

Open Transport Network (OTN)

N50/N70 SERIES: FLEXIBLE ETHERNET TRANSPORT WITH OPTIONAL E1 SUPPORT

Introduction

The Open Transport Network (OTN) is a private communication system providing an extension over fiber for LAN, data, video & voice. The system is based on “nodes” interconnected by two point-to-point fiber optic links forming two counter-rotating rings.

This topology, in combination with the system’s built-in fault recovery features, ensures extremely high service availability. The N50/N70 series is an extension of the OTN-X3M portfolio and adds an extensive set of Ethernet features to the family. Within the N50/N70 series, the N5224C and N7224C offer not only Ethernet/IP functionality, but E1 user interfaces as well.

Product overview

The importance of IT in an organization is growing rapidly due to the fact that applications are migrating to Ethernet for their internal communication.

The N50/N70 series provides an answer to this trend by delivering a reliable and scalable multiservice Ethernet Network.

The N50 (OTN-X3M-2500) and N70 (OTN-X3M-10G) provide a transport

network layer which focuses on reliability and predictability, different service layers with Ethernet user ports focusing on flexibility (SLAN) and a static control plane in the form of a management system (OMS) combining controllability and ease of use (see figures 1 and 4).

The N50/N70 series is a 2U high chassis that fits into a 19” – 60 cm deep cabinet. The chassis supports 2 hot swap power supplies for redundancy reasons. These PSUs have a wide input range and support a mix of AC and DC power.

Despite the small footprint, the product provides front access to all vital components like hot swap power supplies, fan unit and management ports. Furthermore, it allows fast diagnosis of the system via the user friendly display and LEDs.

All this makes the N50/N70 series your ideal platform to create a flexible Ethernet multiservice network with optional E1 interfaces for the transparent transport of E1 data streams. The E1 digital data is multiplexed in the OTN-X3M bandwidth, therefore avoiding the need to use TDM-over-IP conversion techniques for transport over the OTN-X3M network .



N7024CF



N5224C

Features

The N50/N70 series is a range of Ethernet transport products

Variants with 24 and 48 ports, Cu and/or fiber

Variants with 24 Ethernet ports and 24 transparent E1 user interfaces

PoE 802.3at (PoE+) ready off the shelf

Mix of AC and DC power supplies

Easy to install and maintain due to front access of all major components

OTN-X3M-2500 (2500 Mbps) and OTN-X3M-10G (10 Gbps) compatible

Fast reconfiguration (<50 ms) even in large ring networks

Up to 12 SLANs with guaranteed dedicated bandwidth

L2 and L3 services

Extensive network management via OMS

-20°C to +55°C operating temperature



Configurations

The N50 is compatible with OTN-X3M-2500 (2500 Mbps) and the N70 is compatible with OTN-X3M-10G (10 Gbps). The nodes can be combined in a network with N42, N42C and N415 chassis. An N50/N70 only network is also possible.

The OTN-X3M technology gives you fast network convergence (less than 50ms for networks up to 110 nodes and 1000 km of fiber) without impact on the service layers. This is possible by doing network reconfigurations via the transport layer in hardware instead of using software routing protocols or spanning tree in the service layers. Everything is pre-calculated and provisioned up-front via the management system.

For ring interconnection the N50 has 2 SFP slots and the N70 2 XFP slots.

The different versions are summarized in table 1. There are variants for 24 or 48 user ports, all supporting gigabit Ethernet connectivity, which can be mapped into 12 different SLANs giving you 12 different service layers. Of these 12 SLANs, 2 SLANs support the full OTN-X3M ring payload capacity (2.3 Gbps for the N50 and 9.3 Gbps for the N70). The C variants all have copper user ports, whereas the CF variants have combo user ports. Combo ports are a mix of fiber and Cu allowing you to choose between using a port via Cu or plugging in a Small Form factor Pluggable (SFP)-based fast Ethernet or gigabit Ethernet optic if you need a fiber port.

The Nx224C versions support not only 24 Ethernet ports, but also E1 user interfaces. The E1 interface consists of 24 independent circuits for the transparent transport of 2.048 Mbps streams between any two points in an OTN-X3M network. For this purpose

OTN Compatibility	N50/ N70 variants	Cu Ports	Combo Ports Cu/Fo	E1 user Ports
OTN-X3M-2500	N5024C	24		
	N5024CF		24	
	N5224C	24		24
OTN-X3M-10G	N5048C	48		
	N7024C	24		
	N7024CF		24	
	N7224C	24		24
	N7048C	48		

Table 1: N50/N70 Variants

the Nx224C is equipped with 2 50-pin Telco female connectors with 120 Ohm shielded twisted pair circuits.

The platform is fully supported by the OMS, including a set of wizards to configure the more complex settings that have implications on a network wide level.

The N50/N70 series can also be integrated in a bigger IT environment. The different systems are available with a base license pack (covering L2 features like VLAN, IGMP and MSTP) and an enhanced license pack (covering L3 features like OSPF, PIM-SM and VRRP).

The whole series of products is ready for power over Ethernet for 24 ports (24C/CF variants) or 48 ports (for 48C). Activation of power over Ethernet is done via a software license on the OMS. All the versions shown in table 1 use the same power supplies and support a mix of AC and DC.

