Network Centric Railroading
Utilizing
Intelligent Railroad Systems

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Network Centric Railroading

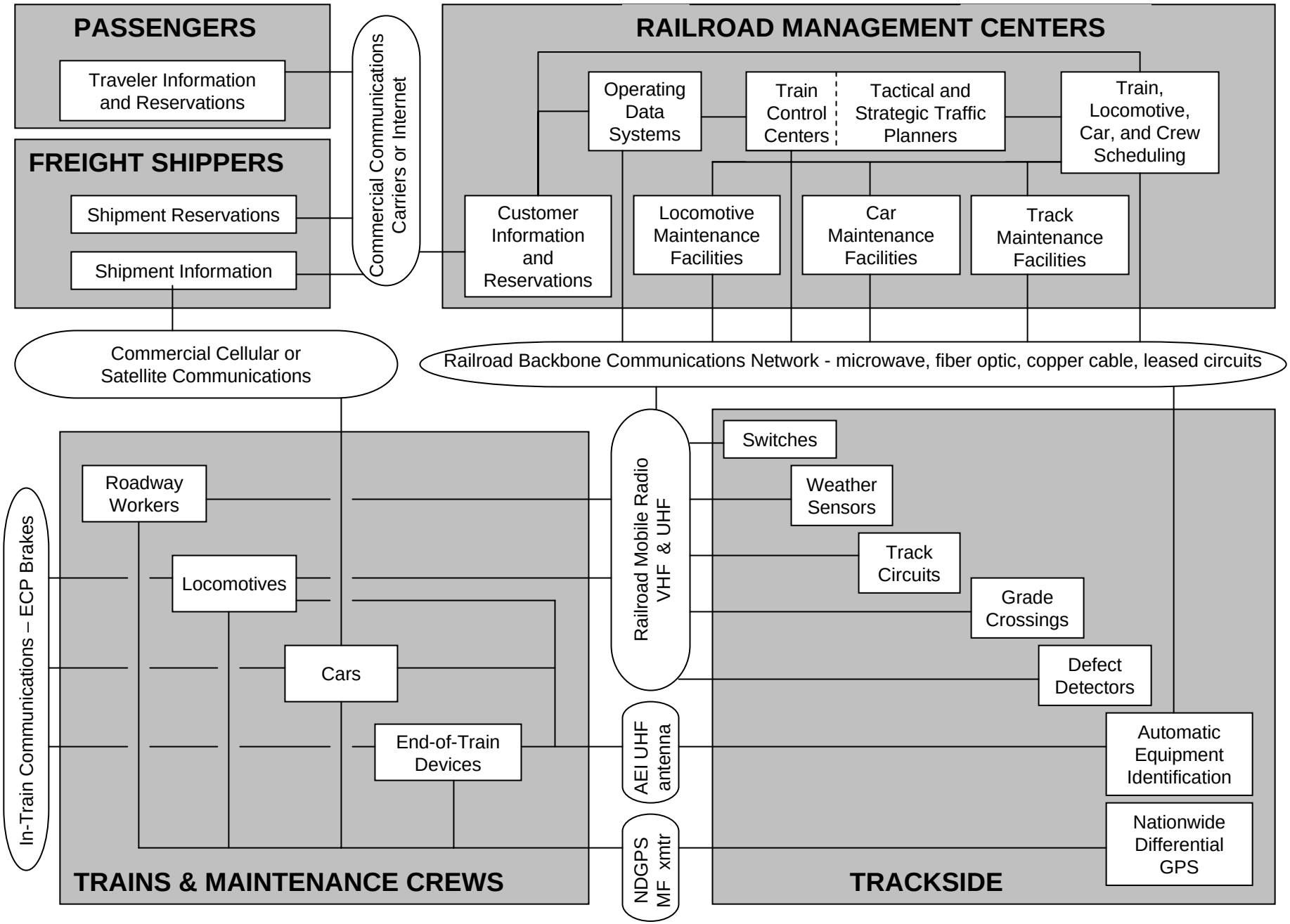
Use ***integrated*** digital data communications, sensors, and computers on railways to:

- Improve both safety and security
- Raise effective capacity
- Improve asset utilization
- Improve customer satisfaction
- Measure and control costs
- Reduce energy consumption and emissions
- Increase economic viability and profits
- ***"Manage the unexpected"***

