DIVISION TRANSIT PROJECT:
A NEW MULTI-MODAL CORRIDOR WITH
NEXT GENERATION TRANSIT SIGNAL PRIORITY

RANDY JOHNSON, PE, PTOE – DKS ASSOCIATES
MARK HAINES, PE, PTOE - CITY OF PORTLAND TRAFFIC SIGNALS, STREET LIGHTING, AND ITS GROUP
- Agency/Partner’s first BRT project
- Existing bus line over capacity
- High Ridership with transit dependent community
- 15 mile corridor with 40 stations
- 1/3 mile station spacing
- 12-min headways
- Congested traffic corridor
- Constrained right-of-way
- $175M total project cost
BEFORE: OUTER DIVISION STREET
SE 80TH TO 174TH

- #1 most dangerous corridor for walking and driving
- #2 most dangerous for cycling
- 13 fatalities / 117 serious injurious in past 10 years!
- Emergency order to reduce speed from 35 to 30mph
- Division Transit Project constructed in parallel with Outer Division Multi Modal Safety Project

76ft (23.2m) curb-to-curb
90 ft (27.4m) right-of-way
NEW ROADWAY DESIGN: MEDIAN + PED CROSSING

Raised Medians with U-turns every 1/4 mile to 1/3 mile
- 1.5 min out of direction travel time

Signalized Pedestrian Crossings every 530ft to 800ft
- 14 new signalized crossings
NEW ROADWAY DESIGN: BUS LANES & BIKE LANES

- Business Access Transit (BAT) Lanes
- Bike lanes with raised protection, cross-bike markings and protected bike signal phasing
NEW BUSES + ENHANCED STATIONS

- Near-Level boarding
- On-board bikes
- On-board fare
- Station amenities
- Weather protection
- Branding
TRANSIT SIGNALS + BIKE SIGNALS
### OPERATIONS GOALS

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Signal Timing</td>
<td>All 45</td>
</tr>
<tr>
<td>Leading Pedestrian Intervals</td>
<td>18</td>
</tr>
<tr>
<td>Pedestrian-Only Signals</td>
<td>14</td>
</tr>
<tr>
<td>Ped Priority User Logic Routine</td>
<td>All 45</td>
</tr>
<tr>
<td>Next Gen TSP</td>
<td>All 45</td>
</tr>
</tbody>
</table>
WHY DO WE USE BUS PRIORITY?

OAR 734-020-0310

“Bus priority system…provide buses the capability to modify green intervals but not the display sequence of a traffic control signal"
TRANSIT SIGNAL PRIORITY – A BRIEF HISTORY

MAC - Mobile Access Router
AVL - Automated Vehicle Location

IR - Infrared
IR Receiver
TOC - Transit Operations Center
TMC - Traffic Management Center

PRS - Priority Request Server
PRG - Priority Request Generator
GPS - Global Positioning System

Signal Communications
Existing Cell Connection

PBOT
DKS
TRANSIT SIGNAL PRIORITY – NEXT GENERATION

Maestro Device

Next Gen TSP

PBOT

DKS

PORTLAND BUREAU OF TRANSPORTATION

Next Gen TSP

Maestro Device

IR - Infrared
IR Receiver
TOC - Transit Operations Center
TMC - Traffic Management Center
MAR - Mobile Access Router
AVL - Automated Vehicle Location

PRS - Priority Request Server
PRG - Priority Request Generator
GPS - Global Positioning System
--- - Signal Communications
--- - Existing Cell Connection
LYT

TSP Cloud Platform

Transit - PRS

Traffic - PRS

CO

Maestro Device

Verizon Cellular Network

Cellular Antenna

GPS Antenna

Other on-board system inputs

INIT GPSgo2 AVL Module

INIT COPilotTrx2 VLU / CAD-AVL

MAR

SIM

CO

PRG

PRS - Traffic

Controller

CO

Legacy V2I

TriMet Transit Vehicle

Traffic Signal Cabinet

Legend

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>CAD/AVL</td>
<td>Computer-Aided Dispatch/Automatic Vehicle Location</td>
</tr>
<tr>
<td>MAR</td>
<td>Mobile Access Router</td>
</tr>
<tr>
<td>CO</td>
<td>Coordinator (priority implementer)</td>
</tr>
<tr>
<td>PRG</td>
<td>Priority Request Generator (priority requesting logic)</td>
</tr>
<tr>
<td>PRS</td>
<td>Priority Request Server (priority granting logic)</td>
</tr>
<tr>
<td>SIM</td>
<td>Subscriber Identity Module</td>
</tr>
</tbody>
</table>

Key

- **PRG Component**
- **PRS Component**
- **CO Component**
- Logical Object
LYT PREDICTIVE MODEL
### Prioritizer Configuration

<table>
<thead>
<tr>
<th>Prioritizer</th>
<th>Enabled</th>
<th>Lock Out Time</th>
<th>PRS Time to Live</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Active</td>
<td>0</td>
<td>20</td>
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### Prioritizer Options

