ARINC RailwayNet℠

HOSTED POSITIVE TRAIN CONTROL (PTC) COMMUNICATION SOLUTION

Rockwell Collins

Building trust every day

Background

Improving rail safety

The National Transportation Safety Board (NTSB) has attributed a number of recent rail incidents to reliance on train crews to comply with safety rules. Thus, it concluded that a significant number of accidents were the result of human error. Prompted by these accidents, the Rail Safety Improvement Act of 2008 was signed into law on October 20, 2008.[1]

This act reduced the number of hours per month railroad employees could work and introduced a number of other safety requirements – one of the most important being the implementation of Positive Train Control (PTC). This system refers to communication-based/processor-based train control technology designed to address a number of rail safety issues including train-to-train collisions, over-speed derailments, incursions into established work-zone limits, and train movement through a main-line switch that is in an improper position.

December 31, 2015 was set as the deadline for implementing PTC technology across the United States rail network. In October 2015, Congress passed a bill extending the compliance deadline to December 31, 2018.[2] The new law allows up to two additional years to finalize full implementation and testing of PTC, provided the railroads meet specific benchmarks.

PTC implementation challenges

Implementing advanced railroad communications and control systems, including PTC, is a significant step toward meeting the industry objectives and associated Federal mandates. However, the scale and complexity of implementing a fully operational PTC system has been a significant challenge for railroads. In fact, the extension bill passed by Congress in October 2015 was a direct result of these challenges. The technological complexities and the scarcity of required subject matter experts continue to be the primary limiting factors in meeting the mandated deadline. In addition, increased track congestion makes it more difficult to get track time to install the large magnitude of wayside equipment required to implement PTC.

Rockwell Collins has been in the forefront of PTC related technologies since 1985, when the Association of American Railroads (AAR) contracted the company to help develop standards for the Advanced Train Control System (ATCS) – to support PTC functionality. Over the years, Rockwell Collins has supported various PTC related projects in the Industry both for the AAR and for individual railroads. In late 2014, Rockwell Collins embarked on an effort to help solve some of the challenges facing the industry for implementation, operation and maintenance of PTC systems. ARINC RailwayNet, a hosted PTC solution, was developed to meet the needs of smaller railroads that are required to implement PTC, but that lack the required IT staff and PTC expertise.

The interoperability challenge

PTC is an overlay system, which relies on pre-existing methods of operation. Those methods of operation rely on railroad operating rules, onboard paperwork, and voice communications between the train engineer and dispatcher. PTC relies on sending messages to locomotives wirelessly from waysides and railroad back-office systems.

The four major Class I Railroads created a "Federated Network" in support of their interoperability requirements and the associated electronic communications connectivity requirement. As depicted in *Figure 1* below, the initial Class I Federated Network is a redundant mesh topology communication network.

An additional estimated 115 railroads, including other Class I railroads, commuters, regional freights railroads and short-line operations, will be obligated to become part of the PTC Federated Network in compliance with the PTC interoperability requirement and the associated electronic communication mandate. The most likely final configuration of the Federated Network required to support the additional railroads is depicted in *Figure 2* below. If all 115 railroads interconnect into the Federated Network, a highly complex network topology will result.

Figure 1: Federated Network, US Class I Railroad Configuration

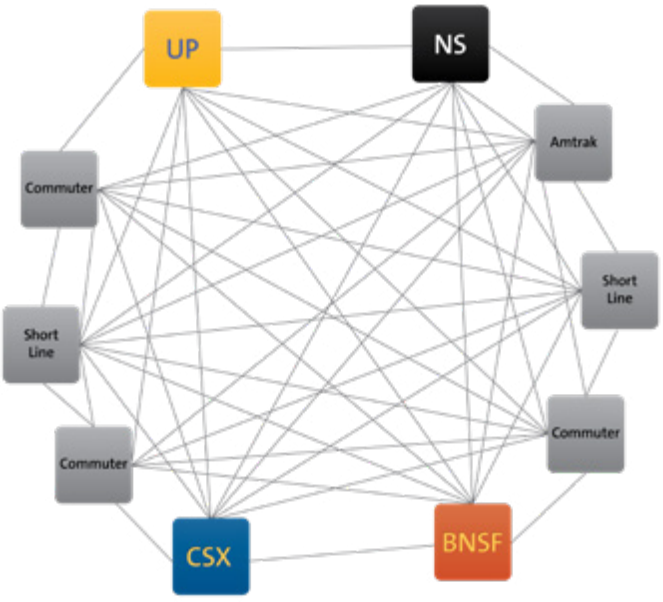


Figure 2: Federated Network, Final Configuration

ARINC RailwayNet minimizes the complexity and risk of the nationwide Federated Network by providing smaller railroads with access to Federated Network connectivity through a hosted service. Rockwell Collins developed ARINC RailwayNet to serve as a node on the Federated Network and enable the flow of PTC messages between Class I, commuter, short line and regional railroad operations. Streamlining connectivity to the Federated Network will enhance the railroads' ability to operate seamlessly and will assist in their ability to meet the mandated interoperability requirements of PTC. A high-level diagram of the initial Federated Network with ARINC RailwayNet hosted service is depicted in *Figure 3*.

