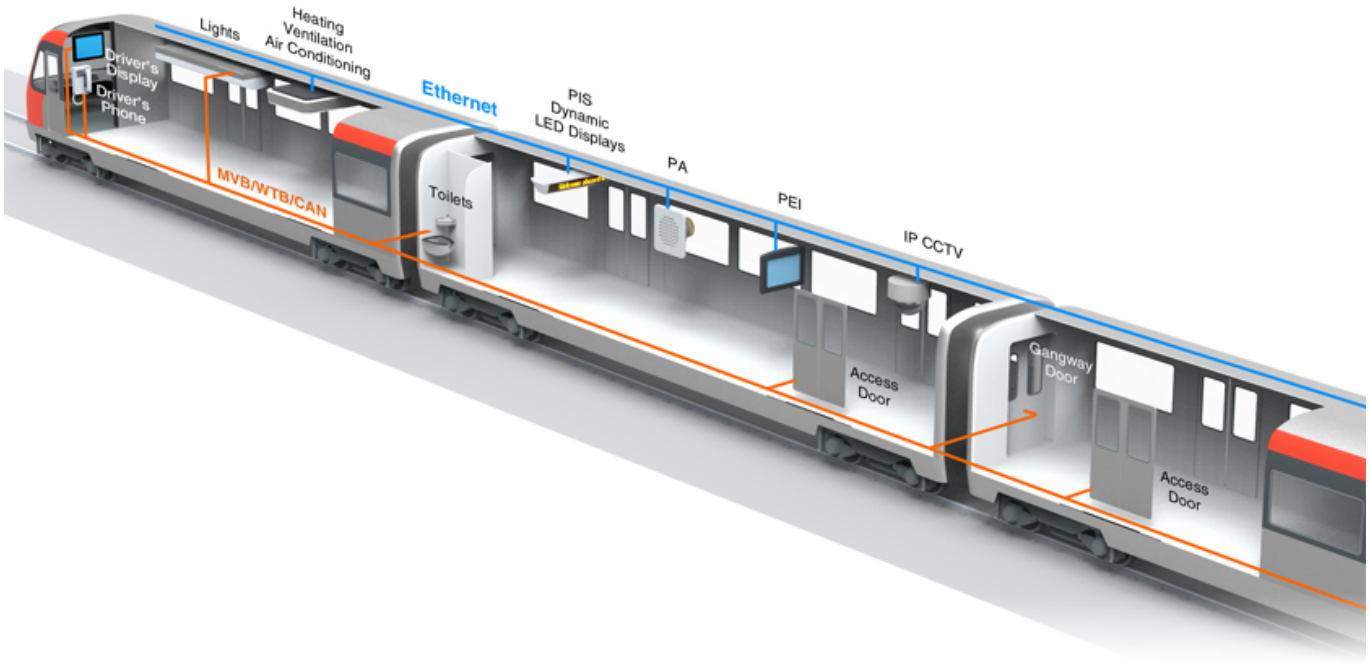
# Refurbishment

## Change is Easy with New Technology to Upgrade Rolling Stock



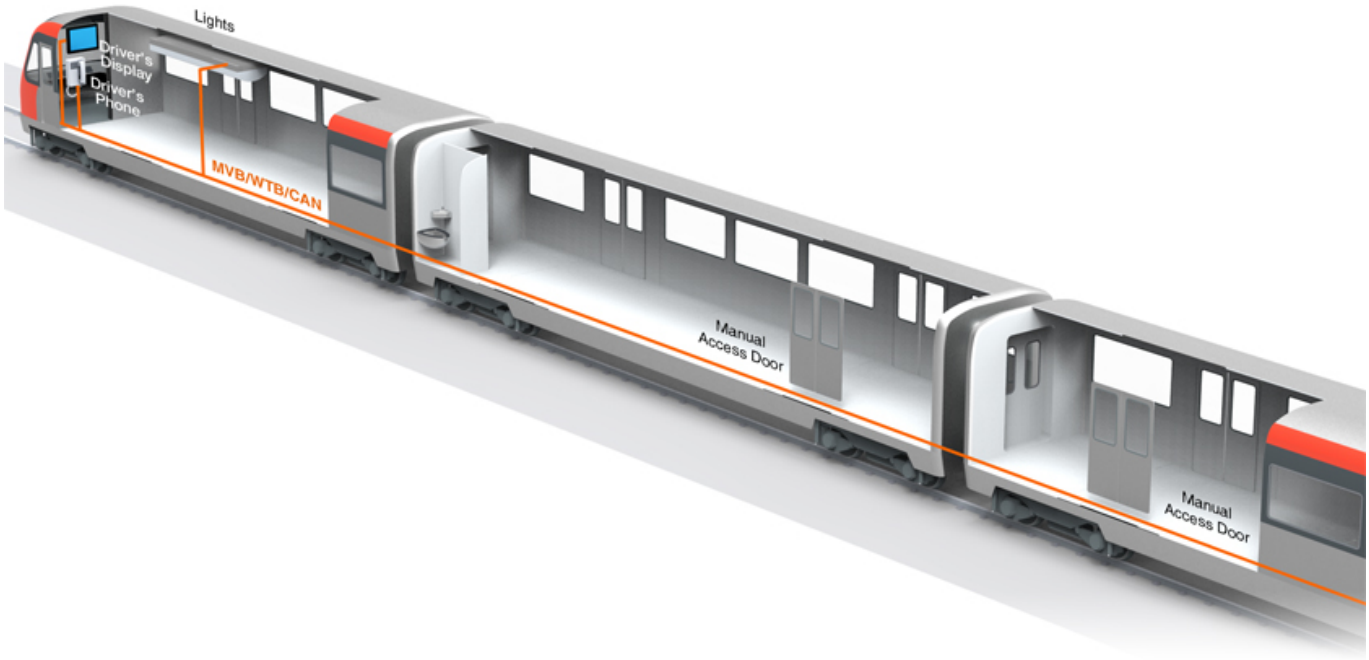

Refurbishing older trains is challenging for several reasons. The Moxa ioPAC 8600 series onboard programmable controller and MAR-2000 series train-to-ground gateway are designed to be ?all-in-one? solutions in a compact platform/device. The onboard ioPAC 8600?s unique 2-wire Ethernet technology allows system integrators to deploy Ethernet IP networks on an