

Wisconsin Traffic Engineering Council

Issue Paper 8 – Signal Preemption & Confirmation, RR Preemption



Background / Overview

The 2003 Manual on Uniform Traffic Control Devices (MUTCD) defines traffic signal preemption as "the transfer of normal operation of a traffic control signal to a special control mode of operation". Preemptive control may be implemented to give priority to trains, boats, emergency vehicles, and light rail transit.

Emergency vehicles (EVs) are at higher risk for involvement in crashes and are subject to unpredictable delays in reaching the scene of a fire or crash. Emergency Vehicle Preemption (EVP) at signalized intersections can offset the effects of congestion by providing a special green interval to the EV approach while providing a special red interval on conflicting approaches.

Approximately every two hours, either a vehicle or a pedestrian is struck by a train in the United States. In 2007, incidents at public highway-rail crossings in the United States resulted in 299 deaths and 817 injuries. Where a signalized highway intersection exists in close proximity to a railroad crossing, the railroad and traffic signal control equipment should be interconnected, and the normal operation of the traffic signals controlling the intersection should be preempted to operate in a special control mode when trains are approaching. The objective of a successful preempt is to take control of the intersection traffic signal displays and provide for the passage of a train, no matter where in the normal traffic signal operation the preempt occurs.

Current National Practices

Over 30,964 signals equipped with EVP technology in 375 separate jurisdictions. About 20 percent of traffic signals in the 78 largest metropolitan areas are equipped with EVP. St. Paul, Minnesota has the oldest continuously operating EVP system in the US; 100% of signals equipped with EVP.

Realized Benefits of EVP include

- Reduced fire/rescue response time
- Reduced EV crashes
- Reduced need for new fire/EMS stations
- Improved insurance rating

The Manual on Uniform Traffic Control Devices recommends the use of traffic signal preemption whenever the distance between the grade crossing and signalized intersection is 200 feet or less. Research has suggested that this distance criterion is inadequate, and that preemption sometimes may be appropriate when the distance is much larger than 200 feet. The Institute of Transportation Engineers (ITE) Recommended Practice on the Preemption of Traffic Signals Near Railroad Grade Crossings highlights the need for preemption to be based on a detailed queuing analysis.

Preemption Sequence

All controller units provide the same basic preemption sequencing: Entry into preemption, Termination of the interval in operation, Clear track intervals/EV, Preemption hold intervals and Return to normal operations

Current Wisconsin Practices

EVP Preemption

Guidance provided in Traffic Guidelines Manual 4-3-22.1 regarding approval processes, funding, installation and operation of EVP at signalized intersections. Traffic Signal Design Manual 7-1-6 has guidance about the signal plans for preemption.

RR Preemption

Guidance provided in WisDOT Traffic Guidelines Manual 4-2-34. Refers to MUTCD Section 4D.13 and 8D.07. Signal controllers should be programmed to operate a sub-routine in case crossing goes into fail-safe mode.

Technical Issues

- EVP Technology Options
 - Radio-based systems
 - Sound-based systems
 - Light and Infra-red based systems
- EVP Operational/Maintenance Issues
 - Weather
 - Line of Sight Requirement
 - Electronic Noise Interference
 - Possible preemption of other approaches
 - Unauthorized use
 - EV Driver Training
- RR Preemption Operational Issues
 - Train Detection Circuitry: Fixed, Motion Sensor, Constant Warning Time
 - Advance/Simultaneous Preemption
 - Phase Plane for RR Preemption: Split Phasing, Simultaneous Intersection Clearance, Concurrent Intersection Clearance
- Institutional Issues with multiple stakeholders
- Public Acceptance

Additional Resources

- Traffic Signal Preemption for Emergency Vehicles: A cross-cutting study .Available online at http://www.itsdocs.fhwa.dot.gov/jpodocs/repts_te/14097_files/14097.pdf
- NCHRP Synthesis: Traffic Signal Operations Near Highway-rail Grade Crossings. Available online at http://onlinepubs.trb.org/Onlinepubs/nchrp/nchrp_syn_271.pdf
- Guide for Traffic Signal Preemption Near Railroad Grade Crossing. Available online at <http://tti.tamu.edu/documents/1439-9.pdf>
- Preemption of Traffic Signals Near Railroad Crossings: An ITE Recommended Practice. Prepared by Traffic Engineering Council Committee TENC-99-06. Washington, DC: Institute of Transportation Engineers, 2006.
- Manual on Uniform Traffic Control Devices. Available online at <http://mutcd.fhwa.dot.gov/pdfs/2003r1r2/mutcd2003r1r2complet.pdf>
- Railroad Preemption Overview. Available online at <http://www.signalsystems.org.vt.edu/documents/July2003AnnualMeeting/3-66/NCHRP3-66%20rr%20preemption%20background%20final.pdf>
- WisDOT Traffic Guidelines Manual 4-2-34