

Cisco Connected Rail

Meeting New Transportation Demands

What You Will Learn

This document describes Cisco® Connected Rail, a component of the Cisco Transportation Smart Solution (TSS) for railways and other mobile transit environments. It explains how Connected Rail helps rail operators and transit authorities do the following:

- Keep passengers and employees safe
- Deliver high-speed voice, video, and data services to passengers and crew
- Integrate multiple single-purpose networks for greater interoperability, improved communications, and lower costs
- Meet legislative safety compliance requirements
- Provide onboard passenger Wi-Fi and other services

This overview will also detail the four subcomponent solutions of Cisco Connected Rail:

1. **Cisco Connected Train** for onboard, IP-based communications, including Wi-Fi services, video surveillance, and automated operations
2. **Cisco Connected Trackside**, a ruggedized IP infrastructure that connects the train to a unified mobile-to-Multiprotocol Label Switching (MPLS) backhaul network and, ultimately, your data center
3. **Cisco Connected Station**, which integrates multiple in-station networks and retail communication systems into a standards-based IP network
4. **Cisco Positive Train Control** is the industry's first end-to-end rail communications network that complies with U.S. Rail Safety Improvement Act requirements. It integrates onboard, trackside, wayside, signaling, and back-office systems and is designed to help prevent train collisions, derailments and other human caused rail accidents.

Click here for more information on Cisco [Positive Train Control](#).

The solutions can be combined in various ways to create applications that extend from onboard trains to trackside to train stations to your data and control centers.

Safety, Mobility, and Efficiency Challenges in the Rail Industry

Safety, mobility, and efficiency goals are behind most decision making in transportation today. New safety mandates, such as the U.S. Rail Safety Improvement Act, requiring new PTC capabilities that can automatically override human error in train operations to improve safety. Meanwhile, passengers expect to have mobile Internet access onboard trains, in stations, and everywhere in between. Operations teams also need mobility to increase responsiveness and productivity.

For end users, selecting Wi-Fi rather than cellular for most of their data consumption is an important consideration for staying within the limits of their mobile data plans. Service providers and rail operators should recognize that the resulting growth in Wi-Fi traffic has strong implications for planning their future networks to accommodate onboard and in-station Wi-Fi. For example, according to the Cisco **Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2013–2018** (February 2014):

- Global mobile data traffic will reach 15.9 exabytes per month or 190 exabytes annually by 2018. How much data is that? Well, it's 134 times more than all IP traffic generated in 2000. And consider that just five exabytes is equal to roughly all of the words ever spoken by human beings. Now, that's a lot of traffic!
- Globally, 54 percent of mobile devices will be smart devices by 2018, up from 21 percent in 2013. By 2018, 96 percent of mobile data traffic will originate from smart devices.
- Mobile data network connection speeds will continue to increase, reaching 2.5 Mbps by 2018. This is more than a seven-fold speed increase compared with 2012.
- The average smartphone will generate 2.7 GB of traffic per month by 2018, a five-fold increase over the 2013 average of 529 MB per month.

Amid all this growth, railways face the following:

- **Aging Systems.** Communications networks have not changed much in the transportation industry for many years. It's grown complicated and costly to maintain and manage multiple, aging proprietary networks. Each supports a specialized application and telecom requirements. Each has different upgrade, maintenance, and operational processes. Without open standards across an infrastructure, solution choices are limited and inflexible. Network rigidity also prevents you from adding new technologies and delivering new services. So you need some way to move forward and bridge the old with the new.
- **Challenging Environmental Conditions.** Rail transportation and public safety environments demand rugged solutions. High-speed networks on a train and trackside must withstand wide temperature swings, extreme weather, vandalism, shock, and vibration, for example. In addition:
 - Power is not as readily available on a train as it is in a building. New capabilities must be implemented using as few devices requiring a nearby power outlet as possible.
 - Train cars aren't designed for large network deployments. Networking equipment must use minimal space.
 - It can be difficult - or impossible - to implement high-speed wireless coverage of the entire rail infrastructure. Geographic factors, right-of-way concerns, and interference often prevent consistent cellular and Wi-Fi coverage.
 - Rail cars move around. Sometimes they are pulled for maintenance or inserted into a different train. Some rail operators prefer to off-board wireless traffic from every car; others only off-board from front and back cars.