Intelligent Railroad Systems

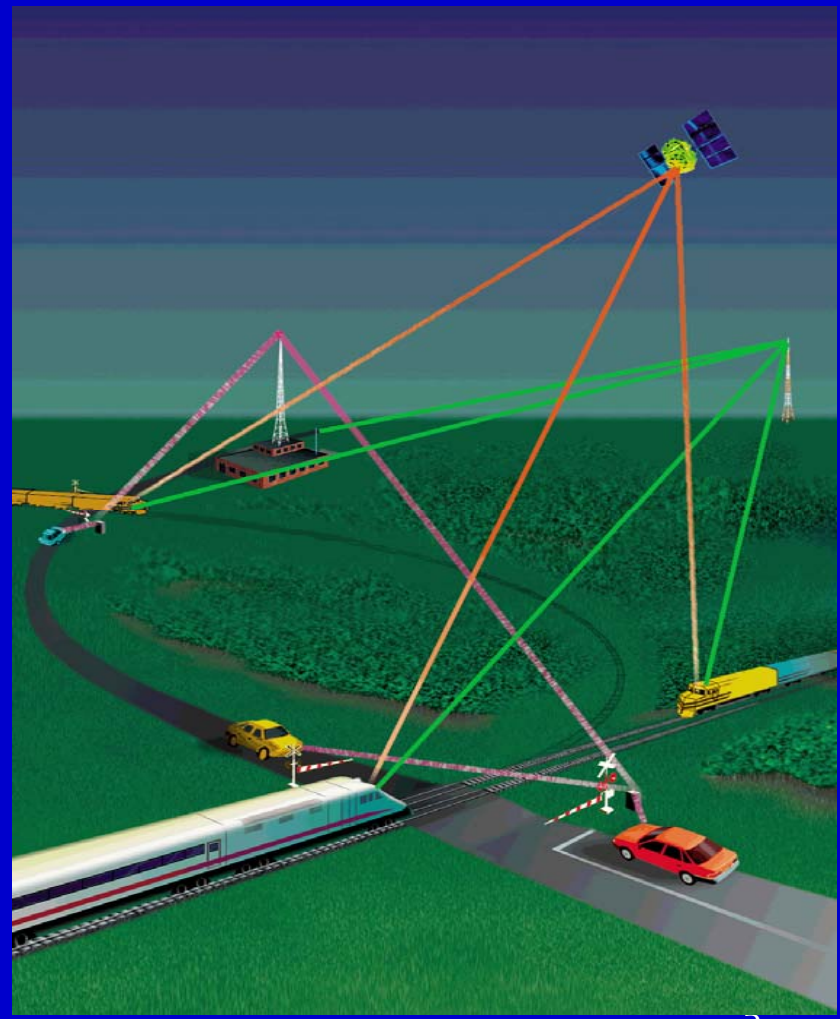
- Apply the same technologies used in:
  - Intelligent Transportation Systems
  - Air traffic control systems
  - Maritime vessel tracking systems
  - Parcel delivery services
  - Emergency response services
  - Military command and control

NETWORK CENTRIC RAILROADING



The Principal Intelligent Railroad Systems

- Digital data communications
- Positive Train Control
- Differential GPS
- Electronically-controlled pneumatic brakes
- Automatic equipment identification
- Intelligent grade crossings



System Security

- Must be designed into Intelligent Railroad Systems before deployment
- Data regarding trains, cars, crews, and shipments must be kept confidential
- Authentication of data will insure that the content is genuine, unaltered, and complete
- Unwarranted extraction of information from communications net must be prevented
- Encrypt data to keep it out of wrong hands

Positive Train Control

- Provides safety benefits by:
  - Preventing collisions
  - Preventing overspeed accidents
  - Protecting roadway workers
- Provides enhanced security through:
  - Monitoring location and speed of all trains
  - Monitoring all switches, bridges, tunnels, etc.
  - Only authorized persons controlling trains
  - On-board enforcement of all movement authorities
  - Remote intervention capability

