



Increasing Driver Awareness with Connected Work Zones

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What is a Smart Work Zone?

FHWA Definition

A "smart work zone system" is the application of computers, communications, and sensor technology to freeway transportation and would possess the following general characteristics:

- a. **Real-time:** The system obtains and analyzes traffic flow data in real-time, providing frequently updated information to motorists.
- b. **Portable:** The system is portable, hence allowing its installation (with minor modifications as necessary) at different locations.
- c. **Automated:** The system operates in an automated manner with as minimal supervision as possible by human operators.
- d. **Reliable:** The system provides accurate and reliable information, keeping in mind the serious consequences of misinforming motorists in work zone situations.

Temporary Signals as “Smart” Devices

- The term “Smart Work Zone” often refers to freeway applications
- Portable Traffic Signals possess all the characteristics of a Smart Work Zone Device
- PTS are Adaptive and Connected



PTS: Adaptive and Connected

Smart Features of Temporary Signals

- Wait Time displays
- Speed Control Systems
- Interconnection with VMS
- Adaptive timings based on traffic conditions (Green and Red interval extensions)
- Real-time signal status alerts
- Remote Video Monitoring
- Remote Programming





Section 1: Adaptive PTS

Adaptive PTS Systems

What are Adaptive PTS Systems?

- Systems that adapt or adjust operation automatically based on traffic conditions
 - These systems can directly influence signal timings
 - These systems can also provide adaptive messaging to motorists
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- Examples:
 - Wait Time Display Systems
 - Speed Control Systems
 - Clearance Extension Systems
 - Driveway Assistance Device





WAIT TIME & STATUS DISPLAY

Wait Time & Status Display

Provides Information to Drivers

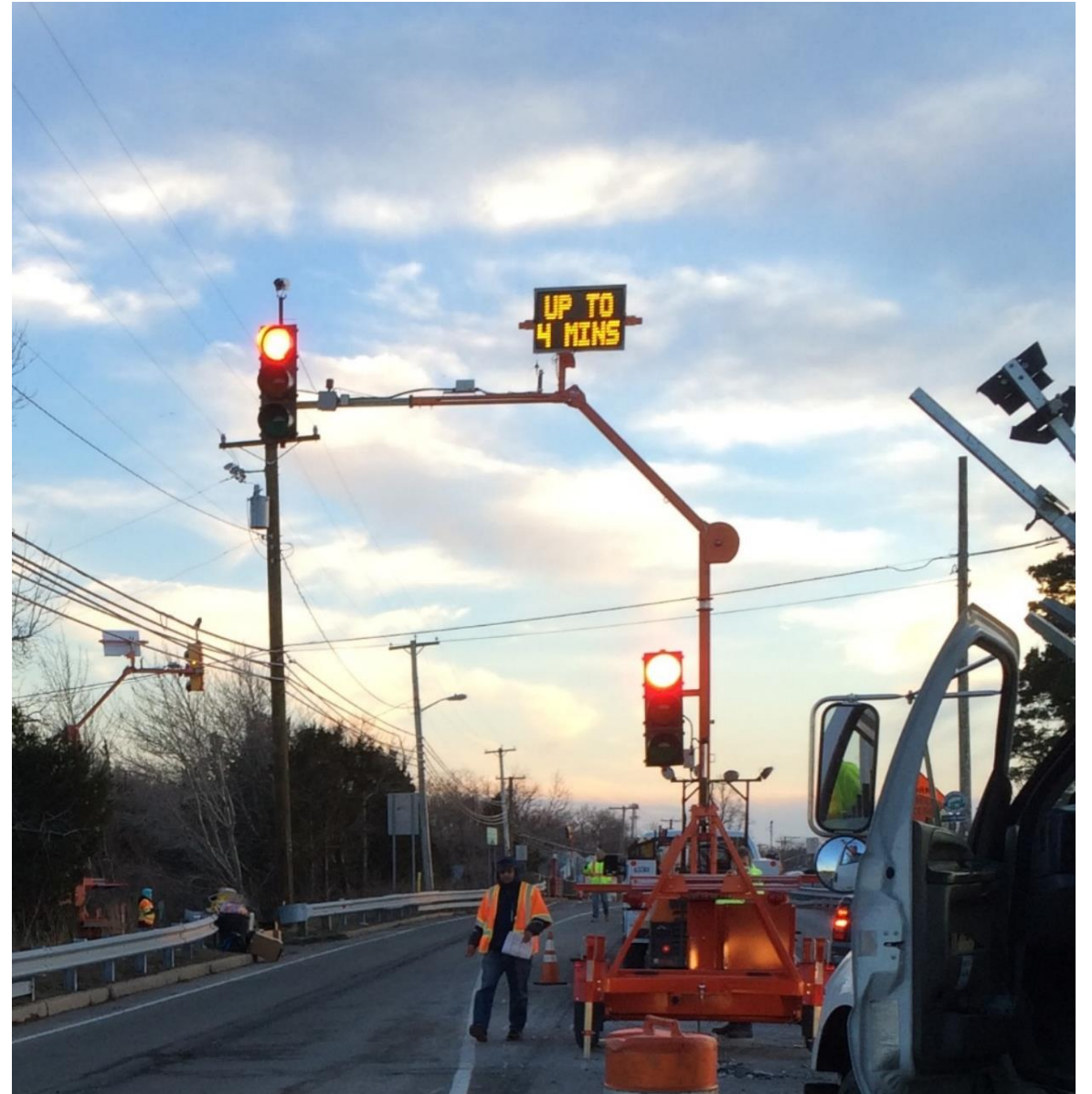
- Relays pertinent information to the motorist such as wait time until next green, and signal faults in real-time.
- Increases driver awareness in unfamiliar settings
- Improves safety during fault scenarios