Table 1. Cisco Connected Rail Features and Benefits

Use Case	Application/Feature/Service	Benefit(s)
Safety	Video surveillance, positive train control (PTC)	Reduced human error and related mishaps, improved situational awareness
Compliance	Support for PTC; automation that overrides human error	Increases ability to meet legislative PTC mandates in the U.S. by December 31, 2015 deadline

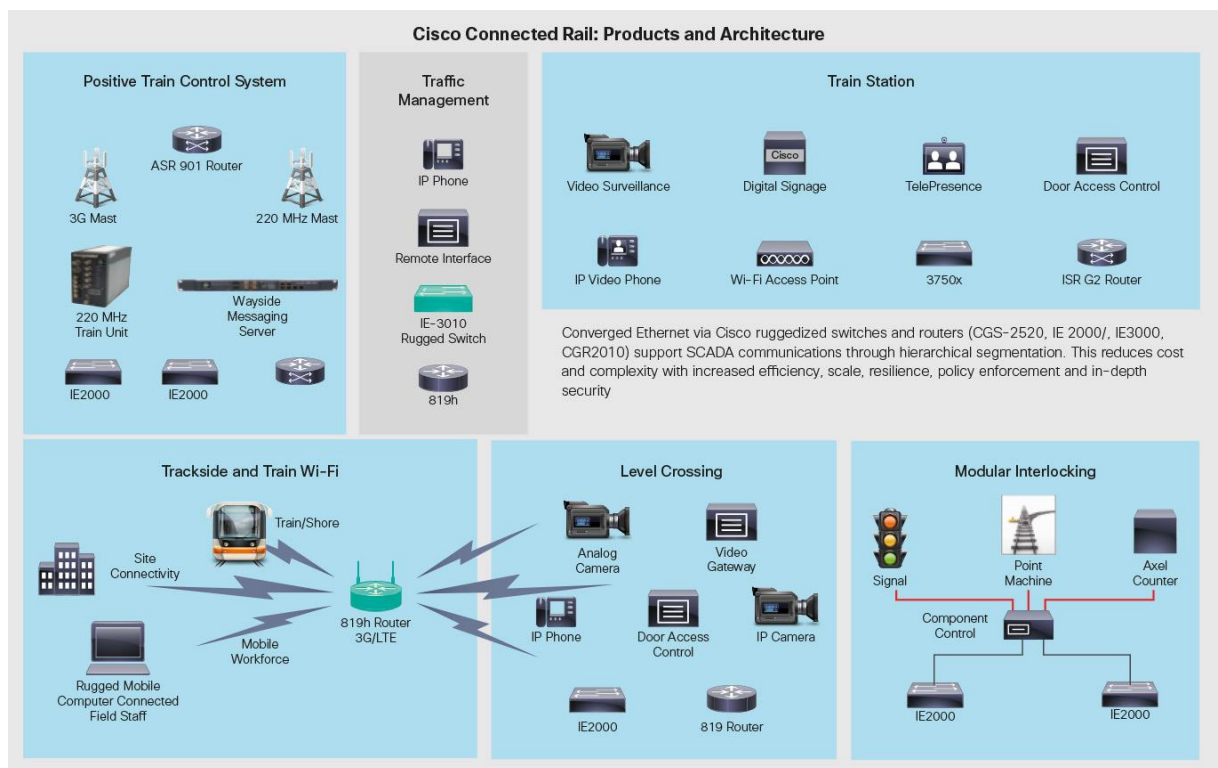
Use Case	Application/Feature/Service	Benefit(s)
Passenger Mobility and Services	<ul style="list-style-type: none"> Onboard Wi-Fi and other mobile Internet access services Bundled Internet access service with monthly ticket fee Onboard screens display location and weather information; travel tips; advertisements 	<ul style="list-style-type: none"> Passenger retention Increased ridership Revenue generation and new business models
Operations	<ul style="list-style-type: none"> Train operators communicate with passengers or crew over IP-based intercom or 220 Mhz radio High-Definition IP video cameras for live monitoring of activity on trains, in stations at trackside Automated systems for correlating data instead of manually viewing multiple screens Consolidate multiple single purpose applications onto one converged IP network 	<ul style="list-style-type: none"> Improved passenger safety More efficient operations Lower operating expenses (OpEx) Reduced capital expense Simplified maintenance Greater network security Move from proprietary to open standards

