Norfolk Southern Rail boosts safety and efficiency with IP network

One of North America's largest freight railways upgrades its microwave communications network to enhance safety, improve operational efficiency and support future business expansion.

NOKIA

Norfolk Southern Corporation, based in Norfolk, Virginia, is one of North America's premier transportation companies, with a market cap of 30 billion United States dollars and annual revenue of 11.6 billion dollars. Its Norfolk Southern Railway subsidiary operates approximately 20,000 route miles in 22 states and the District of Columbia. As the operator of the most extensive intermodal network in the eastern United States and a major transporter of coal, automotive, and industrial products, Norfolk Southern supports international trade with service to every major Atlantic seaport, ten river ports, and nine lake ports. In order to ensure safety, efficiency and its competitive edge, Norfolk Southern has upgraded its communications network to all-IP. Now this leading freight carrier can take advantage of new and emerging IP-based communications solutions and applications to enhance safety, increase operational efficiency and build a competitive advantage to support future business expansion.

CHALLENGES

- Support mission-critical applications such as Positive Train Control (PTC) to enhance safety and efficiency
- Address the need to scale communications for future growth, integrate rail operations data with the enterprise network, increase bandwidth, reduce the costs of legacy solutions and enhance security
- Seamlessly and efficiently migrate legacy time-division multiplexing (TDM) and aging communications infrastructure that cannot support new IP-based applications
- Manage the transition and simplify the procurement process

SOLUTIONS

- Nokia 9500 Microwave Packet Radio (MPR), an efficient backhaul networking solution that reduces the total cost of ownership (TCO) and maximizes spectrum utilization
- Nokia 1830 Photonic Service Switch (PSS) and next-generation dense wavelength division multiplexing (DWDM) to support synchronous optical networking (SONET), and as a partial replacement of the legacy equipment already deployed
- Nokia 7750 Service Router (SR) and 7705 Service Aggregation Router (SAR) to facilitate legacy-to-packet transformation and provide adaptation, aggregation and routing for Ethernet and IP/Multi-Protocol Label Switching (MPLS) networks
- Nokia 5620 Service Aware Manager (SAM) to enable end-to-end network and service management across all domains of the converged, all-IP network
- Predictive equipment forecasting software solution to shorten lead times and allow on-site inventory management

BENEFITS

- A single unified and converged infrastructure based on IP/MPLS that supports both mission-critical and less vital services with high efficiency and lower costs
- High network availability and resiliency through native security services provided by the IP/MPLS solution, including nonstop routing (NSR), nonstop services (NSS), link aggregation group (LAG) and fast reroute (FRR)
- Smooth migration of TDM services through a range of legacy interface cards integrated into the IP/MPLS routers
- A flexible, future-ready network that will support topology and answer communication needs, while ensuring high performance and resilience

"World-class safety and efficiency are our goals. Selection of an IP technology for our transport network that enhances safety and reliability are essential to helping us achieve our mission."

Richard Carter, IT manager, Norfolk Southern Corporation

The vision

Norfolk Southern's vision is to "be the safest, most customer-focused and successful transportation company in the world." With that in mind, its communications transport group can focus on providing secure, reliable, cost effective services for all of its operations, including PTC, emergency communications, VHF radio and video protection, as well as business applications. As rail operations have expanded, the need to better integrate those services with the enterprise network while addressing rising legacy network costs has driven it to take the next step to a state-of-the-art, all-IP, service-rich communications solution.

"Our new IP/MPLS network provided a pathway to migrate from legacy TDM, ATM and frame relay. As such, it supports current and future applications including

Advanced Train Control, PTC, data telemetry for automatic equipment identification and hot box detectors, highway crossing monitor systems, remote video, and enhanced land mobile radio communications for dispatchers and vehicle tracking," notes Richard Carter, Norfolk Southern's IT manager.

Deployed and enhanced over more than two decades, Norfolk Southern's legacy communications network was built on a TDM backbone and hybrid radios, and was not designed to support the new IP-based applications. Still, it represented a considerable investment, so the company sought an efficient and cost-effective transition to the more advanced IP-based infrastructure that leveraged as much as possible from its current network.

Why Nokia?

After a five-year deployment of integrated passive devices (IPDs), Norfolk Southern selected several manufacturers of microwave radios for evaluation. In 2010 Infinity Technology and its channel partner, Seamless Mobility Solutions, presented Nokia's products. After testing and evaluation, it was determined that Nokia's 9500 Microwave Packet Radio would integrate with Norfolk Southern's existing products. This not only offered a technology upgrade, but also potential cost savings.

Nokia's solution also would allow Norfolk Southern to migrate its existing networks and applications to a single IP network without the need to remove and replace legacy infrastructure.

The solution also addressed Norfolk Southern's procurement, logistics and inventory challenges, with predictive equipment forecasting that reduced lengthy lead times while increasing ease and efficiency.

The solutions

Nokia has helped Norfolk Southern establish a 22-state IP/MPLS communications network for its rail operations, featuring more than 225 7750 SRs and 7705 SARs and Integrated Access Devices (IADs), as well as microwave and copper ADSL+. In 2014 Nokia became the supplier of Norfolk Southern's microwave equipment, and today the 9500 MPR is in early stages of deployment. Nokia also has developed a microwave-aware card to go directly into existing IP routers and the 7705 SAR to enable direct provisioning of the radios, eliminating the need for a multiservice switch shelf and a potential point of failure, while providing an opportunity to reduce equipment costs. The entire network is managed end to end by the 5620 Service Aware Manager (SAM).