Time Until Green

2 Methods

- Static display of maximum possible wait time
- Dynamic, real-time countdown





WAIT
1:09

STOP
HERE ON
RED
←



WAIT TIME
00:37



BLUE
DIA
CIR



Time Until Green

Optional Method

- Progress Bar style
- Bar slowly shrinks as red clearance interval elapses
- Eliminates countdown timer, while still providing motorist with pertinent information



Fault Scenarios

MUTCD:

Section 4H.02 Design of Traffic Control Signals for One-Lane, Two-Way Facilities

Standard:

- 01 The provisions of Chapter 4D shall apply to traffic control signals for one-lane, two-way facilities, except that:
 - A. Durations of red clearance intervals shall be adequate to clear the one-lane section of conflicting vehicles.
 - B. Adequate means, such as interconnection, shall be provided to prevent conflicting signal indications, such as green and green, at opposite ends of the section.

Section 4H.03 Operation of Traffic Control Signals for One-Lane, Two-Way Facilities

Standard:

- 01 Traffic control signals at one-lane, two-way facilities shall operate in a manner consistent with traffic requirements.
- 02 **When in the flashing mode, the signal indications shall flash red.**

Guidance:

- 03 *Adequate time should be provided to allow traffic to clear the narrow facility before opposing traffic is allowed to move. Engineering judgment should be used to determine the proper timing for the signal.*

Wait Time & Status Display

SPECIALTY SYSTEMS

- Improves fault scenarios
- Safer than opposing Flash Red indications
- One side: Solid Red, "Signal Fault / Road Closed"
- Other side: Flash Red, "Signal Fault / Proceed with Caution"





ROAD
CLOSED



WAIT



WORK VEHICLE ACCESS





Speed Control System

Speed Control Systems

- Wireless connectivity between PTS and Speed Radar Trailer
- Detects vehicles approaching work zone at unsafe speeds
- Automatically reverts signal to red, prompting vehicles to STOP before entering the zone while speeding





Speed Control Systems

- Programmable speed thresholds
- Ensures vehicles enter the work zone at safe speeds
- Responds to traffic demands in real time





Message Board Interface

RED
SIGNAL
AHEAD



VMS Interface

Operation and Benefits

- Wireless connection between PTS and VMS
- Real-time data exchange between both devices
- Message board displays signal status messages
- Ideal for long work zones, and high-speed or blind approaches





Red Clearance Extension



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The Problem

How to Manage Slow-Moving Vehicles in a Lane Closure?

