Setting the Stage for Transit Signal Priority in San Diego

IBI GROUP
June 20th, 2017
Basic Concept

➢ Reduce the probability of signal delay
➢ Bus places the request for TSP
➢ Signal controls whether to grant the request, or not
Qualitative Benefits

- Positive Perceptions of Transit
- Addresses Areas of Signal Delay
- Incremental Improvements Continue
- Comparatively Low Cost to Rail
- Sets Foundation for where Transit Lies in the Future
## TSP: Misconceptions

<table>
<thead>
<tr>
<th>Topic</th>
<th>Consider</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSP can be expressed as working or not working on a corridor</td>
<td>Rarely is a whole corridor not providing some additional green time for buses, as each intersection operates independently. The effectiveness varies.</td>
</tr>
<tr>
<td>TSP is expensive</td>
<td>TSP is comparatively inexpensive to other BRT elements and physical priority measures. Equipment &amp; install ranges from $10K-$20K per intersection and about $20K-$30K per intersection including design, install, &amp; activation.</td>
</tr>
<tr>
<td>TSP corridors are all the same in the region</td>
<td>Actually, each corridor is unique in terms of equipment, approach, topography, design, TSP settings, and operations.</td>
</tr>
<tr>
<td>It should be easy to determine the quantitative benefits of TSP</td>
<td>Due to the split in data between buses &amp; signals and variability in bus and traffic operations, it is difficult to separate TSP impacts/benefits from other factors.</td>
</tr>
<tr>
<td>TSP should be able to make sure the bus gets a “green” light</td>
<td>TSP activations add green time or reduce red time faced by a bus, but many factors influence if a bus clears an intersection with TSP (e.g. stops, traffic, etc)</td>
</tr>
</tbody>
</table>
San Diego Deployment

➢ 5 Corridors
  ➢ Escondido (Rt 350)
  ➢ SuperLoop (Rt 201, 202, 204)
  ➢ MidCity (Rt 215)
  ➢ Mira Mesa (Rt 237)
  ➢ I-15 BRT (Rt 235)
  ➢ I-15 Weekday Peak Hour (Rt 280, 290)
➢ More than 100 TSP enabled Signals
➢ More than 50 Rapid buses
➢ Pending: South Bay BRT
San Diego Future

1. University Ave (San Diego)
2. Mission Ave (Oceanside)
3. Genesee Ave (San Diego)
4. Highland Ave (National City, Chula Vista)
5. Main St (El Cajon)
6. H St (Chula Vista)
7. 54th (San Diego)
8. Taylor St/Linda Vista (San Diego)
9. Fairmount Ave (San Diego)
10. College Ave (San Diego, Lemon Grove)
2050 Revenue Constrained Rapid Services
October 2015

- **Rapid Transit**
- **Local Bus**
- **Intermodal Transit Center**

0 3 6
0 4 5

MILES
KILOMETERS

SANDAG

IBI GROUP

ITE 2017
Western District Annual Meeting
June 20 2017
Development

➢ Less than Ideal conditions for TSP
  ➢ Heavy Queuing
  ➢ Crossing major through movements
  ➢ Left Turns with heavy traffic
Development “Rules of Thumb”

➢ Trigger Points
  ➢ Green Extensions/Early Green Max
  ➢ 50th and 95th percentile queues
  ➢ Storage Capacity
  ➢ Sight Distances
  ➢ Intersection Spacing
Development “Rules of Thumb”

➢ Transit Stops
  ➢ Consolidate
  ➢ Avoid Near-side stops

➢ Physical Transit Priority
  ➢ Median Guideways
  ➢ Exclusive Transit Lanes
  ➢ Stop Modifications
  ➢ Curp Extensions/Platforms
  ➢ Queue Jump Lanes
SETTING THE STAGE FOR TSP IN SAN DIEGO

Queue jump lane continued through an intersection

Queue jump lane with a designated signal

Continuous queue jump lane with provision for cyclists
## Monitoring & Effectiveness

- **Coordination with Cities and SANDAG**
- **Network Communication and Data Collection**
- **GTFS Data**
- **Ongoing Troubleshooting**
- **Traffic Controller Challenges and High Resolution Logs**
- **Increased value with Physical Changes to roadways and intersections**

