

## Your Trusted Partner in Automation

Moxa is a leading manufacturer of industrial networking, computing, and automation solutions. With over 25 years of industry experience, Moxa has connected more than 30 million devices worldwide and has a distribution and service network that reaches customers in more than 70 countries. Moxa delivers lasting business value by empowering industry with reliable networks and sincere service for automation systems.

### Moxa Sales and Marketing Headquarters

Moxa Corporate Plaza  
601 Valencia Ave., Suite 200  
Brea, CA 92823, U.S.A.  
Toll Free: 1-888-669-2872  
Tel: +1-714-528-6777  
Fax: +1-714-528-6778  
usa@moxa.com

### Moxa Design and Engineering Headquarters

Fl. 4, No. 135, Lane 235, Baoqiao Rd.  
Xindian Dist., New Taipei City,  
Taiwan, R.O.C.  
Tel: +886-2-8919-1230  
Fax: +886-2-8919-1231  
info@moxa.com

### The Americas

#### Moxa Americas

Toll Free: 1-888-MOXA-USA  
Tel: +1-714-528-6777  
Fax: +1-714-528-6778  
usa@moxa.com

#### Moxa Brazil

Tel: +55-11-2495-3555  
Fax: +55-11-2495-6555  
brazil@moxa.com

### Europe

#### Moxa Germany

Tel: +49-89-3700-399-0  
Fax: +49-89-3700-399-99  
europe@moxa.com

#### Moxa France

Tel: +33-1-30-85-41-80  
Fax: +33-1-30-47-35-91  
france@moxa.com

#### Moxa UK

Tel: +44-1844-355-601  
Fax: +44-1844-353-553  
uk@moxa.com

### Asia-Pacific

#### Moxa Taiwan

Tel: +886-2-8919-1230  
Fax: +886-2-8919-1231  
asia@moxa.com

#### Moxa India

Tel: +91-80-4172-9088  
Fax: +91-80-4132-1045  
india@moxa.com

#### Moxa Russia

Tel: +7(495)287-09-29  
Fax: +7(495)269-09-29  
russia@moxa.com

### China

#### Moxa Shanghai

Tel: +86-21-5258-9955  
Fax: +86-21-5258-5505  
china@moxa.com

#### Moxa Beijing

Tel: +86-10-6872-3959/61  
Fax: +86-10-6872-3958  
china@moxa.com

#### Moxa Shenzhen

Tel: +86-755-8368-4084/94  
Fax: +86-755-8368-4148  
china@moxa.com



**MOXA**<sup>®</sup>  
Reliable Networks ▲ Sincere Service

## Integrated IP Solutions for Smarter Railways

Industrial Networking, Computing, and Video Surveillance Solutions

**MOXA**<sup>®</sup>  
Reliable Networks ▲ Sincere Service

Travel Comfortably, Arrive Safely

## Your Trusted Partner in Railway Automation

Moxa is an IRIS-certified global leader in a wide range of IP-based communications solutions. Now, Moxa is contributing its networking expertise and innovative technologies to the railway industry through new market-specific solutions and membership in IEC railway committees. Railway operators world-wide have discovered new operational efficiencies by deploying Moxa's unique time and cost-saving railway technologies, such as intelligent wireless inter-carriage connections, millisecond-speed Ethernet redundancy, and WLAN roaming solutions. With over 25 years of experience in industrial networking, Moxa has a time-tested record of developing products with longevity. By designing for long MTBF, owning all the core component IP, and building long-term partnerships, Moxa helps railway integrators create sustainable solutions with low life-cycle costs for building or upgrading passenger comfort and network operations.



### IRIS-certified for Maximum Quality

Moxa has proven its ability to meet the specific requirements and growing expectations of railway customers by receiving the coveted International Railway Industry Standard (IRIS) certification. This certification attests to Moxa's high standards in all phases of product development, from design to development to manufacturing. The certification covers passenger information systems and communication systems.

### High Longevity with Low Life-cycle Cost

Rail systems need to operate on decades-long lifecycles. With obsolescence management, Moxa acts to minimize the impact of obsolescence and its potential to increase customer cost through proactive strategies. Moxa develops major product components—IP camera modules, RF modules, and CPU chips—entirely in-house to minimize the dependence on additional third-party suppliers. This self-reliance combines with Moxa's history of providing long-lasting high MTBF solutions to create complete railway solutions that railway operators can use with confidence, knowing that they can be maintained for decades to come.

### Operational Efficiency through Innovative Thinking

As a member of IEC rail working groups, Moxa consistently stays ahead of the curve in delivering the innovative features and technologies that maximize the operational efficiency of railway systems, such as intelligent wireless inter-carriage connections, flexible and location-based auto device configuration, millisecond-speed Ethernet redundancy, and millisecond-speed WLAN roaming solutions. These innovations give Moxa's solutions a winning combination of extraordinary flexibility and high performance that railway operators can use to minimize the workload and maximize the efficiency of their operations.

### Answers for Diverse Global Requirements

Although all rail systems across the world face similar challenges, they must also adapt to local operating and regulatory requirements that are specific to each system. Moxa's large portfolio, broad expertise, and customizable products give Moxa the flexibility to deliver solutions tailored for different application needs. This portfolio includes a versatile selection of communications, data control, and computing infrastructure that are all compliant with EN 50155 railway standards, which is the industry benchmark for harsh environmental conditions, including temperature and vibration. Moxa also offers comprehensive service that includes system design consultation, proof-of-concept testing, and on-site support, to ensure that customers receive a solution tailored for their particular application.

# Committed to Improved Passenger Security, Enhanced Traffic Safety, and Higher Operational Efficiency

## Table of Contents

### Industrial Leading Technology

Industrial Auto Configuration	P5
Ethernet Train Backbone	P7

### Onboard System

Onboard CCTV	P9
Passenger Wi-Fi	P13
Passenger Information System	P15

### Wayside System

Communication-based Train Control	P17
Wayside Communication System	P21
Condition Monitoring for Turnouts	P25

Enhancing passenger comfort and maximizing passenger security are two key elements for next-generation trains. However, the conventional train communication networks (TCN) that are commonly available today use a mix of different proprietary technologies that result in unnecessary costs, limits their bandwidth and constrains their ability to improve passenger comfort and security.

Moxa's railway solutions upgrade railway infrastructure operation and maintenance in order to deliver improved passenger security, enhanced traffic safety, and higher operational efficiency for next-generation railway networks. An investment in a modern communications with Moxa's railway solutions will pay off far in the future and offers the following benefits:

#### ▶ Maximized system availability:

- Industrial-grade auto configuration technology: FLI
- Advanced millisecond-level redundancy solutions: Turbo Ring, Turbo Chain
- Seamless and secured wireless train-to-ground connections: Turbo Roaming

#### ▶ Time and cost saving:

- Auto carriage-to-carriage wireless connections: ACC
- Automated dynamic ring coupling
- Intelligent multiple WAN routing platform: MIRF

#### ▶ Future-proof:

- IEC 61375 compliant solutions for train backbone
- Gigabit bandwidth enabled ETBN and ECN

#### ▶ Railway hardened:

- EN 50155/EN 50121-4 compliance, M12 connectors
- -40 to 75°C operating temperature

## Get the Latest Intelligence on Railway IP Technology



**Moxa Railway Newsletter**  
[www.moxa.com/RailNews](http://www.moxa.com/RailNews)

Packed with technical articles, project award announcements, and Moxa event updates, Moxa's Railway Intelligence Newsletter is released quarterly. Subscribe to the newsletter to stay current with the latest railway trends and learn about Moxa's newest IP-based solutions for railway applications.



**Moxa Railway Knowledge Center**

[www.moxa.com/Rail\\_Knowledge](http://www.moxa.com/Rail_Knowledge)

Scalable and future-proof, IP technology has the industry buzzing and will transform railway operations. Visit our knowledge center for insights into market trends, reviews of upcoming industry challenges, and case studies covering how Moxa's solutions are being used in the railway field.

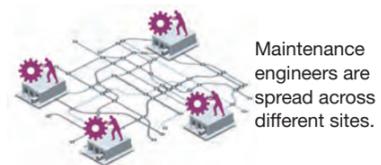
# Achieve Greater Rail Availability through Industrial-grade Auto Configuration

In creating communications networks, rail integrators and operators already understand the important role of constant availability. If a system is to be truly optimized for high availability, it must be very reliable and also very easy to maintain. Thus, by making everyday maintenance procedures more streamlined, efficient, and error-free, rail system integrators can dramatically improve the overall availability of the railway operations.

Automating time-consuming configuration for network devices and system-wide settings delivers dramatic dividends for rail networks. Plug-and-play Ethernet devices are a paradigm shift for rolling stock operations that reduces maintenance costs and increases overall availability, with benefits that can be seen throughout all phases of railway system deployment.

