Update on Crossing Optimization Project

Peninsula Corridor Joint Powers Board
AMP Committee

01/24/2024

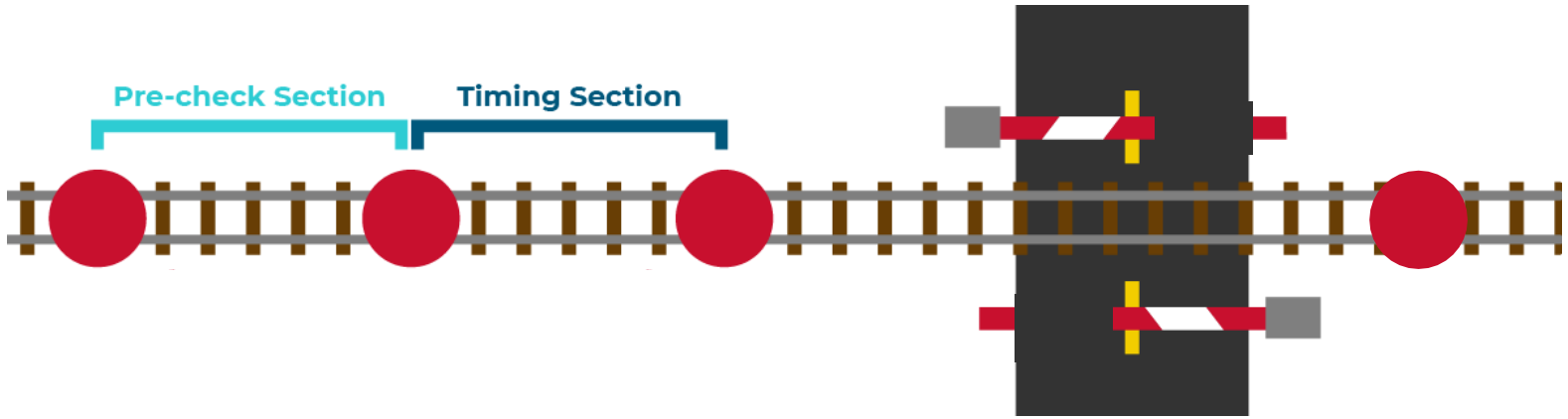
Introduction – 2SC & Wireless Crossing

Two-Speed Check Project Objectives (PCEP)

- Two-Speed Check (2SC) is the default Signal and Crossing System for Caltrain Electrification.
- Provide a Crossing Warning that is compatible with Alternating Current System.
- The solution is fully developed and implemented in coordination with FRA, CPUC and UPRR.
- Two train speeds recognition (MAS 79/Low speed 40) and assigning corresponding crossing activation delay time (customized approach length).
- Stopped or restricted speed train detection and crossing recovery.

Electrification Signal/Crossing Two-Speed Check Concept of Operations

- All 2SC for electrification were designed installed, tested and in production
- System is a track circuit-based system
- System sequentially tracks the train approaching the crossing
- Train speed is categorized by running a vital timer
- Train speed categorization used to delay crossing activation
- Categorization consists of 2 Speeds (79 MPH/MAS & 40 MPH)

