A Green Light for Improved Bus Service

Transit Signal Priority - The New York Experience
Agenda

- Background
- Why revolutionary
- Universal Issues
- Implementation
- Current status
- Future plans

Image from NY Daily News
Public Transit in NYC

- 5.6 million subway and 2.5 million bus trips daily
- 5,700 buses operating on 2,800 miles of routes
- Public transit system operated by MTA NYC Transit
- Streets and traffic signals operated and maintained by NYCDOT
# Traffic Signals in US Cities

<table>
<thead>
<tr>
<th>City</th>
<th>Number of Signalized Intersections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlanta, GA</td>
<td>970</td>
</tr>
<tr>
<td>Detroit, MI</td>
<td>1,300</td>
</tr>
<tr>
<td>Chicago, IL</td>
<td>2,800</td>
</tr>
<tr>
<td>Houston, TX</td>
<td>2,500</td>
</tr>
<tr>
<td>Los Angeles, CA</td>
<td>4,900</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12,470</strong></td>
</tr>
<tr>
<td>New York City, NY</td>
<td><strong>12,743</strong></td>
</tr>
</tbody>
</table>

Source: NYCDOT: Traffic Signals in US Cities
Problem: Bus Speeds in NYC

Average Speed (MPH)

- 1996: 9.1 MPH
- 2002: 8.4 MPH
- 2009: 8.2 MPH

Source: VITA
Solution: Select Bus Service (SBS)

Features

- Bus Lanes
- Pre-Payment
- Transit Signal Priority
- Passenger Info
- Branding
- Stations

Bus Rapid Transit branded as “Select Bus Service” in New York City
Transit Signal Priority (TSP)

Automatic real time signal adjustments to expedite approaching buses:

• Extend **green**

• Shorten **red**

• **Advance green** for queue jump
Direct communication between bus and signal
Requires equipment to receive message
Expensive for thousands of intersections!
NYC TSP Design/Build Pilot (2008)

- A 2.3 mile segment between Saint George ferry terminal and Forest Avenue / Victory Boulevard
- 14 Signalized Intersections
- Limited and Local bus routes
  - 33 individual routes in the AM; 36 in the PM
### TSP Pilot Results

#### Comparative bus travel times (minutes) derived from modeling

<table>
<thead>
<tr>
<th></th>
<th>Existing</th>
<th>Optimization</th>
<th>% Improvement</th>
<th>TSP</th>
<th>% Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AM Peak Period</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TO FERRY</td>
<td>8:48</td>
<td>7:54</td>
<td>10.2%</td>
<td>7:18</td>
<td>7.6%</td>
</tr>
<tr>
<td><strong>PM Peak Period</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FROM FERRY</td>
<td>8:12</td>
<td>8:12</td>
<td>0%</td>
<td>7:24</td>
<td>9.8%</td>
</tr>
</tbody>
</table>

#### Actual bus travel times (minutes) by NYCDOT

<table>
<thead>
<tr>
<th></th>
<th>Existing</th>
<th>Optimization</th>
<th>% Improvement</th>
<th>TSP</th>
<th>% Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AM Peak Period</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TO FERRY</td>
<td>11:48</td>
<td>11:00</td>
<td>6.8%</td>
<td>9:54</td>
<td>10%</td>
</tr>
<tr>
<td><strong>PM Peak Period</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FROM FERRY</td>
<td>12:00</td>
<td>11:38</td>
<td>3.3%</td>
<td>10:42</td>
<td>7.8%</td>
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</tbody>
</table>
Typical TSP

Direct communication between bus and signal
Requires equipment to receive message
Expensive for thousands of intersections!
TSP with NYCWiN

DOT Traffic Management Center (TMC)
- TSP Server

MTA Traffic Center Server

Wireless Network (NYCWiN)

