ITE Designing Signalized Intersections Training Program:

Module 10B - Preemption and Priority

Source – Pete Yauch

Presenter

Pete Yauch, P.E., PTOE, RSP_{2i}

TSM&O Program Manager

Iteris, Tampa, Florida, USA

Preemption

Preemption interrupts normal signal operations to accommodate a special occurrence or event

- Railroad crossing activation
- Emergency vehicle approach
- Drawbridge opening
- Light Rail transit vehicles

Source – Pete Yauch

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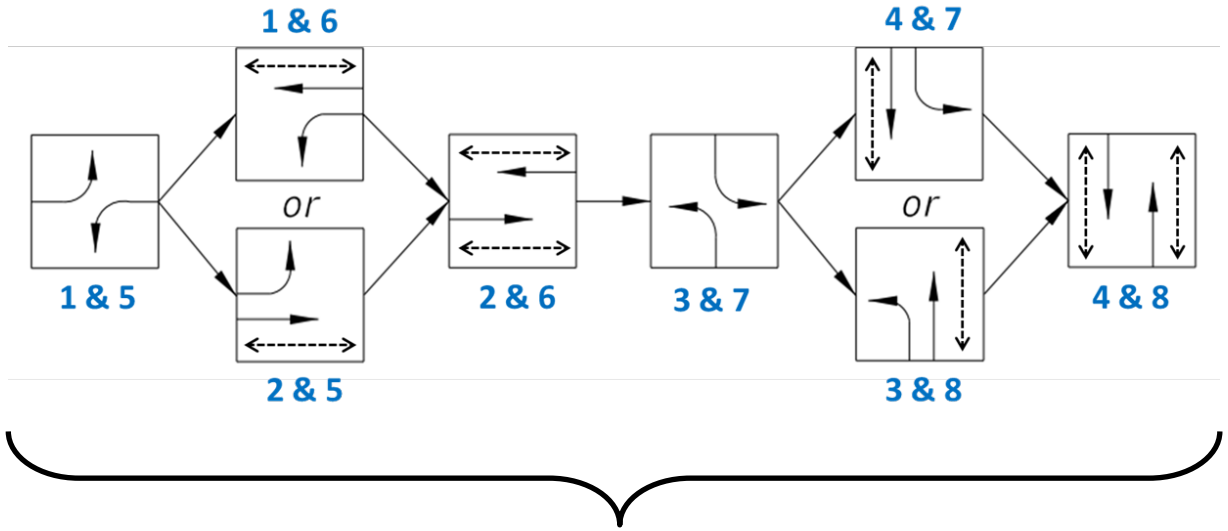
Preemption

- Preemption serves an important safety function
- Preemption often has negative impacts on traffic flow
  - Phase skipping
  - Short phases
  - Resynchronization
- Potential for Left Turn Trap



Source – Pete Yauch

Priority

- Operational strategy that facilitates the movement of in-service transit vehicles, or freight vehicles, through traffic signal-controlled intersections
- Differs from Preemption in that it temporarily modifies signal timing to accommodate traffic – does not interrupt signal cycle

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Preemption / Priority Inputs to Signal Controller

Ten Preemption / Priority inputs are defined

- High-priority inputs PR1 - PR6 are reserved for rail and emergency vehicle preemption.
- Low-priority inputs PR7 – PR10 may be assigned to low-priority preemption or transit priority.
- Higher priority preempts always override lower priority preempt requests (PR1 overrides PR2).
- PR1 and PR2 always override lower priority requests PR3 - PR6 and PR7 - PR10.

Preemption / Priority Inputs to Signal Controller

Preempt #	Preempt Input	Type (typical)
1	1 (steady low)	Rail
2	2 (steady low)	Rail
3	3 (steady low)	Rail or High Priority Emergency
4	4 (steady low)	Rail or High Priority Emergency
5	5 (steady low)	Rail or High Priority Emergency
6	6 (steady low)	Rail or High Priority Emergency
7*	3 (oscillating)	Low Priority Emergency or Transit
8*	4 (oscillating)	Low Priority Emergency or Transit
9*	5 (oscillating)	Low Priority Emergency or Transit
10*	6 (oscillating)	Low Priority Emergency or Transit

* The controller recognizes high-priority as a steady ground true input and low-priority as an oscillating 6.25 Hz input on these inputs.

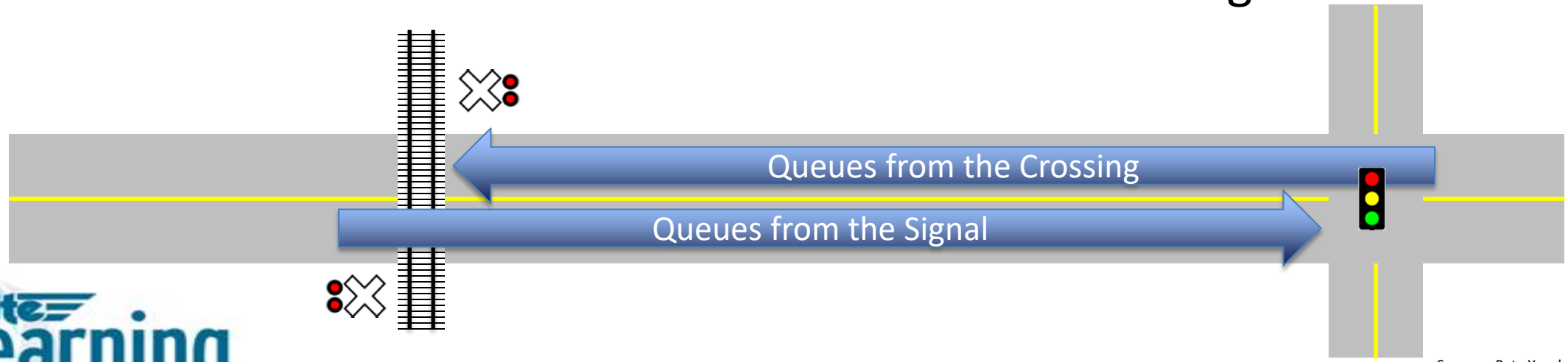
Preemption

- When a preempt request is received, the controller terminates the active phase to service the preempt.
- If coordination is in operation, the preemption call will override coordination.
- The controller then moves to the preemption sequence programmed to service the programmed dwell phase(s) until the preempt input is released.

