OFFICE OF RESEARCH & DEVELOPMENT

2012 R&D REVIEW

Positive Train Location (PTL)

U.S. Department of Transportation
Federal Railroad Administration

JARED WITHERS
General Engineer
Office of Research and Development
Office of Railroad Policy and Development

Program Area & Risk Matrix

Positive Train Location (PTL)

Program Areas \ Risk Factors	Trespass	Grade Crossing	Derailment	Train Collision	All Other Safety Hazards
Railroad Systems Issues					
Human Factors					
Track & Structures					
Track & Train Interaction					
Facilities & Equipment					
Rolling Stock & Components					
Hazardous Materials					
Train Occupant Protection					
Train Control & Communications				X	
Grade Crossings & Trespass					

Acknowledgements & Stakeholders

Industry Advisory Group
Grant recipient: Railroad Research Foundation

- Program Director – Howard Moody

Project manager: Transportation Technology Center, Inc. (TTCI)

- Program Manager – Alan Polivka
- Project Manager – Paul McMahan
- System Engineer – France Collard

Industry advisory group:

- Denise Lyle (CSX), Kevin Kautzman (BNSF), Mike Newcomb (UPRR), Tom Schnautz (NS)
- Adrian Hellman (VOLPE)

Positive Train Location (PTL) Description

- Project is to address known limitations of current PTC designs
  - Accurate, dependable head-of-train location is needed, both at train initialization and during train operation
  - Accurate, dependable end-of-train location is needed to support close following moves

- Seeks to reduce opportunity for human error and negative impacts of PTC on operating efficiency.

Preventable Accidents

	2008	2009	2010	2011
Head On Collision	7	5	4	3
Rear End Collision	17	10	9	16

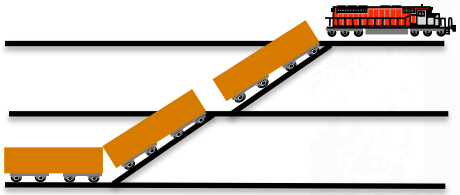
source: http://safetydata.fra.dot.gov/officeofsafety/

End-of-train location derived from:

- **GPS position of locomotive**
- **Crew-entered train length &**
- **Known switch position**

WHAT IF:

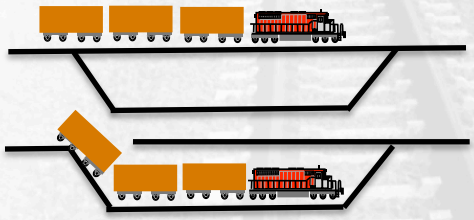
Unknown switch position



Is rear-of-train on Track 1, 2 or 3?

