Engineering Solutions

MASTERS IN MISSION CRITICAL COMMUNICATIONS

XTran for LNG Ship-to-Shore Communications

OTN Systems
committed to get your information across

Liquefied Natural Gas (LNG) is a clear, odourless and non-toxic form of Methane cooled to approximately minus 160 degrees Celsius. By cooling the Methane, it's volume is compressed 600 times allowing the liquefied gas to be economically stored and shipped across the globe. Given it's status as the cleanest fossil fuel, the demand for LNG has more than quadrupled over the last two decades.

However, despite the tens of billions of dollars being invested into the industry each year, most LNG operators still rely on relatively primitive technology, developed during the 1980s, for their critical ship-to-shore communications. The existing design introduces a number of limitations including limited bandwidths, reliability concerns and tanker loading delays.

OTN Systems in conjunction with Engineerin Solutions in Qatar has developed a LNG ship-to-shore communications system based on our XTran product line. The design brings the LNG industry into the high-bandwidth, high-integrity, high-flexibility world of modern communications. The system's reliability improvements, interface flexibility, service expansions and, most importantly, the time savings introduced during vessel loading can save operators tens of millions of dollar per jetty per year. With XTran, modern LNG operators are ready to face the future.

A CRITICAL COMMUNICATIONS LINK

The safe loading and unloading of LNG tankers requires, as an absolute minimum, a fail-safe emergency shutdown (ESD) signal between the tanker and the loading jetty.

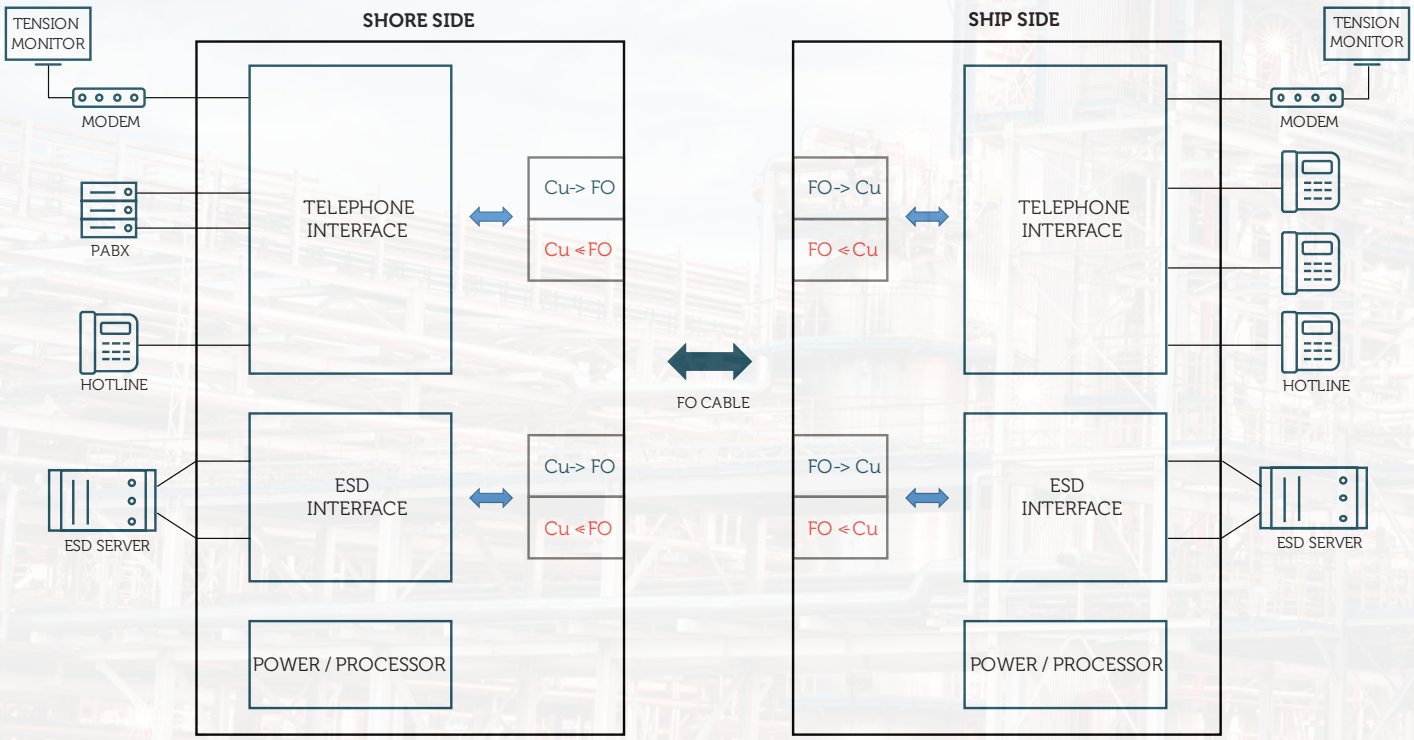
The most common system in use today for the establishment of LNG ship-to-shore links is based on technology developed in the 1980s. The system involves manually connecting to a moored vessel with fibre optic cables incorporating proprietary hooking / unhooking mechanisms. Frequency modulation is then used to multiplex four telephone lines and two contact closures over two fibre pairs.

