

FRA RD&T Transportation Research Board Review



Train Control & Communication Research

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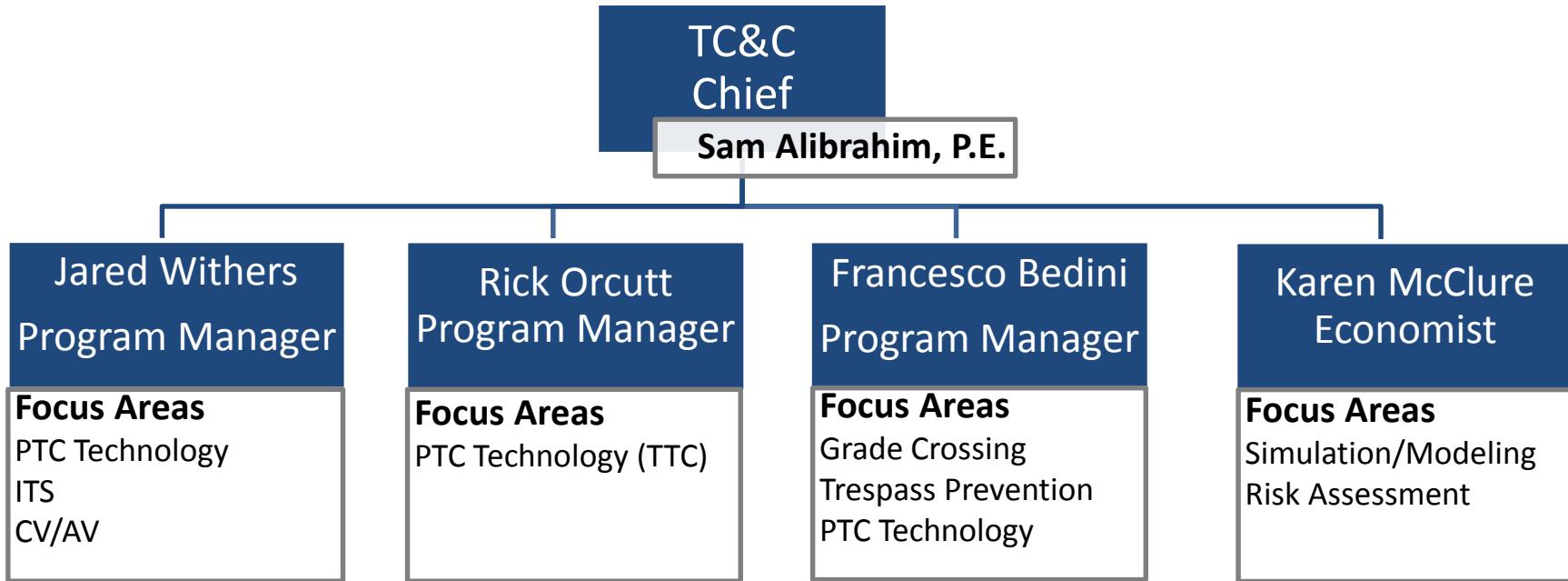
May 14, 2019



U.S. Department of Transportation
Federal Railroad Administration

TC&C Research

Train Control & Communication (TC&C) Staff



Research Areas and Sample Projects

Train Control



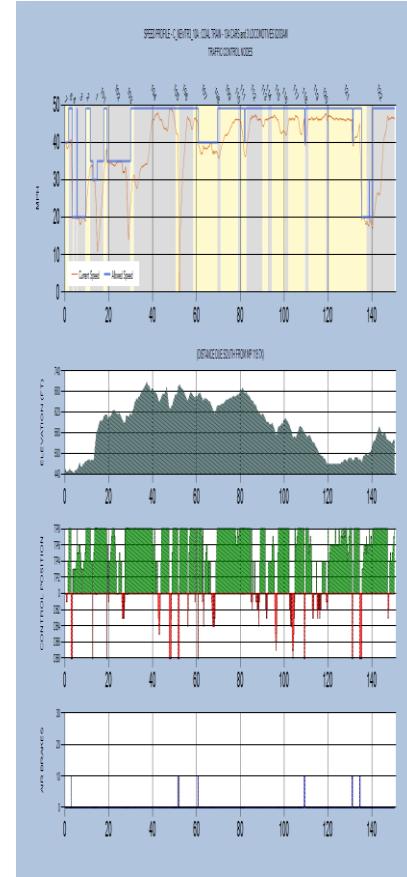
Intelligent Transportation Systems (ITS) (CV/AV)