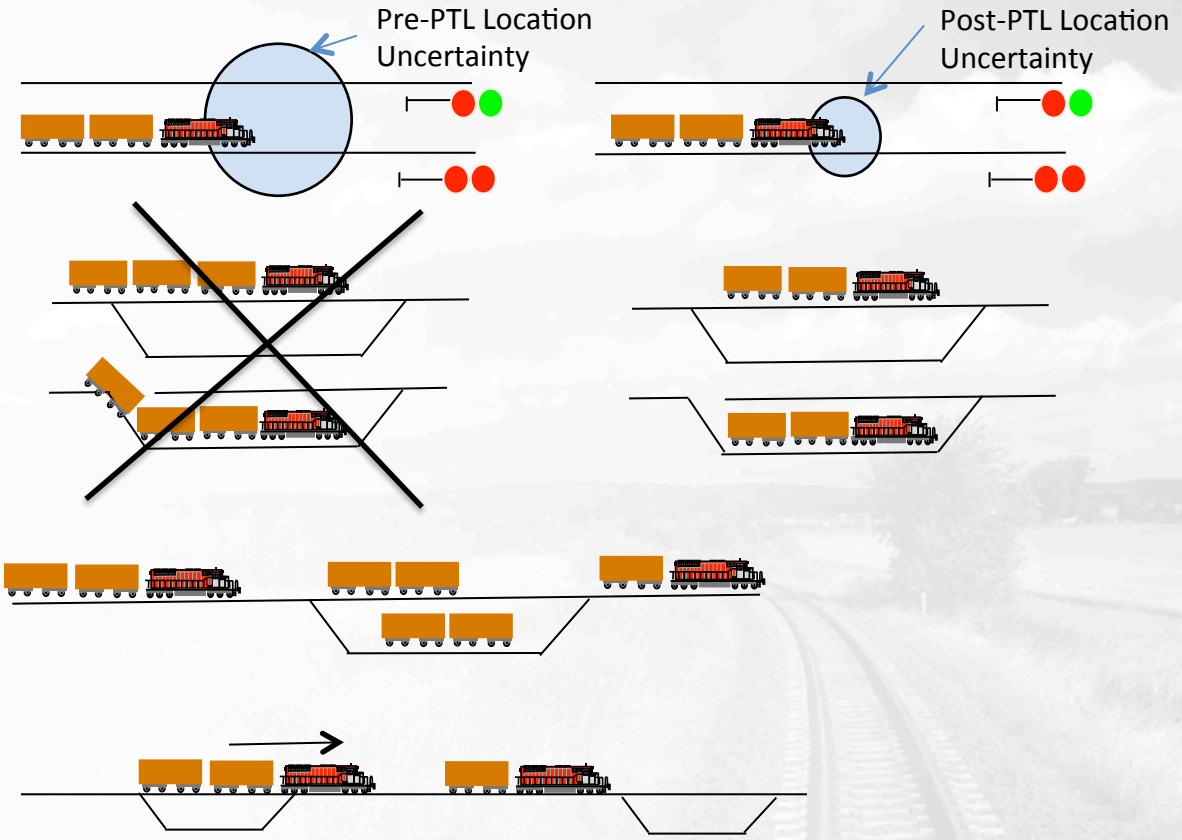
Authority might be released prematurely
(train still in limits in dark territory)

