Shared Railroad Passenger and Freight Operations: The Challenge of Combining High-Efficiency Freight and Reliable Passenger Rail

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RAILTEC
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

NURail Center

Outline

- Introduction to RailTEC & NURail
- US passenger and freight rail transport
  - Heavy-Axle Load (HAL) Freight
  - High-Speed Rail (HSR)
  - Introduction to Shared Use
- Shared Use Implementation Challenges
  - Safety
  - Infrastructure and Rolling Stock
  - Planning and Operations
  - Economic and Institutional

University of Illinois: Rail Transportation & Engineering Center (RailTEC)

- Extensive program of teaching and research in railway engineering
- Scope encompasses:
  - Civil, Mechanical, Electrical and Systems Engineering
  - Rail Infrastructure, Rolling Stock and Operations
  - Rail Freight & Intermodal
  - Intercity and High-Speed Passenger
  - Commuter Rail and Transit
  - Economics, Business, Policy, etc.

NURail Center

U of I RailTEC Leads the National University Rail (NURail) Center

- University Transportation Centers UTCs are consortia of colleges and universities conducting research, education and technology transfer with a specific transportation-related focus
- Funded by the US Department of Transportation (DOT) – Office of the Assistant Secretary for Research and Technology
- University of Illinois led a successful consortium for the first ever rail-focused UTC in 2012: the ***National University Rail (NURail) Center***
- NURail Center focusing on:

Shared Rail Corridors

and

Economic Competitiveness

Elements of North American freight railroad success

- Economies of scale
  - Heavy axle load (HAL) rolling stock
  - Long heavy trains and requisite robust infrastructure
  - Tall clearances
- Energy efficiency
  - Relatively low power:trailing ton ratio
- Strong, lean infrastructure
  - Trackage tuned to traffic demand
  - Traffic control system
  - Labor resources
- Private sector ownership
  - Vertical integration of infrastructure and operation on property owned by railroads
  - Responsive to marketplace and shareholders

US Passenger Service Mostly on Shared Infrastructure

- **Commuter and Regional**: Principally run by state or regional transportation authorities who may or may not own the infrastructure
  - Diesel-electric or electric powered
  - Maximum speed typically 79 mph (higher on NE Corridor)
- **Intercity:** Operated by Amtrak
  - **Northeast Corridor:** (Boston - New York - Washington) Mostly owned by Amtrak, but shared with commuter rail and freight operators
    - Entirely electric
    - Maximum speed 125-135 mph with limited 150 mph
  - **Outside Northeast Corridor:** Amtrak trains operate mostly on freight railroad trackage
    - Diesel-electric locomotive power
    - Maximum speed generally 79 mph
    - Regional trains: travel 100 - 400 miles
    - Long-distance: may travel >2,000 miles

Confusing US High Speed Rail Vernacular

High-Speed Rail (HSR)