Grade Crossing Safety & Trespass Prevention



Modelling & Simulations



Research Areas and Sample Projects

Train Control

- **PTC**

- PTC Test Bed, I-ETMS, ACESS
- Freight/Passenger Advanced Enforcement Algorithm (AEA)
- Positive Train Location (PTL)
- Employee-In-Charge Portable Terminal (EIC-PRT)
- Monitoring Analysis of Integrated Networks (MAIN)
- Enhanced Overlay PTC (EO-PTC)
- Track Circuit Research

- **Next Generation PTC**

- Quasi-Moving Block (QMB)
- Full Moving Block (MB)
- Onboard Broken Rail Detection
- Centralized Interlocking Feasibility and Design

- **Automated Train Operation (ATO)**

- Flexible Operator Location Feasibility Analysis – Phase 1
- Automation Sensor Package - Phase 1

- **Communication**

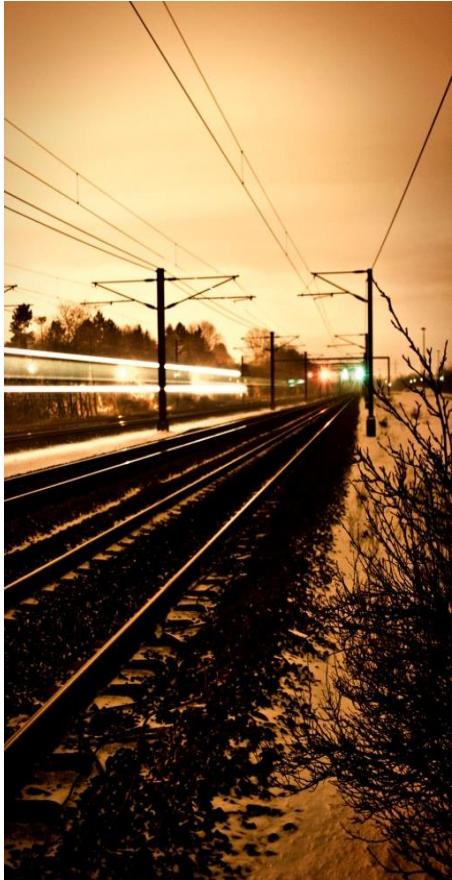
- Communication Test Bed Upgrade at TTCI
- Wireless Communication Roadmap
- Wideband Software-defined Radio Phase 1

- **Train Control Cyber Security**

- Methods for Low Bandwidth Security
- Improved PTC Authentication



Research Areas and Sample Projects



Intelligent Transportation Systems (ITS)

• ITS Research

- Grade crossing taxonomy research
- Higher Performance Digital Radio
- DSRC Performance evaluation for railroad Applications
- Automated vehicles requirement for grade crossing
- Rail Crossing Vehicle Warning (RCVW)



Research Areas and Sample Projects



Grade Crossing Safety & Trespass Prevention

• Crossing Technology Research

- Hump Crossing Scanning and database update
- Automated Lidar grade crossing data extraction
- Low Cost vehicle and pedestrian detection at grade crossing

• Trespass Prevention

- Trespass detection using drones
- Using Artificial Intelligence (AI) for trespass prevention

• Human Factors Studies

- Driver Behavior Analysis



Research Areas and Sample Projects



Modelling & Simulations

- **Simulation**
 - Generalized Train Movement Model
- **Modeling**
 - GrageDec.Net garde crossing on line tool



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- Reports

Environmental Reviews (1450)

Historical Documents (25)

Human Capital Management (3)

Other Reports (678)

Quarterly Performance Reports (32)

Reports to Congress (69)

Research Results (216)

Technical Reports (1579)

Rules & Regulations

05 MAR 2019

TECHNICAL REPORTS

Data Analysis for Maintenance-of-Way Worker Fatigue

AUTHOR: Federal Railroad Administration
OFFICE: RRD
SUBOFFICE: RPD-34
REPORT NUMBER: DOT/FRA/ORD-19/02
SUBJECT: Fatigue Management

KEYWORDS: Fatigue, work schedule, maintenance-of-way, sleep pattern, alertness, shiftwork, hours of service, biomathematical fatigue model

ABSTRACT: This report examines the relationship between accidents and incidents amongst U.S. maintenance-of-way (MOW) employees and their corresponding work schedules to determine if fatigue-related factors potentially contributed to the events. Ten U.S. railroads participated in the study by providing MOW data. Study methodology consisted of using a biomathematical fatigue model to review work schedules to determine if they exceeded fatigue risk thresholds. The report also includes a fatigue risk threshold calculator to inform management of fatigue risk associated with work schedules to facilitate modeling of fatigue prior to the accident or incident. Exceeding the fatigue risk threshold on any of the 12 factors indicates elevated risk due to fatigue accumulation and subsequent impairment of performance. Results indicate that portions of the work schedules exceeded fatigue risk threshold levels for almost all 12 factors measured and in some cases, there were multiple factors that contributed to exceeding the fatigue risk threshold. This understanding can inform efforts to optimize MOW worker schedules to reduce fatigue and related human performance errors. The results may also support changes to safety standards regarding regulations for MOW work/rest periods to be consistent with other railroad employee work/rest regulations.