Invalid Train Length

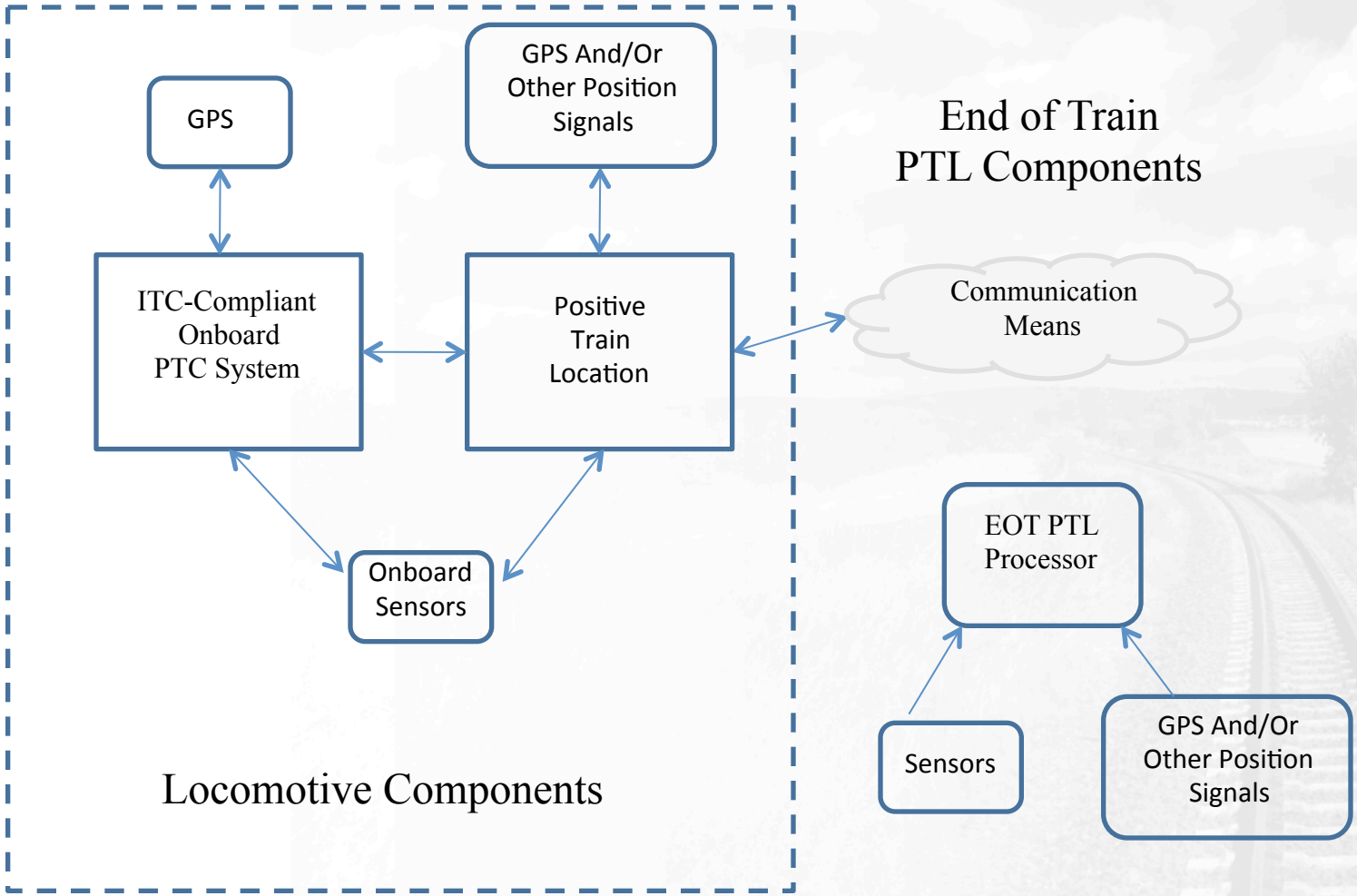


Applications and Benefits

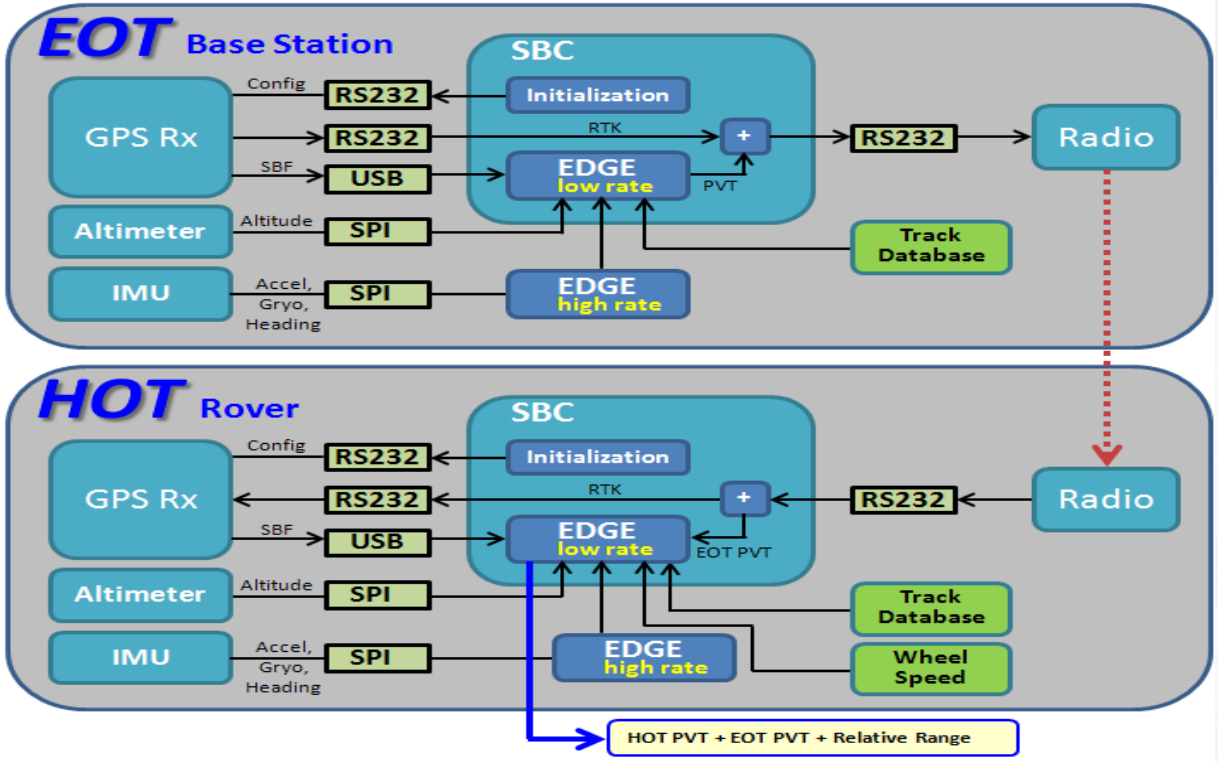
- ✓ Reduced location uncertainty results in positive track discrimination
- ✓ Positive end-of-train location supports automatic safe release of authority behind the train
- ✓ Rear-of-train protection when shunting cars
- ✓ Closer following moves safely reduce buffer between trains and increase capacity
- ✓ Positive EOT location supports implementation of moving block

