Module 24:
Transit Signal Priority in CV Environment

Table of Contents

1. Module Description

In the last several years, transit signal priority (TSP) deployments are increasing as communities search for potential solutions to mobility issues, such as traffic congestion and urban sprawl. Transit solutions and technologies, such as Bus Rapid Transit, are becoming more popular as a potentially cost-effective way for providing high-quality, high-performance mobility to communities.   As deployment of a connected vehicle (CV) environment increase throughout the world, the advantages of deploying TSP using CV technologies also increase. This module introduces the standards that support TSP in a CV environment and how a transit agency can prepare for implementing TSP in such an environment.

2. Introduction/Purpose

Transit managers look at TSP as a potential tool to improve schedule adherence and service reliability and increase transit vehicle efficiency with minimal negative impacts to the full traffic network operations. While TSP is deployed in the US, the advent of CV technology provides additional advantages for the deployment of TSP that can be embraced by regions deploying CV technology.

Module 24: Transit Signal Priority in CV Environment is a continuation of a series of modules on ITS standards for arterial management and transit signal priority. The previous module in the series, Module 20: Application of Arterial Management and Transit Signal Priority Standards, provided details on the standards that support signal control priority and how to use those standards to develop, specify and test a TSP implementation, including implementation in a connected vehicle environment. The focus of this module is the implementation of transit signal priority in a connected vehicle environment. This module introduces the relevant standards to support transit signal priority in a connected vehicle environment and presents how the transit agency can prepare for a CV implementation. This module also provides details and lessons learned from current TSP in a CV environment deployment.

3. Reference to Standards

- APTA TCIP-S-001 4.1.0, APTA Transit Communications Interface Profiles. Washington DC: American Public Transportation Association. https://www.apta.com/research-technical-resources/standards/technology/apta-tcip-s-001-4-1-1/

- NTCIP 1201 Version v03, National Transportation Communications for ITS Protocol, Global Object Definitions. Washington DC: AASHTO/ITE/NEMA, March 2011. https://www.ntcip.org/document-numbers-and-status/

- NTCIP 1211 Version v02.24, National Transportation Communications for ITS Protocol, Object Definitions for Signal Control and Prioritization v02.24. Washington DC: AASHTO/ITE/NEMA, September 2014. https://www.ntcip.org/document-numbers-and-status/

- NTCIP 9001 Version v04, *National Transportation Communications for ITS Protocol, The NTCIP Guide*. Washington DC: AASHTO/ITE/NEMA, July 2009. https://www.ntcip.org/document-numbers-and-status/

- SAE J2735_201603, Dedicated Short Range Communications Message Set Dictionary. SAE International, March 2016. http://standards.sae.org/j2735_201603/

- Traffic Management Data Dictionary v3.03d. Washington DC: AASHTO/ITE, December 2016. https://www.ite.org/technical-resources/standards/tmdd/

4. Case Studies

Multi-Modal Intelligent Traffic Signal Systems (MMITSS)

- University of Arizona, et al., MMITSS Final ConOps - Concept of Operations, Version 3.1 (Updated Final Submission), December 4, 2012. http://www.cts.virginia.edu/wp-content/uploads/2014/05/Task2.3._CONOPS_6_Final_Revised.pdf

- University of Arizona, et al., Multi-Modal Intelligent Traffic Signal System - Final System Requirements Document V4.0, March 7, 2012. http://www.cts.virginia.edu/wp-content/uploads/2014/05/Task3._SyRS_4_PostSubmittal_V3.pdf

- University of Arizona, et al., "Multi-Modal Intelligent Traffic Signal System - System Design Version 1.1." June 16, 2015.

- "Multi-Modal Intelligent Traffic Signal System (MMITSS) Impacts Assessment - Final Report." US Department of Transportation, FHWA-JPO-15-238, August 19, 2015.

USDOT Tampa Hillsborough Expressway Authority (THEA) Connected Vehicle Pilot

- Website - https://www.tampacvpilot.com/

- System Architecture, Use Case 4 - https://rosap.ntl.bts.gov/view/dot/42557

Utah DOT Redwood Road Transit Signal Priority Project

- Presentation - Installing DSRC Systems for Vehicle-to-Infrastructure Applications, Blaine Leonard, Western States Rural Transportation Technology Implementers Forum, October 13, 2017, https://www.udot.utah.gov/main/uconowner.gf?n=42905810652946814

- Redwood Road Transit Signal Priority Project - https://www.itsrm.org/project/test-project/

- Strong Signal, Blaine Leonard, P.E., Roads and Bridges, May 2, 2018, https://www.roadsbridges.com/strong-signal

