Integrated IP Solutions for Smarter Railways

Industrial Networking, Computing, and Video Surveillance Solutions

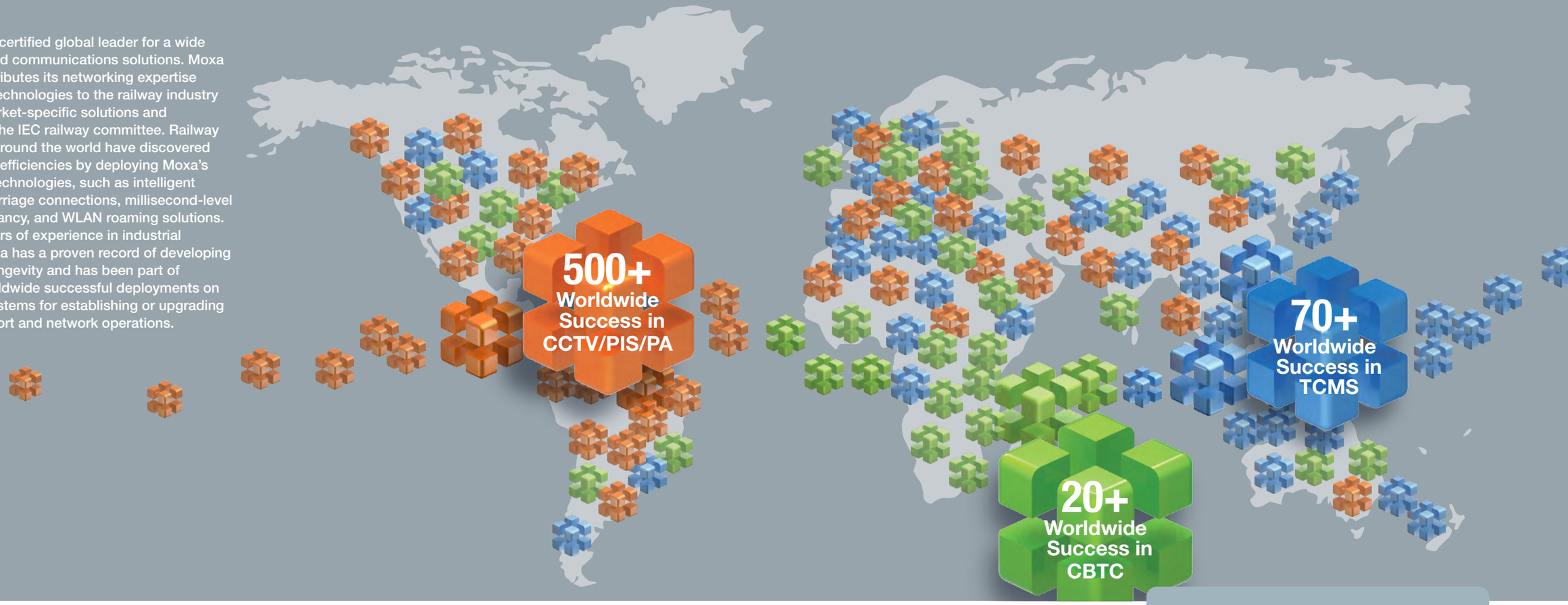
MOXA®

Reliable Networks ▲ Sincere Service

Travel Comfortably, Arrive Safely

Your Trusted Partner in Railway Automation

Moxa is an IRIS-certified global leader for 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 membership of the IEC railway committee. Railway operators from around the world have discovered new operational efficiencies 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 products with longevity and has been part of hundreds of worldwide successful deployments on major railway systems for establishing 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, including design, development, and manufacturing. The certification covers passenger information systems and communication systems.

IRIS Certification

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 industrial IP cameras and NVRs for surveillance systems, tailored-made computers for deployment on trains, as well as controllers and remote I/O for condition monitoring. For the 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.

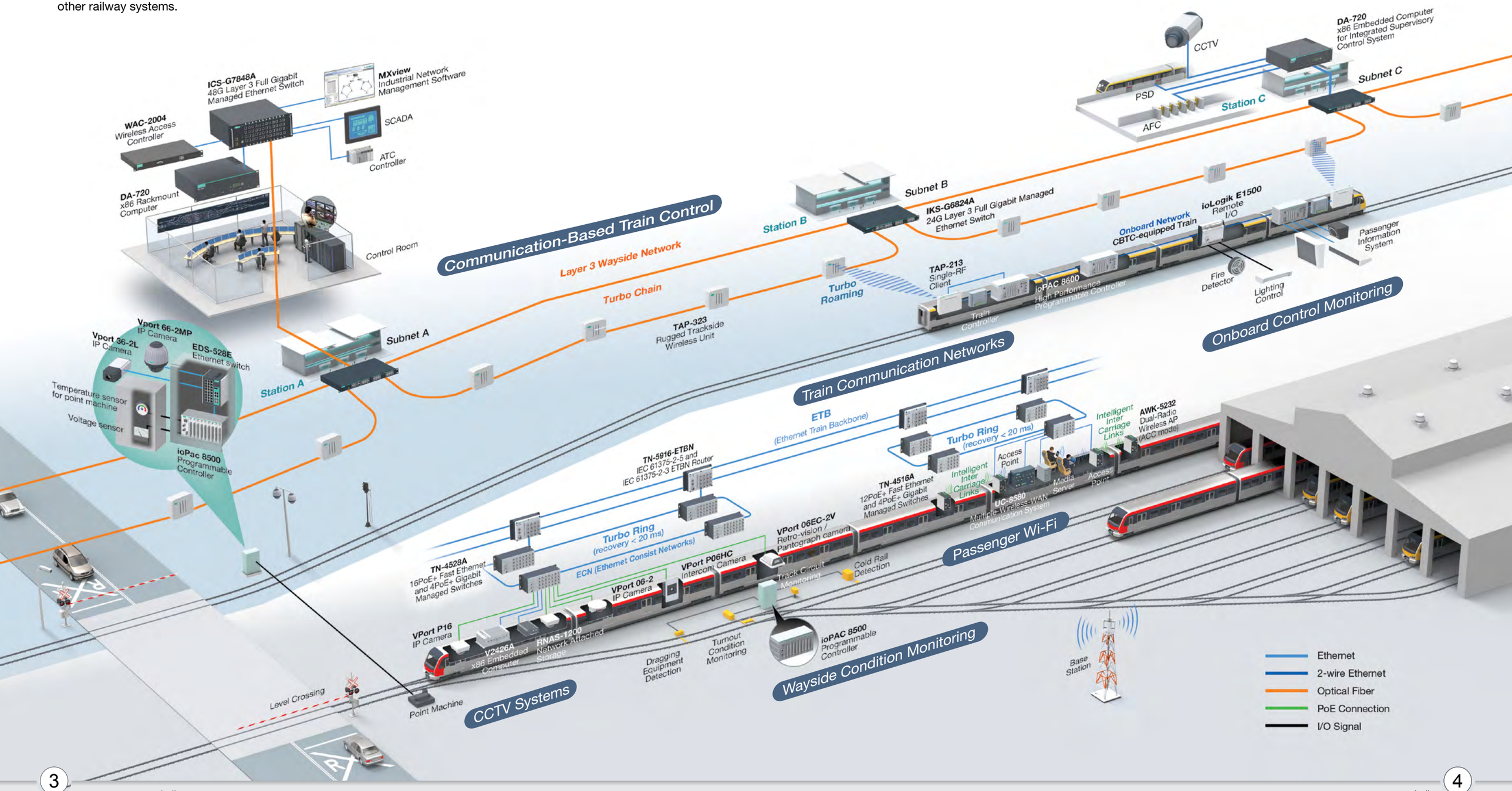
Hundreds of Successful Deployments Worldwide