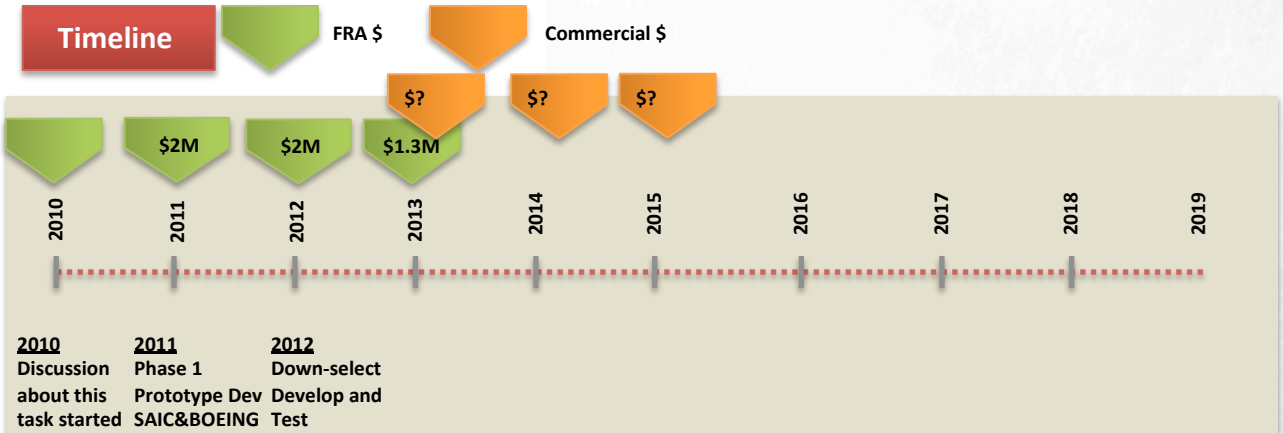


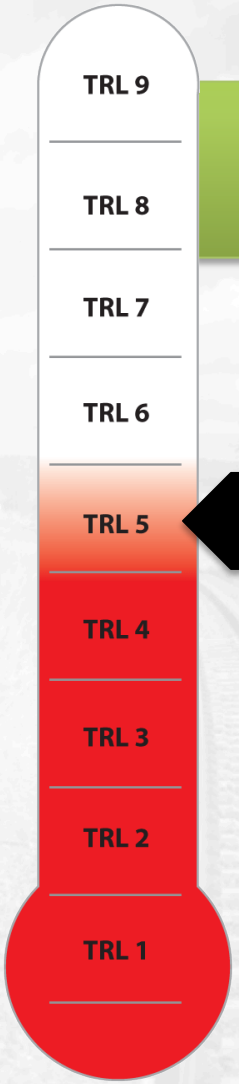
How the Technology Works



PTL Development Schedule & budget







FRA Total Funding: $5.3M

Technology readiness level

Component and/or breadboard validation in relevant environment

Outcomes

Proof of Concept Test Results

Key Performance Parameter	Req'mt Value	SAIC PTL HOT		SAIC PTL EOT	
		x (Across)	y (Along)	x (Across)	y (Along)
Position Mean		0.09 m	0.03 m	0.23 m	0.04 m
Position Std Dev.		0.15 m	0.17 m	0.11 m	0.27 m
Confidence Level @ 1.2 m	99.999 999997% ("10 9's")	99.999999999+% (> Fifteen "9's")	99.9999999998% (Twelve "9's")	99.999999999+% (> Fifteen+ "9's")	99.9991% (Five "9s")
Velocity Mean		0.01 mph		-0.01 mph	
Velocity Std. Dev		0.09 mph		0.12 mph	
Confidence Level @ 0.1 mph	99.99%	NA* (Note: Reference system accurate to only ~0.07 mph, Invalidating statistics)		NA* (Note: Reference system accurate to only ~0.07 mph, Invalidating statistics)	
Course of Travel (CoT) Mean		0.05 deg		0.14 deg	
CoT Std Dev.		0.25 deg		0.41 deg	
CoT Error @ Confidence Level	67%	99.98%		96.5%	

Project Support

Industry-Vendor licensing negotiations occurring now

Field testing commitments from Union Pacific and Burlington Northern

