

An Enhanced Railroad Network for Infrastructure Assurance Analysis

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Experience with Rail Networks

- **Started working on rail routing issues at ORNL for Department of Energy in 1979**
 - INTERLINE model and routing network
 - TRAGIS model
 - Used by DOE for operations and planning
- **JPO Infrastructure Assurance work**
 - Started in 1997
 - Rail Interdependencies
 - Assisted with stovepipe studies
 - 1:100K rail network development

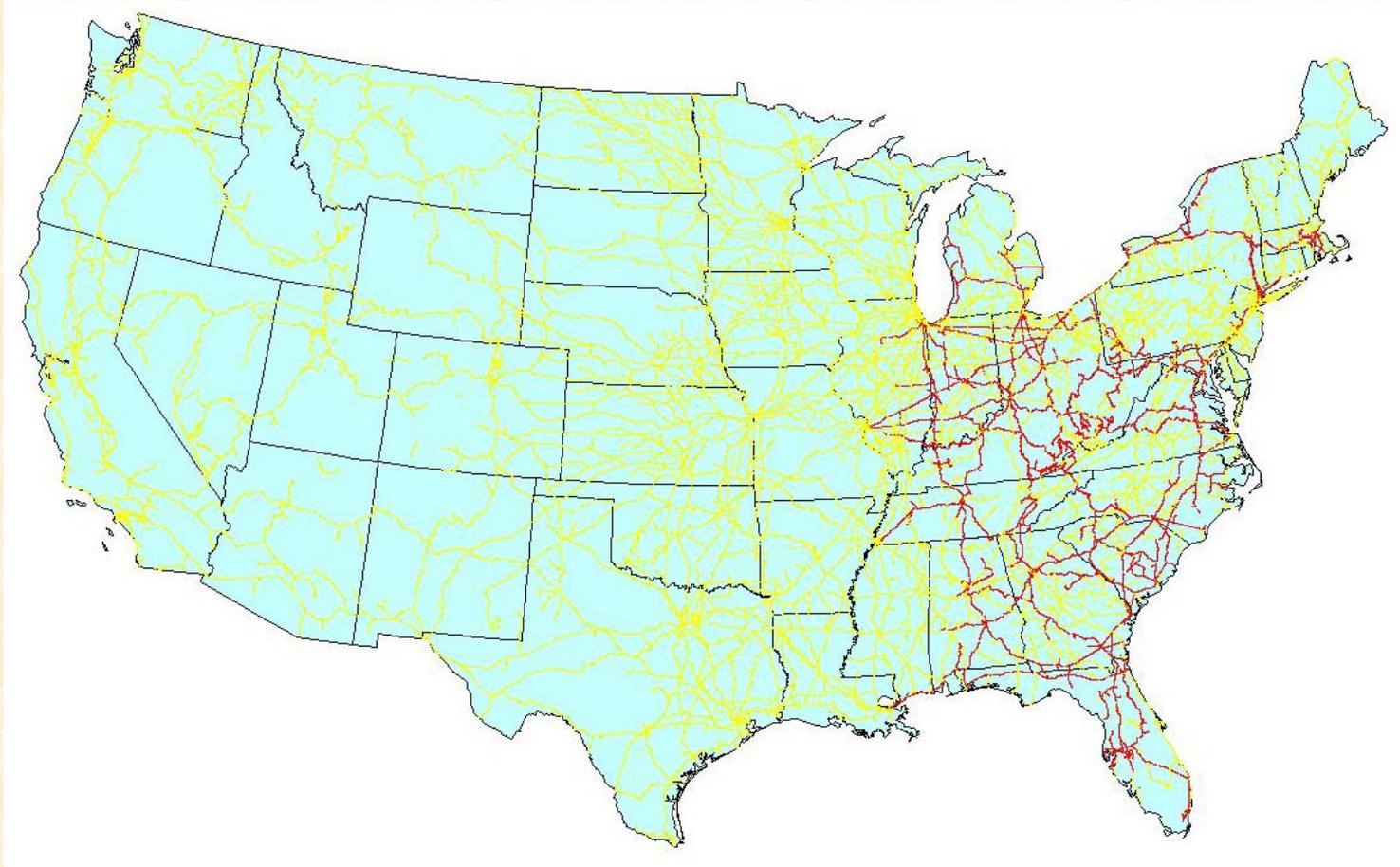
Rail Modeling Issues

- Rail is different than other transportation modes
- Private companies compete for traffic
- Cooperation between companies when origin and destination are not served by same RR
- Interchanges between railroads occur at fixed locations
- Right-of-ways owned by one company
- Trackage rights access by other RRs
- Each railroad attempts to maximize their revenue