Preemption for Highway / Rail Grade Crossings

Two primary functions of railroad preemption:

- Allow any vehicles trapped in the pathway of an approaching train to move forward to a safe position
- Suspend any traffic movements through an intersection toward the railroad track until all trains have cleared the crossing



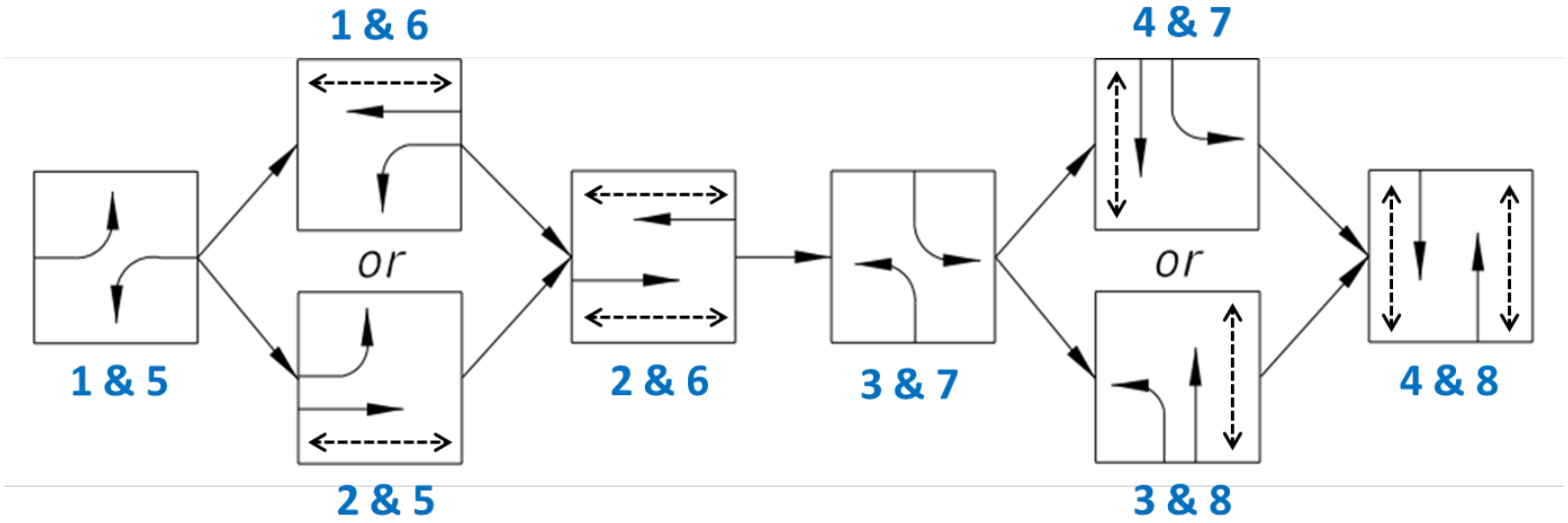
Source – Pete Yauch

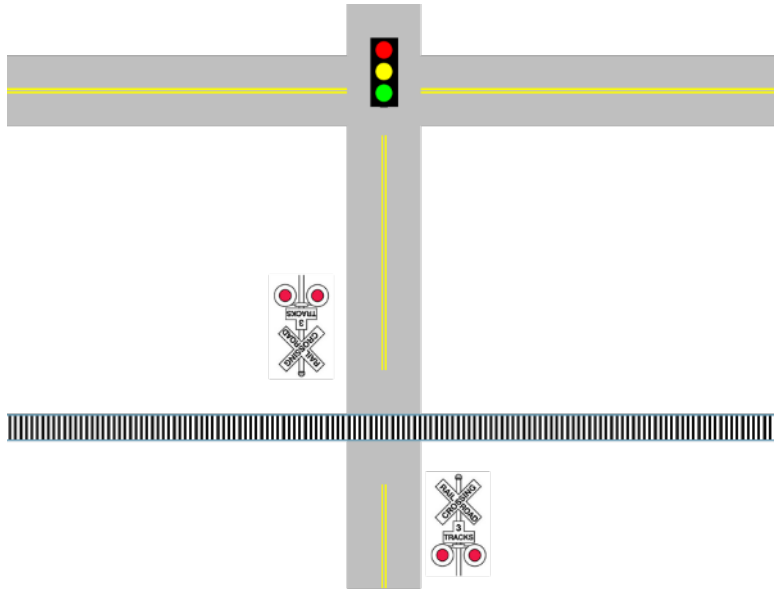
Rail Crossing Preemption Guidelines

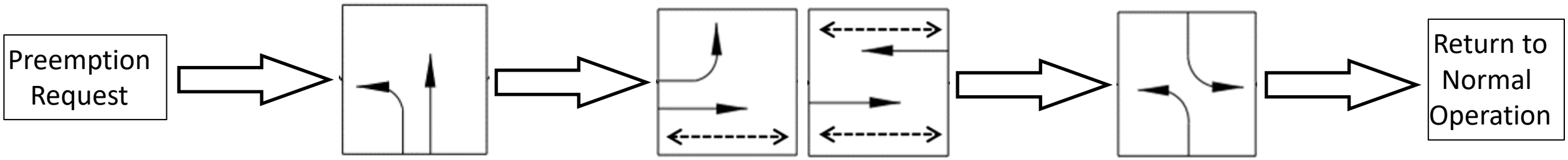
If either of the following conditions are present, consideration should be given to interconnect the traffic signal and railroad grade crossing:

