Highway-Rail Grade Crossing Preemption Seminar

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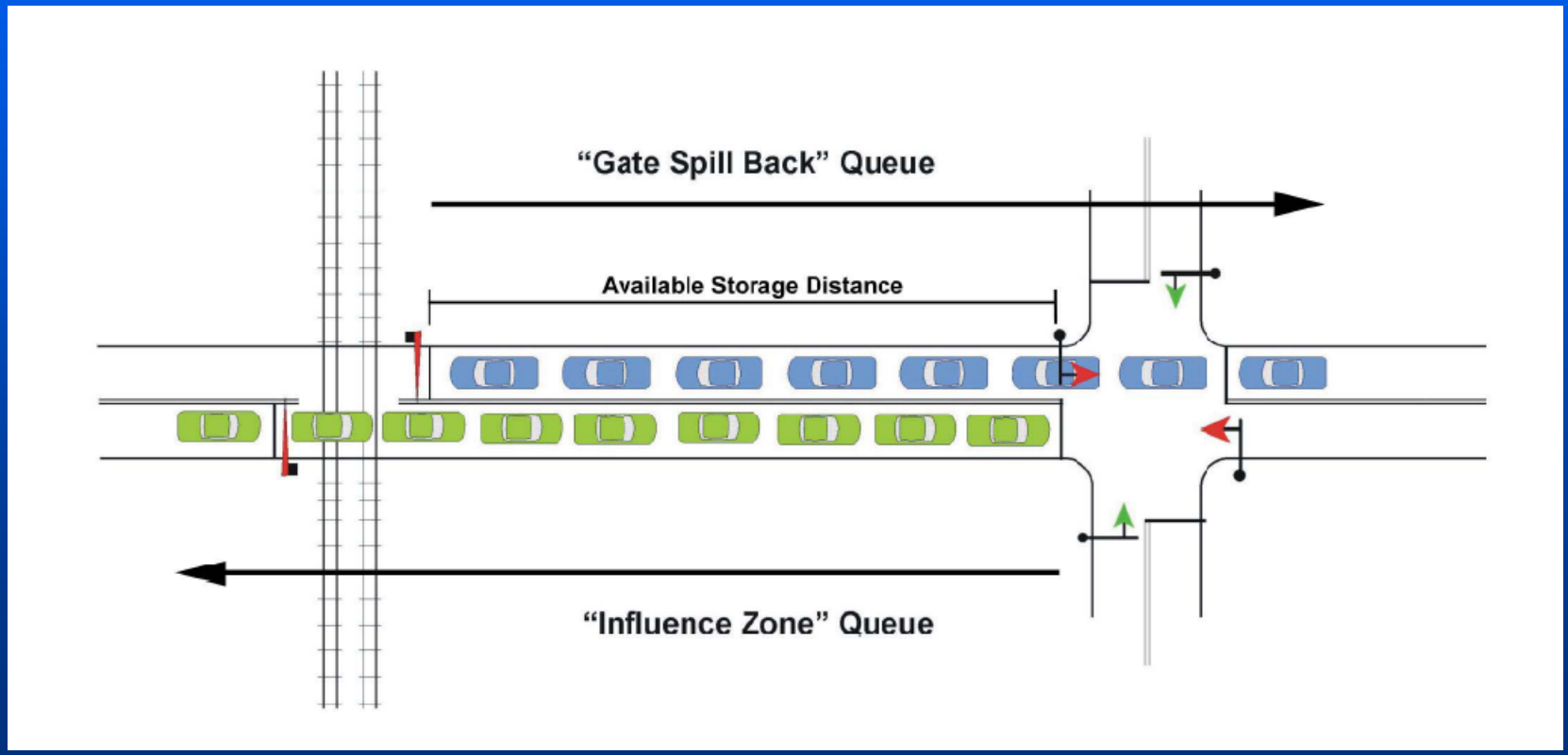
October 10-11, 2007
Sacramento, California

Railroad Preemption

- Required if traffic signal within 200 feet of the railroad crossing
- May also be required if traffic regularly queues onto an adjacent crossing
- Interconnected operation between the traffic signals and crossing warning device
- Sufficient time must be provided to clear design vehicle off of the crossing
- Prohibits traffic from approaching or turning into the crossing while in preemption

Traffic Signal / Crossing Queuing



Highway-Rail Crossing Design

- Jointly developed by the highway department and railroad company
- MUTCD defines minimum standards for warning devices at railroad crossings
- CPUC adds additional requirements and must approve any changes to the design and operation of warning devices
- Type of preemption varies based on site specific conditions

Design Guidelines

- Ensure adequate warning of conditions
- Provide proper guidance for motorists through use of appropriate regulatory signing
- Determine necessary track clearance times and preemption sequence
- Observe motorist behavior to identify problems and adjust the design accordingly
- Safety is the number one concern!