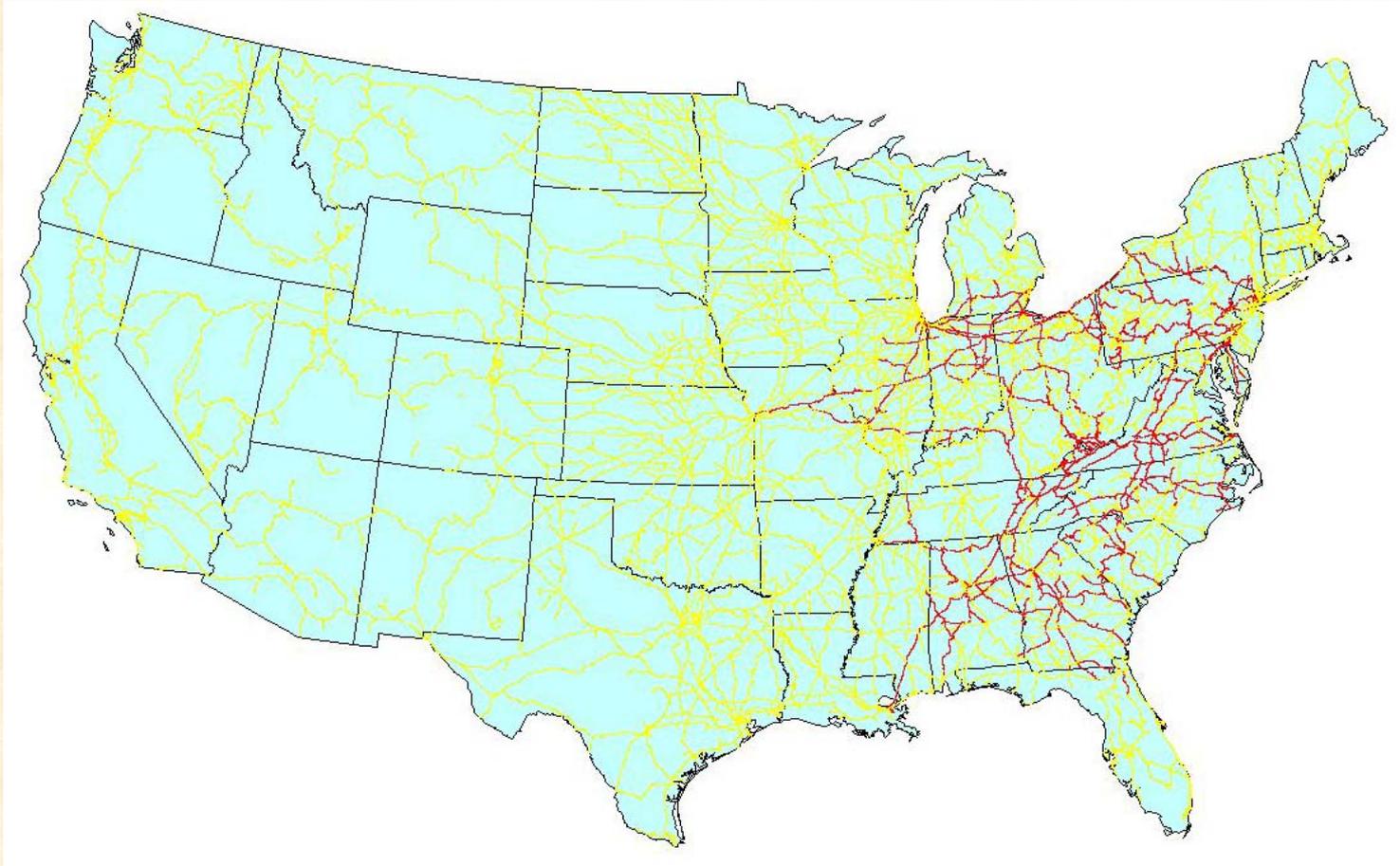
Railroad Companies

- **Over 500 railroad companies in U.S.**
- **Four large systems**
 - **CSX Transportation & Norfolk Southern in east**
 - **Burlington Northern Santa Fe & Union Pacific in west**
- **Canadian railways operate in parts of U.S.**
 - **Canadian National and Canadian Pacific**
- **Regionals**
- **Short lines**

