BELDEN | ◇ OTN Systems

XTran for Railways:
A safe, smart and smooth ride

XTran: MPLS for Operational Telecom made easy

- Tailored for industrial applications

- Intuitive and simple

- Reliable operations in harsh environments

"More than 85 transport authorities around the world currently rely on OTN Systems for their operational communications.

Real-world implementations have been running continuously for over 15 years. Because of its operational simplicity, the network can be maintained with limited efforts and costs."

Mission-critical networks
for railways

Railways are becoming increasingly important as traffic jams grow longer and the environment gets more polluted. Governments are stimulating people to use public transport as much as possible. But are the railways an attractive alternative? The current service level can certainly be improved. Passengers expect the trains to be on time. They would also like to enjoy free Wi-Fi access on board as well as infotainment services. Railway operators need to improve the rail passenger experience significantly to attract more customers.

For train passengers, it should be a given that taking the train is safe and secure.

Unfortunately, many railway organizations hardly make any profit. They are constantly looking to cut costs and speed up the automation process. That's why investing in a network that improves the passenger experience while enabling railway authorities to further automate their processes, is probably a smart thing to do.

The communication needs of a modern railway organization are vast. The network needs to connect stations, control centers, trackside equipment, manned and unmanned stations, signal boxes and traction substations. With the increasing degree of train automation, security measures and passenger services, the network becomes even more critical.

To cater for the needs of railway organizations, OTN Systems has developed the XTran (eXcellence in TRANsport) product line. **With XTran, modern railway operators are ready to face the future.**

A complex environment

National railway operators have multiple applications that all need communication: some between control centers and stations, others go as deep as the trackside level. All these applications can be classified in three groups (see figure below).

- **Signaling**: The most important application in a railway environment is signaling, also referred to as interlocking. This application makes sure that trains run on the right track. Modern interlockings are electronic, but there are still plenty of electrical and electro-mechanical variants in operation. The ERTMS system (European Rail Traffic Management System) aims to enhance safety, increase efficiency of trains and enhance cross-border interoperability of rail transport.

- **Operations**: At the operations level we classify all applications that are necessary to keep public transport running properly. It includes all subsystems to electrify the overhead lines and all vital information systems for passengers.

- **Support**: At the support level we classify the applications which enhance operations, covering electronic ticketing, CCTV for improved security and access control.

The infrastructure is continuously evolving but the legacy is enormous.
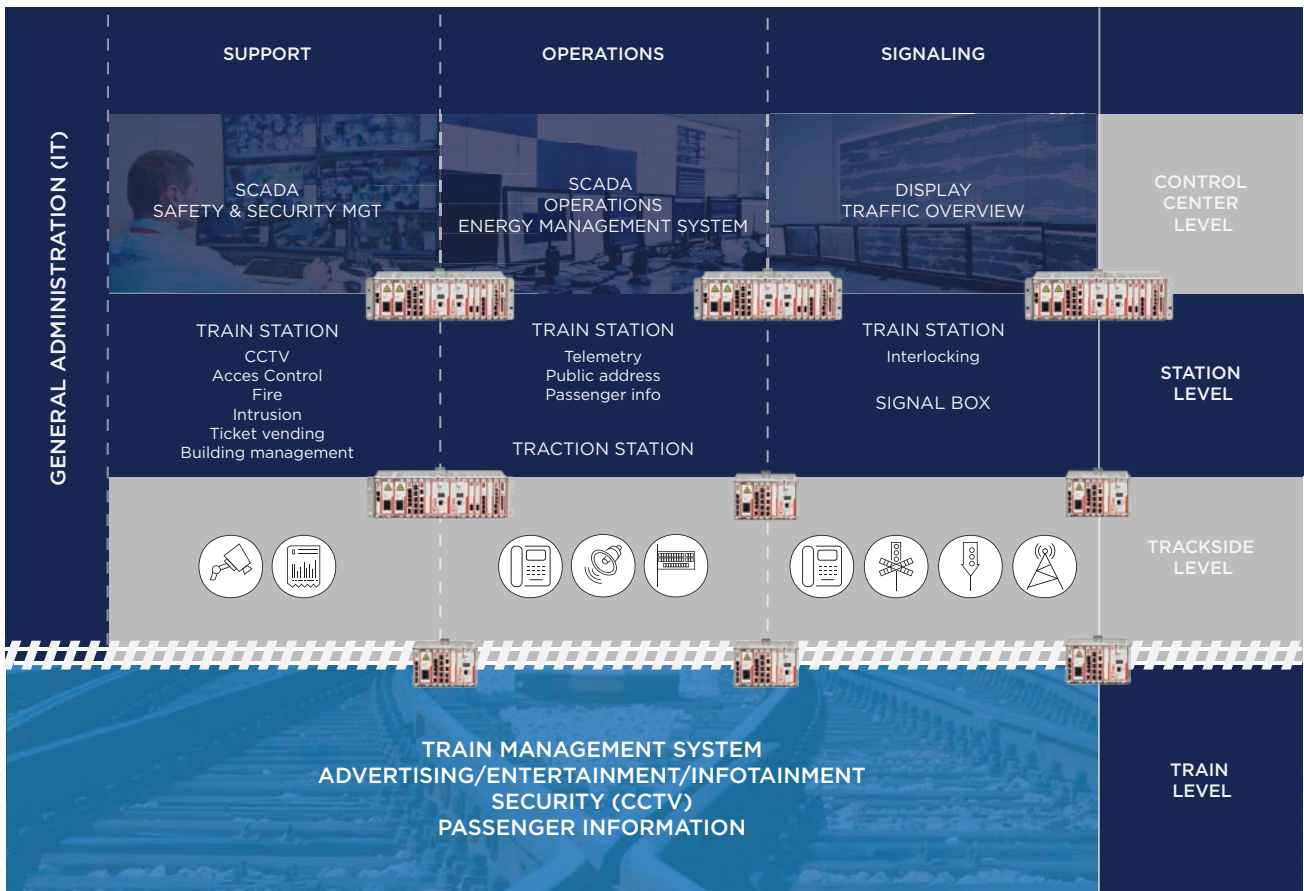
The network is key