existing 2-wire architecture to support the 100 Mbps network currently available on refurbished trains. The MAR-2000 uses bi-directional NATs (network address translation) to facilitate train-to-ground communications. All of these smart functions ease your way to upgrade the old railway communications systems.

### Challenges in Refurbishment

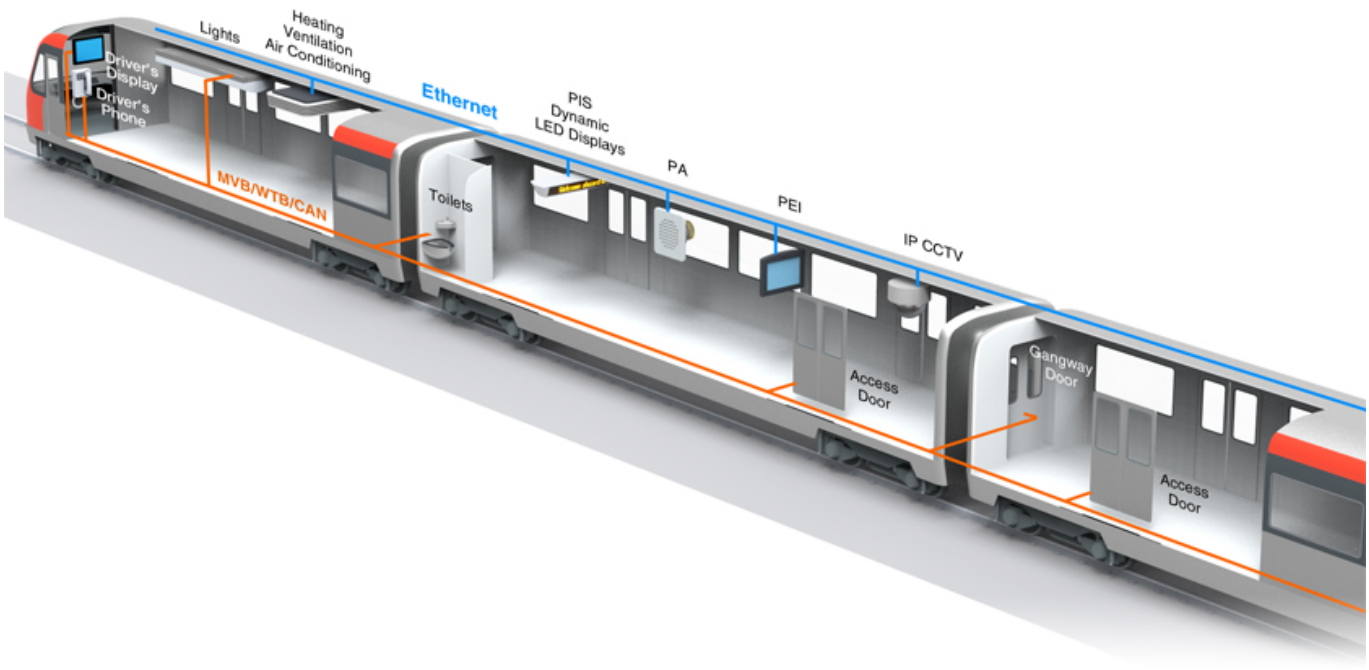
- Not enough installation space
- Limited number of coupler poles
- Limited communications bandwidth
- Lack of knowledge of new technology