- Highway traffic queues that have the potential for extending across a nearby rail crossing
- Traffic queued from a downstream railroad grade crossing that has the potential to interfere with an upstream signalized intersection

Rail Crossing Preemption



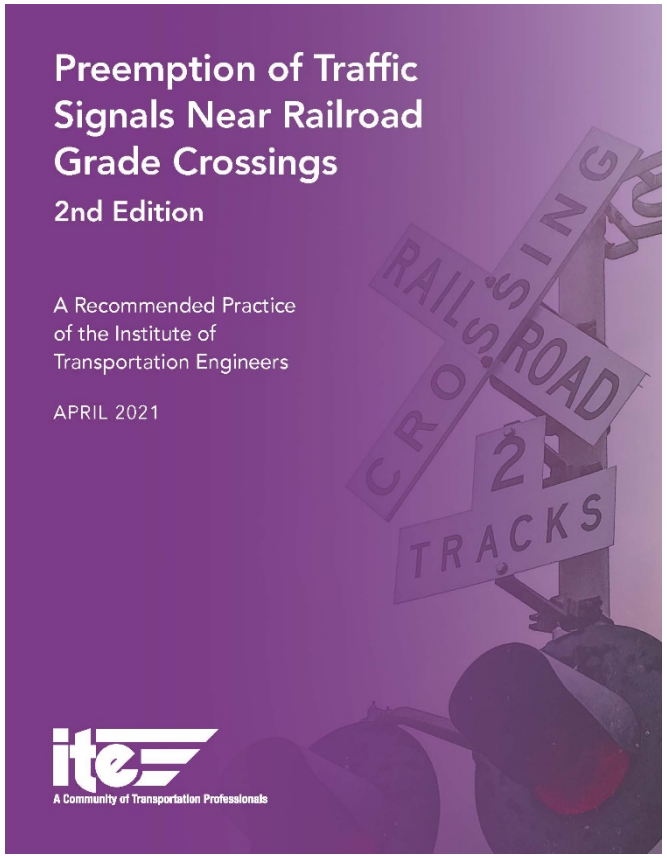




Source – Pete Yauch

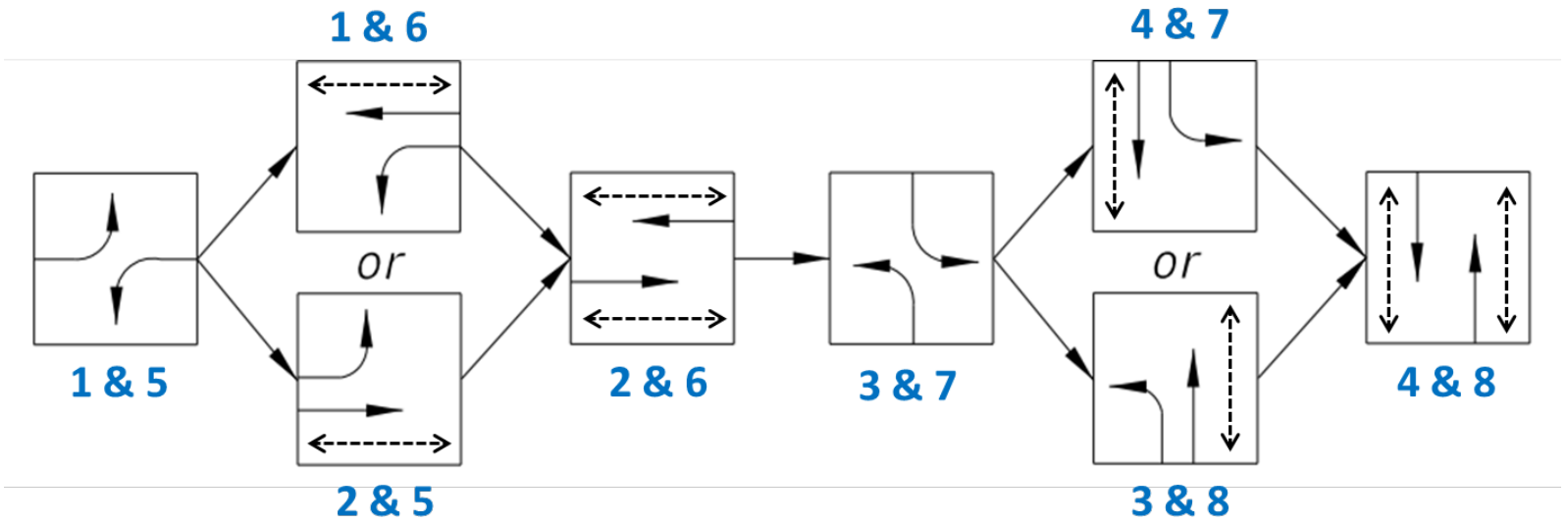
Rail Crossing Preemption – Takeaways

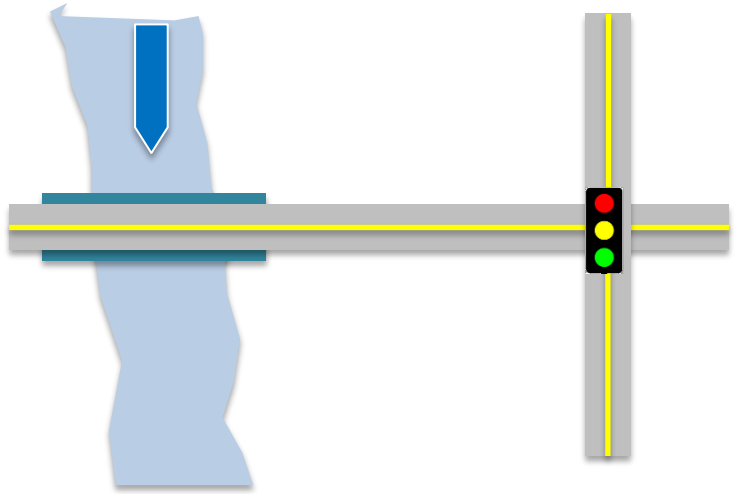
- Preemption design and timing are critical
- Designer needs to know
  - How interface with railroad works
  - Duration of Advance Warning Time
  - Key intersection dimensions
- Watch for Left Turn Trap scenarios
- Be familiar with ITE's 2021 Recommended Practice on rail preemption