Ethernet Services

Gigabit Ethernet user ports

During the last 10 years, Ethernet networks have increasingly gained market traction and have been deployed massively in enterprise LAN networks. In industrial networks also Ethernet is becoming increasingly popular as an access protocol

due to the use of Ethernet and IP technology within applications.

Not only has the use of Ethernet grown over time but the amount of bandwidth used by these Ethernet applications has also increased. Applications that demand access speeds higher than 100 Mbps are becoming a standard. The N50/N70 series responds to this trend with its all gigabit Ethernet ports.

When the capacity of a single gigabit Ethernet access port is insufficient, the N50/N70 series provides link aggregation allowing to combine up to 8 ports in a single aggregated link (see figure 7).

In case applications need to be groomed in the access layer ranging from several fast Ethernet connections to a 1 gigabit Ethernet link, the N50/N70 series in combination with the OTN Systems industrial Ethernet access switches (ETS) is the perfect fit (see figure 8).

SLAN

In a traditional Ethernet network the applications share the same bandwidth and every element in the network is responsible for mixing the different applications. Together they create a single network cloud.

In a Segmented LAN or SLAN the cloud is considered as non-existent. Each

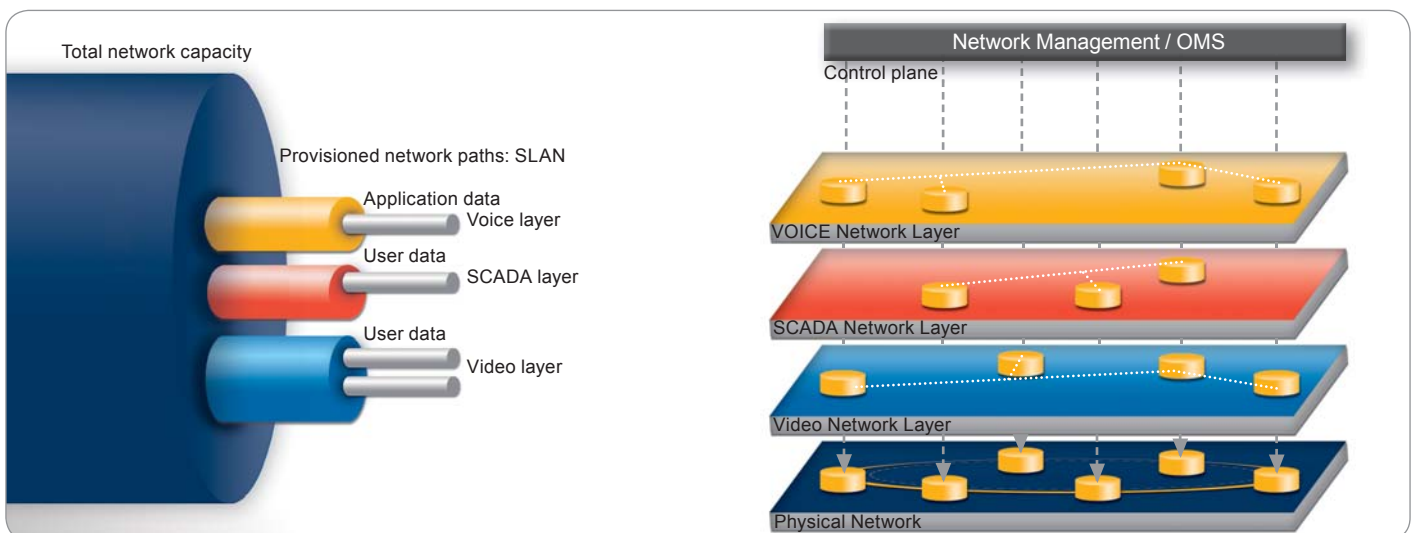


Figure 1: Different application network layers are configured onto a single OTN network

Power Supply configuration	Available PoE power
Single Power supply, high input range (AC or DC)	875 W
Single Power supply, low input range (AC or DC)	375 W
Dual Power supply, high input range (AC or DC) (*)	1612 W
Dual Power supply, low input range (AC or DC)	875 W
Dual Power supply, mix of low/high input range (AC or DC)	1375 W

(*) PoE budget limitation not based on available power budget but on PoE power module of the node

Table 2: Available PoE Power

application has its own 'lane' or service layer in the network, with guaranteed bandwidth and total separation of the different service layers. This is possible because of a technology called Time Division Multiplexing (TDM). The different service layers or SLANs can be controlled and provisioned by a few simple clicks in the management system. This way SCADA, CCTV, voice and other applications run smoothly on the OTN, without interfering with each other.

A layer 2 SLAN together with the transport plane of OTN-X3M offers the scalability of an Ethernet network without the need for spanning tree or any other routing protocol and is therefore an efficient solution for both Point-to-Point and Multipoint services. The bandwidth of a SLAN is selectable from 1 Mbps to the maximum ring capacity (maximum capacity may depend on the SLAN and mode used).

The N50/N70 series is backwards compatible with ET100AE, DAE via HX, HX4 services. It also provides the possibility to configure a service in GX mode (only possible between N50 or N70 devices) for an even higher bandwidth up to the total capacity of the OTN-X3M network.

The platform provides two systems for optimizing traffic within a single SLAN.

