Pulse Points

More efficient and timely bus connections.

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TRANSITMATTERS

Pulse Points

Top-Level Summary

Well designed transit networks revolve around connections between services. To maximize the usefulness of the network, the transfer experience must be safe, convenient, predictable and short. Pulse points, locations where multiple bus routes arrive and depart at the same time, help provide optimal transfer experiences by minimizing wait times. Seamless transfers will improve the rider experience and ultimately increase ridership levels and rider satisfaction.

Overview

Maintaining a reliable and consistent experience is one of the key ways to build bus ridership. Central to reliability is minimizing wait times in between transfers for riders. For more frequent routes, maintaining consistent gaps between buses, or practicing headway maintenance, has been shown to improve passenger wait time variability, bus travel time variability, and overall passenger satisfaction. Read more about headway maintenance here. However, this method cannot be applied to more infrequent routes. As frequency decreases, having buses stick closely to the scheduled time, or using pulse points allows riders to arrive at their stop shortly before a bus arrives with minimum extra waiting time resulting in a better rider experience.

Justification for Pulse Points: Tumultous Transfers

Keeping the time spent at transfer stations to a minimum is essential; otherwise, a rider may spend more time waiting for a bus than riding it. Routes with infrequent service can have misaligned schedules, causing long unpredictable waits for riders and increasing overall trip times. If lines are spread further apart, riders may be forced to rush between two stops in an attempt to make a connection, which can be difficult and dangerous for some riders, and even impossible for those who have limited mobility due to age or disability. In many cases, wait times exceed the time spent moving, which discourages ridership and encourages car use.

Creating an efficient and short transfer experience helps to maintain and increase transit ridership and satisfaction. Wherever possible, riders should wait no more than 15 minutes at a station or stop. This is especially important in a city like Boston where weather conditions can make waits at bus stops unpleasant for much of the year.

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There are two ways to minimize transfer time. In dense areas with high ridership potential, services should operate as frequently as possible: at least every 15 minutes. This practice, known as headway maintenance, gives riders short waits improving their trip. The other approach is to operate a pulse, a regularly scheduled time when several transit services arrive and depart simultaneously at a pulse point. This allows for easy connections and short wait times even if the service is not very frequent. A pulse makes transfers simple for riders and allows trips to take much less time than they would if transfers were not coordinated. Services that run every 20-30 minutes or greater, should run on a pulse to maximize the utility of the route.

Best practices for Pulse Points Operations

A pulse point can be located at a designated central area where many bus routes already meet, at a Transit Hub where there are connections to other modes, or at another location where multiple routes intersect. Nearby routes can be slightly modified so that they all pass through a single point at appropriate times and frequencies so a pulse can be implemented.

The Brockton Area Transit bus system notably uses a pulse. All bus routes pass through the BAT Center on a synchronized schedule to arrive and leave at the same time allowing riders to easily transfer. View the pulse in action below.

A video showing the pulse system in action, at the Brockton BAT Center

Applicable MBTA Bus Routes:

The MBTA has many locations where multiple buses meet, including transit hubs where sometimes dozens of bus routes bring riders to a subway station where they can transfer for rail service heading downtown. There is no coordination between services, even though some routes run very infrequently, especially at night and on weekends. Buses do not wait for late arriving trains, even when the majority of their passengers are on that train, and even when the train is very late. When transferring from the subway to a bus, or from one bus to another, it is not uncommon to have to wait an hour or more to complete your trip. A pulse would significantly reduce travel times for these riders. The following examples highlight a few places where a pulse could be highly effective.

1) Central Square, Lynn

Central Square is a hub for most of the bus routes serving the North Shore. There is already regional rail service nearly every half hour. Additionally, five bus routes terminate at Lynn and run just about hourly, together with the 455 bus which passes through on the way from Wonderland to Salem every half hour and the relatively frequent 441/442 buses toward Wonderland or Marblehead.

Schedule adjustments should be made so that all buses arrive 10 minutes before the train and leave 5 minutes after, or if the train arrives late, as soon as all passengers have made their way to the bus. If some buses cannot be increased from hourly to half-hourly, they would still meet every other train. The 441/442 already runs every 15 minutes so every other trip would meet a train, too.

A map showing a potential Pulse-Point in Lynn

2) Central Square, Waltham

Many riders boarding in or near Central Square are headed toward Cambridge on Route 70, which has very high ridership but runs slowly, infrequently and unpredictably at certain times. Central Square also hosts the Commuter Rail's Waltham station, offering fast service to Cambridge and Boston. However, trips only run every hour on weekdays, every two hours on weekends, and are costly. For example, on a weekday a round trip from Waltham to North Station will cost a rider $14. Central Square also hosts the remains of six former downtown express services that could provide useful service in Waltham with some consolidation and coordination.

