

# Integrated IP Solutions for Smarter Railways

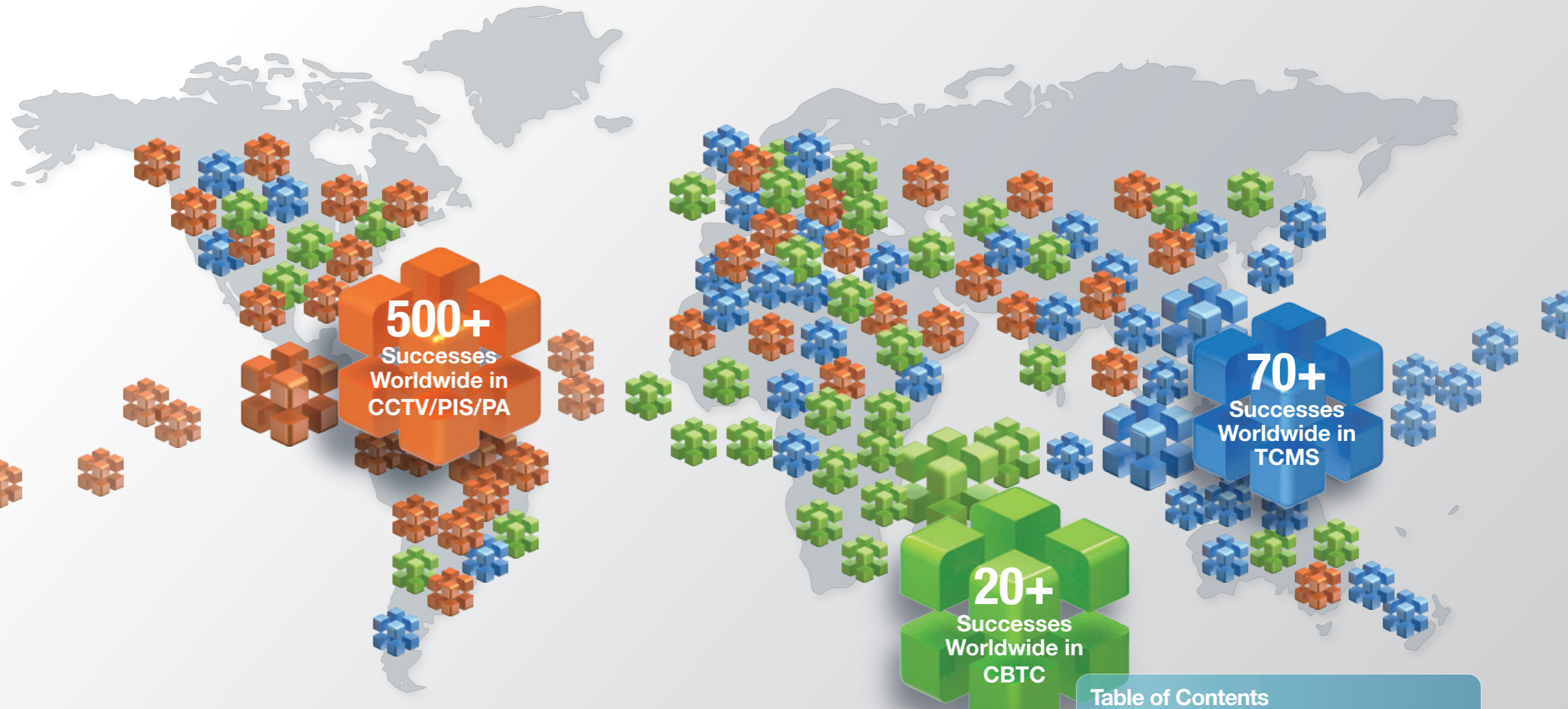
Industrial Networking and Computing Solutions

**MOXA**®

Travel Comfortably, Arrive Safely

# Your Trusted Partner in Railway Automation

Moxa is an IRIS-certified global leading provider of a wide range of IP-based communications solutions. Moxa continually contributes its networking expertise and innovative technologies to the railway industry through new market-specific solutions and its membership of the IEC railway committee and Shift2Rail organization. Railway operators from around the world have discovered new levels of operational efficiency by deploying Moxa's unique railway technologies, such as intelligent wireless inter-carriage connections, millisecond-level Ethernet redundancy, and WLAN roaming solutions. With over 30 years of experience in industrial networking, Moxa has a proven record of developing long-lasting, reliable devices. In addition, Moxa has been part of hundreds of successful deployments in major railway systems worldwide to enhance 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, including design, development, and manufacturing. The certification covers passenger information systems and communication systems.



## Wide-Range of Rail-Certified Products

Moxa's portfolio includes over 400 railway-specific products ranging from onboard to trackside, and end devices to network architecture. Moxa provides integrated IP solutions that enhance the safety and efficiency of railway operations. Our end devices include computers tailor-made for deployment on trains, and controllers and remote I/O products for condition monitoring. For railway IP network design, we utilize our industrial networking expertise to provide a variety of Ethernet switches for onboard, trackside, train stations, control centers, wireless AP/client for train-to-ground communications, and smart network management software to help optimize the efficiency of the network.

## Hundreds of Successful Deployments Worldwide

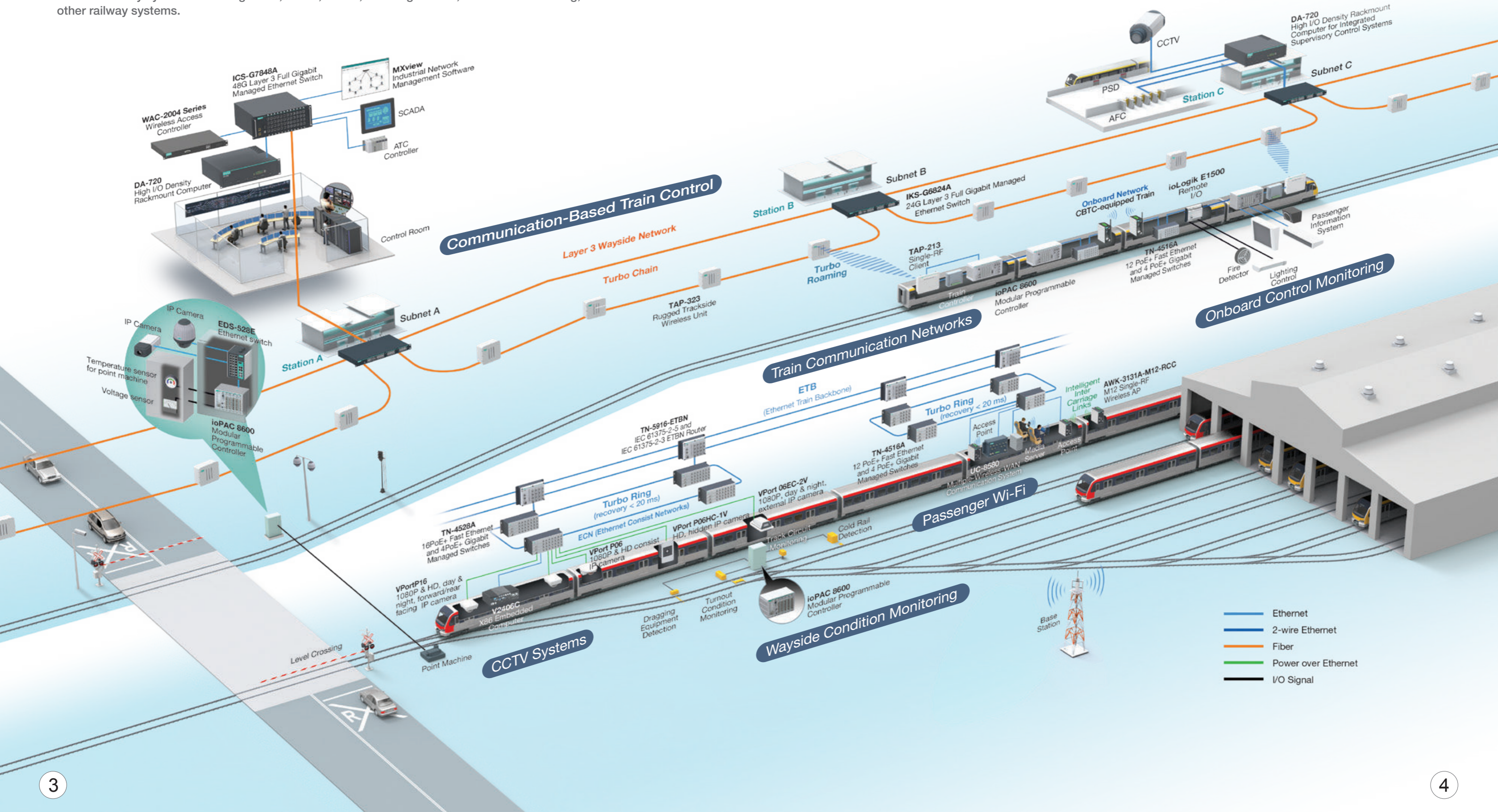
Rail systems operate on a decades-long life cycle. Rail systems are considered mission-critical applications that require highly reliable IP-based solutions. We have been devoted to the railway industry for many years and have established strong credibility by deploying our networking and computing solutions around the world. The hundreds of successful deployments of Moxa's products in major railway systems such as CCTV, PIS (Passenger Infotainment Systems), CBTC (Communication-based Train Control), and TCMS (Train Control Management Systems), have proven that our leading IP solutions are capable of providing high reliability and network availability that meet the demands of the rail industry.