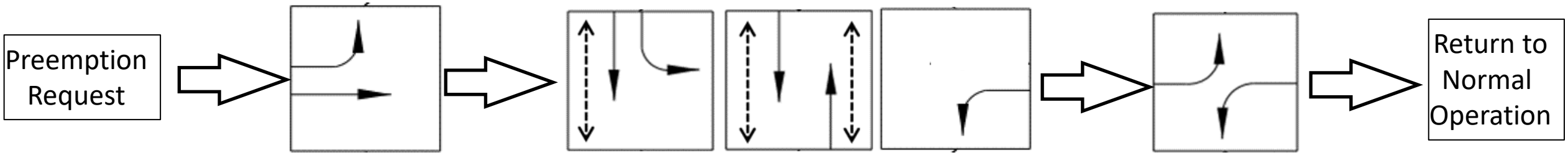


Source – ITE

Drawbridge Preemption







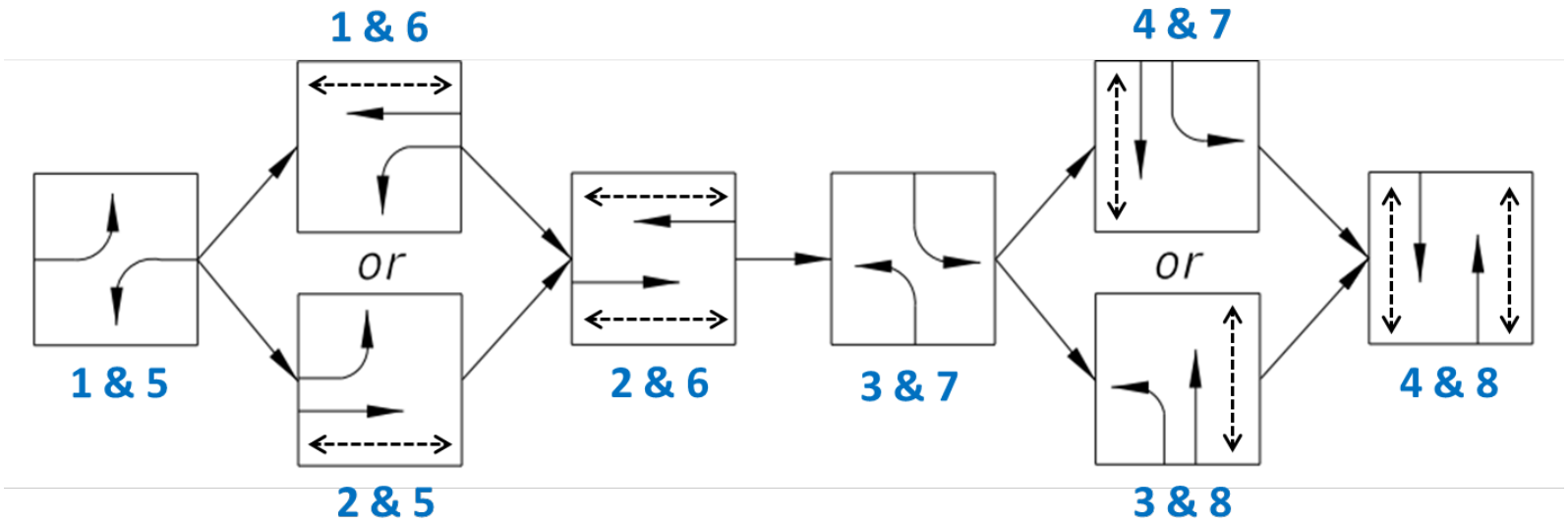
Bridge Clearance Phases

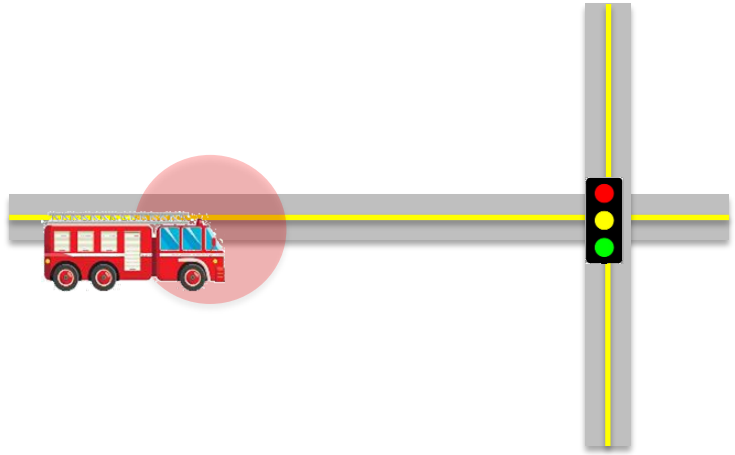
Dwell Phases

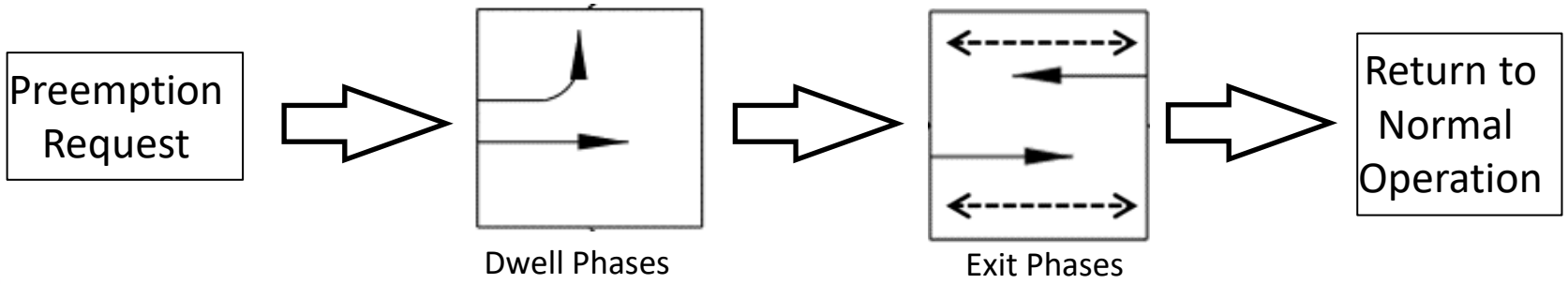
Exit Phases

