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!

- Proposed FTA General Directive 17.1 (January 2017)
  - **Agencies must implement equipment / procedures to reduce incidence of SSOs**

Actions Taken

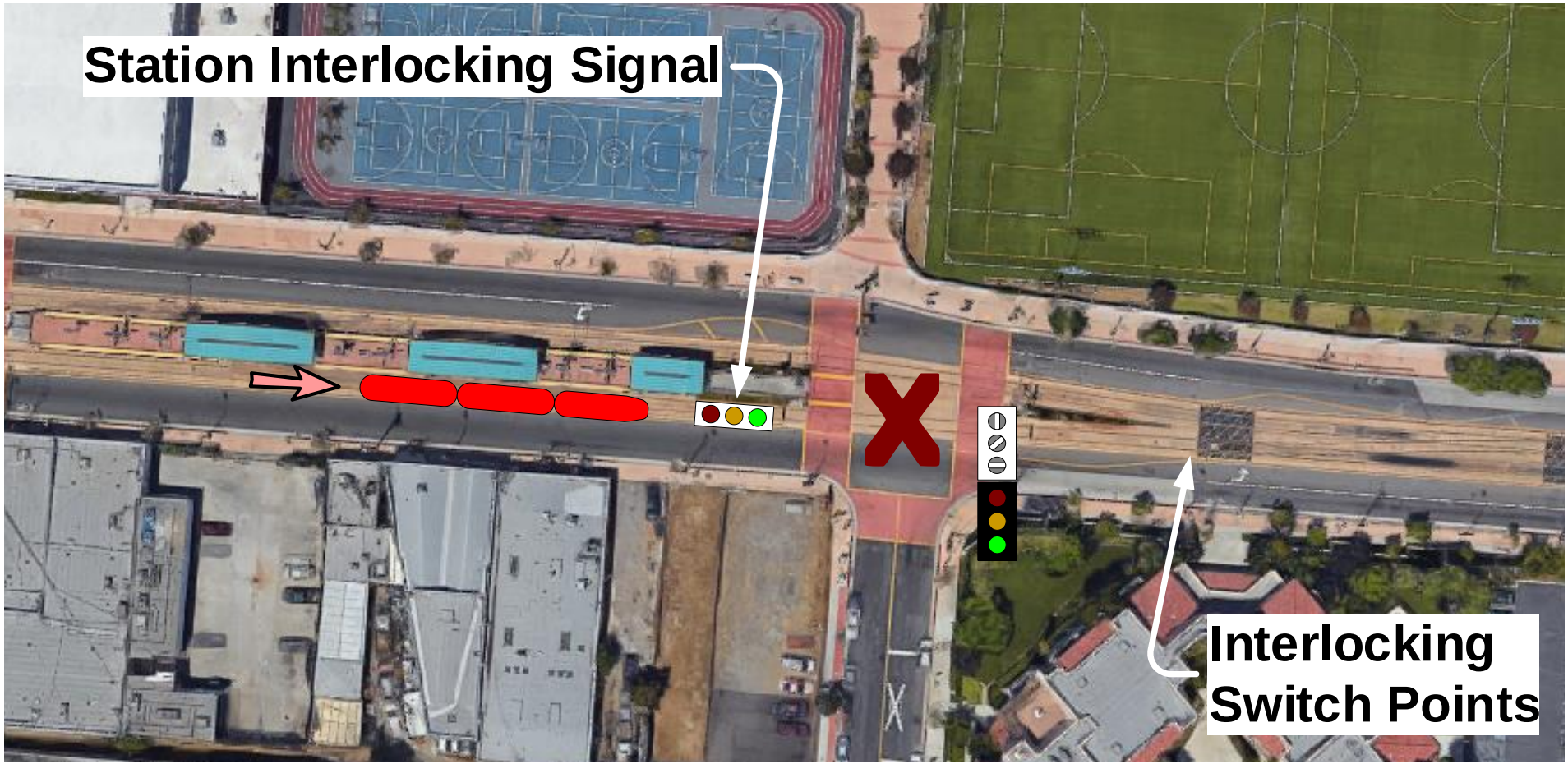
- Reviewed
  - Four scenarios where SSOs happen
  - Four technologies to prevent SSO
  - Inspector General commissioned report:
    - *Review of Metro Safety Culture And Rail Operational Safety* (December 2016)
- Ranked solutions and made recommendations