Rail systems operate on a decades-long lifecycle basis. 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, computing, and video surveillance solutions around the world. With hundreds of successful deployments in major railway systems such as CCTV, PIS (Passenger Infotainment Systems), CBTC (Communication-based Train Control, and TCMS (Train Control Management System), has proven that our leading IP solutions are capable of providing high reliability and network availability that meet the demands of the rail industry.

Table of Contents

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, I/O and video surveillance 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.

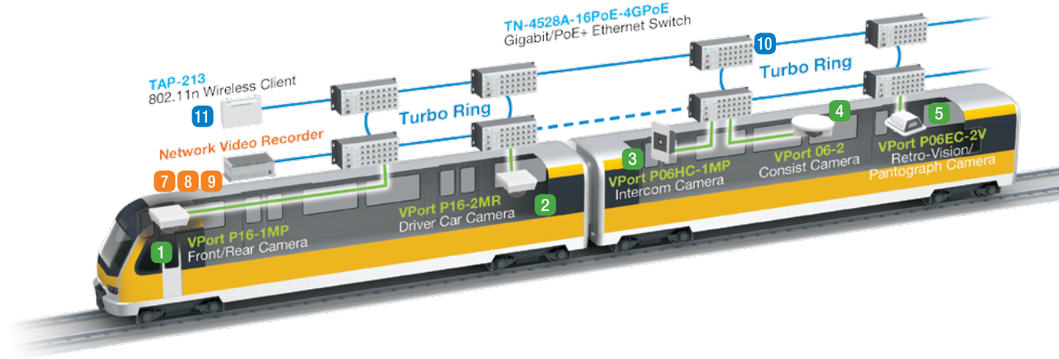


Optimized CCTV Solutions for Any Scene, Any Location, Any Condition

IP-based CCTV systems are a requirement for train operations. Effective video surveillance protects passengers and makes train operations more efficient. This trend has led to increased investment in IP CCTV systems, for onboard, trackside, and train stations. Constructing an IP CCTV system requires high-performance, rail-certified IP cameras and video recorders, as well as reliable network infrastructure to deliver video data from field sites to the control center. Moxa's large product portfolio can fulfill a variety of system demands for CCTV operations.

CCTV System Requirements

- IP cameras with a rugged design that provide excellent video quality for onboard, trackside, or station environments.
- Network video recorders (NVRs) that provide reliable recording processes, fast storage synchronization functions, and a vibration-proof design for use in harsh environments.
- A reliable network to connect onboard and wayside systems to ensure seamless video data communications.



IP Cameras

1 VPort P16-1MP
Front / Rear camera

- Clear & Color image in day & night
- Good image performance in fast light change (such as tunnel in and out)
- Large viewing angle and distance

2 VPort P16-2MR
Driver car camera

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

3 VPort P06HC-1MP
Intercom camera

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

4 VPort 06-2
Consist camera

- Clear image for light fluctuation environment
- Compact size
- Audio or microphone input

5 VPort P06EC-2V
Retro-vision / Pantograph camera

- Exterior housing with de-frost
- Large viewing angle and distance
- Wide operating temperature for outdoor environment
- High speed image