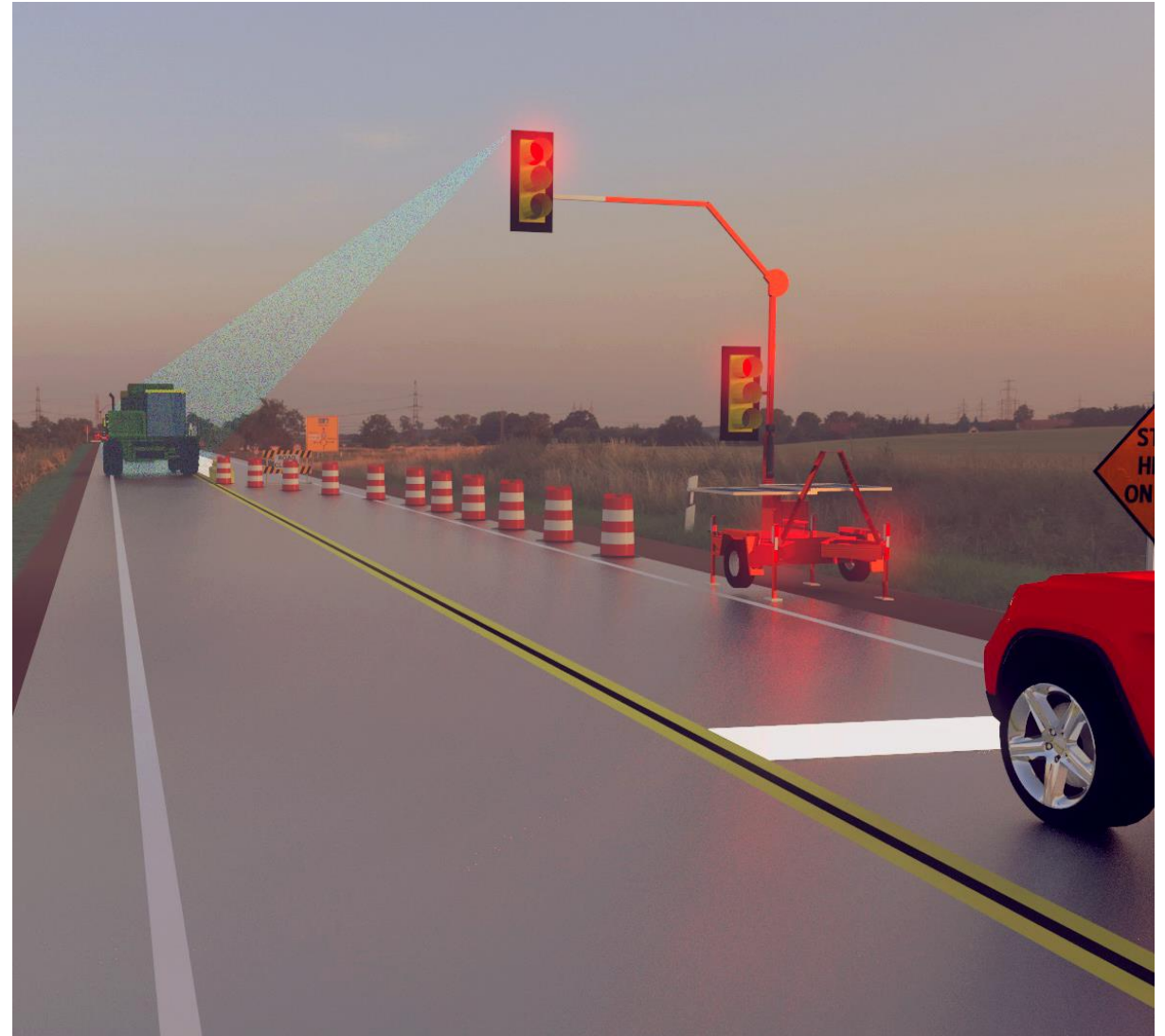
- Red clearance times are calculated based on speed vehicles are moving and distance traveled – these times are fixed
- Slow-moving, or stopping vehicles require more time to clear the work zone
- Vehicles moving too slowly may not exit the zone before an opposing green indication