CSX Transportation



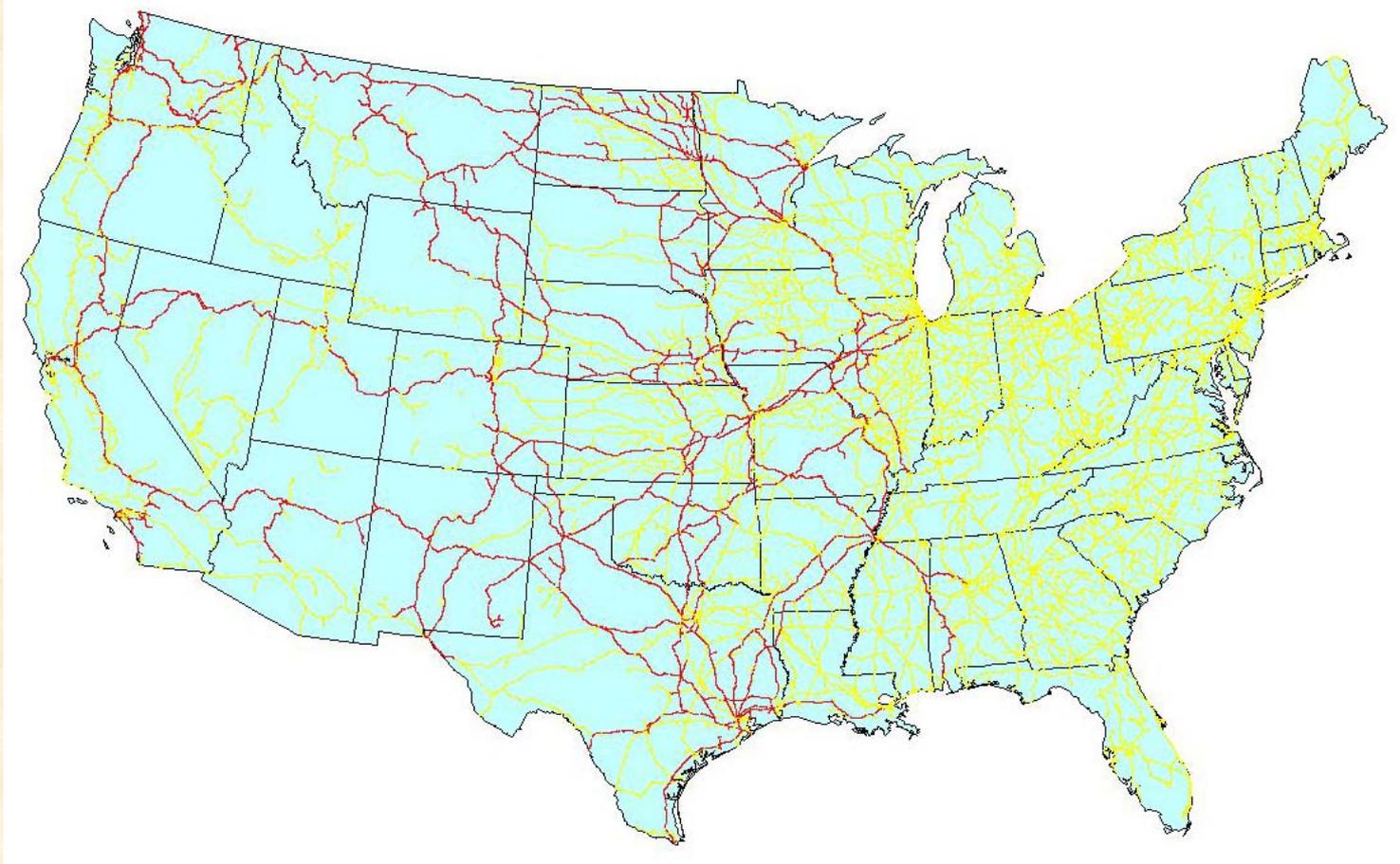
Norfolk Southern Railway



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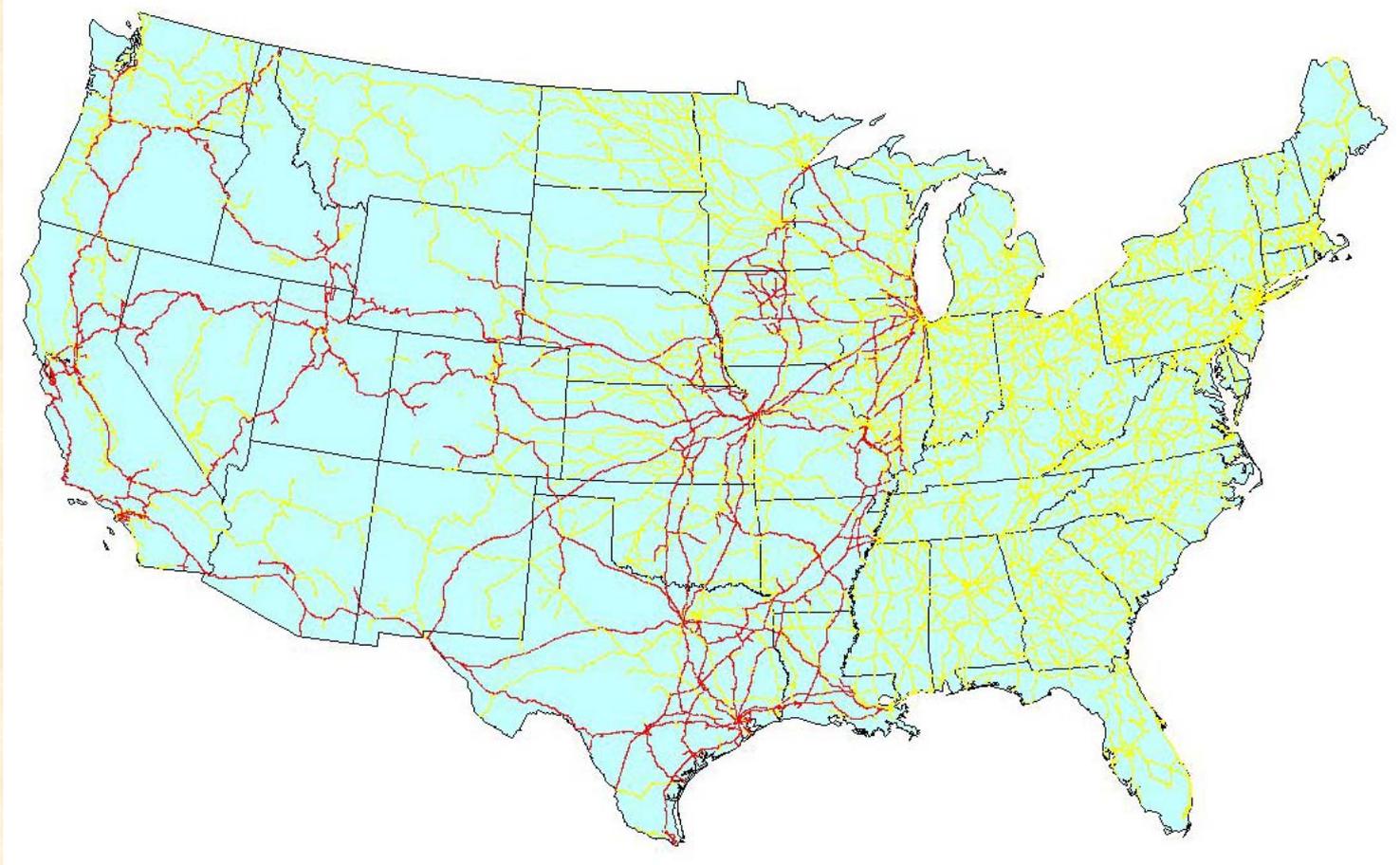
Burlington Northern Santa Fe Railway



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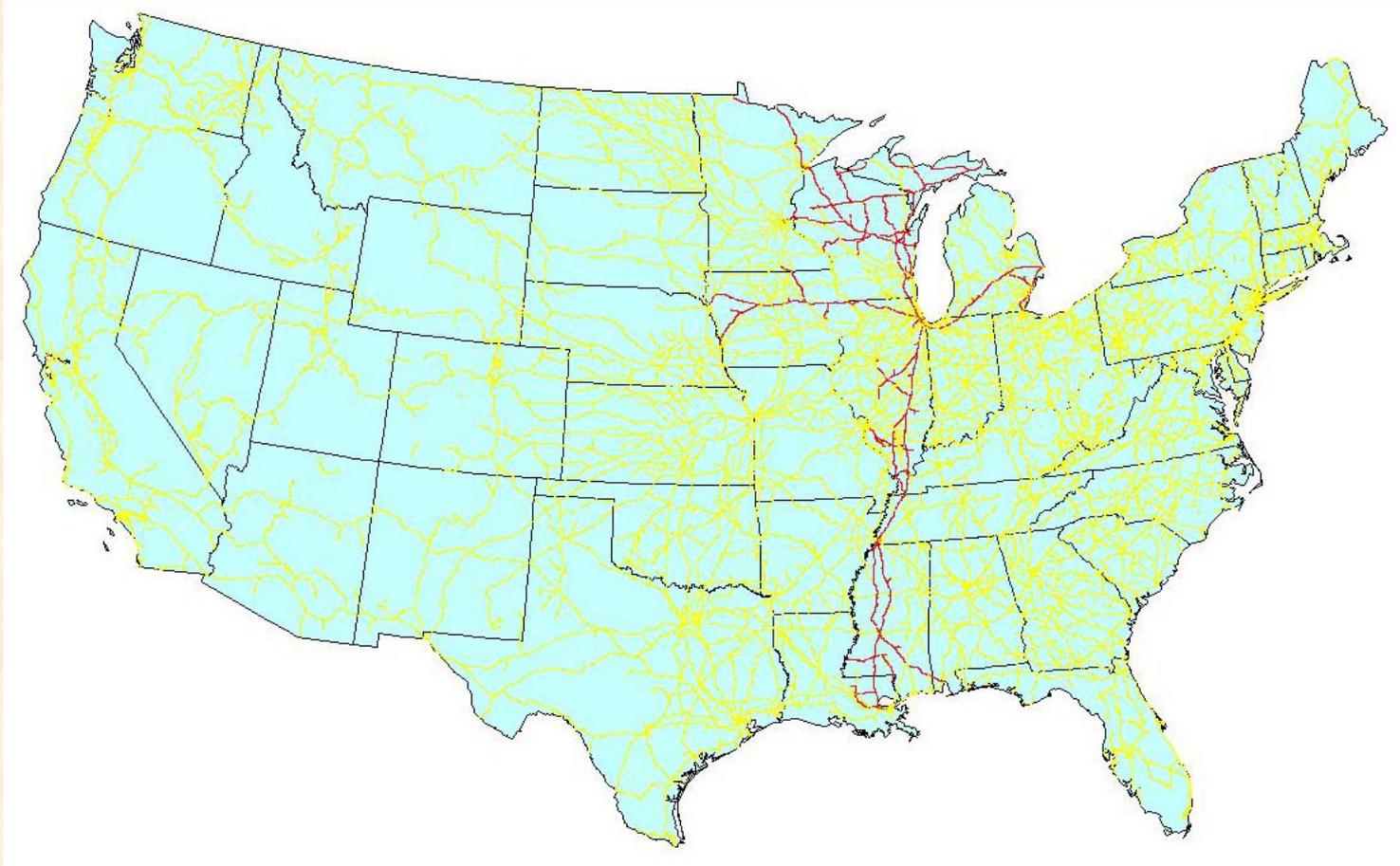
Union Pacific Railroad