6 VPort 66-2MP
VPort 36-2L
VPort 36-1MP
Stationary cameras

- Wide operating temperature for outdoor environment EN 50121-4 rail standard

Network Video Recorder

7 MXNVR-RO-T
NVR

- Good record/live view image
- Digital signature for recording file

8 V2416A/V2616A
NVR Computer

- High CPU performance
- Strong storage function

9 RNAS-1200
Network Attached Storage

- Strong storage function

Video-over IP Network Solution

10 TN-4528A-16PoE-4GPoE
Onboard Ethernet Switch

- 24+4G PoE+ port
- up to 30 watt per PoE port

11 TAP-213
Onboard Wireless AP/ Client

- 300 Mbps data rate
- Fast roaming function

12 TAP-323
Trackside Wireless Unit

- 300 Mbps data rate
- 2 fiber SFP ports and 4 PoE ports

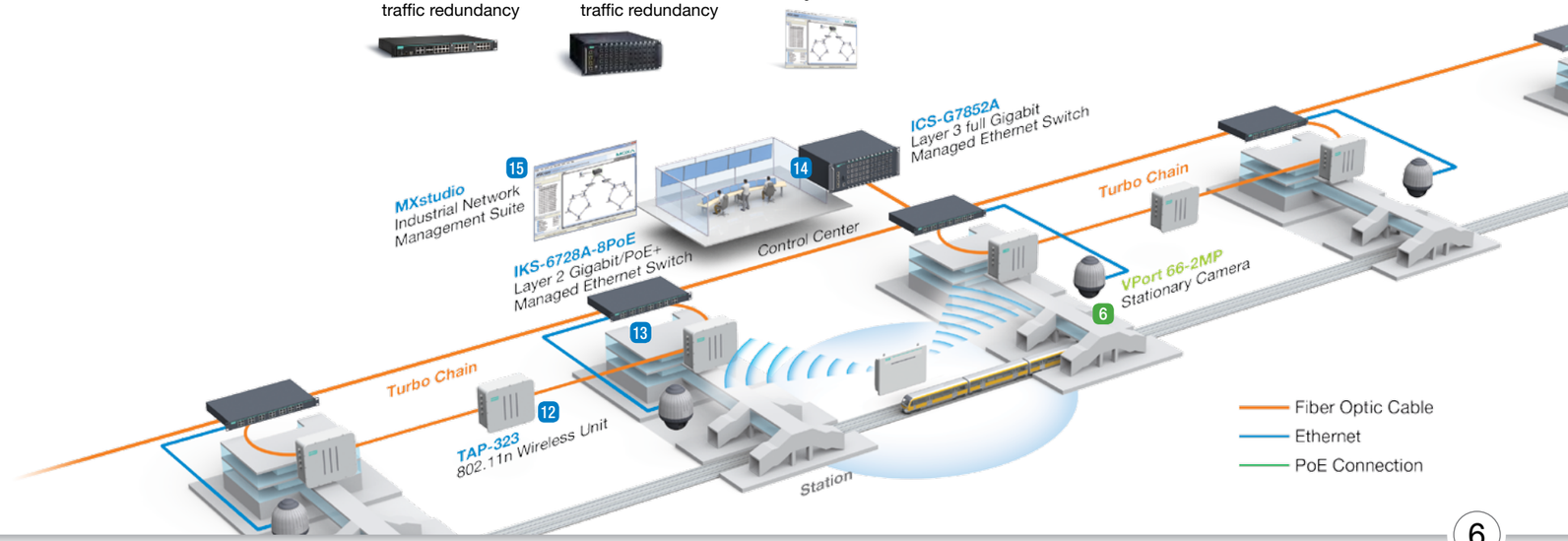
13 IKS-6728A-8PoE
Layer 2 Trackside Ethernet Switch

- 24+4G PoE+ port
- Multicast/unicast traffic redundancy

14 ICS-G7852A
Layer 3 Trackside Ethernet Switch

- 48G+4 10GbE port
- Multicast/unicast traffic redundancy

15 MXstudio
Industrial network management suite for installation, operation, maintenance, and diagnostics



Moxa Solutions

Versatile Camera Types and Installation Options Suitable for Any Location

IP Camera Options

- Mounting: Ceiling mount, panel mount, flush mount, vertical mount and optional mounting accessories are available.
- Lens: Multiple fixed focal-length lenses, including 2.5, 3.0, 3.6, 4.2, 6, 8 mm, are available for different viewing angles and distances.
- Form factor: Both metal and plastic housings are available, and feature EN 62262-compliance, IK8/IK10 vandal resistance and IP 66 rain and dust protection.

IP Camera Technology Highlights

Superior Image Quality under Any Lighting Conditions

As trains pass through tunnels, open air, and shade, the lighting conditions inside and outside the carriages change rapidly, making it difficult to capture smooth images. Moxa's groundbreaking iCapTrue™ technology addresses these challenges to ensure clear and smooth video imaging. This technology includes an advanced AE (Auto Exposure) and AWB (Auto White Balance) algorithm to enable superior image quality, and capture every detail, even when subjected to challenging lighting conditions.


Good WDR performance


Clear/color low lux image


Strong light inhibition


Fast imaging in quick light change

Optimal Streaming Performance in Low-Bandwidth Environments

Moxa's CBR Pro™ is an optimized bit rate control technique designed to enhance image quality even when the network bandwidth is limited. It stabilizes the bit rate and guarantees the system will maintain consistently good video performance even in low-bandwidth environments.

Industrial-Grade Robustness

Passenger safety on trains is highly dependent on a surveillance system that can guarantee continuous footage, even in the challenging conditions onboard trains. All of Moxa's onboard surveillance products are at least IP66- and IK8-rated, EN 50155 compliant, and have an operating temperature range of -40 to 70°C. In addition, Moxa's stringent testing procedures allow us to guarantee reliability and long product lifetimes for our IP cameras, which helps asset owners lower the total cost of ownership by reducing maintenance costs and efforts.

Wide Selection of NVR Solutions for Different Performance Requirements

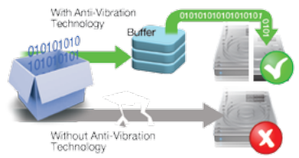
NVR Options

- NVR with surveillance software: the MXNVR-RO-T features video recording, storage, live-view and playback functions.
- NVR computers: the V2416A/V2616A NVR computers provides different level of high performance.
- Video storage: the RNAS-1200 Series has high capacity and reliability for data storage demands.

NVR Technology Highlights

Secure and Reliable Disk Access under Extreme Vibrations and Temperatures

The first priority of an NVR is to ensure video data integrity and avoid any data loss. Moxa's NVR passed the EN 50155 vibration test with the HDDs installed to ensure secure video storage. In addition, the NAS-1200 features the Data XPro technology that prevents 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. When extreme temperatures occur, the Data XPro technology will temporarily stop disk service when it's too high and start again when the temperature returns to normal. The NAS-1200 is able to resist extremely low temperatures by using the Intelligent Heat Solution.



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, requiring a block-by-block journaling operation to re-synchronize the drives. In the past, these synchronizations across 300 GB drives could take several hours or even days. However, 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 keep the trains from running on time.

Digital Signature Enhance Video Security

In order to eliminate the possibility that a recorded file will be tampered with, the MXNVR-RO-T NVR utilizes the advanced digital signature feature that enhances the security of a video file once a video stream is recorded, with zero-impact on recording performance, and complies with the ONVIF standard (ONVIF export file format). When exporting the recorded file from the NVR, the operator can check the validity of the file by using the attached public key to authenticate the origin of the file, ensuring the file is secure.

Live View Software on Trains

Apart from a user-friendly surveillance software for easy monitoring in the control center, train operators also frequently request a similar interface in the driver cab on trains to facilitate real-time responses. Moxa's MXNVR-RO-T NVR features Driver View, which provides real-time video feeds from multiple cameras, and has an easy-to-use interface for use on trains. It shows the status of each camera and allows drivers to monitor any recorded images onboard that require an immediate response.

Reliable Video Data Communications Systems

Onboard CCTV Network Solutions

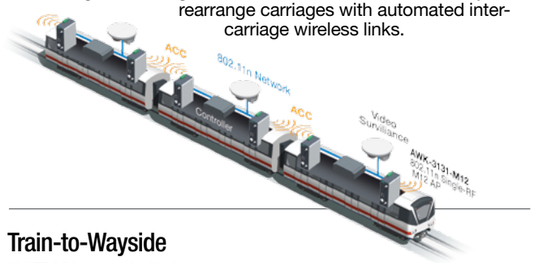
Onboard Ethernet IP Network:

The TN-4500A series onboard Ethernet switches have up to 28 ports, including Gigabit ports for smooth full HD video transmissions and PoE that provide up to 30 watts per port to reduce extra power cable costs. In addition, the TN-4500A series supports Turbo Ring technology for network redundancy to ensure video image failure is less than 20 ms and the Dynamic Ring Coupling technology for easy maintenance of the redundant network when train consists are rearranged.