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# Integrated IP Solutions for Rail Systems

With over 30 years of experience in the railway industry, Moxa has a broad portfolio that provides wired and wireless networking, computing, controller, and I/O solutions for trains, trackside, at stations as well as the control center. Moxa's integrated IP solutions have been deployed all over the world in railway systems including CCTV, CBTC, TCMS, Passenger Wi-Fi, condition monitoring, and other railway systems.



# Onboard Network Solutions

On modern trains, multiple onboard systems are used concurrently to ensure safe and enjoyable journeys for passengers. Moreover, Ethernet train networks make it possible to integrate multiple data applications into the same backbone, which can easily be upgraded to 10G speeds to accommodate more applications in the future. In addition, Gigabit wired speeds and IEEE 802.11n wireless communications are capable of streaming video surveillance data in real-time to optimize response time during emergencies.

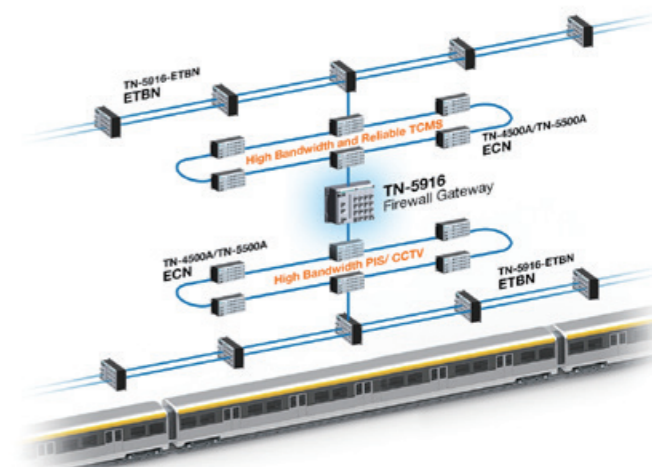
To ensure smooth operations on trains, Moxa's one-stop-shop EN 50155 Ethernet portfolio facilitates high-speed communication and easy integration of cameras, displays, WLANs, and other devices in confined onboard environments to fulfill requirements for different systems, such as TCMS, CCTV, passenger information systems (PIS), and other train-wide communication services.

## Why Moxa

- IEC 61375 compliant ETBN routers for train-wide interoperability
- High-density Fast Ethernet/GbE/10GbE and PoE connectivity for ETB and ECN to integrate onboard systems
- 802.11n dual-band radio devices designed for carrier-to-carrier communication and onboard Wi-Fi services
- Advanced Ethernet redundancy to ensure the smooth train operation

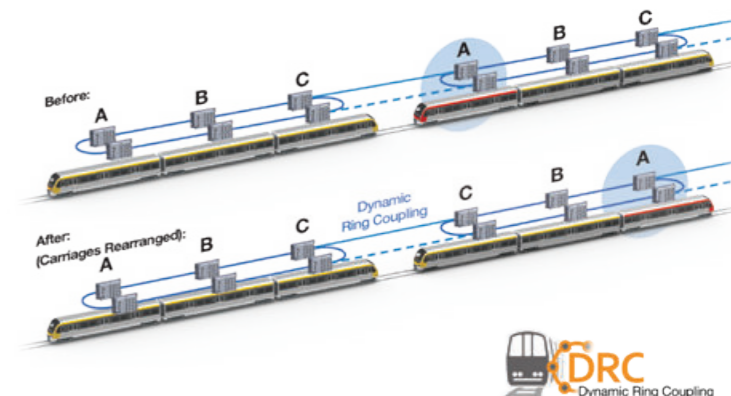
## Full Ethernet Networks with Secured Firewall Gateway

For onboard Ethernet networks, cybersecurity is becoming more important than ever before. Moxa's holistic approach to cybersecurity solutions helps mitigate potential risks to devices and networks. The best way to secure a network is to use the defense-in-depth security architecture, which is designed to protect individual zones and cells. The first step to building a defense-in-depth rail system is to segment networks so that traffic from different systems can be isolated and protected against intentional cyberattacks or human error. By segregating the network, the data from the TCMS system and PIS/CCTV system are transmitted on dedicated channels secured by a firewall gateway. With isolated data streams, operators are guaranteed to have sufficient-bandwidth for data-intensive systems like CCTV, and simultaneously have a dedicated channel to ensure smooth transmission of critical TCMS data.



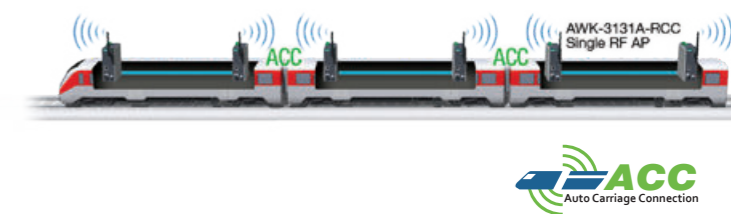
## Intelligent Inter-consist Ethernet Redundancy

Because train carriages and consists are frequently reconfigured, the speed and accuracy with which new inter-carriage and inter-consist links can be established are both key determinants in the overall efficiency of a railway operation. Auto-negotiation is a substantial time-saver, but this is hard to implement on networks that use more sophisticated networking technologies such as a ring redundancy topology. Moxa's ToughNet Ethernet switches feature DRC (Dynamic Ring Coupling), an intelligent Ethernet ring redundancy technology that excels at inter-consist networks. By detecting and automatically reconfiguring the network, DRC reduces configuration time and potential human error, ensuring that the system provides highly reliable and efficient operation, day in and day out.



## Automatic Error-free Inter-carriage Wireless Links

ACC allows operators to enjoy the operational and cost benefits of using wireless inter-carriage links, without introducing new maintenance tasks and security vulnerabilities. When utilizing ACC, each device only needs to be configured once for deployment on any carriage and form links in any train configuration. Operators no longer need to manually change their AP configuration each time they reconfigure the train carriages. ACC technology will intelligently and dynamically form bridge links with 100% accuracy to provide broadband communication throughout the entire train, and still maintain high network security thanks to WPA/WPA2 encryption. ACC also supports high throughput applications through models with 802.11n support in the AWK-3131A-RCC series.



# Train-to-ground Network Solutions

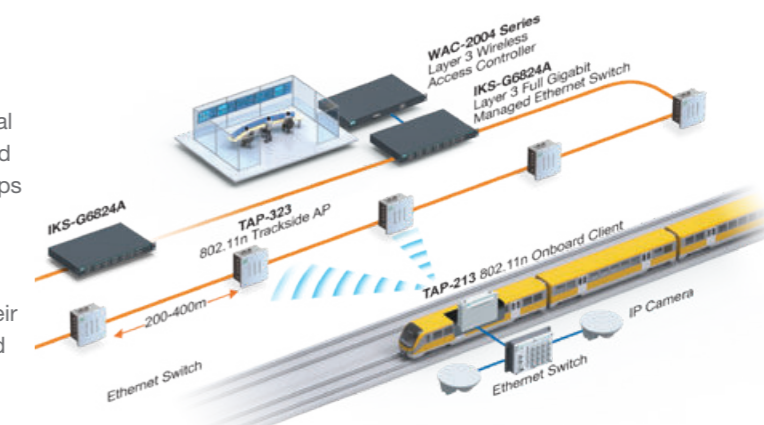
When developing bi-directional communication in train-to-ground applications, wireless and WWAN solutions are simultaneously deployed depending on the environment and application scenario and integrated to create reliable communication channels for critical communication such as CBTC, and non-essential data from passenger information systems and onboard video surveillance. For wireless deployments, Moxa provides 802.11n onboard radio devices and wayside radio APs to provide reliable train-to-ground connectivity through dual-band radios, AC/DC power supplies, and fiber switching to help operators better manage traffic safety and improve operational efficiency. Meanwhile, Moxa's computing platforms supports up to 4 cellular modules. This allows operators to establish reliable train-to-ground cellular WWAN communication, which enables continuous wireless access even on trains that travel over long distances.