Source – Pete Yauch

Emergency Vehicle Preemption







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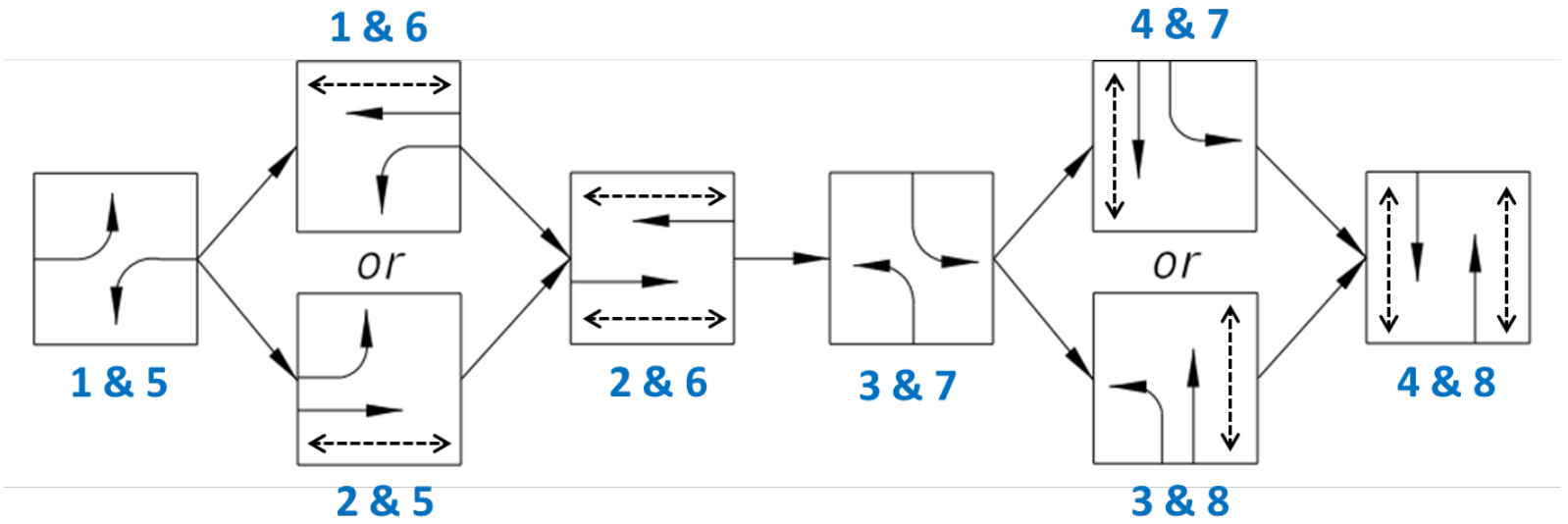
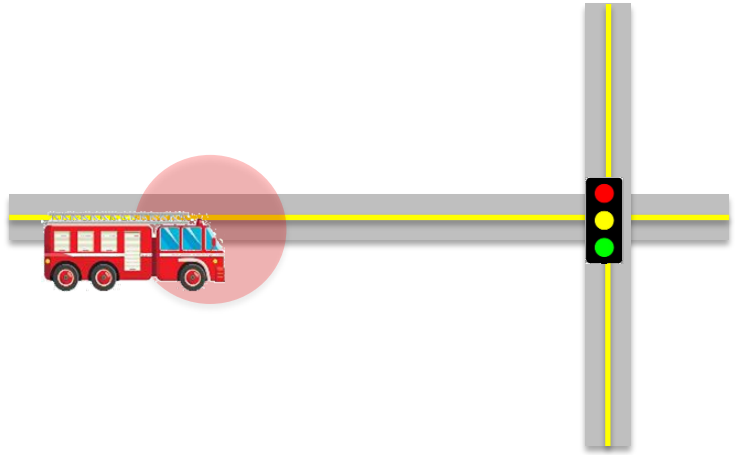
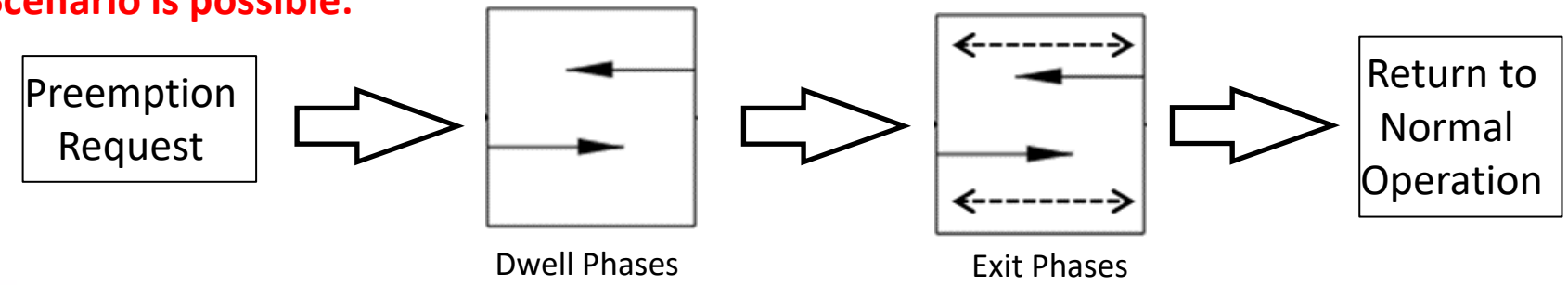
Emergency Vehicle Preemption