≥ 155 mph*

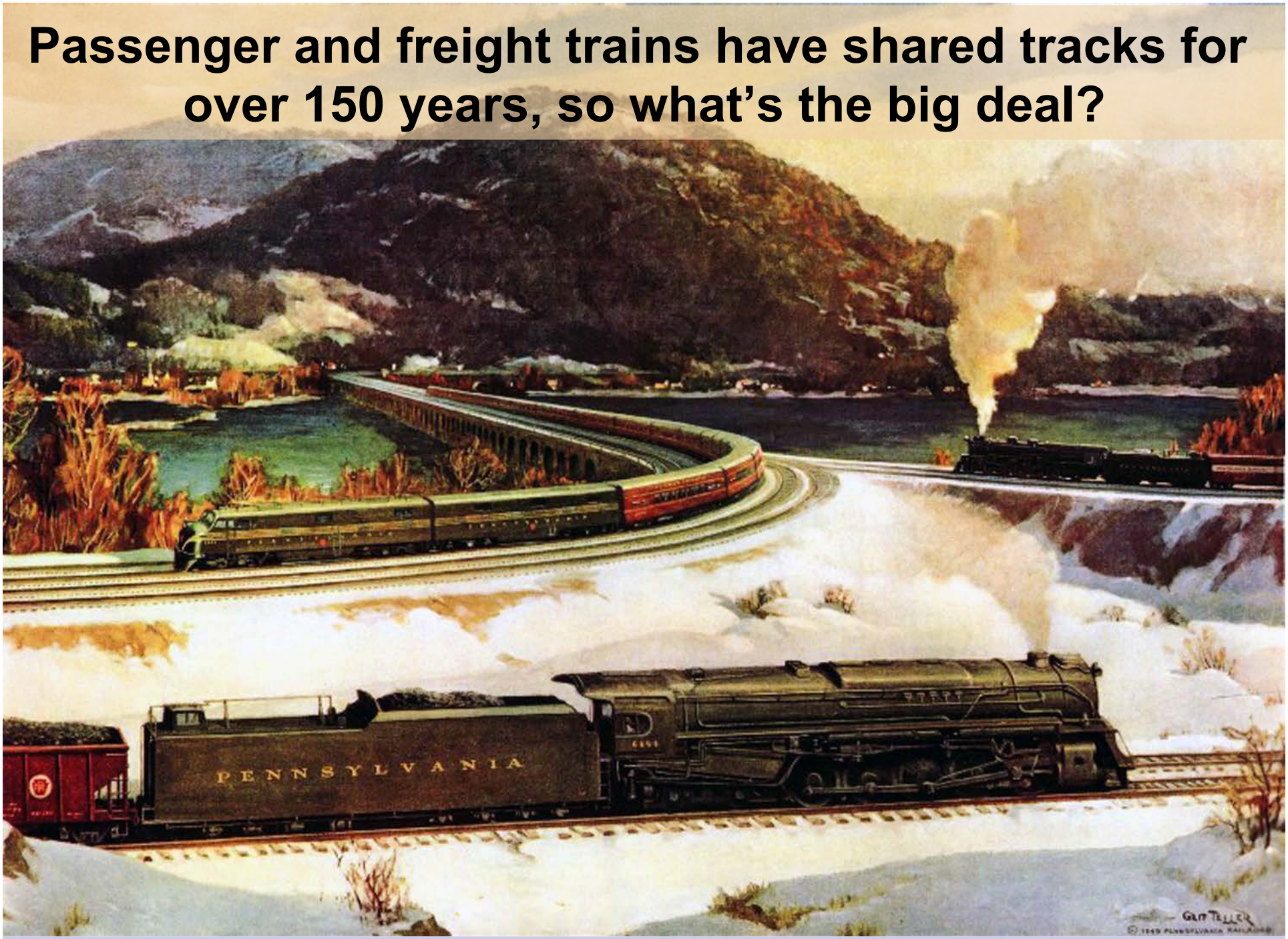
Higher-Speed Rail (HrSR)

80 - 110 mph

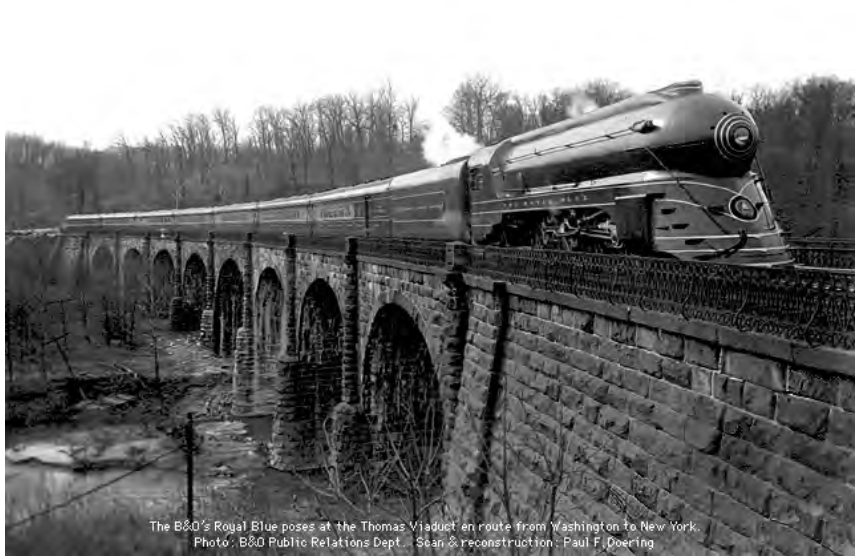
- Explanation for this confusing vernacular is that the International Union of Railways (UIC) defines HSR as ≥ 155 mph (250 kph)
- US maximum passenger speed on most lines outside northeast is 79 mph
- As US began to increase speeds, a means of referring to speeds higher than this norm was needed that was not inconsistent with international definition, hence **high*er*** speed
- Most questions about use of freight railroads for expanded passenger service are related to HrSR service, true HSR will use dedicated lines

* Strictly speaking normal Acela operation at 150 mph, just misses UIC definition, however Acela trains are capable of true HSR speeds

Passenger and freight trains have shared tracks for over 150 years, so what's the big deal?



Not your Grandpa's Railroad!