Cisco Connected Rail solutions help you meet all these challenges while augmenting or extending the life of your existing single-purpose networks. The solution includes proven and tested reference architectures and validated communications network designs for the train, track, backhaul network, and data center to offer immediate benefits. Table 1 lists several of the features and benefits of Cisco Connected Rail.

The Solution under the Hood: Architectures and Designs

The overarching Cisco Connected Rail reference architecture is shown in Figure 1.

Figure 1. Cisco Connected Rail Reference Architecture

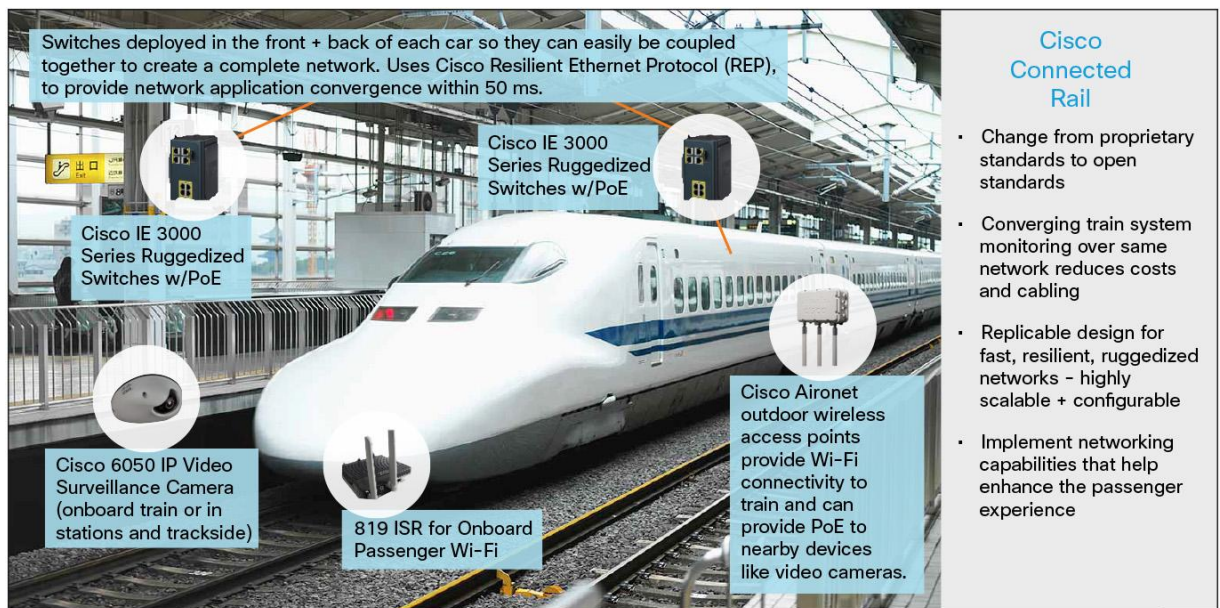


For Full Connected Rail Architecture High Resolution Diagram, [Click Here](#).

Cisco Connected Train

Cisco Connected Train integrates capabilities from multiple proprietary networks in train cars onto a new IP network infrastructure. The solution provides a resilient infrastructure to deliver numerous services, like onboard safety and security (including video surveillance), passenger Wi-Fi services, and collaboration capabilities. Cisco Connected Train also provides a link to dispatch and control center teams for PTC and fleet dispatch features. The Connected Train architecture is shown in Figure 2.