01 MAR 2019

RESEARCH RESULTS

Development of Railroad Trespass and Grade Crossing Training Aids Research

Then, click on Research Results or Technical Reports

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Positive Train Control Progress Report

TRESPASSER & GRADE CROSSING FATALITY PREVENTION SUMMIT
Tuesday, October 30, 2018

Click on Reports



Sample of TC&C Research Partners



U.S. Department
of Transportation

**Federal Railroad
Administration**



American Short Line and
Regional Railroad Association



U.S. Department of Transportation
Federal Highway Administration



U.S. Department of Transportation
Federal Motor Carrier Safety Administration



METROLINK.



**OPERATION
LIFESAVER**
Rail Safety Education



Transport
Canada



BNSF
RAILWAY



NIPPON STEEL &
SUMITOMO METAL



NORTHERN NEW ENGLAND
PASSENGER RAIL AUTHORITY



Short Line Safety Institute



KLD LABS
MEASUREMENT TECHNOLOGIES

MTA Long Island Rail Road

T Massachusetts Bay
Transportation Authority

MTA Metro-North Railroad



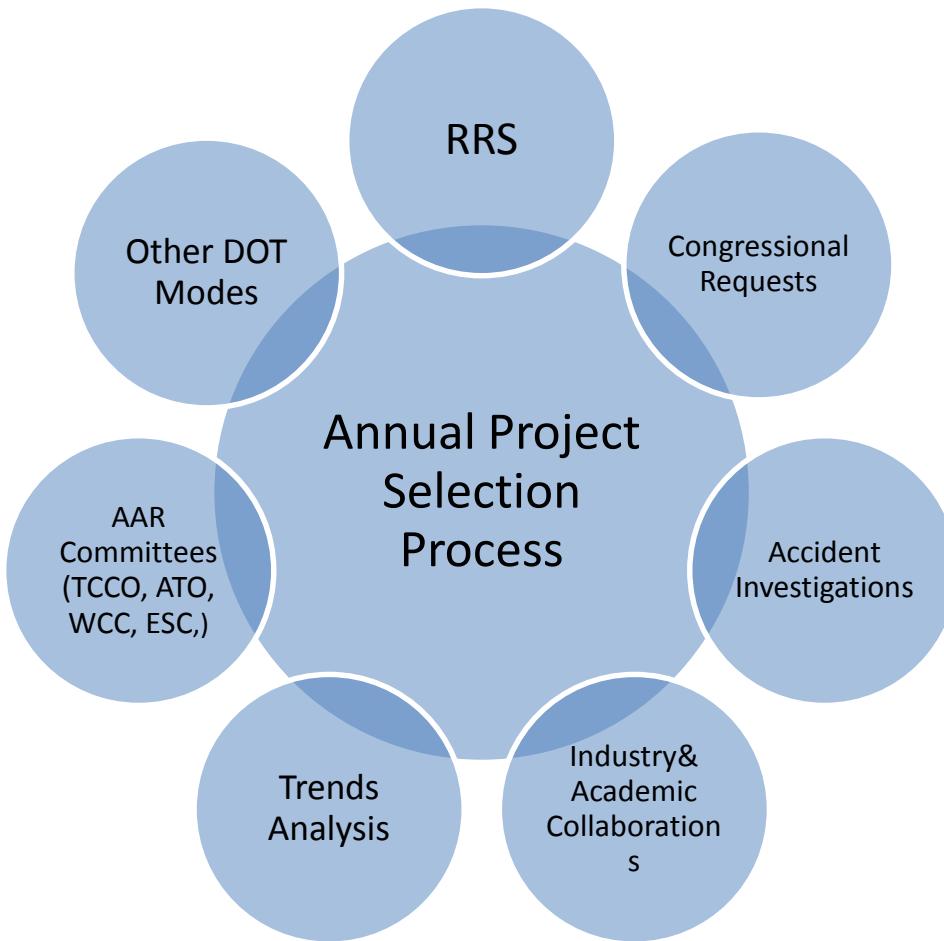
U.S. Department of Transportation
Pipeline and Hazardous Materials
Safety Administration