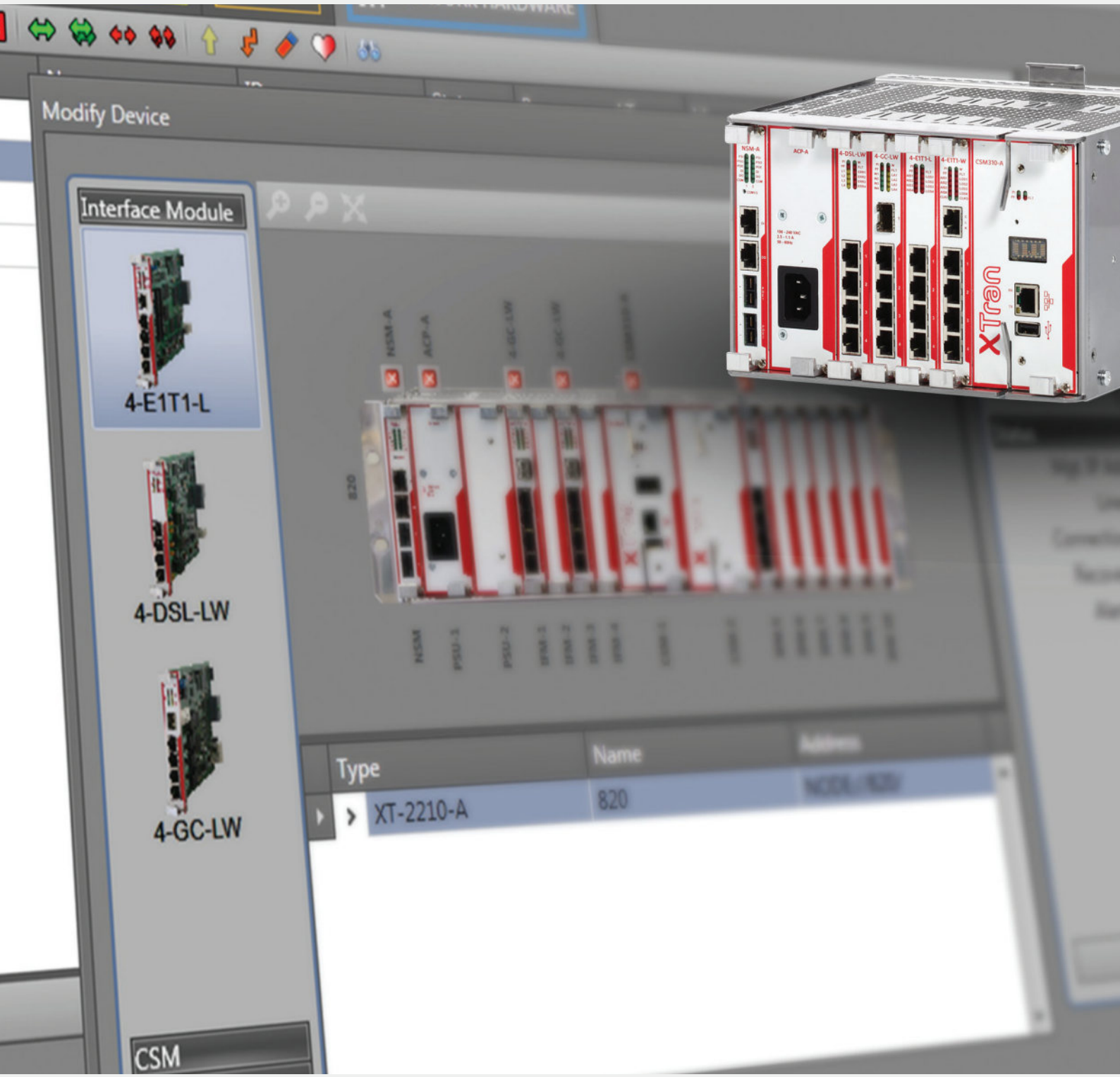
A reliable ship-to-shore communications link is a critical component of any LNG operation.

