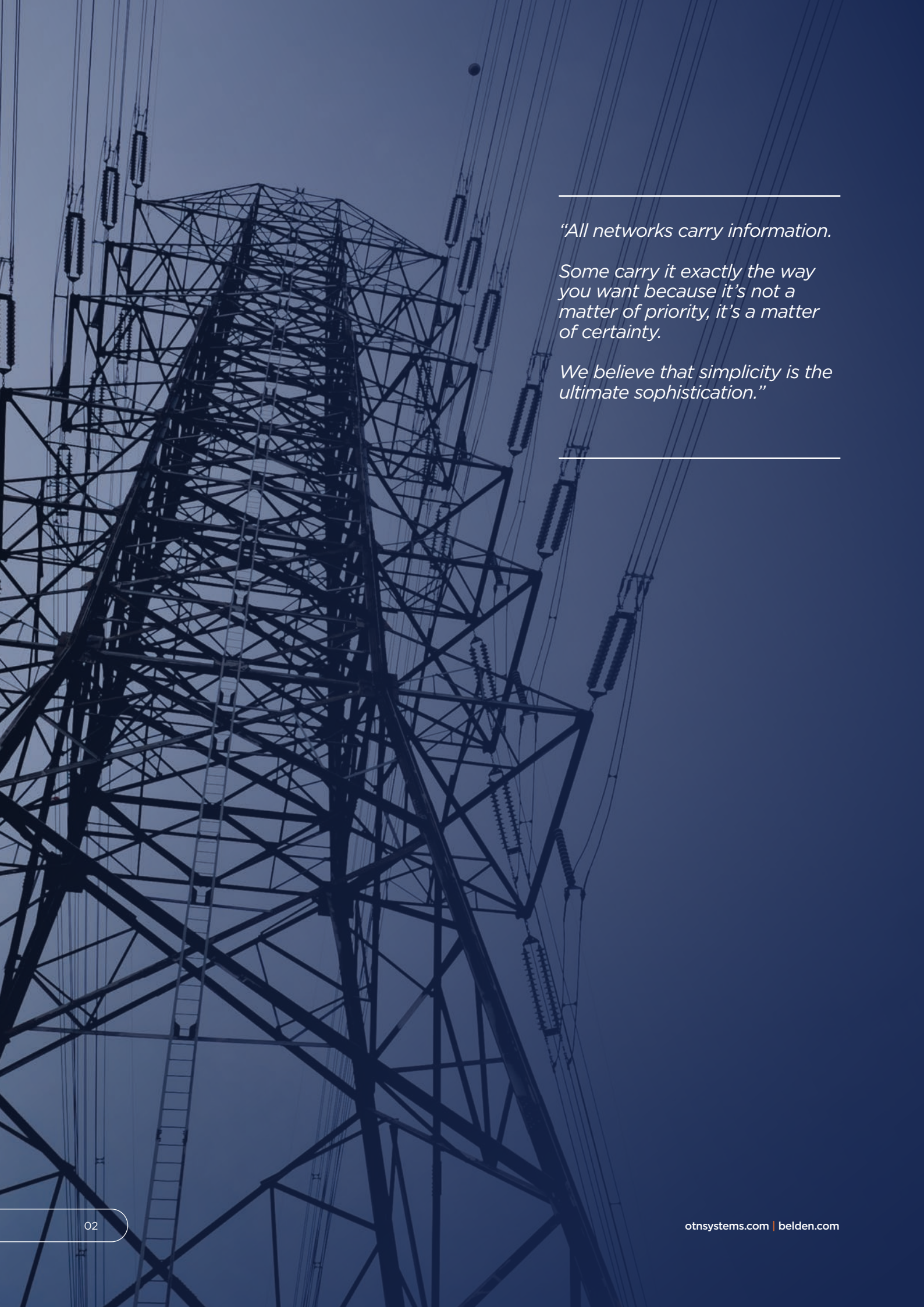
BELDEN | OTN Systems

XTran: Empowering the Grid

XTran: MPLS for Operational Telecom made easy

- Tailored for industrial applications
- Intuitive and simple
- Reliable operations in harsh environments



"All networks carry information.

Some carry it exactly the way you want because it's not a matter of priority, it's a matter of certainty.

We believe that simplicity is the ultimate sophistication."

Mission-critical networks for the power utilities

Building mission critical networks has always been the challenge to address for OTN Systems. During the early nineties, the company started to introduce innovative networking products tailored for specific vertical markets. By keeping a constant focus on the key requirements of its customers, the company gained market leadership in various industrial markets like transportation, oil & gas, and power.