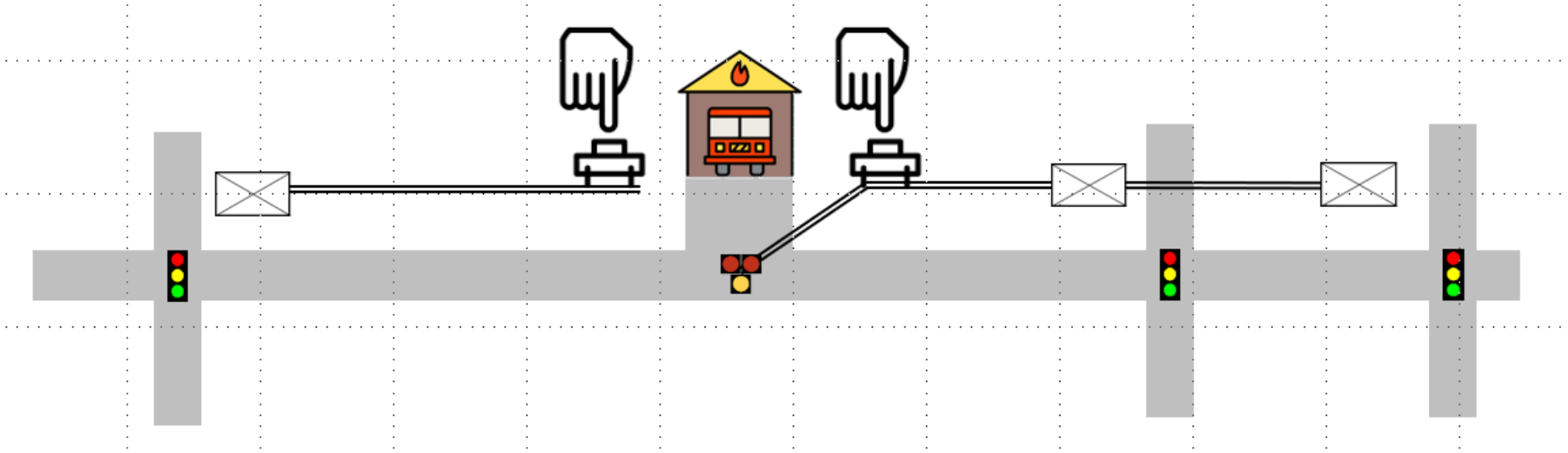


If Left Turn Trap Scenario is possible:



Source – Pete Yauch

Emergency Vehicle Preemption Activation

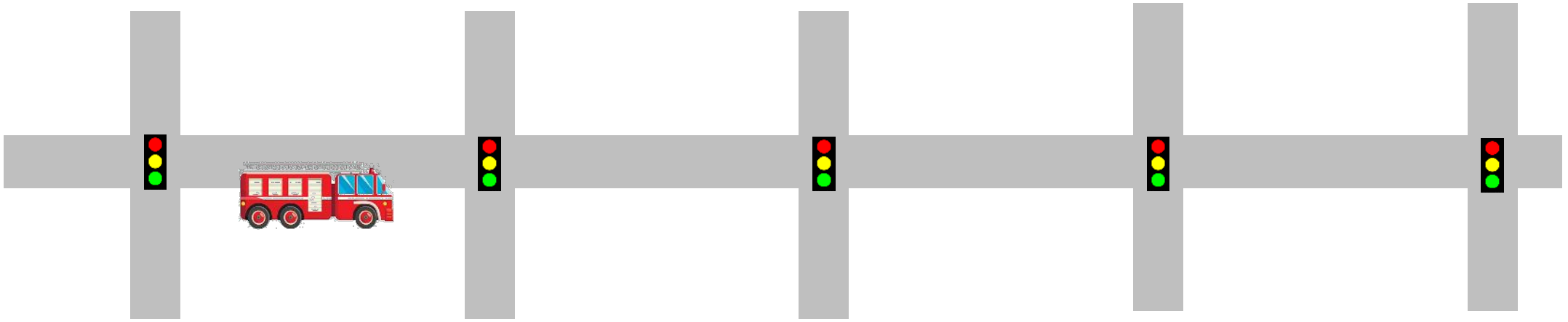


Source – Pete Yauch

Firehouse-based Activation

- Push button activation
- Hardwired or wireless connection to signal controllers
- Can have time delay programmed to create a “green wave”