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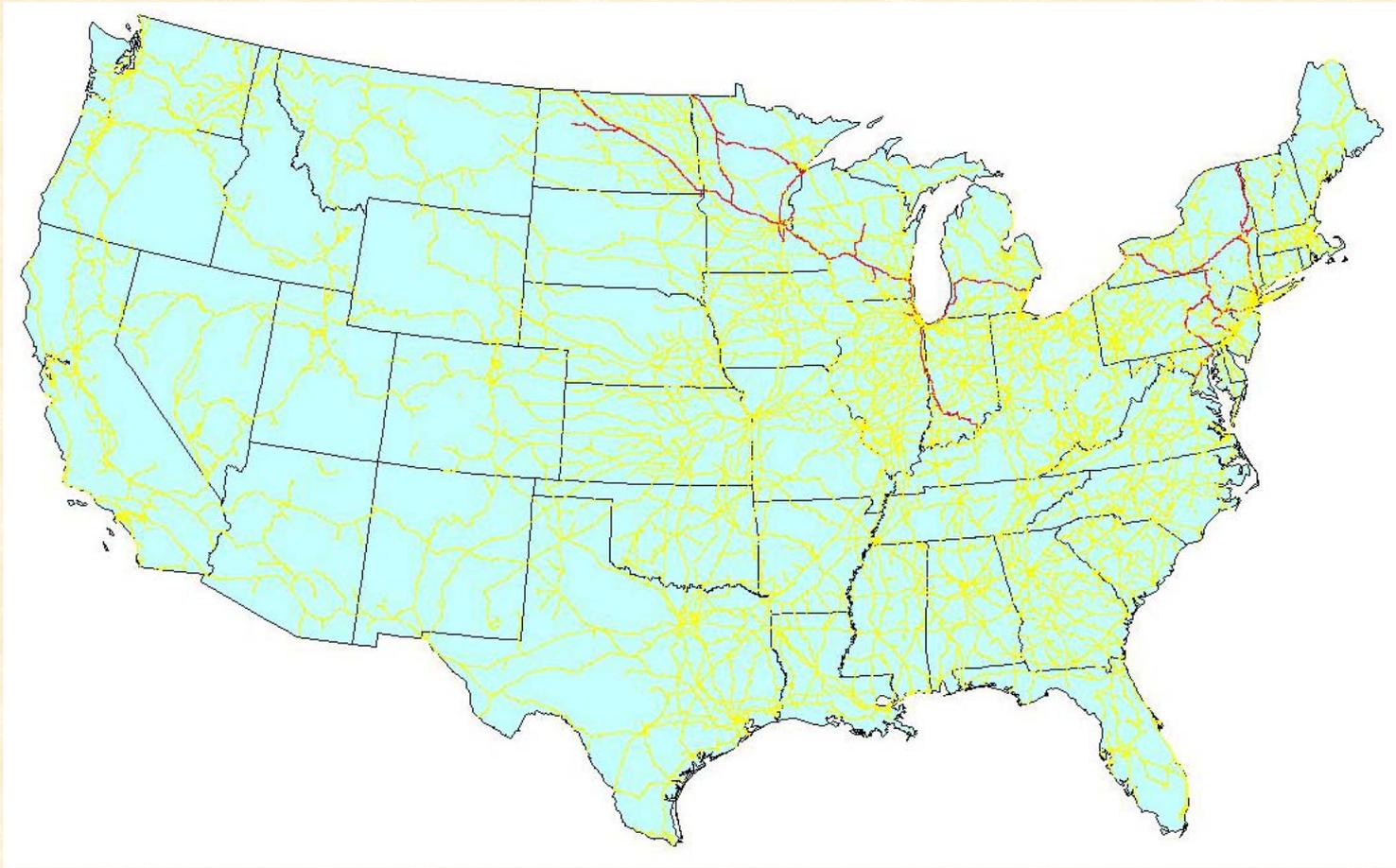
Canadian National Railway



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UT-BATTELLE

Canadian Pacific Railway



Efforts Leading to Enhanced 1:100K Rail Network

- Involved with infrastructure assurance work with JPO
- Examined 1:100K rail networks available
- Rail networks did not have typology or attributes needed for detailed examination
- Funding provided from late 1999 through early 2002 for development of enhanced 1:100K rail network

Enhanced 1:100K Rail Network

- **Based rail network effort on Federal Railroad Administration's 1:100K network**
- **Enhancement work included**
 - **Removal of unneeded lines (abandoned track)**
 - **Inclusion of some excess track**
 - **Refined topology and addition of turnouts**
 - **Review and update of existing attributes**
 - **Additional attributes incorporated to network**

Additional Attributes

- **Interchange locations (Primary, Minor, Terminal, & Detour)**
- **Crew change locations (for major railroads)**
- **Primary classification yard locations (for major railroads)**
- **Number of tracks**
- **Traffic volume (7 classes)**
- **Signal system (CTC, ABS, MAN)**
- **Passing siding frequency**
- **Subdivisions with linear referencing by mileposts**

Processing of Rail Network

- **Work proceeded state by state**
- **Preliminary attribute assignment and refinement defined**
- **GIS processing of the state**
- **Detailed quality review of GIS work**
- **Correction of problems**
- **Final review**