The existing system was developed in the 1980s and comes with many limitations.

In a typical configuration, as illustrated in the block diagram below, the following basic services are provided:

- Two ESD signals, one in each direction.
- Two PBX telephone connections.
- One hotline telephone link for use by control room operators and the loading master.
- One line that uses modems to provide a 9.6 kbps connection for a tension monitoring display at the tanker.

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820
XTran

A PROBLEM IN NEED OF A SOLUTION

There are a number of drawbacks and disadvantages associated with the existing fibre based ship-to-shore communications link. These include:

Loading Delays

Prior to LNG loading the integrity of the ship-to-shore link needs to be verified. Currently, this process cannot commence until the vessel is physically tied to the loading jetty, a communications technician has been called out and the fibre optic cable manually connected to the vessel.

Based on data from the world's largest LNG port at Ras Laffan in Qatar, the above process introduces a delay of 1 - 2 hours from the time of tanker mooring.

Limited Bandwidth

The effective bandwidth of the system is extremely limited typically ranging from only 256 kbps up to 10 Mbps. The lower limit is less than 0.3% the bandwidth of an entry level Ethernet port.

The effective bandwidth of the existing system is extremely limited.

Limited Services

Given bandwidth and interface restrictions, the system is unable to accommodate new services or tie-in to modern Ethernet devices.

Single Point of Failure

A single failure in the fibre medium results in spurious trips of the jetty loading / unloading ESD system. Such shutdowns cause production delays whilst the fibre connection is repaired or a backup employed.

System Downtime

Whilst the electronics associated with the system tend to be reliable, the repetitive hooking and unhooking of the fibre cable in the harsh jetty environment occasionally damages the fragile cable and/or connectors. Repairing such damage can be costly and time consuming.

A single failure in the fibre can can result in spurious trips of the ESD system.

Manpower Intensive

The current system requires the manual connection and disconnection of fibre cables by trained technicians. In addition to being an avoidable expense, the practice also exposes the operator's personnel to unnecessary ongoing health and safety risks.

Minimal Redundancy

Whilst the system is typically employed in conjunction with either an electric or pneumatic backup, such backup systems provide very limited functionality and are only able to support a single ESD trip signal.

The existing system introduces a 1 - 2 hour delay in loading per tanker.

A MODERN SOLUTION

The aforementioned limitations of the existing fibre based ship-to-shore communications link can all be addressed through a wireless implementation of OTN Systems' XTran network. Such a system entails three main components:

- **Multiplexors** to facilitate the transport of multiple signals e.g. ESD, telephones, data, CCTV etc.
- **Radio** units to wirelessly connect the ship-side and shore-side multiplexors.
- **Antenna alignment** units to ensure automatic link establishment and maintain link integrity.

The Multiplexor

The XTran product line by OTN Systems is an ideal choice for the requirements of the ship-to-shore link. The relevant factors and features include:

- A proven track record of reliability and availability across a global installation footprint throughout the oil & gas industry.
- Flexible and fully modular network topologies and bandwidth assignments.
- High availability with fully redundant components including processors, power supplies and interface cards.
- The ability to use existing staff for all operation, maintenance and upgrade activities.

- Service level bandwidth assignments that guarantee data transport (100% QoS), hitless switching and sub-50ms redundancy.
- A minimum cost of ownership with no ongoing training or active maintenance requirements.
- Plug-and-play components for fast change-out whilst the system is still online.
- Compatibility with both legacy and modern level 2 & 3 Ethernet devices.
- A NMS that is completely graphics-based via an intuitive point & click interface along with wizards to avoid human error.
- Hardened and ruggedized to deal with the harsh marine environment.
- Data encryption and segregated management channels to prevent hacking.