The network is a vital cornerstone of the infrastructure and needs to support the complete range of applications. SDH/SONET technology has always been the workhorse to interconnect the different sites. However, virtually all applications are moving towards IP/Ethernet and demand for bandwidth is increasing. This forces railway operators to look at different technologies which seamlessly blend with the current infrastructure while offering a solution to cope with future demands.

The network requirements

The high-level requirements of railway operators for networking equipment can be summarized as follows:

- **High availability:** the network carries mission-critical data. Without the network, proper train operations become impossible.

- **Connectivity:** is considered most important. At the access level all types of peripheral equipment need to be connected to the network. Legacy interfaces are a must.

- **Quality of Service:** the network has to transport specific applications in real time. Delay, jitter and synchronization are important parameters that the network should cater for.

- **Security:** the network should be protected from eavesdropping and hacking.

- **Compatibility:** the network should be able to work with the existing telecom infrastructure. Railway organization use migration scenarios, they simply cannot replace significant parts of their equipment overnight.

- **Built-in redundancy:** the MTBF of the network nodes needs to be high. Redundancy of the control cards and power supplies is a must. A "hot swap" of interface cards is mandatory. Fast reconfiguration in case of link failures is indispensable.

- **Simple and transparent network management:** all network components need to be managed from a single location, the NOC (Network Operations Centre), in an easy way.

- **Future-proof:** the network should be upgradeable as new hardware and software becomes available.

- **Environmentally friendly:** the equipment should be RoHS compliant, use limited energy, have a small footprint and minimum heat dissipation.

- **Ruggedized:** as the equipment is sometimes installed along the track, the equipment should be able to withstand extreme environmental conditions.

The network needs to carry a multitude of services which all have different requirements.

Note that the network needs to carry a multitude of services which all have different requirements of their own. They differ in terms of required bandwidth, QoS, availability and security. The new communications infrastructure should be able to handle all this effectively.

More specific network requirements of the railways

- Compliant with EN50121-4

- High availability configurations

- Low transmission delays

- Synchronization options like SyncE and 1588v2

- Flexible power options

- Industrial design and fanless operation

- Extended temperature range -20 °C up to +65 °C

MPLS-TP: the right networking technology?