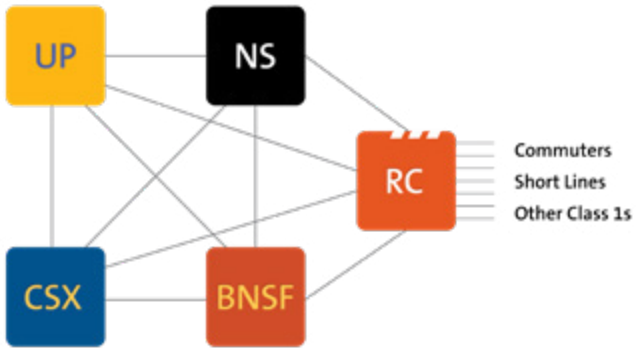


Figure 3: Federated Network, Final Configuration with ARINC RailwayNet℠

ARINC RailwayNet℠ hosted PTC communication solution

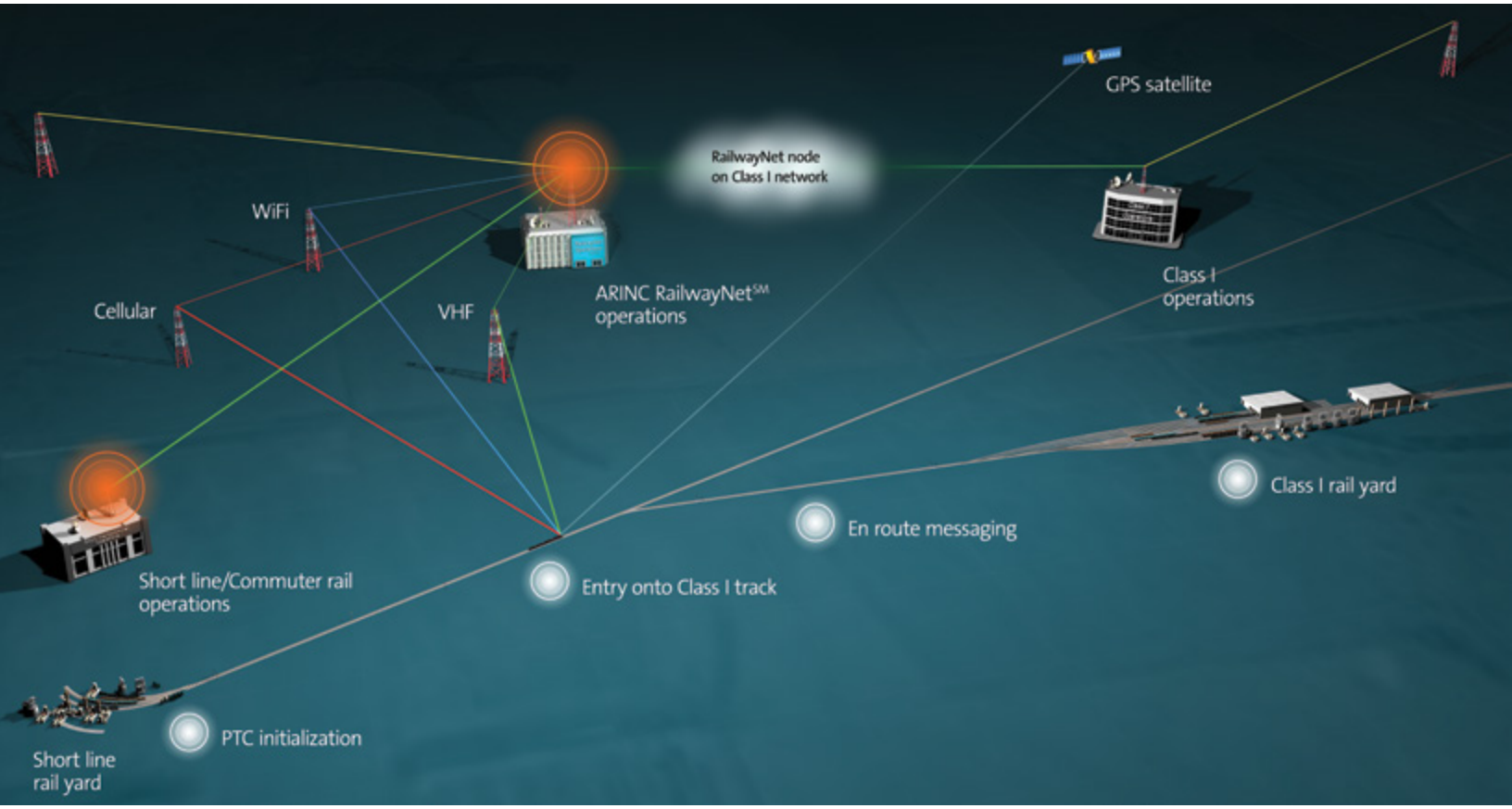
Rockwell Collins' ARINC RailwayNet solutions are built on the company's high availability, high assurance ARINC Global Network (AGN), which has supported complex and critical airline communication for decades. Hundreds of airlines around the world depend on the AGN to deliver flexible, highly reliable, cost-effective solutions.