- Each SLAN has a low and high priority queue where traffic can be prioritized according to the IEEE 802.1p priority standard.
- For multipoint SLANs the platform also provides a system for congestion handling.

Congestion occurs in a SLAN when a Ring Buffer somewhere on the ring reaches a specific threshold value. When a node becomes congested this is communicated to the other nodes in the same SLAN. In case of congestion, all nodes automatically switch over to their configured Fairshare Rate. This mechanism guarantees that all nodes within a single SLAN receive an equal portion of the programmed

bandwidth. All these parameters can be configured via the OMS.

Port to SLAN mapping

The front panel ports can be configured for separate operation, each over its own Ethernet SLAN or can also be interconnected to assign different front ports to a SLAN.

VLAN to SLAN mapping

The N50/N70 series supports VLANs 802.1q, which allows the logical separation of applications within a single Ethernet link. The ports on the N50/N70 series can be set to VLAN transparent or to VLAN compatible by assigning VLAN IDs. When configured in VLAN compatible mode, the Ethernet ports will filter packets based on VLAN IDs.

When tagged frames are received on a front-end port VLAN, the different frames can be mapped in a SLAN based on the VLAN tag. This is extremely useful when the N50/N70 series is used in combination with an industrial Ethernet access switch (see figure 9).

L2 services

The platform supports different Ethernet L2 features that help integrate the different applications. Examples of

these features are IGMP snooping/proxy, which is useful for IP video applications or other applications that require multicast IP traffic. It provides filtering of multicast traffic on the user ports. Other examples are link aggregation, spanning tree and multiple spanning tree. It also provides QoS features like flow control (802.3x), rate control and broadcast limiting. All these features are configurable per SLAN and run independently from each other.

L3 services

L3 services can be tunneled over a normal SLAN. By activating the enhanced license pack on the N50/N70 device via the OMS, the node will also support features like OSPF, VRRP, PIM-SM on a per SLAN level. So you will have the choice to tunnel the L3 protocols or to peer the protocols per SLAN. Peering is done by initiating different router instances on a single N50/N70 keeping separate routing tables for each SLAN (VRF).

For redundant access on L3 level the platform provides support for VRRP (see figure 10).

PoE

In case the N50/N70 device is activated via the OMS for power over Ethernet,

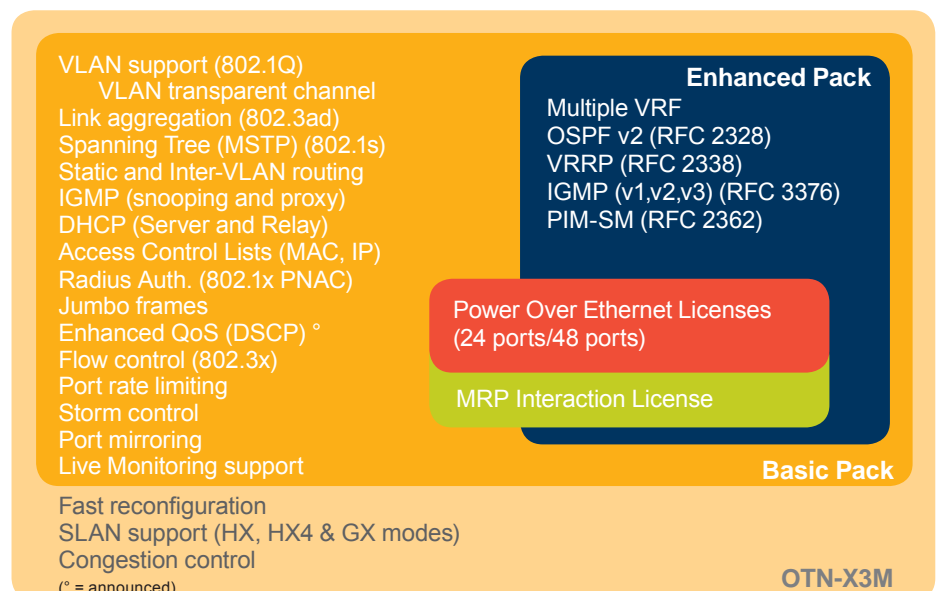


Figure 2: Feature Packs

power can be delivered according to the 802.3at standard (also known as PoE+). The power budget that is reserved for power over Ethernet depends on the amount of power supplies and the supplied input voltage (high range or low range – see product specification table).

See table 2 for the available power over Ethernet budget in case of single or dual power supply operation.

The distribution of the power over the different PoE ports is based on prioritization and PoE classes and is fully configurable via the OMS.

In case of a reduction of the available power budget (because of a failing power supply) the prioritization will be used to shut down low priority ports to guarantee the power towards higher priority ports.

MRP ring protection interaction. Some access rings use MRP (Media Redundancy Protocol, IEC62439-2) for their ring protection. The N50/N70 node can participate to such ring as an MRP Client.

Adding features over time

The N50/N70 series license program offers enhanced service level and higher network flexibility. This license program makes your investment future proof: just buy the additional feature sets when you need them.

The N50/N70 series license program optimizes the Total Cost of Ownership (TCO) and Return on Investment (ROI) by adding features as the set of used applications grows over time.