For the last twenty years, railway organizations have mainly been building their mission-critical networks with SDH/SONET gear. This technology suited them well because it fulfilled their main requirements. For the timing sensitive applications, the technology has proven to have very short and predictable transmission delays, which is an absolute "must have" for railways. To obtain high availability, SDH/SONET offers unique features like 1/1 protection and sub-50ms reconfiguration in case of link failures. Again, perfect for a railway environment. One of the major difficulties is the management system as it is often cumbersome.

Carriers started to replace their legacy SDH/SONET technology by packet technology years ago due to the spectacular increase of packet data. As SDH/SONET is on the decline, no new products are being released and shipments are mainly for extensions of existing networks. As a result, a future-proof network for railway operators can only be packet based. This statement is confirmed by the fact that the typical railway applications are also moving towards packet data. For example, the GSM-R equipment, which traditionally came with E1 interfaces, is now offering Fast Ethernet connectivity. The successor of GSM-R, FRMCS (Future Railway Mobile Communication System) to be introduced as of 2025, is entirely packet based.

Various packet transport technologies have emerged to replace the traditional SDH/SONET: MPLS, carrier Ethernet and more recently, MPLS-TP (Multiprotocol Label Switching - Transport Profile).

MPLS was introduced at the beginning of the century and has been embraced by many carriers. Work on the MPLS-TP standard began in 2008.

XTran

MPLS-TP comes with extra functionality to support mission-critical transport of information.

MPLS-TP uses the main functionalities of MPLS but comes with extra features to support mission-critical transport of information. The standard is drafted in a cooperation between the ITU-T (International Telecommunication Union) and the IETF (Internet Engineering Task Force). To name some of the benefits of MPLS-TP compared to MPLS:

• Deterministic character and improved network predictability:

  » Some MPLS features such as PHP, ECMP, LSP Merge were removed in order to improve network predictability.

  » Bi-directional MPLS-TP tunnels use the same path (congruent paths). This assures that delays are always symmetrical and that fault tracing is made easy.

• Predefined back-up paths can easily be set up to cope with fault conditions (< 50 ms switchover) in order to improve network resilience.

• Improved OAM (Operations, Administration and Maintenance): for better fault and performance management and improved network visibility.

It's obvious that MPLS-TP is the ideal packet technology for the railway operator. One can consider it as the packet alternative to "good old SDH/SONET". It goes without saying that the technology is better suited for the ever increasing amount of packet data. It's remarkable that, despite being a packet-based technology, it offers the same functionality in terms of network resilience and predictability as SDH/SONET. Moreover, MPLS-TP offers unique features making the network operator's life less complex.

MPLS-TP offers unique features making the network operator's life less complex.

XTran: eXcellence in TRANsport

An XTran network consists of nodes, interconnected by copper or fiber, and a management system called TXCare. A variety of node types is available providing the ideal solution for each location. All nodes are hardened, ideal for trackside applications. The network is perfectly scalable from tens of nodes to thousands of nodes. Cost-effective SHDSL modules are available to reach the furthest outskirts of a territory. Any topology can be constructed with the XTran portfolio. On the WAN side, 1Gbps Ethernet, 10Gbps, 40Gbps and 100Gbps interfaces are available.

XTran comes with an unprecedented suite of interface cards for legacy equipment, including the popular analogue circuits for operational telephony, as well as state of the art Ethernet/PoE.

One can create various types of logical tunnels between the nodes: point-to-point, multipoint and logical rings. Creating back-up paths is only a mouse click away.

Predictability is key in railway networks. With XTran, in conjunction with TXCare, one is able to configure the delay, wander and jitter of each individual connection. In this way, timing sensitive railway applications will work flawlessly over an XTran network.

Redundancy is key in order to maximize network availability. Common control, switching fabric, network synchronization, uplinks, MPLS tunnels, pseudowires and power modules can all be duplicated. The hardware is hot-swappable. Obviously, this results in spectacular MTBF figures for network availability.

XTran comes with a unique set of features

- Hitless switching on circuit emulation. Not a single bit of information will get lost in case of a failure of the prime route.

- 802.1x, Radius Authentication, Access Control Lists and wire speed encryption of the links between the nodes.

- Fanless design.

- OAM according to Y.1731 and BFD providing in service monitoring.

- Sub-50 ms protection switching for any network topology.

- EN50121-4 compliance.

- Layer 3 routing for increased flexibility.