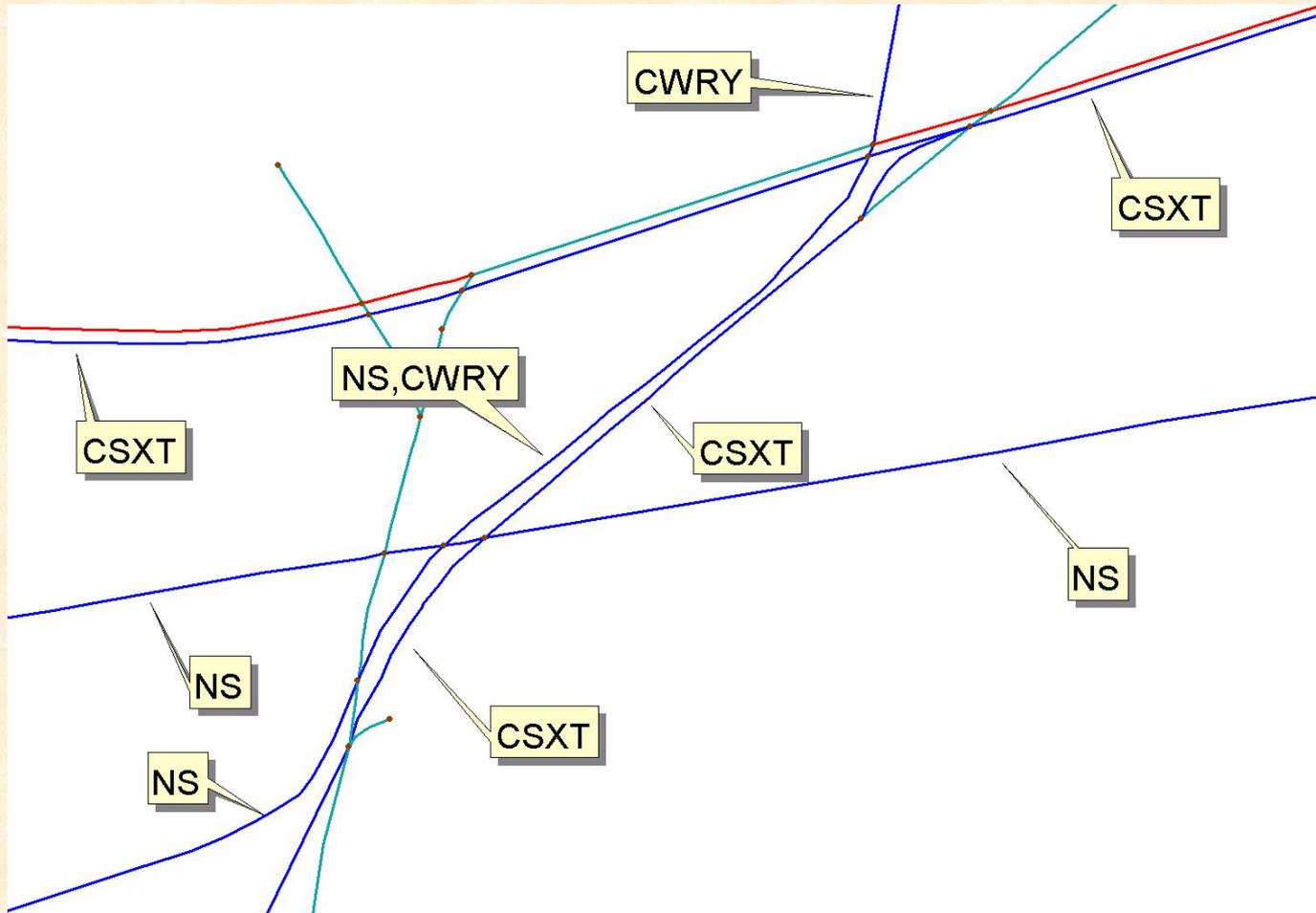
Examples of Improvement

- **Various attributes are now consisted**
- **FRA network did not have STRACNET lines connecting**
- **Lines with passenger movements (Amtrak, commuter, and scenic operations) now in network**
- **Industrial spurs to power plant locations (coal and nuclear) included in network**
- **Topology vastly improved**

