Ethernet Service Description

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Contents

1 Introduction

Northern Light Optical Exchange Ethernet service provides seamless, high-performance capacity via NORDUnet's exceptionally resilient Nordic network.

This document highlights the benefits of Ethernet and outlines the offered Ethernet service between points of presence in the Nordic region and northern Germany. The service is accessible in Oslo, Stockholm, Copenhagen, Helsinki and Hamburg.

Beyond that NORDUnet offers connectivity to Europe, Russia, Asia and the US via partners. NORDUnet can also assist in the ordering of local tail in order to connect to the Nordic NREN or direct to a NORDUnet POP.

Northern Light Optical Exchange Ethernet service is outlined below

For further information about the NORDUnet network service please read NORDUnet Network Service Description.

2 Ethernet Service Description

Ethernet technology is a well known technology that has been deployed for decades in Campus Networks to provide LAN (Local Area Network) services. Due to the lower pricing of Ethernet interfaces compared to the traditional SDH and PDH technologies, Ethernet has become very important in today's MAN (Metropolitan Area Networks).

Ethernet supports also higher bandwidths with fine granularity which is not available with traditional SDH networks.

Ethernet technology has the following applications and advantages:

- Suitable for transport of IP traffic.
- Provide easy interconnection between LANs.
- Point to point services.
- Aggregation and point to multipoint services.
- Traffic differentiation.
- Network segmentation with VLANs.
- Network security by dedicated links or virtual networks.

NORDUnet's NOX is an SDH based Ethernet MAN which is usually used as an intermediate step in the transition from a traditional, time-division based network, to a modern statistical network (such as Ethernet).

In this network architecture, the existing SDH infrastructure is used to transport high-speed Ethernet connections. The main advantage of this approach is the high level of reliability, achieved through the use of the native SDH protection mechanisms, which present a typical recovery time of 50 ms for severe failures.

3 NOX Ethernet Service

The NOX Ethernet services are offered as PoP-to-PoP in the Nordic. The service is accessible in Copenhagen, Hamburg, Helsinki, Oslo and Stockholm.
The Ethernet services are delivered by means of the Alcatel TSS 1850 platform and the Alcatel 1626 T-ROADM. The Alcatel TSS 1850 is a Multiservice Provisioning Platform (MSPP) which means that can deliver Ethernet over SDH services or traditional carrier Ethernet Services.

NORDUnet's network is currently build using SDH interfaces in the core network. This gives the customer the complete flexibility provided by the Ethernet technology in addition to the redundancy and OAM capabilities provided by the SDH technology.

Ethernet is map into SDH framing by using GFP (Generic Frame Protocol, ITU-T G.7041). In order to provide higher bandwidths concatenation is used. This is the process of summing the bandwidth of n x SDH containers into a larger container.

IP and Ethernet technologies match better with the granularity provided by virtual concatenation. Thanks to virtual concatenation NORDUnet is able to provide any bandwidth up to 10 Gbit.

Examples of possible bandwidths are:

Table 1 Example of possible BW

Physical interface	Bandwidth/Bit Rate	Virtual Concatenation
Gigabit Ethernet	599 Kbps	VC-4-4v
Gigabit Ethernet	1000 Mbps	VC-4-7v
10GE	2000 Mbps	VC-4-14v
10GE	4000 Mbps	VC-4-28v
10GE	10000 Mbps	VC-4-64v

NORDUnet is also able to provide Ethernet service where the Ethernet termination is at the customer site. In this case, NORDUnet can provide one Ethernet end point and a SDH end point. The Ethernet service can be delivered via an SDH physical interface and a number of virtually concatenated VC-4s.

More information regarding the SDH interfaces is provided in the SDH Service Description Documentation.

3.1 Physical interfaces

The following physical interfaces are available for customer interconnection.