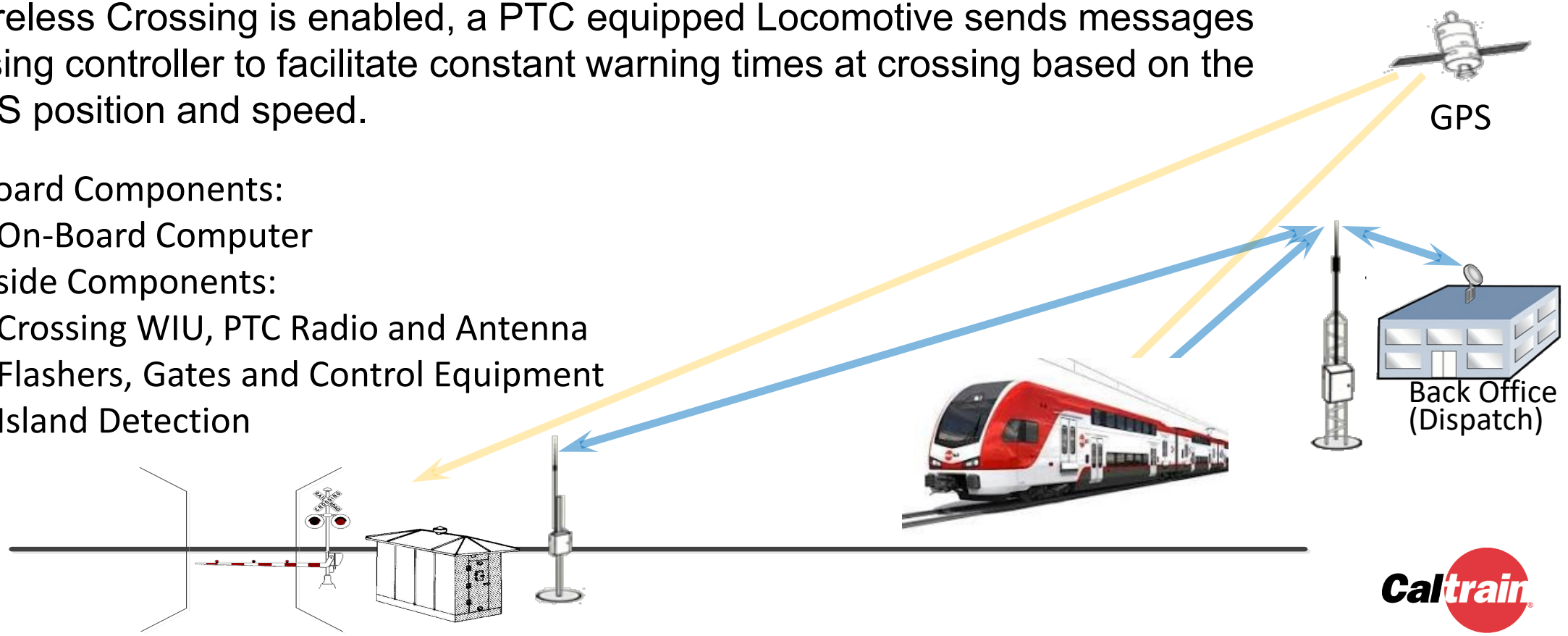


Wireless Crossing Project Objectives

- Wireless Crossing is not required for Caltrain Electrification.
  - *It is an enhancement.*
- Improve Warning Time Consistency
- Provide Warning Time Activation performance similar or better when compared to other Constant Warning Time technologies
- Reduce or eliminate the activation of a near-station crossing when a train is scheduled to stop at the station
- Crossings will only activate when the train is departing the station

Wireless Crossing Concept of Operations

- When Wireless Crossing is enabled, a PTC equipped Locomotive sends messages to a crossing controller to facilitate constant warning times at crossing based on the trains GPS position and speed.
  - Onboard Components:
    - On-Board Computer
  - Wayside Components:
    - Crossing WIU, PTC Radio and Antenna
    - Flashers, Gates and Control Equipment
    - Island Detection



Caltrain Crossing Systems Evolution

Predictor (CWT)

- **Meets all system safety and regulatory requirements**
- System is Track Circuit based
- Recognition of **all speeds**
- Provides relatively uniform warning time for trains traveling consistent speed
- Constant Warning Time Design
- System Recovers when Trains are stopped at Stations
- Incompatible with Caltrain Electrification System

Two Speed Check

- **Meets all system safety and regulatory requirements**
- System is Track Circuit based
- Recognition of **79 MPH** or **40 MPH** Train Speed
- Warning Times are longer for slower trains
- Fixed Approach Design with delay timers (79 MPH or 40 MPH)
- System Recovers when Trains are Stopped at Stations
- Compatible with Caltrain Electrification System

