Future Freight Railroad Control Systems: What Will They Look Like?

National Transportation Safety Board
Positive Train Control Seminar

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Current Freight Railroad Train Control Technologies are "Mature"

- Timetable and train order
  - Timetable and train order operation first used by railroads in the early 19th Century
  - Transmission of movement authorities by voice radio, with the same functionality, replaced written train orders in the 1980s
- Automatic Block Signals
  - First installed in New Jersey in 1893
  - Provides broken rail protection, train separation
- "Centralized Traffic Control" or "Traffic Control System"
  - Current "state of the art" train control system
  - First deployed on Toledo & Ohio Central Railroad in 1927

But if it’s not broke…

- Current control systems are managing to handle record rail traffic levels
- Control-system-related accidents are at low levels
- Technical problems such as “false clear” signals are rare
- As far as railroad train control is concerned, then, why should the future look different from the past?

Reasons for Looking for a New Technology

- Current control systems must be replaced as they wear out.
- IF NOT NOW, then WHEN is it sensible to look for better technology instead of replacing in kind?
- GPS and wireless networking, which could form the basis of a better control system, have been widely applied in other transportation modes…why not rail?

Limited Trials of New Technology are Under Way…

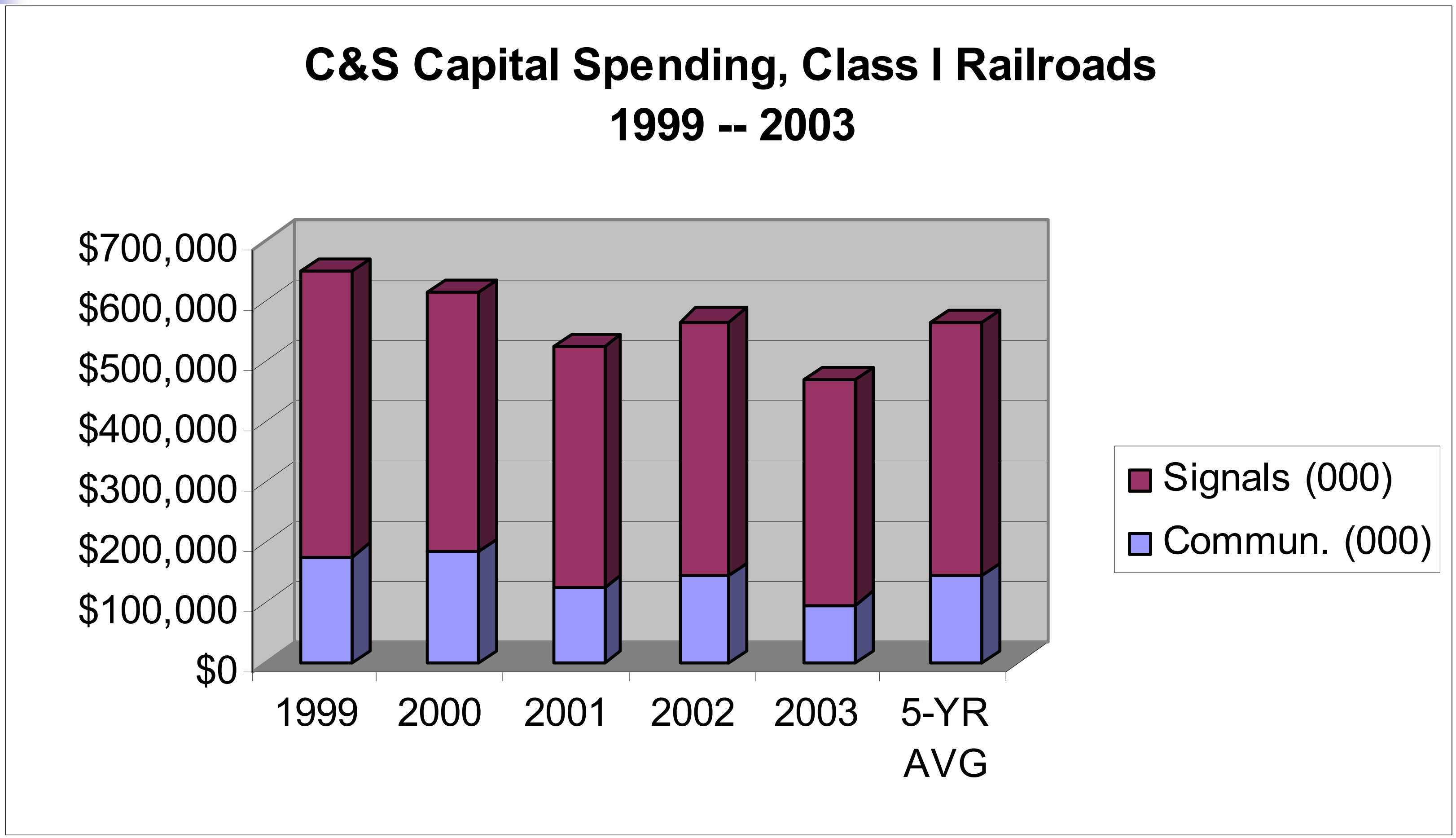
- BNSF "ETMS" (Enhanced Train Management System) in southern Illinois
- CSX "CBTM" (Communications Based Train Management) in South Carolina
- North American Joint PTC Project in Illinois
- CBTC (Communications Based Train Control) on MTA New York City Transit