Several upgrade paths exist:

- PoE migration path
 - N5024C/N7024C via 24 port PoE license (AG-L361)
 - N5024CF/N7024CF via 24 port PoE license (AG-L361)
 - N5224C/N7224C via 24 port PoE license (AG-L361)
 - N5048C/N7048C via 48 port PoE license (AG-L363)

- Protocol license migration path via Enhanced license pack (AG-L362)
- MRP Interaction license (AG-L364)

All licenses are controlled and organized via the OMS for ease of use and guarantee a smooth migration from one feature to another.

E1 Services

Description

The E1 interfaces of the N5224C/ N7224C versions allow transparent transport of up to 24 independent 2.048 Mbps (E1) digital streams. Each E1 interface can transport the E1 data between any two points in the network and is fully compatible with the E1-24P card available for N42/N415 X3M nodes.

For this purpose the Nx224C is equipped with 24 independent circuits for on premise/short-haul applications. The physical interface consists of two 50-pin Telco connectors, each equipped with twelve 120 Ohm balanced shielded twisted pair circuits.

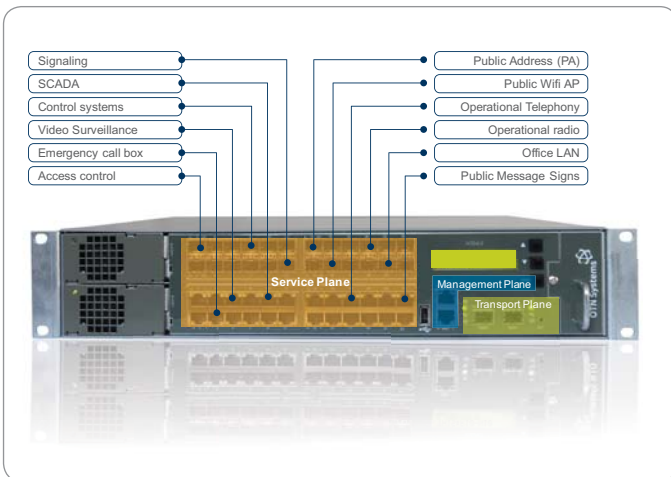


Figure 3: Mapping the applications to the service planes

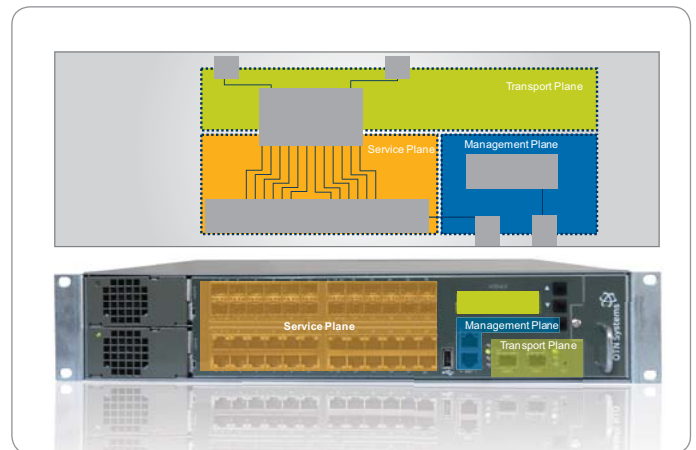


Figure 4: Product setup: Service / transport / management plane

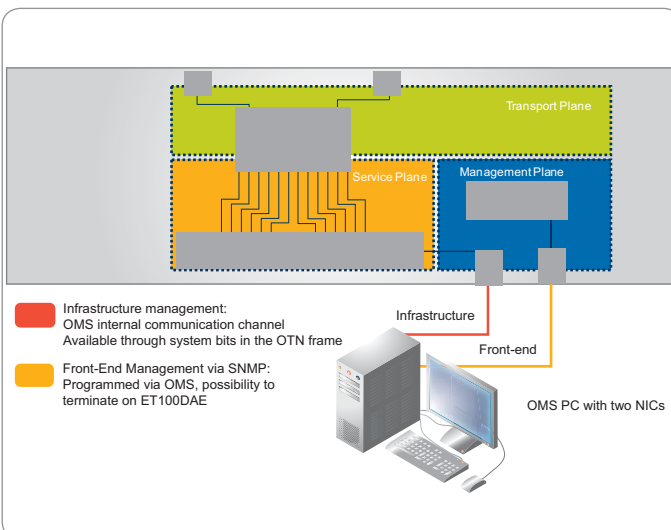


Figure 5: Connecting the management system

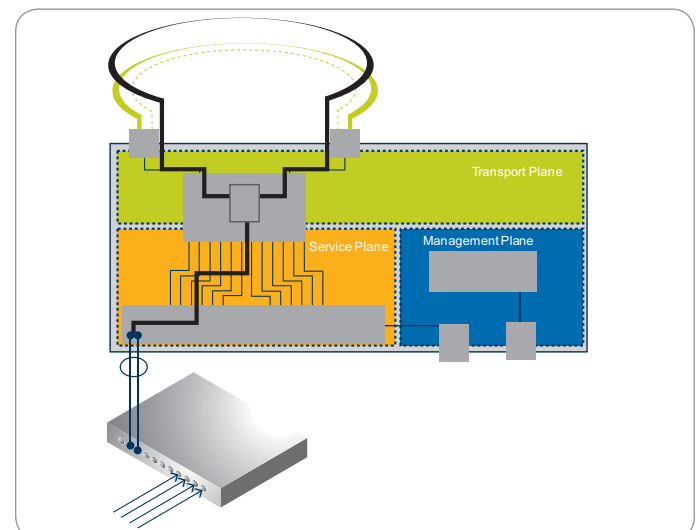


Figure 7: Link aggregation (IEEE 802.3ad)

Operation

The received line signal is multiplexed into the OTN-X3M frame at one side of the link. After transmission over the OTN-X3M network the data is decoded to the original line format. Status logic provides for every circuit status and status information to the OMS and to the front panel display, such as Loss of Signal (LOS), Alarm Indication Signal (AIS) and loopback info.

