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Issues with Advance Train Preemption of Traffic Signals

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and

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Texas Transportation Institute

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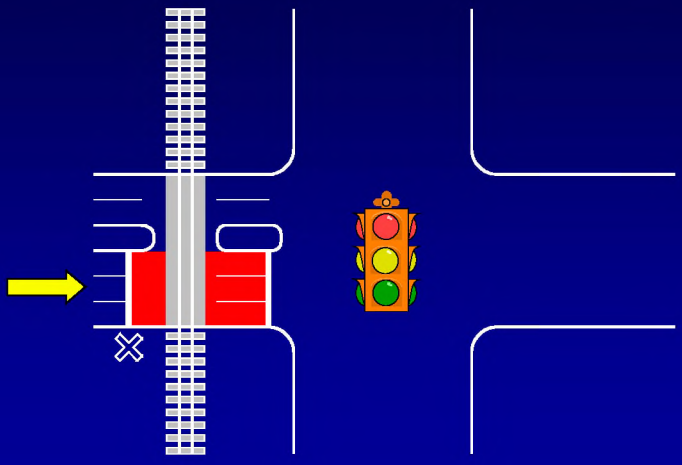
Location



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Rail Preemption

- Designed to **transfer right-of-way** to the track movement and **clear vehicles** off the track(s) before the train arrives
- Preemption sequence in traffic signal controller:
  - ➤Initiated by a signal from the rail equipment
  - ➤Transfer right-of-way to track movements
  - ➤Service and terminate track movements
  - ➤Must be done before **train arrives!**

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Current Design Methodology

1. Use maximum right-of-way transfer time
2. Assumes a heavy vehicle stopped on track
3. Calculates time to get that vehicle off track
4. Track clearance green time set to this value
5. Request advance preemption time, if needed
6. Assures vehicle is off track when train arrives

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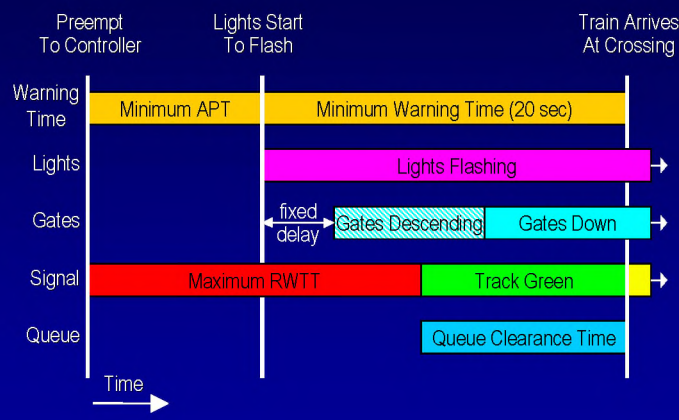
Design Case



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Question

- Is this good enough to guarantee safe **operations**?

No!

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Operations

- **Variability** impacts preemption operations
- Variability in **traffic signal operations**
  - ➤Due to unknown controller state at preemption initiation
  - ➤Affects right-of-way transfer time

- Variability **in rail operations**
  - ➤Due to "train handling"
  - ➤Affects warning times

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Data Collection

- Train monitoring opportunities at TTI
  - ➤Instrumented rail corridor in College Station, TX
  - ➤Good relationship with City of College Station
- Train data collection
  - ➤Logged signal changes
  - ➤Logged preemptions
  - ➤Logged lights & gates
  - ➤Logged train arrivals