The AGN is one of the world's largest private ground-based networks supporting over 3,000 participants in the aviation community including airlines, Civil Aviation Authorities (CAAs), airport facility management and government agencies involved with the transportation industry.

Rockwell Collins leveraged this aviation messaging expertise, along with more than 30 years of experience in the rail industry working with PTC related technologies, systems and operations, to develop ARINC RailwayNet.

The AGN network and supporting facilities and processes provide the foundation for the rail industry shared Interoperable Train Control Messaging (ITCM) service and hosted PTC back-office services. This enables ARINC RailwayNet to provide the necessary functionality, performance and, most importantly, the interoperability required to provide a hosted PTC service for the nation's regional railroads, short line and commuter rail lines.

ARINC RailwayNet provides connectivity from locomotives and existing office systems into the Federated Network using industry-standard ITCM messaging software.



How it works

ARINC RailwayNet is a Tier 1 member of the Federated Network and is directly connected to all of the Interoperable Train Control (ITC) member railroads required to support short line and commuter operations connection to the shared network.

ARINC RailwayNet, provided as an Infrastructure as a Service (IaaS), is designed to help meet the availability standards required for PTC operations. As a hosted solution, it provides full-featured network management and infrastructure, hardware, network, operating systems, and applications for fault, performance, security and configuration management.

The service includes a 24/7/365 network operations center and help desk with PTC-trained staff to rapidly triage and escalate service restoration and minimize service impacts. Monitored systems include ITCM infrastructure, third-party back-office solutions and other office support functions. Other capabilities include hosted Management Information System (MIS) services (including the Key and Certificate Authority services) as well as a management portal.

The network is monitored from the Federated Network connections to the PTC communication systems on locomotives. Communications protocols are established for notification regarding service-impacting disruptions.

ARINC RailwayNet also includes a full test-network connected to the Federated Test Network to facilitate end-to-end system testing without impacting production operation. This is a critical component that enables the testing and validation of software updates prior to placing them into a live operational production environment.

ARINC RailwayNet, in conjunction with its third-party hosted applications, provides the capability to initialize trains via the Federated Network. To enable the most cost-effective configuration and to minimize the onsite communications infrastructure, Rockwell Collins supports locomotive initialization over nationally recognized cellular service providers. Private and secure connections are established with the cellular carriers that will terminate into the ARINC hosted service.

Rockwell Collins provides a web service interface for entry of crew and consist information. Rockwell Collins can also provide MPLS circuit connections to those systems. Initialization over interoperable Wi-Fi and PTC 220 radio is also supported.

The AGN, upon which ARINC RailwayNet is built, has historically achieved 99.999 percent availability. This high reliability communications service includes physically separated communications links, server redundancy, and a geographically separated disaster recovery site that can provide full system functionality within seconds should an outage occur.

Security is enhanced through design of tightly controlled communications, stringent firewalls, and the Rockwell Collins' Cybersecurity Operations Center (CSOC). These measures provide comprehensive intrusion protection, as well as timely notification in the event of an intrusion.

Rockwell Collins also provides third-party back-office solutions for crew initializations along with required equipment, maintenance, technology refresh, testing and installation activities.

For locomotives, Rockwell Collins can provide cellular service from the locomotive to the company's hosted service operations center. For connections to freight and commuter railroad office locations (for non-hosted PTC office functions), the company utilizes dual MPLS connections between the customer office facilities and Rockwell Collins' ARINC network operations center in Annapolis, Maryland. These on premise, fixed-circuit routers are provided and monitored 24/7 as part of the high availability network services.

A summary of the ARINC RailwayNet PTC hosting service functionality is shown below.