All-Red Flash Operation

- Not recommended for new designs
- Used when incompatible moves are not protected or prohibited at the intersection
- Commonly found at intersections with permissive turns and two-phase operation
- Provides the least amount of direction to motorists and pedestrians
- Should only be used where gates are not present

Limited Service Operation

- Recommended for new designs
- Used when incompatible moves are protected or prohibited during preemption
- Allows compatible moves to proceed during preemption
- Maintains positive right-of-way control at the intersection
- Provides greatest amount of direction to motorists and pedestrians

Pre-Signal Operation

- Stops traffic before the crossing
- Used to prevent traffic from queuing across the tracks
- Must be interconnected to railroad crossing warning system
- Very effective at keeping tracks clear
- Does not eliminate need for green track clearance

Pre-Signal Design

Traffic Signal Timing

- Right-of-Way Transfer Time (RWTT) is the maximum amount of time needed to change from the current signal indication to the track clearance green indication
- Queue Clearance Time is the time required for a design vehicle stopped within the MTCD to startup and move through MTCD
- Separation Time is the amount of time that the MTCD is clear of vehicles prior to train arrival at the crossing

Variables in Preempt Timing

- RWTT can vary from zero to maximum depending upon which phase the traffic signal is in when preemption is activated
- A short or zero RWTT can cause green track clearance to end prior to the gates being down
- This can be prevented by dynamically adding RWTT to the green track clearance or by holding green track clearance until the gates are down

Types of Preemption

- Simultaneous Preempt occurs when the traffic signal and railroad warning devices are notified of an approaching train at the same time
- Advance Preemption is when the traffic signal is notified of an approaching train prior to the railroad warning devices
- Advance Preemption Time (APT) can sometimes be less than designed if a train restarts near the crossing

Advance Preemption

- Advance Preemption is not guaranteed when trains are accelerating, such as departing from a nearside station stop
- Signal controllers using Advance Preemption should also monitor the crossing warning relay (XR) so that a shortened advance warning does not result in the gates coming down before the green track clearance is shown

Advance Preemption Worksheet

- **Used to determine the Advance Preemption Time required at an intersection based on distances and design vehicle characteristics**

