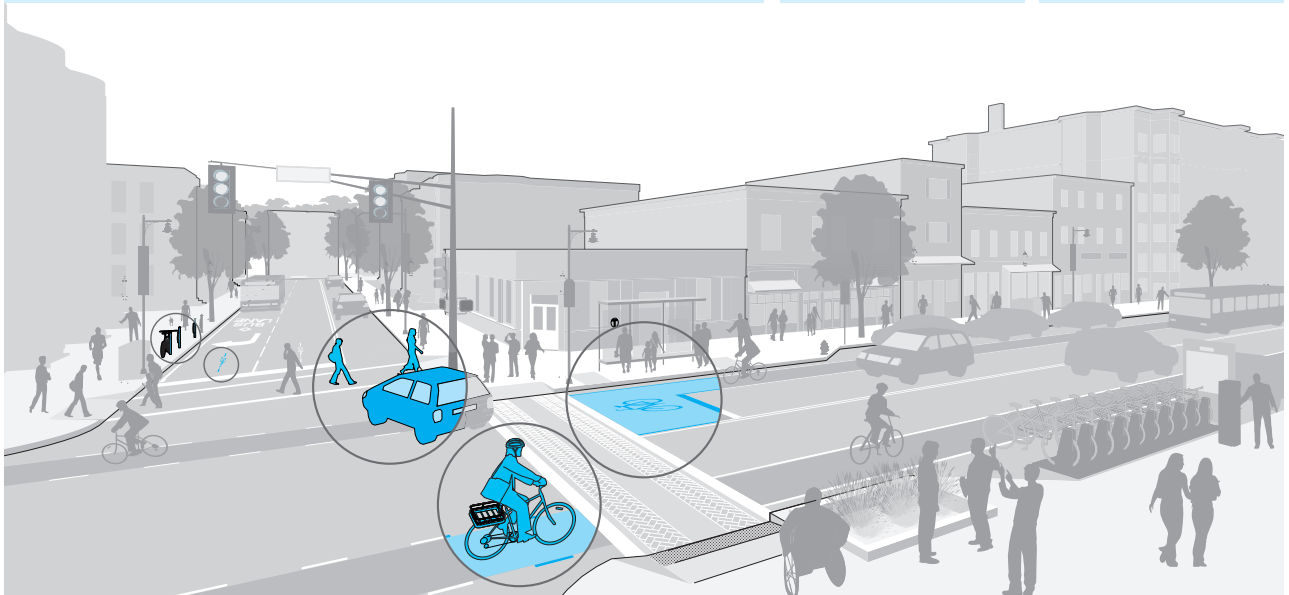


- Well-maintained and bicycle-friendly intersections:
- ▶ Good pavement quality
  - ▶ Materials that reduce vibrations
  - ▶ Connections to other bikeways
  - ▶ Wayfinding signs
  - ▶ Bicycle parking

## Minimal Delay



- ▶ Responsive traffic signals
- ▶ Bicycle signals
- ▶ Bicycle detection
- ▶ Direct routes across complex intersections





# Motorist Experience

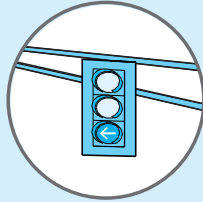
The primary needs of motorists include:

## Safety



Designs that reduce conflicts and the severity of crashes:

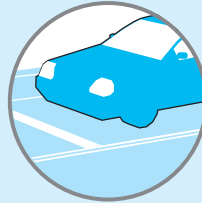
- ▶ Improved sight lines and visibility
- ▶ Dedicated space for all modes
- ▶ Warning signage and pavement markings
- ▶ Well-lit crossings



Safe options for turning movements:

- ▶ Phase-separated turning movements
- ▶ Advanced stop bars
- ▶ Separate turn lanes (only when necessary)

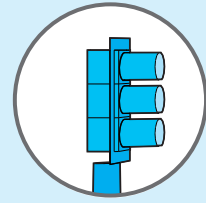
## Convenience



Well-maintained intersections:

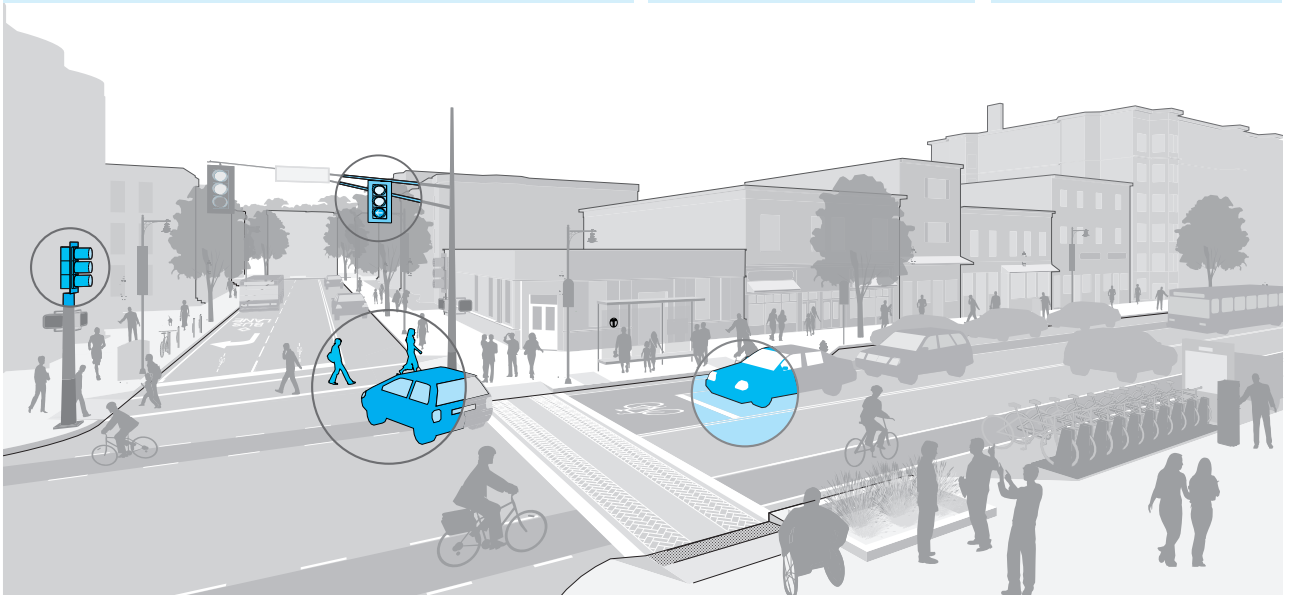
- ▶ Good pavement quality
- ▶ Wayfinding signage

## Minimal Delay



Responsive signal design:

- ▶ Coordinated signal timing
- ▶ Responsive loop detectors and signals



# Multimodal Level of Service

## Overview

Level of Service (LOS) is used to measure the effectiveness of streets and roadways in meeting the needs of travelers based on various modeling techniques. Traditionally, LOS in urban areas focused particularly on the capacity of intersections, specifically on the amount of delay caused to motorists.

The 2010 Highway Capacity Manual (HCM) provides methods for measuring multimodal level of service (MMLOS) that enables road designers to balance the interrelated needs of all modes of transportation. This is a particularly useful tool for intersection design. The 2010 HCM introduces new modeling techniques that cover a broader range of factors that are important to non-motorized users, such as perceived comfort and safety in the roadway environment. A transit quality of service is a new feature of the 2010 HCM as well. The following factors are taken into account for MMLOS:





- ▶ **Pedestrian LOS:** includes the traditional measure of delay and sidewalk capacity (based on volumes and sidewalk width), but now also includes a pedestrian quality of service model. The model uses traffic volumes, speeds, and the quality of the buffer between the sidewalk and roadway to determine how comfortable and safe a typical pedestrian feels when walking adjacent to and crossing the road.
- ▶ **Transit LOS:** determined for “urban street facilities” and “urban street segments.” Factors include the frequency of service, travel time speeds, crowding, reliability, amenities at stop, and pedestrian LOS.

- ▶ **Bicycle LOS:** includes two models that measure capacity—one for roadways and one for shared use paths. A third model provides a measure of bicyclists’ feeling of comfort along a roadway, given various traffic factors including travel volumes, speeds, lane widths, presence of a shoulder or bicycle lane, presence of occupied on-street parking, etc.
- ▶ **Motor vehicle LOS:** the HCM continues to provide a motor vehicle LOS model that measures capacity (or delay) at intersections.

Multimodal LOS will be used as a planning tool to balance the needs of all modes during future transportation projects in the City of Boston. Designers should use this tool to balance maximizing safety and accessibility with improving mobility and reducing delay for all modes.