Applications

Due to its transparent design the E1 interface can be used for many different applications independently of the higher layer protocols. Examples include:

- PBXs with remote shelves using a proprietary protocol for the extension of the system bus can be interconnected via the Nx224C using 2.048 Mbps interfaces
- interconnection of LAN routers using an E1 interface
- interconnection of video equipment using 2.048 Mbps external codecs

Increased Service Availability with Redundant Power Supplies

Every version of the N50/N70 series can be powered with one single AC or DC Power Supply. Moreover, the N50/N70 series can also be equipped with a second optional internal redundant power supply, available in both AC and DC versions (mix is possible). In case of a power supply failure the redundant power supply provides an immediate failover without any system downtime. Installing the redundant power supply drastically decreases the risk of service outage and offers a higher level of service availability.

The power supplies of the N50/N70 series are accessible via the front and are therefore very easy to replace in the field.

Security

Security is a growing issue. The N50/N70 series includes some state of the art built-in security features that make it almost impossible to hack the services configured on an OTN-X3M network:

- SLAN, true hardware separation of services
- Possibility to disable the front-end ports
- Link status monitoring via OMS
- In-band management channel
- No access from a user port to the management channel
- MAC based ingress access control lists per user port
- IP based access control lists
- 802.1x PNAC authentication (RADIUS)

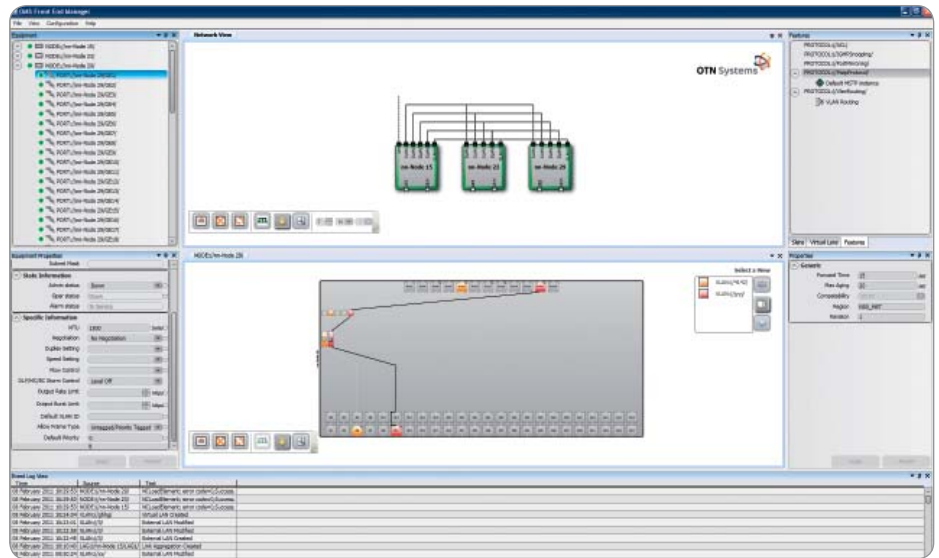


Figure 6: FEM (Front-End Manager)