5. Glossary

Term	Definition
Coordinator	A logical device or program/routine that provides coordination. An integral part of a Traffic Signal Controller.
National Transportation Communications for ITS Protocol	A family of standards that provides both the rules for communicating (called protocols) and the vocabulary (called objects) necessary to allow electronic traffic control equipment from different manufacturers to operate with each other as a system.
Priority	The preferential treatment of one vehicle class (such as a transit vehicle, emergency service vehicle or a commercial fleet vehicle) over another vehicle class at a signalized intersection without causing the traffic signal controllers to drop from coordinated operations. Note: Priority may be accomplished by a number of methods including changing the beginning and end times of greens on identified phases, changing the phase sequence, or inclusion of special phases, without interrupting the general timing relationship between specific green indications at adjacent intersections.
Priority Request	The information that describes a need for priority service based upon user defined criteria (such as the number of minutes behind schedule, vehicle occupancy levels, vehicle class, etc.). Note: A priority request is sent from a Priority Request Generator to a Priority Request Server.
Priority Request Generator	A logical or physical entity that initiates a priority request.
Priority Request Server	A logical or physical entity that manages and prioritizes one or more service requests.
Signal Control Priority	An operational strategy that provides preferential treatment (priority) to facilitate the movement of fleet vehicles through signalized intersections.
Transit Signal Priority	A subset of Signal Control Priority focusing on transit fleet vehicles.

6. References

Professional Capacity Building Modules

- CSE201. Introduction to Security Credential Management System https://www.pcb.its.dot.gov/stds_training.aspx

- CV265, Introduction to IEEE 1609 Family of Standards for Wireless Access in Vehicular Environments (WAVE) https://www.pcb.its.dot.gov/stds_training.aspx

- CV 273. Introduction of SPaT/MAP Messages.
  https://www.pcb.its.dot.gov/stds_training.aspx

- Module 8. Arterial Management and Transit Signal Priority: Understanding User Needs for Signal Control Priority (SCP) Based on NTCIP 1211 Standard, Part 1 of 2
  https://www.pcb.its.dot.gov/StandardsTraining/Modules.aspx?Year1Transit=1&ModuleID=63#mod63

- Module 9. Arterial Management and Transit Signal Priority: Specifying Requirements for Signal Control Priority (SCP) Based on NTCIP 1211 Standard, Part 2 of 2.
  https://www.pcb.its.dot.gov/StandardsTraining/Modules.aspx?Year1Transit=1&ModuleID=64#mod64

- Module 11. Transit and the Connected Vehicle Environment/Emerging Technologies, Applications, and Future Platforms
  https://www.pcb.its.dot.gov/StandardsTraining/Modules.aspx?Year1Transit=1&ModuleID=66#mod66

- Module 20. Application of Arterial Management / Transit Signal Priority Standards
  https://www.pcb.its.dot.gov/StandardsTraining/Modules.aspx?Year1Transit=1&ModuleID=89#mod89

- Module 23. Leveraging Communications Technologies for Transit On-Board Integration.

Transit Signal Priority

- Transit Signal Priority (TSP): *A Planning and Implementation Handbook*. Washington DC: ITS America, May 2005.
  http://nacto.org/docs/usdg/transit_signal_priority_handbook_smith.pdf

- Li, Y., Koonce, P., Li, M., Zhou, K., Li, Y., et al., Transit Signal Priority Research Tools. U.S. Department of Transportation, Federal Transit Administration, May 2008.
  http://nacto.org/docs/usdg/transit_signal_priority_research_tools_caltrans.pdf

- Transit Signal Priority: *Current State of the Practice* (2020), National Academies of Sciences, Engineering, and Medicine, The National Academies Press, 2020.
  https://doi.org/10.17226/25816

7. Study Questions

1. What is a disadvantage of using a traditional optical TSP system?

    a) Special equipment is required for each intersection

    b) Line of sight is required

    c) Limited amount of information can be transferred

    d) All of the above

    e)

2. What is a mandatory element of the SRM?

    a) Request Identifier

    b) Requestor Identifier

    c) SequenceNumber (message counter)

    d) Estimated time of arrival

3. Where would a PRS NOT likely to be located?

    a) A transit vehicle

    b) A traffic management center

    c) A signal controller cabinet

    d) A traffic signal controller

4. Which of the following is an important consideration when deploying TSP in a CV environment?

    a) Security

    b) Physical architecture

    c) Criteria for granting priority requests

    d) All of the above

8. Icon Guide

The following icons are used throughout the module to visually indicate the corresponding learning concept listed out below, and/or to highlight a specific point in the training material.

1) **Background information:** General knowledge that is available elsewhere and is outside the module being presented. This will be used primarily in the beginning of slide set when reviewing information readers are expected to already know.

2) **Tools/Applications:** An industry-specific item a person would use to accomplish a specific task and applying that tool to fit your need.

3) **Remember:** Used when referencing something already discussed in the module that is necessary to recount.

4) **Refer to Student Supplement:** Items or information that are further explained/detailed in the Student Supplement.

5) **Example:** Can be real-world (case study), hypothetical, a sample of a table, etc.

6) **Checklist:** Use to indicate a process that is being laid out sequentially.