…But (Except for New York) the Level of Expenditures is Small Compared to Spending on Conventional Systems

- Total spending on the Illinois project has been about $100 million over 10 years… about half from the railroad industry, the rest from FRA
- The two other freight railroad pilot projects have involved much smaller dollar amounts so far

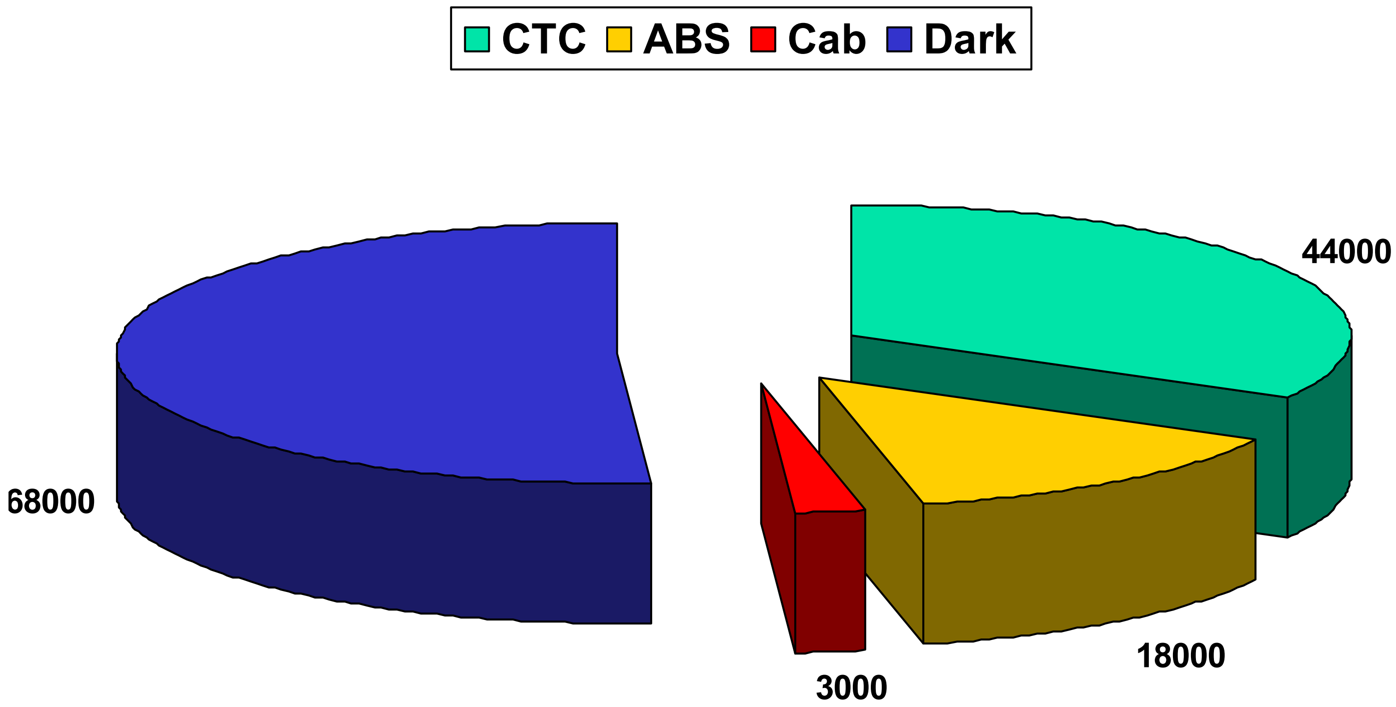
In contrast…

The Class I railroads have spent an average of $564 million annually over the last five years on C&S capital investment


C&S Capital Spending, Class I Railroads
1999 -- 2003
$700,000
$600,000
$500,000
$400,000
$300,000
$200,000
$100,000
$0
1999
2000
2001
2002
2003
5-YR AVG
Signals (000)
Commun. (000)

Source: STB

Route Mileage by Signal Control Type*



*Data from Volpe Rail Network, VNTSC. Volpe Rail Network describes the U.S. Class I network as of 1996. The network contains 133,000 route miles, of which 65,000 are equipped with some type of signal control.

