Positive Train Control

Should the Railroads Consider It?

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Disclaimer

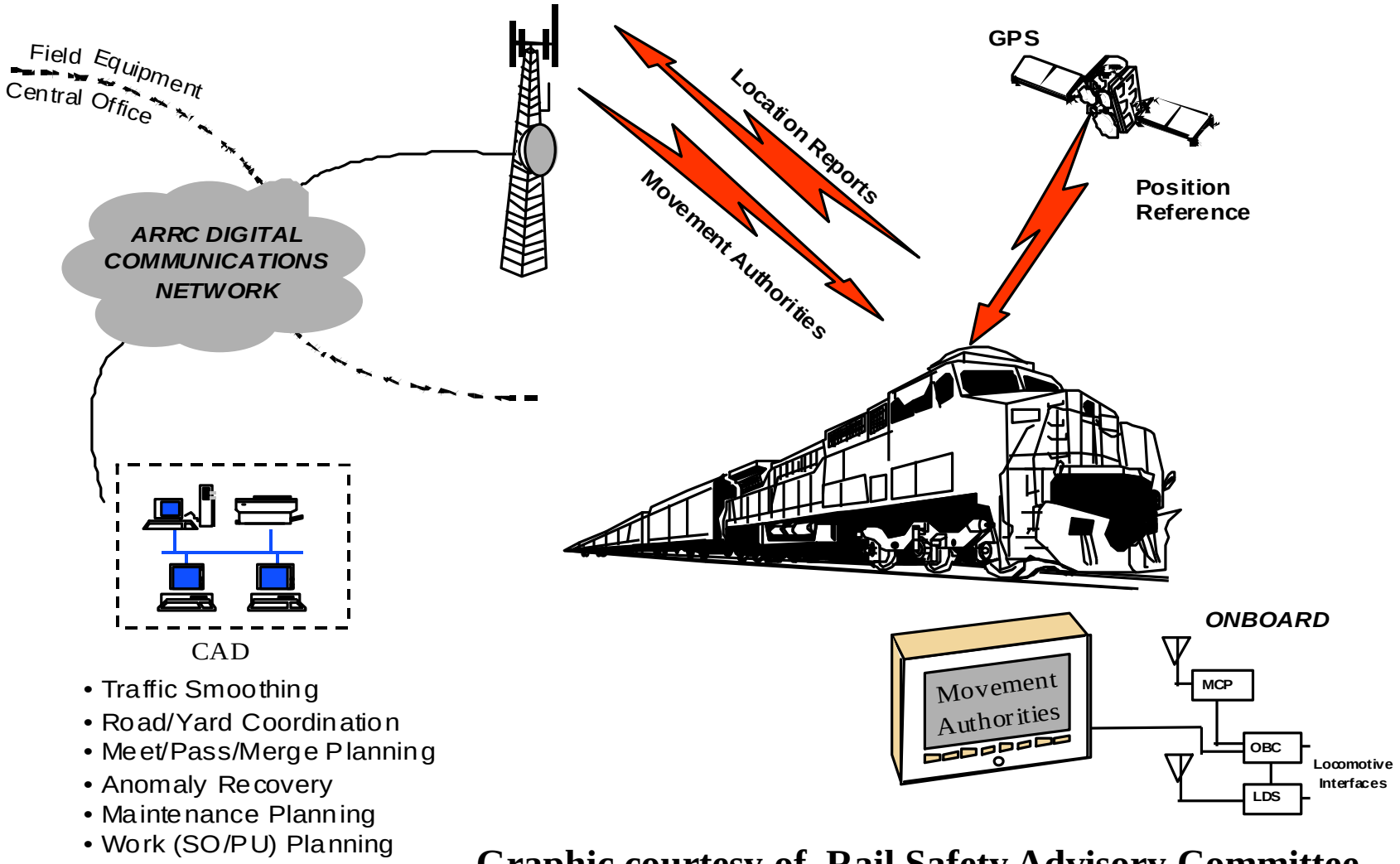
- The United States Surface Transportation Board (STB) takes no official position on Positive Train Control.