Scenarios Reviewed

- Scenario 1: Nearside Station Stop
- Scenario 2: Nearside Run Through
- Scenario 3: No Stop Near Interlock
- Scenario 4: Reverse Running
- Reviewed where not to stop, safe stopping distances and distractions

Scenario 1: Nearside Station Stop

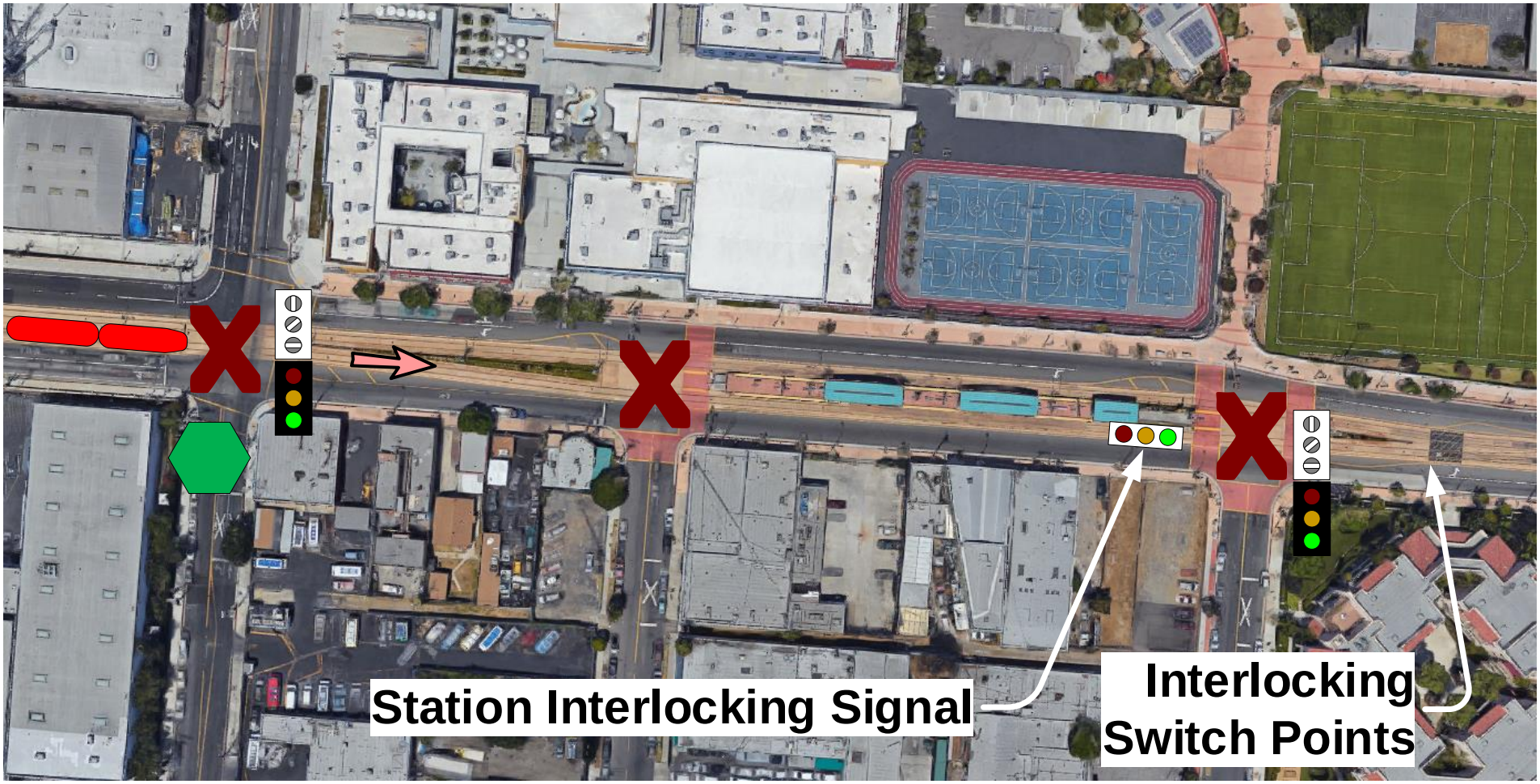
Train stopped at station before interlocking