Wireless Crossing

- **Meets all system safety and regulatory requirements**
- System is PTC based
- Recognition of **all speeds**
- Provides relatively uniform warning time for trains traveling consistent speed
- Constant Warning Time Design
- Eliminates the 1 of 2 activations associated with a station stop train
- Compatible with Caltrain Electrification System

Caltrain Electrification Crossing System – (2SC + Wireless Crossing)

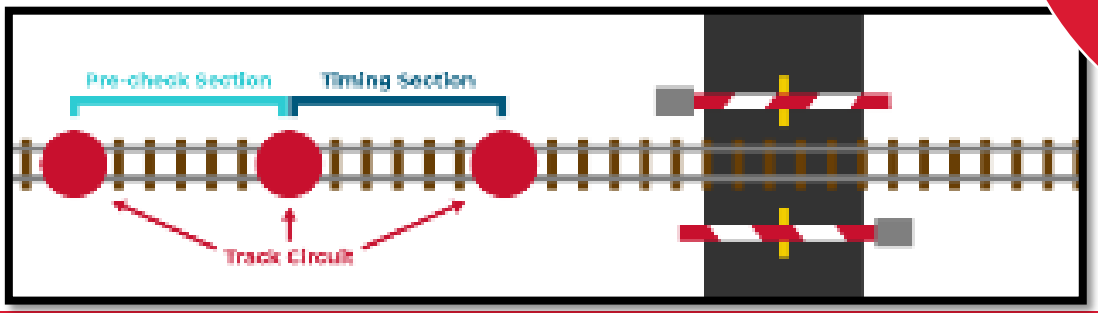
2SC System – Default System

- Speed Selection
  - ➢(Fixed 79/40)
- Stopped Train Recovery (Station Stop – 2 activations)
- Recovery timeout functionality for failed trainset and station stop scenarios
- Utilizes Signal System

Wireless System – Enhancement

- Warning Device Activation
  - ➢(CWT)
- Station Stop Near-Side
  - ➢1 of 2 activations eliminated
- Handshake developed between Wireless Crossing and 2SC systems
- Utilizes PTC system

Caltrain Crossing System



Wireless Crossing Project

Grade Crossings by City

City	Number of Crossings
San Francisco	2
South San Francisco	1
San Bruno	1
Millbrae	1
Burlingame	5
Burlingame/San Mateo (Peninsula Avenue)	1
San Mateo	8
Redwood City	6
Atherton	2
Menlo Park	4
Palo Alto	4
Mountain View	2
Sunnyvale	2
San Jose	2

Wireless Crossing Functionality Improvement

Wireless Crossing Technology being deployed to

- 41 At-Grade Crossings
- 2 Pathway Grade Crossings
- Not on UPRR ROW

9 of 43 locations completed

Performance Changes Post-Commissioning

- Station Stop Inhibit (Near-Side Station Stop)
  - 18 Stations located on Crossing Approach Circuits
    - Eliminates Activation while passenger train berthing at station
- Wireless System Activation
  - Through Movement Trains

Wireless Crossing Users

- Caltrain Passenger Trains

2SC Only Users

- UPRR, ACE & AMTRAK

Wireless Crossing Pilot Performance

Wireless Crossing Locations Currently Commissioned - Comparison (2SC vs Wireless Crossings) (Average Warning Time Values in seconds)					
City	**Crossing**	**Status**	**2SC**	**Wireless Crossings**	**2SC vs Wireless Percentage Change**
Millbrae	Center Street	Complete	59s	38s	-36%
Millbrae	Santa Paula Ped	Complete	58s	41s	-30%
Burlingame	Broadway	Complete	60s	44s	-27%
Burlingame	Morrell Pedestrian	Complete	44s	35s	-12%
Burlingame	Oak Grove Avenue	Complete	61s	48s	-21%
Palo Alto	East Meadow Drive	Complete	47s	43s	-10%
Palo Alto	Charleston Road	Complete	47s	40s	-14%
San Jose	Auzerais Avenue	Complete	59s	41s	-30%
San Jose	Virginia Street	Complete	52s	45s	-14%