Interest in PTL sensor suite as a development platform

Key Success Factors

- Reduce train collisions
- Allow track discrimination at PTC initialization without human input
- Positive EOT location supports implementation of moving block
- Support increased capacity through tighter fleeting of trains
- Support automatic authority release behind trains in dark territory
- Protect rear of train when shunting cars
- Provide positive determination of switch and block clearing
- Provide additional input for train integrity determination
- More precise train length measurement improves braking performance predictions

OFFICE OF RESEARCH & DEVELOPMENT

2012 R&D REVIEW

Connected Vehicles Highway-Rail Feasibility Study and Proof of Concept

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Program Area & Risk Matrix

Connected Vehicles Highway-Rail Feasibility and Proof of Concept

Program Areas / Risk Factors	Trespass	Grade Crossing	Derailment	Train Collision	All Other Safety Hazards
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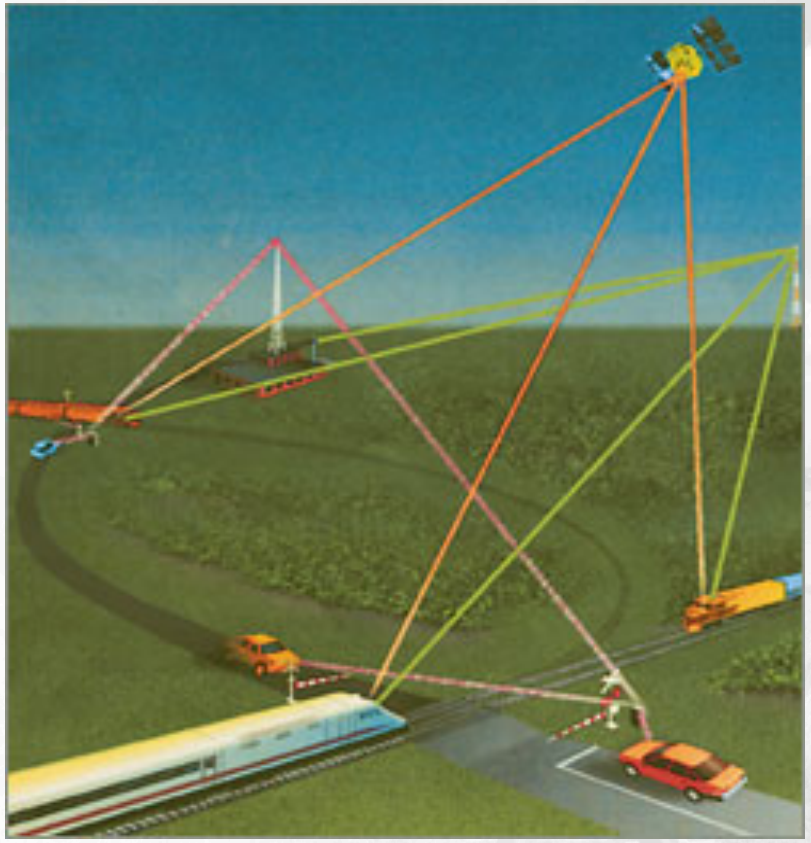
Hazardous Materials					
Train Occupant Protection					
Train Control & Communications		X			
Grade Crossings & Trespass		X			