U.S. Department of Transportation

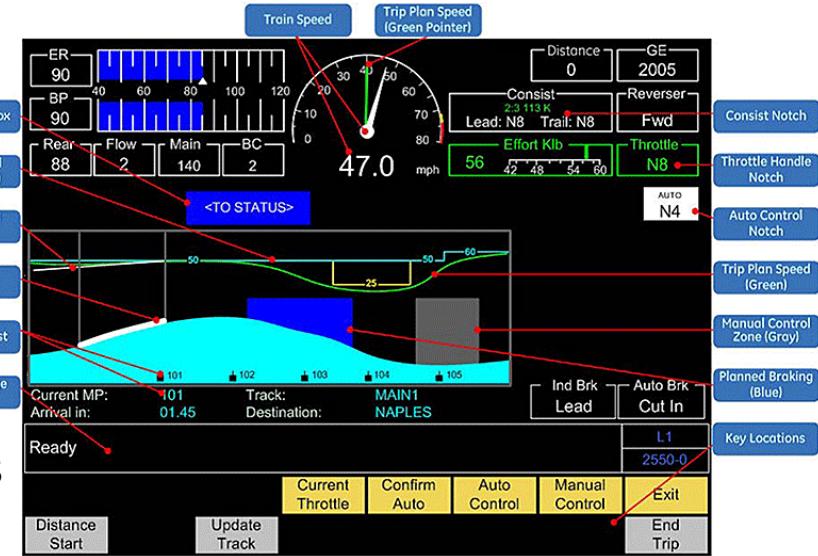
Federal Railroad Administration

TC&C Project Selection and Prioritization



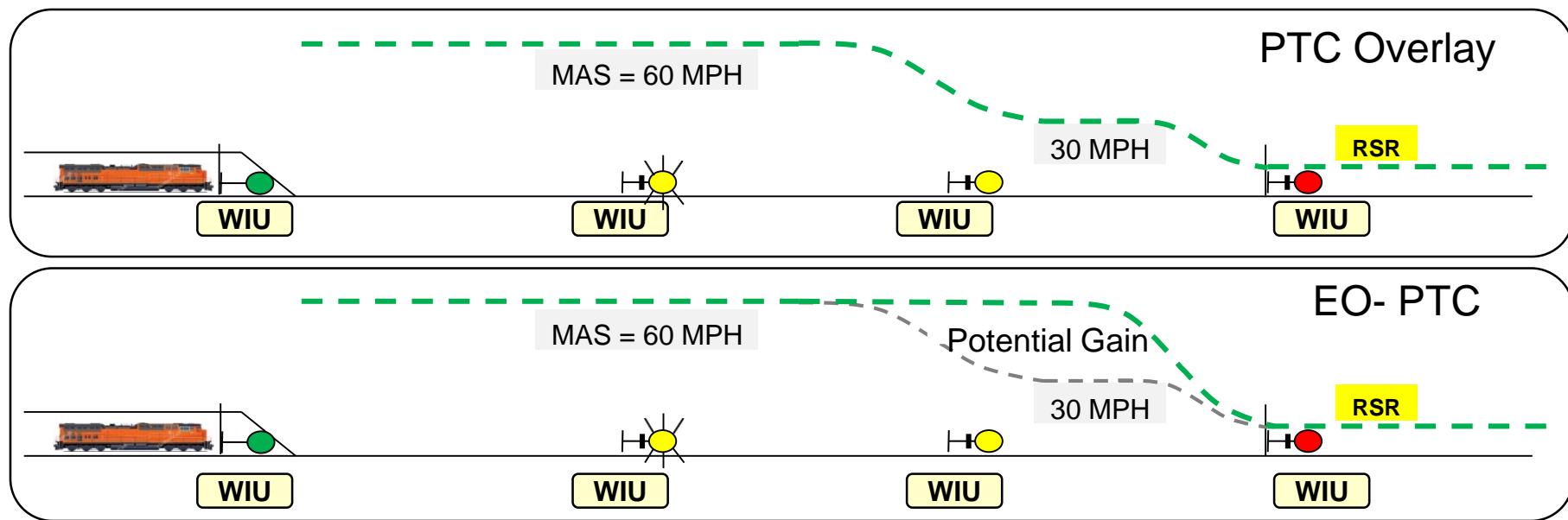
Higher Reliability and Capacity Train Control (HRCTC)

- Current overlay PTC can impact RR operations by stopping or slowing trains prematurely or unnecessarily due to:
 - Message communication failures
 - GPS issues
 - Incorrect data in the system
 - Conservative braking enforcement algorithms
 - Operator error during initialization or operation
- HRCTC Program Concept:
 - Identify significant PTC impact scenarios and bottlenecks
 - Develop potential solutions and migration plans