Network management is king

With TXCare, OTN Systems follows the SDN (Software Defined Networks) philosophy. A network is as clever as its network management system. TXCare offers end-to-end service performance monitoring, element management and full network management. Failures in the network are detected instantaneously, diagnosed and repaired. Most importantly, TXCare is extremely **intuitive and user friendly.** It takes only a few days of training to turn a network novice into a TXCare expert having full control over the XTran network.

TXCare allows the network engineers to configure the network entirely off-line. In this way all bottlenecks can be verified in advance and surprises during the network roll-out are avoided.

A variety of XTran node types
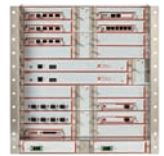
Model	XTD-2110-A	XTR-2124-A(F)	XT-1104-A	XT-2206-A	XT-2209-A	XT-2210-A	XT-2215-A
Hardware							
Redundant PSU	✓	✓	–	✓	✓	✓	✓
Redundant CSM	–	–	–	✓	✓	✓	✓
Din rail mountable	✓	–	✓	–	–	–	–
Fan-less	✓	✓	✓	✓	✓	✓	–
Modular slots	–	–	4	6	9	10	15
Connectivity							
Ethernet (CU, F, PoE)	✓	✓	✓	✓	✓	✓	✓
Sector interfaces	2 serial	2 serial	✓	✓	✓	✓	✓
L3 Routing	✓	✓	✓	✓	✓	✓	✓
Speed							
Max WAN Speed	10G	10G	10G	10G	10G	10G	100G
Management							
TXCare	✓	✓	✓	✓	✓	✓	✓
SD Card	✓	✓	✓	✓	✓	✓	✓

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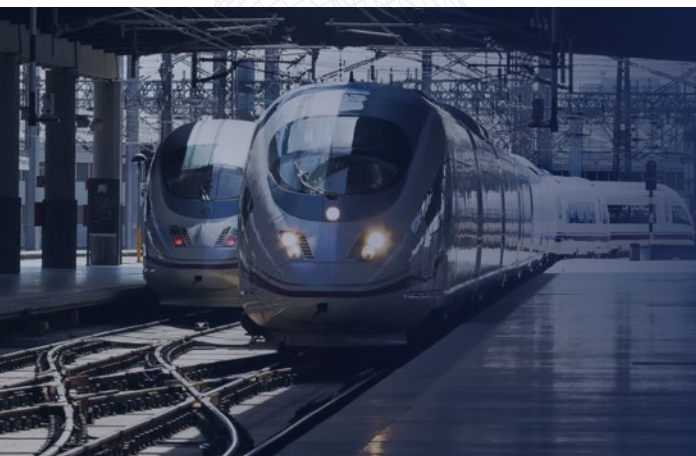
Tailored for industrial applications

- Built on MPLS-TP standard

- Sector specific capabilities

- Future-proof

Intuitive and simple

- NMS made easy

- Fast diagnostics

- Seamless support for legacy

Reliable operations in harsh environments

- Optimized network security

- Unmatched network resilience

- Rugged industrial design

Railways and XTran: the perfect fit!

The XTran product is the result of an in-depth focus on the requirements of the railways combined with the latest available technologies in the ICT world. XTran allows end-users to migrate all their applications on a single network, without compromises, whenever they feel the time is right. Many railways still feel reluctant to implement their timing sensitive services on packet-based networks. With XTran there's no longer the need to.

IoT, infotainment, smart maintenance, FRMCS,...: XTran is ready to handle the future!

No doubt, the fit is perfect.

ABOUT OTN SYSTEMS

OTN Systems develops mission-critical networks for specific industrial markets. The company is the designer and supplier of the XTran (eXcellence in TRANsport) product line.

By working closely with numerous customers over 30 years, OTN Systems has acquired the necessary expertise to come up with perfect networking solutions. The company is headquartered in Olen in Belgium and has offices all over the world. From these regional offices the local partners and customers are supported. With its unique portfolio and more than 500 satisfied customers in 75 countries, OTN Systems promises you peace of mind when it comes to mission critical networking.

We are committed to getting your information across.

OTN Systems became part of the Belden group in January 2021. Belden connects and protects organizations worldwide with the industry's most complete suite of end-to-end networking solutions.

OTN Systems

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