Quantifying the Benefits of New Bus Priority Logic in SCOOT

Dr Helen Gibson
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20% reduction in delay over typical TRANSYT fixed time system

Over 200 towns and cities worldwide  Continuous development
• **Provides bus priority in a SCOOT network**
  - Extensions, Recalls, Stage (phase) skipping

• **Flexible – different levels of priority**
  - Takes into account traffic conditions
  - Degree of saturation
  - Co-ordination

• **Differential priority - ‘target buses needing priority’**
  - Potential for high priority to fewer buses
  - Improves regularity
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Recalls

Stages

- Bus detected
- Bus passes through junction

Recovery
Detection

• How to detect the bus?
  • Transponders
  • Automatic Vehicle Location (AVL)

• Where to detect the bus?
  As far upstream as possible BUT an accurate journey time prediction is needed
  • 10 – 15 seconds from stop line
  • 70 – 100m upstream of the stop line
  • After bus stops
• **BUS – GPS based AVL**
  - bus priority
  - real time passenger information
  - operational management
  - performance assessment

• **Virtual detectors – locations configured in the on-bus computer**

• **No on-street hardware to detect buses**

• **Flat fare ticketing, off bus ticketing reduce bus stop dwell times**
Use of AVL for Bus Priority at Traffic Signals

GPS differential station

Differential correction value & Priority Request Level

Location

GPS receiver

Priority request

Global Positioning Satellites

Signal status; Priority request (optional), etc.

Signal timings; Local extension permit (optional).

Traffic Signal Controller

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• **Multiple detection points**  
  • Can have more than one bus detector on a link

• **Cancel detector**  
  • Can curtail green extension when bus exits link

• **Long bus journey times**  
  • Can detect buses earlier  
  • Delays decision until correct point in cycle

• **Predictive priority**  
  • Detect bus before it reaches bus stop  
  • Bus stop dwell time included in bus journey time  
  • Need to allow extra time for green extension due to more variable journey time (Bus Variability parameter, BVARY)  
  • Use cancel detector to curtail extension – reduces wasted green time
Evaluation of New Bus Priority Features

• SCOOT–VISSIM micro-simulation study
• On-street trials in London
Where to put the Cancel Detector

- Local extensions
  - Detectors can be placed at the stop line

- Central extensions have a transmission lag
  - A simulation study was required

- VISSIM model of Balls Pond Road
  - Bus stop close to stop line

- Multiple runs to get an average delay per vehicle
Dwell time 20s
Std dev 5s

42m, 6s

100m, 43s
SCOOT Parameters

- To make best position of cancel detector easy to spot, settings that exaggerate the effect were chosen.
- Large opposing flows
- Extension saturation target set to 130%
- Maximum extension set to 30 seconds.
- BVARY for upstream detection: 10 seconds
- BVARY for downstream detection: 2 seconds
Delay to buses along study link

- Blue line: Cancel ON
- Red line: Cancel OFF
- Green line: Downstream
- Purple line: Bus Priority OFF

Distance (metres) from stopline

Delay (seconds per vehicle)
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Results

• Ideal location of cancel detector
  • From graphs: 30 to 40 metres from stop line.
  • 10 metres uncertainty in location from iBUS.
  • Place cancel detector at 30 metres.

• Use of upstream detector saves buses 10 seconds compared with downstream detector.

• Use of cancel detector saves private vehicles 8 seconds compared with upstream detector alone, but is 8 seconds worse than downstream detector.

• Private vehicles suffered due to high opposing flows and long extensions.
Reduced Flows

- Reduce opposing flows by 25%
- Reduce maximum extension to 20 seconds

<table>
<thead>
<tr>
<th>Bus Priority</th>
<th>Bus Detectors</th>
<th>BVARY</th>
<th>Delay per bus on priority link</th>
<th>Delay per private vehicle over network</th>
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<tr>
<td>OFF</td>
<td>None</td>
<td>N/A</td>
<td>52.9</td>
<td>74.3</td>
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<tr>
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<td>Downstream</td>
<td>2</td>
<td>46.6</td>
<td>75.6</td>
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<tr>
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<td>Upstream</td>
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<td>44.2</td>
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<td>Upstream</td>
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<tr>
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<td>Upstream</td>
<td>10</td>
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<tr>
<td>ON</td>
<td>Up and cancel</td>
<td>2</td>
<td>43.4</td>
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<td>Up and cancel</td>
<td>10</td>
<td>43.8</td>
<td>76.9</td>
</tr>
</tbody>
</table>
Findings to Date

• Early bus detection is beneficial even in the absence of a bus stop

• Important to reduce priority settings
  • if more than one arm is granted priority
  • if opposing flows are heavy
  • if there are high bus flows on side streets

• In these cases:
  • Use extension target saturation of 100%
  • Use maximum extension of 15 seconds

• It is possible for buses to receive priority with little disbenefit to other vehicles, particularly if the buses are on the main link
Conclusions

• New facilities enable buses to be detected further from stop line
• Useful for where bus stops are near stop line
• Enables more extensions to be granted
• Cancel detector means unnecessary “wasted” green reduced
• Need to be cautious if multiple arms are set up for bus priority, or if bus flows are high and junctions are busy.