## Today's Industrial Challenges

- Rail operators and their front-line maintenance staff are not yet very familiar with operating Ethernet networks.
- Configuring network settings and devices is time-consuming and also requires diverse expertise.
- Dispatching maintenance engineers to each station results in high labor costs.



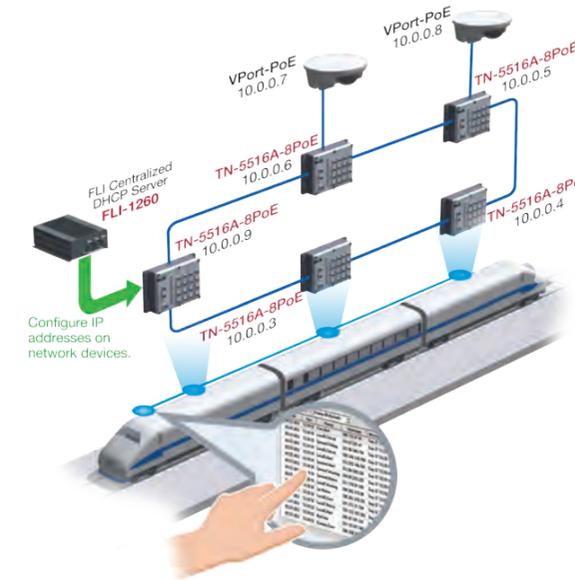
## Moxa Solutions

Flexible, Location-Based, Intelligent (FLI) Technology

Moxa's FLI is a convenient auto-configuration technology that automates common configuration tasks while remaining highly deterministic. An FLI server extends the reach of Option 82 so that even end devices will be able to identify their physical topological location to the server. This allows the server to consistently deliver the same IP address to the IP devices deployed in the same location. As a result, Camera 2 in Car 2 will always be assigned exactly the same IP address, even after it's been rebooted or replaced. In car swapping, FLI can maintain this IP consistency according to the new connection as well.

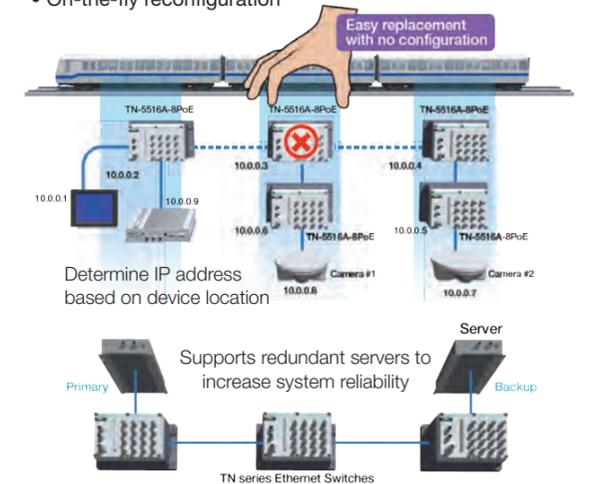
In addition to assigning IP addresses, FLI can also configure network devices in the same way. For example, Camera 2 in Car 2 will also always be assigned the same camera privacy mask settings.

FLI technology gives rail operators the convenience of an automatic configuration system, without compromising on consistency or determinism. This reduces maintenance time substantially by reducing maintenance workload and minimizing maintenance errors. Furthermore, with FLI, the entire network configuration is centralized in a central location. This makes it much easier to reconfigure the entire network, as the entire network can be reconfigured from a single location instead of individually reconfiguring each individual device.



## Summary of Benefits

- **Flexibility**
  - Manage all Ethernet devices in one centralized file
  - Use open standards for end devices
- **Location Awareness**
  - Set IP by device location on the Ethernet topology
- **Intelligence**
  - Supports redundant server
  - Always listen to the right server even if there are multiple DHCP servers connected to the network
  - On-the-fly reconfiguration



## Matching Products

**FLI Server** **FLI-1260**  
Pre-configured Moxa computers only

**Ethernet Switch** **ToughNet Series**  
Auto-configured Moxa Ethernet switches only

**Auto-configured Moxa end devices**

**Auto-configured Moxa and other devices**

- AWK-3131-M12-RCC series wireless APs
- NPort 5450AI-M12 series device servers
- VPort P06-1MP-M12 series IP cameras
- ioLogik E1510-M12-T series Ethernet I/O

# Maximizing the Value of Ethernet Technology in Multimedia Train Backbone

Conventional WTB and MVB networks have limited ability to support multiple services. To replace these inadequate technologies, train communications networks are now turning to IP-based Ethernet Consist Networks (ECN) and Ethernet Train Backbones (ETB). System operators are beginning to recognize that IP technology offers a complete package that can meet rising network demands, reduce operating costs, and deliver improved functionality. Moxa offers a wide selection of EN50155 compliant industrial Ethernet switches to help operators build IP train networks that integrate multiple isolated and disconnected systems to create a solution that operates more efficiently and remains expandable in the future.

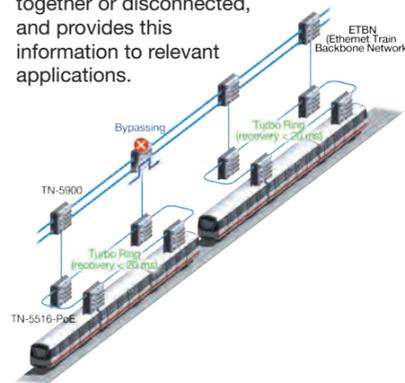
### Today's Industrial Challenges

- Higher bandwidth to satisfy multimedia services
- Simpler network connections with reduced wiring and costs
- Cost-effective paths to realize high network availability

### Moxa Solutions

#### IEC 61375-2-5 Compliant Train Ethernet Routers

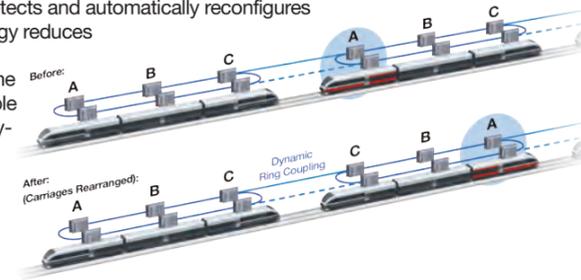
Moxa's industry-leading TN-5916 series Ethernet routers are designed according to the specifications laid out in the IEC 61375-2-5 standard. The TN-5916 series routes traffic between Ethernet Train Backbones and Ethernet Consist Networks. In addition, the TN-5916 router handles the train inauguration as cars of a train are connected together or disconnected, and provides this information to relevant applications.



### Advanced Ethernet Redundancy

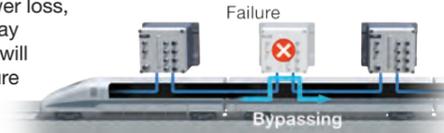
#### Designed for Higher Operational Efficiency

Moxa's TN advanced series Ethernet switches feature Dynamic Ring Coupling technology that excels in inter-consist network redundancy. When train carriages are reordered, Dynamic Ring Coupling detects and automatically reconfigures the network. This technology reduces configuration time and potential human error, so the system is both highly reliable and efficient to operate day-to-day.



#### Bypass Relay Function in Linear Topology

In a linear topology, a failure in any of the upstream links will result in the failure of the downstream links as well. To prevent such a failure, Moxa's TN-5510A/5518A series provides 2 optional Gigabit Ethernet ports with bypass relay function. If one of the Ethernet switches fails due to power loss, its ports are bypassed with the relay circuit, and the transmission lines will interconnect automatically to assure continuous system operation.



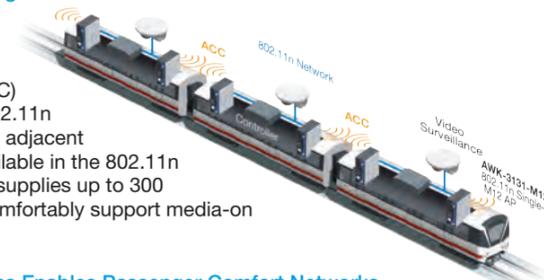
#### Turbo Ring™ for Fast Ring Redundancy

All of Moxa's managed Ethernet switches support Turbo Ring™, which has a super fast fault recovery of under 20 ms at a full load of 250 Ethernet switches to minimize downtime caused by network failure. If a path in the network fails, the system will return to normal communication in under 20 ms.



