PTC-220, LLC Overview

History

- Concept is to secure spectrum to support interoperable PTC
  - Wireless connectivity has been one of the "Achilles Heels" of PTC development efforts to date
  - Acquire spectrum as needed to meet demand

- 7 Equal Members comprised of the Class 1 railroads
  - Formed by NS and UP in late 2007
    - Original purchase of 280 kHz of nationwide 220 MHz spectrum
    - Various nationwide licenses and aggregated regional licenses
  - Joined by BNSF and CSX in early 2010
    - BNSF spectrum added 100 kHz of nationwide spectrum
  - Joined by CN, CP, and KCS in 2011

- Operates through multiple committees made up of volunteers from the Members
    - Management Committee, Spectrum Management Committee (SMC), Legal, Finance, Tax

Why 220 MHz for PTC?

- Considerations
  - Availability, Cost, Propagation, Compatibility with Rail Infrastructure
- Evaluation
  - 44 MHz, 160 MHz, 220 MHz, 450 MHz, 900 MHz, Cellular, Satellite
- Findings
  - VHF is best suited to rail infrastructure
  - 160 MHz issues with existing voice use and other users
  - Others seeking to purchase spectrum for commercial use impacts availability and cost (ie: competing with cell providers)
- Selected 220 MHz
  - Available, Cost effective, Propagates well, leverages existing railroad tower infrastructure, minimizes interference when co-located with existing 160 MHz

Making shared spectrum work…

- Unprecedented complexity for railroad industry to deploy a fully interoperable nationwide data radio network capable of supporting PTC's low latency requirements

- Spectrum Management Committee
  - Manage spectrum licenses and leases
  - Primary goal of efficient spectrum use
  - Construction planning and coordination
  - Congested area designs
  - Mitigate and address radio interference
  - Monitor demand and identify capacity constraints
  - Dispute resolution

Operating Plan

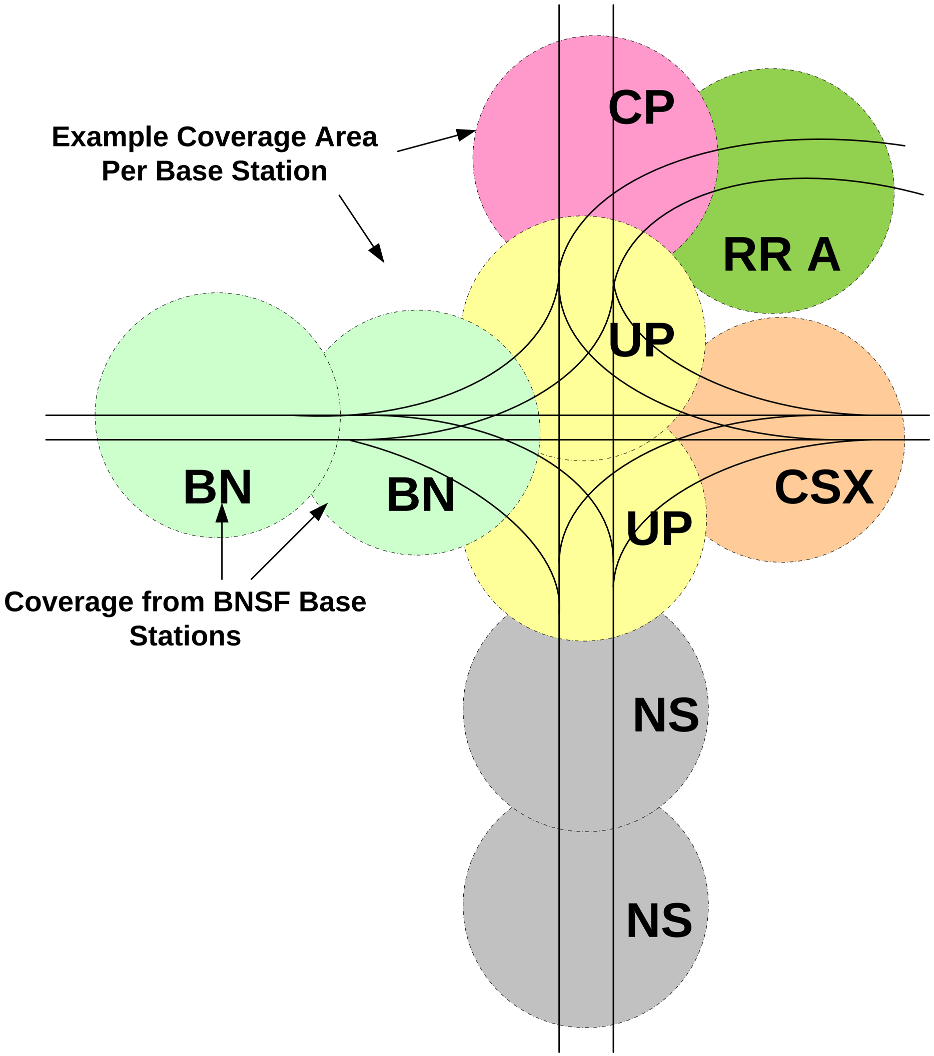
- PTC-220 owns spectrum licenses and leases spectrum to users who are responsible for buildout and associated infrastructure
  - Members represent overwhelming majority of PTC deployment mileage
  - All Members will have leases
  - Non-member leases provided on spectrum availability
  - Infrastructure is shared to maximize spectrum efficiency