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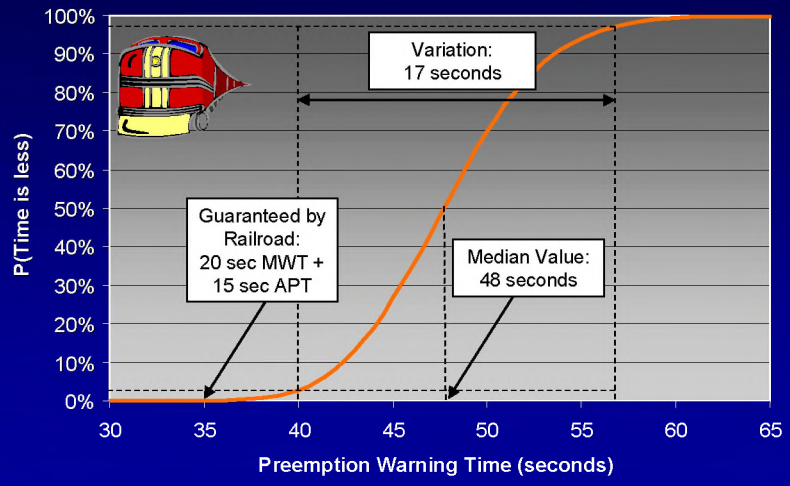
Preemption Warning Time Distribution



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Problem

- Exists with **advance preemption**
- Preemption initiation and warning device initiation are **independent** processes

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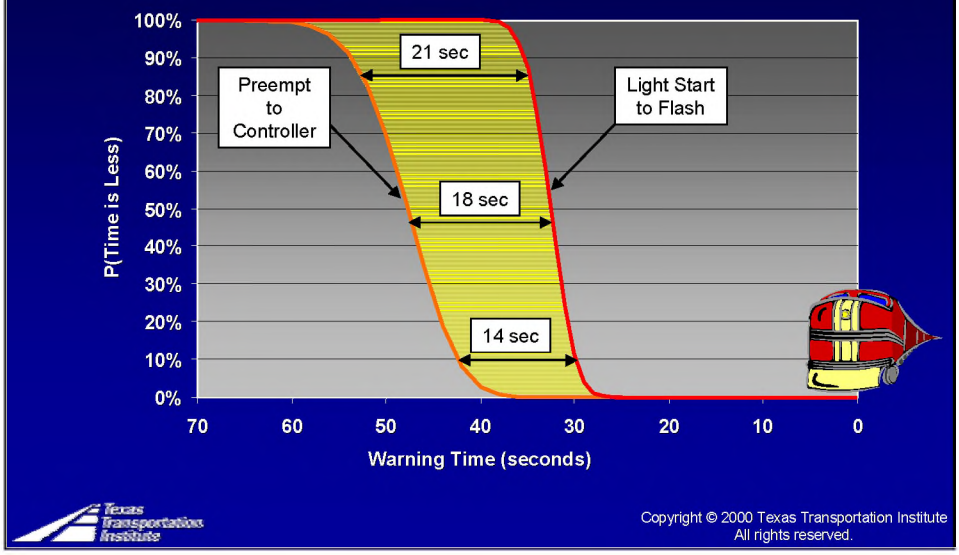
"Uncoupling" of Events



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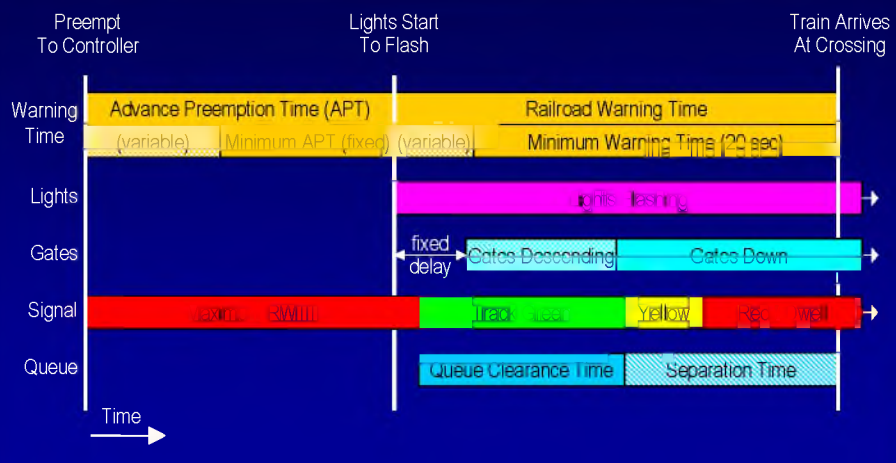
Operations (1)