MUTCD/AREMA Method Revised 11/3/2006

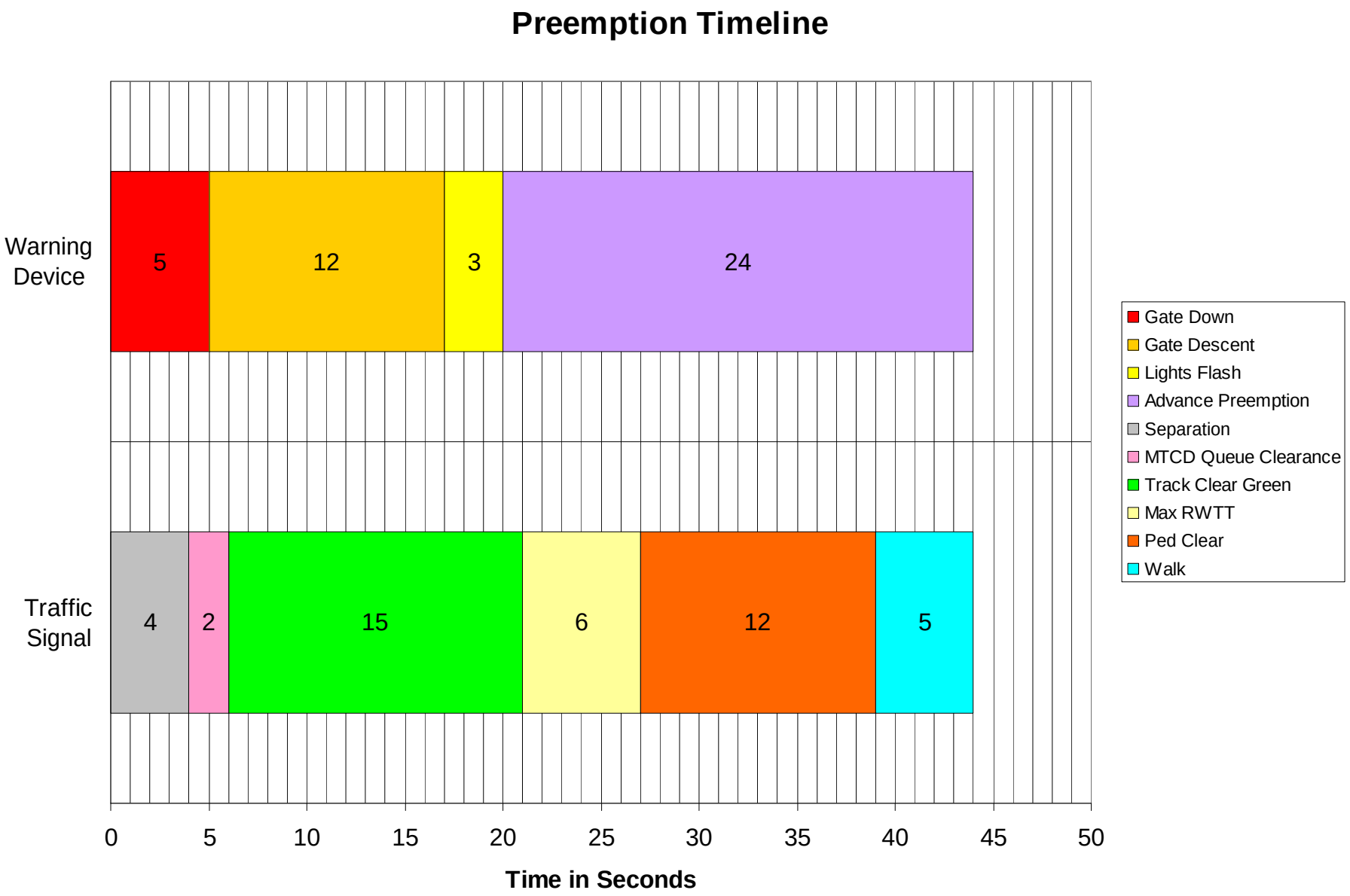
Definitions

Point A:	RR Limit Line or Gate
Point B:	First RR Track Centerline
Point C:	6 ft from Far Rail of Last Track
Point D:	Limit Line of Furthest I/S Approach Lane

Point A to B	12	ft	(min 12 ft)
Point B to C	12	ft	
Point C to D	29	ft	
Min Track Clearance Dist, MTCD	24	ft	
Clear Storage Dist, CSD	29	ft	
Length, L	53	ft	

	Car	Truck	Bus	Semi
Vehicle Length (ft)	15	30	40	55
Queue Space (ft/veh)	21	36	46	61
Vehicles within L (veh)	2.5	1.5	1.2	0.9
Vehicles entirely within L (veh)	2	1	1	0
Start moving last vehicle in L (sec)	**5.4**	**3.9**	**4.5**	**4.0**
Move front of vehicle thru L (sec)	**4.8**	**5.3**	**4.5**	**9.7**
Move entire vehicle thru MTCD (sec)	4.1	5.3	4.9	11.8

Green Track Clearance Time	**15**	sec
MTCD Queue Clearance Time	**17**	sec
Min Walk	5	sec
Max Ped Clearance	12	sec
Max RWTT	6	sec
Separation Time	4	sec
Maximum Preemption Time	**44**	sec
Lights Flash	3	sec
Gate Descent	12	sec
Minimum Time, MT	20	sec
Clearance Time, CT	0	sec
Minimum Warning Time, MWT	20	sec
Buffer Time, BT	5	sec
Total Warning Time, TWT	25	sec
Equipment Response Time, ERT	5	sec
Advance Preemption Time, APT	**24**	sec
Total Approach Time, TAT	54	sec


Preemption Timeline
Warning Device
Traffic Signal
5
12
3
24
4
2
15
6
12
5
0
5
10
15
20
25
30
35
40
45
50
Time in Seconds
Gate Down
Gate Descent
Lights Flash
Advance Preemption
Separation
MTCD Queue Clearance
Track Clear Green
Max RWTT
Ped Clear
Walk

San Fernando Road Project

- Traffic signal upgrades including the installation of pre-signals at three locations
- Interconnection upgrade to supervised relay circuits and IEEE 1570 serial preempt
- Advance warning time to clear pedestrians
- Shortened advance warning protection for restart moves and accelerating trains
- Gate down monitoring to extend track clearance green