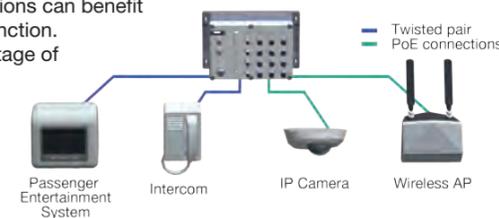
#### 802.11n Auto Inter-Carriage Connections

For carriages that are connected wirelessly, Moxa's Auto Carriage Connection (ACC) will automatically form 802.11n wireless bridges between adjacent wireless APs. ACC is available in the 802.11n AWK-RCC series, which supplies up to 300 Mbps of bandwidth to comfortably support media-on demand services.



#### Gigabit and PoE Solutions Enables Passenger Comfort Networks

More and more systems are converging on the onboard Ethernet network, and some of these systems consume a lot of bandwidth. Moxa's Ethernet switches can deliver Gigabit speed to provide enough bandwidth to support applications today and tomorrow. In addition, all applications can benefit from the ToughNet series' PoE function. Network builders can take advantage of Power-over-Ethernet technology to power networked devices in difficult-to-reach locations and to simplify field wiring and reduce installation costs.



### Highlighted Products

ToughNet TN Series Railway Routers and Ethernet Switches



#### Router Series

**TN-5916 Series**  
EN 50155 NAT 16-port router

#### Layer 3 Series

**TN-5816/5818 Series**  
EN 50155 16/16+2G-port layer 3 Gigabit managed Ethernet switches

#### Layer 2 Gigabit/PoE Series

**TN-5518A/5510A Series**  
EN 50155 16+2G/8+2G-port Gigabit managed Ethernet switches with 8 PoE ports

#### Layer 2 Faster Ethernet Series

**TN-5524-8PoE/5516A/5508A Series**  
EN 50155 24/16/8-port managed Ethernet switches with 8 PoE ports

#### TN-5300 Series

EN 50155 8-port unmanaged Ethernet switches

AWK-RCC Series Railway Wireless APs



#### AWK-3131-RCC Series

Industrial IEEE 802.11a/b/g/n wireless AP/bridge/client

#### AWK-5232-RCC Series

Industrial IEEE 802.11a/b/g/n dual-RF wireless AP/bridge/client



✓ Location: Helsinki, Finland  
Product Used: TN-5916 Series

✓ Location: Paris, France  
Product Used: TN-5508

✓ SeriesLocation: Norway  
Product Used: TN-5516 Series, TN-5516-8PoE Series

✓ Location: Taipei, Taiwan  
Product Used: TN-5516 Series

✓ Location: Ukraine  
Product Used: TN-5518

# Optimized CCTV Solutions for Any Scene, Any Location, Any Condition



IP-based CCTV systems are becoming an absolute requirement for train operations. Effective video surveillance protects passenger safety and makes train operations more efficient, which has led to increased investment in onboard IP CCTV systems. These systems have expanded in scope and reach, and cameras and NVR computing platforms are now being deployed in more and more locations throughout the train. These new video surveillance applications have introduced important new IP video requirements: as IP cameras and computers are deployed in more and more locations onboard a train, there is a corresponding increase in the performance, reliability, and design requirements for those IP cameras and computers.

## New Locations and New Requirements for Onboard IP CCTV

- More cameras with different form factors and easy installation for different locations on the trains
- Continuously crystal-clear image quality in a wide dynamic range of dark and light environment
- High performance video streams for smooth video surveillance
- Vibration, humidity, and dust resistant devices for harsh onboard environments

## Moxa Solutions

### Any Scene, Any Location, Any Condition

#### Superior Image Quality under Any Lighting Conditions

Trains are not an ideal filming environment. The lighting conditions onboard a train will vary wildly as the vehicle passes through a variety of different environments, including tunnels, open air, and shade. To continuously provide crystal clear image quality, the IP cameras must capture a wide dynamic range of dark and light, as well as reduce noise and motion blur. Moxa's IP cameras capture sharp full motion video images at HD resolution, and use advanced image technologies such as DNR (Digital Noise Reduction), BLC (Backlight Control or Black Level Control), and WDR (Wide Dynamic Range) to provide a clear picture in any lighting condition or environment.



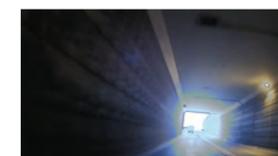
Good WDR performance



Clear/color low lux image



Strong light inhibition



Fast imaging in quick light change

#### Optimal Streaming Performance in Low-Bandwidth Environments

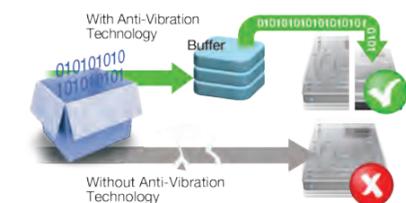
Video streaming is a major component of IP surveillance systems, and affects both the network and video performance. Moxa's systems use custom technology to deliver consistent video quality without overwhelming network resources. Moxa's IP cameras deliver up to a maximum of three independent video streams (two H.264, one MJPEG) simultaneously, and CBR Pro™ technology stabilizes the bit rate and guarantees that even in low-bandwidth environments, the system will maintain consistent video performance.

#### Secure & Reliable Disk Access under Extreme Vibrations

The first priority in NVR is to maintain the integrity of the video data and avoid any data loss.

Moxa's SafeGuard™ technology secures the data on NVR computers and rugged NAS devices with intelligent protection against data corruption, even during extreme vibrations or shocks.

For NVRs, SafeGuard includes a patented bracket that protects the hard disk by directly absorbing kinetic energy and balancing the hard disk to avoid excessive vibration and shock. For NAS devices, SafeGuard will prevent data loss when disk vibration exceeds a pre-set threshold by automatically saving data to a non-volatile 1.5 GB solid-state memory buffer and storing it there until the vibrations drop to tolerable levels. Even if the system suddenly crashes, all the data will remain in the buffer when power is restored.



Patented Vibration Protection for Data Drives



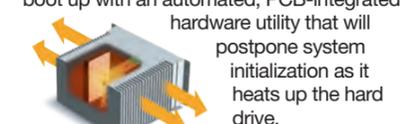
#### 15-second RAID 1 Synchronizations on NAS Crashes

Synchronization issues have hobbled RAID in time-critical scenarios such as train maintenance at a station. Any sudden power losses that interrupt disk I/O during write operations will leave data inconsistent across the array, requiring a block-by-block journaling operation to re-synchronize the drives. In the past, these synchronizations across 300 GB drives could take hours or even days; but with Moxa's implementation of write-intent bitmap technology, drive synchronizations following crashes only take about 15 seconds in RAID 1 mode. At that speed, the NAS maintenance operation doesn't need to keep the trains from running on time.



#### -40 to 70°C Temperature Tolerance

All of Moxa's EN 50155 products are compliant with the essential sections of EN 50155 and EN 50121-3-2. The VPort P06-1MP-M12-T is the world's first IP camera that can operate safely in -40 to 70° C temperatures without fans or heater, and complies with the highest EN 50155 TX temperature criteria. In addition, Moxa's computers with SafeGuard™ technology use passive heat exchange to keep it cool in high temperatures. This allows them to easily meet the 70°C heat tolerance demanded by EN 50155 TX. For extremely low temperatures, Moxa's Intelligent Heat Solution guarantees that your system will boot up with an automated, PCB-integrated hardware utility that will postpone system initialization as it heats up the hard drive.



**Versatile Camera Types and Installations for Any Location**

Moxa provides a variety of EN 50155 IP cameras and all the different applications, carriages, and installation environments in onboard CCTV systems.

**Choice of IP Cameras**

- Mounting: Ceiling mount, panel mount, flush mount and vertical mount. In addition, optional mounting accessories are provided.
- Lens: Several fixed focal-length lenses, including 2.5, 3.0, 3.6, 4.2, 6, 8, 16 mm, are provided for different viewing angles and distances.
- Form factor: Both metal and plastic housings are provided, and feature EN 62262 IK9/IK10 vandal resistance and IP 66/54 rain and dust protection.

**Wide Selection of Railway Computers for Different Performance Levels**

Moxa provides diverse NVR computing platforms and NAS devices to fulfill various customer demands. The choice and versatility of Moxa's onboard NVR portfolio includes solutions for driver car NVR, passenger car NVR, NAS, or gateway applications. Further options include different performance levels (from entry level to extreme performance), device role, functionality, and form factor, so that there is a Moxa solution that will excel in any type of application.