Figure 2. Cisco Connected Train Architecture

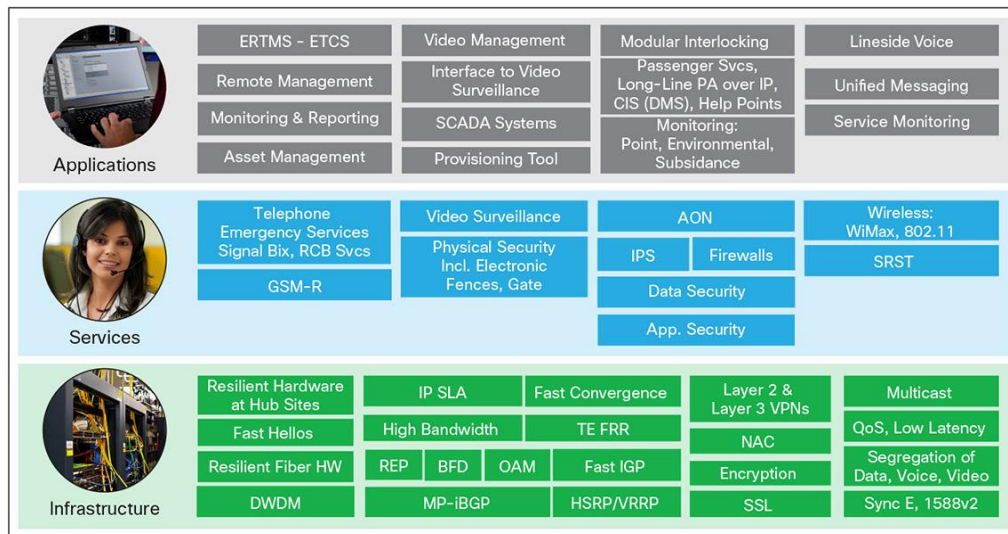


The high-speed Cisco Connected Train network is built on hardened, small-form-factor switches and routers that support consumer and business mobility features. Wireless access points (APs) provide Wi-Fi connectivity to rail personnel and passengers. The network also supports comprehensive video surveillance, with a dedicated video surveillance media server on each car to store video archives from the onboard IP cameras.

Cisco Connected Trackside

Trackside APs are ruggedized and ready for almost any environment. They connect to the transport network with fiber or copper connections. They can even provide Power over Ethernet (PoE) to a nearby device, like a video surveillance camera. Wireless APs can be connected to Cisco Industrial Ethernet switches, which connect directly to network access nodes. The Cisco Connected Trackside architecture is shown in Figure 3.

Figure 3. Cisco Connected Trackside Architecture



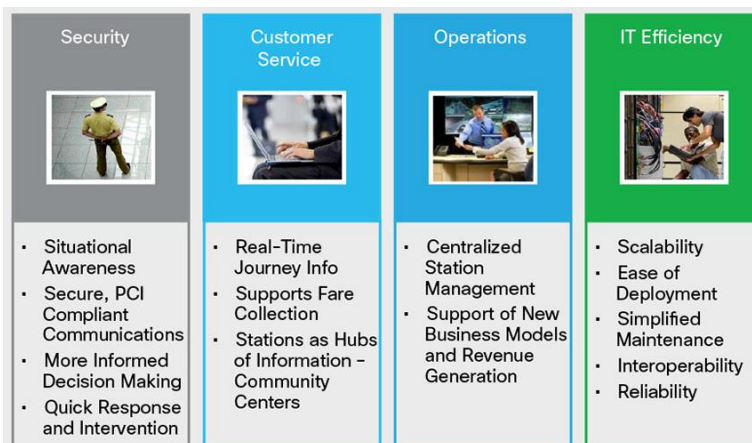
Note that Cisco Connected Train + Cisco Connected Trackside + 220 MHz radio, when combined enable Cisco Positive Train Control (PTC) 1.0. Cisco PTC 1.0 is the industry's first comprehensive network solution for PTC compliance. It integrates onboard, trackside, wayside, signaling, and back-office communication networks to provide a redundant and resilient bidirectional communications network. A compliant PTC system automates override capabilities in the event that an operator is incapacitated or distracted and misses a signal.