## Why Moxa

- Controller-based Turbo Roaming with quick 50 ms hand-over times
- AeroLink Protection provides wireless redundancy at the network level
- Data rates of up to 300 Mbps
- Dual-SIM capability to ensure that the network will not experience downtime if one SIM fails in a module
- Up to 3 cellular module slots and 1 customizable slot for a cellular module to enable seamless transitioning between carrier services across multiple regions

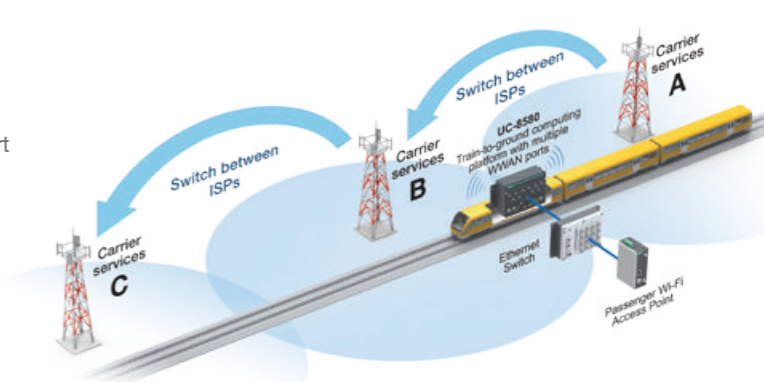
## Wireless Communications for Multiple Rail Systems

Moxa's train-to-ground TAP Series wireless devices are the ideal ruggedized wireless solution for railway onboard train-to-ground applications. The TAP Series allows data rates of up to 300 Mbps with the IEEE 802.11n standard so that it can ensure seamless data communications for multiple applications such as CBTC and CCTV from onboard to wayside. Moxa also offers IP68-rated products for onboard and trackside applications. With their vibration-proof design, the TAP Series can ensure uninterrupted connections on moving trains.



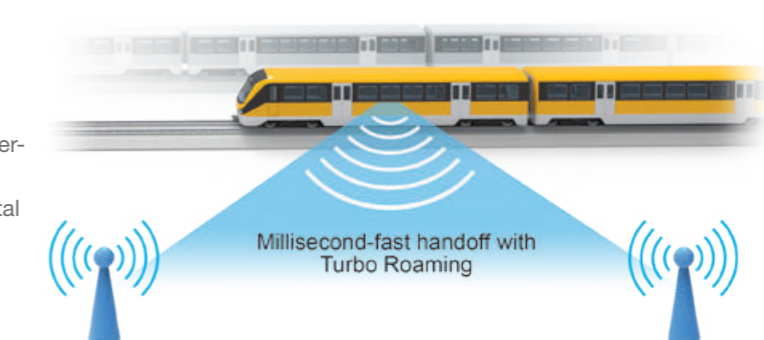
## Train-to-Ground WWAN Solution

Moxa's train-to-ground computing platform, the UC-8500 Series, supports up to 4 cellular module slots, with up to 3 cellular module slots and 1 customizable module slot to support dynamically switching between carrier services when the train moves across regions. This allows operators to deploy reliable train-to-ground WWAN communication, which enables continuous wireless access even on trains that travel over long distances. In addition, each 4G/LTE module has two SIM card slots that can be leveraged to enable a redundant cellular connection to guarantee uninterrupted service in case one connection becomes unavailable.



## Uninterrupted Train-to-Ground Communications

To keep roaming working on high-speed trains, Moxa's controller-enabled Turbo Roaming performs pre-authentication and accelerates roaming for handoff times under 50 ms, which is vital to achieve uninterrupted train-to-ground connectivity.



# Wayside Communications Solutions

Wayside signaling and communication systems that are used along the trackside require large networks to collect and transmit data between trains and back to the control center. Some wayside systems also have to collect additional data from railroad turnouts and level crossings in order to ensure smooth daily operations. Moxa's wayside Ethernet switches provide a wide selection of 10GbE, GbE, Fast Ethernet, and fiber-optic connectivity options. Furthermore, these switches are capable of Layer 3 traffic segregation, Layer 2/3 millisecond-level multicast redundancy, wide operating temperature ranges, and EN 50121-4 capabilities to allow diverse track equipment, signal, and control networks to be integrated into a single network backbone for durable wayside operations.

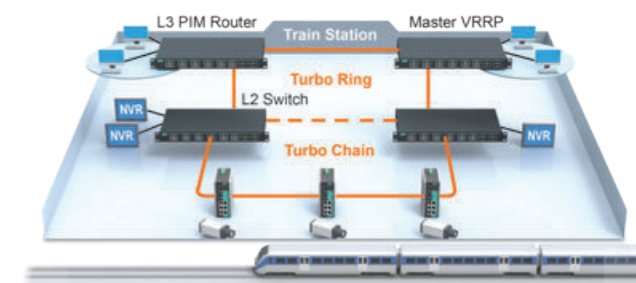
## Why Moxa

- Versatile connectivity options including 10GbE, GbE, Fast Ethernet, PoE, and fiber
- Layer 3 traffic isolation for segregating critical and non-critical data
- Millisecond-fast multicast routing and switching redundancy
- Easy-to-use network management for wayside operations
- Resilient and cost-efficient network expansion
- EN 50121-compliant ruggedness



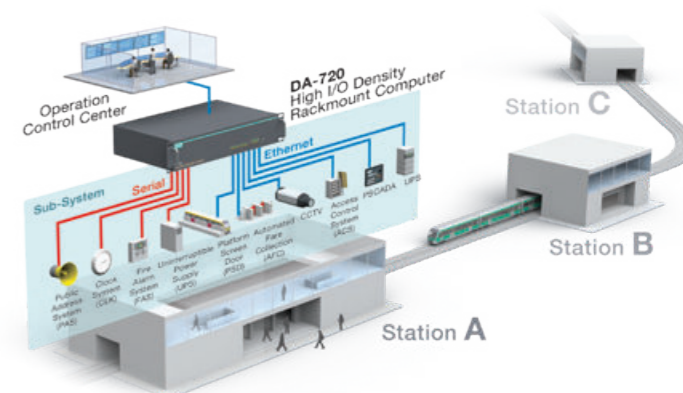
## Wayside Network Redundancy: V-ON

With the demand of connecting more and more systems in railway applications, it becomes more and more important to have resilient connections that can recover within milliseconds. To prevent data loss on layer 2 and layer 3 multicast networks, Moxa introduced V-ON, an innovative technology that integrates Turbo Ring and Turbo Chain protocols and optimizes multicast traffic to enable data, voice, and constant connectivity, especially for multicast-intensive train station applications.



## Computing Platform for Integrated Supervisory Control Systems

As more and more subsystems are integrated into the core rail system, increasing the complexity of the networks and interfaces, the use of integrated supervisory control systems (ISCSs) with front-end processors in rail automation systems is increasing. Compliant with the EN 50121-4 standard for rail automation, Moxa's DA-720 computers, which provide isolated LAN ports to connect more than 10 independent subsystems, are the best fit for ISCSs.



## Wayside Communication Networks

In order to provide seamless video surveillance monitoring at the control center, wayside communication networks require: Moxa's layer 2 and 3 managed Ethernet switches support up to 48G and four 10GbE ports for large scale video over IP networks. MXstudio is a network management suite designed for installation, operation, maintenance, and diagnostics on rail networks.



# Maximizing the Value of Ethernet Technology for TCMS

Conventional WTB and MVB networks have limited ability to support multiple services. As many of these systems now need to be updated, train communications network operators are turning to IP-based Ethernet Consist Networks (ECN) and Ethernet Train Backbones (ETB). System operators are beginning to recognize the benefits of IP technology as it offers a complete package that can meet rising network demands, reduce operating costs, and deliver improved functionality. Moxa offers a wide selection of EN 50155-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.

