Five Key Requirements of Railway Trackside Backbone Networks

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

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

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

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

Vital and Non-Vital Network Segregation

TCP/IP is very widely used, so most of the railway mainline communications systems now share the same network "cloud" to communicate. This convergence is very convenient for system builders and operators, but does pose a potential risk: that auxiliary data (such as diagnosis data) may interfere in the transmission of core data (such as signal and interlocking data).

Unless the core network and the auxiliary network are physically separated, railway communication networks need a solution that will avoid any potential interference of the transmission of critical data. For example, railway operations would grind to a halt if a virus infection and broadcast storm were to shut down all of the communications on the network.

VLANs (Virtual LAN) are a solution that can segregate core from auxiliary data and protect vulnerable network devices from attack. However, even when the network is segregated by VLAN—indeed, even if the network is physically separated—communications between the core network and the auxiliary network is still inevitable. Therefore, layer 3 switches, or even a gateway or router, must be used in the network.

The Moxa Featured Solution: PT-7000 series industrial Ethernet switches, ICS series industrial Ethernet switches

Moxa PT-7000 series, including the PT-7728 and PT-7828, are switches specially designed for wayside applications. The PT-7000 series includes EN-50121 compliance and wide temperature features. The PT-7828 Layer 3 Ethernet Switch is especially useful for segregating larger networks. For even larger and more sophisticated networks, the ICS-G7848 and G7826/7828 provide up to 48 ports with advanced Layer 3 networking and extremely high gigabit bandwidth.

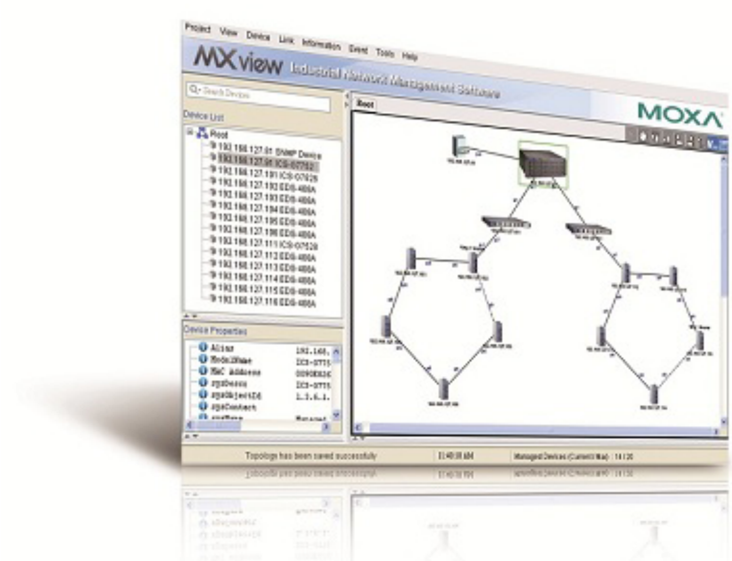
User-Friendly Network Management

Network Management Software (NMS) is important for managing and monitoring network devices. A train communication network will include Ethernet switches, terminal servers and other network devices such as interlocking controllers.

It is important to remember that an NMS used in a railway mainline network has very different requirements than one used in an office network. Railway operators expect the following features:

- More visualized user interface that display physical or pseudo links and POE
- Automatic topology discovery via LLDP
- Real-time link status & traffic statistics Real-time alarm via SNMP Trap or SNMP Inform
- Network reporting functions Support for large networks (2000 nodes)
- Displays a diverse range of devices used in railway networks (through MIB compiler)

Moxa Featured Solution: MXview industrial NMS



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

Reliable and Self-Healing Fibre Links

Optical fibber is very affordable and widely used in todays networks, and is particularly suited for long-distance communications scenarios, such as mainline signalling and control networks. The depots and stations of a mainline transportation grid typically cover a wide physical area; the distance between two depots could be anything from a hundred meters to many kilometres. Consequently, it is very important to have a variety of multi-mode, single-mode, and long-haul design fibber available.

IEEE 802.1D/w STP/RSTP was originally designed to avoid network loops, but it has the incidental benefit of providing network recovery and self-healing if any one link or node fails in the network. However, IEEE 802.1 D/W has a major disadvantage: convergence time. As more nodes (Ethernet switches or hubs) are added to the network, convergence (or recovery) time grows exponentially. This is not a huge defect for office networks, where there are comparatively few nodes, and each node covers many network devices. But a railway mainline communications network is just the opposite—there are many network nodes, and each node only covers a few devices. What's more, convergence time is even more important for signalling and control communications than it would be in an office network; mainline communications networks need to recover from node or link failures quickly to re-establish critical transmission of signalling and control data.

Moxa Turbo Ring™ is a proprietary enhanced ring network technology that excels in mainline signalling and control communications because it delivers excellent convergence time on large-scale networks. Even in a large network of up to 250 nodes, network recovery can be achieved within 20 ms.

Moxa Featured Solutions: Turbo Ring, PT-7000, IKS-6000, EDS-400A, 500A, 600 series Ethernet switches, IMC-101, and PTC-101 series media converters

The Moxa portfolio of Ethernet switches includes the rackmount PT-7000, IKS-6000 series, and the DIN-rail-mounted EDS-400A, 500A, and 600 series. These not only support Turbo Ring and Turbo Chain redundancy technology, they also come with reliable industrial designs that overcome the severe environments at railway remote sites. The Ethernet switches have a wide operating temperature range of -40 to 75/85°C and high EMC/EMI resistance.

Moxa also offers optical fibre-to-Ethernet converters, the IMC-101 and PTC-101 series, which are excellent partners for the Ethernet switches.

Resilient and Flexible Network Expansion

Once a network finally meets all the other requirements of railway operations, it can become difficult to expand without severe disruption. This is particularly true because railway networks often need to maintain network redundancy, even in large-scale deployments. In these circumstances, fibre cabling is always a major cost, as is the complexity of the network topology.

Moxa Turbo Chain technology is an evolution of Turbo Ring which provides a complementary solution that can easily create network expansions which seamlessly integrate and interoperate with any existing network without compromising redundancy. Turbo Chain works with any network architecture, such as a SONET/SDH telecom network or the RSTP/STP networks that are common in Operation Control Centre (OCC) and larger yards.

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

Where it is not possible to install fibre, it is still possible to extend the range of an Ethernet network by using DSL technology and existing copper wiring. This removes the need to deploy costly fibre infrastructure, and still allows the Ethernet network to communicate over long distances.

Connectivity with Legacy Devices

Even as railway networks embrace new, more reliable, and more convenient communications technologies, operators still need to connect with legacy devices such as interlocking controllers, axle counters, and switchable balises. These devices typically use a RS232 or RS422/485 communications interface, either for configuration, diagnosis, or data transmission purposes.

Terminal servers are invaluable for connecting these legacy serial devices to TCP/IP networks. For networks that do not use TCP/IP, traditional serial-to-serial equipment-to-equipment communication and conversion is still very useful in signalling and control applications. In fact, by using serial-to-fibre converters, it's easy to extend serial communications over long distances.

Moxa Featured Solutions: NPort IA5000AI series, NPort S8000 series

Moxa NPort IA5000AI series include 1, 2, or 4 isolated serial ports. Wide temperature (-40 to 75°C) models are available for severe operating environments. The NPort 5650I-8-DT is the 8-port option (wide temperature model is also available).

The NPort S8000 series is a specially designed terminal server with 4 isolated serial ports, and 2 fibber ports. As a terminal server it has all of the managed features of Moxa Ethernet switches, such as Turbo Ring, Turbo Chain, LLDP, and VLAN.