Plug-and-play components with no ongoing training or active maintenance requirements.

XTran

The Radio

The Ethernet radio units used for the wireless link have been designed for operation in the extreme marine environment by a global leader in the field with a proven track record for reliability.

To ensure link integrity, the units are capable of redundant operation through either polarization, space and/or frequency diversity.

The units are available in multiple ITU frequency bands in order to comply with the licensing requirements of the various countries visited by the tanker. Simple frequency switching allows each unit to operate across all the terminals within a port.

Simultaneous loading of multiple tankers at multiple terminals is a core feature.

The Antenna Alignment Unit (AAU)

Through continuous small adjustments across three dimensions, the antenna alignment unit ensures that a radio link is maintained throughout a tanker's movements.

With GPS capability to facilitate fast link acquisition and the intelligence to differentiate between the primary radio signal and any side lobes, the unit effectively maximises signal strength and availability.

THE WIRELESS SHIP-TO-SHORE SYSTEM

The components of the wireless ship-to-shore link are integrated into a complete system as per the diagram below.

The system allows the LNG tanker to establish a high capacity, reliable and flexible ship-to-shore link as soon as it is within the vicinity of the terminal.

As the availability of all communication and ESD services can be verified prior to tanker mooring, once moored the vessel is able to immediately commence loading / unloading thus saving up to 2 hours per operation.

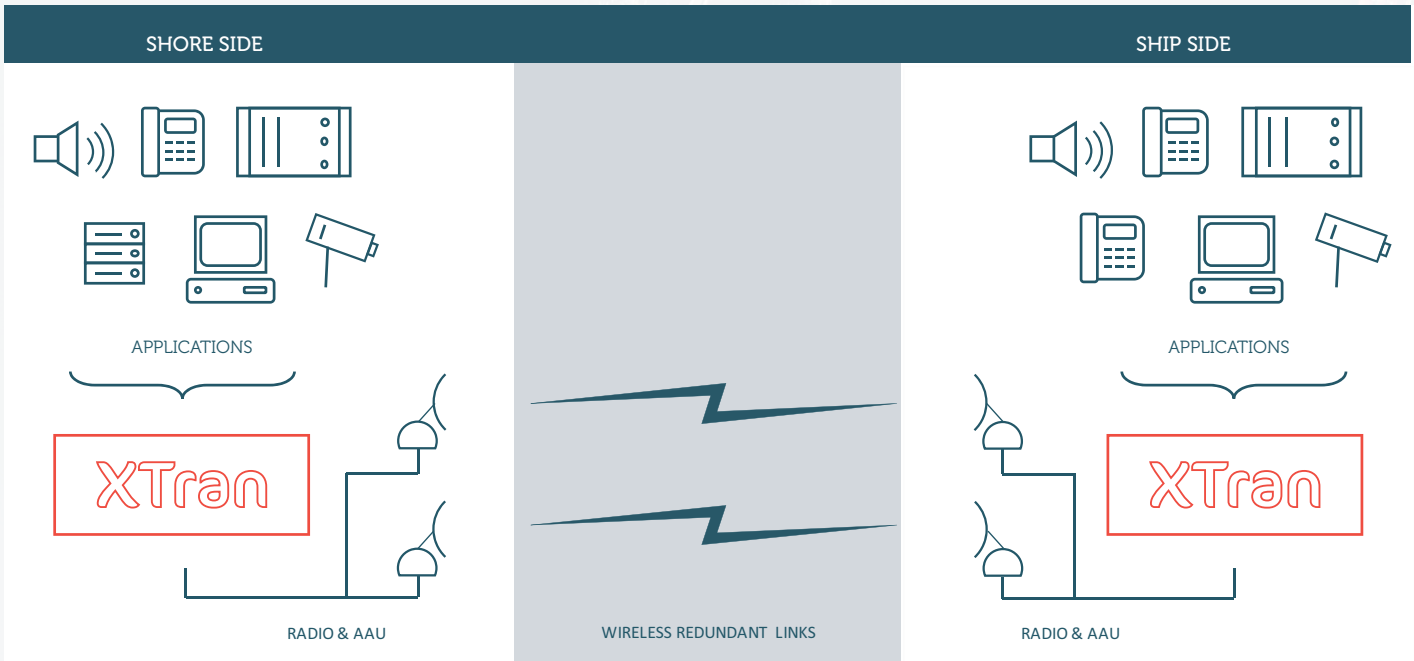
All onshore services remain available on the vessel until the time of it's departure from the terminal area.