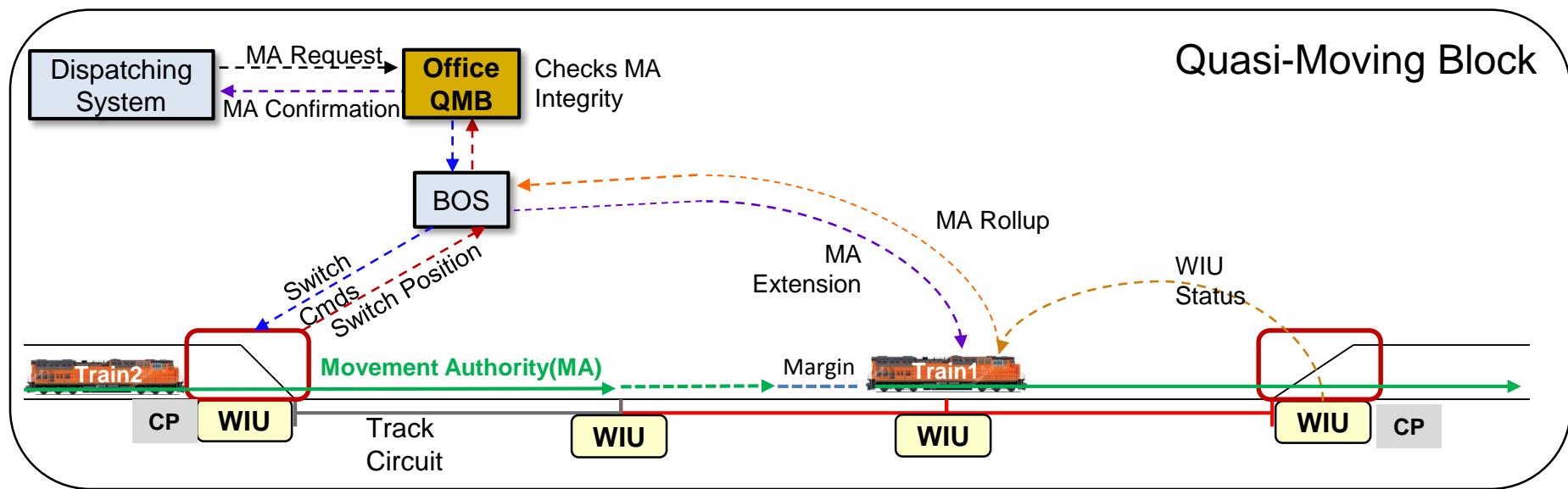
Enhanced Overlay PTC (EO-PTC)

- Relax speed restrictions for approach and advance approach signal aspects
- Benefits:
 - Provides recovery of some capacity lost to PTC
 - Minimal changes to current overlay PTC
- Recently implemented through firmware update and operating rules change



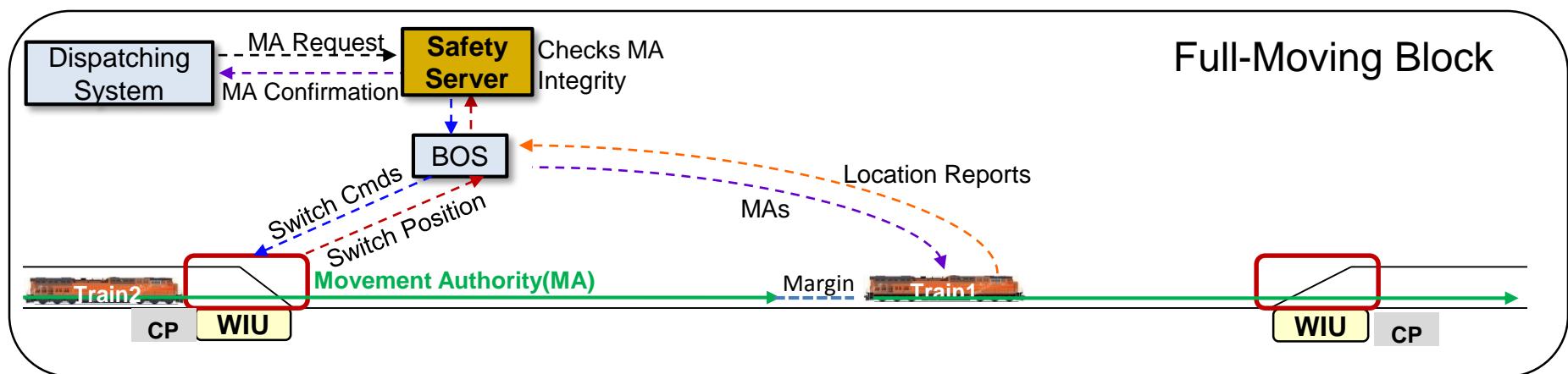
Quasi-Moving Block (QMB)