- Non-Member Lease Guiding Principles
  - Non-members pay their fair share
  - Reasonable allocation of costs:
    - Acquisition cost of 220Mhz spectrum (usable for PTC)
    - PTC-220 Ongoing operating costs
  - Lease rate calculations should be simple and easy to understand

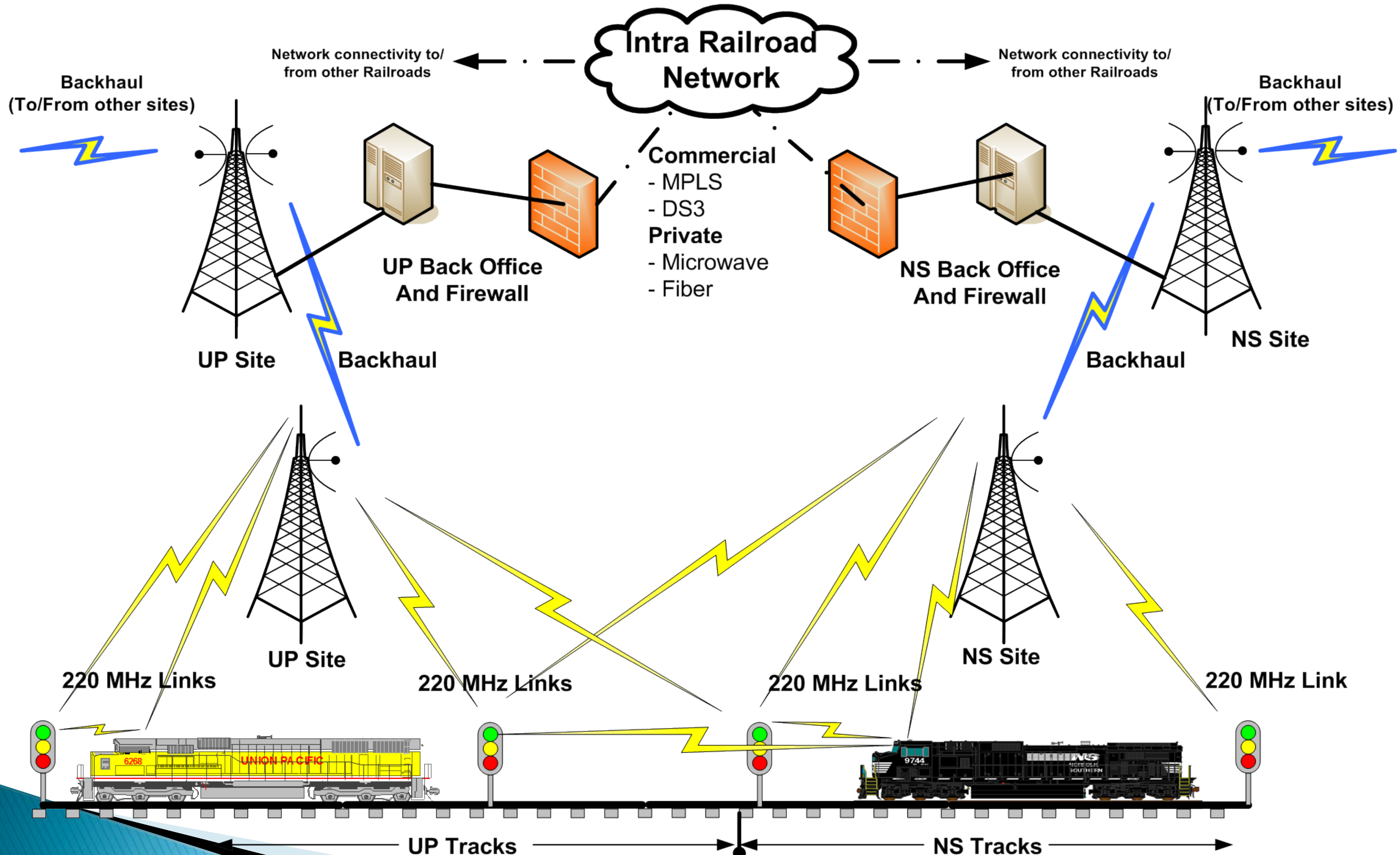
Progress Toward Implementation

- Tools and processes for shared network planning and coordinated deployment
- Congested areas require greater coordination and planning due to high demand and limited spectrum availability

Example Joint Operations Diagram
LLC Members and one Non-Member User



PTC 220 MHz Lessee Infrastructure and Network Connectivity Diagram



Substantial progress to date

- Current spectrum holdings appear to address most of the PTC deployment demand
- Collaborative relationship with FCC to facilitate efficient use of spectrum to support deployment for PTC
- Planning tools and software to support complex planning have been developed and are being used
- Lease holders have completed work on over 2,600 sites (nearly 400 base station and over 2,200 wayside)
- Field testing and validation of radio network is underway

More work to be done

- Secure additional spectrum where needed
  - While most areas have enough spectrum, some congested areas will require more
- Complexity of congested areas such as Chicago and Northeast are likely to require iteration and refinement
  - Congested areas present challenges due to complexity of rail networks and density of operations
  - Analysis either underway or completed in 8 congested areas
  - Designs must account for other 220 MHz licensed spectrum users to mitigate interference
- Validation of shared network and design must be completed to assure PTC interoperability is supported
- Lease holders still need to install over 35,000 sites to fully support PTC deployment