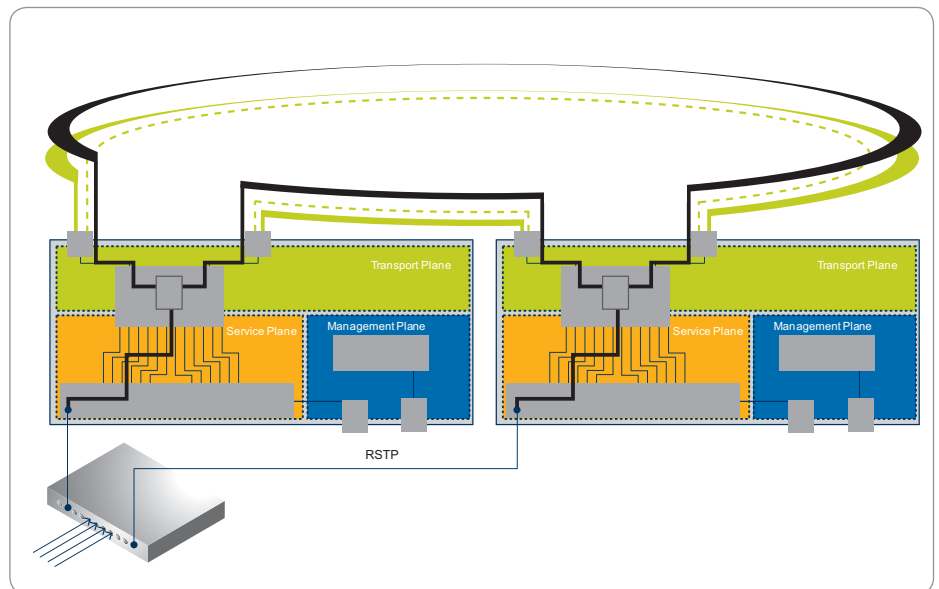


Figure 8: Dual homing on L2

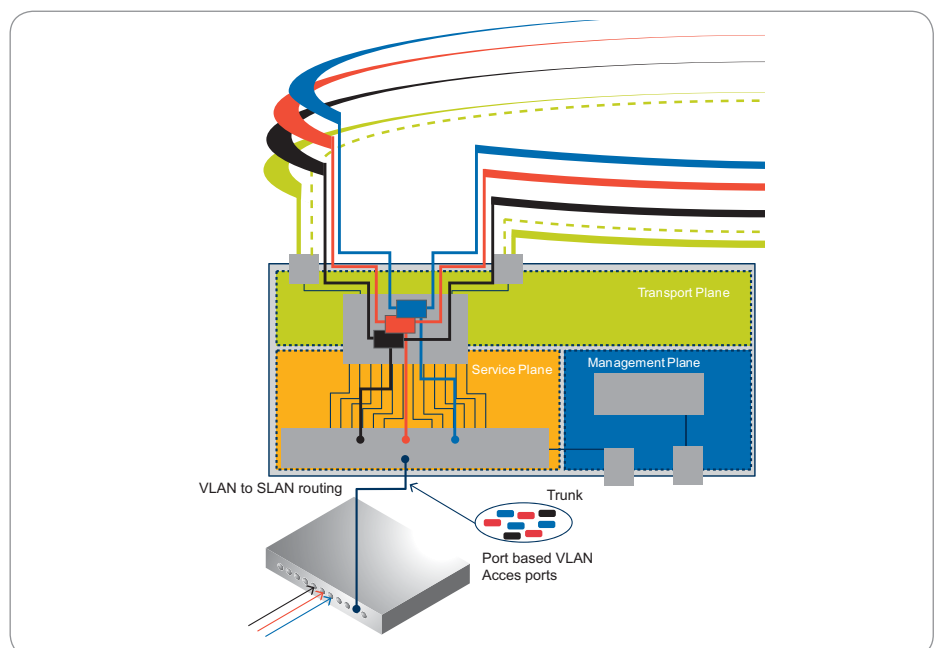


Figure 9: VLAN to SLAN mapping

Features and benefits

Feature	Benefits
Industrial Ethernet with router and optional E1 functionality	Compact form
	Everything front accessible
	Wide range AC and DC power supplies
	Redundant built-in power supplies, mix of AC and DC possible
	Hardware is PoE-ready off the shelf
	Base license pack designed for L2 operation and hardware QoS
	Enhanced license pack designed for advanced IP routing
	OTN-X3M technology for efficient secure Ethernet segments (SLAN) and transparent E1point-to-point services
Superior manageability	Major and minor alarm contacts (normal closed, to indicate the alarm status of the node)
	OTN Network management system (OMS)
	Wizard enabled management for network wide configuration of L2 and L3 features
	Modular management system with selectable northbound interfaces for integration with central alarm systems or SNMP based umbrella management system
	Display for fast diagnostics and base configuration
Intelligent Ethernet access platform	(Remote) Port Mirroring : monitor online traffic ingressing/egressing a specific node port through the network
	Configurable front-end port mapping to SLAN
	VLAN to SLAN mapping
	Ethernet access ready via RSTP or VRRP
Layer 2 Ethernet services	DHCP Server / DHCP Relay
	Efficient point-to-point and multi-point services thanks to the SLAN concept
	Up to 12 SLAN with configurable bandwidth
	Congestion control per SLAN
	2 queues per SLAN for prioritization of traffic within an SLAN
	Port based VLAN
Layer 3 Ethernet services	IGMP snooping and proxy / V1 V2 V3
	Multiple routers (VRF instances) per device with independent routing tables
	Support for Unicast routing via OSPF and multicast routing via PIM-SM
Power over Ethernet	Power over Ethernet (802.1af / 802.1at) with up to 30 Watt on all RJ-45 ports
Superior redundancy for fault backup	Transport functions of OTN-X3M technology allows for network reconfiguration without convergences of the service layers
	RSTP (Rapid Spanning Tree) for redundant L2 access
	MSTP allows rapid spanning tree per VLAN
	VRRP for redundant access on L3
	Link aggregation
Robust multicast control	IGMP Snooping helps enable intelligent management of multicast traffic by examining IGMP messages.
	IGMP proxy for scalable multicast designs
	IGMP fast leave for surveillance
	PIM-SM for large scale CCTV solutions
Advanced QoS	Robust SLAN concept with bandwidth guarantee
	Prioritization of VLAN based traffic within a single SLAN
	Congestion control per SLAN for ring optimization
	Broadcast storm control
	Support for flow control per port towards front-end connected applications
Network security	Support for flow control per port towards front-end connected applications
	OTN-X3M based service segmentation
	Independent service plane and control plane (OMS management channel, SNMP SLAN)
	SNMPv3 front-end management
	Access Control Lists on L2 and L3
E1 services (N5224C and N7224C only)	802.1x PNAC authentication to RADIUS Server
	24 independent circuits
	Fully transparent to all higher layer protocols (standard and proprietary)
	Compliant with ANSI T1.102, ITU-T G.703, ITU-T G.823
	Asynchronous mapping of point-to-point connections between a port on the Nx224C and another port on a Nx224C or E1-24P interface card
	Alarm and status indication on-board and via the OMS Management System