- Onboard sets targets based on Movement Authorities (MA) and field indications
 - Office is responsible for extending train MAs, trains are responsible for rolling up their own MA and notifying Office
- Utilizes Centralized Interlocking
- Elimination of wayside signals
- MA is given to the end of the block



Full Moving Block (FMB)

- Back Office send MAs up to leading train, with some margin
- Elimination of conventional track circuits (requires alternative broken rail protection)
- Benefits:
 - Increased capacity
 - Quicker recovery from disruptions
 - Enhanced reliability, reduced maintenance
 - Rear-end collision protection in close following moves



Automated Train Operation (ATO)

- Integration of existing and new technologies for enhanced automation of operations
 - Not a single technology – an operational concept enabled by multiple supporting technologies
 - Requires human oversight / support at some level – various levels of automation may be considered ATO

ATO

PTC

- Safety
- Conveyance of MDs
- Train Location Tracking

EMS

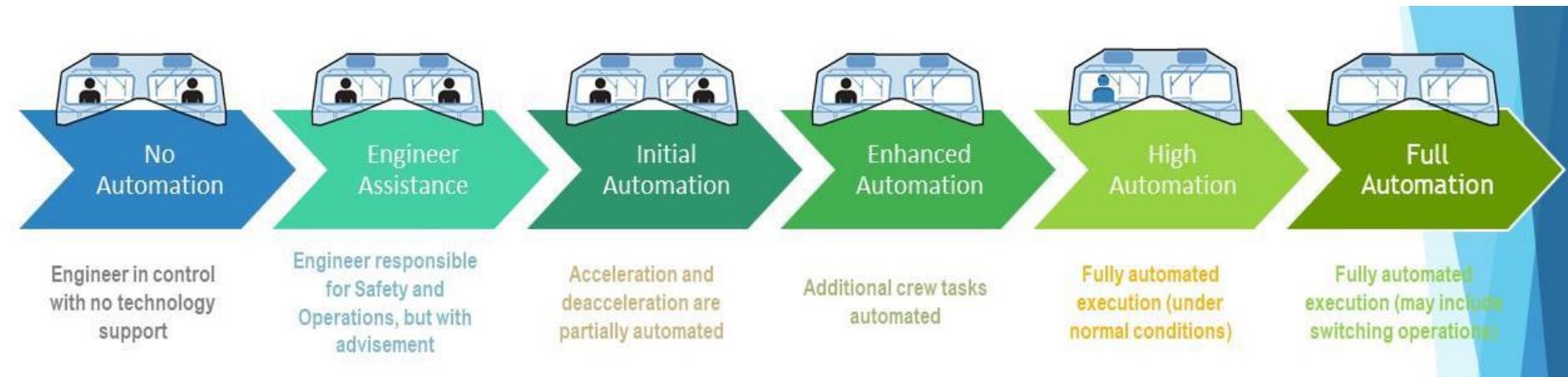
- Train Level Optimization
- Train Start/Stop
- Speed Management

Add'l Supporting Systems

- Hazard Detection
- Hazard Identification



Automated Train Operation (ATO)