Positive Train Control Components

- Along the wayside
  - Digital data radios and backbone comm net
  - Wayside interface units at switches and detectors
- On locomotives and maintenance vehicles
  - On-board computer with digital maps
  - Positioning system
  - Throttle-brake interface
  - Integrated displays
- At the control center
  - Dispatching computer with displays

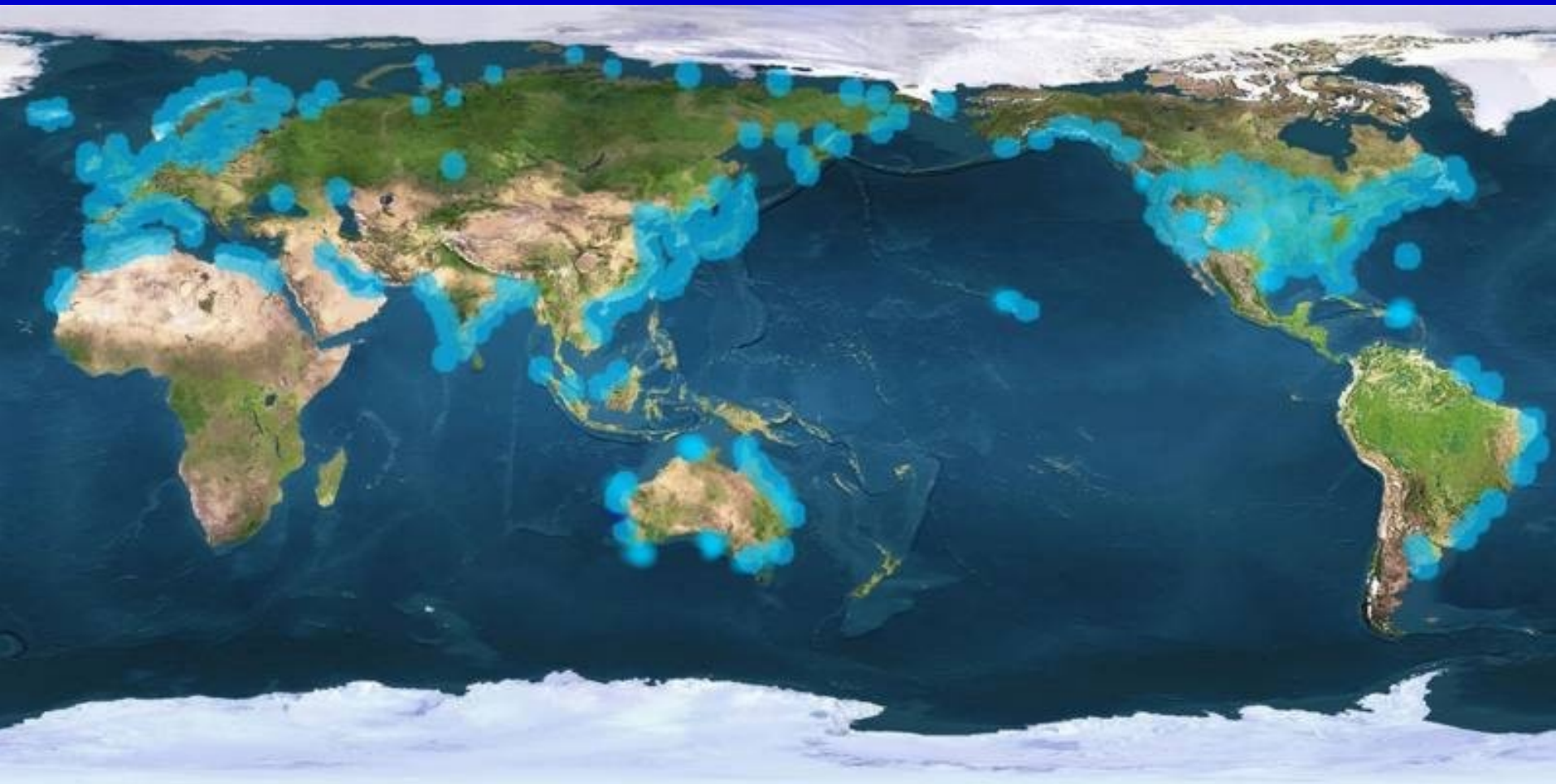
PTC Positioning

- Train positioning integrates multiple inputs:
  - Augmented GPS
  - Odometer
  - Switch position indicators
  - Digital track map in on-board computer
- Train position sent by data link to control center; movement authorities sent by data link from control center to trains
- Track centers are 4 m apart, which requires 1-2 m accuracy (i.e., DGPS)
- Accurate positioning also needed at clearance points at switches