- Interoperability with existing systems

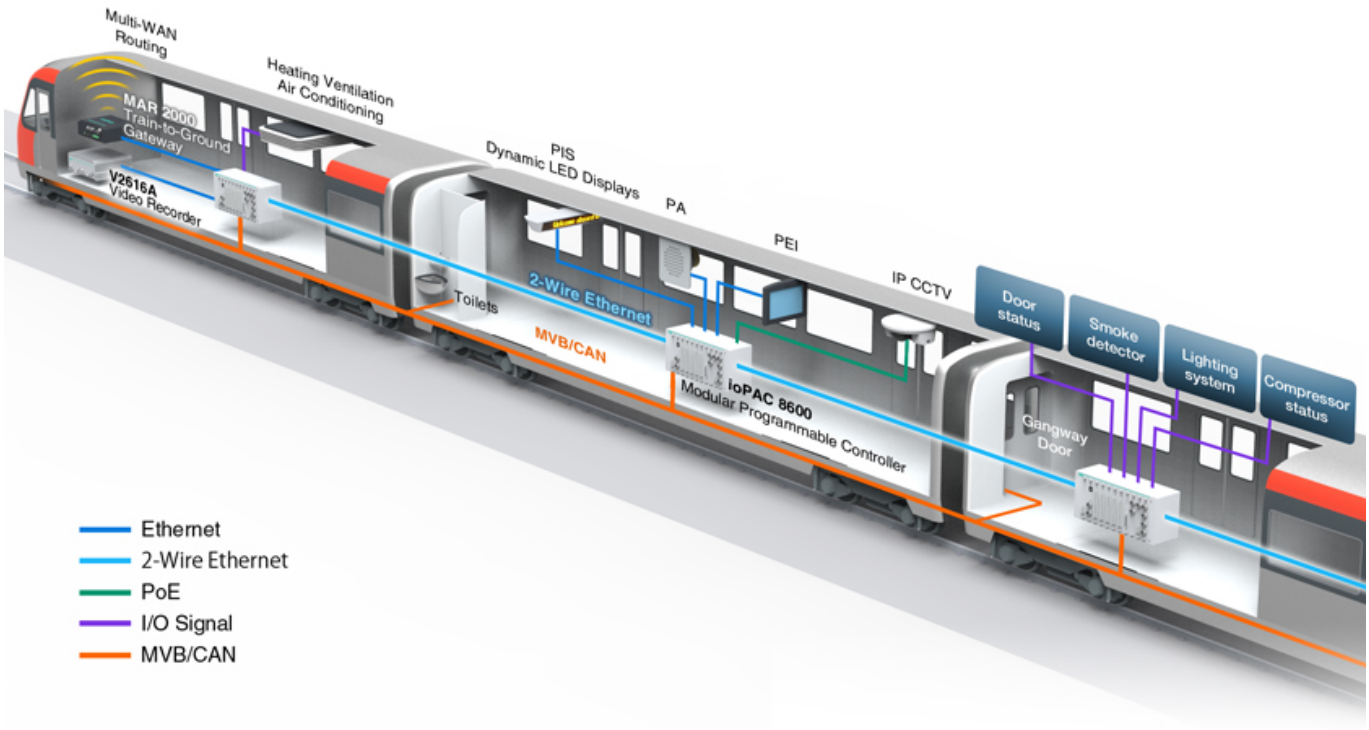
## Trains Yesterday?