Product specification

Description		N50/N70 Value	
Performance:	Forwarding rate:	95,23 mpps @ minimum length packets	
	MAC addresses	16k	
	IGMP groups and multicast entries	1000	
	maximum transmission unit (MTU)	9k	
	MSTP instances	64	
	VLAN IDs	4k	
	Link aggregation	8 groups of 8 links	
	SLAN forwarding capacity	8 Gbps @ minimum length packets / SLAN	
	VRF instances	12	
	Number of routes	2k	
	Number of ACL entries L2 and L3	798	
	Number of VRRP interfaces	24 per node	
	Connectors and cabling:	Ethernet user ports	10BASE-T ports: RJ-45 connectors, 2-pair Category 3, 4, 5(E) or 6 unshielded twisted-pair (UTP) or shielded twisted-pair (STP) cabling
			100BASE-TX ports: RJ-45 connectors, 2-pair Category 5(E) or 6 unshielded twisted-pair (UTP) or shielded twisted-pair (STP) cabling
		1000BASE-T ports: RJ-45 connectors, 2-pair Category 5(E) or 6 unshielded twisted-pair (UTP) or shielded twisted-pair (STP) cabling	
		SFP based ports: 1000BASE-X or 100BASE-FX SFP modules	
OTN-X3M:		SFP (N50) / XFP (N70)	
Management: 10/100 (Infrastructure)		100BASE-TX ports: RJ-45 connectors, 2-pair Category 5(E) or 6 unshielded twisted-pair (UTP) or shielded twisted-pair (STP) cabling	
Management: 10/100 (Front-end)		100BASE-TX ports: RJ-45 connectors, 2-pair Category 5(E) or 6 unshielded twisted-pair (UTP) or shielded twisted-pair (STP) cabling	
	Diagnostics and logging	USB 2.0	
Indicators:	User ports	Ethernet: Per port status LEDs: RX, TX, Link, Speed, Duplex	
	Transport plane	SDH synchronization level, OTN synchronization level, Bit errors	
	Alarm contacts	Major, Minor status	
	Display for system information	Node number, neighbor nodes, Ring status Hardware/firmware versions, Alarm relay status	
Dimensions (HxWxD)		482 mm x 88 mm x 410 mm (19 x 3.5 x 16.1 inches)	
Power consumption Input (measured@input)			
If single PSU	Without use of PoE:	With use of PoE: $P_{in} = (125 \text{ W} + \text{Delivered PoE Power})/PSU_n$	
	$P_{in} = 150 \text{ W}$	If delivered PoE power < 75 W: $P_{in} = (125 \text{ W} + \text{Delivered PoE Power})/0.6$	
		If delivered PoE power ≥ 75 W: $P_{in} = (125 \text{ W} + \text{Delivered PoE Power})/0.8$	
If dual PSU	Without use of PoE:	With use of PoE: $P_{in} = (125 \text{ W} + \text{Delivered PoE Power})/PSU_n$	
	$P_{in} = 200 \text{ W}$	If delivered PoE power < 275 W: $P_{in} = (125 \text{ W} + \text{Delivered PoE Power})/0.6$	
		If delivered PoE power ≥ 275 W: $P_{in} = (125 \text{ W} + \text{Delivered PoE Power})/0.8$	
Power specifications	AC input voltages	100-240 VAC +/- 10%	
	DC input voltages	18-60 VDC	
	Output ratings	1000 W @ 180-240 VAC (Hi input range) / 500 W @ 100-180 VAC (Lo input range)	
	Output ratings	1000 W @ 48 VDC (Hi input range) / 500 W @ 24 VDC (Lo input range)	
MTBF values (@25°C)	N5024C	36.6 Y	
	N5024CF	31.5 Y	
	N5048C	31.5 Y	
	N7024C	35.8 Y	
	N7024CF	30.9 Y	
	N7048C	30.9 Y	
Environmental	PSU 90-264 VAC	34.0 Y	
	PSU 18-60 VDC	34.0 Y	
Environmental	Temperature	-20°C to +55°C (-4°F to +131°F) (Ambient)	
	Humidity	Humidity: 10% to 85% NC at 25°C	
Weight	N5024C	7.0 kg (25.1 lbs)	
	N5024CF / N5048C	7.5 kg (26.2 lbs)	
	N7024C	7.0 kg (25.1 lbs)	
	N7024C / N7048C	7.5 kg (26.2 lbs)	
	PSU units	1.2 kg/unit (2.6 lbs)	

