Preventing LRV Signal Stop Overruns in Street Running Territories

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Agenda

1. Problem Statement
2. Actions
3. Scenarios
4. Technologies
5. Recommendations
Problem Statement

- LA LRVs operate in street running mode
- Distractions and conflicting indications
- Drivers occasionally overrun interlocking stop signal!
  - Agencies must implement equipment / procedures to reduce incidence of SSOs
Actions Taken

• Reviewed
  – Four scenarios where SSOs happen
  – Four technologies to prevent SSO
  – Inspector General commissioned report:
    • *Review of Metro Safety Culture And Rail Operational Safety* (December 2016)

• Ranked solutions and made recommendations
Scenarios Reviewed

- Scenario 1: Nears ide Station Stop
- Scenario 2: Nears ide Run Through
- Scenario 3: No Stop Near Interlock
- Scenario 4: Reverse Running
- Reviewed where not to stop, safe stopping distances and distractions
Scenario 1: Nearsida Station Stop
Train stopped at station before interlocking

Station Interlocking Signal

× = Intersection(s) to consider not blocking.
Scenario 2: Nearsaside Run Through

Train at 35 mph, not stopping at station

Note: Used 650 feet median estimate of LRV safe stopping distance when at 35 mph. Not the typical and not the worst case.
Scenario 3: No Stop Near Interlock
Normal Ops, No Station Stops near Interlocking
Scenario 4: Train Reverse Running

Interlocking switch points

Train in Reverse Running
Technologies Evaluated

- Existing Cab Signal System
- Wayside RFID Tags and Beacons
- GPS Based Train Control, Continuous Backhaul and Optional Wayside Communications
- Collision Avoidance System

Pros and Cons are LA Metro specific
Existing Cab Signal System

- Manufactured by Ansaldo
- Currently:
  - ATP on dedicated line sections
  - Speed limit in street running mode
- Type I and enhanced Type II
- Pro: Used now by Metro and in all vehicles
- Pro: Installation and operations friendly
Wayside RFID Tags and Beacons

- IG Report: Siemens Trainguard ZUB-200
- Overlay system
- Intermittent Protection Enforcement Braking
- Pro: Designed for heavy and light rail service
- Con: Must install on all 400+ LRVs
- Con: Must integrate with existing onboard equip.
- Con: Installation, operational risks and $$
GPS Positive Train Control / Backhaul & Wayside Comms

- E.g., Interoperable Electronic Train Management System (I-ETMS)
- Continuous radio to train comms, PTC 220 MHz/Other technology
- Radios at wayside points, optional
- Pro: Provides braking curve
- Con: Not designed for light rail
- Con: Acquire spectrum
Collision Avoidance System

- Designed for protecting work zones
- Provides notification when nearing work zone
- Pro: Inexpensive equipment
- Con: Three new pieces of equip. per LRV
- Con: Non-vital and non-directional
- Con: A novel application
## Stop Signal Overrun Technology Evaluation Criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Possible Values</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1 Ease of Implementation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 Designed for and proven in light rail service</td>
<td>1,2,3</td>
<td>3</td>
</tr>
<tr>
<td>1.2 Currently used at Metro</td>
<td>1,2,3</td>
<td>3</td>
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<tr>
<td>1.3 Risk of challenges when integrating with existing SCADA system</td>
<td>1,2,3</td>
<td>2</td>
</tr>
<tr>
<td>1.4 Effort needed for updating Metro’s operating rules for new system</td>
<td>1,2,3</td>
<td>3</td>
</tr>
<tr>
<td>1.5 Effort needed for integrating with existing LRV’s</td>
<td>1,2,3</td>
<td>3</td>
</tr>
<tr>
<td>1.6 Effort needed for integrating with existing ATC system</td>
<td>1,2,3</td>
<td>3</td>
</tr>
<tr>
<td><strong>2 Operational Impact</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1 System complexity impact on operations and maintenance</td>
<td>1,2,3</td>
<td>3</td>
</tr>
<tr>
<td>2.2 Installation impact on operations for LRVs</td>
<td>1,2,3</td>
<td>3</td>
</tr>
<tr>
<td>2.3 Installation impact on operations for the wayside</td>
<td>1,2,3</td>
<td>2</td>
</tr>
<tr>
<td>2.4 During operation</td>
<td>1,2,3</td>
<td>3</td>
</tr>
<tr>
<td>2.5 Risk of negative reliability and service availability impact</td>
<td>1,2,3</td>
<td>3</td>
</tr>
<tr>
<td>2.6 Impact on user training</td>
<td>1,2,3</td>
<td>3</td>
</tr>
<tr>
<td>2.7 Risk vendor does not accept liability for usage</td>
<td>1,2,3</td>
<td>3</td>
</tr>
<tr>
<td><strong>3 Other Items</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1 Risk that safety is neither equivalent nor better than current system</td>
<td>1,2,3</td>
<td>3</td>
</tr>
<tr>
<td>3.2 Cost of procuring equipment</td>
<td>1,2,3</td>
<td>3</td>
</tr>
<tr>
<td>3.3 Cost of wayside and LRV installation and integration</td>
<td>1,2,3</td>
<td>2</td>
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<tr>
<td>3.4 Risks of regulatory approvals delaying implementing technology</td>
<td>1,2,3</td>
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<tr>
<td><strong>Total</strong></td>
<td>17 to 51</td>
<td>48</td>
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</table>
Recommendation for LA Metro

Augment existing Cab Signal System

• Least disruptive installation
• Least disruptive to operations
• Least impact to onboard ATC equipment
  – Only software change for 400+ vehicles
• Staff already fully familiar
• Should be most cost-effective
Metro has 2 Cab Signal Systems: I & II

- **Type I:** 100 Hz / 250 Pulse Code
  - Code rate determines discrete speed command
  - On older lines

- **Type II:** Audio Frequency Shift Key (FSK) with 91 bit digital message, containing:
  - Speed, distance to go, speed at distant location
  - Location info, other instructions
  - Adds braking curves, better passenger comfort
  - On newer lines
# Recommendation for LA Metro

## LA Metro Cab Signal Line Modes

<table>
<thead>
<tr>
<th>Line</th>
<th>Mode</th>
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<tbody>
<tr>
<td>Metro Blue Line (MBL)</td>
<td>x</td>
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<tr>
<td>Metro Green Line (MGL)</td>
<td></td>
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<tr>
<td>Pasadena Gold Line (PGL), including the Eastside Extension</td>
<td>x</td>
</tr>
<tr>
<td>Exposition</td>
<td>x</td>
</tr>
<tr>
<td>Crenshaw Line (Future)</td>
<td></td>
</tr>
<tr>
<td>Foothill Extension</td>
<td>x</td>
</tr>
<tr>
<td>Regional Connector (Type I) (Future)</td>
<td>x</td>
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</table>
Recommend Evaluate Type II Cab Signal

- Goal: Suitable speed profiles and stopping locations to maintain normal operation and protect signals at stop. For example:
  - Near-side, far-side station stop, and run-thru
  - Don’t stop LRV blocking an intersection
  - Make all signal aspects and indications consistent across all modes!
Recommendation for LA Metro

Evaluate Type II Cab Signal Issues for SSO

- Locations for loops – site-specific
- Basis for stopping distance calculation: Must consider safe braking and actual stopping location under typical adhesion conditions
- Integration with Aspect Display Unit and Train Operator Display
Key Presentation Takeaways

- Determine scenarios to protect
- Determine evaluation criteria specific to agency
- Rank solutions against criteria
- Consider future needs when choosing
- Design protection specifically for each interlocking and scenario