Wireless Crossings Benefits

- Provides an improved level of grade crossing safety
- Reduces the length of long warning times
- Reduces the number of activations

Mary Avenue Performance Improvements

Mary Avenue (Sunnyvale Station)	Single Weekday Combined Warning Time & Activations by type				
	Current Cumulative Totals (2SC)		Projected Cumulative Totals (Wireless Crossing)		Delta
	# of Activations	(HH:MM:SS)	# of Activations	(HH:MM:SS)	(HH:MM:SS)
MT1 Station Stop Activations	39	0:30:17	0	0:00:00	**0:30:17**
MT1 Through Move Activations	52	1:03:52	52	0:52:11	**0:11:41**
MT2 Through Move Activations	57	0:44:21	57	0:36:14	**0:08:07**
Totals	148	2:18:30	109	1:28:25	**0:50:05**

Caltrain Wireless Crossing Project Schedule

- In May 2022, the JPB Approved an increase to the original Contract No. 18-J-T-49 with Wabtec Railway Electronics, Inc. ("Wabtec"), in an amount not to exceed $4.9 million for completion of Wireless crossing work. Total Wabtec contract value for wireless crossing is $7.88 million.
- Proof of concept demonstration was completed in April of 2022.
- The wireless crossing implementation schedule was to follow PCEP 2SC implementation sequence.
- Project completed 9 out of 43 crossings cutover as of December 2023.
- Received FRA Test request approval and coordination is on-going
- On-going CPUC for GO-88 Approval with each city
- Wireless Crossing Total Project Budget is $12 Million. Project is fully funded.

Wireless Crossing Project Remaining Work

Cutover #	City	Crossings
3	San Mateo	Howard Ave, Peninsula Ave, North Lane and Baywater Ave
4	San Mateo	Bellevue, First Ave, Villa Terrace Ave, Second Ave
5	San Mateo	Third Ave, Fourth Ave, Fifth Ave, Ninth Ave
6	Palo Alto	Palo Alto Avenue (Alma), Churchill Ave
7	Redwood City	Whipple, Brewster, Broadway, Maple
8	Mountain View & Sunnyvale	Rengstorff, Castro St., Mary Ave, Sunnyvale Ave
9	Atherton & Menlo Park	Encinal, Glenwood, Oak Grove, Ravenwood Ave.
10	SSF & San Bruno	South Linden, Scott Street
11	Redwood City & Atherton	Main St., Chestnut St. Fair Oaks Lane, Watkins Ave.
12	San Francisco	Mission Bay and 16th Street

- Remaining cutovers scheduled for completion by July 2024
- Project Completion expected for Quarter 3 of 2024

Caltrain Wireless Project Top Risks

- Track Access for remaining field testing and cutover
  - Coordinate with Rail Operations and plan for post PCEP construction cutover from April through June 2024
  - Coordinate with PCEP Burn in and Pre-Revenue Service Testing schedule

- Field Support TASI Resources Availability
  - Coordinate and secure required flaggers and maintainers