Messaging functions	Description	Included
Back-office messaging	Message transmission for the railroad back office	•*
Inter-office messaging	Message transmission between assets and railroad back offices in support of train initialization	•*
Systems management gateway	Messaging systems management	•
Systems management	Remote asset monitoring and control	Optional
Back-office area communications	Communications infrastructure at the Annapolis facility in support of railroad remote asset connectivity via cellular and internet connections	•
Key exchange server	Security keys with data store	•

Back-office functions	Description	Included
Geographic	SubDiv/District mandatory directives	•*
Crew and train initialization	Storage and delivery of crew and consist information, train IDs and clearances	•*
Distribution	Communications software upgrades	•*

* Requires third-party software license

ARINC RailwayNet offering

Interoperable messaging

To meet the complex startup challenges of mandated PTC requirements, it's critical for freight and commuter railroads to choose a highly reliable, cost-effective data networking solution. ARINC RailwayNet ensures PTC interoperability with partner railroads by hosting industry standard software in the company's high availability Infrastructure as a Service (IaaS) facility in Annapolis, Maryland. The shared network will support all ITCM/ITCSM message exchanges. Of particular interest to tenant railroads is providing connectivity to their host railroads for train initialization and termination. While the tenant locomotive is on the PTC territory of a host rail, the locomotive will be communicating to the host railroad's office system, possibly through the host railroad's wireless network (especially the 220 MHz radio base stations of the host). However, the tenant railroad will still have to provide crew validation and consistent information to the host railroad via ITCM messaging. All railroads operating within PTC territory will have to support ITCM messaging between their office, locomotive, and wayside systems, as well as to any partner railroads where their locomotives will run on another railroad's PTC territory. ARINC RailwayNet provides hosted PTC office functions in addition to the critical ITCM messaging services and ITCSM system monitoring functions.

AIM® integration server

The ARINC RailwayNet integrations server and software provides connectivity between the railroad IT systems and the hosted back-office components. The functions of this application include:

- Interface with customer's IT gateway
- Interface with back office
- Manage crew authentication through the customer's IT gateway
- Functions to assign train ID to trains based on the clearance number
- Functions to manage train consist through the customer's IT gateway
- Functions to track, display, and store events and alarms

As with the company's aviation services, Rockwell Collins has designed ARINC RailwayNet – and specifically the integration server – to be capable of interfacing to ITC back office, wayside and onboard components from multiple vendors as new sources of supply become available to the industry. Rockwell Collins has also developed interfaces to ACSES and ITCS components from multiple vendors so it is well positioned to assist customers with their PTC implementations.

PTC testing tools

Built on the Rockwell Collins' AIM® platform, Rockwell Collins developed PTC testing tools for a prominent Class I railroad. As an authorized reseller of these PTC testing tools, Rockwell Collins is able to assist rail industry customers in testing their own PTC implementations. These tools can be used from initial system level testing through the life cycle of the system to test compatibility of new software releases with existing components.

Rockwell Collins is using these tools to support a phased series of testing between its customers and their partner railroads including lab testing, simulation and lab-to-lab testing via the test Federated Network. Pre-production testing helps reduce the risk of impacting operations when railroads are ready to move into 'Revenue Service Demonstration' (RSD) type testing.

Engineering staff with PTC expertise

Rockwell Collins brings a long history of PTC related experience to ARINC RailwayNet. The company's work in PTC began in the mid-80s with its assistance in developing the ATCS specifications for the AAR. Since then, Rockwell Collins has been involved in a number of pilot projects, including its most recent endeavor, the development of a back-office solution and the support of PTC testing with a number of Class I railroads. In addition, the Rockwell Collins professional staff rigorously applies proven configuration and software management process experience to keep current with advancing industry techniques in software implementation, testing and technology integration. These professional skills and experience will help further the company's ability to quickly adapt to the present and possible future PTC compliance regulations.

Summary

As the Class I railroads advance and progress in their efforts to complete Revenue Service Demonstration on multiple subdivisions, Rockwell Collins has availed its services to support a number of these efforts. With the implementation of ARINC RailwayNet, the company is now in a position to better assist small railroads in implementing their PTC systems in a coordinated manner with their partner Class I railroads.

Notes:

[1] United States. Department of Transportation. Federal Railroad Administration. Public Law 110-432 – Rail Safety Improvement Act of 2008, October 16, 2008, https://www.fra.dot.gov/eLib/Details/L03588.

[2] United States. Congress. House. H.R.3819 - Surface Transportation Extension Act of 2015, October 29, 2015, https://www.congress.gov/bill/114th-congress/house-bill/3819.

Building trust every day.

Rockwell Collins delivers innovative aviation and high-integrity solutions that transform commercial and government customers' futures worldwide. Backed by a global network of service and support, we are deeply committed to putting our solutions to work for you, whenever and wherever you need us. In this way, working together, we build trust. Every day.

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