Estimated Replacement Cost of Current Control System

- A recent *Railway Age* article ("C&S Buyers' Guide") cited a cost of $140,000 per mile for new CTC (including grade crossing protection)
- At these costs, replacement of the signal equipment on the existing 65,000 miles of signaled track with modern CTC equipment would cost more than $9 billion.

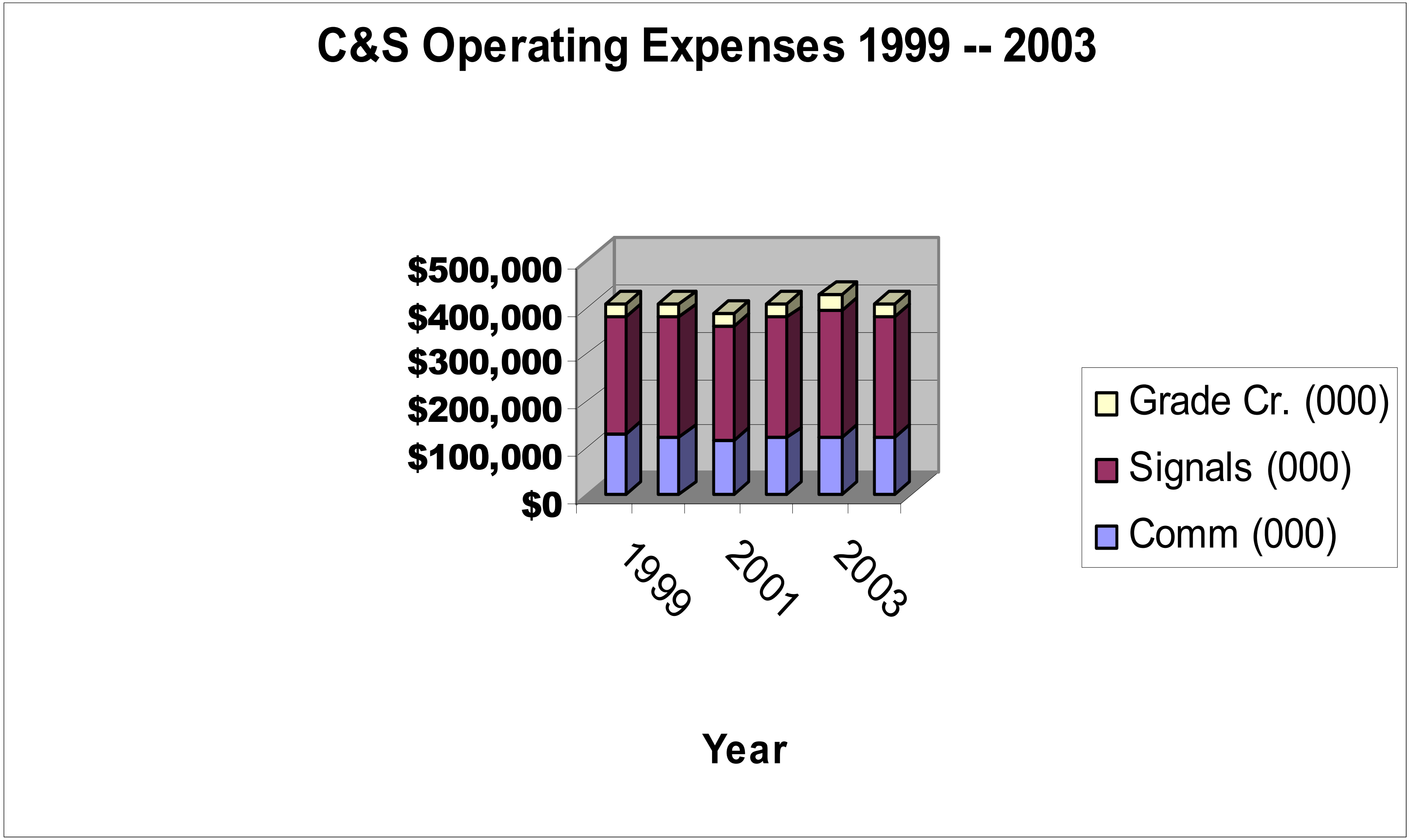
Railroads are Replacing Existing Equipment on About a 20-year Cycle

- Total signal capital expenditures by Class I railroads over the last five years averaged $418 million annually
- At $140,000 per mile, that was enough to replace about 3,000 miles of CTC per year

This means that…

- Stockholders will pay more than $9 billion over the next 22 years to replace 75-year old technology IN KIND, with no gain in functionality
- Is this the best strategy for the railroad industry to follow?