X = *Intersection(s) to consider not blocking.*

Scenario 2: Nearside Run Through

Train at 35 mph, not stopping at station

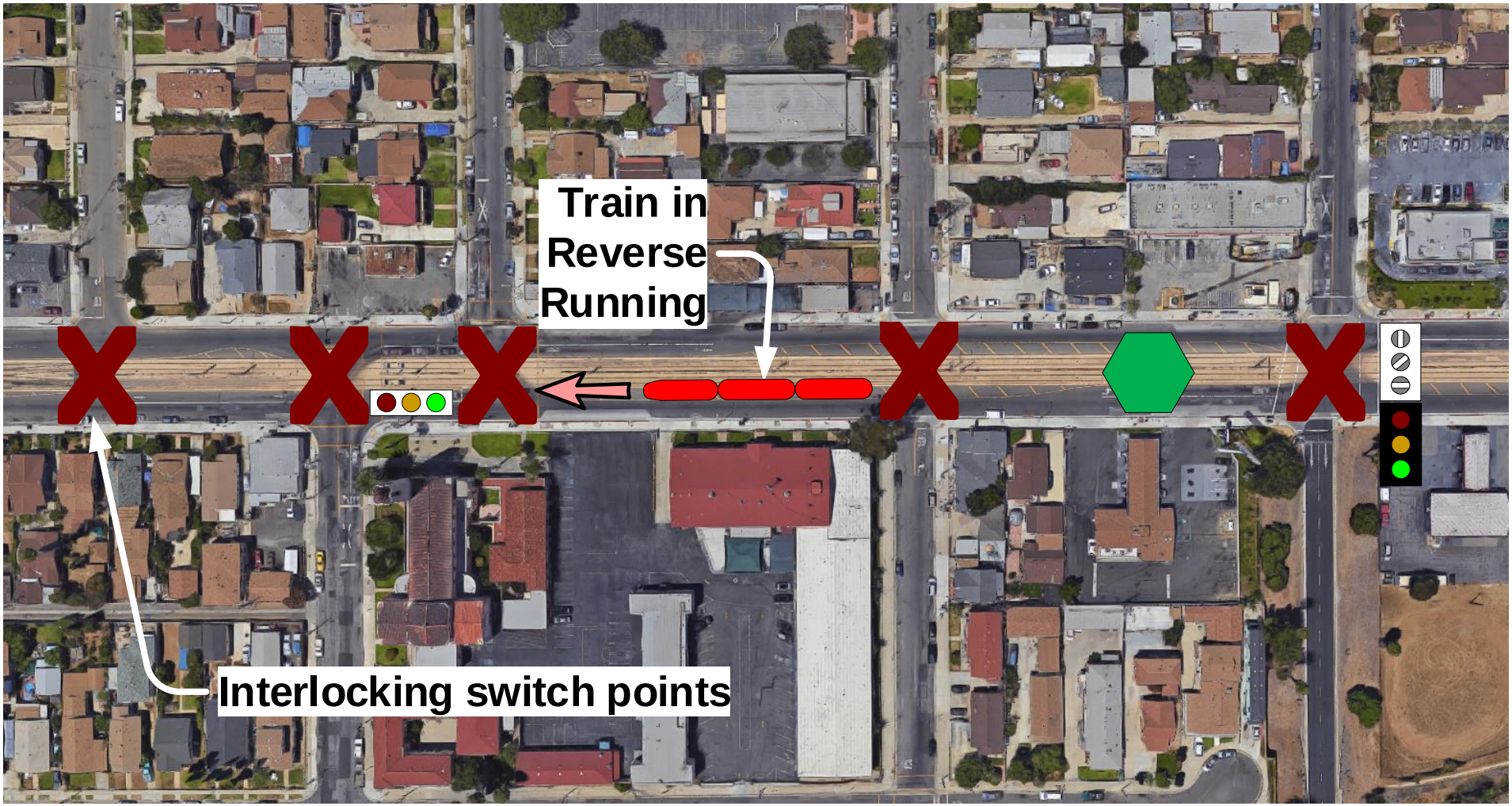


⬢ *= Start of safe stopping distance.* ***Note:*** *Used 650 feet median estimate of LRV safe stopping distance when at 35 mph. Not the typical and not the worst case.*

Scenario 3: No Stop Near Interlock

Normal Ops, No Station Stops near Interlocking

Scenario 4: Train Reverse Running



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

Typical Evaluation Scorecard

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

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

Recommendation for LA Metro

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		
Line	Mode	
	Type I	Type II
Metro Blue Line (MBL)	x	
Metro Green Line (MGL)		x
Pasadena Gold Line (PGL), including the Eastside Extension	x	
Exposition	x	
Crenshaw Line (Future)		x
Foothill Extension	x	
Regional Connector (Type I) (Future)	x	

Recommendation for LA Metro

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