**Find the Best-Fit Products for Your Onboard CCTV Applications**



**Front/Rear-facing Camera**

**VPort P16-1MP-M12**

- Clear & Color image in day & night
- Good image performance in fast light change
- High-speed imaging



**Intercom Camera**

**VPort P06HC-1MP-M12**

- Video/audio record
- Interoperation with intercom
- Flush mountable



**Driver Car Camera and Computer**

**VPort P26A-1MP-M12-IR IP Camera**

- Built-in IR for low lux environment
- Color image for identifying the panel LED indicator



**Consist Camera and Computer**

**VPort P06-1MP-M12 IP Camera**

- Clear daylight image
- Compact size
- Audio or microphone input



**TC-6110 Series Train Computer**

- Intel Atom D525 1.8 GHz
- High-performance platform with 4 IP camera channels at full D1 live view video
- Compact 3U rackmount housing



**V2616A Series NVR Computer**

- Intel Core i5/i7 CPU
- 2 hot-swappable and 1 internal 2.5" HDD/SSD slots for inserting additional storage media
- Supports RAID 1/0 functions for data reliability



**V2416A Series Train Computers**

- Intel Celeron/Core i7 CPU
- 2 hot-swappable 2.5" HDD/SSD slots for inserting additional storage media
- User-defined programmable LEDs and API for storage management



**RNAS-1200 Series Network-Attached Storage**

- Marvell 1.0 GHz processor
- Dual Gigabit PoE+ LAN Ports
- JBOD, BIG, RAID 0, and RAID 1 functions available



**Expert Technology**

**CBR Pro™:**  
Advanced CBR for Better Image Quality with Limited Bandwidth

Download white paper:  
[www.moxa.com/rail/wp/CBR](http://www.moxa.com/rail/wp/CBR)

**SafeGuard™:**  
Railway Data Security: Building a Durable NVR Platform

Download white paper:  
[www.moxa.com/rail/wp/SafeGuard](http://www.moxa.com/rail/wp/SafeGuard)



**Location:** Los Angeles, USA  
**Product Used:**

- TN-5516-8PoE-24-T PoE managed Ethernet switches
- VPort P06-1MP-M12 IP Camera
- ioLogik E1510-M12-CT-T remote I/O

**Location:** Montreal, Canada  
**Product Used:**

- VPort 16-M12 IP Camera

**Location:** Estonia  
**Product Used:**

- TN-5524-8PoE PoE managed Ethernet switches
- VPort P06-1MP-M12 IP Camera

**Location:** Sydney, Australia  
**Product Used:**

- TN-5524-8PoE PoE managed Ethernet switches
- VPort-P06 IP Camera

**Location:** Taipei, Taiwan  
**Product Used:**

- VPort P16-2MP-M12/VPort P26A-2MP-M12/VPort P06HC-2MP-M12 onboard IP cameras
- V2416, V2616 onboard NVRs
- TN-5516-8PoE-48 PoE managed Ethernet switches

# Enhancing Passenger Comfort with Intelligent Wireless Technology

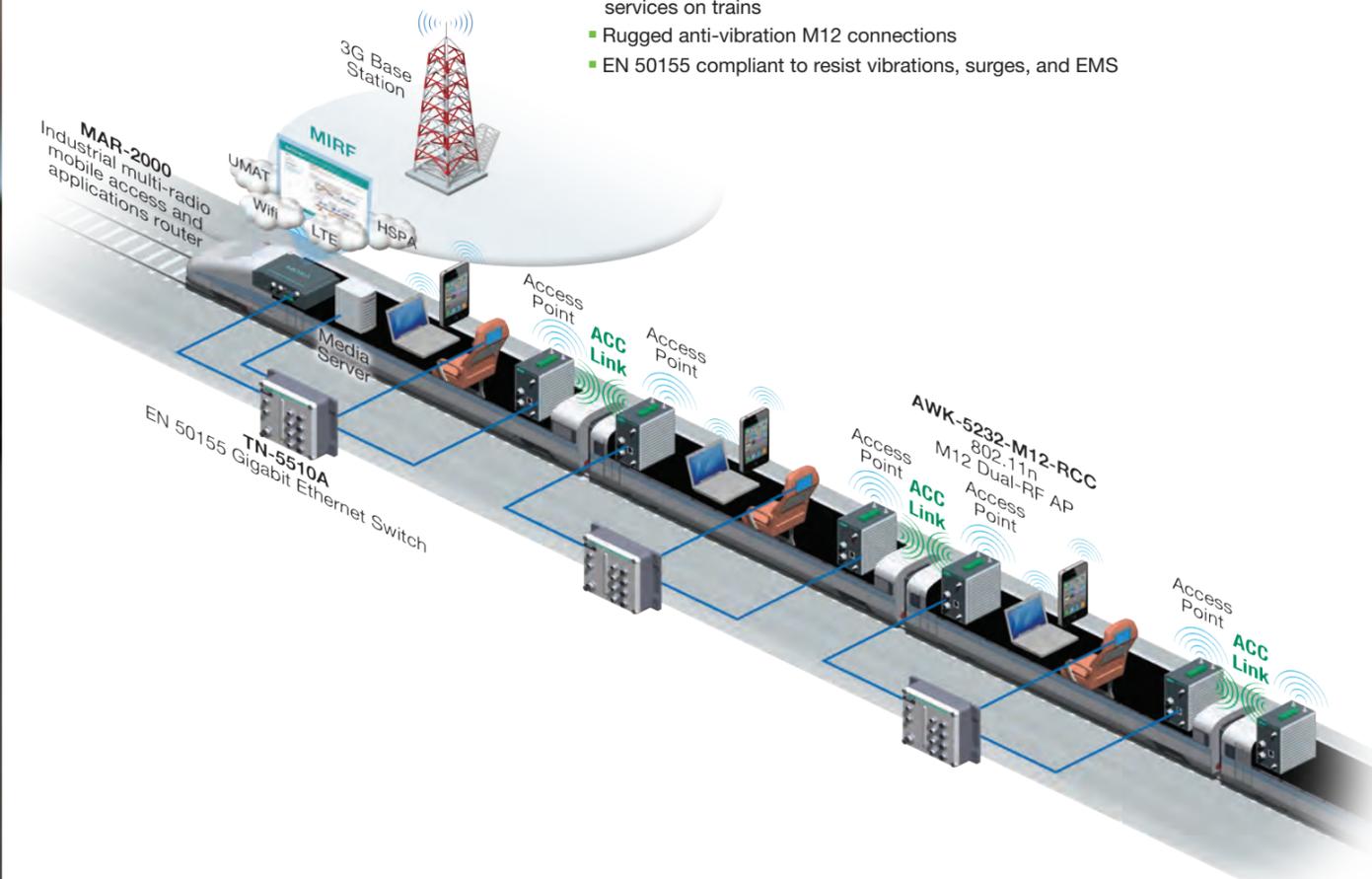
A train-wide passenger Wi-Fi system must be able to flexibly adapt to train consist changes during daily operations. Moxa's ACC (Auto Carriage Connection) technology easily and automatically creates wireless connections between train cars without modifying existing cables and couplings. In addition, when a train enters a new region, it must contend with different wireless interfaces such as Wi-Fi, UMTS, HSPA, WiMax, and LTE. Moxa's MAR-2000 series programmable routers simplify the coding of multiple-WAN routing applications, speeding up application development processes and significantly shortening custom development times for the system integrators.

## Network Requirements

- Flexible carriage-to-carriage links that adapt when train consists change
- Intelligent multiple wireless routing platform for traveling across wide geographies
- High network capacity to support media-on-demand services
- Robust connections in constant vibration
- Resistant to harsh environmental conditions

## Moxa Solutions

- ACC (Auto Carriage Connection) technology:
  - Connect and disconnect inter-carriage APs automatically
  - Minimize manual efforts and errors
- Dual-radio design (AWK-5232-M12-RCC):
  - One RF operates as an ACC link, and the other RF acts as an AP for onboard Internet access
- MIRF (Mobile Intelligent Routing Framework) technology:
  - Optimize network bandwidth and automate system configuration for diverse wireless networks to adapt to different network conditions along a long train route
- 802.11n solution with 300 Mbps bandwidth to fulfill demanding media-on-demand services on trains
- Rugged anti-vibration M12 connections
- EN 50155 compliant to resist vibrations, surges, and EMS



## Highlighted Products

- AWK-RCC Series**  
IEEE 802.11a/b/g/n Wireless Radio AP/Bridge/Client
- MAR-2000 Series**  
Industrial multi-radio mobile access and applications router
- TN Series**  
EN 50155 Gigabit/PoE Ethernet Switches

**Expert Technology**

**ACC:** Create Error-free Inter-carriage Connections Automatically  
Download white paper: [www.moxa.com/rail/wp/ACC](http://www.moxa.com/rail/wp/ACC)

**MIRF:** An Intelligent Wireless Routing Platform for Rolling Stock  
Download white paper: [www.moxa.com/rail/wp/MIRF](http://www.moxa.com/rail/wp/MIRF)

**Worldwide Deployment**

Location: Germany  
Product Used: Customized AWK-5232-M12-RCC wireless AP

Welcome aboard th

## Integrated Solutions for Passenger Information System on Refurbish Trains

Upgrading passenger information systems on aging trains is subject to many limitations, including space constraints, wiring difficulties, and other costs. Moxa's ioPAC 8020 is an EN 50155 compliant RTU controller with a rich selection of serial, I/O, and Ethernet ports in a compact housing designed for space-constrained onboard environments. It enables the convergence of multiple subsystems, so the passenger information system can integrate the track location data, PA system, LED displays, and train information to give passengers both audio and visual update about the status of the train.