Emergency Vehicle Preemption Activation



Source – Pete Yauch

Moving Vehicle Activation

- Optical / Infrared
- GPS / Radio
- Siren
- Connected Vehicle Applications

Emergency Vehicle Preemption - Takeaways

- Impacts on Traffic Flow
  - Transition after preemption
  - Frequency of preemptions
- Authorized Use Only
  - Emergency runs only
  - Unauthorized users
- “Outrunning” the Preemption
- Watch for Left Turn Trap Scenarios

Source – Pete Yauch

Priority – Transit and Freight

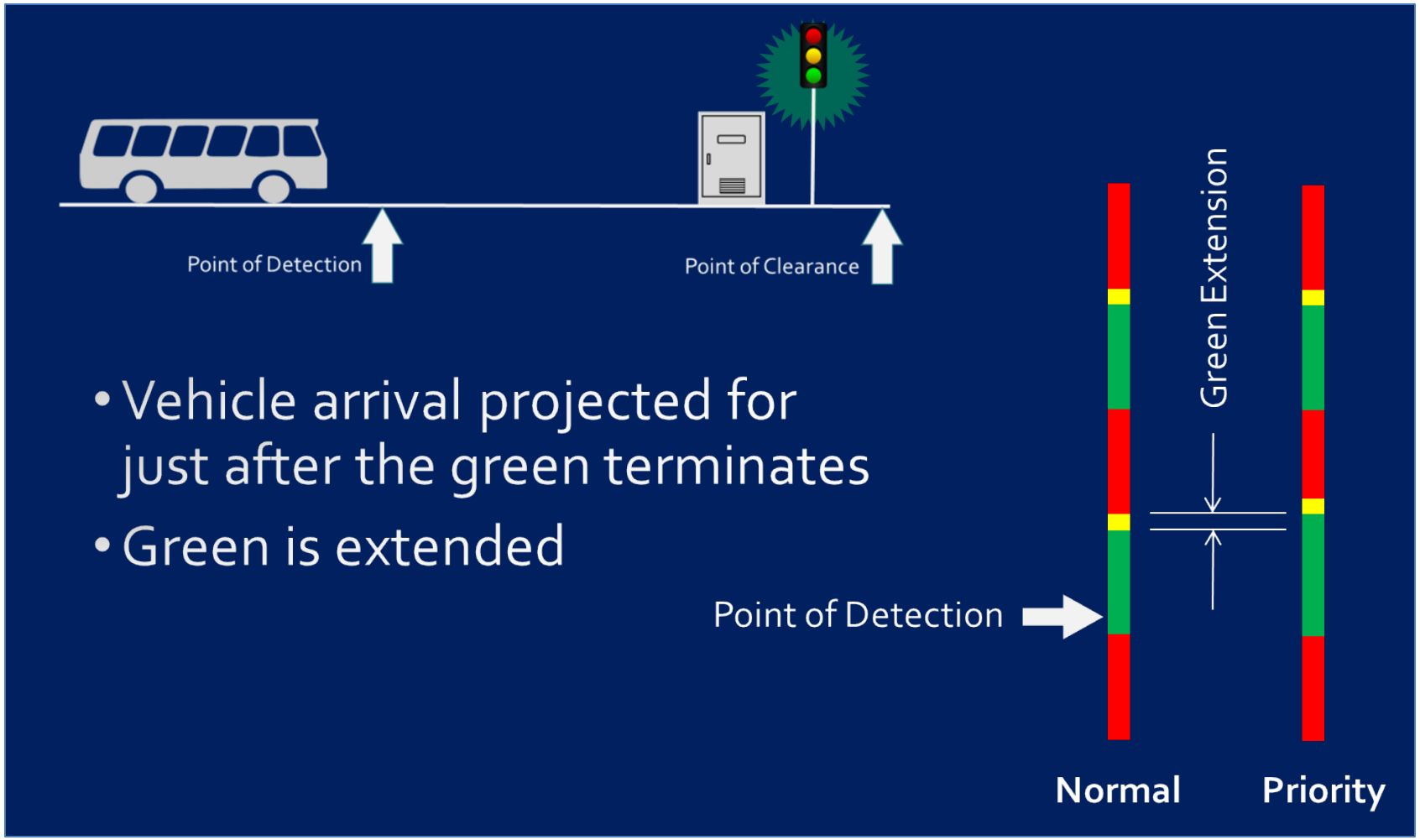
Operational strategy that facilitates the movement of in-service transit vehicles, or freight vehicles, through traffic signal-controlled intersections

Source – Pete Yauch

Green Extension Strategies – TSP

- Extends the green time for the movement when a transit vehicle is approaching
- Applies only when the signal is already green for the movement
- Requires the detection of the approaching transit vehicle
- *Generally,* will not affect coordination
- Can also be used for freight – primarily to reduce the need for heavy trucks to stop