NYCWiN

ASTC Traffic Controller

Verizon

GPS

MTA Traffic Center Server
Benefits of NYCWiN for TSP

- Eliminates need for infrastructure changes to traffic controllers
- Requires only in-vehicle systems – GPS modem and computer to locate vehicle’s position
- Cost effective for TSP city-wide!
- Potential for chaos!
First Corridors

472 intersections
55 miles

Webster Avenue:
- Bx41 SBS
- 67 intersections
- 5.3 miles

Main Street & Kissena/Parsons Boulevard:
- Q44, Q25
- 53 intersections
- 5.0 miles

Hillside Avenue:
- Q43
- 40 intersections
- 3.3 miles

125th Street & Astoria Boulevard:
- M60 SBS
- 63 intersections
- 6.8 miles

Merrick Boulevard:
- Q5
- 26 intersections
- 3.6 miles

Nostrand Avenue:
- B44 SBS
- 33 intersections
- 4.3 miles

Utica Avenue:
- B46 Limited
- 54 intersections
- 4.2 miles

Lower Manhattan:
- M15 SBS
- 34 intersections
- 2.2 miles

Victory Boulevard:
- S61, S62, S66, S91 Limited, S92 Limited
- 33 intersections
- 5.7 miles

Hylan Boulevard:
- S79 SBS
- 69 intersections
- 14 miles

TRANSPORT SIGNAL PRIORITY PROJECTS IN NEW YORK CITY
# Participants and Roles

<table>
<thead>
<tr>
<th>Agency</th>
<th>Contractor</th>
<th>Responsibilities</th>
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<tbody>
<tr>
<td>NYCDOT</td>
<td>Project Management, TMC, Roadways, Signals</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GPI</td>
<td>Traffic Engineering, TSP Operating Parameters</td>
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<tr>
<td></td>
<td>TransCore</td>
<td>TMC Systems for TSP, Provide/Support Signals, System Integration</td>
</tr>
<tr>
<td></td>
<td>Peek</td>
<td>Traffic controllers &amp; their TSP software</td>
</tr>
<tr>
<td>MTA</td>
<td>Bus on-board systems, messaging to TMC</td>
<td></td>
</tr>
<tr>
<td></td>
<td>GTT</td>
<td>GPS on-board software to request TSP</td>
</tr>
<tr>
<td></td>
<td>Verizon</td>
<td>Wireless communication between buses and MTA</td>
</tr>
<tr>
<td>NYC DoITT</td>
<td>NYCWiN wireless communication between TMC and traffic signals</td>
<td></td>
</tr>
</tbody>
</table>
Lower Manhattan TSP

M15 SBS
34 Intersections
2.2 mile corridor

South Ferry

Houston Street
Implementation Questions

- Which intersections?
- What phases?
- How much time?
- When to act?
- Which call?
- Queue jumps?
- What are the effects?
Constraints

- Coordination
- Capacity
- Cross-street traffic
- Bus stops
- Other corridor traffic
- Pedestrians, seniors
Why Simulate?

- Answer implementation questions
- Optimize system to maximize ridership
- Determine travel time savings for riders
- Determine effects on other traffic
- Provide justification for funding
3-D Simulation of Lower Manhattan
Results

- Intersections and their approaches recommended for TSP:
  - Where and how queue jumping should be applied
  - Travel time savings for buses
  - Effects on other traffic