A potential Pulse-Point in Waltham

The train schedule can be adjusted so that eastbound and westbound trains arrive at about the same time. Route 70 can be increased to run every 15 minutes and coordinated with each hourly train arrival. Other routes such as the 61, 553, 554, 556 and 558, which are or could be hourly, can be scheduled to arrive ~5 minutes before the train and depart ~5 minutes after. This would allow easy transfers in all directions and include a buffer in case an arriving bus or train is late, however, bus operators could hold the bus for longer if necessary.

3) Quincy Center, Quincy

From most places in Quincy, it's fairly easy to access the Red Line to Boston but not so easy to move around the city. A dozen routes fan out from Quincy Center providing service in different directions but often at low frequencies. The Red Line is also less frequent on its branches which can exacerbate long wait times, in addition to many emerging speed restrictions and slow zones. The TransitMatters Data Dashboard shows that between December 1, 2022 and March 1, 2023 slow zone induced delays increased 126%, and as of February 28, 2023 there were 37 speed restrictions on Red Line. Current Red Line conditions may discourage riders away from public transit, but integrating pulse points into Quincy's bus network can keep people out of their cars.

A pulse point at Quincy Center would make local and regional travel easier by minimizing wait times and creating consistent hourly or half-hourly schedules for all routes. Bus arrivals and departures should be scheduled around the Red Line at night and on weekends when it's less frequent. Furthermore, as suggested for Central Square in Waltham, buses would be held if necessary for late arriving trains and other buses.

A potential Pulse-Point in Quincy Center

Implementation Details:

Pulses work best when the routes involved have a consistent frequency and reasonably reliable trip times to ensure all buses arrive at the pulse at the appropriate time. Each pulsing route should have a consistent clockface frequency that repeats, such as :25 and :55 past each hour, which makes it easy for riders to understand and remember. On time bus arrivals and departures are critical to success. If routes are extremely crowded or travel through high-traffic areas they could be subject to variability in trip times that will make the pulse difficult to operate. Systemwide operational changes such as transit signal priority and bus lanes should be implemented to ensure on-time arrivals. Stop consolidation and route alterations could also be considered if needed to improve reliability. Increased frequency can also help minimize variability in trip length and make a pulse more feasible. Procedures should be developed to hold buses beyond the scheduled layover time for minor delays on other routes but schedules should be designed with enough layover time so that held buses are rare.

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Appropriate Conditions:

The need for high reliability and consistency often requires a pulse to operate in a subset of a system where there are not too many routes trying to line up.

Pulses are best suited for the end of a route or at major intersections high with traffic points as the bus will be stopped for an extended period. A pulse point may be located at an off-street transit center or on-street hub with enough space for riders to be out of the roadway and sidewalk and for multiple buses to layover simultaneously. Additionally, facilities should have restrooms available for both riders and operators, as well as a sheltered waiting area, preferably indoors. Ideally, riders should be permitted to wait on their first bus until their second bus arrives. See the Mobility Hubs Toolkit for more information on upgrading bus stops.

Pulses are not appropriate for situations where routes operate at high frequency, buses that run every 15 minutes or less, as the main benefit of reduced wait times would not apply. Pulses are advised for bus route frequencies of 20-30 minutes or greater. In some cases, the schedules may need to be adjusted to achieve a more even, consistent frequency. A pulse is impossible with a variable frequency or an overly ambitious frequency which causes buses to be late often.

Pulses are not optimal for routes that service similar or parallel corridors as riders are unlikely to need to transfer between these routes. For routes serving the same street until they split it is best to maintain a consistent frequency on the shared segment.

If a connection point has only two routes it would be better to combine, or rather interline, those routes into one longer route so there is no waiting. Interlining is a common strategy to eliminate transfers and avoid having to turn around if it's difficult to do so. Interlining and pulsing can be done together for locations with more than two routes.

Summary:

Pulse points are a useful tool to reduce wait times and make infrequent routes, routes with 20-30 minute frequency or greater, safer and easier to use by having buses meet at a central location at the same time. Pulse points keep overall travel times to a minimum by keeping transfers short, increasing rider safety and comfort and increasing ridership.

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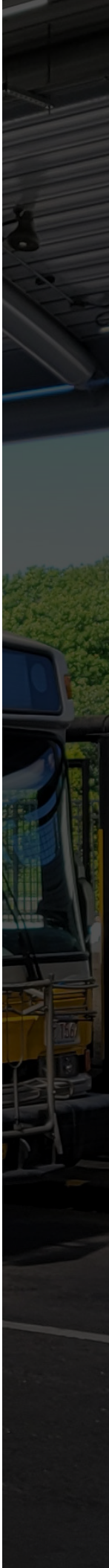

1. MBTA “MBTA Monthly Speed Restrictions Report” (2023) https://cdn.mbta.com/sites/default/files/2023-03/20230302_speed-restrictions-feb2023.pdf