Green Extension Strategies – TSP

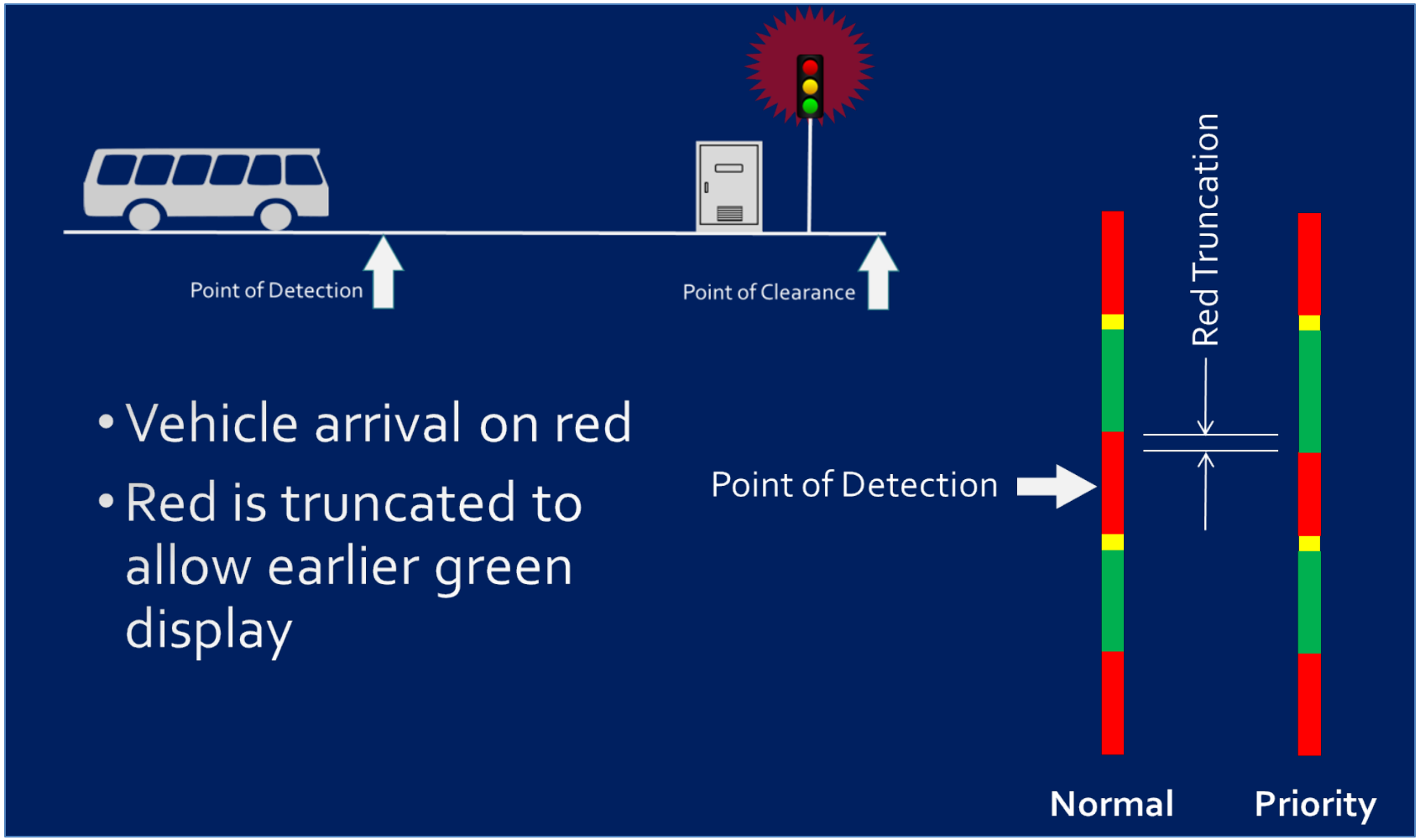


Source – Pete Yauch

Red Truncation Strategies – TSP

- Advances the onset of green for the movement when a transit vehicle is approaching
- Applies only when the signal is red for the movement
- Requires the detection of the approaching transit vehicle
- *Generally,* will not affect coordination

Red Truncation Strategies – TSP



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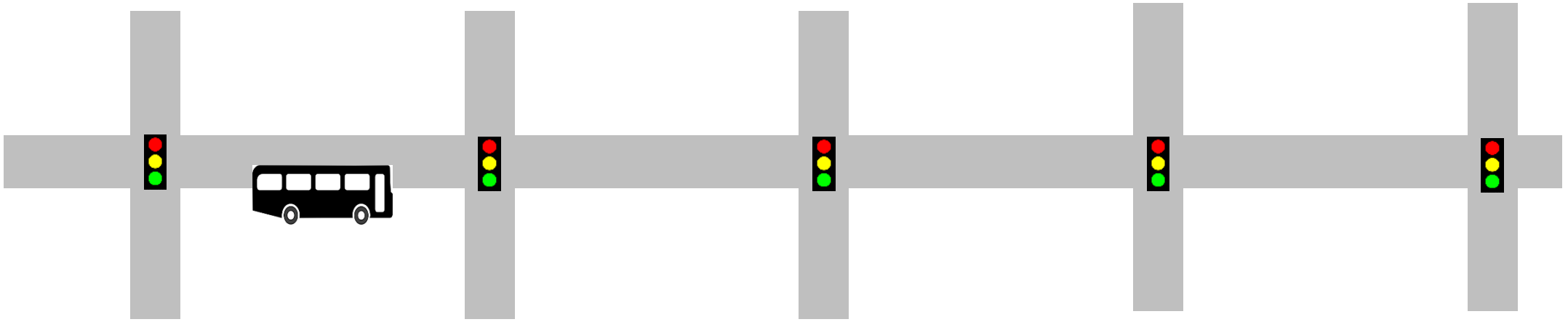
Priority Activation



Source – Pete Yauch

Moving Vehicle Activation

- Optical / Infrared
- GPS / Radio
- Connected Vehicle Applications
- RFID Tags

Resources

- Signal Timing Manual – Second Edition, NCHRP Report 812, 2015
  Chapter 10 – Preferential Treatment

- Highway-Rail Crossing Handbook, Third Edition, FHWA, 2019

- Preemption of Traffic Signals Near Railroad Grade Crossings Recommended Practice, Second Edition, ITE, 2021

Source – Pete Yauch

Contact:

Pete Yauch, P.E., PTOE, RSP_{2i}
TSM&O Program Manager
Iteris, Inc.
Tampa, Florida

pyauch@iteris.com