Q/A

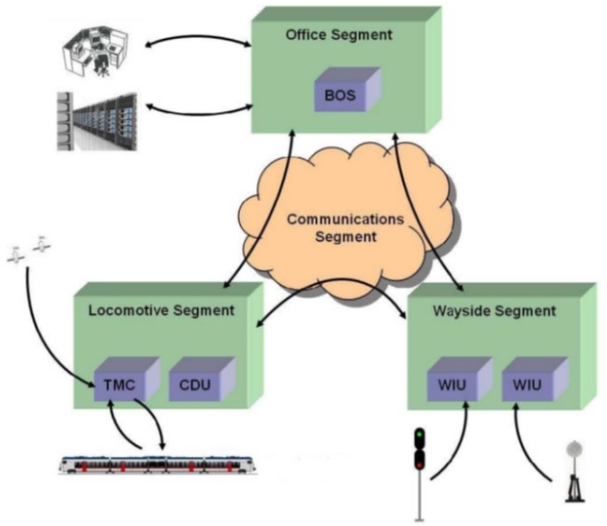
FOR MORE INFORMATION

WWW.CALTRAIN.COM

Backup Slides – Technical Discussion

Wireless Crossing & PTC Interface

Locomotive Segment	Software contains wireless crossing capability	Communicates with Wayside Interface Unit	Decides when to Inhibit and Activate Warning Devices	Provides Preemption Call for Interconnected Grade Crossings
Communications Segment	Fiber Optic, Cellular, and Radio Communications	Facilitates Messaging between Train OBC and Wayside WIU		
Office Segment	Schedule Management Support	Track Database Management	Management of Locomotive Type Functionality	
Wayside Segment	Grade Crossing PTC Capable Equipment	Applies Wireless Controls and checks safety conditions	Application Logic Updated	Interfaces with Warning Devices and Interconnect Circuits



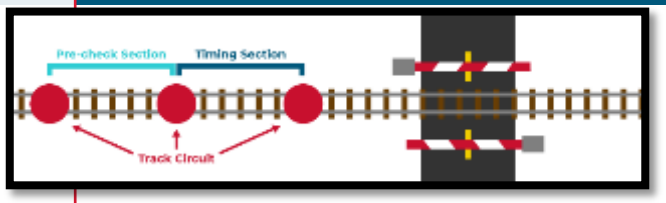
Warning time vs. Gate Down Time

- Crossing Warning Time
  - ❑ The length of time from when a train activates the crossing to when it reaches the roadway. Each crossing is designed to deliver a specific amount of warning.
- Gate down time vary at different crossings
  - ❑ Factors that impact gate down time
    - Track curvature, civil speed restrictions
    - Proximity to terminals and station stops
    - Freight and tenant traffic
    - Train length
    - Speed restrictions
    - Extended crossing approach