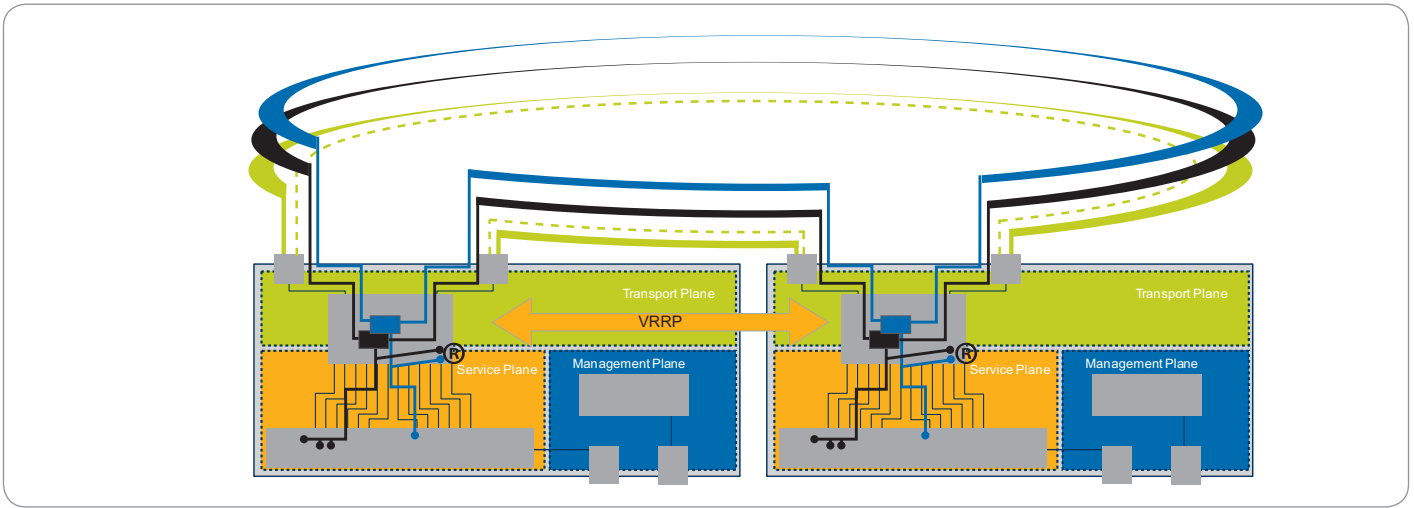


Figure 10: Router Redundancy

Robust management

The entire platform is provisioned and monitored via a central management system called the OMS (OTN Management System). The OMS is a network management system providing a full view over the entire network for configuration and monitoring.

The management system can be divided into two different parts. The first part manages the infrastructure: nodes, links between nodes, power supplies, SLAN configurations, programming the SLANs and setting up the N50/N70 series front-end management SLAN.

The infrastructure part of the OMS accesses all nodes via an in-band communication channel which is established as soon as the nodes are powered up and interconnected.

The second part manages the different front-ends of the N50/N70 series. An extensive set of wizards is provided to help the operator with the configuration of network wide settings.

For this reason the OMS workstation requires two network interface cards. One is used for communication with the infrastructure of the N50/N70 series and all other BORA cards in the network using the OMS connector. The second network interface card is connected to the MGT connector and has access to all N50/N70 front-end switches (see figure 5).

The platform also provides I/O contacts. A minor and major alarm contact are

available on the back connector of the node. During normal operation, these alarm contacts are closed.

When the node is not receiving synchronization signals from either of the rings, the major alarm contact is opened.

When the node is not receiving synchronization signals from at least one ring, the minor alarm contact is opened.

Applications

Figure 7 and 8 give an idea of the possibilities of the N50/N70 series to increase capacity (fig.7) or availability (fig.8). Figure 9 shows the VLAN to SLAN mapping possibility. Figure 10 shows the use of inter VLAN routing and VRRP.

Product specification

Standards and protocols

- IEEE 802.1s (MSTP)
- IEEE 802.1w (RSTP)
- IEEE 802.1x (PNAC)
- IEEE 802.3ad
- IEEE 802.3x full duplex on 10BASE-T, 100BASE-TX, and 1000BASE-T ports
- IEEE 802.1D Spanning Tree Protocol
- IEEE 802.1Q VLAN
- IEEE 802.3 10BASE-T
- IEEE 802.3u 100BASE-T
- IEEE 802.3ab 1000BASE-T
- IP routing: Inter-VLAN Routing, Static Routing, OSPFv2 (RFC 2328)
- Gateway redundancy: VRRP (RFC 2338)

- Multicast management: IGMP v1,v2,v3 (RFC 3376) and PIM-SM (RFC 2362)
- Management: SNMP versions 1, 2, and 3 (front-end management)
- Management: SNMP versions 1 and 2 (OMS northbound) for connection to an umbrella monitoring system.

Ordering information

Hardware

- S30826-B40-X501: N5024C
- S30826-B40-X701: N7024C
- S30826-B41-X510: N5048C
- S30826-B41-X710: N7048C
- S30826-B42-X501: N5024CF
- S30826-B42-X701: N7024CF
- S30826-B43-X501: N5224C
- S30826-B43-X701: N7224C

Product licenses

- AG-L398 OMS License for one N50/N70 node
- AG-L361 License PoE 24 ports for one N5024C, N7024C, N5024CF, N7024CF, N5224C or N7224C
- AG-L363 License PoE 48 ports for one N5048C or N7048C
- AG-L362 Enhanced license pack for one N50/N70
- AG-L364 MRP Interaction license for one N50/N70

Power supplies

- AC-PSU V30812-A5020-A71
- DC-PSU V30812-A5020-A72