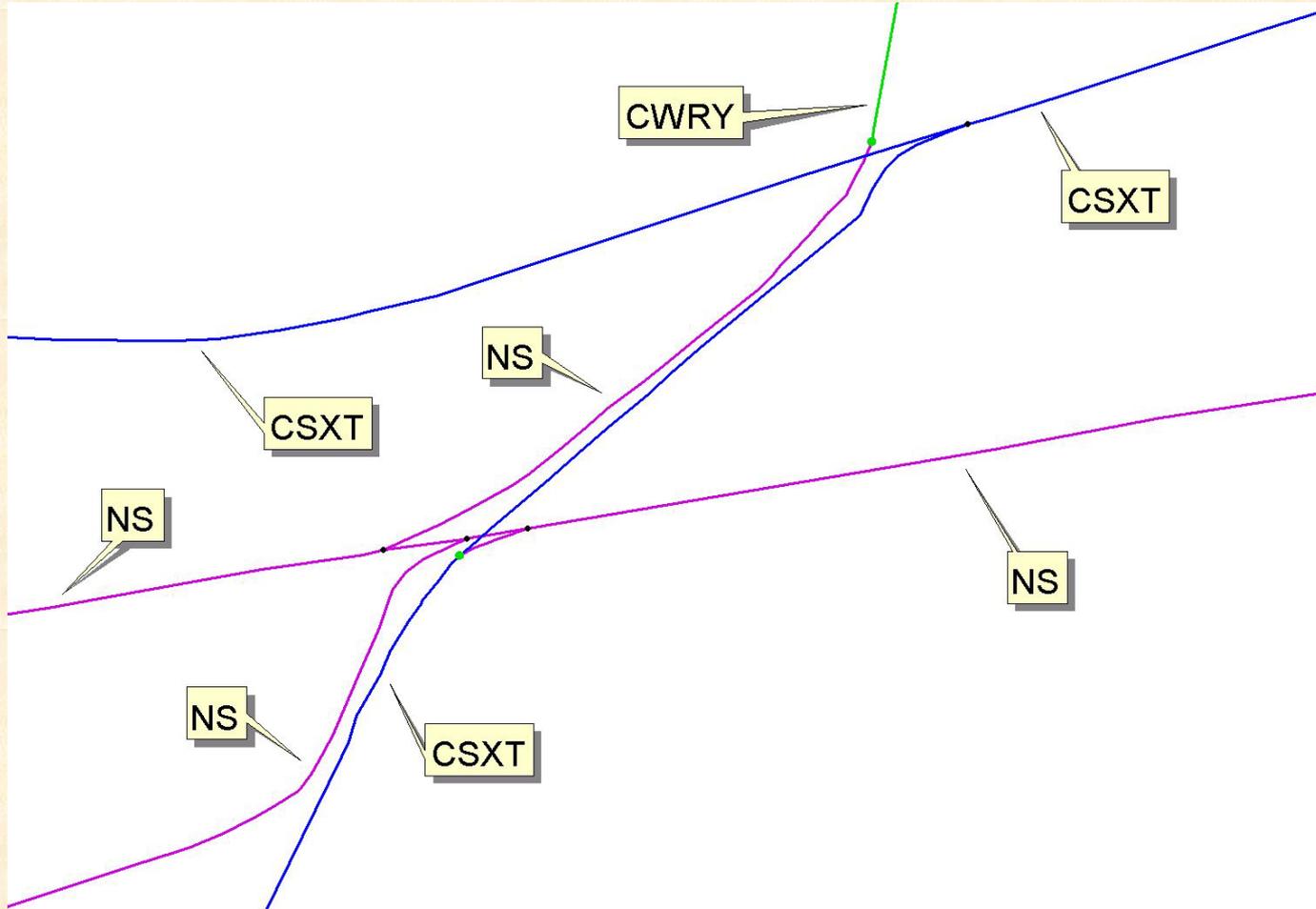
Differences in Networks-Suffolk, VA

- **Lack of turnouts**
- **Removal of a NS diamond**
- **Connecting track between CSXT and NS**
- **CWRY should not have trackage rights**