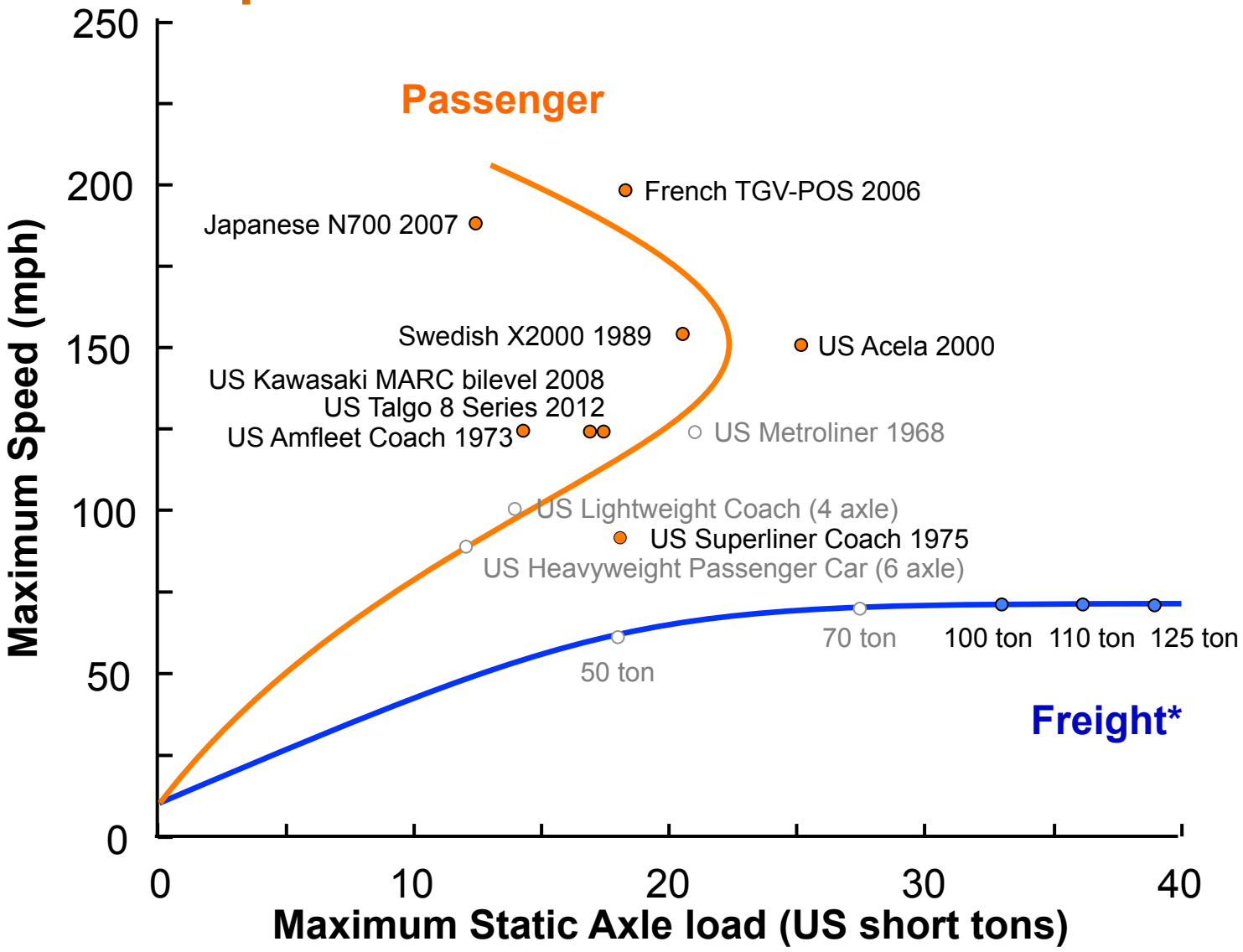


- The most successful freight and passenger railroads in the world are now highly specialized for their purpose
- Systems are *optimized* for their respective roles transporting ***freight*** or ***passengers***

High-Speed Rail (HSR) and Heavy-Axle Load (HAL) freight are like oil and water…they don't mix well

- HSR and HAL freight trains share track gage and traffic control system, but little else
- Increasing incompatibility between modern, highly efficient (HAL) freight trains and passenger train operation
- This is especially true for very high-speed (HSR) passenger trains