<table>
<thead>
<tr>
<th>Intersection</th>
<th>Extended Phase</th>
<th>Truncated Phase(s)</th>
<th>Max. Extension/Truncation (s)</th>
<th>Detection Zone (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Street and Whitehall Street</td>
<td>A</td>
<td>C</td>
<td>7</td>
<td>208</td>
</tr>
<tr>
<td>Water Street and Broad Street</td>
<td>A</td>
<td>B</td>
<td>7</td>
<td>220</td>
</tr>
<tr>
<td>Water Street and Coenties Slip</td>
<td>A</td>
<td>B</td>
<td>8</td>
<td>273</td>
</tr>
<tr>
<td>Water Street and 55 Water Street (mid-block)</td>
<td>A</td>
<td>B</td>
<td>8</td>
<td>200</td>
</tr>
<tr>
<td>Water Street and Old Slip</td>
<td>A</td>
<td>B</td>
<td>9</td>
<td>222</td>
</tr>
<tr>
<td>Water Street and Gouverneur Lane</td>
<td>A</td>
<td>B</td>
<td>8</td>
<td>238</td>
</tr>
<tr>
<td>Water Street and Wall Street</td>
<td>A</td>
<td>B</td>
<td>17</td>
<td>422</td>
</tr>
</tbody>
</table>
Comparison with and without TSP

Existing (no TSP)

Active TSP

Early return to green

Intersections Crossed: 10
Next:
Pike / Madison

Intersections Crossed: 13
Next:
Madison / Oliver

Time saved to last intersection:
02:50
Results

Previous illustration:

• Typical savings of 3 min. 14 sec. for AM SB buses

• TSP actions at 8 of 24 available intersections

• 6 TSP actions were early return to green and 2 were green extensions

The benefits of this type of analysis to optimize TSP operation are clear.
High Quality Visualization

Allen and Delancey Street, Lower Manhattan
<table>
<thead>
<tr>
<th>Period</th>
<th>Min/Bus-Trip</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NB/EB</td>
<td>SB/WB</td>
</tr>
<tr>
<td>AM Peak</td>
<td>3.5</td>
<td>2.6</td>
</tr>
<tr>
<td>Mid-Day</td>
<td>0.7</td>
<td>1.7</td>
</tr>
<tr>
<td>PM Peak</td>
<td>3.2</td>
<td>2.6</td>
</tr>
</tbody>
</table>
Current Status

• TSP operational in Lower Manhattan
• “After Study” confirmed effectiveness
• Analyses underway for 10 other corridors
• Four corridors coming on line in fall 2015:
  ✓ Brooklyn – Nostrand Avenue, Utica Avenue
  ✓ Bronx – Webster Avenue
  ✓ Staten Island – Hylan Boulevard (including portion in Brooklyn)
• More corridors being selected for future expansion
Next Steps

- Perform After Studies on 4 new corridors
- Implement TSP on remaining 6 study corridors
- Develop TMC systems for on-going monitoring and fine-tuning of TSP operations
- Develop TSP plans for more corridors – 10 more envisioned now!
Next Steps - TSP Support Systems

• New simulation displays to:
  – Confirm input specifications
  – Visualize impacts on signal operations

• New displays in Traffic Management Center:
  – Confirm input specifications
  – Verify field operations
  – Assess impacts
New Displays - TSP Action Map

Northbound / Eastbound

- # of Truncations: 4
- # of Extensions: 2

Existing Signal Plan

- Average TT Savings: 00:03:15
- Standard Deviation: 00:00:35
- # of buses/peak hour: 7

- No TSP Action Executed
- 1-3 Truncations Executed
- 4-5 Truncations Executed
- 6+ Truncations Executed
- 6+ Extensions Executed
- 4-5 Extensions Executed
- 1-3 Extensions Executed
- Both Truncations/Extensions Executed
New Displays - TSP Signal Operations

<table>
<thead>
<tr>
<th>Location</th>
<th>Normal Cycle</th>
<th>Max TSP Cycle</th>
<th>Avg TSP Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Avenue &amp; E. 1st Street</td>
<td>45/55</td>
<td>30/70</td>
<td>40/60</td>
</tr>
<tr>
<td>Allen Street &amp; Stanton Street</td>
<td>40/60</td>
<td>35/65</td>
<td>37/63</td>
</tr>
<tr>
<td>Allen Street &amp; Delancey Street</td>
<td>48/52</td>
<td>40/60</td>
<td>45/55</td>
</tr>
</tbody>
</table>

- Main Street Green
- Main Street Red
Questions?

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