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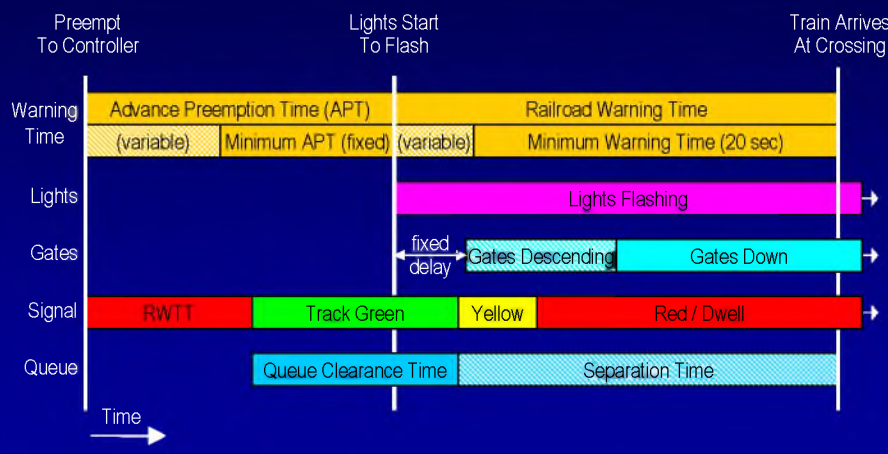
Operations (2)



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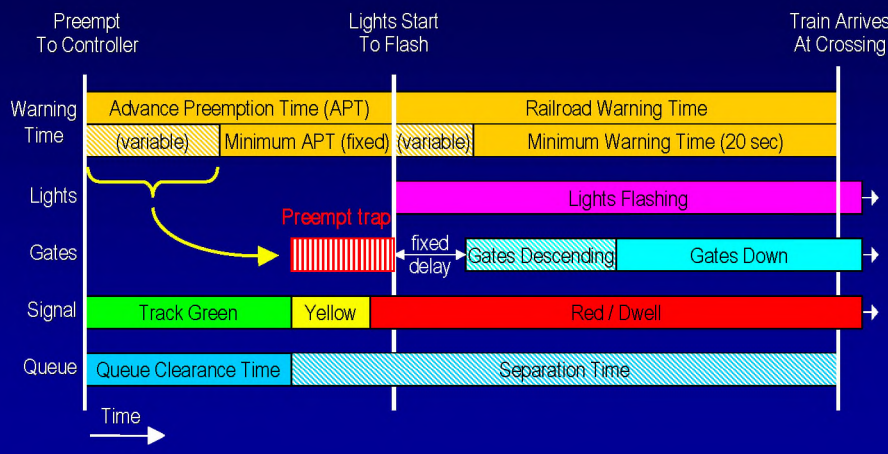
Operations (3)



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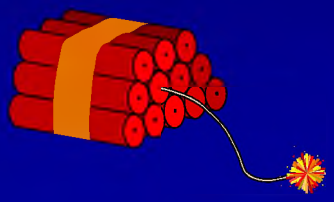
"Preempt Trap"

- Track clearance green may end before warning lights start to flash
- Vehicles have no indication of impending train arrival and **may cross tracks**
- **But the track clearance interval has already expired!**