The integrated ioPAC RTU controller and ioLogik E1500 railway remote I/O can also collect crucial status information about the train's doors, HVAC system, compressors, breaks, and lights. This information can help maintenance engineers to identify potential problems in a timely manner, which not only reduces maintenance effort, but also provides better availability of service.

### Network Requirements

- Quickly replace devices without any complex IP or device setup
- Leveraging existing 2-wire cable to build up IP network for cable limitation
- Compact size to fit into the space-limited environments on trains
- Modular and expandable I/O modules designed for flexibility
- Programmable open platform for easy integration
- Compliance with all railway requirements for higher reliability

### Moxa Solutions

#### ioPAC series EN 50155 Railway RTU Controllers

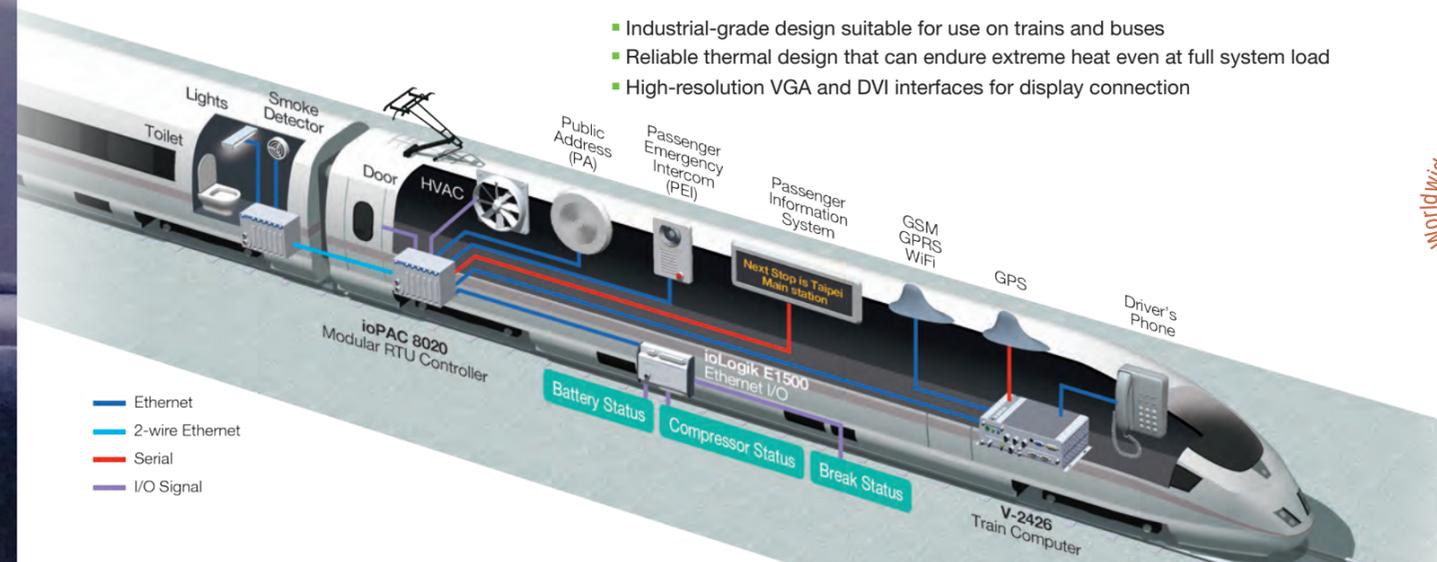
- ACS (Auto Carriage Sequence)
  - Easy to sort out carriage sequence in seconds
- 2-wire Ethernet switch for daisy-chain topologies with by-pass function to leverage existing cables for cost saving on mid-life train
- Compact design that combines serial, I/O, Ethernet, and computing capabilities all in one box
- Comprehensive SDK for I/O and active reports reduces programming hours

#### ioLogik E1500 EN 50155 Railway Ethernet I/O

- Wide operating temperature: -40 to 85°C (-40 to 185°F)
- Channel-to-Channel isolation (DI only)
- Robust and compact design for harsh environment

#### V2400A Series EN 50155 Railway Computers

- Industrial-grade design suitable for use on trains and buses
- Reliable thermal design that can endure extreme heat even at full system load
- High-resolution VGA and DVI interfaces for display connection



- Ethernet
- 2-wire Ethernet
- Serial
- I/O Signal

### Highlighted Products

**ioPAC 8020 Series**  
Modular RTU Controller 

**ioLogik E1500 Series**  
Railway Ethernet I/O 

**V2400 Series**  
x86-based Embedded Computer 

### Expert Technology

#### ACS (Auto Carriage Sequence)

Train consists can change frequently, sometimes even in the course of one trip. However, the train-wide passenger information system must be able to immediately adapt to these changes. Moxa's Auto Carriage Sequence technology quickly and automatically sets the train car sequence, even when they change.

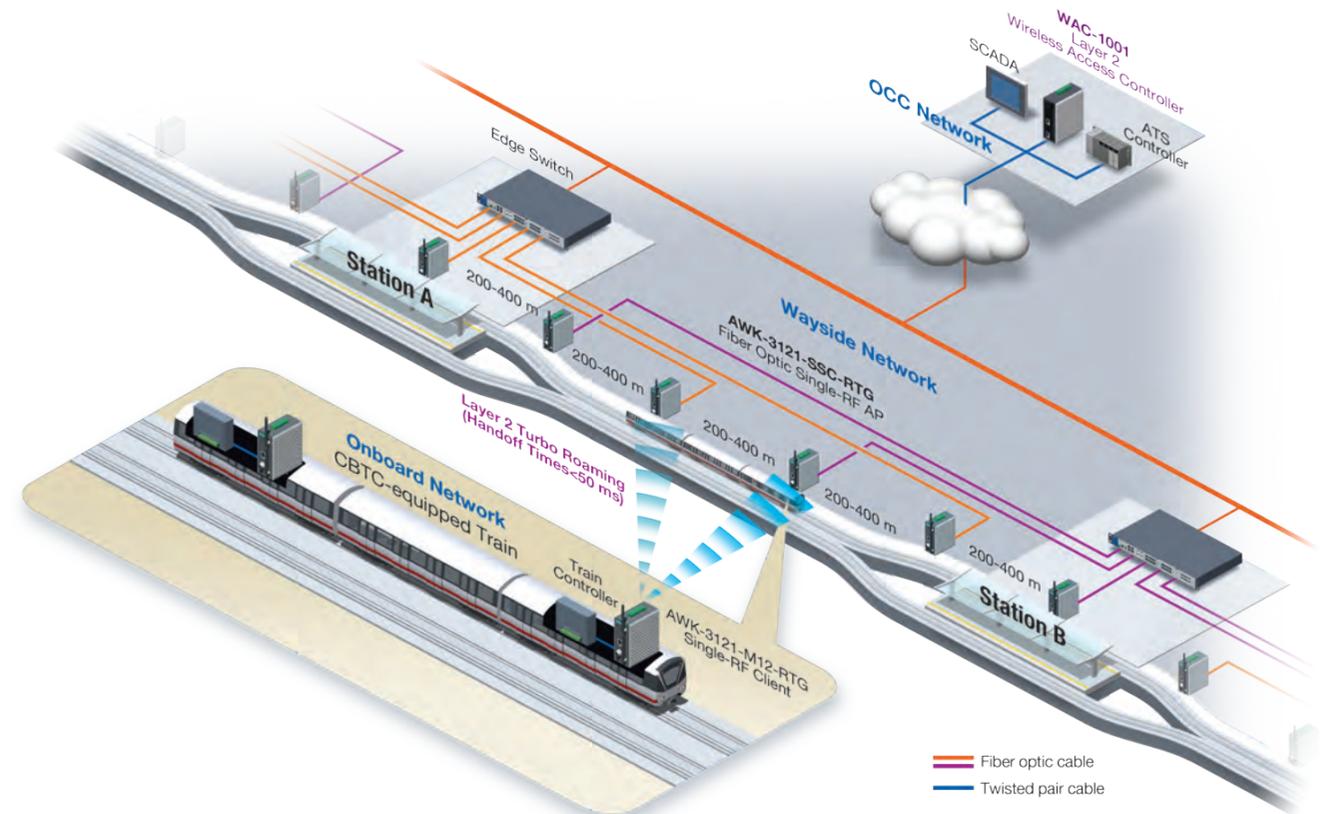


- ✓ Location: Germany  
Product Used: ioPAC 8020 series modular RTU controller
- ✓ Location: United Kingdom  
Product Used: ioLogik E1500 EN 50155 compliant Ethernet I/O
- ✓ Location: America  
Product Used: ioLogik E1500 EN 50155 compliant Ethernet I/O
- ✓ Location: Taiwan  
Product Used: ioPAC 8020 series modular RTU controller