- The opinions expressed in this presentation are solely those of the presenter and in no way reflect any position or opinion of the STB or any other agency of the United States government.

Lots of Systems

- Advanced Railroad Electronics System
  - Burlington Northern Railroad, 1983-1991
- Advanced Train Control System
  - Association of American Railroads, 1982-1992
- Incremental Train Control System
  - Amtrak/Conrail, 1989 – present
- Communications Based Train Control
  - New York City Transit Authority, 1991 – present
- Positive Train Control
  - Railroad industry development, 1992-current
- Electronic Train Management System
  - Burlington Northern Santa Fe, 2000-current
- Computer-Based Train Management
  - CSX, 1995-current

PTC System Diagram



- Traffic Smoothing
- Road/Yard Coordination
- Meet/Pass/Merge Planning
- Anomaly Recovery
- Maintenance Planning
- Work (SO/PU) Planning

Graphic courtesy of Rail Safety Advisory Committee

What Can It Do?

- Can Improve Service
- Can Reduce Cost
- Can Increase Revenue
- The system can improve safety as well, but for a system as inherently safe as the railroad, this is not a real driver.

How Can It Do All This?

- It can improve visibility
- Even in the most sophisticated of territory a dispatcher will know a train’s actual position only about once every fifteen minutes.
- Think about driving a car that will automatically follow the lane; but, you can open your eyes only once every quarter-hour.

Why Does Visibility Help?

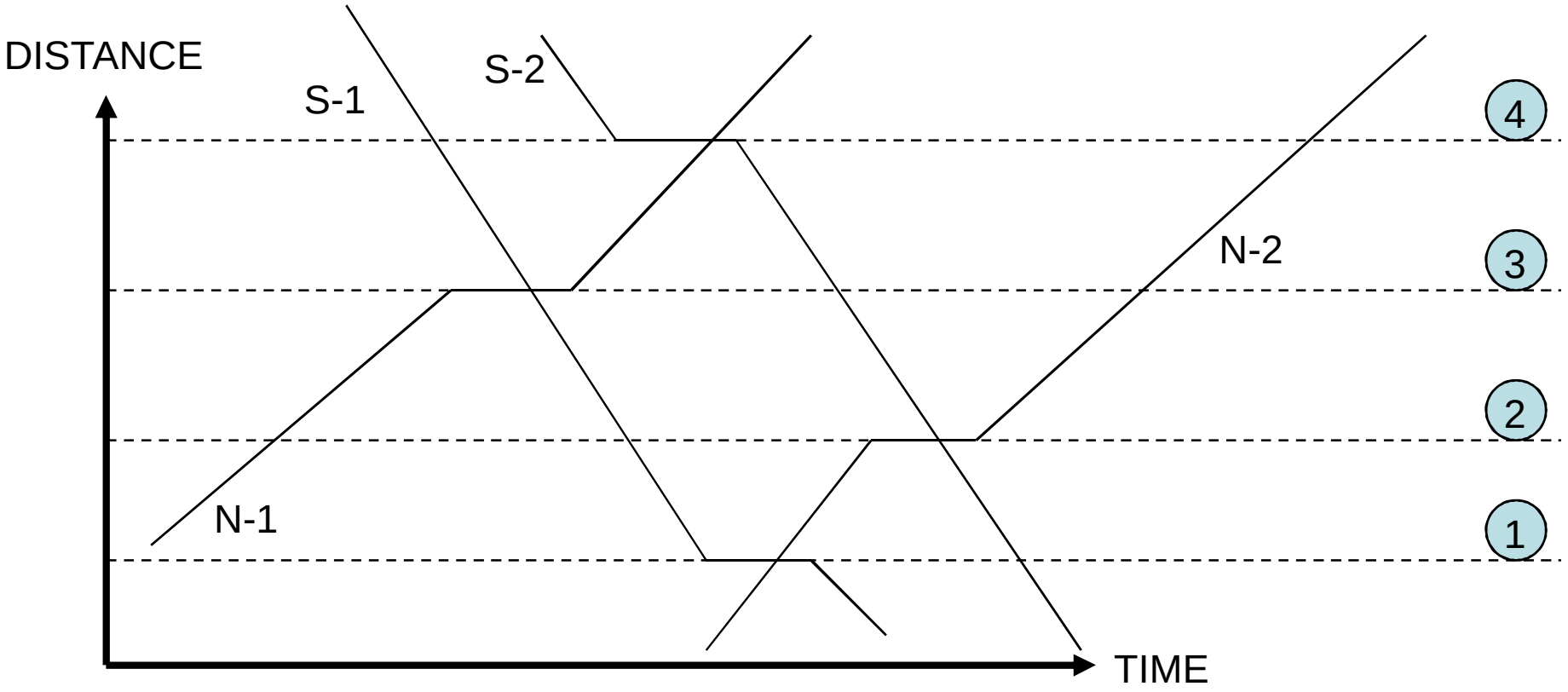
- At first, one may conclude that railroad operations do not require lots of visibility because the operation is so tightly controlled.
- However, with visibility, dispatchers will be able to issue track occupancy permits so that trains move more efficiently.
- This will allow trains to get to where they are going more quickly and reliably.