## Train Communication Network Requirements

- Flexible network connection to realize high network availability
- Easy installation and maintenance for diverse Ethernet devices
- Future-proof design based on the IEC 61375 standard for Ethernet train communication networks

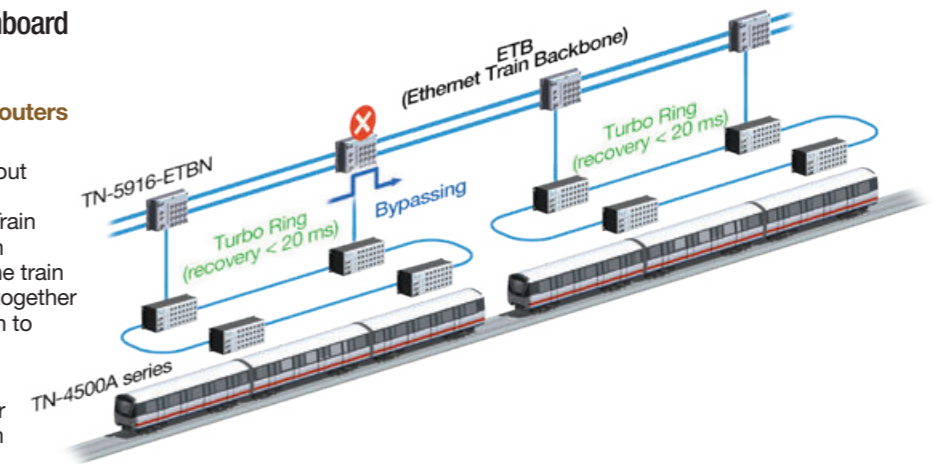
## Moxa Solutions

### IEC 61375 compliant IP Solutions for Onboard TCMS Networks

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

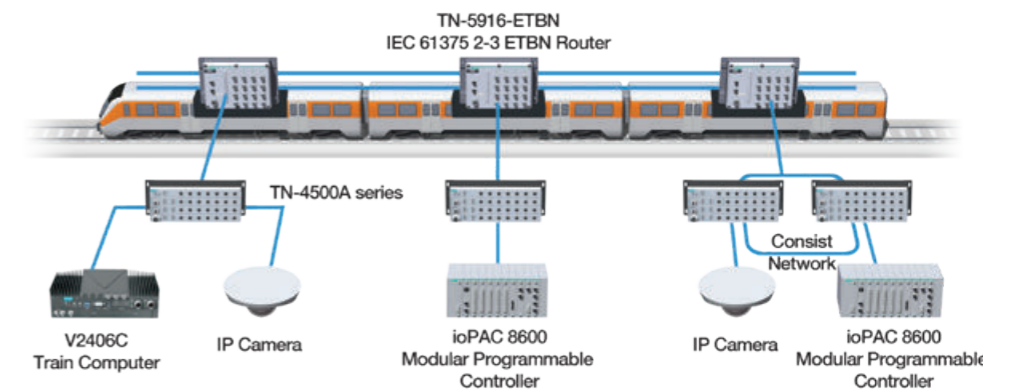
Moxa's TN-5916-ETBN Ethernet routers are designed according to the specifications laid out in the IEC 61375-2-5 standard. The TN-5916-ETBN Series routes traffic between Ethernet Train Backbones and Ethernet Consist Networks. In addition, the TN-5916-ETBN router handles the train inauguration as cars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

In the event of a power failure during operation, the TN-5916-ETBN supports power failover without affecting data transmissions in other consists and offering seamless network recovery when the power is recovered.



#### Integrated IP Solutions for TRDP Networks

Moxa's TCMS network solution comprises a controller and an Ethernet router. Compliance with the IEC 61375-2-3 standard allows the TN-5916-ETBN to act as an ETBN router and the ioPAC 8600 programmable controller to act as a CCU, which together control end devices such as IP cameras and remote I/O devices on the TRDP network.



#### Integrated IP Solutions for Train-to-ground Communications

Moxa's UC-8580 train-to-ground computing platform has multiple WWAN ports to ensure that train operators can meet their connectivity requirements. To provide more comprehensive solutions, the UC-8580 computing platform can be equipped with up to 3 cellular module slots and 1 Wi-Fi module slot to increase flexibility for different communication scenarios. Moreover, the UC-8580 features dynamic routing that can optimize connections based on geographic location or device connectivity status.

**Scenario: Trains at the station**

**Solution:**

- LAN can be used via an existing AP at the station to send large amounts of data between the vehicle and the station

**Benefit:**

- Reduce carrier fees

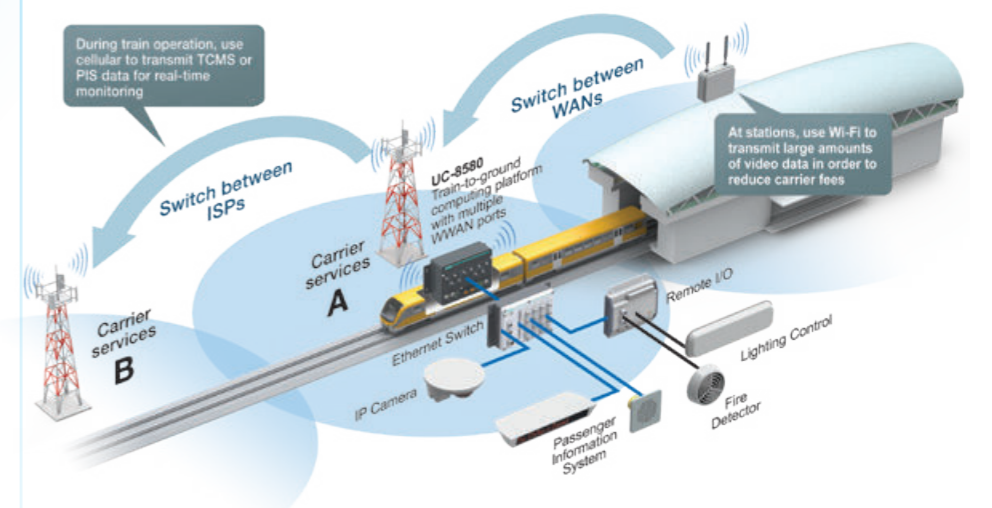
**Scenario: Trains along the trackside**

**Solution:**

- WWAN can be used to transmit TCMS or PIS data for real-time monitoring
- Supports up to 4 WWAN connections and 2 SIM card slots per cellular module (3 standard plus 1 customized). Dual-SIM capability ensures that the network will not experience downtime if one SIM in a module fails

**Benefit:**

- Seamless switchover between ISPs to ensure constant connectivity



### Train Management System

Routine maintenance on railway assets can generate unnecessary costs and downtime. Current manual inspections of trains are a considerable expense for operators and it is impossible to predict damage occurring during normal operation. Automated condition monitoring of this equipment allows operators to adopt predictive maintenance methods that can save money over the course of the equipment's lifecycle and prevent costly network delays. Train management systems are not just a single solution but consist of separate integrated applications for monitoring train conditions and controlling and automating train operations. Moxa offers a diverse range of computer products which can be used in a number of applications, including