HAL vs HSR specialization: Maximum speed versus maximum static axle load



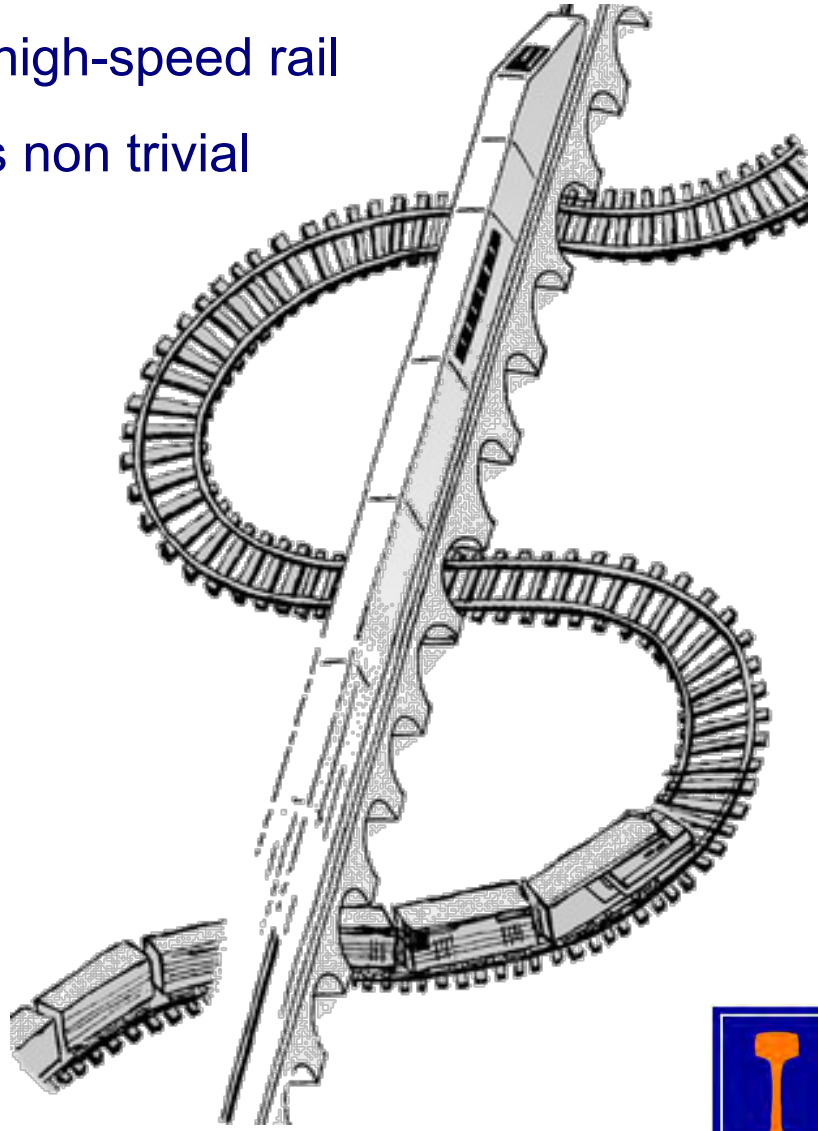
- Note that the Japanese N700 axle load is nearly 4 times less than the heaviest US freight car axle load

HAL and HrSR

- Heavy axle load (HAL) freight = 33-39 ton axle loads and speeds up to 70 mph
- Passenger train speeds up to 110 mph (HrSR)
- Can we accommodate the requirements of both, while maintaining high efficiency and performance of each?

Adapting HSR engineering and technology to US

- Extensive international experience with high-speed rail
- Adapting these to the US environment is non trivial
- Variety of challenges including:
  - Safety
  - Infrastructure & Rolling stock
  - Planning and Operation
  - Economic and Institutional
- These require multiple, context-dependent solutions
- R&D needed and implementation may be costly
- Institutional and regulatory flexibility essential for success



Study of Major Technical Challenges and Research Needs

- University of Illinois conducted a study for the US DOT Federal Railroad Administration
- "*Investigating Technical Challenges and Research Needs Related to Shared Corridors for High-Speed Passenger and Railroad Freight Operations DOT/FRA/ORD 13/29*"
- Identified and described a number of technical and Institutional challenges that must be addressed in order to increase passenger train speed and frequency on US freight railroads

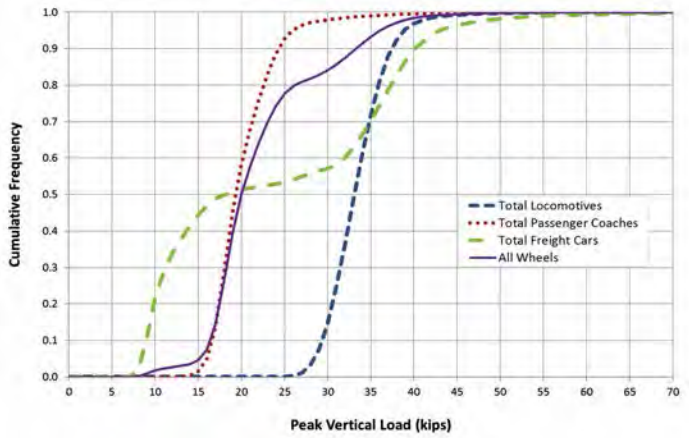
https://www.fra.dot.gov/eLib/details/L04578