## Trains Today?



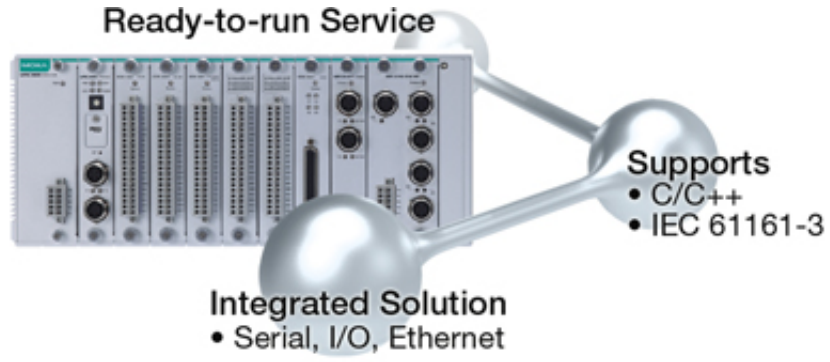

## Adding New Technology to Optimize Old Rolling Stock




## *Modular Programmable Controller*

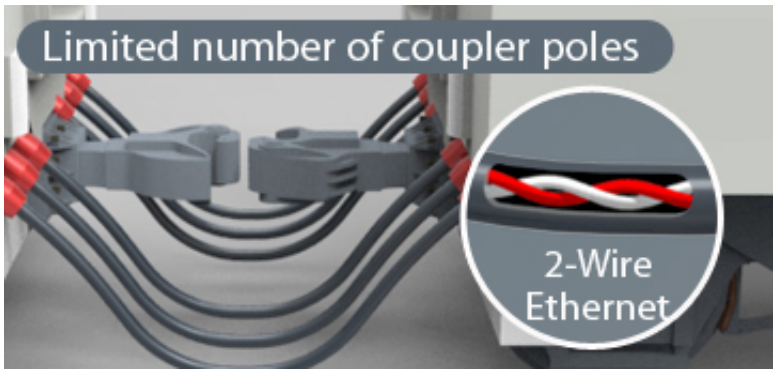
## Integrated Control and Management Platform

The ioPAC programmable controller not only combines serial, I/O, and Ethernet interfaces into a single device, it also supports the C/C++ and IEC 61131-3 programming languages and ready-to-run services, including data logging and email alarms. Packing all of these great features into one device simplifies system development, reduces the amount of maintenance required, and improves service and network reliability.



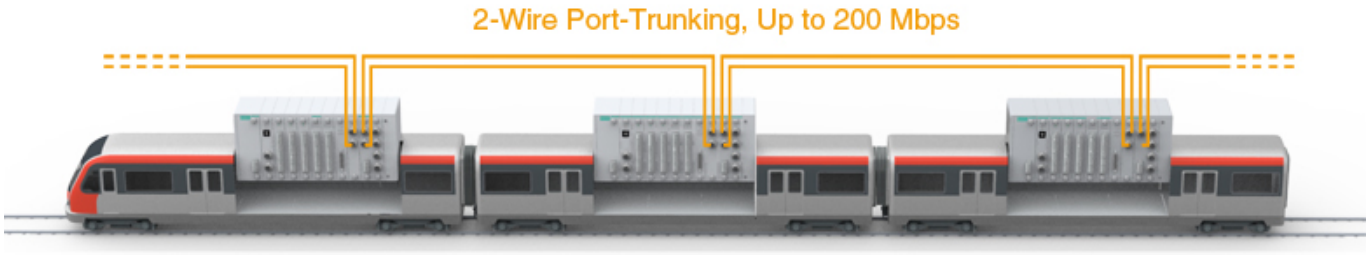
## 2-Wire Ethernet Reaches up to 100 Mbps

A refurbished train may only have a limited number of coupler poles. The Moxa ioPAC 8600?s unique 2-wire Ethernet technology allows system integrators to deploy Ethernet (IP networks) on existing 2-wire architecture to support the 100 Mbps network currently available on refurbished trains, thereby further reducing the cost and effort associated with other applications. Compared to VDSL (Very high bit rate DSL) technology, 2-wire Ethernet offers a reduced connection setup time. In general, it takes less than five seconds to set up the communication link.