Unlike the existing fibre link, the wireless system has no single points of failure. Component reliability is also improved.

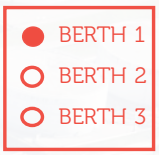
Link Redundancy, Reliability & Security

Given the criticality of the link, each component of the wireless system operates with full 1+1 redundancy as an absolute minimum.

- The XTran nodes are provided with dual processors, dual power supplies and dual interface cards. For additional space diversity the nodes can also be split across multiple units.
- The radios operate with space and frequency diversity in addition to options for polarization diversity.
- Service level bandwidth assignments and the assignment of prioritisation levels ensure critical systems are always available.
- Automatic system recovery normally takes less than 50ms and should be transparent to the services carried.
- Narrow beam widths, data encryption and segregated management channels ensure link security and prevent hacking.



VESSEL APPROACHES TERMINAL



OPERATOR SELECTS DESIRED JETTY / BERTH

WIRELESS REDUNDANT LINKS ESTABLISHED

VESSEL NAVIGATES TERMINAL

VESSEL MOORS AT REQUIRED BERTH

LOADING / UNLOADING OPERATIONS

VESSEL DEPARTS TERMINAL

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THE BUSINESS CASE

Revenue and Export Volumes

The revenue an LNG operator receives is directly related to the volume of LNG exported which in turn depends on the efficient turn-around of tanker loading and unloading operations. The loading delays, spurious shutdowns and downtime of the existing ship-to-shore fibre based link all negatively impact export volumes.

Based on data out of the world's largest LNG export facility at Ras Laffan in Qatar, the ability to establish and verify the integrity of the ship-to-shore communications link prior to vessel mooring would save between 1 and 2 hours per shipment. Considering the actual loading time of a typical (130,000 m3) shipment is 22 hours, a 1 hour time saving per shipment translates into up to 15 additional shipments per annum from each jetty.

The potential additional income runs into the tens of millions of dollars per jetty per annum.

Note that such savings only consider loading delays during standard operation, when the impact of improved equipment reliability and reduced spurious shutdowns is considered the savings are likely to be even greater. Similar time savings can also be expected at the unloading location.

The potential additional income runs into the tens of millions of dollars per jetty per annum.

New Applications

The utilisation of a flexible multiplexor in conjunction with high capacity wireless links will allow for the development of new applications to further enhance the safety and efficiency of loading operations.

Examples may include:

- **Docking Aid Systems** - LNG jetties typically incorporate large displays of the tanker approach speed and distance for the benefit of the pilot. A wireless Ethernet link would allow such data to be directly available in the tanker bridge.
- **CCTV** - Video streams from LNG tanker cameras can be transmitted onshore for review by dedicated and trained port security personnel.
- **Corporate Information Systems** - Access can be provided on the bridge to the loading supervisor and any other approved personnel.
- **High Speed Internet & Phone Lines** - Services can be made available for the convenience of tanker crews. After weeks on the high seas using slow and expensive satellite links, the convenience of such services should not be underestimated.
- **Document Exchange** - Files can be exchanged and shared between the tanker and onshore systems regardless of size or format.

CLEVER

Clever data telecommunications for smart operators.

Automatic setup of the network

One-click provisioning via management system

Provisioned active and backup path

Minimum training and maintenance

Optimised performance for each application

TAILORED

Tailored to the LNG industry's specific market needs.

Mix of legacy, IP and non-IP devices

Integrated access (fiber and copper)

Support for sector specific protocols

Modular design and upgradeable bandwidth

SAFE

Safe investment in the future of your operations.

Redundancy on every level

Excellent return on investment

Extended product life cycles

Industrial design (suitable for harsh marine environment)

COMMITTED TO GET YOUR INFORMATION ACROSS

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

By working closely with numerous customers over 26 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. OTN Systems' customers are spread over more than 70 countries around the globe.

With a unique product portfolio, more than 400 satisfied customers and a partner network reaching out to every corner of the world OTN Systems promises you peace of mind when it comes to mission critical networking: OTN Systems is committed to get your information across.

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Ref. No.: XX-B082-E-1
Issued January, 2017
Specifications subject to change as design improvements are implemented.