### Table: Event Schedule

<table>
<thead>
<tr>
<th>Event Code</th>
<th>Event Param</th>
<th>Timestamp</th>
<th>TSP Active</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>4</td>
<td>14:30:21</td>
<td>YES</td>
</tr>
<tr>
<td>16</td>
<td>4</td>
<td>14:35:21</td>
<td>NO</td>
</tr>
<tr>
<td>16</td>
<td>6</td>
<td>14:36:21</td>
<td>NO</td>
</tr>
<tr>
<td>16</td>
<td>8</td>
<td>14:37:21</td>
<td>NO</td>
</tr>
<tr>
<td>16</td>
<td>10</td>
<td>14:38:21</td>
<td>NO</td>
</tr>
<tr>
<td>16</td>
<td>12</td>
<td>14:39:21</td>
<td>NO</td>
</tr>
<tr>
<td>16</td>
<td>14</td>
<td>14:40:21</td>
<td>NO</td>
</tr>
<tr>
<td>16</td>
<td>16</td>
<td>14:41:21</td>
<td>NO</td>
</tr>
</tbody>
</table>

**Legend:**
- **Green:** Event is fully active
- **Red:** Event is fully inactive
- **Yellow:** Event is partially active

**NOTE:**
- Total green = 4
- Yellow = 4
- Red = 5
- Green = 3
### Factors Affecting TSP Operations and Performance

<table>
<thead>
<tr>
<th>Topography</th>
<th>Traffic queues at the intersections</th>
<th>Cross-street traffic volumes</th>
<th>Bus left turns on route</th>
<th>Oncoming traffic volumes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near-side or Far-side stops</td>
<td>Volume of Boarding’s</td>
<td>Transit Operation methods (headways vs. schedule)</td>
<td>Transit vehicle operator experience</td>
<td>Transit vehicle characteristics</td>
</tr>
<tr>
<td>Community characteristics (residential vs. business, schools)</td>
<td>Types of Boarding’s (Boarders with special needs and bicycles)</td>
<td>Proximity of corridor intersections</td>
<td>TSP technologies used and ambient or environmental conditions</td>
<td>Parameters and Thresholds</td>
</tr>
</tbody>
</table>
Lessons Learned: Big Picture

➢ Signals are always only an opportunity for delay, and TSP is a method of reducing the probability of that delay

➢ TSP measurements indicate run time reductions from 2%-16% with 6%-10% typical

➢ Centralized TSP data collection, and transit and signal data comparison remains difficult
Lessons Learned – Planning

➢ TSP may not be effective outbound from a transfer point for the first few intersections
➢ Where possible, limit left-turns at signalized intersections across median transitways
➢ Physical Treatments are most effective where significant traffic queues occur, they are also more difficult to implement in these areas.
➢ Detailed understanding of signal operations on a corridor are necessary early in planning.
Lessons Learned – Design

➢ Consider trade-offs between pedestrian access to/from stations and bus movement at signals
➢ Always place advance and stop line detection for buses in dedicated bus lanes
➢ Avoid near-side transit stops near signals on transitways.
➢ Current Signal Controller Considerations
➢ Keep options open for future flexibility (e.g. TSP equipment – RF, CV, Center to Center)
Lessons Learned – Design

- Specifications:
  - Appropriate Equipment Set
  - Selecting specific controller software/firmware
  - May require some sole source pieces of equipment
- Testing
- Passive TSP signal coordination
- Still no Caltrans TSP in the region

**Current Standard**
1:170E Traffic Controller
Serial Communications
McCain 233RV2.1A or MC1.C firmware
764 GTT Multimode Phase Selector Card
768 GTT Auxiliary Harness
721/722 GTT Optical Receiver

**Current Standard**
2:2070ATC Traffic Controller
Ethernet/IP Communications
McCain Omni eX Software
764 GTT Multimode Phase Selector Card
768 GTT Auxiliary Harness
721/722 GTT Optical Receiver
Managed Rugged Comm Switch
Lessons Learned – Operation

- If new software, firmware, or equipment is involved, leave plenty of lead time for bench testing and possible “fixes”
- TSP green extensions and early greens are typically set between 15 & 25 seconds, and with cycle lengths 80 seconds or greater
- Signal coordination should be in place prior to construction, or updates made after
- Many configuration details:
  - TSP equipment functional and updated timings in place
  - Implement TSP settings at all signals
  - Configure and load TSP on buses
Lessons Learned – Operations

- Checking Operations
  - Allow two weeks of “operations prior to drawing TSP data/results
  - Easier to identify problem locations
  - On network communication equipped corridors, can identify TSP requests but difficult to determine:
    - How many would have been green anyway
    - How many green extensions/early greens and for how long
    - Did bus clear the intersection?
- Before and After TT Runs
Questions?
Thank you!

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