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CASE STUDY

Light Rail Train Preemption and Priority in Minneapolis, MN

The Challenges

Reducing delays from repeated LRT preemptions

The METRO Blue Line, or "Hiawatha Line" was the first light rail train (LRT) system in Minnesota. Opened in 2004, it is 12 miles in length and it connects the regional airport with the Mall of America, Downtown Minneapolis and Target Field. It's been a very successful line in terms ridership, exceeding projections by 30%.

A portion of the line runs parallel to the very busy Hiawatha Ave. commuter corridor. In this area, a series of five signalized intersections suffered repeated "gate down" preemptions due to randomly arriving trains. The random nature of the preemption events meant that phase movements that conflict with the LRT might, at times, have to wait through three successive events, with **wait times** measured up to **11 minutes.**

The most significant challenge was the random distribution of trains. Equally spaced trains with 5+ minute spacing would not have raised concerns. But, when a second train arrives shortly after its predecessor, major delays will occur.

Eliminating LRT stops between stations

When busy LRT lines overlap, and also compete with other traffic, train congestion can be a problem. This was indeed the case in downtown Minneapolis where the Blue Line and the Green Line overlapped between two stations and through three signalized intersections. The overlapping lines meant that 400+ LRT trips were occurring daily within a critical portion of the traffic control system that needed to remain in coordination with the surrounding grid network.

The net effect was that LRTs would regularly have to stop between the stations, causing an **average estimated delay** of approximately **1 minute.**

The LRT stoppages were occurring because the traffic signals were running fixed time, TOD-based coordination plans and the LRTs were arriving and departing the stations randomly. Furthermore, the sequences available to the existing controllers were inflexible, especially with regard to pedestrian movements. They also failed to properly support emergency vehicle preemption.

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The Solution

Oriux's GREENWave advanced TSP and LRT algorithm

Oriux's GREENWave traffic controller features the most advanced Transit Signal and Light Rail Preemption algorithm in the market and is the preferred traffic controller by some of the major transit agencies in North America.

With the assistance of ACT Traffic Solutions, Oriux's exclusive distributor in Minnesota, a customized solution was developed for the City of Minneapolis to reduce the delays from repeated LRT preemptions and eliminate stops between LRT stations.

The ultimate solution involved a unique combination of features in GREENWave, including "Max Delay Recovery", peer to peer logic, pedestrian overlaps and transit priority.

Under normal operation, with LRTs present in or between the stations, the intersections now run a new fixed time plan that guarantees progression in both directions. This plan eliminates unexpected stoppages between stations. The plan also integrates with neighboring intersections in the grid network during the peak hours.

Peer to peer logic was used to notify all controllers when LRTs were absent so more time could be allocated to general traffic flow. Peer to peer communications also came into play during conditional transit priority events.

This segment of the Blue Line is contiguous with another 10 intersections that rely on GREENWave's Transit Signal Priority (TSP) functions. Again, peer to peer logic is used to activate TSP along the route. Transit Priority works in conjunction with time of day signal coordination plans to allow trains to move from station to station without stopping in between. When trains are not present, TSP allows extra green time to be given to non-transit vehicle phases and extra walk time to be given to pedestrian movements.

The entire corridor is monitored on Oriux's Spinnaker ATMS by both City traffic staff and Transit staff, giving complete visibility of real time operations and historical logs for maximum civic benefit. The powerful TSP logs in GREENWave provide a clear understanding of the impact of TSP events on general traffic.

The Results

Results of the change were immediate and impressive. Former wait times to service a phase movement were recorded as high as 11 minutes. After deployment, maximum wait times are about 4 minutes. Also, the new system easily met the project goal of reducing travel time by 1 minute, allowing the transit agency to remove one train set from daily operation.

- ✓ Reduced wait times from repeated LRT preemptions from 11 minutes to 4 minutes.
- ✓ Reduced travel time by 1 minute.
- ✓ Allowed the transit agency to have shorter and more reliable train travel times.

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