Measuring the Effects of Congestion and Request Location on Transit Signal Priority

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Outline

- Introduction
- Objective
- Study Design
- Test Scenarios
- Results
- Conclusions/Future Research
Introduction

- Transit Signal Priority Concept
- “Smart bus” knows location and schedule status
- Bus communicates priority request to signal
- Local controller provides priority
Onboard System

PCMIA Card

Control Head

Schedule deviation
Priority Call Sequence
TSP Criteria

- Is the bus within Portland city limits?
- Is the bus on route?
- Are the bus doors closed?
- Has the request already been sent?
- Is the bus behind schedule?
Signal Timing

Standard Plan

Green Extension

Green extension allows bus to get through the signal
Signal Timing

**Standard Plan**

- **27.5 seconds**
- **34.5 seconds**
- **32 seconds**
- **39.5 seconds**

**Red Truncation**

- **23 seconds**
- **29.5 seconds**
- **35 seconds**
- **42 seconds**

Red truncation allows the bus to get started through the intersection sooner.
Objective

To evaluate the relationship between Congestion and the distance at which a bus calls for Signal Priority.
Modeling

Single intersection

Intersection of NE 33rd Ave and Sandy Blvd Portland, Oregon
Hardware-in-the-Loop

Set up showing desktop computer, CID, and 170 Controller
Study Design

- Software - Vissim, Sychro
- TOD Plans – Not used
- Approach v/c ratios - 1.1, 0.9, 0.7, 0.5
- Volumes - 1640, 1330, 1040, 735 V/hr
- Buses - Route 12, 15 min headways, staggered starts
Study Design

- Data Collection
- Three Categories – Travel Time, Waiting Time, Delay
  - Travel Times – Fixed 1000 ft section
  - Waiting time
  - Delay – Buses only
Signal Timing

Standard Plan

Red Truncation

27.5 seconds
34.5 seconds
39.5 seconds

23 seconds
29.5 seconds
42 seconds

23 seconds
35 seconds
42 seconds
## Scenarios

Bus stop locations – Far and Near

### Call distance vs v/c

<table>
<thead>
<tr>
<th>Call Distance</th>
<th>v/c Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>420 feet</td>
<td>1.1 0.9 0.7 0.5</td>
</tr>
<tr>
<td>350 feet</td>
<td>1.1 0.9 0.7 0.5</td>
</tr>
<tr>
<td>280 feet</td>
<td>1.1 0.9 0.7 0.5</td>
</tr>
</tbody>
</table>
### Results-Avg Travel Times

#### Table 1 Average Travel Times

<table>
<thead>
<tr>
<th>v/c</th>
<th>Direction</th>
<th>280 ft</th>
<th>350 ft</th>
<th>420 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>East</td>
<td>66.7</td>
<td>64.8</td>
<td>64.1</td>
</tr>
<tr>
<td></td>
<td>West</td>
<td>75.6</td>
<td>76.3</td>
<td>80.9</td>
</tr>
<tr>
<td>0.9</td>
<td>East</td>
<td>62.5</td>
<td>62.2</td>
<td>61.8</td>
</tr>
<tr>
<td></td>
<td>West</td>
<td>75.4</td>
<td>70.1</td>
<td>73.0</td>
</tr>
<tr>
<td>0.7</td>
<td>East</td>
<td>61.4</td>
<td>62.1</td>
<td>59.3</td>
</tr>
<tr>
<td></td>
<td>West</td>
<td>70.0</td>
<td>68.0</td>
<td>69.3</td>
</tr>
<tr>
<td>0.5</td>
<td>East</td>
<td>62.5</td>
<td>60.8</td>
<td>60.2</td>
</tr>
<tr>
<td></td>
<td>West</td>
<td>64.9</td>
<td>64.7</td>
<td>67.3</td>
</tr>
</tbody>
</table>
Results – Farside

Figure 1-Eastbound Travel Times

Travel Time (sec)

v/c Ratio

280 ft
350 ft
420 ft
Results - Nearside

Figure 2-Westbound Travel Time

Travel Time (sec) vs. v/c Ratio for 280ft, 350ft, and 420ft.

- 280ft (Deep Purple)
- 350ft (Yellow)
- 420ft (Pink)

Travel Time decreases as v/c Ratio decreases.
Results – Delay
Farside

Figure 3-Eastbound Delay

<table>
<thead>
<tr>
<th>Delay (sec)</th>
<th>v/c Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>280 ft</td>
<td>1.1</td>
</tr>
<tr>
<td>350 ft</td>
<td>0.9</td>
</tr>
<tr>
<td>420 ft</td>
<td>0.7</td>
</tr>
</tbody>
</table>
Results – Delay Nearside

Figure 4-Westbound Delay

- v/c Ratio
- Delay (sec)

- 280 ft
- 350 ft
- 420 ft
Results - Wait Time Farside

Figure 5-Eastbound Wait Time
Results - Wait Time Nearsid
Conclusions/Further Research

Near side

Far side

Call button

2 Hour Cycles
Acknowledgments

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Thank You