Red Clearance Extension

How It Works

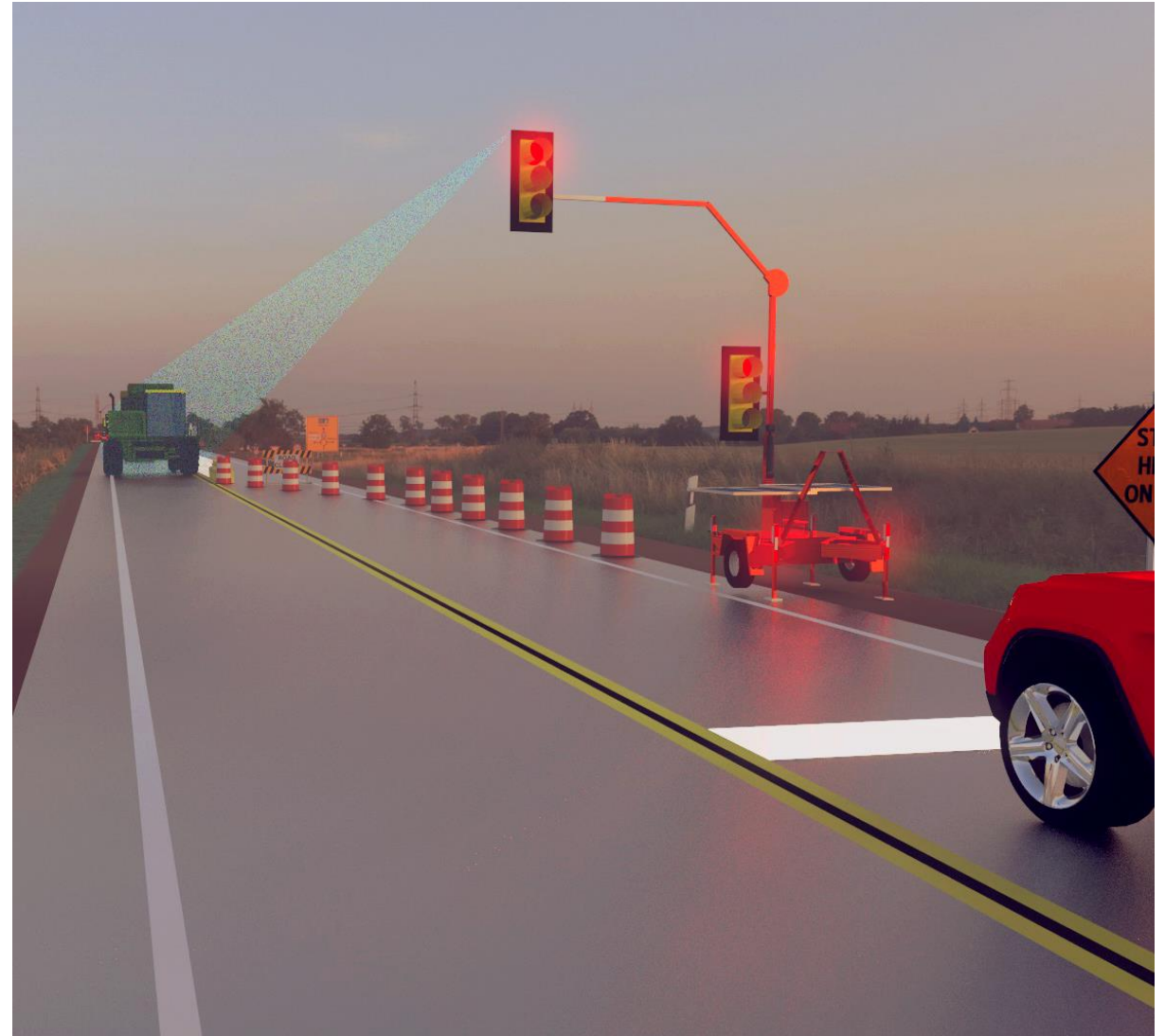
- Clearance Extension System detects vehicles that are still in the work zone when green time is expiring
- Vehicles detected when Red Time expires get additional time to clear
- Vehicle sensors can be installed at each signal, or remotely within the work zone via a mobile platform