…And It's Not Cheap to Maintain, Either



But based on historical trends and current spending, the future of freight railroad train control systems…

- …will consist of replacement of existing ABS and CTC with “modern” CTC, which offers:
  - No increase in functionality
  - No enforcement

Is There a Better, Cheaper, Safer Way?

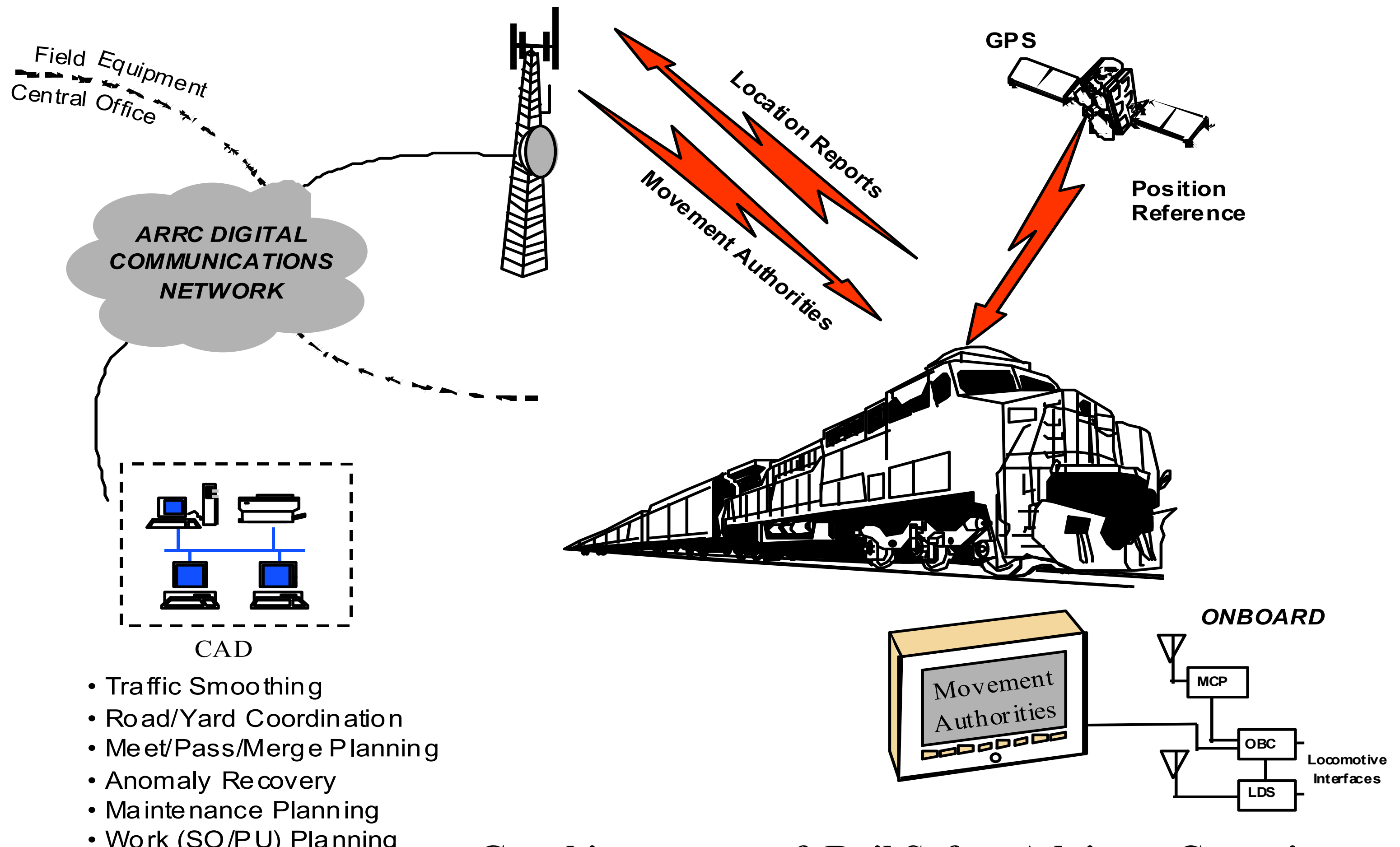
- Maybe. Communications-based systems have been in testing since the 1980s. They include Burlington Northern's ARES, the AAR/CN ATCS, the North American Joint Positive Train Control Project…and the CBTC project at MTA New York City Transit

Communications-based control systems – what do they do?