# Minimized Headways with Safe Operations



CBTC uses constant bi-directional radio communications between train and trackside equipment to increase line capacity by reducing headways. To do this, the moving block train control system needs real-time train operating data to enforce safe spacing. Any communications loss may disrupt the CBTC and bring trains to a stop. Consequently, CBTC networks have strict standards for availability and latency. In metro lines, frequent train roaming may cause long latency in RF-based CBTC networks. A roaming handoff time of less than 50 ms is vital for uninterrupted train-to-trackside connectivity. Momentary breaks may occur on radio networks; but a CBTC can only tolerate a packet loss rate of under 0.1%.



### Network Requirements

- **Fast secure roaming:**  
Handoff of less than 50 ms for continuous CBTC operations
- **Sufficient throughput:**  
4 Mbps throughput to support all CBTC functions
- **Error tolerance:**  
Packet loss rate of less than 0.1%
- **Network latency:**  
Maximum latency of 5 ms to achieve overall CBTC performance

### Moxa Solutions

- **Layer 2 Turbo Roaming (handoff <50 ms):**
  - WAC-1001 wireless access controller enables rapid roaming with centralized security
  - 3 non-overlapping channels of roaming for less interference
  - Packet loss rate of under 0.1%
- **Network latency under 1 ms**
- **Stable throughput: 4 Mbps of throughput**
- **Roaming diagnosis service**

### Highlighted Products

#### WAC-1001

Layer 2 Wireless Access Controller

- Enables layer 2 roaming with centralized security
- Supports inter-controller roaming
- IEEE 802.11i-compliant wireless security
- Redundancy via hot standby controller



#### AWK-3121-RTG Series

Industrial IEEE 802.11a/b/g wireless AP/client

- QoS (WMM) and VLAN for efficient network traffic
- Supports controller-based Turbo Roaming
- Compliant with essential sections of EN 50155
- M12 anti-vibration connectors (AWK-3121-M12-RTG)
- -40 to 75°C operating temperature range (T models)



### Expert Technology

#### Turbo Roaming:

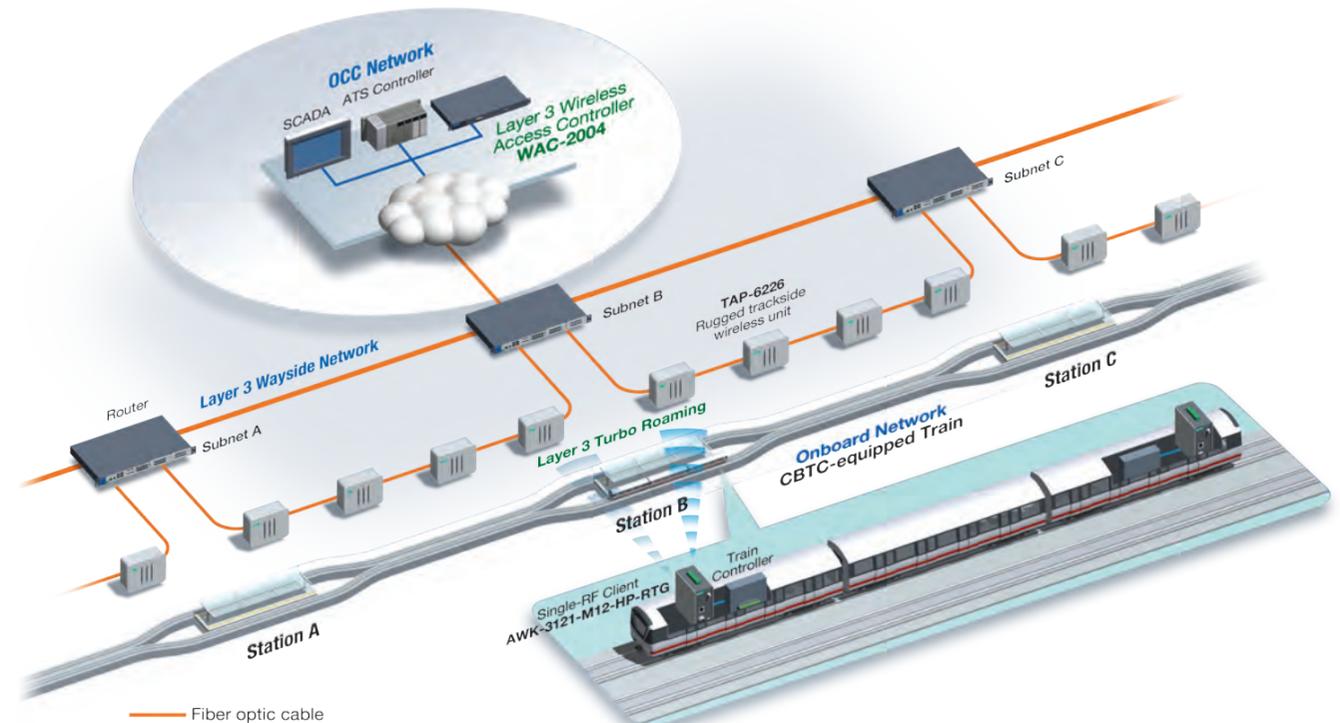
Truly Uninterrupted Train-to-Ground Communications with Turbo Roaming under 50 ms



Download white paper:  
[www.moxa.com/rail/wp/TR](http://www.moxa.com/rail/wp/TR)

## Fast Secure Handover on Layer 3 CBTC Networks

For long-range rail lines, the wayside network consists of several subnets distributed across multiple base stations. The risks of CBTC service can be minimized by using redundant links to each train. A radio CBTC network consists of onboard radio and wayside radio APs. Wayside APs are connected to different subnets by linking physically to station routers. Onboard the train, two clients are placed at each end of the train for redundancy. Each client associates with different wayside APs, and only one radio link is active at a time. To secure communications across subnets, Moxa's L3 wireless access controller (WAC-2004) enables a Layer-3 handover delay of less than 50 ms, seamlessly exchanging the data needed for safe operations between train and ground.



### Network Requirements

- Layer 3 roaming (handoff <50 ms) for cross-subnet mobility
- Adaptable to various wayside antenna scenarios:
  - Waveguide scenario: waveguides or leaky cables are installed along the track
  - Free propagation scenario: antennas are positioned at distinct points along the track

### Moxa Solutions

- Rugged trackside wireless unit
  - Complete integration solution of dual radios, managed fiber Ethernet switch with AC power supply.
- Sub-50 ms Layer 3 Turbo Roaming:
  - WAC-2004 Layer 3 wireless access controller enables cross-subnet roaming
  - Inter-controller roaming
  - IEEE 802.11i-compliant wireless security
  - Redundancy via hot standby controller
- Universal roaming scheme up to support a variety of wayside propagation modes

### Highlighted Products

#### TAP-6226 Series

##### Rugged Trackside Wireless Unit

- Two dual-band IEEE 802.11a/b/g compliant
- Railway approved IP68 housing
- Controller-based Turbo Roaming
- Two fiber ports with Turbo Chain and four M12 ports with PoE
- High transmit power for extended reach
- -40 to 75°C operating temperature range
- Compliant with essential sections of EN 50155



#### WAC-2004

##### Layer 3 Wireless Access Controller

- 2-in-1 AP controller and Mobile IP home agent
- Millisecond-level controller-based Turbo Roaming
- IEEE 802.11i-compliant wireless security
- Layer-3 Mobile IP technology
- Up to 450 Mbps throughput for tunneling
- Scalable tunneling capacity



#### AWK-3121-RTG Series

##### Industrial IEEE 802.11a/b/g wireless AP/client

- QoS (WMM) and VLAN for efficient network traffic
- Supports controller-based Turbo Roaming
- Compliant with essential sections of EN 50155
- M12 anti-vibration connectors (AWK-3121-M12-RTG)
- -40 to 75°C operating temperature range (T models)



# A Robust Communication Network for Mainline Signaling and Train Control

Today's railway infrastructure must shoulder greater demands for inter-city and inter-state transportation. Growing urbanization has increased the number of passengers that rely on metropolitan rail systems, and increased economic activity at industrial facilities, mines, and ports now tax the transportation mainline. Ideally, a railway system should meet growing capacity requirements while still using existing infrastructure without compromising on safety and security. Thanks to advancements in automated signaling and train control systems, this is now possible.