Differential GPS

- Augments signals from GPS constellation: 1-to-2 meter positioning accuracy
- DGPS monitors GPS integrity; users receive warning of GPS degradation within 5 seconds
- Currently operational in US with single coverage over 95% of country and double coverage over 65%
- Signals available to anyone with proper receiver; no user fee
- International standard (RTCM 104) developed by USCG; used in 40 countries

Worldwide DGPS Coverage



Automatic Equipment Identification

- Two passive AEI (ie., RFID) tags installed on each North American freight car and locomotive since 1995; AAR Interchange Rule, no government involvement
- Readers at track-side interrogate tags at 900 MHz radio frequency; they require periodic “tuning” to maintain 100% read rate
- Tags respond with vehicle initial and number
- Can be integrated with wayside equipment sensors to identify specific cars with problems
- Active tags with read-write capability also available; require periodic battery replacement

AEI Tag and Reader

AEI Tags for Containers and Trailers

- ISO has adopted same tag for containers as a voluntary standard
- Railway AEI standard is based on ISO container tag standard
- ATA has adopted same tag for truck trailers and chassis as a voluntary standard
- It would be ideal if container and trailer tagging standards became mandatory as with rail cars

Work Order Reporting

- Instructions sent from control center to train crews to set out and pick up loaded and empty cars en route
- On-board train consist updated automatically based on crew acknowledgement of work order completed
- Location of set-outs automatically recorded
- Train consists in central computers also updated in real time
- Customers can be automatically notified of impending or actual car placement
- Important for establishing “custody chain” of shipments

Tracking Hazmat and Other Shipments

- AEI confirms the locos and cars on each train and sends it to operating data system
- DGPS receiver determines location of the loco to within 1-2 meters and speed to within 1-2 km/hr and data radio transmits it back to dispatchers and operating data system
- Work order reporting system confirms set-outs and pick-ups and sends it to operating data system
- Data in train location, train consist, work order reporting, and waybill data bases can be merged to ***precisely*** locate ***every*** car/shipment
- Authorized parties (at railway and shipper) can inquire about precise car/shipment location

Other Intelligent Railroad Systems

- Knowledge display interfaces
- Crew alertness monitoring systems
- Track forces terminals
- Wayside equipment sensors
- Wayside track sensors
- Locomotive health monitoring systems
- Energy management systems
- Vehicle-borne track monitoring sensors
- Crew registration and time-keeping systems
- Car on-board component sensors
- Car on-board commodity sensors
- Intelligent weather systems
- Tactical traffic planners
- Strategic traffic planners
- Train, locomotive, car, and crew scheduling systems
- Emergency notification systems
- Yield management systems
- Travelers' advisory systems

Impediments to Implementation of Network Centric Railroading

- Magnitude of costs; competition for capital
- Pressure by the investment community to deliver near-term on investments
- Shortage of capital due to mergers and post-merger problems at US railways
- Time to implement – 7 to 10 years in the US; 3 to 5 years on smaller railway systems
- Lack of trained staff
- Fear of change, institutional and individual
- Unwilling to view existing systems as sunk costs

More Impediments to Implementation of Network Centric Railroading

- US railways do not think customers will pay more for improved service
- US railways discount “soft” efficiency benefits heavily, count only “hard” labor and fuel savings
- Some rwys try to minimize cost of subsystems and not optimize total system
- Some rwys want PTC based on existing operating rule books, not on new paradigm
- Rwys are implementing independent, not integrated systems
- Separation of rwys into infrastructure and operating companies

Summary

- Network Centric Railroading is an ***integrated*** "system of systems"
- The world economy is growing; officials are concerned about highway capacity
- Railway security continues to be a front-page story, "Where are the hazmat shipments?"
- Railways need more profits
- Railway safety, security, efficiency, and profitability are all achievable with Network Centric Railroading and intelligent railroad systems
- Network Centric Railroading can help railways play a more significant role in their national economies

Questions ?

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