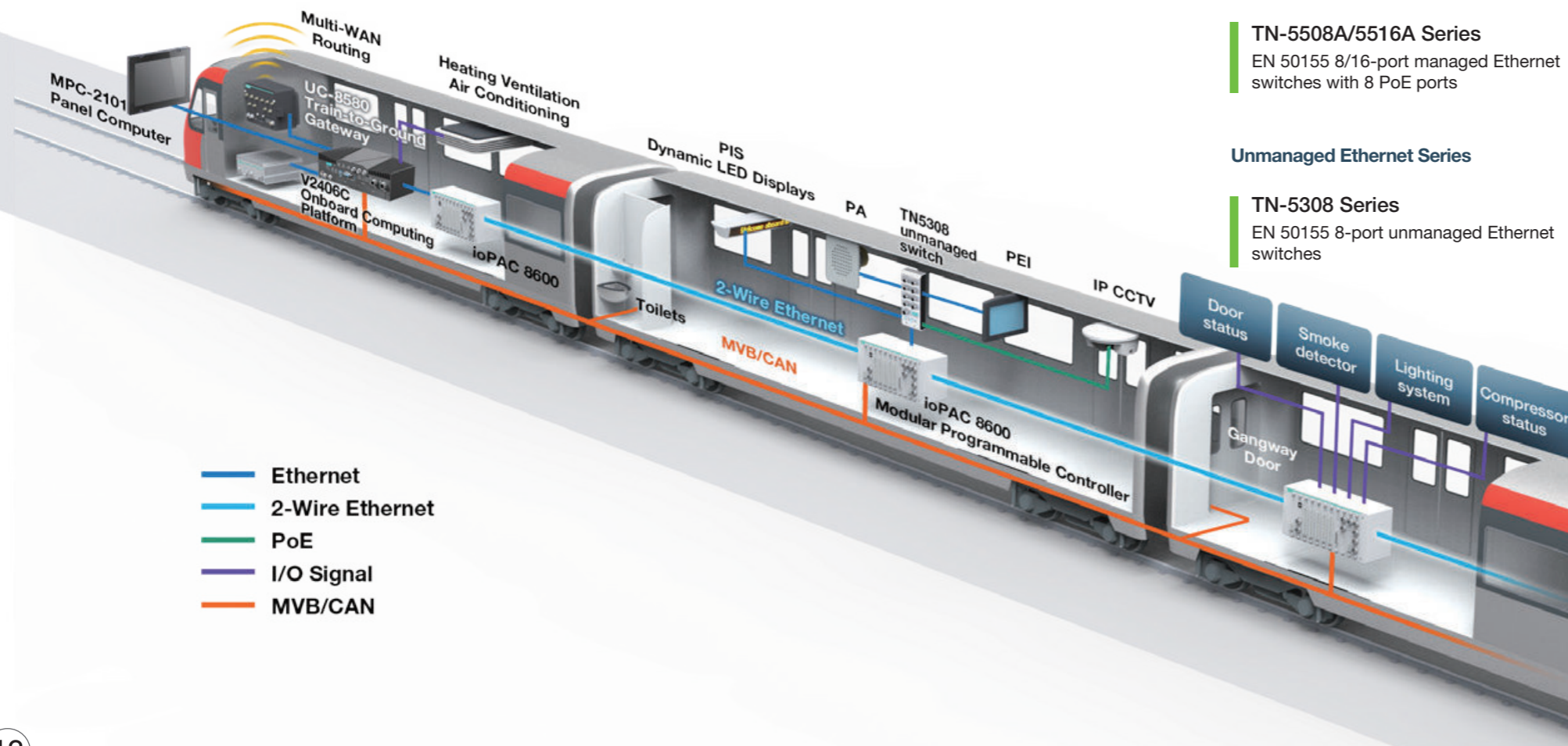
- Train condition monitoring
  - Fleet management
  - Onboard systems diagnostics
- Train device control and monitoring
  - Brakes, traction, door, lighting, compressor management
- Train environmental monitoring
  - Wayside sensor data acquisition

#### Multi-purpose computing platform

Moxa's V2406C acts as an EN 5015:2017 rolling stock computer featuring various I/O and communication interfaces.

#### Easily monitor operation status in driver's cabin

Moxa's panel computers are outfitted with IP66-rated M12 connectors to provide anti-vibration and waterproof connections and feature a 1000-nit LCD panel offering a sunlight readable, projected capacitive multi-touch screen.



### Highlighted Products

#### ToughNet TN Series Railway Routers and Ethernet Switches

##### Router Series

**TN-5916/TN-5916-ETBN Series**  
EN 50155 NAT 16-port router & IEC 61375-2-3 and 2-5 ETBN router



##### Layer 2 Gigabit/PoE Series

**TN-4500A Series**  
EN 50155 12+4G/24+4G-port Gigabit Ethernet switches with up to 20 PoE ports



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



**TN-G6500 Series**  
EN 50155 Full Gigabit Switches



##### Layer 2 Fast Ethernet Series

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



##### Unmanaged Ethernet Series

**TN-5308 Series**  
EN 50155 8-port unmanaged Ethernet switches



#### AWK-RCC Series Railway Wireless APs

**AWK-3131A-RCC Series**  
Industrial IEEE 802.11a/b/g/n wireless AP/bridge/client



#### Rugged Controllers

**ioPAC 8600 Series**  
Modular Programmable Controller



#### Rail Computers

**UC-8500 Series**  
Vehicle-to-ground computing platform with multiple WWAN ports



**V2406C**  
Multi-purpose onboard computing platform



**MPC-2101/2121 Series**  
Industrial fanless panel computers

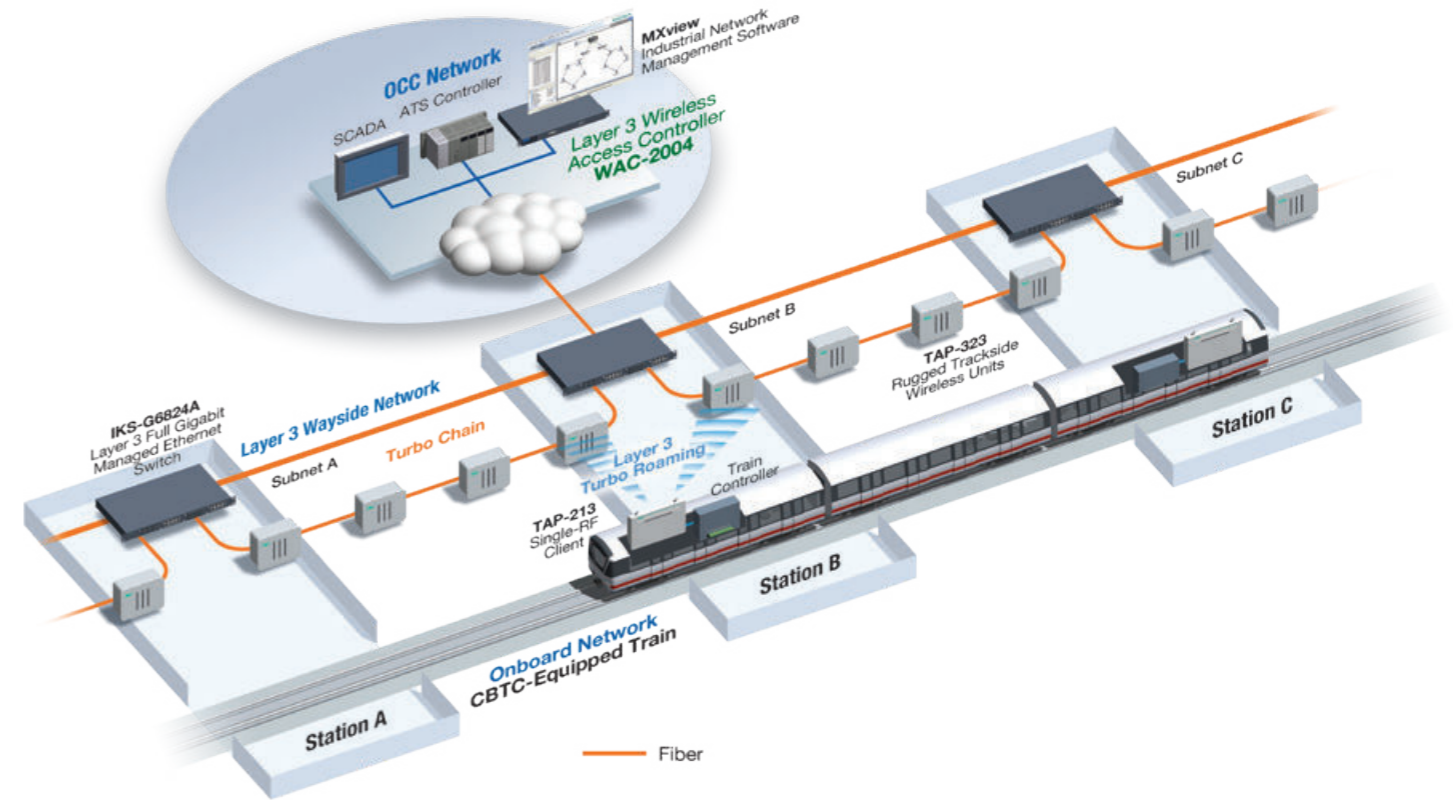


# Enable Continuous Train Operation on Layer 3 CBTC Networks

To ensure fast and safe train operations, the rail signaling system must be able to maintain smooth and continuous communications between the trains and the trackside. It takes three critical elements to make this happen: fast and secure train-to-ground communications, a redundant trackside network, and easy-to-use network management tools. Moxa provides a train-to-ground wireless AP/client to achieve seamless roaming performance, wayside Ethernet switches that offer network redundancy technology, and smart network management software for easy network monitoring and maintenance.