Cisco Connected Station

With Cisco Connected Station, you can deliver innovative services to passengers. Station staff get more efficient communications. Cisco Connected Station integrates proprietary networks in stations into a new multiservice network. One that lets you unify displays, voice communications, fire and safety alarm systems, and passenger services applications into one manageable infrastructure. In addition, the architecture provides a model for physical security and help points to enhance station physical security and to simplify monitoring. It's designed to help stations enhance safety and security, deliver new passenger services, and simplify operations.

The architecture for Cisco Connected Station is shown in Figure 4.

Figure 4. Cisco Connected Station Architecture



Cisco provides a validated design for backhauling remote radio traffic. The transport network consists of access, aggregation, and core networks. It provides a resilient communication path between Connected Train, Connected Trackside, Connected Stations, and the data center. This network includes ruggedized Ethernet switching at the edge and a multipath, IP-based MPLS transport network with subsecond reconvergence for communications between trains and your data center. The architecture for train-to-data center backhaul is shown in Figure 5.

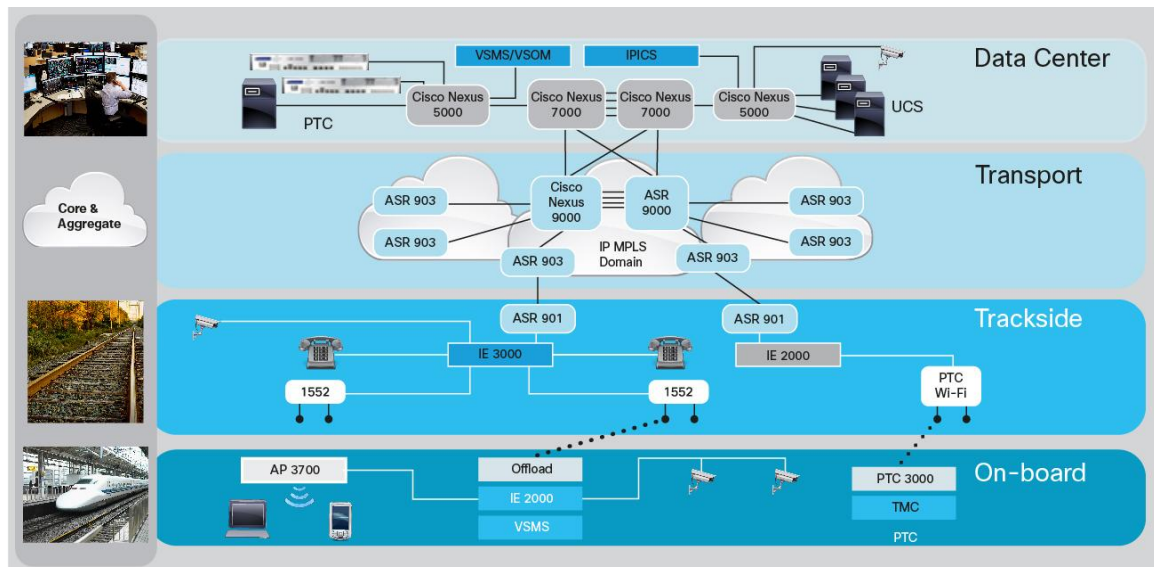
A Virtualized Multiservices Data Center (VMDC) validated design, also shown at the top of Figure 5, creates a data center network to support high-speed mobile networking for rail applications. The data center also houses Cisco Connected Rail application servers. These application servers may run directly on physical servers or be virtualized through the use of a hypervisor. They include the following:

- Back Office Server (BOS) and mobility anchor used for Cisco PTC 1.0
- Cisco Video Surveillance Manager (VSM) application servers including the Cisco Operations Manager and Long Term Storage
- Other servers, such as the Cisco IP Interoperability and Collaboration System (IPICS). This system dissolves communication barriers between land mobile radio (LMR) systems and devices such as mobile phones, landline phones, IP phones, and PCs. IPICS is a scalable, cost-effective way for all rail and security personnel to communicate quickly using any desktop or mobile device wherever they are located. It simplifies radio dispatch operations and accelerates incident and emergency response times. It also adds new capabilities to your existing communications equipment.