With the latest product family called XTran (eXcellence in TRANsport), the company is again at the forefront of technology. XTran uses **cutting edge packet technology** and was designed from day one with the requirements of the power utilities in mind.

The result is stunning.

In search of the right network solution

Telecommunication needs for power utilities differ to a great extent from the requirements encountered in a carrier or an enterprise environment. Carriers want to sell telecom services, while optimizing business processes is key in the enterprise world. Utility companies however have a different challenge as they need to deliver power to their customers, in an efficient way, **100% guaranteed**. A reliable telecommunication network is an important building block to achieve this.

Maximizing the lifetime of legacy equipment

Utility companies have built up their power grids over many decades. The lifecycle of the grid components is long. Step up transformers, protection relays or circuit breakers may well be in place for 30 years and are still running fine. Needless to say that the network needs to handle all this **legacy equipment** for quite some time.

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Operational simplicity as a prerequisite

Most of the power utility personnel are engineers with multidisciplinary skills and know-how. As everything is interconnected, they need to have a thorough understanding of multiple technical aspects of the grid's operations. The same is true for the staff in charge of the operational telecom network. They need to understand all applications supporting the grid like SCADA, protection, energy management and the impact of the operational telecom on these critical applications. Hence, they should be relieved from having to handle a highly complex telecom infrastructure.

Therefore, the network must be **easy to manage** - making sure that all technical staff is supported effectively for their mission critical applications at all times.

One can't expect the protection engineer to handle a highly complex telecom infrastructure.

Zero impact of environmental conditions

Power substations do not look like telco rooms or data centers. Air-conditioning: probably not. Room temperatures: unpredictable. EMC/EMI: you bet! The electro-magnetic fields that are present in the substations are significant, especially when a short circuit occurs. In particular on this occasion the network plays a vital role. The network equipment needs to be **hardened** and needs to comply with the most demanding environmental standards like IEC 61850-3 and IEEE 1613.

When every bit matters...

In case the grid suffers from a short circuit, the affected part should be taken out of service in no time. Therefore, protection relays are installed at each end of the power transmission lines. These devices constantly monitor the current on the line and will detect any anomaly. For the grid to respond in time and in a correct manner, communication between these protection devices is of the utmost importance. This functionality is

often referred to as “teleprotection”. If an anomaly is validated, the protection relay will command a circuit breaker on the line to switch off. The fault is cleared properly if both circuit breakers at the end of the line are “tripped”, i.e. have put the line out of service. All this needs to happen in milliseconds. In the case of differential protection, the delay of the data transmission has to be constant and symmetrical.

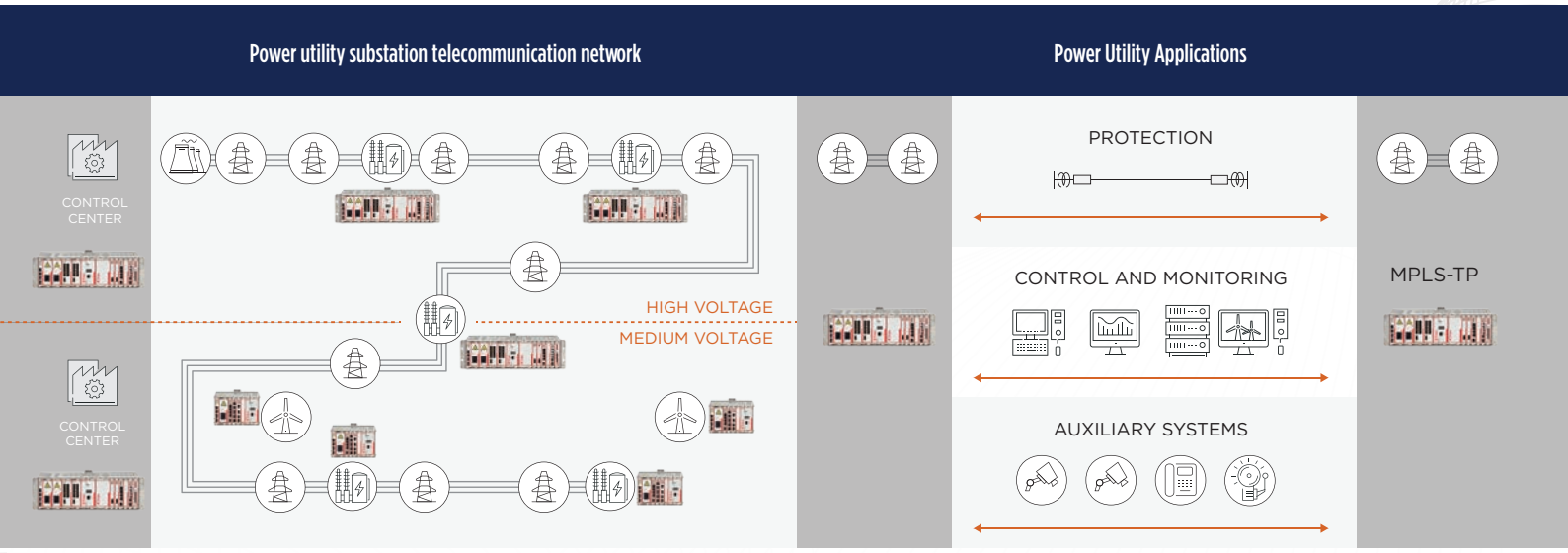
These applications result in some pretty stringent requirements in terms of **network performance.** If the fault isn’t cleared properly, chances are high that the fault propagates through the grid resulting in a black-out (**dependability**).

