U.S. Department of Transportation
Federal Railroad Administration

RESEARCH RESULTS
FRA OFFICE OF RAILROAD POLICY & DEVELOPMENT

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POSITIVE TRAIN CONTROL SHARED NETWORK

SUMMARY

The Interoperable Train Control (ITC) Positive Train Control (PTC) Shared Network (IPSN) project investigated anticipated industry benefits and the level of support for the development of a hosted technological platform for PTC messaging across multiple railroads. A hosted network would reduce the number of interconnections between Class 1 railroads and the short line and commuter railroads; help minimize the required number of communication links to send and receive PTC messages to tenant railroads; and provide centralized personnel and IT infrastructure to support the railroads in performing PTC message interchange with their host railroads, which yields efficiencies in manpower and technical PTC implementation complexity.

ARINC (Rockwell Collins) led the IPSN project, which requires the development and testing of integrated PTC messaging infrastructure in a laboratory environment.

The project aims to support the needs of short line and commuter railroads that may not have the technical capability or staff to fully support a full PTC implementation, and is focused on achieving PTC safety improvements with reduced program deployment and operational risks for the smaller railroads.

The methods utilized during the IPSN project included conducting industry research on PTC implementation needs, developing a concept of operations, and demonstrating the shared network concept for multiple railroad use.

The results of this project validated industry benefits and support for the development of a hosted environment for PTC messaging across multiple railroads.

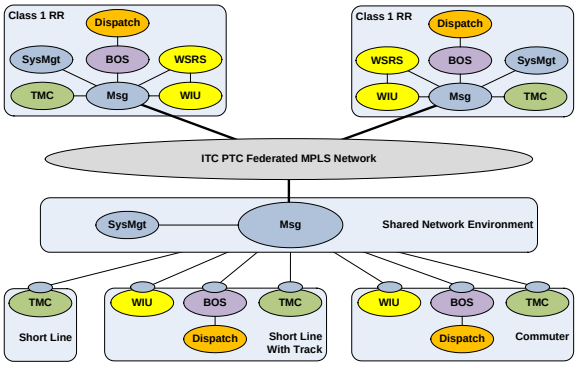

Figure 1. ITC PTC Shared Network Concept

BACKGROUND

On October 16, 2008, President Bush signed the Rail Safety Improvement Act (RSIA) (H.R. 2095) into law. The statute requires that PTC systems be installed on designated track segments in the US by December 31, 2015. On July 21, 2009, FRA issued a Notice of Proposed Rulemaking (NPRM) to implement the statutory mandate. It was the first of several iterative implementing regulations issued by FRA in support of PTC system deployment, including a rigorous certification process and the criteria for determining if track is included or excluded from the PTC requirement. A final ruling on yard limits was issued on August 22, 2014. Integrating the PTC systems that belong to commuter and short line railroads with Class 1 railroad systems is a daunting task (See FRA Report to Congress- PTC Implementation Status, Issues and Impacts, August 2012). .

A shared infrastructure to support PTC system interoperability could aid the short line and commuter railroads subject to the Congressional mandate. However, there is great complexity in the networking and PTC message flows in a shared environment, and the concept to support a shared infrastructure of this magnitude had never been validated.

OBJECTIVES

The IPSN project was intended to develop and demonstrate a concept in which multiple railroads utilize a shared network to support ITC PTC interoperability with Class 1 railroads. The IPSN was designed to reduce PTC implementation costs, minimize short line and commuter rail and FRA resources needed to test PTC, reduce training and support requirements, simplify the PTC network's configuration, and reduce the complexity of interoperable PTC messaging.

METHODS

The IPSN project's research featured multiple industry discussions on PTC messaging needs; development of a concept of operations to meet those needs in a shared network environment; validation of the messaging concepts through the lab engineering; and testing and demonstration of a proof-of-concept shared environment utilizing virtualization and simulation technologies.