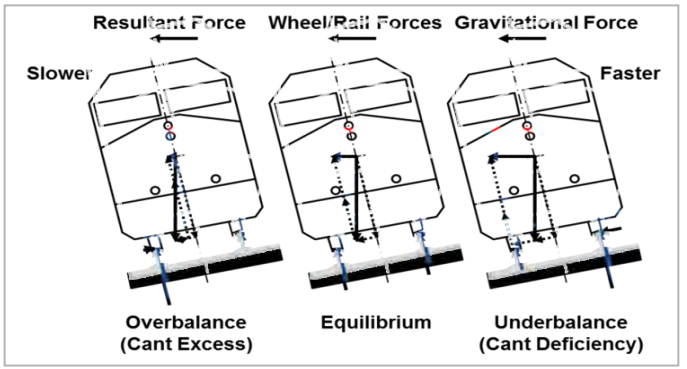
Safety and Risk Considerations

- Track centers
- Adjacent track derailments
- Safety of maintenance and train crews
- Capacity effects of work on adjacent tracks
- Aerodynamic effects of high-speed rail
- Wayside defect detection
- Broken rail detection
- Grade crossing protection

Infrastructure and Equipment

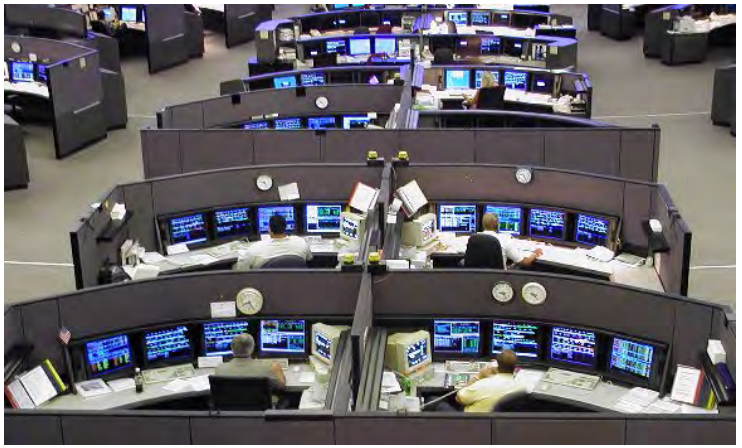
- Track alignment and geometry
- Wheel loads and track response
- Differing vehicle-track interactions
- Track type – ballasted/slab
- Special trackwork
- Track transitions
- Stations, platform height & position
- Clearances
- Rolling stock standards
- Truck design / tilt technology
- Train-control technology (PTC)