Will Yards Get Too Many Trains?

- No, there are a fixed number of trains and a fixed number of yards; unless that ratio of trains to yards changes this cannot happen.
- But since trains arrive where they are going at more reliable times, the yardmasters will be able to plan their work better and get it done more efficiently.
- This happens because of better visibility.

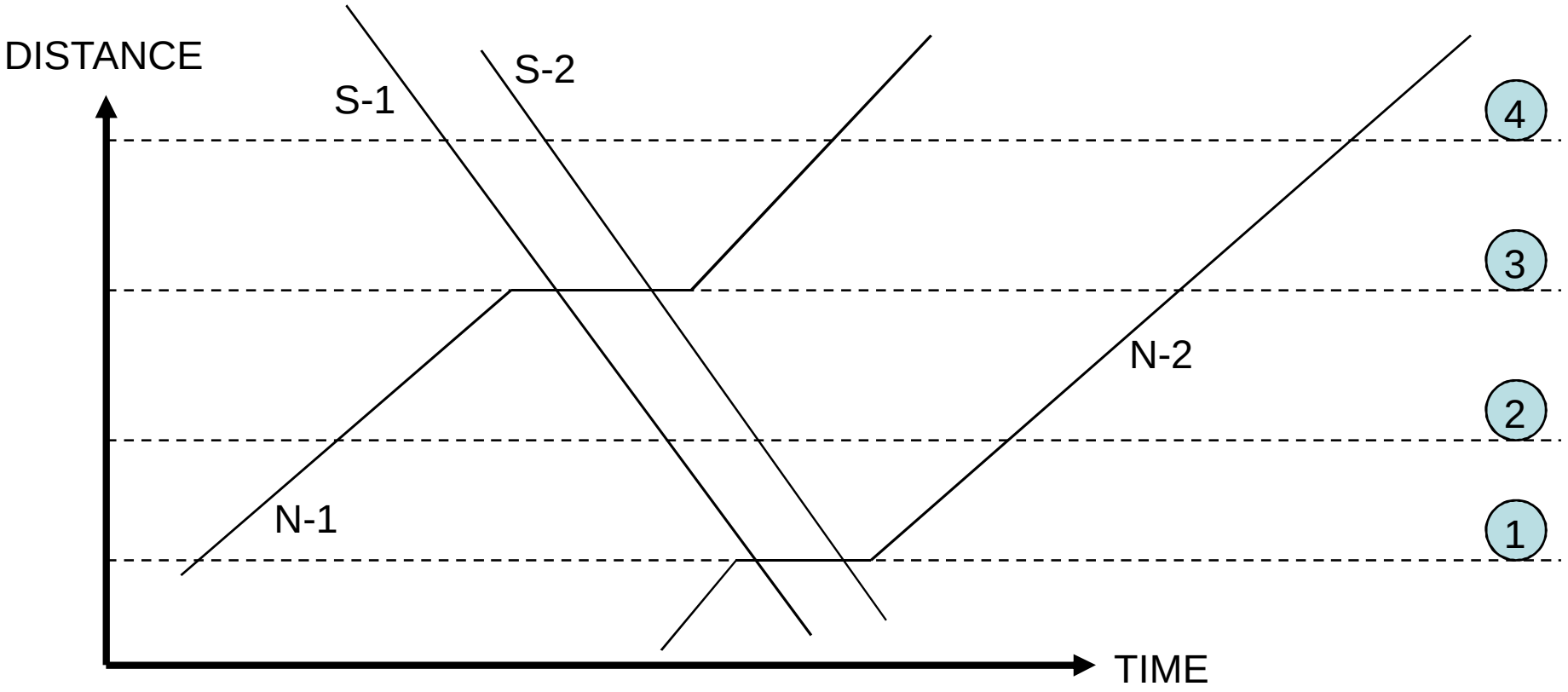
Dispatching Result Found on BN

- Each of four trains takes siding once…