Protection applications result in some pretty stringent requirements in terms of network performance.

Also, false trip signals should be avoided by all means (**security**). Needless to say that the underlying telecommunication network needs to be highly reliable and secure.

Underpin the specifics of the industry

Power utilities have developed their own way of working. They managed to define telecom standards solely for utilities. For example the IEEE C37.94 was drafted to interconnect “teleprotection” data over fiber optic links. Another example is the IEEE standard 1588v2 which adopted a profile specifically for power utilities for time synchronization in the substations. Obviously, these **specifics** need to be supported by the network.



MPLS-TP: the right networking technology?

Until recently, power utilities built their networks with SDH/SONET gear. It matched the power industry's requirements in terms of bandwidth, predictability and availability.

Carriers started to replace their legacy SDH/SONET by packet technology years ago due to the spectacular increase in internet traffic. No new SDH/SONET products are being released and shipments are mainly for extensions of existing networks. As a result, a future-proof network for power utilities can only be packet based. This statement is confirmed by the fact that the utility world is now embracing packet based standards. For example IEC 61850, an international standard defining communication protocols for intelligent electronic devices at electrical substations, has been extended to inter-substation communication in IEC 61850-90-1.

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. The work on MPLS-TP was started in 2008.

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 cooperation between the ITU-T (International Telecommunication Union) and the IETF (Internet Engineering Task Force).

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

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) supporting better fault and performance management – further improving the operator's visibility on the network behavior.

It is obvious that MPLS-TP is the ideal packet technology for power utilities to deal with the ever increasing amount of data. One can consider it as the packet-alternative to "good old SDH/SONET". 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.

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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. The most compact one offers a handful of ports, is DIN-rail mountable and supports the full MPLS-TP protocol suite. The largest one is modular in design, supports layer 3 routing and is typically used in central locations. All nodes are substation hardened. The network is perfectly scalable from tens of nodes to potentially 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 a C37.94 board, as well as state of the art Ethernet/PoE interface boards.

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 power networks. With XTran, in conjunction with TXCare, one is able to configure the delay, wander and jitter of each individual connection. In this way, the utilities' protection scheme 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. This is extremely useful for eliminating "false trips" during automatic network reconfiguration.
- 802.1x, Radius Authentication, Access Control Lists and wire speed encryption of the links between the nodes to enhance security.
- Fanless design.
- OAM according to Y.1731 and BFD provides protection and performance management.
- Sub-50 ms protection switching for any network topology.
- IEEE 1613/IEC 61850-3 compliance.

Network management is king

With TXCare, OTN Systems largely 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 important, 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	✓	✓	✓	✓	✓	✓	✓

XTran: MPLS for Operational Telecom made easy

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

Power Utilities and XTran: the perfect fit?

The XTran product is the result of an in-depth focus on the requirements of the power utilities 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. Many utilities still feel reluctant to implement their protection schemes on packet based networks. With XTran there's no longer a need to:
XTran is ready to handle data streams coming from automation, protection and auxiliary systems.

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

Industrielaan 17b,
2250 Olen, Belgium

Tel: +32 14 25 28 47
E-mail: info@otnsystems.com
www.otnsystems.com

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