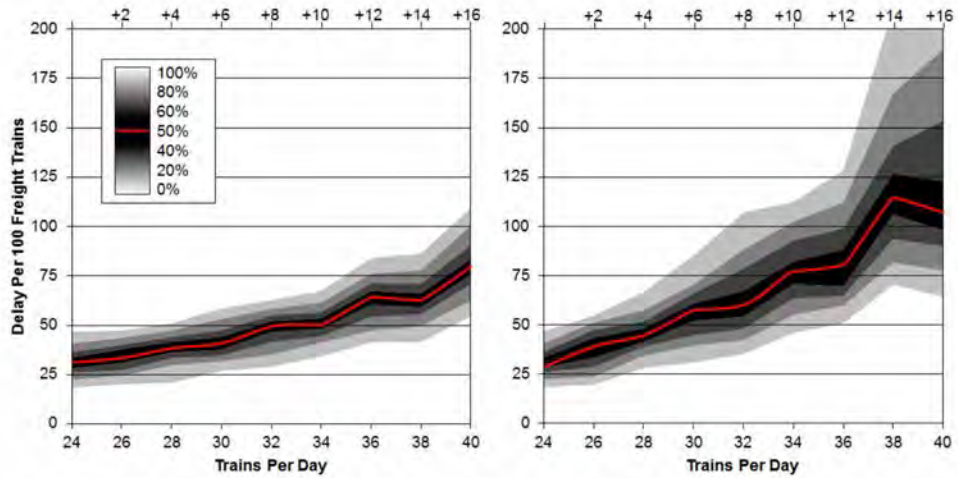


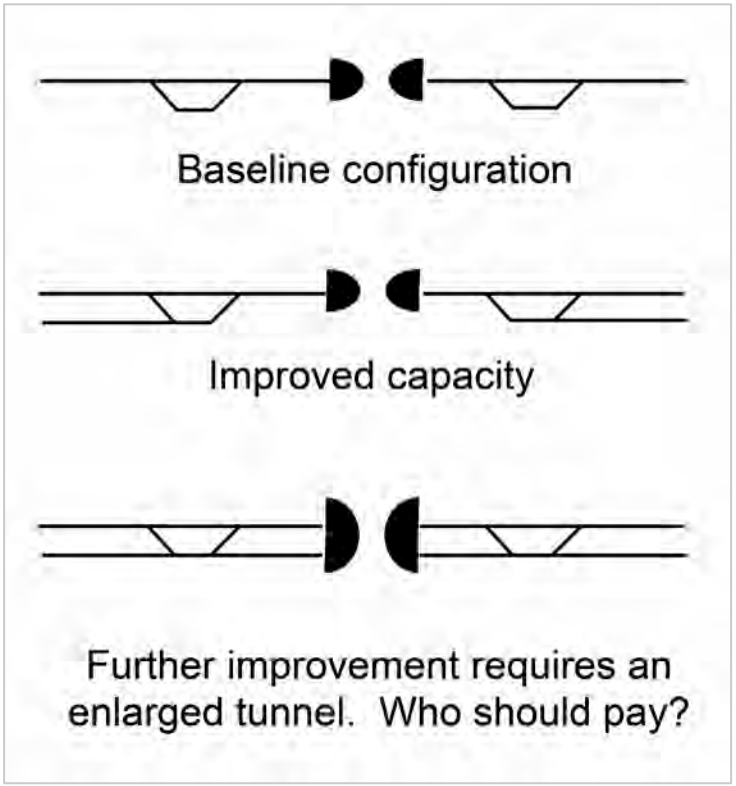


Planning and Operation

- Planning processes
- Host railroad negotiation
- Scheduling
- Interference & incompatibility
- Capacity & service quality
- Reliability & train delays
- Train control & operations (PTC)

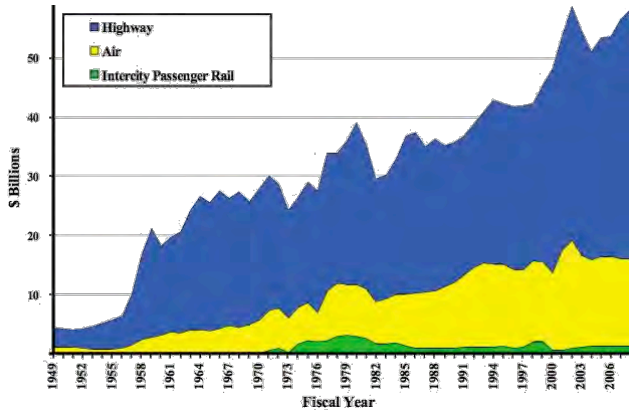


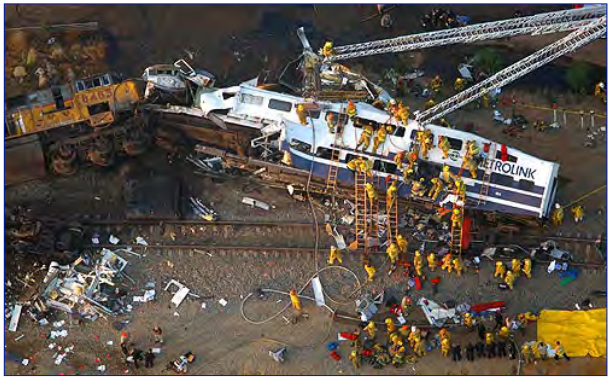


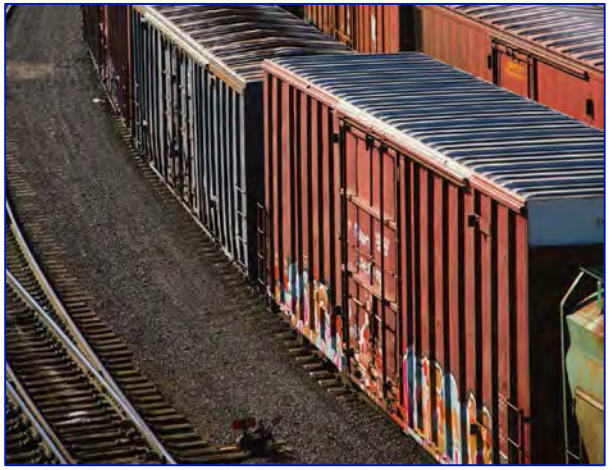


Economic and Institutional

- Capital cost sharing
- Sustainable funding
- Grant agreement structure
- Passenger operation viability
- Maintaining freight service
- Performance incentives/penalties
- Public/private partnerships
- Liability and risk management
- Stakeholder objectives
- Regulatory compliance