Visibility Makes This Possible

- Four trains, but only two take siding…



We Can Examine Data to See How Well Dispatchers Use Better Data

- Dispatchers always try to do the best job they can. More information leads to better job.

- We can check it out—just look at the amount of excessive train time consumed in dark territory compared to signaled territory.

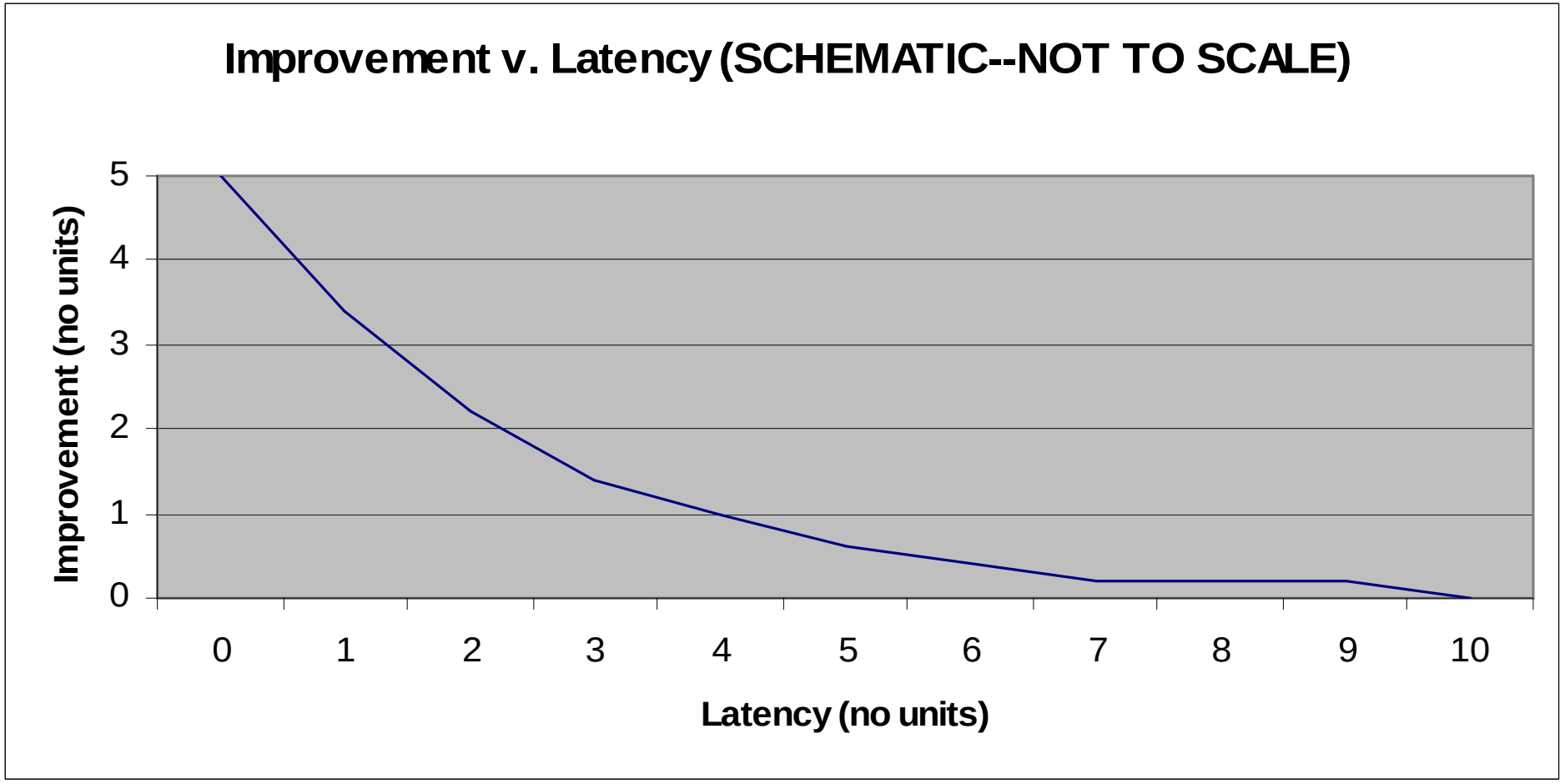
How Do We Compare Excessive Train Times by Territory?