## CBTC Network Requirements

- Seamless train-to-ground rail signaling transmissions
- Fast failover redundancy ensure reliable trackside networks
- Easy-to-use network management tools for the control center

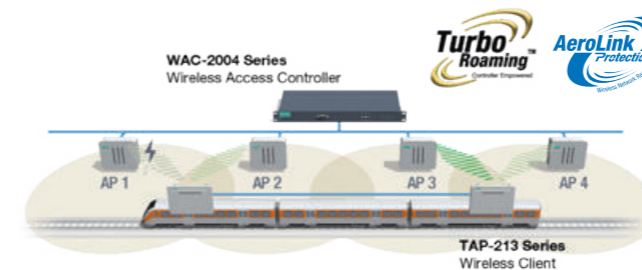


## Moxa Solutions

### Wireless Train-to-ground Communications

#### Wireless Controllers Enable Faster Roaming Times

To provide fast roaming for high-speed trains, Moxa's rail-specific Turbo Roaming technology is enabled by a Wireless Access Controller (WAC) that offers centralized roaming and security management. When roaming to the next AP, the client can be pre-authenticated by the WAC to bypass the re-authentication process, reducing the switch-over time to less than 50 ms. High-standard security protocols such as WPA, WPA2, and 802.11i are also integrated into the control function to ensure secure network access.



#### Multiple-Channel Roaming

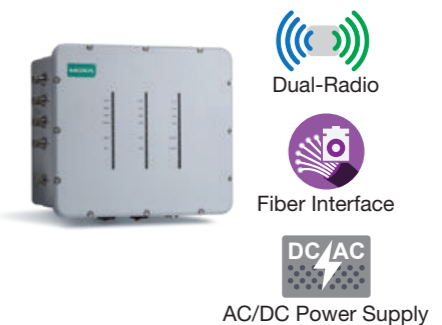
On a WLAN, adjacent APs should work through different channels to avoid radio interference. Moxa provides three non-overlapping channels for roaming to avoid adjacent channel and co-channel interference.

#### AeroLink Protection for Wireless Redundancy

Moxa provides the most reliable train-to-ground wireless link with AeroLink Protection technology. Multiple wireless redundancy links can be formed from train-to-ground so if a single wireless link is broken, communication will not be affected due to the quick failover to another redundant train-to-ground path. AeroLink Protection provides wireless redundancy at the network level, preventing any single point of failure for the radios onboard. A link failover time of less than 500 ms ensures fast wireless link recovery.

#### Rugged Trackside Wireless Unit

The TAP-323 trackside wireless unit is designed for train-to-ground wireless communication. It is a highly compact and rugged wireless unit that integrates two access points, a managed fiber switch, and a wide-range AC/DC power supply, all in one IP68-level outdoor box. It's a cost-effective, time-saving solution that simplifies your complex wayside WLAN network deployment.



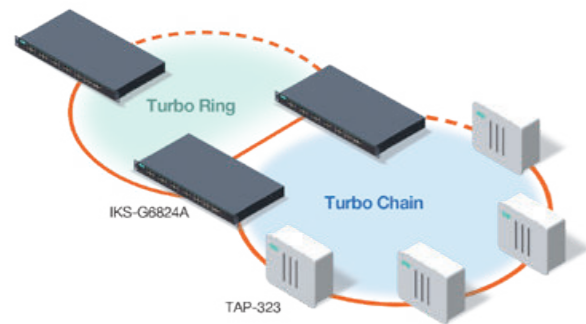
## Reliable Trackside Networks with High Availability and Flexibility

### 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 area. The distance between two depots could be anything from a hundred meters to many kilometers. Moxa's large portfolio of Ethernet switches supports multi-mode, single-mode, and long-haul fiber ports. Moxa's switches utilize our own Turbo Ring™ network redundancy technology specifically designed for use in trackside network communications. In addition, the switches deliver excellent convergence times for large-scale networks. Even for a large network with up to 250 nodes, network recovery can be achieved within 20 ms.

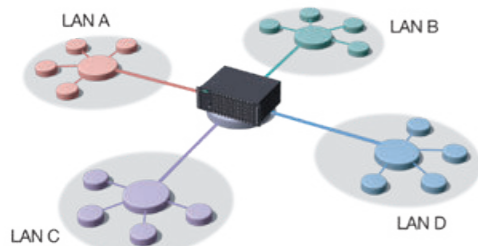
A network that is already up-and-running can be difficult to expand without causing severe disruption to the network. Moxa's Turbo Chain technology overcomes this problem by expanding the network and allowing it to seamlessly integrate and function with the existing network without causing disruption. Turbo Chain works with any network architecture, such as a SONET/SDH telecom network or the RSTP/STP networks that are common in an OCC (operation control center) and larger rail yards. The beauty of Turbo Chain is that it can attach (hook) the expansion onto any existing network, while still maintaining a strong convergence time when a network node or link goes down.

The best way to leverage Turbo Ring on a CBTC application is to form an Ethernet backbone along the track. Then, Moxa's trackside APs are able to create several individual 'chains' on the Turbo Ring network in order to gain high-level redundancy on the trackside network.



### Layer 3 Wayside Ethernet Switches for Vital and Non-Vital Network Segmentation

CBTC trackside 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 or broadcast storm were to shut down the communications network. Moxa's ICS and IKS series Ethernet Layer 3 switches are specifically designed for wayside applications. They are EN-50121-4 compliant and can operate in temperatures ranging from -40 to 75°C. The IKS-G6824A Layer 3 Ethernet switch is especially useful for segregating larger networks.



## Large-Scale Network Management Tools

### 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, as opposed to enterprise office networks. The NMS includes all of the features below.



- Automatic topology discovery via LLDP
- Real-time link status and traffic statistics
- Real-time alarm via SNMP Trap or SNMP
- Informative network reporting functions
- Support for large networks (up to 20,000 nodes)
- Displays a diverse range of devices used in railway networks (through MIB compiler)
- Visualized virtual LAN
- Supports MXview ToGo mobile app for remote monitoring and notifications—anytime, anywhere

### Fast and Easy-to-use Industrial Network Configuration Tool

Moxa's MXconfig is a comprehensive Windows-based utility that is used to install, configure, and maintain multiple Moxa devices in large-sale CBTC networks. MXconfig decreases configuration time and effort, making it easier to deploy hundreds of TAP-323 wireless units and configure their settings, or when performing trackside maintenance of the devices.



- Mass configuration function to reduce setup time
- Topology analysis to eliminate manual configuration errors
- Configuration overview for efficient management

## Highlighted Products

### Onboard Devices

#### TAP-213

Railway onboard 802.11n IP68 wireless AP/client



#### AWK-3131A-M12-RTG Series

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



### Trackside Devices

#### TAP-323

Trackside 802.11n IP68 wireless AP consisting of dual radios and a managed fiber Ethernet switch with AC power supply



#### WAC-2004 Series

Layer 3 wireless access controller



#### IKS-G6824A

24G-port Layer 3 full Gigabit managed Ethernet switches



#### IKS-G7826A/G7828A

24G+2 10GbE/24G+4 10GbE-port Layer 3 full Gigabit managed Ethernet switches



### Network Management

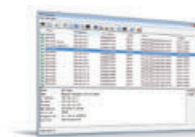
#### MXview / MXviewToGo

Industrial network management software designed for converged automation networks



#### MXconfig

Industrial network configuration tool



### Expert Technology

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

Download the white paper: <https://www.moxa.com/en/literature-library/truly-uninterrupted-train-to-ground-communications>



The Reliability of Wired Networks with the Cost Savings of Wireless

<https://www.moxa.com/en/literature-library/the-reliability-of-wired-networks-with-the-cost-savings-of-wireless>



# 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.

## IP CCTV Network Requirements

- 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

### Onboard IP CCTV Solutions

#### 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 & FHD 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.



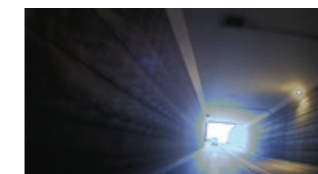
Good WDR performance



Clear/color low lux image



Strong light inhibition



Fast imaging in quick light change

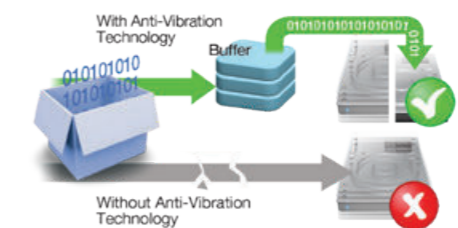
### Optimal Streaming Performance in Low-bandwidth Environments

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 four independent video streams (H.264 or 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.