Using the input from the industry discussions and the concept of operations development, ARINC conducted the engineering, test and demonstration of the prototype shared network across four distinct development cycles. Each development cycle was launched with a cycle planning session, and the cycle would focus on a major use case for the shared network, with increasing complexity in terms of virtual machine development, PTC messaging, and networking complexity across a multiple railroad shared infrastructure. The objectives for each development cycle were:

- Development Cycle 1 – Develop a prototype representing tenant railroads that do not own any track on the host PTC-enabled track
- Development Cycle 2 – Develop a prototype representing host short line and commuter railroads that must provide back office functions for tenant railroads
- Development Cycle 3 – Extend the shared environment across a real network to simulated Class 1 back offices in geographically separated cloud environments
- Development Cycle 4 – Conduct a real Train Management Computer (TMC) initialization through the shared environment, and develop a plan for test and integration capability for the short line and commuter railroads

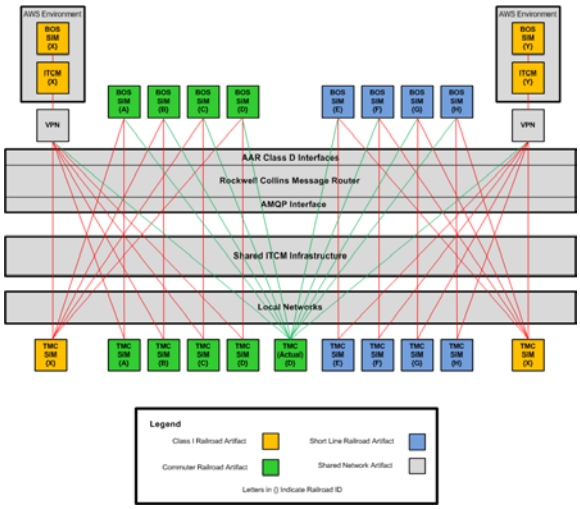

Figure 2. Final Objective Environment

RESULTS

A concept of operations document was developed from a series of industry discussions. The Concept of Operations was validated through a series of four lab development cycles. A final report document was generated that recorded the project's results. The core research concepts, which were the result of the industry discussions, concept of operations development, and IPSN lab work, follow:

- A shared infrastructure that supports multiple railroads can be integrated and tested to meet core PTC requirements.
- A shared infrastructure concept that can meet the PTC technical and operational requirements and needs of the railroads.
- Interoperability issues/risks can be minimized or mitigated between ITC railroads and the other rail operators which use an IPSN approach.
- A shared environment can potentially reduce the resources needed by railroads and FRA for PTC testing.
- A shared environment can address training requirements for the railroads and allow them to focus on operational aspects and components of PTC.
- A shared environment can help address both the configuration management and IT governance challenges for short line and commuter railroads.
- Operations of I-ETMS-equipped short line and commuter railroads in the context of the railroad utilizing the IPSN can be conducted with no variance to that provided under the I-ETMS PTCDP operating under type approval FRA-TA-2011-02.
- The impact of operational changes to the railroads' policies, procedures, methods or daily work routines are no different than those for railroads deploying I-ETMS without the use of an IPSN.
- Utilizing the shared network environment, a real TMC can be initialized, engaged into active state, and conduct enforcement braking to a stop at a switch.
- The short line, commuter, and Class 1 railroads are very interested in the shared network concept.
- The short line railroads need education and assistance in planning for PTC. Discussions with their Class I host railroads must progress so the short line railroads understand their requirements from the host railroad to effectively plan. They need a cost effective approach to implement PTC.
- The cost of PTC is significant for the commuter railroads and it may have an impact on capital investment and the state of good repair initiatives for their infrastructure and equipment. Commuter railroads have launched PTC projects and are investing in the technology. However, they are also in need of a cost-effective solution for PTC.

CONCLUSIONS

The conclusion of this effort is a shared hosted network that can be developed to meet the interoperable PTC system messaging needs of multiple short line and commuter railroads.

FUTURE ACTION

Additional effort is expected to be conducted to develop and further validate a shared network environment to benefit railroad PTC operation.

MAJOR REFERENCES

A list of the major references utilized follow:

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[3] ITC – Systems Management Requirements, S9451, Version 2.54, June 28, 2013.
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[5] Positive Train Control Office-Locomotive Segment Interface Control Document (ICD), Release 2.11.1, Association of American Railroads, October 26, 2012.
[6] Benefits of a Shared Facility/Service, Dennis Lengyel, ARINC, WebEx presentation to APTA CEOs. September 12, 2012.
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[9] White Paper prepared for BAA, Bill Everett, ARINC, March 12, 2013.
[10] ASLRRA PTC Symposium – How Does it all Work Together, Bill Everett, ASLRRA Technology Committee, Presentation at the ASLRRA PTC Symposium, Atlanta GA. April 28, 2013.

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KEYWORDS

Positive Train Control (PTC), Interoperable Train Control (ITC), Shared Network, Hosted Network, Infrastructure as a Service (IaaS)