Green Line Transit Signal Priority: Implementation and Lessons Learned

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Green Line Background

- 11-mile LRT line
- 16 stations
- Interlined with Blue Line in downtown Minneapolis
Green Line Background

Transit Signal Priority (TSP) call sent to downstream signal

Signals are interconnected via fiber network

LRT detection at each signal

TSP call sent from upstream signal
Green Line Operations

- **TSP Initial Challenges**
  - Signal timing, including TSP, must still serve all phases and pedestrians every phase
    - Available TSP time about 10 seconds
  - Need to accommodate two-way LRT and vehicle progression
  - With TSP and optimized coordination, 20%-60+% of trains stopping at signals with lower traffic volumes
  - Trains that get out of the signal coordination “green band” fall further behind schedule
New Approach – Predictive Priority

- Objectives:
  - Give LRT the best opportunity to receive a green indication based on predicted arrival of train
  - Do not cause significant additional delay to vehicle or pedestrian phases
  - Disrupt signal sequence and traffic operations as little as possible
Predictive Priority – Before Conditions

- Example — Data collected 6am to 6pm, Tuesdays through Thursdays

<table>
<thead>
<tr>
<th>Fairview/University</th>
<th>Left Turn Delay</th>
<th>NB/SB Cross Street</th>
<th>NB/SB Pedestrians</th>
<th>EB Trains</th>
<th>WB Trains</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours of Analysis</td>
<td>Delay (sec)</td>
<td>Number of observations</td>
<td>Delay (sec)</td>
<td>Number of observations</td>
</tr>
<tr>
<td></td>
<td>36</td>
<td>71</td>
<td>2,070</td>
<td>58</td>
<td>2,242</td>
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</tbody>
</table>
Predictive Priority Process

- Develop and test new controller databases
  - Use LRT detection from intersection immediately upstream
  - Serve LRT phase when train arrives at intersection, if possible
    - EVP overrides LRT call
    - Pedestrian clearance always served
    - Minimum vehicle phases always served
  - Serve other phases with demand immediately after LRT clears
    - Gives left-turn and cross street traffic more opportunities to be served, especially during longer cycle lengths

- Implement new programming and monitor results
  - Use controller data and observations to identify if there are impacts or adjustments are needed
Predictive Priority – After Conditions

- Example — Data collected 6am to 6pm, Tuesdays through Thursdays
  - Reduced delay for left-turn and cross street vehicles
  - Slight increase in delay (+3 sec) for cross street pedestrians

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<td>53</td>
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<td>3,646</td>
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<td>3,280</td>
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</table>
Before Conditions – August 2014

Schedule time of 27 to 28 min

Green Line Transit Signal Priority
After Conditions – December 2014

Schedule time of 27 to 28 min

LRT Travel Time (min)

LRT Trips – Westgate Station to Union Depot Station

Green Line Transit Signal Priority
Predictive Priority Results

- 3 to 5 minute reduction in average travel times
- 25% increase in on-time performance
- Elimination of 13th consist (gap train)
- Improved customer experience
Lessons Learned

- Robust detection system is critical
  - Provides maximum flexibility in operations
- Involve signal controller vendors early and often
- Identify operational priorities and understand trade-offs
- Data-driven approach demonstrates the benefits and lack of impacts for all modes
Acknowledgements

- City of Saint Paul Traffic Operations
- Traffic Control Corporation
- Metro Transit Rail Operations