(Recovery <20 ms)

Onboard Wireless Networks:

If you need a wireless CCTV network, our AWK-RCC series supports the 802.11n standard at up to 300 Mbps bandwidth for video transmissions. It supports ACC technology that secures the carriage-to-carriage connection, and also makes it easy to rearrange carriages with automated inter-carriage wireless links.



Train-to-Wayside CCTV Network Solutions

Train-to-Ground Wireless Communications:

Our train-to-ground TAP series wireless devices are able to deliver fast handover times with Turbo Roaming technology and 300 Mbps data rate with 802.11n standards that ensure seamless video data communications from onboard to wayside.

Wayside Communication Networks:

In order to provide seamless video surveillance monitoring at the control center, wayside communication networks require

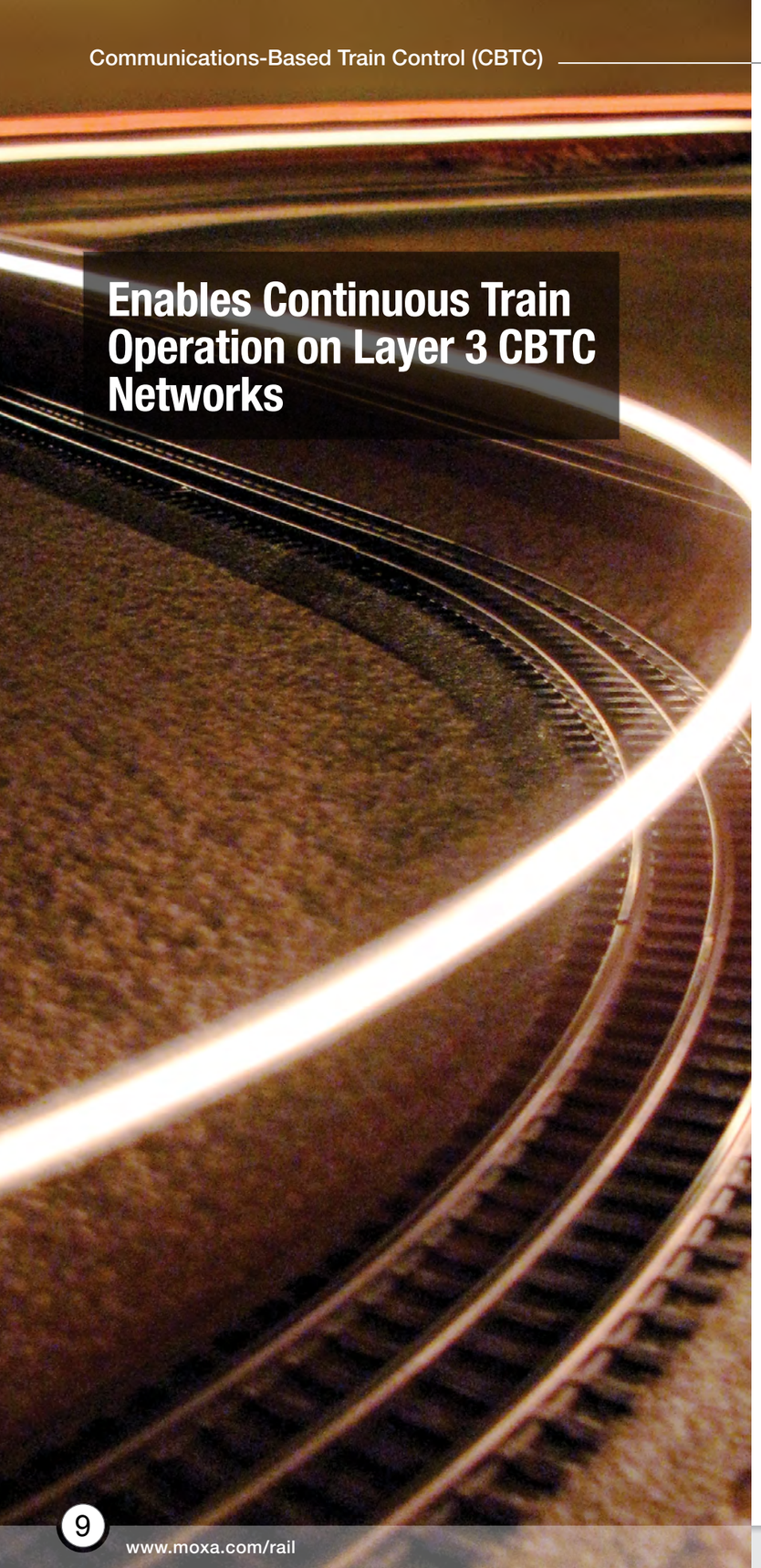
Moxa's layer 2/3 managed Ethernet switches that support up to 48G and 4 10GbE ports for large scale video over IP networks.

Moxa's V-On technology optimizes the network for multicast/unicast traffic and delivers milliseconds network failover.

Moxa's MXstudio provide the network management suite for installation, operation, maintenance, and diagnostics the rail networks.

Worldwide Deployment

- **Location: Los Angeles, USA**
  Products Used:
  - TN-5516-8PoE-24-T PoE managed Ethernet switches
  - VPort P06-1MP IP camera
  - ioLogik E1510-M12-CT-T remote I/O
- **Location: Montreal, Canada**
  Products Used:
  - VPort 16-M12 IP Camera
- **Location: Estonia**
  Products Used:
  - TN-5524-8PoE PoE managed Ethernet switches
  - VPort P06-1MP IP camera
- **Location: Sydney, Australia**
  Products Used:
  - TN-5524-8PoE PoE managed Ethernet switches
  - VPort P06-1MP IP camera
- **Location: Taipei, Taiwan**
  Products Used:
  - VPort P16-2MP, VPort P26A-2MP, VPort P06HC-2MP onboard IP cameras
  - V2416, V2616 onboard NVRs
  - TN-5516-8PoE-48 PoE managed Ethernet switches
- **Location: Prasa South Africa**
  Products Used:
  - VPort 06-1MP, VPort P16-1MP onboard IP cameras
- **Location: Makkah-Madina, Saudi Arabia**
  Products Used:
  - VPort P06-1MP onboard IP cameras
- **Location: Ouargla, Algeria**
  Products Used:
  - VPort 36-1MP stationary IP cameras
  - ICS-G7852A/G7752A Layer 3 managed Ethernet Switch
  - IKS-6728A-8PoE, EDS-P510A-8PoE Layer 2 managed Ethernet Switch
  - MXstudio network management tool