Red Clearance Extension

Benefits

- Allows for more efficient programming – no overcompensating for slow vehicles with long red times
- Improved safety and peace of mind for workers





Section 2: Connected PTS

Connected PTS Systems

What are Connected PTS Systems?

- Systems that provide connectivity between PTS system and remote user/stakeholder
- Typically use internet connectivity to remotely monitor work zone data/signal operation

- Examples:
 - Remote Monitoring Systems
 - Live Video Monitoring
 - Remote PTS Programming

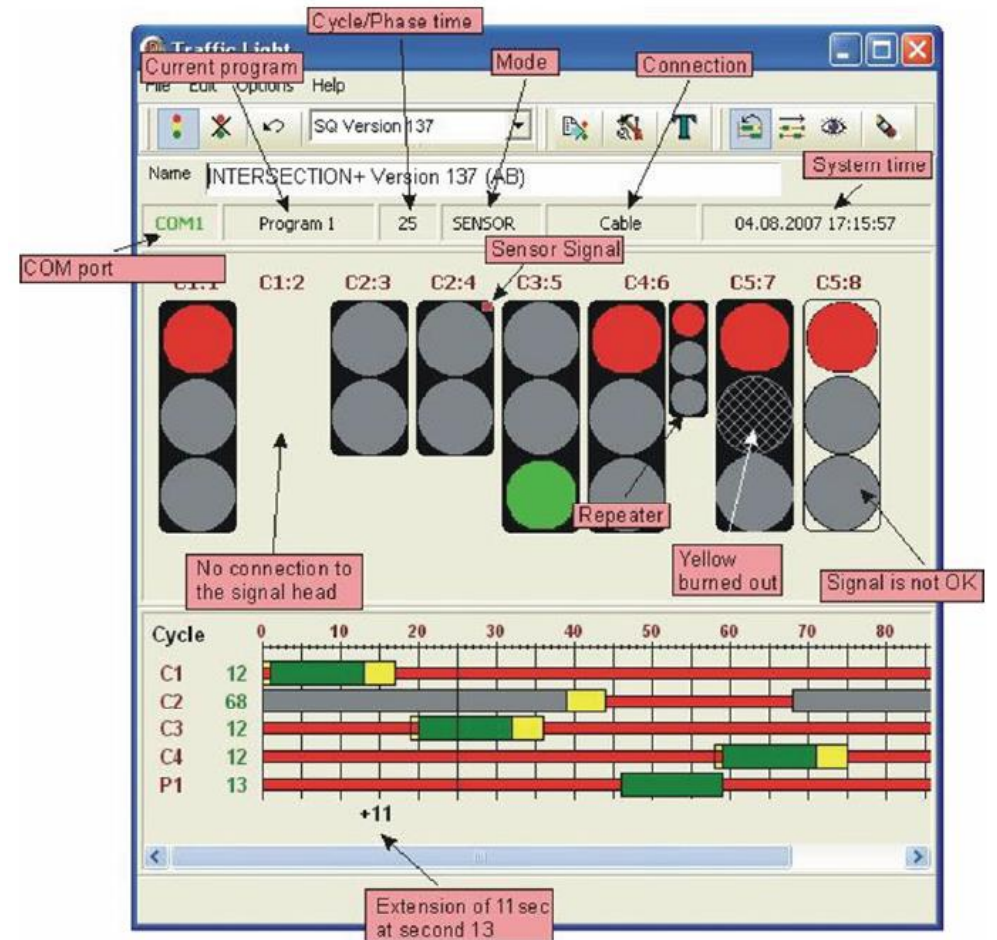


Remote Monitoring Systems

Remote Management Systems (RMS)

Stay Informed On The Go

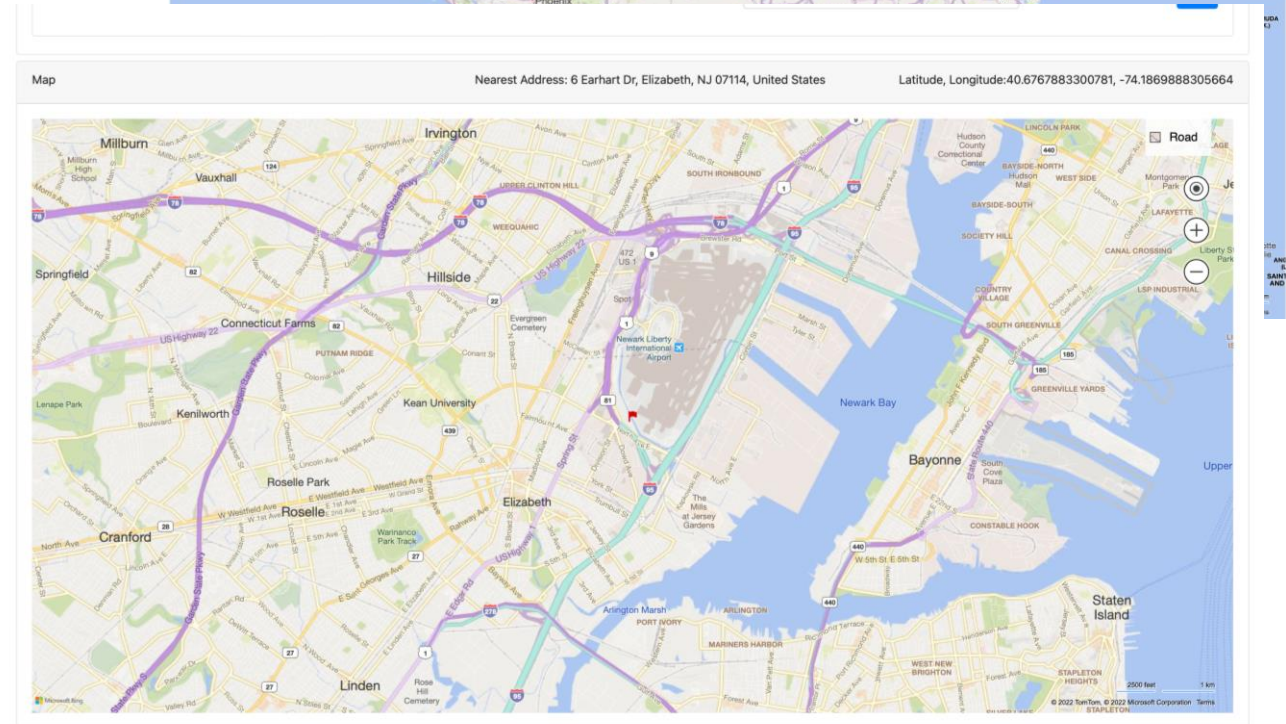
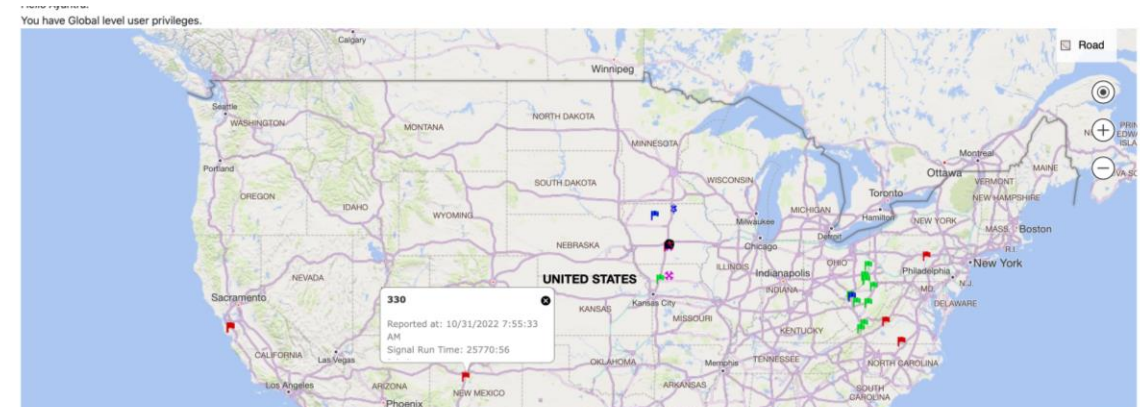
- RMS systems combine GPS and cellular technology to provide text/email alerts to end users and project stakeholders
- Daily battery health reports can be configured and delivered as SMS texts or emails
- System faults, voltage alarms, and geofence alerts available
- Satellite Systems are also available for areas without cellular access