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Solutions

Treat the symptoms

and / or

Treat the cause

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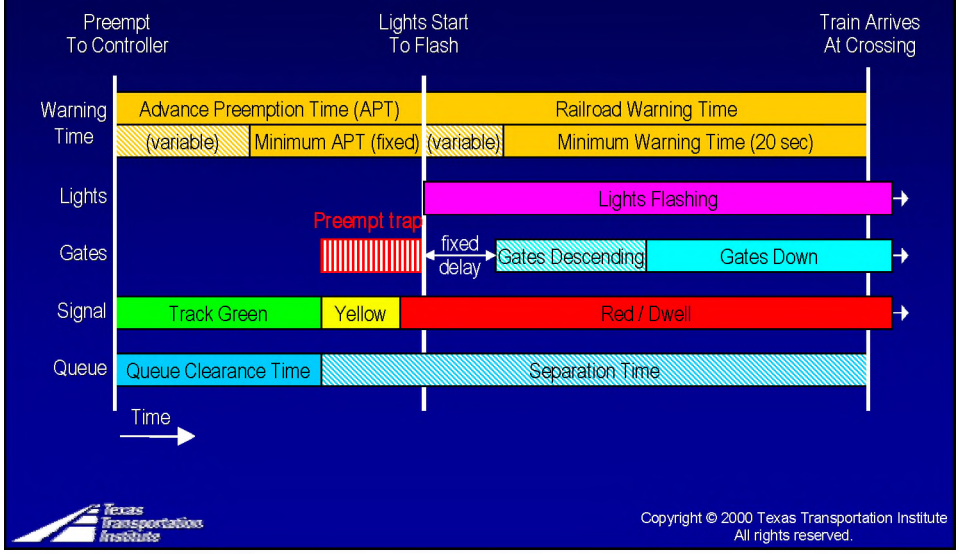
Treat the Symptoms



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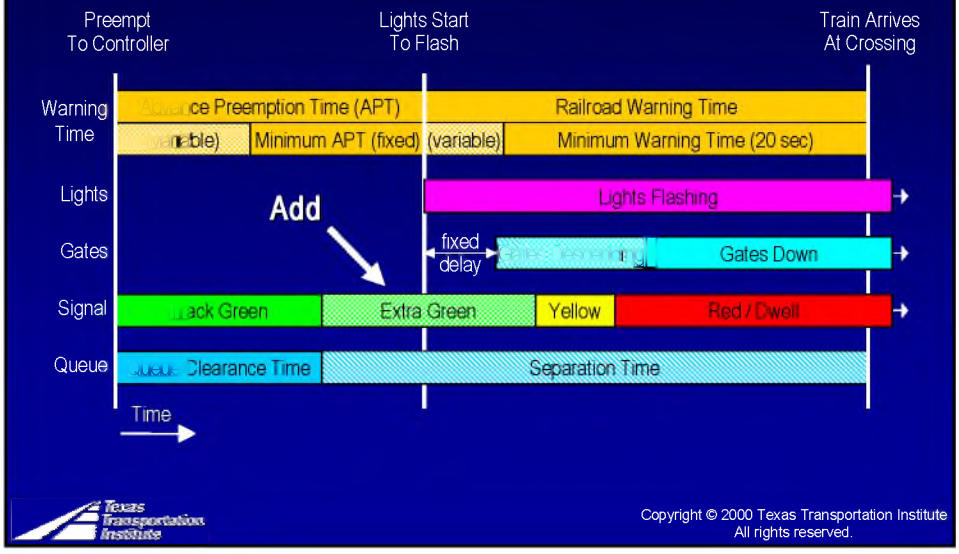
Treat the Symptoms



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Treat the Symptoms

- Provide **more than the minimum** required track clearance green
- Balance probability of preempt trap with operational efficiency
- For example:
  - ➤Set track green to APT + 15 seconds
  - ➤Design for measured APT times

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Treat the Cause (one method)

- Reduce variability in rail operations:
  - ➤Reduce variability in advance preemption time
  - ➤Use a “not-to-exceed” timer to **control maximum APT** as per 2000 AREMA Signal Manual