Conventional train control systems use manual, solid-state-based route management and interlocking mechanisms. Modern electronic, computer-based approaches that harness Information and Communications Technology (ICT) dramatically improve railway safety and capacity. However, computer-based train control relies on a robust and reliable communications network—as do other railway devices, LEUs, axle counters, interlocking controllers, balises, and intercoms.

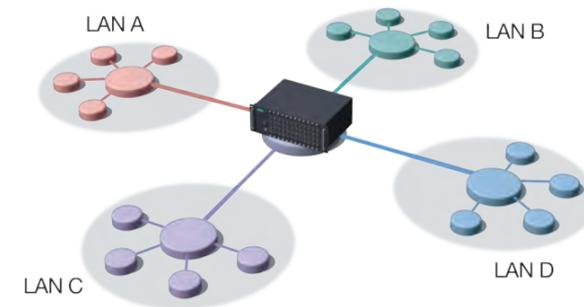
The most popular off-the-shelf ICT solutions are all based on TCP/IP communications, while more and more Ethernet-enabled devices are available for mainline signaling and train control applications. To build a robust trackside backbone communication network using TCP/IP and Ethernet technologies, operators must achieve five key requirements:

- Vital and non-vital network segregation
- User-friendly network management
- Reliable and self-healing fiber links
- Resilient and flexible network expansion
- Connectivity with legacy devices

## Moxa Solutions

### ■ Layer 3 wayside Ethernet switches for vital and non-vital network segmentation

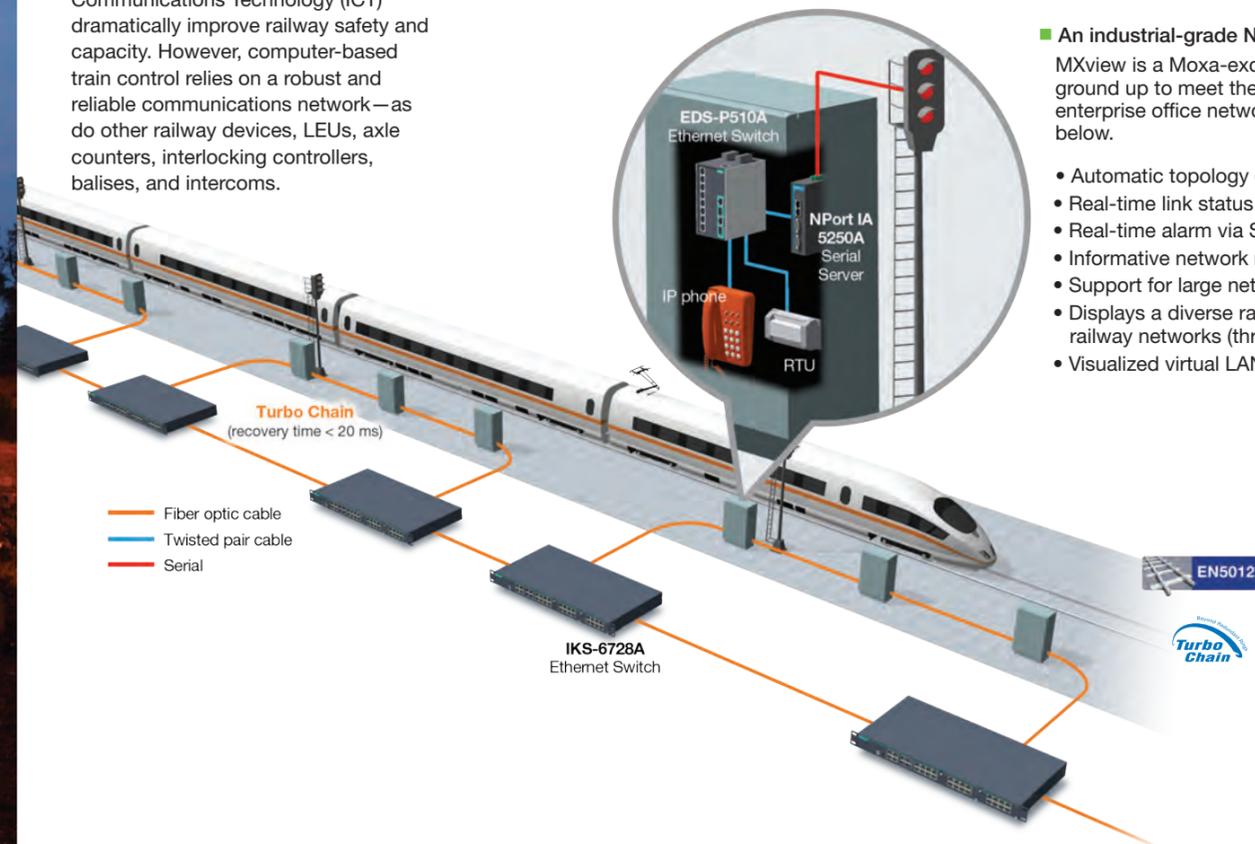
Railway communication networks need a solution that will avoid any potential interference in the transmission of critical data. For example, railway operations would grind to a halt if a virus infection and broadcast storm were to shut down the communications network. Moxa's ICS and IKS series solutions are Ethernet switches specifically designed for wayside applications. It is EN-50121-4 compliant and can operate in temperature extremes of -40 to 75°C. The IKS-G6824 Layer 3 Ethernet switch is especially useful for segregating larger networks.



### ■ An industrial-grade NMS for easier wayside network management

MXview is a Moxa-exclusive industrial NMS that was specifically designed from the ground up to meet the needs of industrial and railway communications networks, not enterprise office networks. Its feature portfolio meets all of the requirements outlined below.

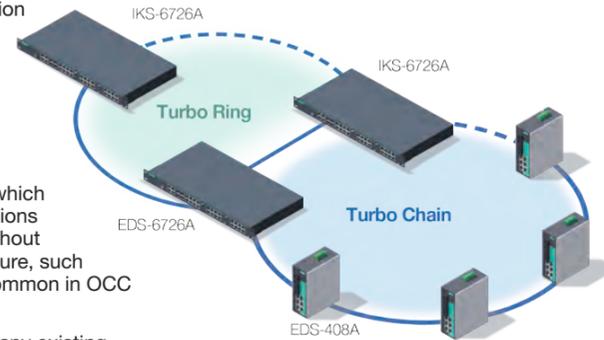
- Automatic topology discovery via LLDP
- Real-time link status & traffic statistics
- Real-time alarm via SNMP Trap or SNMP
- Informative network reporting functions
- Support for large networks (2000 nodes)
- Displays a diverse range of devices used in railway networks (through MIB compiler)
- Visualized virtual LAN



■ A reliable fiber backbone with fast self-healing functionality for large-scale networks

Wayside data packets need to travel long distances because the depots and stations of a mainline transportation grid typically cover a wide physical area; the distance between two depots could be anything from a hundred meters to many kilometers. Moxa's wide portfolio of Ethernet switches includes the rack-mount PT-7000, IKS-6000 series, and the DIN-rail mounted EDS-400A, 500A, and 600 series, all of which possess available multi-mode, single-mode, and long-haul design fiber ports. They also support Turbo Ring™ network redundancy technology that excels in mainline signaling and control communications because it delivers excellent convergence time on large-scale networks. Even in a large network of up to 250 nodes, network recovery can be achieved within 20 ms.

In addition, Moxa also offers optical fiber-to-Ethernet converters, the IMC-101 and PTC-101 series, which are excellent complements for the Ethernet switches. These complete solutions have rugged wide operating temperature range of -40 to 75/85°C and high EMC/EMI resistance. The new PTC-101-M12 Ethernet-to-fiber media converters convert from 10/100BaseT(X) to 100BaseFX. The models are available with SC/ST connectors in fiber and M12 connector in Ethernet to provide a reliable communications link. The PTC-101-M12 is compliant with EN 50121-4 and excels in the high-vibration wayside environment of railway applications.



■ Turbo Chain enables resilient and flexible network expansion

Once a network is up and running and fulfilling all the other requirements of railway operations, it can become difficult to expand without severe disruption. Moxa's Turbo Chain technology is an evolution of Turbo Ring which provides a complementary solution that can easily create network expansions which seamlessly integrate and interoperate with any existing network without compromising redundancy. Turbo Chain works with any network architecture, such as a SONET/SDH telecom network or the RSTP/STP networks that are common in OCC (operation control center) and larger yards.