Table 2 Physical interfaces

| Interface	Type	Fibre Characteristics	Connector	Standard
Gigabit Ethernet	1000B-SX	• 550 m MMF 50 µm (500 MHz Km @ 850nm) • 500 m MMF 50 µm (400 MHz Km @ 850nm) • 275 m MMF 62.5 µm (200 MHz Km @ 850nm) • 220 m MMF 62.5 µm (160 MHz Km @ 850nm)	LC/PC on SFP	IEEE 802.3z

	1000B-LX	• 550 m MMF 50 µm (400 MHz Km @ 1300nm) • 550 m MMF 62.5 µm (500 MHz Km @ 1300nm) • 5000 m SMF 10 µm		
	1000B-ZX			
10 Gigabit Ethernet	10GBASE-LR	• SMF 1330 nm	LC/PC on XFP	IEEE 80.23ae
	10GBASE-ER	• SMF 1550 nm		
	10GBASE-LW (I-64.1)	• SMF 1330 nm		
	10GBASE-EW (S-64.2b)	• SMF 1550 nm		

3.2 Ethernet Services

NORDUnet is able to provide the following type of services:
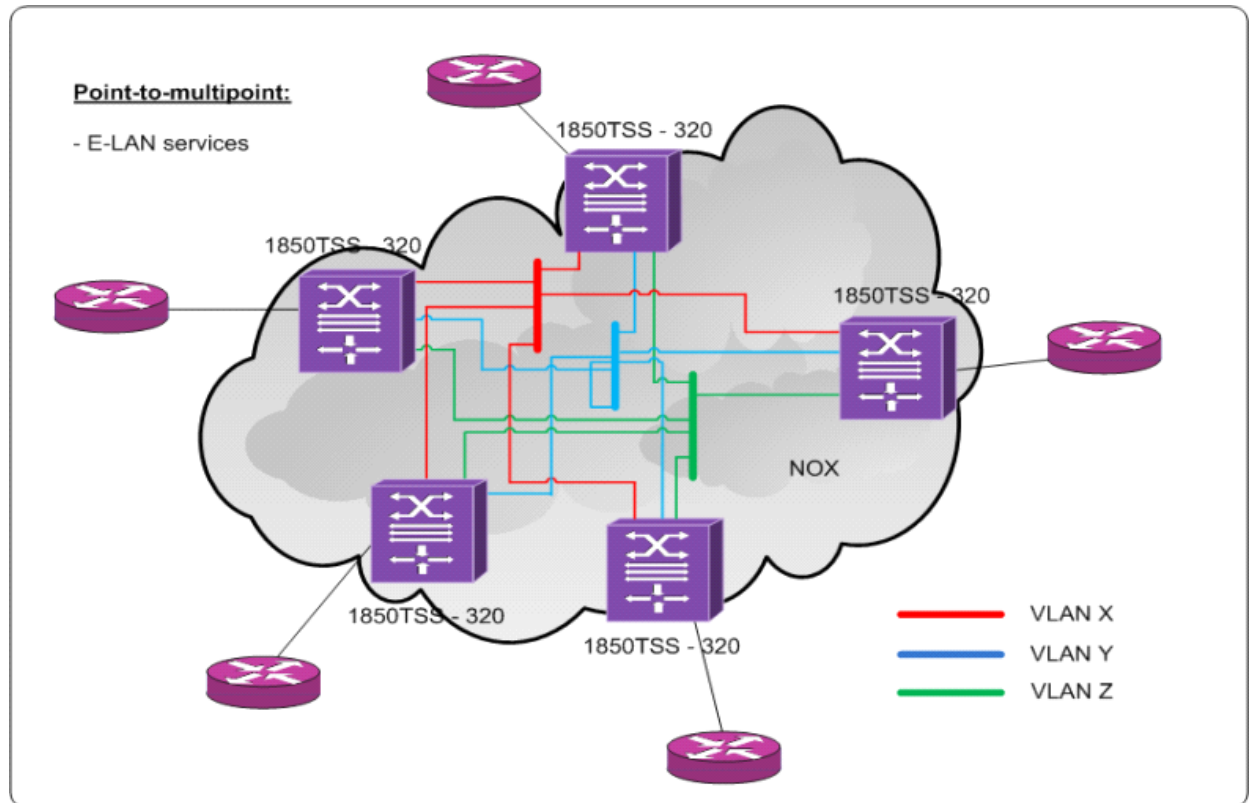
- Point to point:

    o   Without VLAN segmentation.
    o   With VLAN segmentation.