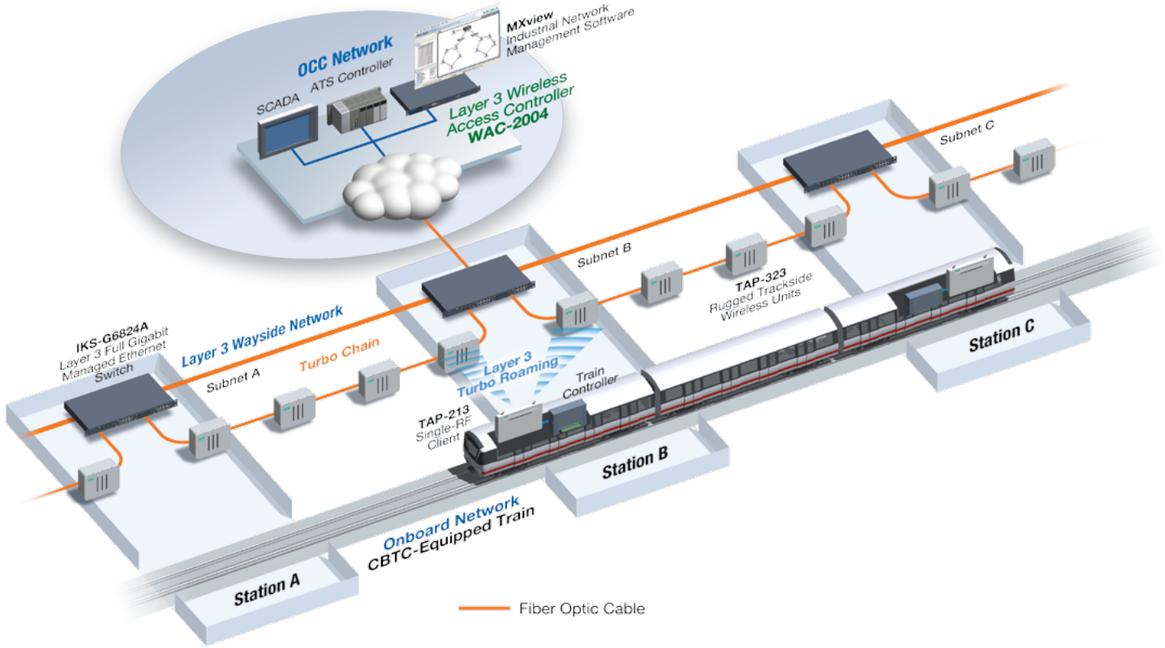


Enables Continuous Train Operation on Layer 3 CBTC Networks

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, 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 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 tool at the control center

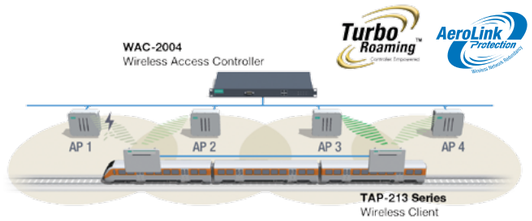


Moxa Solutions

Wireless Train-to-Ground Communications

Wireless Controller Enables Faster Roaming Time

To allow seamless 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, which reduces the switch-over time to less than 50 ms. High-standard security protocols such as WPA, WPA2, and 802.11i are also adapted 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 the AeroLink Protection technology. Multiple wireless redundancy links can be formed from train-to-ground so that if for any reason a single wireless link is broken, the 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 that prevents any single point of failure for the radios onboard. A link failover time of less than 50 ms ensures fast wireless link recovery while supporting both L2 and L3 wayside networks.

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 outdoors box. It's a cost-effective, time-saving solution that simplifies your complex wayside WLAN network deployment.

Dual-Radio

Fiber Interface

DC/AC

AC/DC Power Supply

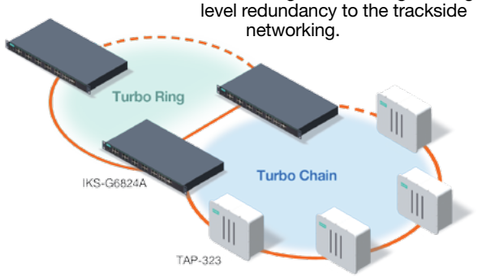
Reliable Trackside Networks with High Availability and Flexibility

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 wide portfolio of Ethernet switches supports multi-mode, single-mode, and long-haul design fiber ports. They also support Turbo Ring™ network redundancy technology that excels when used in trackside network communications because it delivers excellent convergence time for large-scale networks. Even in a large network of up to 250 nodes, network recovery can be achieved within 20 ms.

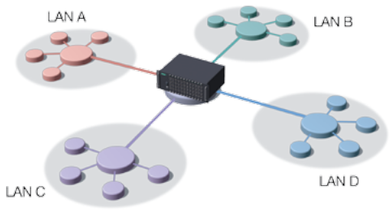
Once a network is up and running and fulfilling all the other requirements of railway operations, it can become difficult to expand without severe disruption. Moxa's Turbo Chain technology is an evolution of Turbo Ring which provides a complementary solution that can easily create network expansions that seamlessly integrate and function 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 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 strong convergence time when a network node or link goes down.

Moreover, the best approach of leveraging the Turbo Ring/Chain technology on the CBTC application is to use Turbo Ring to form an Ethernet backbone along the track, and those trackside Moxa APs is able to create several individual "chains" on the Turbo Ring network, to gain a higher level redundancy to the trackside networking.



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. It is EN-50121-4 compliant and can operate in temperature 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. 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
- Supports MXview ToGo mobile app for remote monitoring and notification—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 the large-sale CBTC networks. It decreases the configuration time, making it even more convenient when you want to deploy hundreds of TAP-323 wireless units and configure their settings, or perform trackside maintenance of the devices.