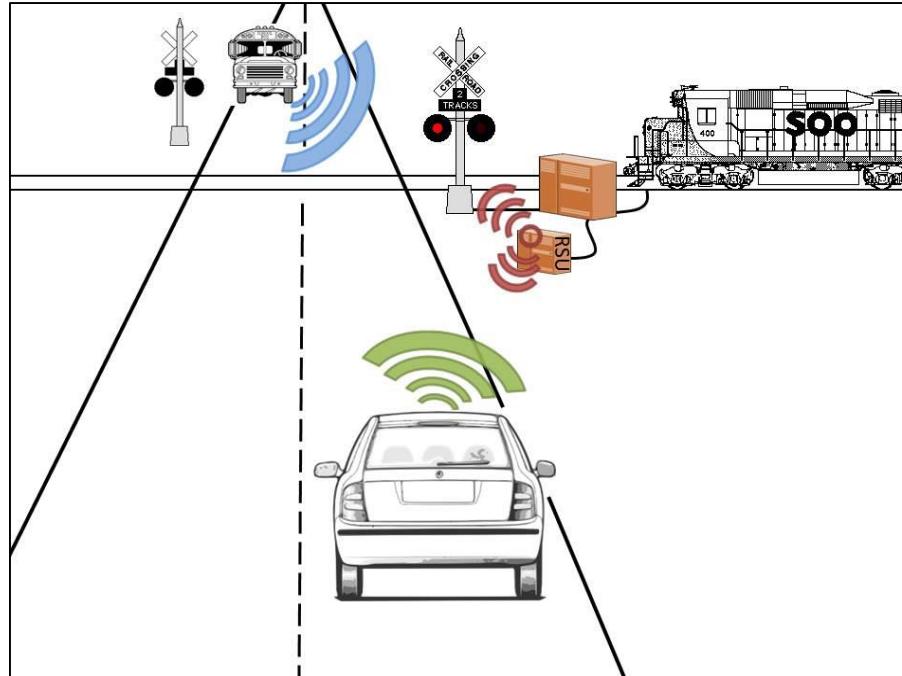


- Focus is on analysis and definition of concepts and specifications for “High Automation”
- Standards will support varying levels of automation
- Deployment and evolution through levels of automation can be determined by each individual railroad



Rail Crossing Violation Warning (RCVW)

- Connected vehicle safety application for grade crossing warning
- Warn drivers of imminent violation of a rail crossing protection system
- Jointly funded by FRA and FHWA
- Continuing development in partnership with Honda

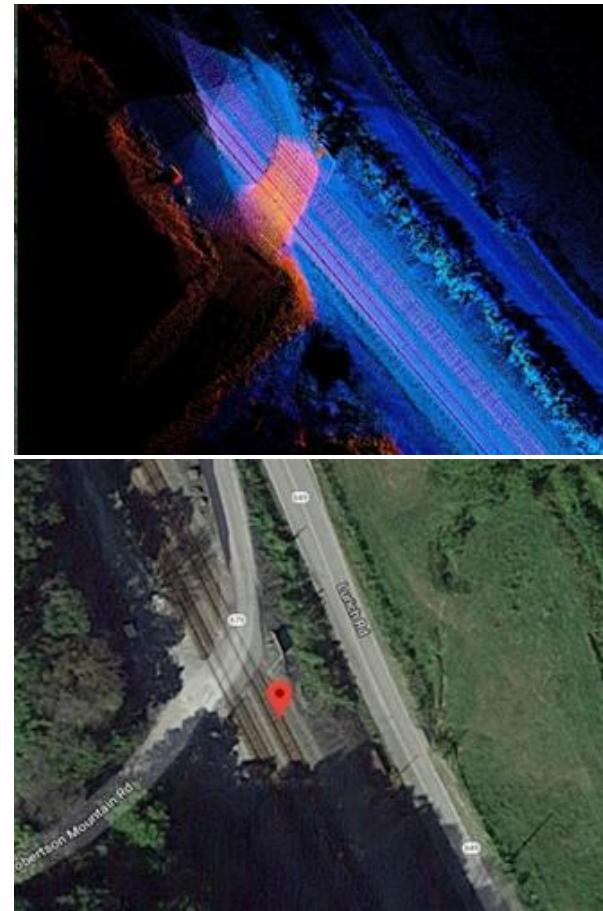


Rail Crossing Violation Warning (RCVW)



LiDAR Hump Crossing Survey Data

- Augment FRA's National Grade Crossing Inventory database with LiDAR point clouds of humped crossings.
- System designed to capture topography at speeds up to 60 MPH.
- Parameters reported at automatically detected grade crossings include:
 - Detection of Crossing
 - Crossing Profile
 - Roadway/Track Crossing Angle
 - Railroad/Subdivision
 - Track Class
 - Number of Tracks
 - Length of Crossing
 - Location of Crossing (GPS/MP)



FRA LiDAR Grade Crossing Survey System

- FRA initial full LiDAR Surveying System was installed on the DOTX 218 research vehicle for demonstration and further development.



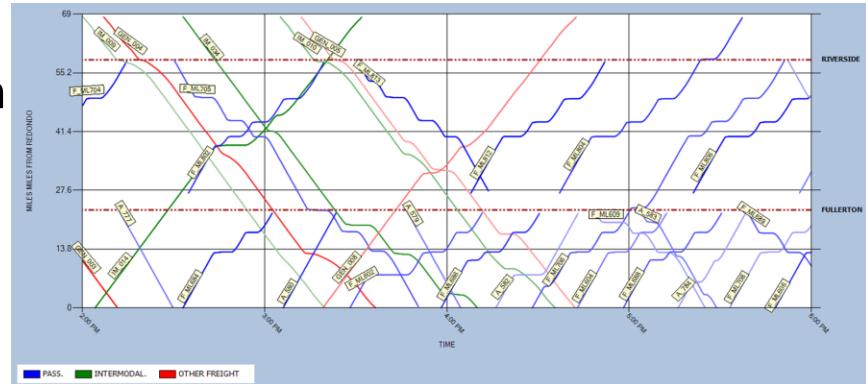
UAV based Trespass Detection System

- Evaluate UAS capabilities (flight duration, payload, scanning technologies, etc.) for railroad applications
- Test the effectiveness of UAS technology to detect trespassers on railroad property.
- Provide law enforcement the capability and flexibility to cover wider area.