<table>
<thead>
<tr>
<th>Prioritizer</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
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<tr>
<td>Lockout After First Service</td>
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<td>Presence Only Check-in</td>
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<td>Extend Walk Rest</td>
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<td></td>
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<tr>
<td>Use Phase History</td>
<td></td>
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</table>

### Prioritizer Phase Settings

<table>
<thead>
<tr>
<th>Prioritizer</th>
<th>Enabled</th>
<th>Priority</th>
<th>Priority Phases</th>
<th>Skip Phases</th>
<th>Slip Ped</th>
<th>Delay Time</th>
<th>Arrival Time</th>
<th>Max Presence</th>
<th>Reservice Lockout</th>
<th>Free Pri Min</th>
<th>Free Pri Max</th>
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<tbody>
<tr>
<td>2</td>
<td>Enabled</td>
<td>0</td>
<td>9</td>
<td></td>
<td></td>
<td>0</td>
<td>40</td>
<td>180</td>
<td>0</td>
<td>Min Green</td>
<td>Max Green</td>
</tr>
<tr>
<td>6</td>
<td>Enabled</td>
<td>0</td>
<td>6</td>
<td></td>
<td></td>
<td>0</td>
<td>40</td>
<td>180</td>
<td>0</td>
<td>Min Green</td>
<td>Max Green</td>
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</table>
# USER PROGRAMS – TSP

## Program Statements

### Program 4

<table>
<thead>
<tr>
<th>Statement</th>
<th>Result Value</th>
<th>Result</th>
<th>Index</th>
<th>Operation</th>
<th>Parameter A</th>
<th>Index</th>
<th>Parameter B</th>
<th>Index</th>
<th>Delay</th>
<th>Ext.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>Ped Detector Call</td>
<td>4</td>
<td>Result = A</td>
<td>Global Variable</td>
<td>20</td>
<td>None</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>Call side street ped during prioritor 2,5,6</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>None</td>
<td>0</td>
<td>Result = A if R</td>
<td>Ped Call</td>
<td>4</td>
<td>Global Variable</td>
<td>90</td>
<td>0.0</td>
<td>0.0</td>
<td>set controller free if not ph 4 unless ETA is</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>Coordination Free Switch</td>
<td>1</td>
<td>Result = Latch(A, B)</td>
<td>Previous Line Result</td>
<td>0</td>
<td>Global Variable</td>
<td>33</td>
<td>0.0</td>
<td>0.0</td>
<td>set controller free if not ph 4 unless ETA is</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>Phase Force Off</td>
<td>2</td>
<td>Result = A</td>
<td>Previous Line Result</td>
<td>0</td>
<td>None</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>force off phase 2</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>Phase Force Off</td>
<td>6</td>
<td>Result = A</td>
<td>Previous Line Result</td>
<td>0</td>
<td>None</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>force off phase 6</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>Local Variable</td>
<td>14</td>
<td>Result = A</td>
<td>Prioritor Arrival Time</td>
<td>2</td>
<td>None</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>LV 14 + Prioritor 2 ETA Timer</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>Local Variable</td>
<td>15</td>
<td>Result = A if R</td>
<td>Local Variable</td>
<td>14</td>
<td>Number</td>
<td>400</td>
<td>0.0</td>
<td>0.0</td>
<td>LV 15 = True if LV 14 &gt; 40s</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>Local Variable</td>
<td>16</td>
<td>Result = A if R</td>
<td>Local Variable</td>
<td>14</td>
<td>Number</td>
<td>500</td>
<td>0.0</td>
<td>0.0</td>
<td>LV 16 = True if LV 14 &lt; 50s</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
<td>None</td>
<td>0</td>
<td>Result = A AND B</td>
<td>Local Variable</td>
<td>16</td>
<td>Prioritor Status</td>
<td>2</td>
<td>0.0</td>
<td>0.0</td>
<td>True if LV 16 true and Prioritor 2 active</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>Local Variable</td>
<td>17</td>
<td>Result = A AND B</td>
<td>Previous Line Result</td>
<td>0</td>
<td>Local Variable</td>
<td>15</td>
<td>0.0</td>
<td>0.0</td>
<td>LV 17 = ETA of Prioritor 2 between 50s and</td>
</tr>
<tr>
<td>11</td>
<td>0</td>
<td>Local Variable</td>
<td>18</td>
<td>Result = A</td>
<td>Prioritor Arrival Time</td>
<td>6</td>
<td>None</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
<td>LV 18 + Prioritor 3 ETA Timer</td>
</tr>
<tr>
<td>12</td>
<td>0</td>
<td>Local Variable</td>
<td>19</td>
<td>Result = A if R</td>
<td>Local Variable</td>
<td>18</td>
<td>Number</td>
<td>400</td>
<td>0.0</td>
<td>0.0</td>
<td>LV 19 = True if LV 18 &gt; 40s</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>Local Variable</td>
<td>20</td>
<td>Result = A if R</td>
<td>Local Variable</td>
<td>18</td>
<td>Number</td>
<td>500</td>
<td>0.0</td>
<td>0.0</td>
<td>LV 20 = True if LV 18 &lt; 50s</td>
</tr>
<tr>
<td>14</td>
<td>0</td>
<td>None</td>
<td>0</td>
<td>Result = A AND B</td>
<td>Local Variable</td>
<td>20</td>
<td>Prioritor Status</td>
<td>6</td>
<td>0.0</td>
<td>0.0</td>
<td>True if LV 20 true and Prioritor 3 active</td>
</tr>
<tr>
<td>15</td>
<td>0</td>
<td>Local Variable</td>
<td>21</td>
<td>Result = A AND B</td>
<td>Previous Line Result</td>
<td>0</td>
<td>Local Variable</td>
<td>19</td>
<td>0.0</td>
<td>0.0</td>
<td>LV 21 + ETA of Prioritor 3 between 50s and</td>
</tr>
<tr>
<td>16</td>
<td>0</td>
<td>Global Variable</td>
<td>30</td>
<td>Result = A OR B</td>
<td>Local Variable</td>
<td>17</td>
<td>Local Variable</td>
<td>21</td>
<td>0.0</td>
<td>0.0</td>
<td>True if LV 17 or LV 21 true</td>
</tr>
<tr>
<td>17</td>
<td>0</td>
<td>None</td>
<td>0</td>
<td>Countdown A seconds if R</td>
<td>Number</td>
<td>9</td>
<td>Phase On</td>
<td>4</td>
<td>0.0</td>
<td>0.0</td>
<td>True 9 seconds into ph 4</td>
</tr>
</tbody>
</table>
| 18        | 0            | Global Variable | 33 | Result = Latch(A, B) | Previous Line Result | 0 | Global Variable | 30 | 0.0 | 0.0 | OV 33 + Latch previous until OV 30 is true
USER PROGRAMS – TSP
USER PROGRAMS – TSP
TRANSIT SIGNAL PRIORITY ROUTINE
TRANSIT SIGNAL PRIORITY ROUTINE