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

Highlighted Products

Onboard Devices

TAP-213
Railway onboard 802.11n IP68 wireless AP/client

Trackside Devices

TAP-323
Trackside wireless unit consisting of dual radios, and a managed fiber Ethernet switch with AC power supply

WAC-2004
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 white paper:
www.moxa.com/rail/wp/TR

Turbo Roaming™ Controller Empowered

Turbo Chain: A New Recovery System Beyond Ethernet Redundant Ring Technology

Download white paper:
www.moxa.com/rail/wp/TC

Beyond Redundant Rings
Turbo Chain

Worldwide Deployment

Location: Stockholm, Sweden
Products Used:
- TAP-6226 wireless units
- WAC-2004 Layer 3 wireless access controller
- AWK-3121-RTG wireless clients
- MXconfig network configuration tools

Location: China
Products Used:
- AWK-3121-RTG wireless AP/clients
- WAC-1001 Layer 2 wireless access controllers

Location: Mumbai, India
Products Used:
- TAP-6226 wireless units
- WAC-2004 Layer 3 wireless access controller
- AWK-3121-RTG wireless clients

Location: Ritadh, Saudi Arabia
Products Used:
- TAP-6226 wireless units
- AWK-3121-RTG wireless clients

Location: Copenhagen, Denmark
Products Used:
- TAP-6226 wireless unit

Maximizing the Value of Ethernet Technology for Train Communication Network

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 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 network

Moxa Solutions

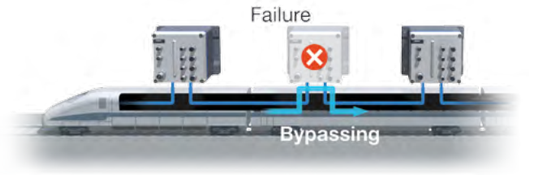
Advanced Ethernet Redundancy

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

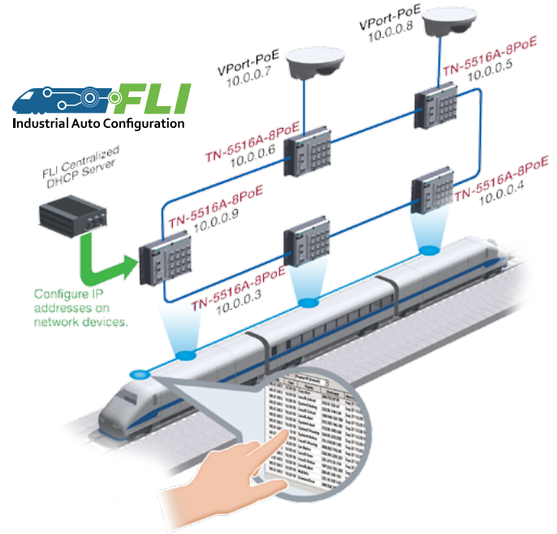
All of Moxa's managed Ethernet switches support Turbo Ring™, which has a super fast fault recovery time of less than 20 ms at a full load of 250 Ethernet switches to minimize downtime caused by network failure. If a path in the network fails, the system will return to normal communication in under 20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



Easy Deployment, Flexible Maintenance

Maximize System Availability with Automated Device and Network Configuration

Moxa's FLI is a convenient auto-configuration technology that automates common configuration tasks while remaining highly deterministic on trains. A FLI server extends the reach of DHCP 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 at the same location. Therefore, 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 accuracy.



Flexibility

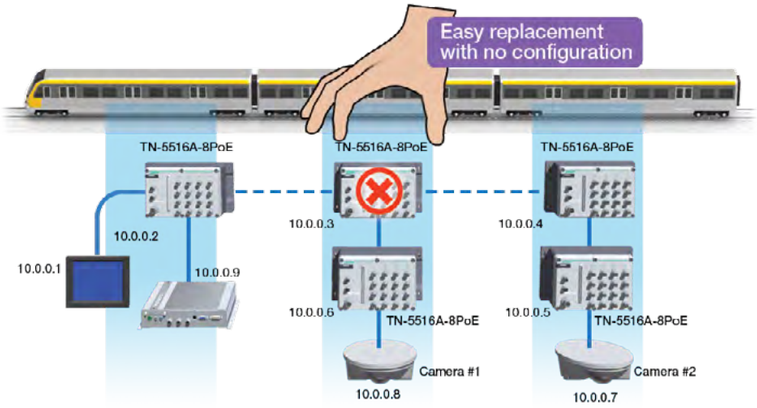
- Manage all Ethernet devices from one centralized file
- Use open standards for end devices

Location Awareness

- Set the IP by device location on the Ethernet topology

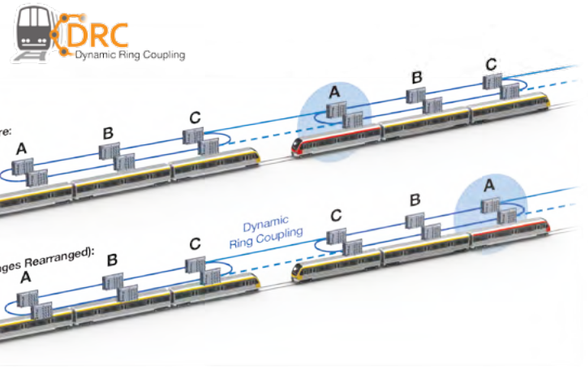
Intelligence

- Supports redundant servers
- Always follow the correct server even if there are multiple DHCP servers connected to the network
- On-the-fly reconfiguration



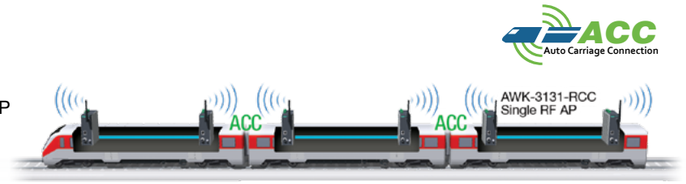
Intelligent Inter-Consist Ethernet Redundancy

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 it's 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 re-compose 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 because it is available in 802.11n for the AWK-RCC series.