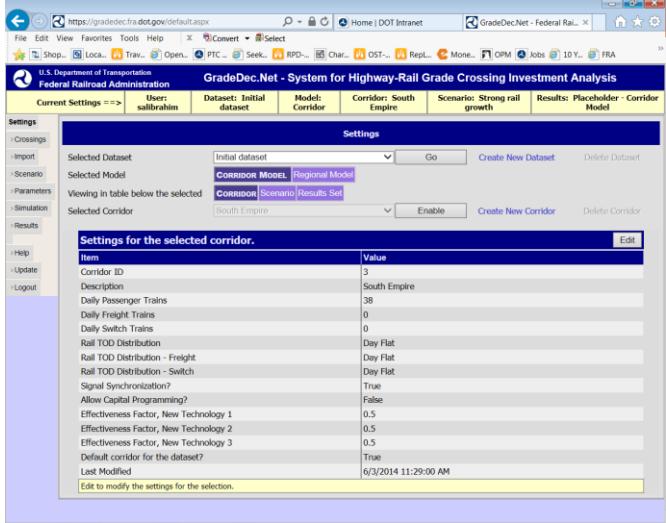
Generalized Train Movement Simulator (GTMS)

- Web based train movement model to calculate time, position, speed, and in-train forces.
- Central dispatching algorithm to prioritize train movement, makes routing decisions, prevents train deadlock, to provide safe train separation.
- Animation to identify chock points and shows the effects of capital improvements
- Simulate up to 10 years of operation in a single run and derive the probability of each PTC preventable accident.
- FRA RD&T established a user group and conducts workshops to help interested parties learn this tool, provide support and enhancement as needed.



GradeDec.Net

- Web based grade crossing (GC) benefit cost analysis tool with easy access to the FRA crossing database and accident data.
- Used by Federal, State, Local transportation authorities, railroads, academics, and consultants to evaluate GC upgrades, closures, grade separations and impact on vehicle queues and spillbacks
- FRA RD&T periodically conducts workshops to help interested parties learn this tool and providing support and enhancement.



The screenshot shows the GradeDec.Net software interface. The title bar reads "GradeDec.Net - System for Highway-Rail Grade Crossing Investment Analysis". The main menu includes File, Edit, View, Favorites, Tools, Help, and a "Convert" option. The sub-menu "Convert" has options like Shop, Local, Travel, Open, PTC, Seek, RPD, Char., OST, Repl., More, OPM, Jobs, 10 Y., and FRA. The top right shows "GradeDec.Net - Federal Rail" and a user icon. The left sidebar has a "Settings" menu with "Crossings", "Import", "Scenario", "Parameters", "Simulation", and "Results". The main content area has tabs for "Dataset", "Model", "Corridor", "Scenario", and "Results". The "Dataset" tab is selected, showing "Initial dataset" and "CORRIDOR MODEL" (selected). The "Model" tab shows "CORRIDOR Scenario Results Set" and "South Empire" (selected). The "Corridor" tab shows "South Empire" and "Enable" buttons. The "Scenario" tab shows "South Empire" and "Create New Scenario" and "Delete Scenario" buttons. The "Results" tab shows "Placeholder - Corridor Model" and "Create New Results" and "Delete Results" buttons. The "Settings for the selected corridor" table lists various parameters with their values:

Item	Value
Corridor ID	3
Description	South Empire
Daily Passenger Trains	38
Daily Freight Trains	0
Daily Switch Trains	0
Rail TOD Distribution	Day Flat
Rail TOD Distribution - Freight	Day Flat
Rail TOD Distribution - Switch	Day Flat
Signal Synchronization?	True
Allow Capital Programming?	False
Effectiveness Factor, New Technology 1	0.5
Effectiveness Factor, New Technology 2	0.5
Effectiveness Factor, New Technology 3	0.5
Default corridor for the dataset?	True
Last Modified	6/3/2014 11:29:00 AM



Thank You!

Got PTC?