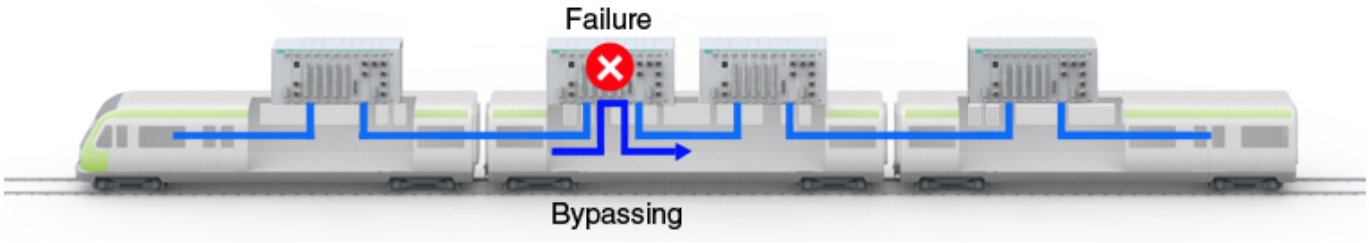

**Ethernet Over a Daisy-Chained 2-Wire Connection for 200 Mbps Ethernet Backbone**

With two 2-wire Ethernet modules on one ioPAC controller unit, the ioPAC 8600?s port trunking feature allows devices to communicate by aggregating up to 2 trunk groups, with the potential bandwidth of the connection reaching 200 Mbps. This gives you more flexibility in setting up your network connections, since the bandwidth of a link can be doubled.



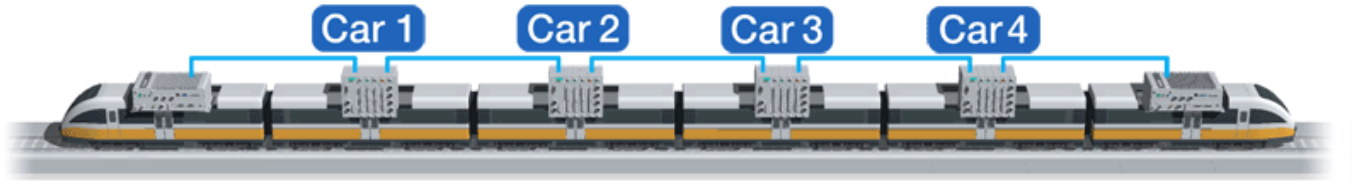

**Bypass Relay Function in Linear Topology**

In a linear topology, a failure in any of the upstream links will result in the failure of the downstream links as well. For railway communication systems with interconnected networks, such a failure will cause chaos. To prevent such failures, Moxa´s ioPAC 8600 series provides bypass relay functionality. If one of the Ethernet modules fails due to power loss, its ports are bypassed with the relay circuit, and the transmission lines will interconnect automatically to ensure continuous system operation.



## Efficient Automatic Carriage Sequencing (ACS)

Older train systems run on a daisy-chain network topology based on either CANbus or RS-485. When it comes time to switch to an IP-based network on the refurbished train, duplicating the automatic carriage sequencing function is not easy to do. Moxa gets around this challenge by building support for ACS functions directly into the new IP network, greatly reducing the effort required by the system integrator.



