POWER, SIGNALS AND TRAFFIC INTERFACE

Power

The TriMet light rail system is powered by a conventional 750-volt DC overhead system. In central city areas, a single contact wire is used to minimize the amount of overhead wiring. All other locations use a dual-wire catenary, having a contact wire supported by a messenger wire, allowing higher speeds and requiring fewer poles.

Minimizing visual impact

In Downtown Portland, ornamental poles support the overhead wiring and street lighting. In some locations, buildings and bridge structures are used to avoid the need for poles. A handful of buildings on 5th and 6th avenues in Downtown Portland were utilized in this manner. Extensive tree planting and tall buildings often mask the silhouette of the wires. On Interstate MAX, light poles in the street median support the overhead.

Substations

Substations convert high voltage power from the public supply to the 750-volt DC power used by trains. MAX substations are spaced at roughly one mile intervals. The power system can bridge any one substation so trains can continue to run when a substation or its supply is down.

On the MAX Orange Line, one substation was replaced with an energy storage unit that captures and stores electrical energy generated by trains during braking, and feeds it back into the system when the trains accelerate.

Signals and train control

Approximately 30 percent of the TriMet light rail transit (LRT) line operates in the median of city streets. In these sections, train operation is based on traffic signals and line of sight. Train operators observe traffic signals and are prepared to stop short of any obstruction. Speeds do not exceed 35 mph in these sections and are generally restricted to 15–30 mph.

Block signal system and ATS

Where operating speeds do not allow line-of-sight operation, TriMet uses three-aspect, Automatic Block System (ABS) wayside signals. In these sections, Automatic Train Stops (ATS) apply train braking automatically should the train operator fail to obey a red (stop) signal. In some sensitive areas, ATS also provides for speed enforcement. Approximately 70 percent of the MAX alignment uses ABS signaling.

Interlockings provide for both interline routes and turn-backs, with power switches where the MAX Red Line, Yellow Line, Green Line and Orange Line intersect the Blue Line. The end of each line has turn-backs with power switches. Reverse running is provided in the Washington Park tunnel and in single-track sections of the MAX Red Line.

The ABS system provides a design headway of two minutes forty-five seconds for a scheduled headway of three minutes. One section of track, between Gateway and Lloyd Center, is built to accomodate 2-minute scheduled headways.

Traffic interface

TriMet and the local traffic signal jurisdictions use various interconnect methods to accomplish two major goals: first, to provide safe operations for both MAX and vehicle traffic, and second, to minimize delays to both MAX and vehicle traffic. Traffic interface has to be site specific, use proven equipment, and be simple to program and maintain.

Preempt strategies

Preemption varies by degree. For the most part, MAX operates between station platforms without stopping for intermediate intersections.

East Burnside Street sections of Interstate MAX, and Portland to Milwaukie

In these segments, the trains operate at track speeds of up to 35 mph within the median of city streets.

Trains preempt the intersections using conventional traffic signal equipment. Trains are detected by inductive loops or by train-to-wayside communications loops, and the intersection controller starts a pre-timed routine that will bring up the preempt while the train is still a safe stopping distance from the intersection.

Wayside preempt indicators display four traffic signals to the LRT operator: yellow horizontal, flashing yellow horizontal, white vertical and flashing white vertical. Colored signal indications such as Ts or Xs can be misinterpreted by vision-challenged motorists. To avoid confusion to motorists, TriMet has adopted the bar signal system used in Europe for buses and rail transit.

A "Decision Point" marker is installed on the track to help the operator decide what speed to use. In the event a preempt does not occur, the train can stop at the normal service braking rate. A second detector communicates with the traffic signal controller as soon as the train has cleared the intersection, allowing normal operation to resume.

Hillsboro

Hillsboro uses a similar concept except that the narrow roadway prevented installation of left turn pockets at intersections. Left turns are permitted across the tracks by running the trains through the intersections on an "all-red" phase. Left turns are then permitted simply by not being prohibited. Train speeds do not exceed 25 mph in this segment.

Downtown Portland

The city center's 200-foot blocks and alternating one-way streets allow a traffic progression at approximately 15 mph in all four directions. MAX runs on the Morrison/Yamhill streets and the 5th/6th avenues couplets within this progression. TriMet operates at 3-minute headways in the streets with negligible impact on cross traffic.

On 5th and 6th avenues, buses and light rail trains share dedicated transit lanes on the right. Trains travel in the center or right lane, stopping at curbside platforms on the right approximately every 5 blocks. Buses also travel in the center or right lane except to pull over at their stops. Motor vehicles and bikes only travel in the left hand lane. Separate signals are used for trains, buses, and cars and bikes. When trains have a signal to proceed through an intersection, buses, cars and bikes traveling in the same direction have red lights until the train has cleared the intersection. Right turns across the transit lanes are prohibited except at three signalized intersections.

On Yamhill and Morrison streets, parallel traffic can turn across the tracks on a green signal. A train-actuated white bar signal allows the train to enter the intersection ahead of any turning traffic. The few seconds required for this advance white bar is gained by shortening the two succeeding green phases.

Gated crossings

The MAX system includes 48 at-grade crossings which are equipped with gates, lights and bells. Crossings adjacent to stations use wayside signals and ATS to hold the train at the platform until the minimum crossing warning is completed. Where signal-controlled intersections are close to gated crossings, interconnect systems provide traffic time to clear out.

Gates, lights and bells are used in conjunction with ABS where line of sight operations are impractical due to LRT speeds and/or track alignment.

Traffic signals and MAX interlockings

Where the track configuration, street geometry and MAX operations dictate, street interlocking protection facilitates train moves by means of powered switches. Traffic signal preempt and route signaling are merged into a single signal head to simplify the information given to the operator.

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