- Paper by Smith and Resor in 1997 did just that.
- Premise used in paper is that we can measure the amount of excessive time by looking at the time of a train simulator compared to actual time and looking at amount of track capacity that was used.

What Did the Smith and Resor Paper Look At?

- Paper pointed out that only three things can keep a system in its desired state: (1) accuracy of restoring force, (2) size of restoring force, and (3) frequency of restoring force.
- The first of these depends a lot on excess capacity, the second is an option the railroads do not have, and the third can be improved markedly by PTC.
- So the paper controlled for capacity and developed the relationship between frequency and amount of excessive time.

Here Is a Schematic Picture of the Results



PTC Can Add Railroad Capacity

- How? – Much previous research on this has focused on closer headways. However, a very large capacity increase can happen by reducing excessive train times.
- When trains move at zero MPH, the capacity of the system is zero—just as a jammed highway is.
- PTC can enable more efficient and effective meets and passes, so the trains are spending a lot less time moving at zero MPH.

Tunnel Vision

- In more sophisticated language: sub-optimization.
- Positive Train Control is a *network system*—it is not a special-purpose item. Nevertheless, people will look at it only in terms of their own small part of the operation.
- Signal specialists see it only as a signal replacement. Dispatchers see it only as a dispatching tool. Yardmasters see it only as an assist in the yard.

Would Revenues Increase?

- The improvements in operating cost assume no changes in volume. This means significant slack capacity and an improvement in shipment reliability.
- The number one concern of shippers is reliability. Shippers will pay for greater reliability.
- With reliability higher, we can keep the volume unchanged but increase price.

How Much Would This Price Increase Provide?

- That is hard to say. There are trade-offs between price, quantity, and operating costs. Some believe that railroads could see as much as $900 million/year more.

- Lots of trade-offs:
  - Keep prices the same and increase volume.
  - Keep volume the same and increase prices.
  - Keep price and volume the same and reduce capacity.

An FRA Report Suggests that PTC May Even be Cheaper than CTC

- Cost to replace CTC elements as they wear out: $9.1 billion over 22 years.
- Cost for PTC instead: $7.7 billion (when including parts of CTC that must be kept) over a shorter period.
- A very high cost of capital could make the investment unwise, but in the long run, PTC might be cheaper and better.

What Is the Rate of Return?

- We could say that this investment has negative cost, leading to an infinite IRR. But the investment will likely happen faster than CTC would be replaced, so the IRR is not infinite, but would be quite large.
- Many studies, even those conservative in estimating the amount of benefit and liberal in estimating the amount of cost, find the system highly beneficial.
- Some studies find that there is virtually no chance that an investment in this technology will return less than the amount needed to satisfy shareholders—if the system works as expected.

What Would Keep the Investment from Going Forward?

- Several possibilities:
  - It changes business practices profoundly and may not work as expected; is it too risky?
  - No Class I railroad, until recently, has consistently earned its cost of capital.
  - Railroads spend large amounts of capital simply to replace items that wear out.
  - The investment is network-oriented.