The primary CBTC functions are:

- management of track occupancies through centralized route and block interlocking logic
- issuance of movement authorities via the data link to equipped trains and work vehicles
- tracking of equipped train location and track occupancies via the data link;
- speed enforcement for equipped trains
- enforcement of limits of authority for equipped trains
- pacing for fuel economy for equipped trains
- monitoring and control of wayside systems
- reporting of equipped train diagnostics and operating parameters
- general exchange of instructions and messages.

PTC System Diagram



Graphic courtesy of Rail Safety Advisory Committee

Let’s Talk About New York

- MTA New York City Transit is a transit system, not a railroad…but the system has:
  - 722 main track miles
  - 180 interlockings
  - 6,000 rapid transit cars
  - 4 million riders per day

Why has New York Adopted CBTC?

- Decision was made to switch to CBTC because existing control systems were functionally obsolete and expensive to maintain
- NYCT expects CBTC to be safer and have a lower life-cycle cost than the equipment it replaces
- Revenue operation will begin in May – on schedule and on budget – on the Canarsie Line

What Will PTC Cost?

Cost per Segment (2001 $)

Segment	Unit	Estimated Cost Per Unit	
		Low	High
Vehicle	Each	$30,000	$75,000
Wayside	Track Mile	$16,000	$24,000
Central Office	Each	$100 million	$500 million

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Totals to be Equipped

Category	Class I Totals
Locomotives	20,506
Route Mi	99,250
Central Office	One for each Class I

Total Estimated Cost, PTC

Segment	System Cost	
	Low	High
Vehicles	$615,180,000	$1,537,950,000
Wayside	$1,588,000,000	$2,382,000,000
Central	$100,000,000	$500,000,000
Total	$2,303,180,000	$4,419,950,000

Source: "Quantification of the Business Benefits of Positive Train Control", FRA, 3/16/2004

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But Remember…

- This cost is not *in addition to* the $564 million annually being spent by railroads on C&S capital investments
- The PTC investment will replace some of the C&S investment
- How much?

Net Cost of PTC

- With PTC, railroads will retain home signals at control points, plus relay cases, switch machines, other wayside equipment
- PTC will replace existing code line, where this still exists
- PTC will also replace communications lines and signals between control points, plus grade crossing track circuits

A Recap

- Cost of CTC: $140,000 per mile
- Cost of replacing code line, wayside signals, crossing protection: $90,000 per mile
- Continuing capital expenditure required to retain and periodically replace equipment at control points after PTC is in place: $50,000 per mile

Comparison: Signals vs. PTC ($ in billions)

	Signals	PTC Low	PTC High
Control Points	$3.25	$3.25	$3.25
Other	$5.85	$2.30	$4.42
Total	$9.10	$5.55	$7.67
Net Savings	--	$3.55	$1.43

The Bottom Line

- Railroads will still have to spend $50,000 per mile on regular replacement of power switches, home signals, relay cases and other equipment at interlockings
- This totals to $3.25 billion, of the previously estimated $9.1 billion replacement cost of signals
- In addition, railroads will have to spend between $2.3 billion and $4.4 billion on PTC
- Net *savings* to the industry over 22 years: somewhere between $1.43 billion and $3.55 billion, as compared to retaining and replacing existing signal systems

Also…

- In addition to a capital cost savings, the railroads will also realize:
  - 100% control system coverage
  - Real-time location information for all trains
  - Positive enforcement of ALL movement authorities, even on “dark” territory

In Addition, Potential Railroad Business Benefits May Include

- Line capacity enhancement
- Improved service reliability
- Faster over-the-road running times
- More efficient use of cars and locomotives (due to real-time location information)
- Reduction in loco failures (due to real-time diagnostic data)
- Larger “windows” for track maintenance
- Fuel savings (from “pacing” of trains)

According to Robert Turner, Senior VP, Corporate Affairs, Union Pacific Railroad, the following is the cost of a one MPH reduction in system average velocity:

	#	Annual Cost	Total
Locos	250	$161,173	$40,293,250
Cars	5,000	$4,713	$23,565,000
Workers	180	$59,650	$10,737,000
			$74,595,250

If UP is about 20% of the industry, a one MPH improvement should be worth about $373 million annually to the Class I industry, and a 2.5 MPH improvement about $932 million

So the question is, if….

- It costs less than replacing the existing signal system…
- Covers the entire network, rather than 50% of it…
- Enforces authorities, eliminating most human-factors accidents…
- Potentially offers major savings through improvements to railroad operating efficiency…
- **Why hasn't the industry adopted it?**