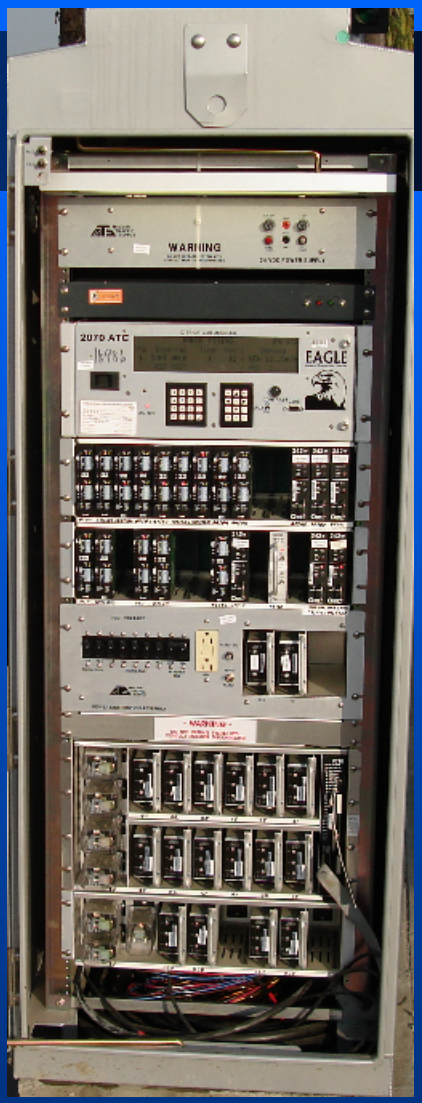
Pre-Signal Installation

IEEE 1570 Serial Preempt

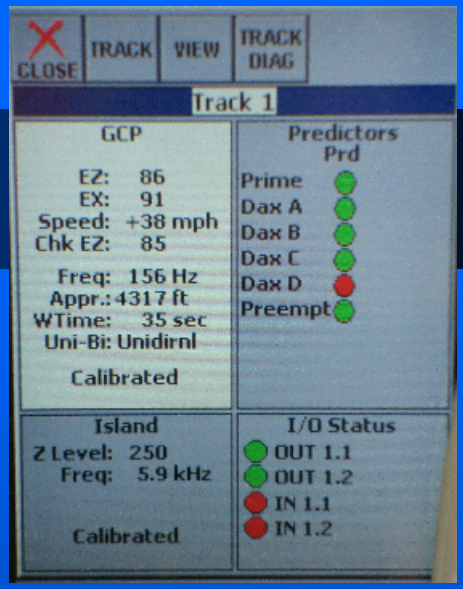
- Vital serial communications between the wayside equipment and the traffic signal equipment
- Provides the traffic signal equipment additional information not available through relay circuits
- Provides the railroad equipment with information on the status of the traffic signal equipment
- Preempt information can be used to manage the crossing by omitting phases prior to train arrival and extending green track clearance until gates are down

IEEE 1570 Serial Preempt

- **Standard message contents:**
  - Railroad System Operational
  - Train Presence Detection
  - Warning System Activation
  - Preempt Activation
  - Entrance Gate Status
  - Exit Gate Status
  - Island Status
  - Train Direction
- **Used to preempt traffic signal**

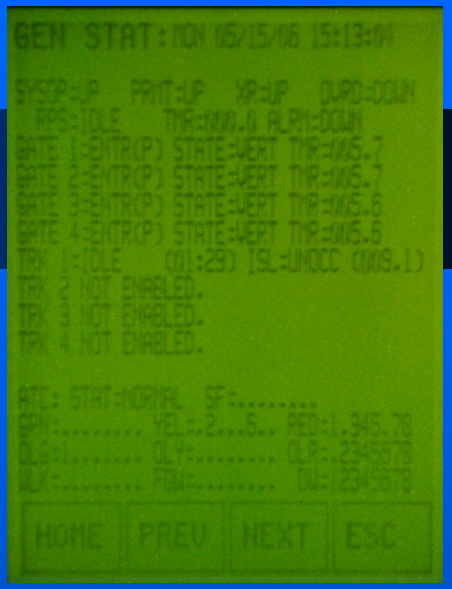


IEEE 1570 Serial Preempt



- **Extended message contents:**
  - Train Classification
  - Train Movement Plans
  - Estimated Time of Arrival
  - Estimated Time of Departure
  - Estimated Speed at Crossing
  - Estimated Train Length
  - Train Direction
- **Used for highway traffic planning and motorist information systems**

IEEE 1570 Serial Preempt



- **Traffic signal message contents:**
  - **Phase Status**
  - **Overlap Status**
  - **Pedestrian Status**
  - **Preemption Status**
  - **Battery Status**

- **Can be used for event recording of the traffic signal and to monitor for malfunctions**

LA City Model 2070 Controller Software

- Provides a guaranteed RWTT interval in addition to green track clearance
- Able to monitor supervised preempt circuits and enter all-red flash if a failure is detected
- Implements the IEEE 1570 serial preempt protocol
- Provides intervals to clear pedestrians and omit phases prior to green track clearance
- Monitors gate position and holds green track clearance until gates are down
- Maximum preempt timer sets flashing operation

Normal Operation