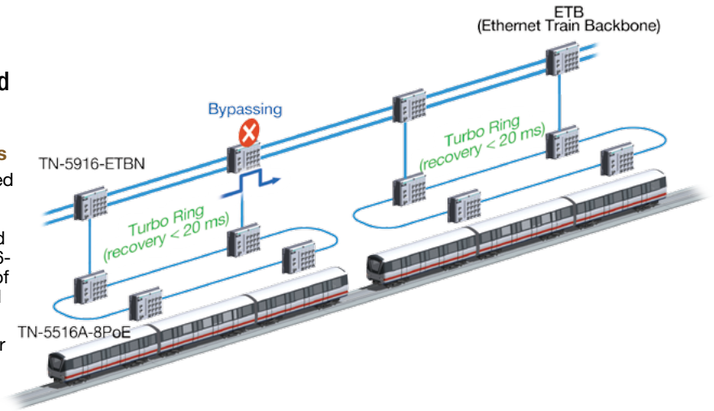


IEC 61375 Compliant IP Solutions for Onboard TCMS Network

IEC 61375-2-5 Compliant Train Ethernet Routers

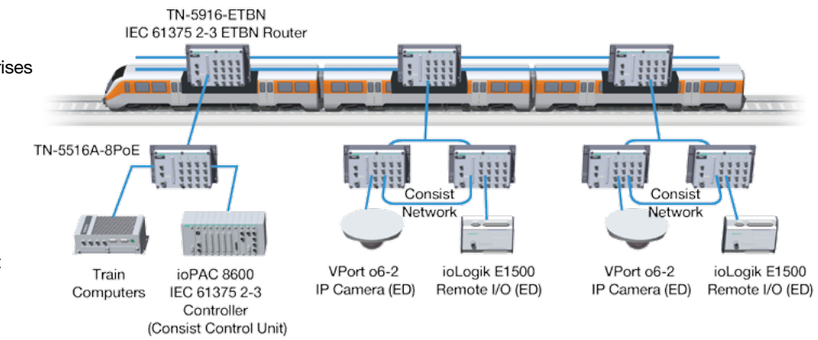
Moxa's TN-5916-ETBN Ethernet routers are designed according to the specifications laid out in the IEC 61375-2-5 standard. The TN-5916-ETBN series routes traffic between Ethernet Train Backbones and Ethernet Consist Networks. In addition, the TN-5916-ETBN router handles the train inauguration as cars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

During operation, the TN-5916-ETBN enables power failure 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 I/O controller to act as a CCU to control end devices such as IP cameras and remote I/O on the TRDP network. Moreover, to provide comprehensive solutions, our VPort06-2 is IEC 61375-2-3-compliant to allow it to communication with the ETBN by the TRDP network.



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

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

Layer 2 Faster Ethernet Series

TN-5516A/5508A Series
EN 50155 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

IEC 61375 Compliant Products

TN-5916-ETBN
IEC 61375-2-3 and 2-5 ETBN router

ioPAC 8600 Series
IEC 61375-2-3 Programmable Controller

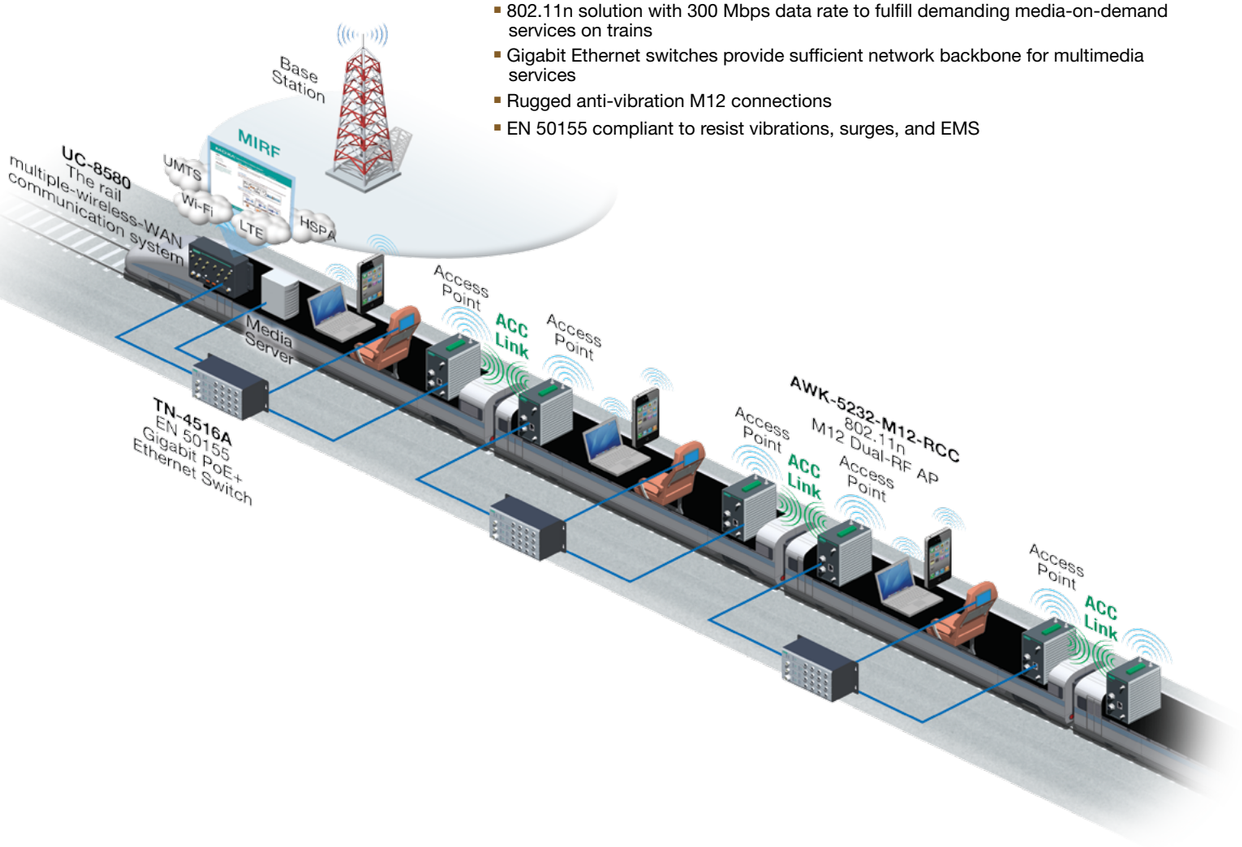
VPort 06-2
IEC 61375-2-3 Full HD IP Camera

Worldwide Deployment

- **Location: Helsinki, Finland**
  Products Used:
  • TN-5516 Series
- **Location: Paris, France**
  Products Used:
  • TN-5508 Series
- **Location: Norway**
  Products Used:
  • TN-5516 Series,
  • TN-5516-8PoE Series
- **Location: Taipei, Taiwan**
  Products Used:
  • TN-5516 Series
- **Location: Ukraine**
  Products Used:
  • TN-5518 Series
- **Location: China**
  Products Used:
  • TN-5516 Series

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 UC-8580 series multiple-wireless-WAN communication system simplify the coding of multiple-WAN routing applications, speeding up application development processes and significantly shortening custom development times for 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
- Connections capable of withstanding constant vibrations
- Operational even under 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 data rate to fulfill demanding media-on-demand services on trains
- Gigabit Ethernet switches provide sufficient network backbone for multimedia services
- 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

UC-8580 Series
The rail multiple-wireless-WAN communication system

TN-4516A 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

MIRF: An Intelligent Wireless Routing Platform for Rolling Stock
Download white paper:
www.moxa.com/rail/wp/MIRF

Worldwide Deployment

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

Location: Across Europe
Products Used:
- AWK-3131-RCC wireless AP

Integrated Solutions for Onboard Condition Monitoring

Moxa's ioPAC 8600 is an EN 50155 compliant controller with serial, I/O, CAN, and Ethernet all contained in a compact housing unit that is designed for use in space-constrained onboard environments.