Updated Crossing Warning System Design

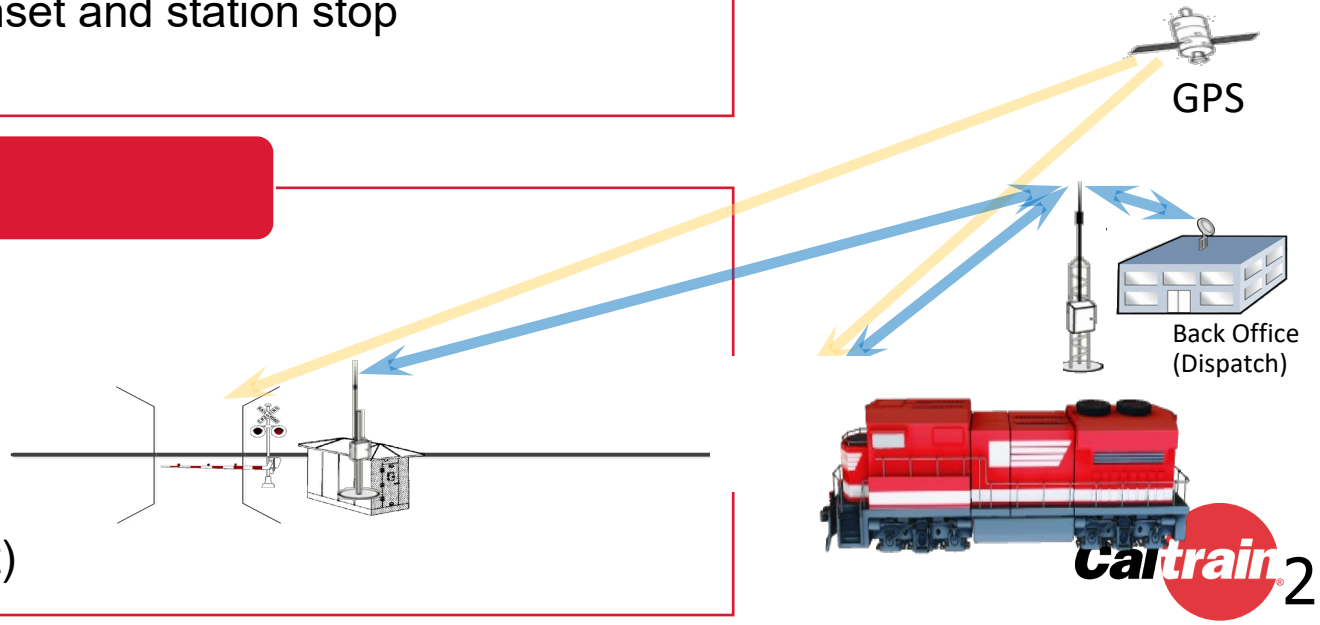
Conventional Warning System

- Handshake developed between Wireless System and Convention system
  - Designed to function as “one system”
- Conventional system is the default system
- Conventional system provides:
  - Restart functionality for trains that have stopped on the approach
  - Detection and activation for all non-Caltrain vehicles
  - Recovery timeout functionality for failed trainset and station stop scenarios



PTC Control Integration

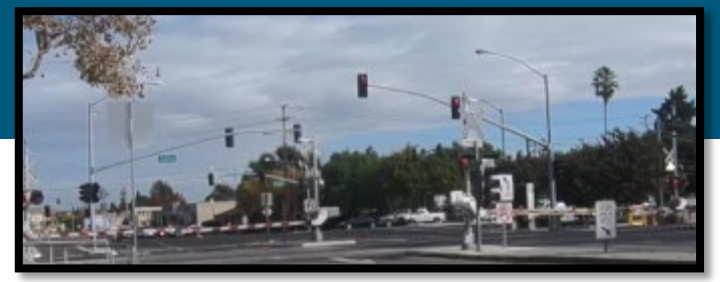
- PTC Supplemental Crossing Controls
  - Warning Device Activation
  - Advanced Preemption
    - Advanced Pedestrian Preemption
  - Station Stop Inhibit
    - OnBoard Soft-Key (warning system restart)



Common Passenger Train Movement Types

Express Movement Trains

- No significant variation of train speed on approach circuits of the grade crossing



Express Movement Trains (Station Stops Far-Side)

- Passenger train slows across roadway before stopping at station

Station Stops Near-Side

- Train activates warning devices, but stops before reaching the crossing
- Trains departing stations close to roadways follow specific operating rules to ensure it is safe to enter the roadway
- Train departing stations (Whistle Mic Activation, next Track Circuit occupancy, and GCOR 6.32.2)

Warning Device Cycle Activations per Movement Type

- Express Movement = **1** Activation
- Station Stop Near-Side = **2** Activations

Project Safety & Performance Enhancements

Express Movement Trains

- Consistent Warning Time for trains traveling at a consistent speed
- A train traveling 30 mph, or 79 mph will result in similar warning time
- Constant Warning Time Detection (CA MUTCD definition) in an Electrified Environment

Express Movement Trains (Station Stops Far-Side)

- Longer warning times due to deceleration after detection reduced by 20% to 30%

Station Stops Near-Side

- PTC allows for the First of Two activations to be eliminated when safe to do so
  - Benefits vary based on train schedule
    - 104 Train per day schedule with all trains stopping at the station projection:
      - **1.5 hrs** of activation time eliminated daily (Based on 102 second warning time)
      - **156** total warning device cycle activations reduced by **52** activations
  - Onboard Soft-Key in development to allow train engineer to re-start warning device cycle reducing dependency on older technologies

Warning Device Cycle Activations per Movement Type

- Express Movement = **1** Activation
- Station Stop Near-Side = **1** ~~**2**~~ Activation~~s~~ (First Activation Eliminated)