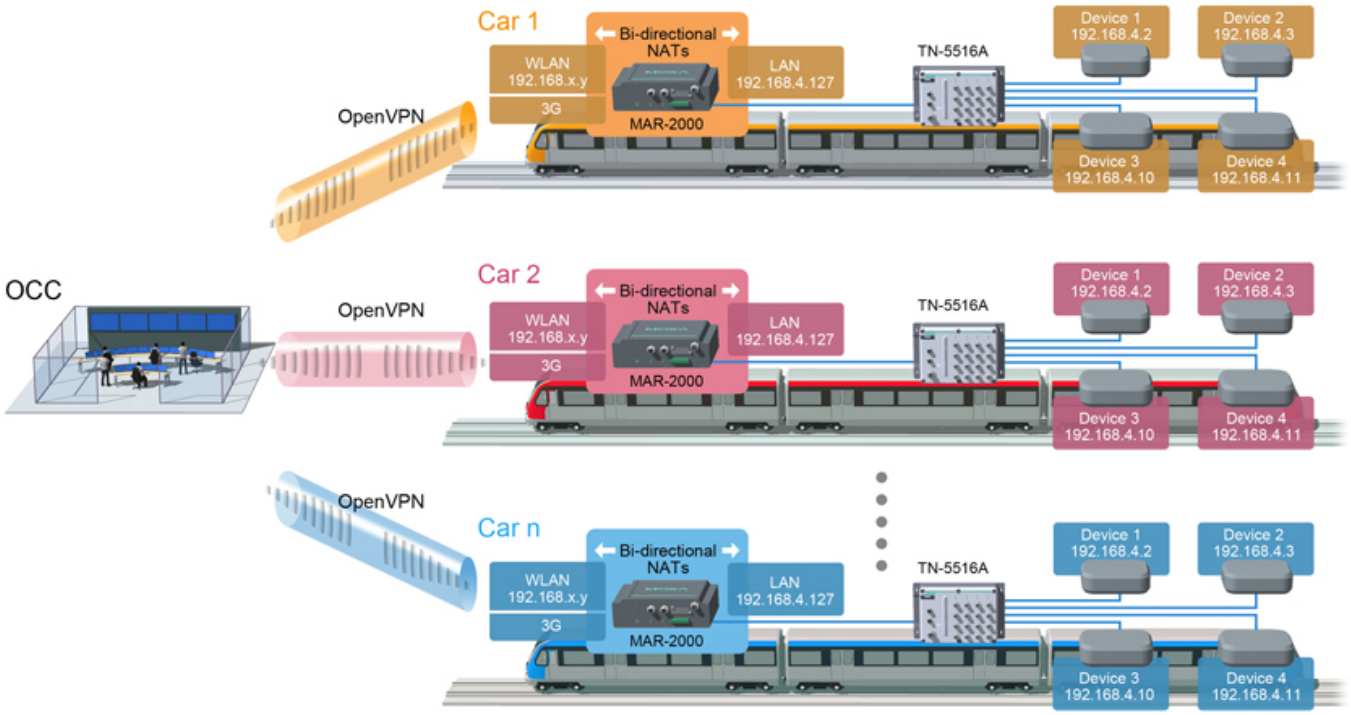

## Train-to-Ground Gateway

Enhancing train-to-ground communications for refurbished rolling stock is a must for improving passenger comfort and security. For space-constrained refurbished trains, the Moxa MAR-2000 offers a compact, EN 50155 compliant, bi-directional train-to-ground gateway, equipped with multi-WAN connectivity solutions that make refurbishing easy and reliable.

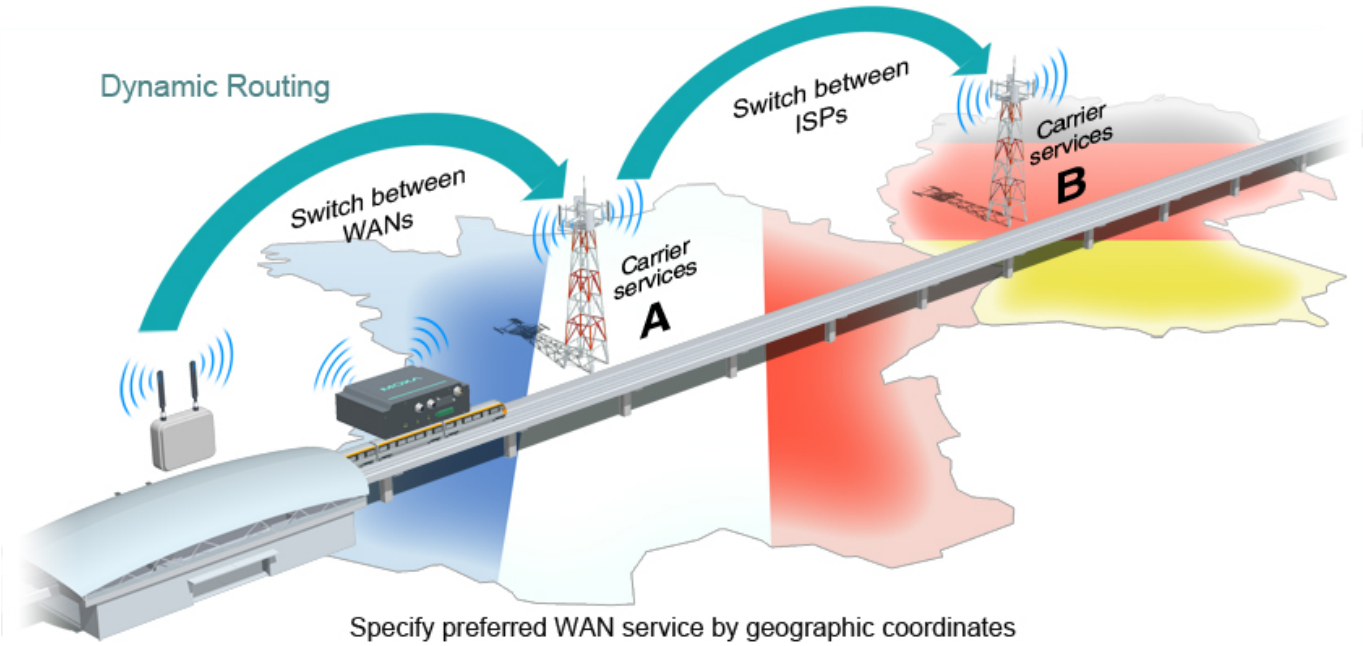
## 3-in-1 Router/Computer/Modem that Costs Less and Requires Less Space