The beauty of Turbo Chain is that it can attach (hook) the expansion onto any existing network, while still maintaining strong convergence time when a network node or link goes down.

■ Robust connectivity with legacy devices

Even as railway networks embrace new, more reliable, and more convenient communications technologies, operators still need to connect with legacy devices such as interlocking controllers, axle counters, and switchable balises. These devices typically use a RS232 or RS422/485 communications interface, either for configuration, diagnosis, or data transmission purposes. Moxa NPort IA5000AI series serial device servers include 1, 2, or 4 isolated serial ports featuring wide temperature from -40 to 75°C for severe operating environments. The NPort S8000 series is a specially designed terminal server with 4 isolated serial ports, and 5/8 Ethernet ports. As a terminal server it has all of the managed features of Moxa Ethernet switches, such as Turbo Ring, Turbo Chain, LLDP, and VLAN for higher network availability and better management purposes. The latest NPort 5000AI-M12 is compliant with EN 50121-4 and essential sections of EN 50155, covering operating temperature, power input voltage, surge, ESD, and vibration, making them suitable for rolling stock and wayside applications where high levels of vibration exist in the operating environment.



Highlighted Products

ICS-G7000 Series

Layer 3 full Gigabit modular managed Ethernet switches



IKS-6728-8PoE Series

24+4G-port Gigabit modular managed PoE+ Ethernet switches



EDS-600 Series

Compact modular managed Ethernet switches



EDS-P510A-8PoE Series

8+2G-port Gigabit PoE+ managed Ethernet switches



IMC-101 series

Industrial 10/100BaseT(X) to 100BaseFX Media Converters



NPort S8000 series

Combo switch / serial device server



MXview

Industrial network management software designed for converged automation networks



Expert Technology

Turbo Chain:



Moxa's innovative Turbo Chain technology is a new self-healing technology that dramatically simplifies the construction of trackside networks. Unlike traditional coupling technology, Turbo Chain's extraordinary interoperability and topological flexibility delivers significant savings in development costs, time, effort, cabling, and required Ethernet devices

Download white paper: [www.moxa.com/rail/wp/TC](http://www.moxa.com/rail/wp/TC)



Worldwide Deployment

Location: Australia

Product Used:

- EDS-505A/EDS-508A/ IKS-6726 series managed Ethernet switches

Location: Asia

Product Used:

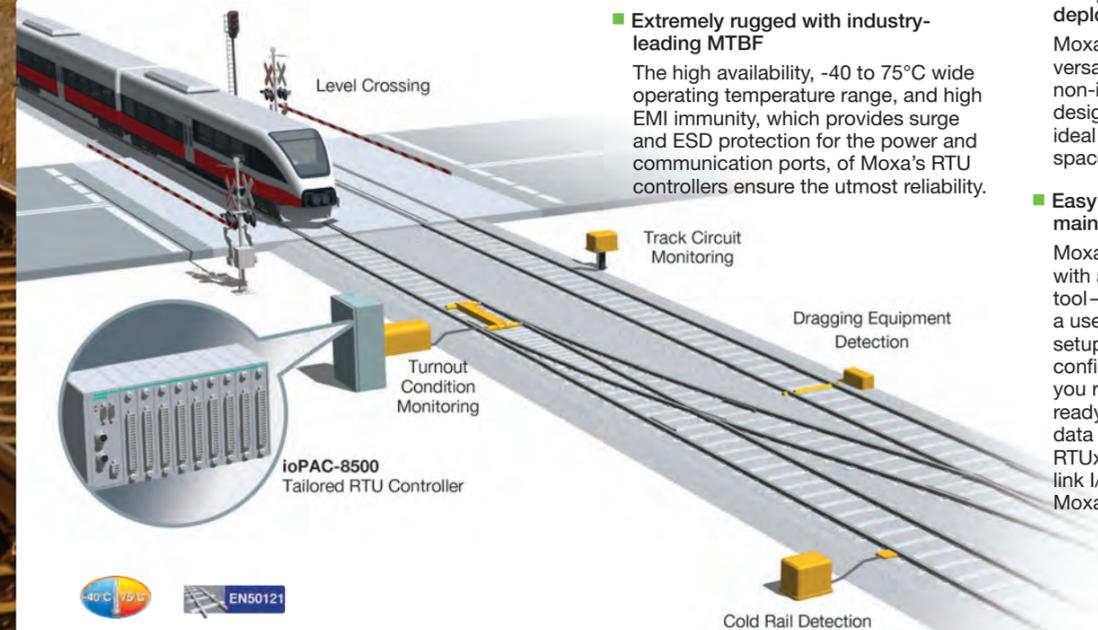
- EDS-205A/EDS-208A/ EDS-408A 3 fiber series managed Ethernet switches
- V2401/V2402, V2406 series embedded computers
- MXview industrial NMS



# Ensure Wayside Operation Efficiency with Industry Tailored Solutions for Turnouts and Level Crossings

The high financial and reputational costs of railway accidents and long delays have led railway infrastructure managers to adopt increasingly sophisticated preventive maintenance systems. However, the ability of railway operators and maintenance engineers to prevent costly system failures and optimize resource allocation depends on myriad real-time wayside asset condition information provided by separate monitoring systems. These data acquisition systems are often comprised of many sensors, transducers, and remote terminal units running on different platforms and closed communication protocols, which can make maintenance more challenging and costly.

Moxa's EN 50121-4 compliant modular RTU controllers are tailored for railway asset monitoring applications; and offer system integrators a more accurate, open platform field solution to collect large amounts of real-time condition monitoring data. Besides being easily and non-intrusively integrated and maintained, Moxa RTU controllers can monitor all critical assets from any remote location.



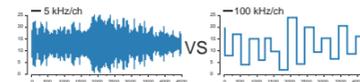
## Network Requirements

- Modular and compact design to fit in space-limited cabinets
- More accurate data to respond more quickly and correctly
- Compliant with railway standards for harsh environments
- Easy to do maintenance without stopping system

## Moxa Solutions

### RTUs Tailored for Railway Asset Monitoring and Preventive Maintenance

- Precise data acquisition takes the trouble out of troubleshooting  
Moxa RTU controllers offer kHz-level analog input sampling rates, giving engineers the analog data accuracy they need to correctly analyze events with precise millisecond-level timestamps for event sequencing.



- Certified equipment for railway applications  
Moxa's RTU controllers are the world's first RTU controllers that are compliant with the EN 50155, EN50121-3-2, and EN 50121-4 railway standards, which require products to withstand high levels of vibration.
- Extremely rugged with industry-leading MTBF  
The high availability, -40 to 75°C wide operating temperature range, and high EMI immunity, which provides surge and ESD protection for the power and communication ports, of Moxa's RTU controllers ensure the utmost reliability.

### Easy Deployment, Integration, and Maintenance

- Support for all major programming language such as IEC 61131 and C/C++  
Moxa's RTU controllers support railway standard C/C++ and IEC 61131-3 programming, which enable easy integration with any system platform.
- Hot-swappable modules save time for service visits  
All the I/O modules on Moxa's RTU controllers are hot-swappable so users can replace the modules without shutting down the system. The CPU will then automatically configure the new module. This intelligent architecture means that hardware can be easily upgraded and maintained without highly specialized knowledge or training.
- Compact modular design for easier deployment  
Moxa RTU controllers support a versatile collection of I/O modules. The non-intrusive, compact, and modular design makes Moxa RTU controllers ideal for wayside cabinets with limited space.
- Easy system configuration and maintenance with RTUxpress  
Moxa RTU controllers come equipped with an intuitive offline configuration tool—RTUxpress—that provides a user-friendly interface for device setup, tag management, and service configuration. This utility can help you reduce programming effort with ready-to-run services for alarms, data logging, and communication. RTUxpress also enables you to easily link I/O events and services with Moxa's TagEasy feature.

## Highlighted Products

**ioPAC 8500 series**  
Rugged modular RTU controllers



**ioPAC 5542 Series**  
Rugged, compact RTU controllers



### Expert Technology

#### KHz AI Sampling Rate Enables Accurate Monitoring

Moxa's RTU controllers use C/C++ standard programming for front-end data processing. These controllers can help to monitor the power, temperature, current, force, and status of the turnout. With a KHz sampling rate and pre-recording functions, this product can provide high resolution and precise time-based data.

### Worldwide Deployment

- ✓ Location: Poland  
Product Used: ioPAC 8500 modular RTU controller
- ✓ Location: Australia  
Product Used: ioPAC 8020 modular RTU controller
- ✓ Location: Taiwan  
Product used: ioPAC 8500 modular RTU controller
- ✓ Location: China  
Product: ioPAC 8500 modular RTU controller