Other Functionality & Requirements

Drivers, Vehicles and Pedestrians

- Public Drivers see more consistent warning times, leading to less confusion compared to extended gate-down times
- Traffic flow over grade crossing allowed to continue when a train is berthing, and berthed at a station
- Reduction in Traffic Advanced Preemption Calls & Warning Device Activations

Extended Station Dwell

- The system will allow for passenger trains to dwell for extended periods of time without activating the warning device cycle

Station Overrun Scenarios

- If a passenger train overruns or bypasses a Schedule Station Stop, it will be prevented from entering the adjacent crossing
- Train Engineers will have the flexibility to reposition their trains

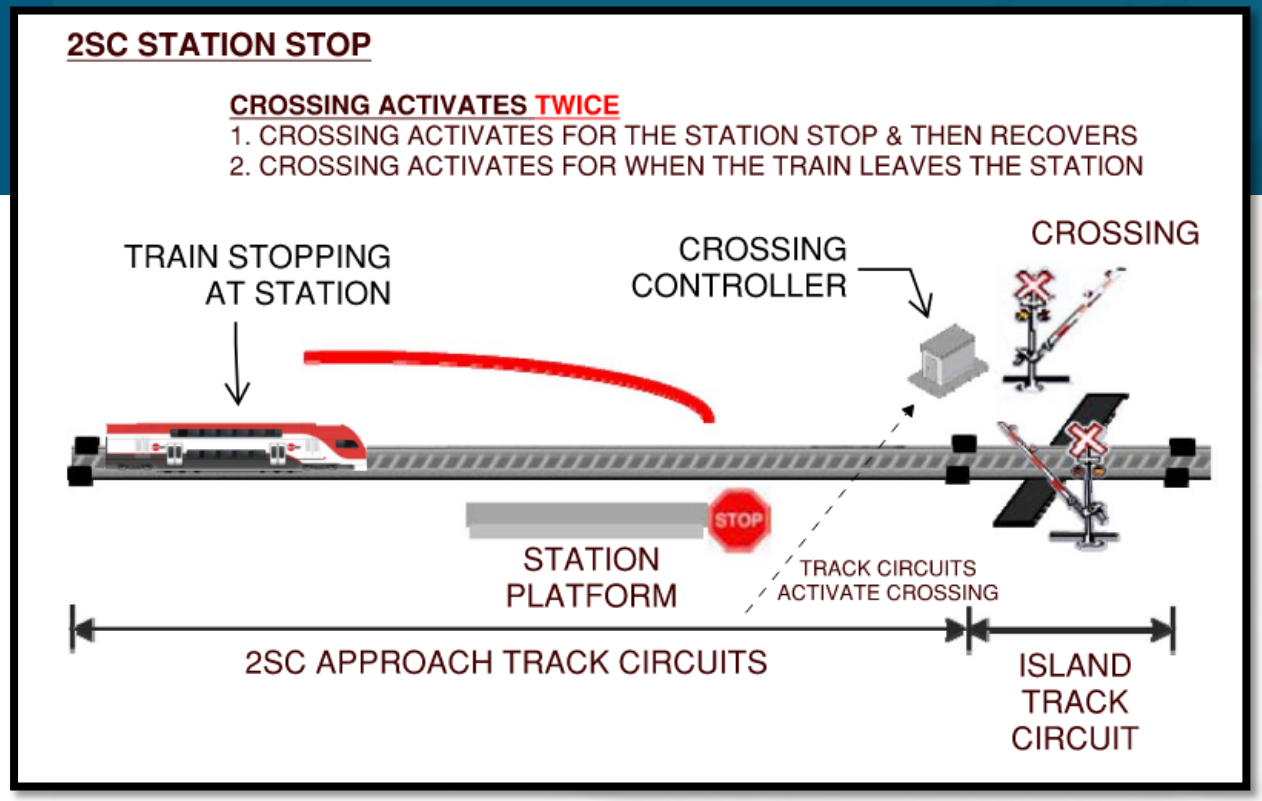