Norfolk Southern's legacy network, comprised of more than 435 TDM nodes, is being migrated to IP/MPLS in phases. This is facilitated by Nokia's MPLS routers and switches, which can operate in hybrid modes. The new IP/MPLS infrastructure is able to integrate all services in a single and unified network, with guaranteed QoS for each application. Applications now supported and enhanced by IP/MPLS include the following:

APPLICATION	IP/MPLS SERVICE
Positive Train Control (PTC)	EPIPE, Virtual LAN (VLAN)
Crossing & surveillance	EPIPE, Virtual Private LAN System (VPLS)
Closed circuit television (CCTV)	EPIPE (VPLS)
LMR communications	CPIPE & EPIPE (VPLS)
Hot Box & Hot Wheel detectors	Standalone applications transmitted over same network
Vehicle tracking	EPIPE (VPLS) or L3 interface
Emergency voice communications	EPIPE (VLAN) to third-party device
Corporate voice communications	EPIPE (VLAN) to third-party device
Data center	EPIPE (VLAN)

"Positive Train Control is one of the many drivers that led us to a new IP/MPLS communications network. The ability to separate and prioritize traffic for train control allows use of the same network to handle critical and non-critical traffic. Our new network is positioned for current and future service requirements."

Richard Carter, IT manager, Norfolk Southern Corporation

The benefits

Norfolk Southern now employs a single unified and converged IP/MPLS infrastructure that supports both mission-critical and less vital services. This solution enables the network to operate more efficiently, and with scale that will allow the company to easily support future business expansion. With the Nokia 5620 SAM, the network fully supports and manages multiple technologies, such as optical, packet microwave and IP/MPLS.

“We’ve found this unified IP/MPLS network manageable, maintainable and effective at minimizing service disruptions,” Carter notes. “We sought carrier-grade technology, and we selected a solution from Nokia combined with Bell Labs innovation that simplified management, reduced outages and lowered outage-related costs.”

High network availability and resiliency are achieved through NSR, NSS, LAG and FRR. Traffic engineering and isolation also benefit, since the converged communications supports all services, with IP/MPLS assuring that critical applications always use the same path on the IP network, and that multiple critical data flows are never mixed in the same IP session or path. A flexible design enables IP/MPLS to meet any network topology and answer all needs while providing high performance and resilience.

Legacy support is available in the range of interface cards available in IP/MPLS access routers, which allow the smooth migration of any existing legacy network without changes to existing equipment such as sensors, radio systems, and analog cameras. Flexible synchronization options include Synchronous Ethernet (SyncE), similar to synchronous digital hierarchy (SDH) and SONET. These system-timing capabilities provide a quick and easy way to achieve frequency synchronization and the benefits of an Ethernet-network without changing existing TDM-network applications.

Next steps

Since 2010, network deployment has been phased with the intention of not disturbing critical operations. A full 150-site microwave radio deployment is to be phased in over the next four to five years, with Norfolk Southern and Nokia now performing the detailed network assessment. The microwave backhaul will play a critical role in delivering a key benefit of IP/MPLS, and will be particularly beneficial for Norfolk Southern’s operations because it supports non-line-of-sight operations and is suitable for installation in areas susceptible to high interference like cities, airports, and seaports. It also has significant capacity benefits – up to 1Gbp/s with up to four radios using the IP/MPLS router’s LAG feature – and is compatible with point-to-point, mesh and ring topologies, providing service in all situations.

Summary

With its converged IP/MPLS communications network incorporating microwave backhaul, Norfolk Southern is now operating more safely and efficiently, with higher reliability and cost savings. The new network is designed to scale easily, and is ready to support PTC now, and next-generation IP applications in the years to come. Additionally, Nokia offloaded from Norfolk Southern the manually intensive procurement and management functions, making the upgrade easier.

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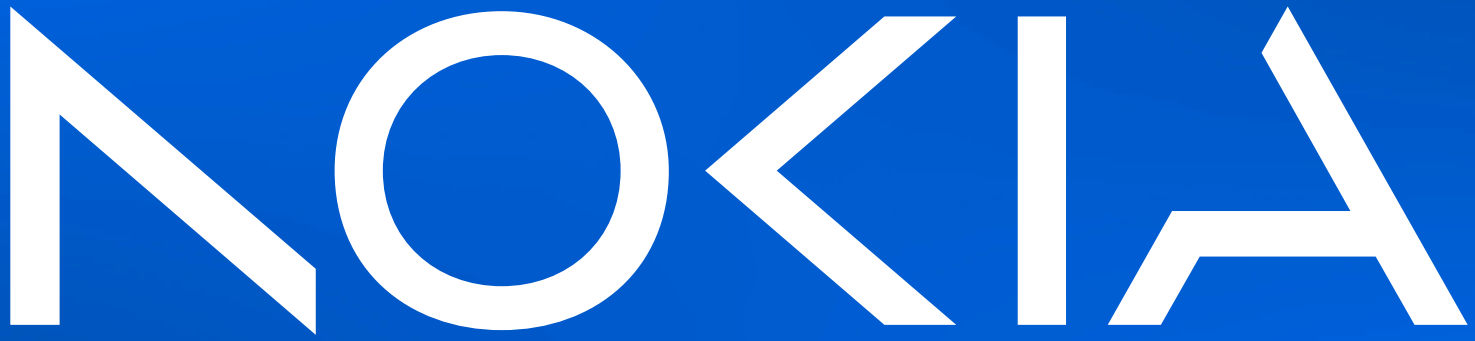

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