Acknowledgements & Stakeholders

- Intelligent Transportation Systems (ITS) Joint Program Office
- Research and Innovative Technology Administration (RITA)
- Volpe Center
- Transport Canada
- Federal Highway Administration (FHWA)
- Federal Motor Carrier Safety Administration (FMCSA)
- Federal Transit Administration (FTA)

Description of Project

- RITA ITS and industry partners are ramping up focus on V2I solutions.
- Opportunity for equipping crossing safety infrastructure with connected vehicles solutions.
- Increased safety at highway-rail crossings.

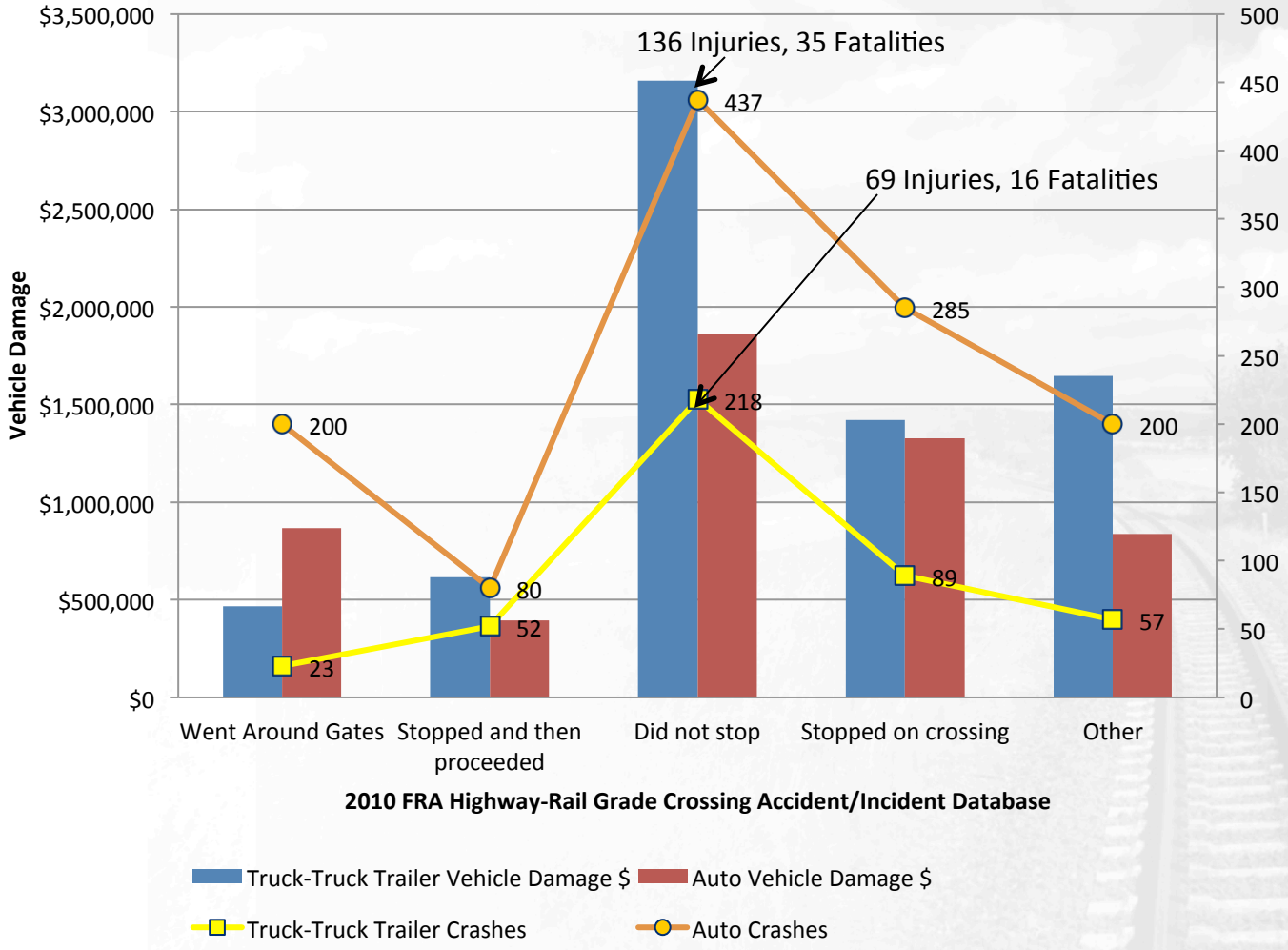


1. Approaching train communicates to crossing gates.
2. Activated gates transmit a status signal via DSRC radio.
3. Drivers approaching the crossing receive an in-car warning.