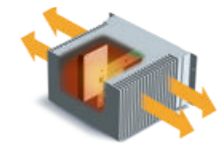
For NVRs, SafeGuard includes a patented bracket that protects the hard disk by directly absorbing kinetic energy and balancing the hard disk to avoid excessive vibration and shock. For NAS devices, SafeGuard will prevent data loss when disk vibration exceeds a pre-set threshold by automatically saving 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

### -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.



### Easily monitor operation status in driver's cabin

Moxa's rugged, fanless panel computers are built to withstand extreme operating conditions such as when serving as the HMI in the train driver cabin. They are equipped with IP66-rated M12 connectors to provide anti-vibration and waterproof connections and feature a 1000-nit projected capacitive multi-touch LCD screen that is readable under direct LCD sunlight.

**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 to optional mounting accessories.
- Lens: Several fixed focal-length lenses, including 2.5, 3.0, 3.6, 4.2, 6, 8 mm, are provided for different viewing angles and distances.
- Form factor: Available in both metal and plastic housing and feature EN 62262 IK8/IK10 vandal resistance and IP 66/67 rain and dust protection.

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

Moxa provides diverse NVR computing platforms to fulfill various customer demands. The choice and versatility of Moxa's onboard NVR portfolio includes solutions for driver car NVR, passenger car NVR, or gateway applications. Furthermore, Moxa offers different options based on performance levels, device role, functionality, and form factor, providing a solution for all types of applications

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



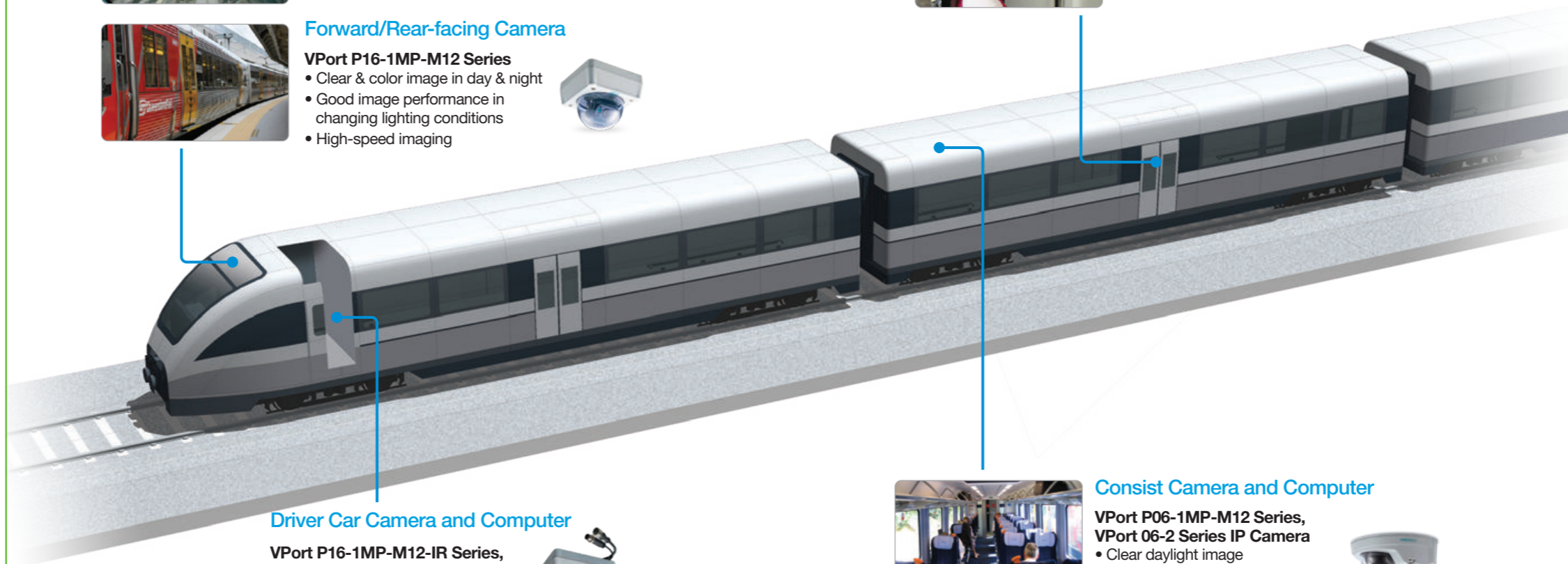
**Forward/Rear-facing Camera**

- VPort P16-1MP-M12 Series**
- Clear & color image in day & night
  - Good image performance in changing lighting conditions
  - High-speed imaging



**Hidden Camera**

- VPort P06HC-1V Series**
- Compact size
  - Flush-mountable



**Driver Car Camera and Computer**

- VPort P16-1MP-M12-IR Series, VPort P16-2MR Series IP Camera**
- Built-in IR for low lux environments
  - Color images in low-light environments



**V2406C Series Computer**

- Intel 7th Gen U-type CPU
- 2 hot-swappable HDD/SSD
- 2 Mini PCIe slots w/ dual SIM for onboard applications that require high availability



**MPC-2101/2121 Series Computer**

- Intel Atom® E3845
- 500-nit or sunlight-readable 1000-nit LED backlight
- M12 I/O port for high-vibration environments



**Consist Camera and Computer**

- VPort P06-1MP-M12 Series, VPort 06-2 Series IP Camera**
- Clear daylight image
  - Compact size
  - Line-in or built-in microphone



**V2406C Series Computer**

- Intel 7th Gen U-type CPU
- 2 hot-swappable HDD/SSD
- 2 Mini PCIe slots w/ dual SIM for onboard applications that require high availability





## Integrated Solutions for PIS/PA

In order to reduce maintenance efforts and improve the availability of services on trains, train operators need a scalable and reliable network upgrade to ensure uninterrupted operation of onboard systems as well as provide a better user experience for passengers. Moxa has developed two products in accordance with the EN50155 standard, the AWK-3131A-RCC wireless AP and ioPAC 8600 controller, which allow train operators to monitor the status of different onboard systems and integrate information into the TCMS. By deploying a fast and robust wireless foundation, the ACC (auto carriage connection) technology is able to easily and automatically create wireless connections between train cars without modifying existing cables and couplings.

### Network Requirements

- Ability to quickly create wireless bridges between carriages
- Quick device replacement without additional configuration or device setup
- Use existing 2-wire cable for the IP network
- Compact size that fits in the space-limited environments on trains
- Modular and expandable I/O modules
- Programmable open platform for easy integration
- Compliance with all railway requirements for greater reliability

### Moxa Solutions

#### AWK-3131A-RCC EN50155 Railway Wireless APs

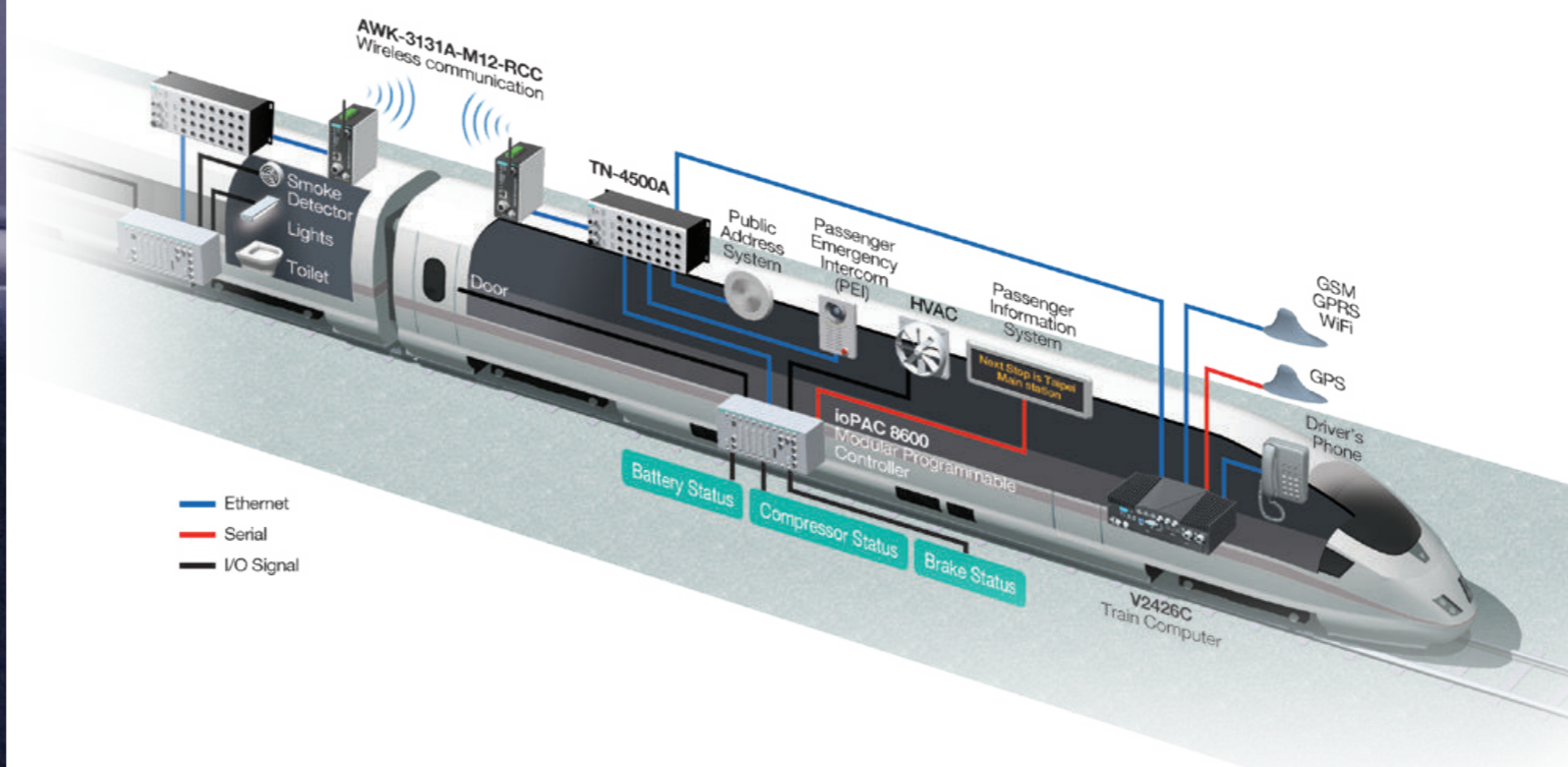
- Designed specifically for rail carriage-to-carriage communication
- High-speed wireless connectivity with up to 300 Mbps data rate
- MIMO technology to enable multiple concurrent data streams

