Implementation of Transit Signal Priority (TSP) and Preemption at Grade Crossings

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Overview

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• Concept of Operations
• Transit Signal Priority (TSP)
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Introduction

- Denver RTD’s FasTracks Program
• I-225 or Aurora Rail Line
  - Extension of existing H Line: 10.5 miles
  - Addition of R Line
  - Eight new stations
Background

- I-225 Rail line is divided into Segment 1 and 2

- Segment 2 is further divided into Area A through Area G for ease of design and construction
• Area B (aka The Horseshoe) is further divided into Area B1 and B2
Area B1

- Spans from Exposition Ave & Abilene St to Sable Blvd & Exposition Ave

- Train travels with the flow of the automobile traffic through non-gated crossings

- Train travel is controlled by the traffic signal controller via bar signals
Area B2

- Spans from Sable Blvd & Exposition Ave to 2nd & Abilene Station

- There are three gated crossings along Sable Blvd north of Aurora Metro Center Station: Alameda, Commercial and Bayaud

- The segment from Metro Center Station to the Ellsworth Crossing was nicknamed “The Gauntlet”
• Alameda Ave
  - Six lane major arterial
  - Closely spaced coordinated signalized intersections from I-225 Interchange to Sable Blvd
  - Additional left and right turn lanes will be added resulting in a nine lane LRT crossing
  - Opening day (2016) Average Daily Traffic on Alameda Ave at the crossing is projected to be approximately 42,000 vehicles per day
Background

- Sable Blvd
  - Four lane minor arterial
  - Coordinated traffic signals
  - Opening day (2016) Average Daily Traffic on Sable Blvd at Alameda Ave is projected to be approximately 19,000 vehicles per day
Background

- Focal Point – Alameda Ave Crossing
  - Size of crossing (traffic volume and number of lanes)
  - High volume coordinated arterials
  - Required traffic signal progression to avoid severe impacts to traffic operations and safety concerns
Background

- Candidates for Traffic Signal Preemption
  - Alameda and Sable
  - Bayaud and Sable
- Recommendation from the 2009 Manual on Uniform Traffic Control Devices (MUTCD), Section 8C.10 states
  - “When a highway-LRT grade crossing equipped with a flashing-light signal system is located within 200 feet of an intersection or midblock location controlled by a traffic control signal, the traffic control signal should be provided with preemption in accordance with Section 4D.27.”
Background

• Traffic Signal Preemption
  - Intersection right-of-way transfer
  - Track clearance green phase to clear potentially queued automobiles from the track prior to gates descending
  - Prevents conflicting traffic signal phases from activating while the train occupies the crossing

• Traffic Signal Preemption Drawbacks
  - Random activation
  - Impacts to traffic progression
  - Potential for long traffic signal coordination recovery times
Concept of Operations

- Balance train and traffic operations
  - Minimize impact to traffic operations including signal coordination
  - Provide safe operations at the intersections and crossings
  - Controlled release of the train
  - Once the train is released, it continues without stopping through “The Gauntlet”.
  - Utilize transit signal priority with background preemption
Transit Signal Priority (TSP)

- TSP – An operational strategy that accommodates the movement of transit vehicles including light rail through signalized intersections.

- Passive TSP - the transit signal phase in a traffic signal is accounted for in the normal traffic signal cycle and operates continuously.

- Active TSP - the ability to shorten conflicting phases, extending non-conflicting phases, modify phase sequences and skip phases to serve the transit vehicle.

- Typically used for transit vehicles at signalized intersections without railroad grade crossings warning devices
Transit Signal Priority (TSP)

- TSP with Background Preemption
  - Utilizes TSP routines to mimic traditional traffic signal preemption.
  - Multiple TSP routines or “linked” priorities activated one after another.
    - Priority #1 - Right-of-Way (ROW) transfer and track clearance green phase.
    - Priority #2 - Dwell
  - Failsafe - A delayed background preemption routine can be activated after priority #2 expires to prevent the traffic signal from bringing up conflicting automobile phases while the gates are down.
Transit Signal Priority (TSP)

• Advantage

  – TSP routines exit back into the background coordinated traffic signal cycle.

  – For full priority within the traffic signal controllers being used on the I-225 Rail Line project, two options are available:

    o Option 1: Jump directly to the current location of the signal’s coordination timer.

    o Option 2: Go through offset transitions in the traffic signal cycle which could take up to three traffic signal cycles to get back into coordination.
Outbound Train Progression

Legend:
- Train Detected
- RR Warning Device Call
- Transit Signal Priority Call
TCC - Traffic Controller Cabinet
SB - Signal Bungalow
Inbound Train Progression

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Alameda/Sable Traffic Signal

“READY”
Summary

- Traffic signal preemption was determined to be problematic within “The Gauntlet” due to:
  - Randomness
  - The need to minimize disruption to traffic signal coordination and traffic flow
  - High traffic volume crossing at Alameda Ave
  - Long recovery time required for the traffic signal cycle to regain coordination

- The use of TSP was agreed to by stakeholders as a way to balance traffic and train operations while maintaining safe operations.

- Background preemption will be implemented as part of the failsafe system.

- Currently working towards final design.

- Bench testing will be performed to confirm the validity of the concept and design.
QUESTIONS?