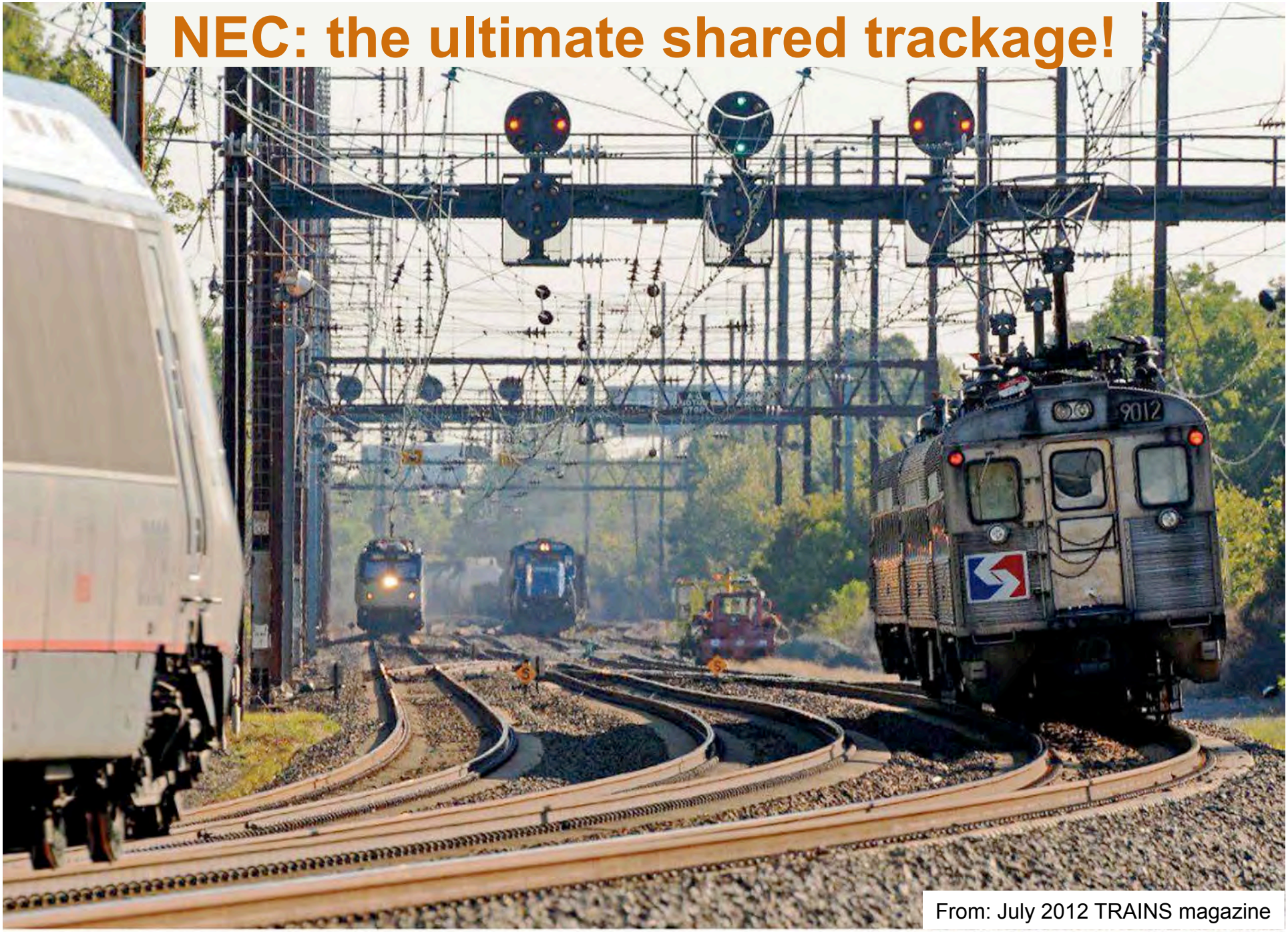
Numerous Stakeholders With Multiple, and Sometimes Conflicting, Objectives