- High bandwidth for train-to-ground bi-direction communication
- Automatically switches between the best wireless connection by the defined switching policies
- A programmable platform and also customer can embed their own debian-ARM program into MAR-2000

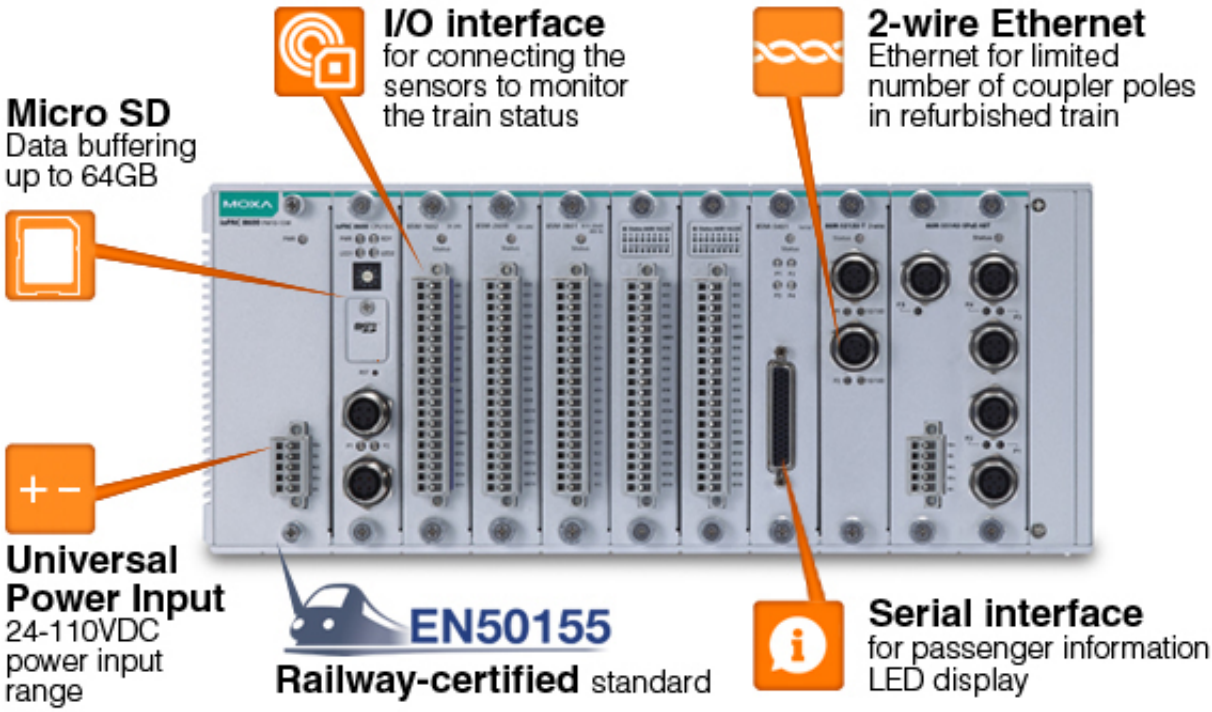
## Train-to-Ground Bi-Directional Communications




## Simple Trans-Regional Multi-WAN Connectivity




## Modular Programmable Controller




## Designed for Global Railway Standards

- 24V-110VDc full range isolated power input module
- Modularized design with 15W/50W power module
- 24-110V and ch-ch isolated DI/O
- C/C++ and IEC 61131-3 programming
- Multiple communication interface in a compact housing: 2-wire and PoE unmanaged switch

**Train-to-Ground Gateway**

**Simple and Programmable Platform**

- A simple configuration Web UI
- Easy for customer embedding their new developed Debian-ARM program