#### ioPAC 8600 EN 50155 Railway Programmable Controllers

- High-performance ARM-based CPU (up to 1 GHz) suitable for different railway applications
- Comprehensive SDK for I/O and active reports reduce the amount of programming required
- Compact design that combines serial, I/O, Ethernet, and computing capabilities into one device
- 2-wire Ethernet switch for daisy-chain topologies with a bypass function to leverage existing cables and reduce costs for upgrading older trains

#### V2406C Series EN 50155 Railway Computers

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



### Highlighted Products

**ioPAC 8600 Series**  
Modular Programmable Controllers



**V2406C Series**  
X86-based Embedded Computers



#### Layer 2 Gigabit/PoE Series

**TN-4500A Series**  
EN 50155 12+4G/  
24+4G-port Gigabit  
Ethernet switches with  
up to 20 PoE ports



**TN-G6500 Series**  
EN 50155 Full Gigabit  
Switches



**TN-G4500 Series**  
EN 50155 10GbE Full  
Gigabit Switches



#### AWK-RCC Series Railway Wireless APs

**AWK-3131A-RCC Series**  
Industrial IEEE 802.11a/b/g/n  
wireless AP/bridge/client



#### EN 50155 Panel Computers

**MPC-2101/2121 Series**  
Industrial fanless panel  
computers



#### Expert Technology

**ACC Technology**  
Moxa's ACC (Auto Carriage Connection) technology easily and automatically creates wireless connections between train cars without modifying existing cables and couplings.

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

Concern for passenger safety, and the high financial cost and potential loss of reputation due to railway accidents and long delays have led railway infrastructure managers to adopt increasingly sophisticated preventative maintenance systems. However, the ability of railway operators and maintenance engineers to prevent costly system failures and optimize resource allocation depends on the large amounts of 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 programmable 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 programmable controllers can monitor all critical assets from any remote location.

## Network Requirements

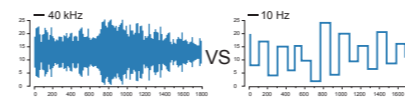
- Modular and compact design fits in space-limited cabinets
- Accurate data aggregation to facilitate more accurate responses
- Compliant with railway standards for harsh environments
- Easy to perform maintenance without stopping the system

## Moxa Solutions

### Programmable Controllers Tailored for Railway Asset Monitoring and Predictive Maintenance

#### ■ Precise data acquisition makes troubleshooting easier

Moxa programmable controllers offer up to 40 kHz 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 programmable controllers are compliant with the EN 50155, EN 50121-3-2, 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 programmable controllers ensure the utmost reliability.

### Easy Deployment, Integration, and Maintenance

#### ■ Supports IEC 61131-3 and C/C++ programming languages

Moxa's programmable controllers support the IEC 61131-3 railway standard and C/C++ programming, enabling easy integration with any system platform.

#### ■ Hot-swappable modules save time on service visits

All the I/O modules on Moxa's programmable 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 programmable controllers support a versatile collection of I/O modules. The non-intrusive, compact, and modular design makes Moxa programmable controllers ideal for wayside cabinets with limited space.

#### ■ Easy system configuration and maintenance with RTUxpress

Moxa programmable 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

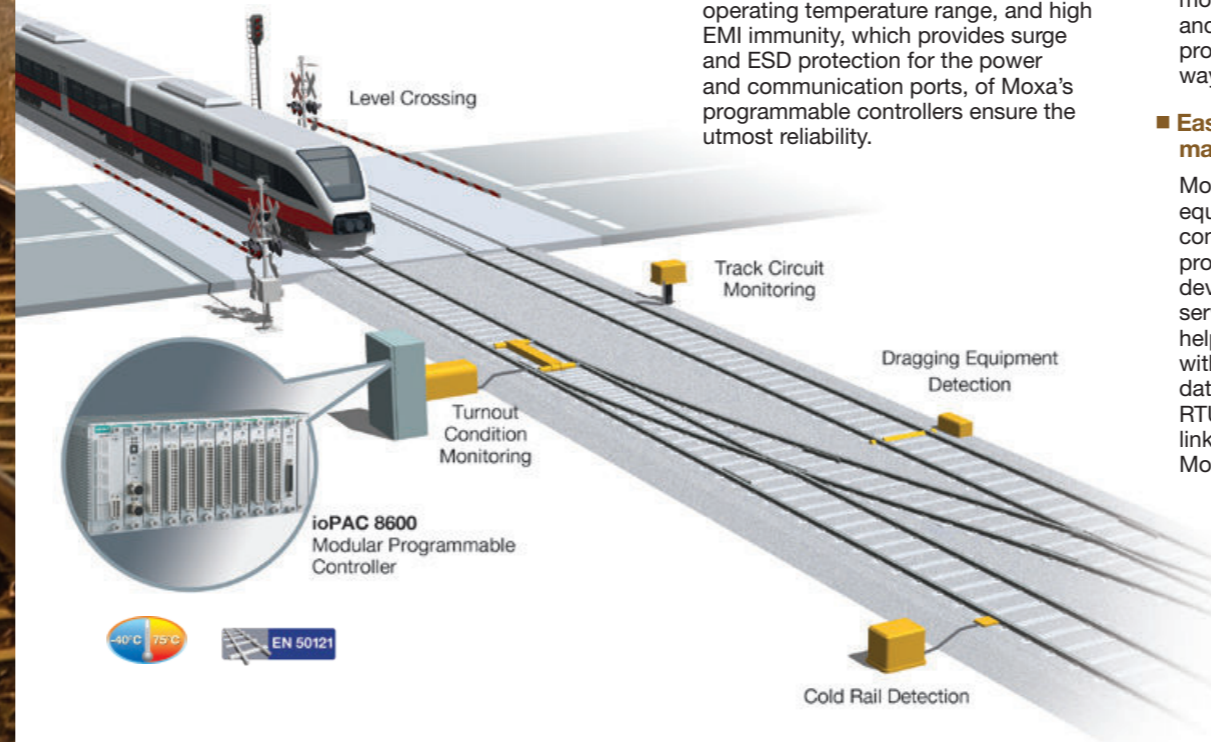
ioPAC 8600 Series  
Modular Programmable Controllers



### Expert Technology

#### 40 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 40 kHz sampling rate and pre-recording functions, this product can provide high resolution and precise time-based data.



## Your Trusted Partner in Automation

Moxa is a leading provider of edge connectivity, industrial computing, and network infrastructure solutions for enabling connectivity for the Industrial Internet of Things (IIoT). With over 30 years of industry experience, Moxa has connected more than 65 million devices worldwide and has a distribution and service network that reaches customers in more than 80 countries. Moxa delivers lasting business value by empowering industries with reliable networks and sincere service. Information about Moxa's solutions is available at [www.moxa.com](http://www.moxa.com).

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