FRA Network at Suffolk, VA



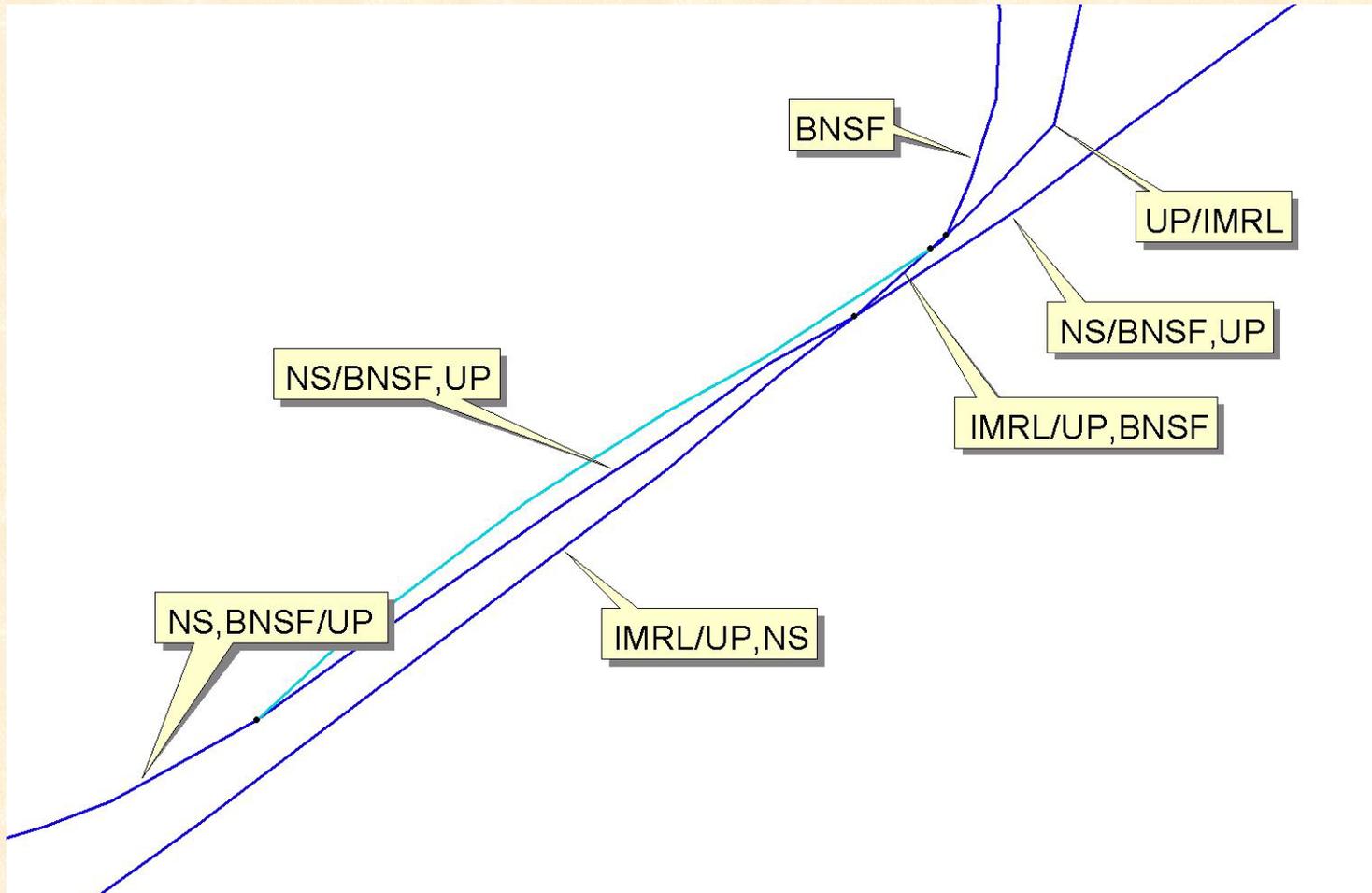
Enhanced Network at Suffolk, VA



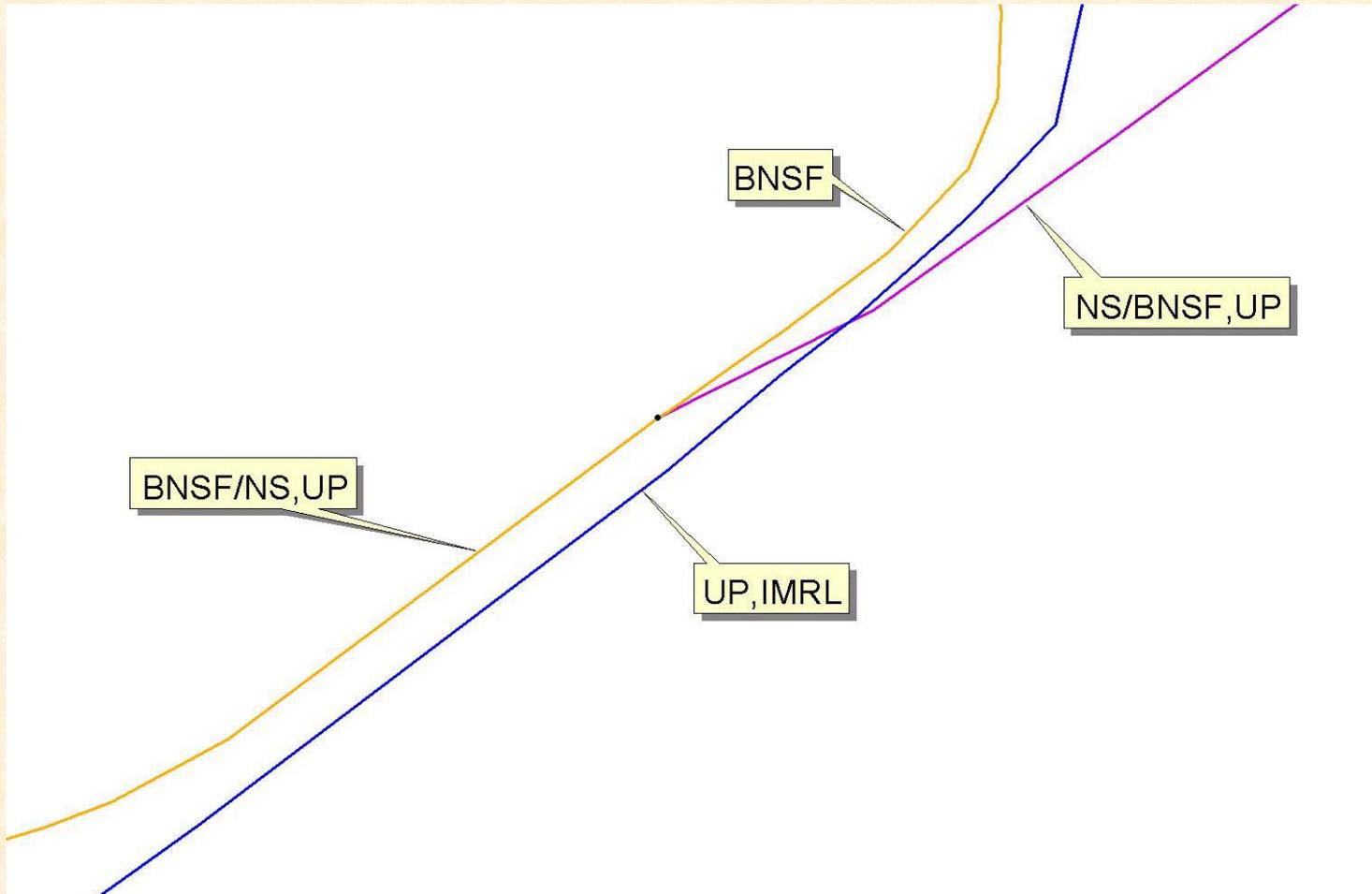
Differences at Birmingham, MO

- **FRA network shows BNSF and UP/IMRL on the same line at Birmingham**
- **NS does not have trackage rights south of Birmingham**
- **The NS and UP/IMRL lines cross with no connects**