Quick Look: Validated Cisco Connected Rail Components

- **Wi-Fi Access Points:** Cisco offers a range of wireless APs designed for onboard and trackside deployment, including Cisco Aironet® 3700 Series wireless LAN access points, Cisco Aironet 3600 Series wireless LAN access points, and Cisco Aironet 1552 outdoor access points
- **Wireless LAN Controller (WLC):** The Cisco 5500 Series Wireless Controller provides high-performance, scalable, and reliable services for wireless networking. It can support up to 500 access points. For larger deployments, the Cisco 8500 Series Wireless Controllers offer the same functions with higher scale.
- **Subscriber Policy Control:** For service providers who offer mobile services to rail passengers and operations teams, the Cisco Service Provider Wi-Fi solution offers subscriber policy control to create revenue-generating opportunities. Cisco Quantum Policy Suite (QPS) for Wi-Fi is a carrier-grade policy and subscriber data management software solution for controlling, monetizing, and personalizing Wi-Fi offerings.
- **Industrial Ethernet Switching:** The Cisco IE 2000 and 3000 Series of Industrial Ethernet switches provide on- and off-the train switching. Onboard the train, a ruggedized rail-certified Layer 2 switch provides Ethernet connectivity. Off-board, standard Cisco Industrial Ethernet switches support Layer 2/3 connectivity with flexible configuration options.
- **Routers:** Cisco 819 Integrated Services Routers (ISRs) offer flexible off-boarding and Layer 3 routing. Onboard devices use the Cisco 819 as their default gateway. The data center uses Cisco ASR 1000 Series Aggregation Services Routers for terminating routed connections.
- **IP Video Surveillance:** Cisco provides video surveillance cameras including the rugged, high-definition (HD), IP67-rated 6050, and media servers. The Cisco Video Surveillance Manager (VSM) management suite lets you view and archive video and manage the video surveillance infrastructure.
- **Cisco Unified MPLS for Mobile Transport (UMMT):** Cisco UMMT is a scalable and resilient backhaul network for mobile voice, video, and data traffic between the train and the data center. It complements existing backhaul networks to enhance their capacity and resiliency.

Figure 5. Connectivity from Train to Data Center



Summary

Use Cisco Connected Rail to integrate the capabilities of multiple standalone networks with an open-standards IP infrastructure. The newer, more reliable network lets you add rich capabilities to achieve safety, mobility, and efficiency goals. You can implement video surveillance to protect assets and monitor passenger safety. Give station and trackside employees mobile communication capabilities to maintain situational awareness. And more easily meet industry regulations and compliance requirements using the same physical infrastructure. All thanks to the converged Cisco Next-Generation IP Network.

Why Turn to Cisco?

Cisco architecture and validated network designs, built on open standards, let you take advantage of commercially available products and services to lower costs while improving performance. Whether you are a railroad operator, transit authority, or first responder, you gain the benefits of IP networking capabilities that have been proven in every other industry around the world. Get the high capacity needed to support today's rail applications and services with the flexibility you need to easily adapt over time. Cisco Services help you plan, build, and manage the new capabilities cost-effectively. With Cisco, you can support new and future requirements, lower your total cost of ownership, reduce deployment costs, manage risk, and deliver high performance of your Connected Rail solution.

Cisco Services

From strategy to execution, we help you plan, build, manage, and support your Cisco Transportation Smart Solution. We apply our industry leading experience to help you improve system operational efficiency, scalability, security, and profitability. With an end-to-end approach that aligns outcomes to your business goals.

For More Information

For more information about Cisco Connected Rail, visit <http://www.cisco.com/go/connectedrail>.




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