Remote Management Systems (RMS)

Stay Informed On The Go

- Users can geolocate signal systems across multiple projects
- Quick views of all signal status
- Only 1 RMS device is required to monitor and entire signal network
- Some DOT's have requested alerts when a PTS system is turned on





Live Video Monitoring

Work Zone Video Monitoring

Real-Time Video Streams of Work Zone

- 360° PTZ cameras allow for live view of the work area or approaching traffic
- Full 1080 HD video up to 60 frames per second
- Remotely controllable via desktop web browser or mobile smartphone apps



Work Zone Video Monitoring

Data Storage

- Multiple simultaneous streams can be viewed at once
- Ability to locally record to DVR, or save video/photos remotely





Remote PTS Programming

Remote PTS Programming

Remote Programming

- There have been recent movements within the industry to remotely program signals
- Several factors to consider:
 - Local geography & signal locations
 - Nature of work
 - Traffic volumes
- Remotely configuring a signal is much different than remotely changing Message Boards

Remote PTS Programming

Access signal data from anywhere

- Allows for live monitoring of signal operation
- Ability to remotely adjust timings via the internet
- This functionality is typically behind multiple levels of encryption and password protection
- It is highly encouraged that an individual be on-site to approve the timing changes and observe traffic after the changes are implemented

Remote PTS Programming

Capabilities

- Remote start and stop of signal timing program
- Remote change of timings
- Remote error log/data log access
- Real-time views of active detection inputs





The Big Close

Application Requirements & Signal & Component Choice



Application Requirements & Signal & Component Choice



VIDEO MONITORING

Allows users to monitor work zone activities via live stream video, accessible from any internet-connected device. 360-degree rotation, as well as zoom and tilt controls are included.



LEFT TURN ARROW

MUTCD-Compliant turn arrows can be added to the SQ3TS for dedicated turning lanes. This addition allows for safe traffic flow through intersections during construction and peak traffic times.



ARM SYSTEM

Digitally manage and monitor your PTS fleet with access to signal timing data and event logs, and also configure email and SMS text message alerts to be delivered based on



WAIT TIME DISPLAY

Provides drivers with a visual display of the amount of time remaining before the next green indication. The system is ideal for long work zones with high Red Clearance intervals and potentially



QUESTIONS

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