The ioLogik E1500 series is a rugged remote I/O designed for railway applications. The integrated ioPAC controller and ioLogik E1500 railway remote I/O enable the monitoring of multiple subsystems and easily integrate information about doors, HVAC system, batteries, rest rooms, brakes, and the lighting system into the TCMS. This information can help train operators identify potential problems quickly, which reduces maintenance effort, and also provides better availability of services.

Network Requirements

- Quickly replace devices without any complex IP configurations or device setup
- Use existing 2-wire cable for the IP network
- 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 8600 EN 50155 Railway Programmable Controllers

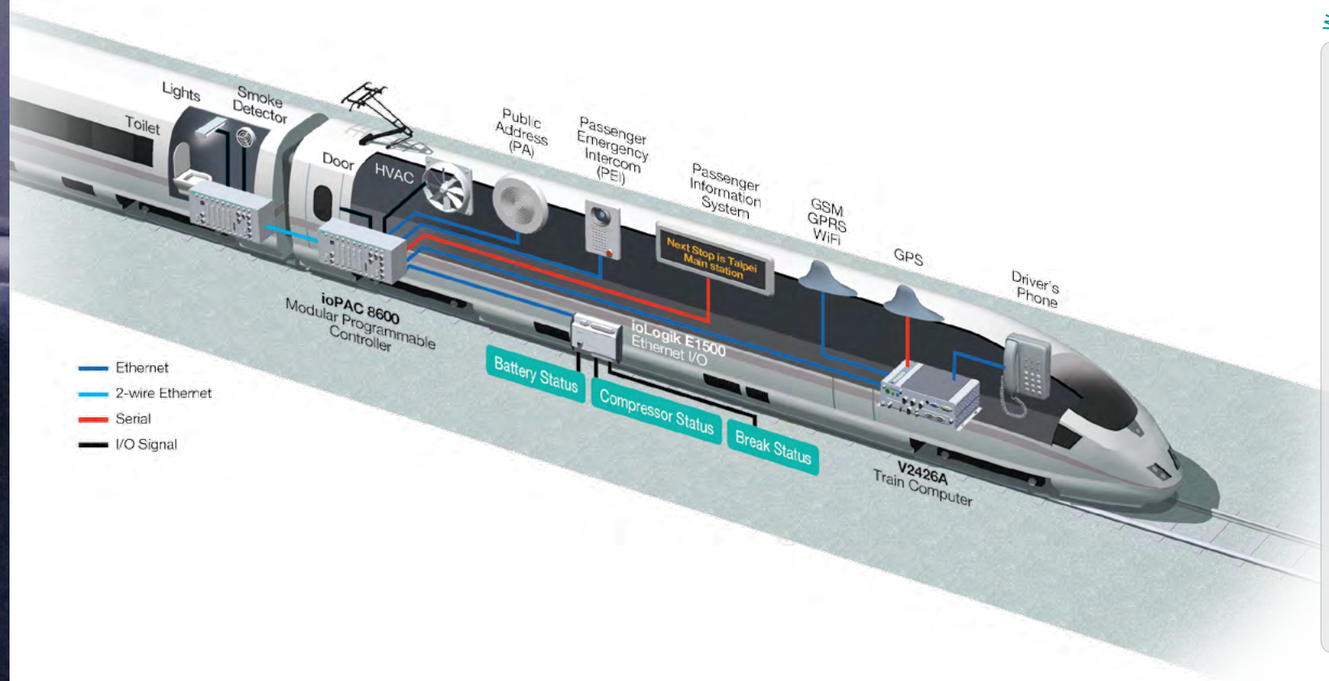
- Up to 1GHz high performance ARM-based CPU fulfill different railway applications
- Comprehensive SDK for I/O and active reports reduces the amount of programming required
- Compact design that combines serial, I/O, Ethernet, and computing capabilities all in one box
- 2-wire Ethernet switch for daisy-chain topologies with bypass function to leverage existing cables and reduce costs for revamping mid-life trains

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 environments
- Built-in two LAN ports for daisy-chain network connection (by request)

V2426A Series EN 50155 Railway Computers

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



Highlighted Products

ioPAC 8600 Series
Modular Programmable Controllers

ioLogik E1500 Series
Railway Ethernet I/O

V2426A Series
x86-based Embedded Computers

Expert Technology

2-Wire Ethernet Technology

Moxa's innovative 2-wire Ethernet technology can run up to 100 Mbps Ethernet with bypass function on two legacy cables. This technology allows aging trains to utilize an Ethernet network when using limited legacy cables. With two 2-wire Ethernet switch modules and 4 legacy cables, the Ethernet network can reach up to 200 Mbps with redundancy.

Worldwide Deployment

Location: Germany
Products Used:
- ioPAC 8020 series modular programmable controller
- ioLogik E1500 EN 50155 compliant Ethernet I/O

Location: United Kingdom
Products Used:
- ioLogik E1500 EN 50155 compliant Ethernet I/O

Location: America
Products Used:
- ioLogik E1500 EN 50155 compliant Ethernet I/O

Location: Taiwan
Products Used:
- ioPAC 8020 series modular programmable controller

Location: China
Products Used:
- ioLogik 8500 modular programmable controller

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

In addition to the concern for the safety of the passengers, the high financial and reputational costs of 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 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 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 to fit in space-limited cabinets
- More accurate data to facilitate faster and 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

Support IEC 61131-3 and C/C++ programming language

Moxa's programmable controllers support railway standard IEC 61131-3 and C/C++ 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 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 8500 Series
Rugged modular programmable controllers

ioPAC 5542 Series
Rugged, compact 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.

Worldwide Deployment

Location: Poland
Products Used:
- ioPAC 8500 modular programmable controller

Location: Australia
Products Used:
- ioPAC 8020 modular programmable controller

Location: Taiwan
Products Used:
- ioPAC 8500 modular programmable controller

Location: China
Products Used:
- ioPAC 8500 modular programmable controller

Location: The Netherlands
Product Used:
- ioPAC 8500 modular programmable controller

Your Trusted Partner in Automation

Moxa is a leading provider of industrial networking, computing, and automation solutions for enabling the Industrial Internet of Things. 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 industrial communications infrastructures.

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