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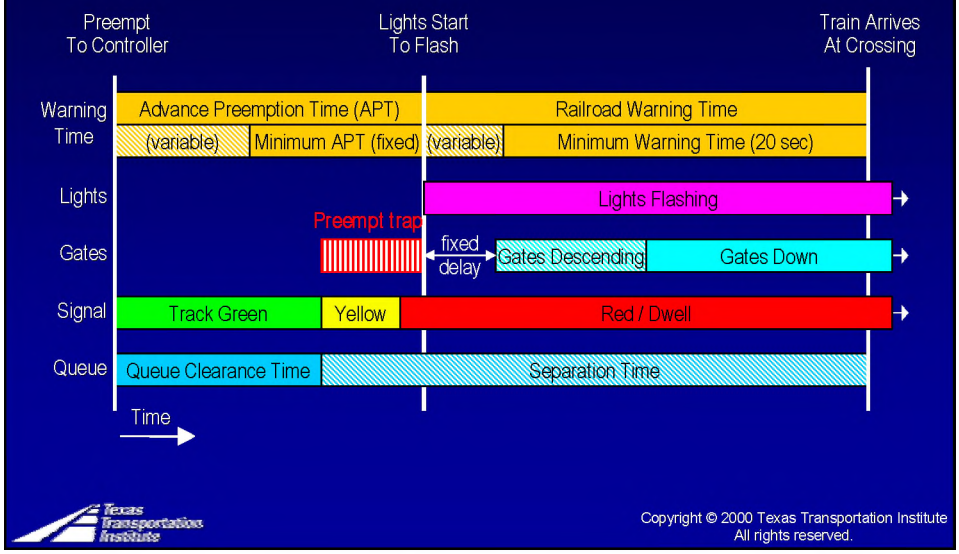
Treat the Cause (one method)



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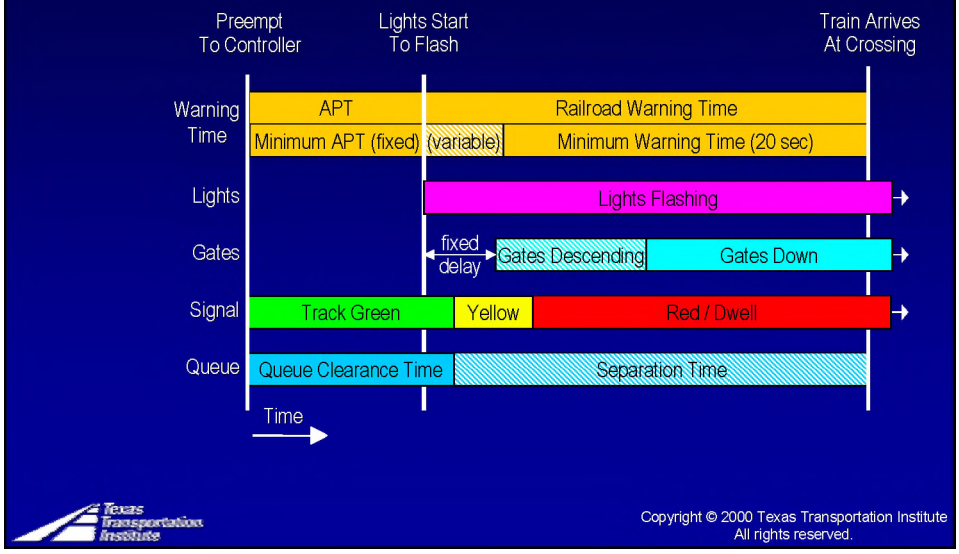
Treat the Cause (one method)



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Conclusion

- **Be aware** of the potential problems of advance preemption
- Take the necessary steps to avoid (or at least minimize the probability of) the **preempt trap**
- Consider **design and operational** scenarios

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For More Information

- http://transops.tamu.edu/content/gradecrossing.cfm
- More extensive presentation
- Manual on good practice
- E-Mail: roelof@tamu.edu

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Questions?

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