Meeting the Communication Challenges for Positive Train Control
What is Positive Train Control?

- **Railroad Safety Advisory Committee- 3 core objectives**
  1. Prevent train to train collisions.
  2. Enforce all forms of speed limits (permanent, temporary speed restrictions, and switch speeds).
  3. Protect roadway workers working within their authorized limits.
     - PLUS 1: Protect against switches not lined properly.
PTC - Objectives

• Safety
  – Warnings and Alerts
  – Enforcement of safe practices

• Efficiency
  – Instructive display
  – Electronic communication
  – Visibility in Non-Signal Territory

• Vitality
  – Designed with same integrity of existing signaling systems
  – Fails to known safe state
RAILROAD INDUSTRY LEADERS AGREE ON ESTABLISHING POSITIVE TRAIN CONTROL INTEROPERABILITY STANDARDS

FOR IMMEDIATE RELEASE:

OMAHA, Neb., FORT WORTH, Texas, and NORFOLK, Va., October 8, 2008 – Union Pacific Corporation (NYSE: UNP), Burlington Northern Santa Fe Corporation (NYSE: BNI) and Norfolk Southern Corporation (NYSE: NSC) today announced that they have reached an agreement on establishing interoperability standards for Positive Train Control (PTC), a critical component to safely implementing PTC technology across all rail systems.
ITC Agreement

- BNSF/CSX/NS/UPRR sign agreement to establish positive train control interoperability standards
  - Develop PTC standards
    - Uniform interface standards
    - Messaging format
    - Wireless protocol
    - Braking Algorithm
  - Interoperable hardware platforms
    - Waysides
    - Base stations
    - Locomotives
  - Infrastructure sharing
  - Utilization of 220MHz frequency spectrum
Train Control Interoperability

- Must have agreement at many levels to interoperate
  - Application- System Functional Behavior
  - Messaging- Format, Content, Track Database
  - Crew Display (HMI)- Same form, function, feel
  - Wireless (RF) protocols- Minimized wireless infrastructure
  - Transport protocols- Support multiple wireless/wired paths
- FRA approval of “Type Approval” for joint operation
Norfolk Southern Pilot Territory

- Charleston to Columbia
  - Non-signaled
  - 114 Route Miles

- Columbia to Charlotte
  - Signal Territory - ABS & CTC
  - 108 Route Miles

Charlotte
Columbia
Charleston

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OTC - Electronic Delivery

The Track Database, Train Clearance, Bulletins and Track Authorities, are sent electronically for display to the crew. This data is used by OTC to generate Warnings and Enforcement.
OTC - Warnings and Alerts

System monitors safe operating conditions including switch positions, speed restrictions and authorities and provides warnings of changing conditions.
OTC - Enforcement

If action is not taken to bring the train into safe operating conditions, the system will apply brakes to bring the train to a safe stop.
PTC Segments

Office Segment
- Dispatch
- Asset Tracking System
- Message Router
- OTC Back Office
- Communications Segment
- Locomotive Segment

Wayside Segment
- Wayside Control Points
- Monitored Switches
- Other Monitored Devices

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Background

S/A BOS
TCP/IP
XML
SOAP/HTTPS
UDP
Routining

UTCS
ATCS
TCP/IP
XML
SOAP/HTTPS
JMS/MQ

EMP
G/D BOS (1)
G/D BOS (2)
CI BOS

Management
Transformation
Routing

Business Process
Messaging
(Local Queues)
Monitoring
Auditing
Logging
Alerting

Engineering GIS
Network Time Server(s)

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November 19, 2008

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Wayside to Locomotive Components

Wayside

Wayside Communications Module (WCM)

Radio (Pilot: 220 MHz RCL)

Class C

WIU

Locomotive

Locomotive Communications Module (LCM)

Radio (Pilot: 220 MHz RCL)

Class C

TMC

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On-Board Network (OBN) Enclosure
Back-Office Network Components

• OBN Back-End
  – Firewall Services
  – VPN Services
  – Routing Services
  – Mobile IP Home Agent Services

• OTCMR/BOS Network Hosting
PTC-220 LLC

- 200 KHz nationwide
- 8 x 25 KHz channels OR 4 paired channels
- 80 KHz regional/nationwide

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Nationwide 220 MHz spectrum

• Acquisition 220 MHz spectrum nationwide
  – Need separate spectrum for wide area data services for train control
  – Similar propagation characteristics to existing VHF voice radio systems
  – No off-the-shelf radio design available to support train control
Key High Level technical details:

1. Radios will operate on 220 MHz channels
   - Radios will support office to locomotive comms.
   - Radios will support locomotive to wayside comms.
2. Three discreet radios under development
   - Base
   - Locomotive
   - Wayside
3. Channel access is TDMA
   - Base assigns channel slot
4. All radios will use GPS-based timing
In Conclusion

• Effective communication paths will be:
  – Crucial to successful PTC deployment
  – Multiple paths - 220 MHz, Digital cell, Satellite, 802.11

• Evaluating new technology options
  – WiMax
  – LTE