Station Stops

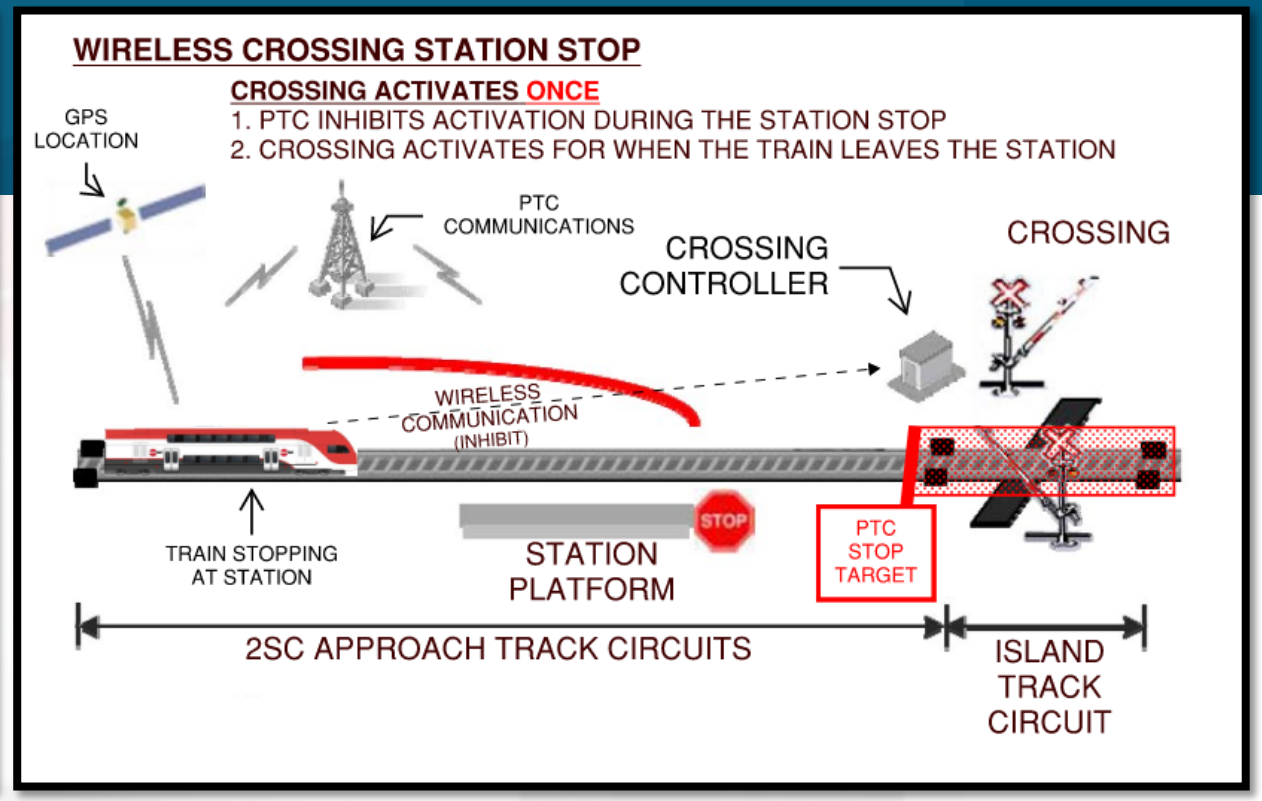
- The Inhibit control will be released once the train is berthed, and the system will revert to the conventional system
- The PTC system will not provide positive start for the grade crossing

Train Crew

- The system will not unreasonably restrict or distract the train engineer from performing their duties

Station Stop Functionality – 2SC vs Wireless





Wireless Crossings Benefits

Burlingame Station Stop (North Lane & Oak Grove Avenue)

- 35 Scheduled daily Station Stop activations will be eliminated
- Oak Grove Avenue = 32 Minute reduction
- North Lane = 45 Minute reduction
- Variation in cumulative reduction values due to the proximity of the station to the grade crossing, and normal train handling through the area.