FRA Network at Birmingham, MO



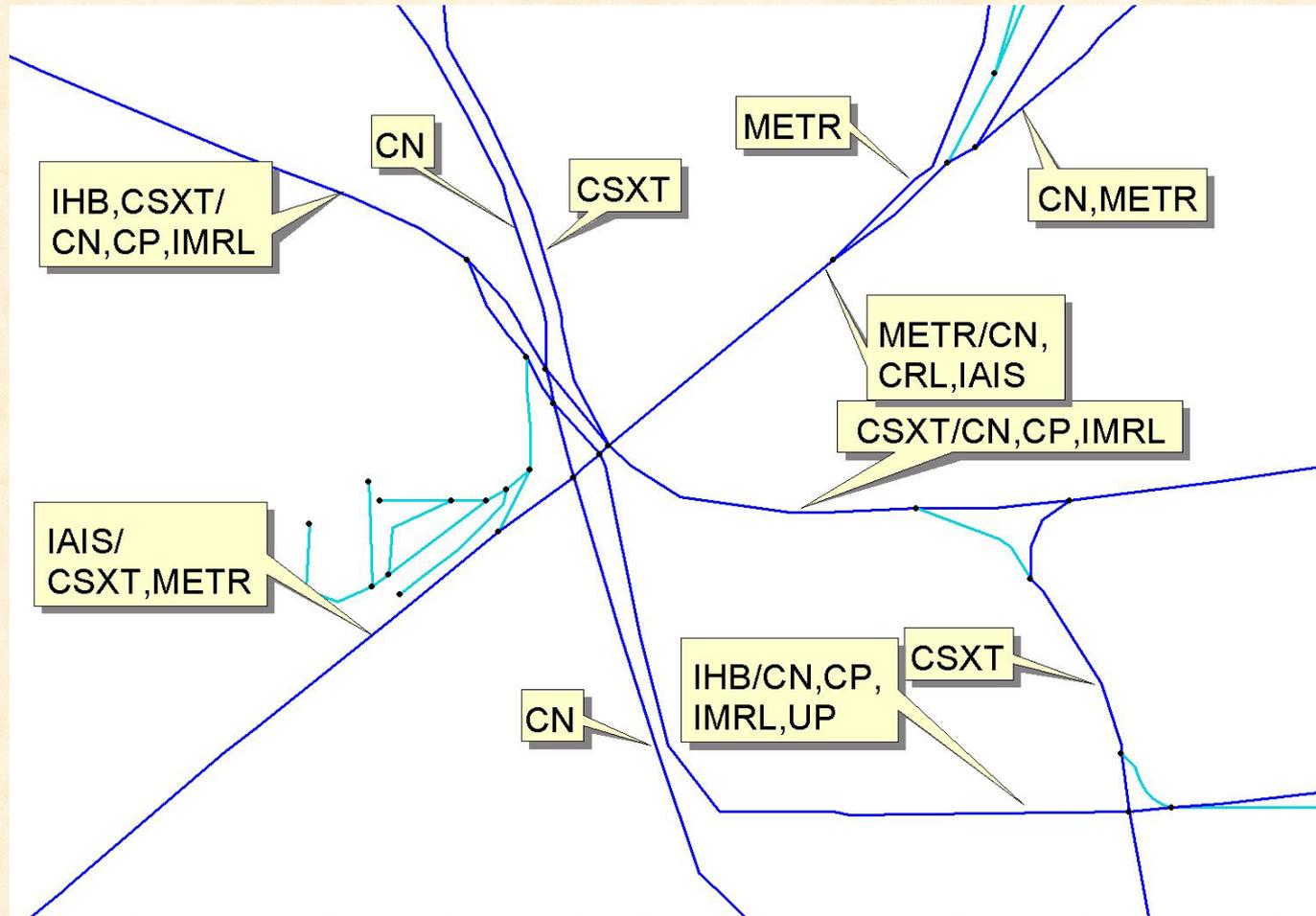
Enhanced Network at Birmingham, MO



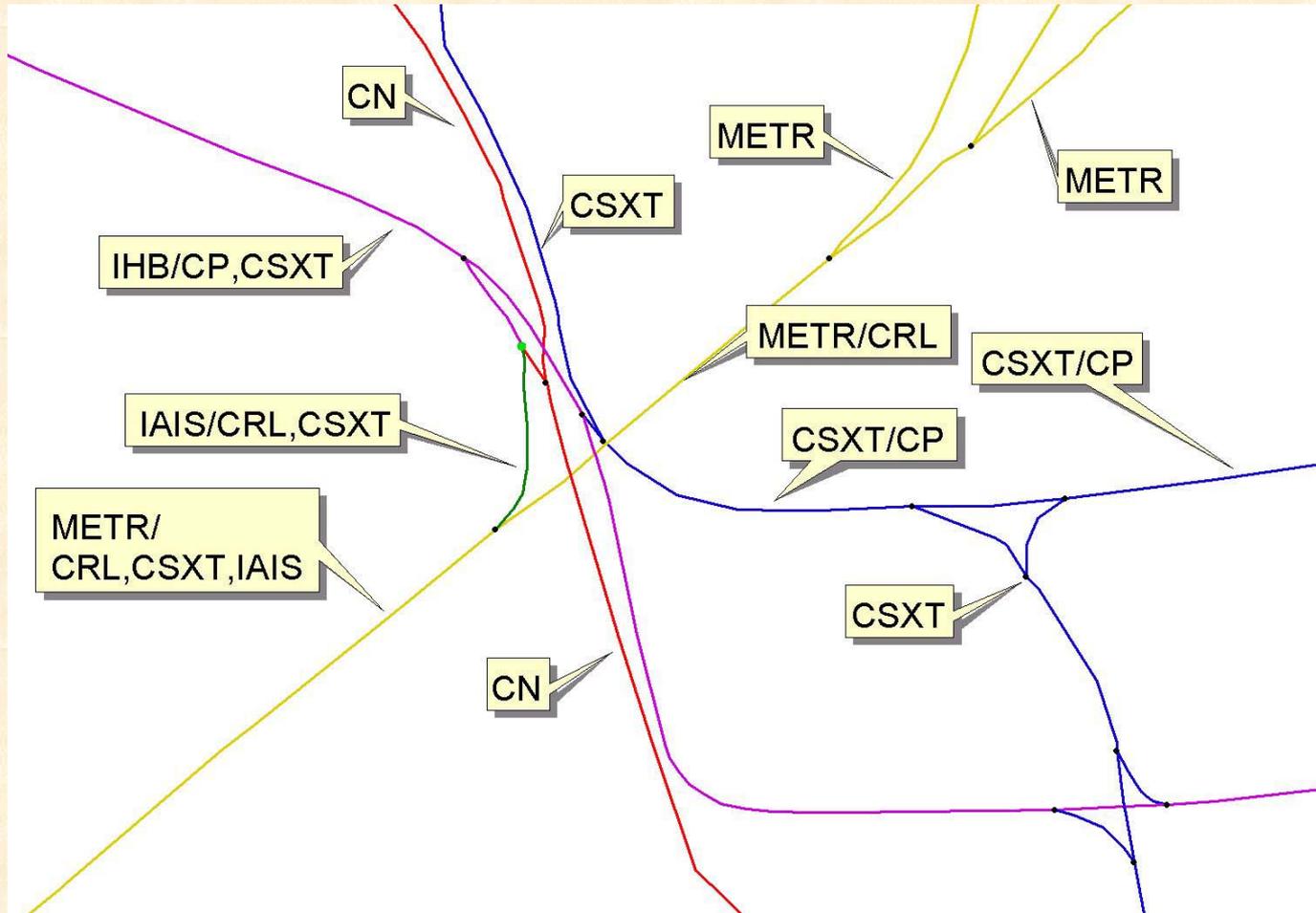
Differences at Blue Island, IL

- **IHB line connection with CSXT line north of METRA commuter line**
- **CN and IAIS should not continue northeast of Blue Island**
- **IAIS connection west of Blue Island**
- **Turnouts on CSXT line**

FRA Network at Blue Island, IL



Enhanced Network at Blue Island, IL



Other Considerations

- Rail infrastructure is NOT static
- Traffic patterns change
- Lines are abandoned
- Lines are sold to short lines
- New connections are built
- Signal systems enhanced
- Additional mains added
- New passing siding constructed

Additional Features Needed

- **Capacity of rail lines are a function of:**
 - Number of tracks
 - Signal system
 - Frequency of passing sidings
 - Grade of track
- **Grade data not included in network yet**
- **Time in transit is import when examining alternative routes**
- **Maximum operating speed not included yet**

Additional Infrastructure Data that Can Be Included in Rail Network

- **Bridges**
 - Location
 - Type
 - Length
 - Number of spans
- **Tunnels**
 - Location
 - Length

Data Sources

- **Data on infrastructure comes from each railroad company**
 - Employee timetables (operating instructions)
 - Track charts/profiles
- **Railroads consider this information as proprietary**
- **Most companies have cooperated and provided data**

Current Status of Rail Network

- **Network delivered to JPO in May 2002**
- **Incorporated into development version of TRAGIS model for testing**
- **Release with production version of TRAGIS model early CY 2003**
- **Currently no funding for continued maintenance and update**

Conclusion

- **This network is the best available**
- **Changes continue in the “Real World” of rail infrastructure**
 - **IMRL purchased by DME and renamed ICE**
 - **NS has obtained trackage rights on CN & RBMN resulting in traffic pattern change between Buffalo, NY and Allentown, PA**
 - **DME planning to start construction of 200+ mile line to Powder River Basin in Wyoming**