- Infrastructure owners
- Rail traffic controllers *(in U.S. often the same as owner)*
- Service operators
  - Freight *(in U.S. often the same as owner)*
  - Passenger
- Federal, state, regional and municipal government agencies
- Regulators
- Suppliers
- Non-government organizations (NGOs)
- General public
- ***Cooperation and regulatory & institutional flexibility essential***

Shared Use Operations

- Who operates the trains and who owns the right-of-way?
- For shared use operations, good partners are a must
  - Each must understand and respect the other's requirements
  - Each situation is unique
  - Agreements must reflect the desired outcomes
- Once the joint requirements are articulated, the infrastructure configuration can be determined
  - Size and configuration drives investment requirements
  - Investment drives the maintenance requirements
- Amtrak's Northeast Corridor (NEC) is arguably the most complex shared corridor in North America
  - Mostly owned by Amtrak
  - 9 commuter partners
  - 7 freight partners

NEC: the ultimate shared trackage!



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A northbound Acela and southbound *Regional* approach at Newport, Del., while SEPTA and NS trains wait on Sept. 19, 2008. Michael S. Murray

Acknowledgements and Contact Information

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Appendix: Shared Use Implementation Challenges Summary

- ***Safety and Risk Considerations***
  - Track centers
  - Adjacent track derailments
  - Safety of MW and T&E crews
  - Capacity effects of work on adjacent tracks
  - Aerodynamic effects of HSR
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  - Capital cost sharing
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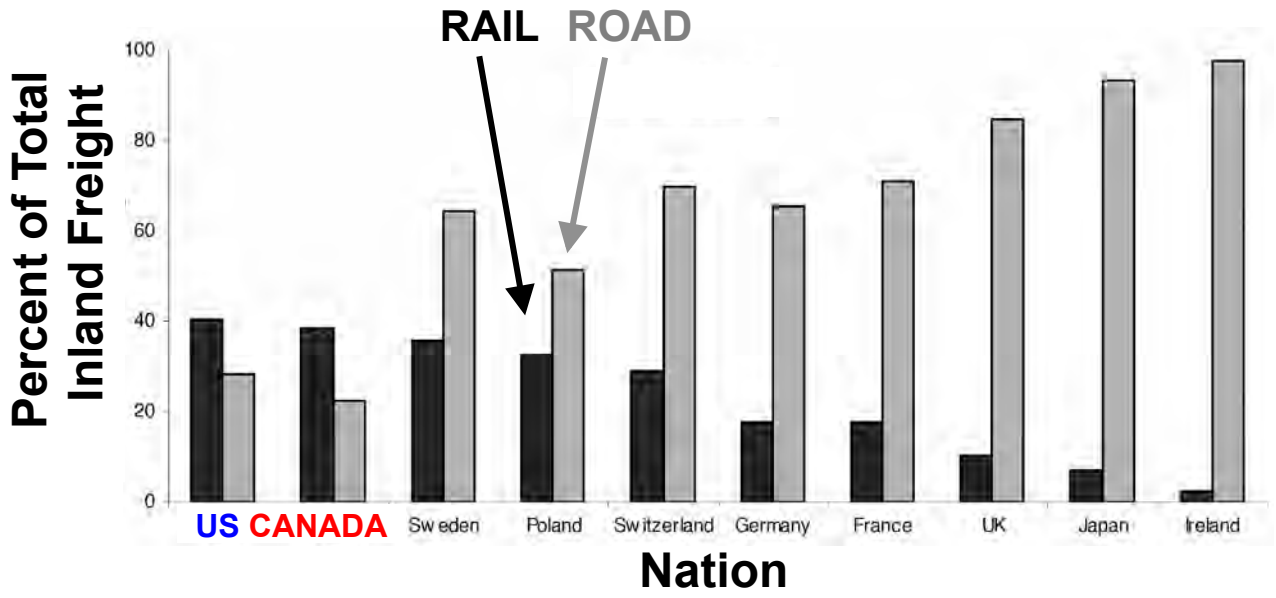
  - Freight service levels
  - Performance incentives/penalties
  - Public/private partnerships
  - Liability and risk management
  - Stakeholder objectives
  - Regulatory compliance
  - Grant agreement structure

So how do the Europeans and Asians have such successful passenger rail systems?

- Dedicated rail lines for very high speed (>155 mph)
- Principal focus on passenger, *not freight*, on non-dedicated rail lines
  - Much more rail freight moves by truck
  - Many overseas railroads *lose money* on freight transport



- 2003 data from Organisation for Economic Co-operation and Development