ETA > 120s
Signal > 3 ahead
TSP Inactive
TRANSIT SIGNAL PRIORITY ROUTINE

120s > ETA > 90s
TSP Checked In
TRANSIT SIGNAL PRIORITY ROUTINE

90s > ETA > 30s
Ped Priority
TRANSIT SIGNAL PRIORITY ROUTINE

30s > ETA > 15s
TSP Active
TRANSIT SIGNAL PRIORITY ROUTINE

#2 or 26 or 22/26 depending on active bus calls

#23 or 27 or 23/27 depending on active bus calls

Ph 21 and 25 only used during EV prompt for NB/SB - not part of phase rotation otherwise

[Diagram of transit signal priority routine with specific lane assignments and directions]
TRANSIT SIGNAL PRIORITY ROUTINE

- For 22 or 26 or 23/26 depending on active bus calls
- For 23 or 27 or 23/27 depending on active bus calls

Phases 21 and 25 only used during EV preempt for NB/SW - not part of phase rotation otherwise
TRANSIT SIGNAL PRIORITY ROUTINE

ETA < 15s
TSP Active
TRANSIT SIGNAL PRIORITY ROUTINE

Ph 21 and 25 only used during EV preemption for NB/SB - not part of phase rotation otherwise
TRANSIT SIGNAL PRIORITY ROUTINE

Ph 21 and 25 only used during EV preemption for NB/SB - not part of phase rotation otherwise
TRANSIT SIGNAL PRIORITY ROUTINE

ETA < 0.5s for >20s OR
TSP Checked Out
TRANSIT SIGNAL PRIORITY ROUTINE

TSP
Inactive
TRANSIT SIGNAL PRIORITY ROUTINE
TESTING...
TWO BUSES – ONE PASSING
TWO BUSES – ONE PASSING
TWO BUSES – ONE PASSING
TWO BUSES – ONE PASSING
TWO BUSES – ONE PASSING
TWO BUSES – ONE PASSING
TWO BUSES – ONE PASSING
TWO BUSES – ONE PASSING
TWO BUSES – ONE PASSING
TWO BUSES – ONE PASSING
TWO BUSES – ONE PASSING
TWO BUSES – ONE PASSING
TWO BUSES – ONE PASSING
RESULTS AND WHOLE SYSTEM VIEW

On-Time - Past 31 Days

- TSP OFF Study
- PBOT Custom Programming OFF Study

Graph showing on-time performance from May 11 to June 10, 2023, with notable drops on May 23 and May 26.
RESULTS AND WHOLE SYSTEM VIEW

TSP OFF Study

PBOT Custom Programming
OFF Study
RESULTS

Line 2 Service

Division FX-2 Opens
TSP AI Learning Period

TSP Equilibrium

Snow days

60’ Bus Recall

TSP Off Study
QUESTIONS?

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