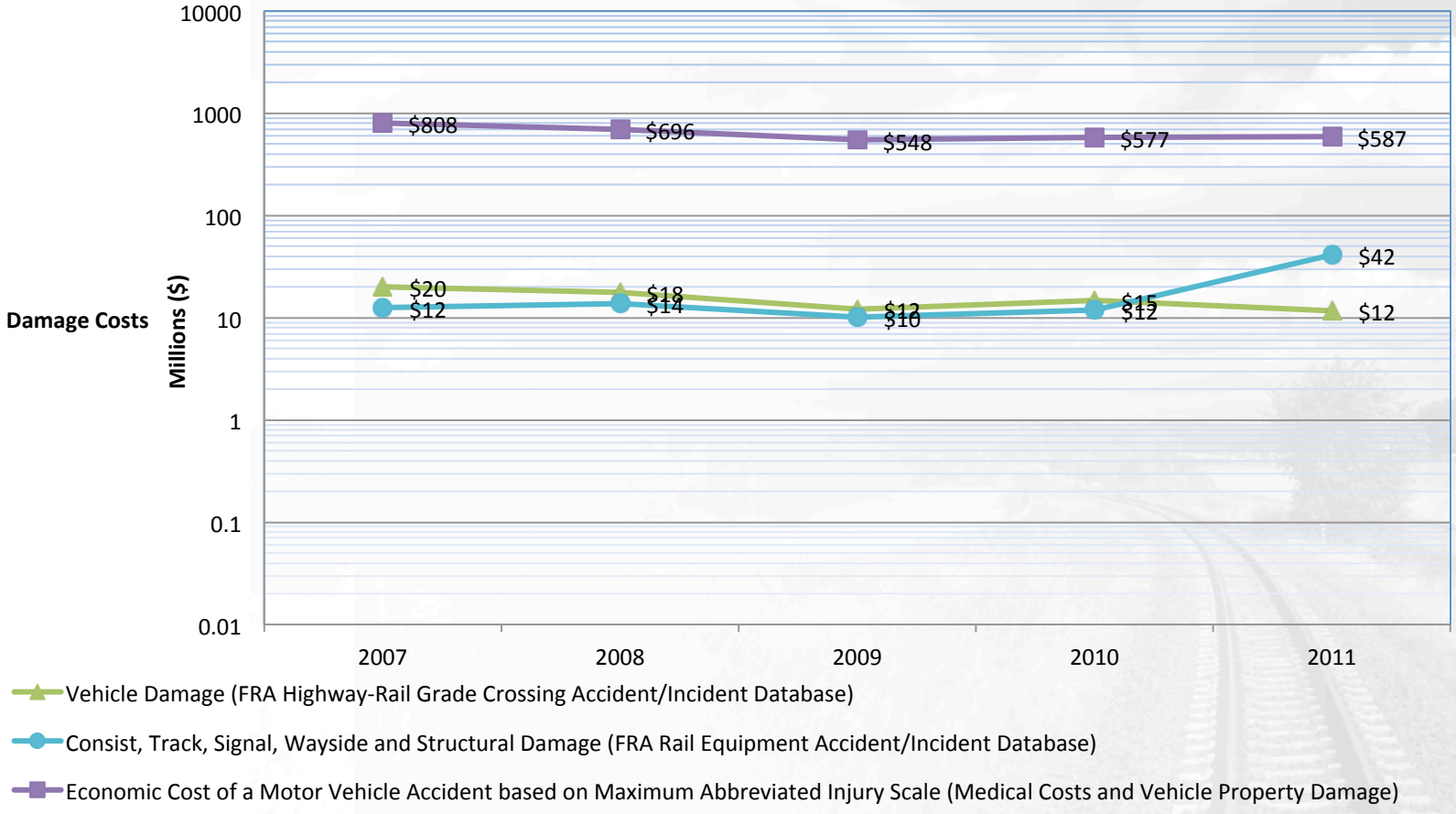
Objectives

- Complete feasibility analysis, crash analysis, concept of operations.
- Integrate Digital Short Range Communications (DSRC) into active crossing protection systems to enable in-car warning of an active crossing.
- Conduct proof of concept.
- Coordinate with the OEM and aftermarket industry to implement capabilities in production vehicles

Crash Analysis



Benefits


Damage Costs
Millions ($)
10000
1000
100
10
1
0.1
0.01
2007
2008
2009
2010
2011
$808
$696
$548
$577
$587
$20
$18
$12
$14
$12
$10
$15
$12
$42
$12
Vehicle Damage (FRA Highway-Rail Grade Crossing Accident/Incident Database)
Consist, Track, Signal, Wayside and Structural Damage (FRA Rail Equipment Accident/Incident Database)
Economic Cost of a Motor Vehicle Accident based on Maximum Abbreviated Injury Scale (Medical Costs and Vehicle Property Damage)

Operational Scenarios

Operational Scenario	Example
Public Vehicle	Vehicle approaching a crossing will be alerted to the status of the crossing and approaching trains
Trucks and Commercial Vehicles	Vehicle approaching a crossing will be alerted to the condition of the crossing (steep hump or sharp turns)
First Respondent & Emergency Vehicles	Vehicle approaching a crossing will be alerted to the status of the crossing closure to find alternative route

Rail-Highway Connected Vehicle

FRA Total Funding: 500k

Technology readiness level

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Key Success Factors

- Reduce grade crossing accidents
- Reduce emergency vehicle response time
- Enable cost effective active warning at dark territory crossings
- Keep Rail active in ITS JPO discussions

Break | Nearby Food Options
(all within 5-7 minutes walking distance)

- Au Bon Pain: 601 Indiana Ave NW # 1Washington, DC 20004
- Burger King: 501 G Street NW, Washington, DC 20001
- Chipotle: 601 F Street NW, Washington, DC 20005
- Cosi: 601 Pennsylvania Ave NW # 2 Washington, DC 20004
- Dunkin Donuts: 601 F Street NW, Washington, DC 20004
- Firehook Bakery & Coffee House: 441 4th Street NW, Washington, DC 20001
- Jack's Famous Deli: 501 3rd St NW # 2, Washington, DC 20001
- Quiznos Sandwiches: 772 5th St NW, Washington, DC 20001
- Starbucks: 443 7th St. NW, Washington, DC 20004
- Subway: 501 D Street NW, Washington, DC 20001