    Point to point services provides the possibility of interconnecting two sites for Ethernet transport. The traffic can be segmented into several VLANs if this is required. There is also possibility for different types of traffic classification and prioritization. This solution gives the customer a total control over the quality and the security of the link.

Figure 1 Point-to-point service
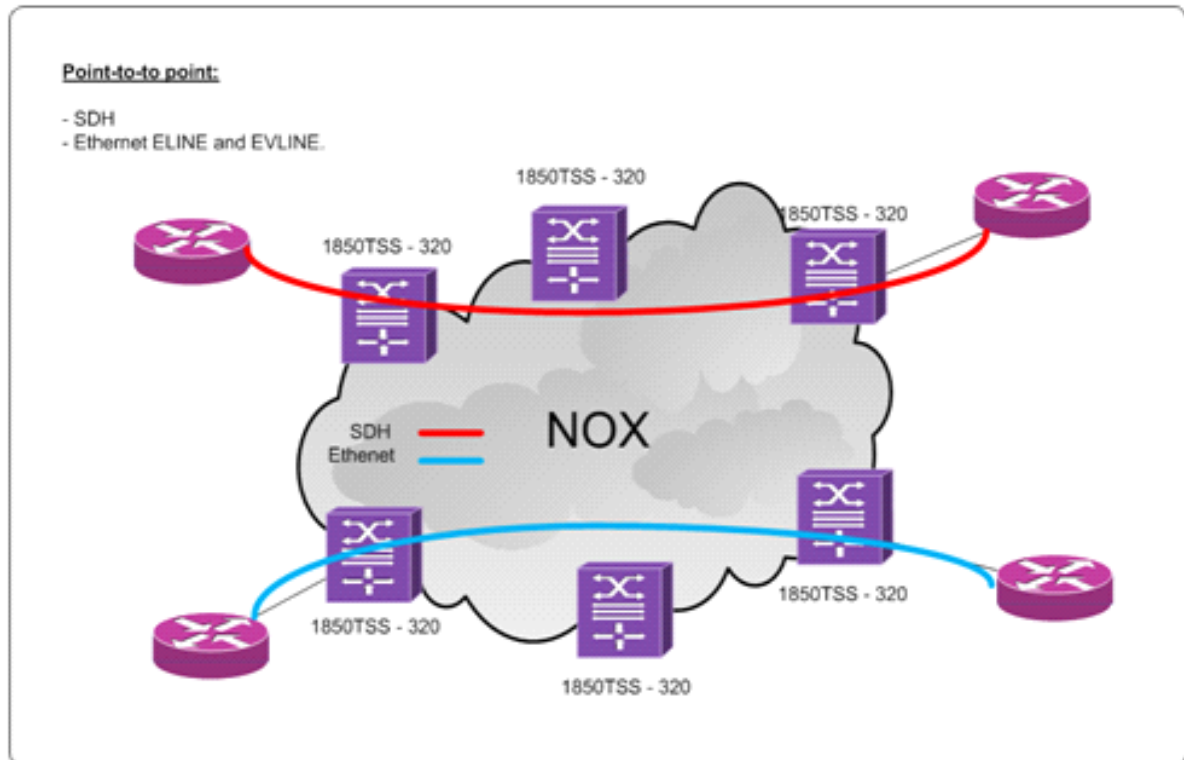
- Multipoint to multipoint (Full-mesh):

  - LAN services:

    - Without VLAN segmentation.
    - With VLAN segmentation.

    Multipoint to multipoint service provides the customer the possibility of interconnecting several locations like they were in the same LAN. The traffic can be also segmented into several VLANs if required and different QoS can be applied to each VLAN or to specific traffic inside a VLAN. This service simulates a Layer 2 Network.

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Figure 2 Point-to-multipoint services

> o Aggregation services (HUBSpoke Topology)
>
>   ▪ Without VLAN segmentation.
>   ▪ With VLAN segmentation.
>
> Aggregation services are a type of point to multipoint solution where the traffic flows from different location to a central location. The same possibilities than in the point to multipoint solution apply.

Figure 3 Aggregation services (HUB-Spoke Topology)
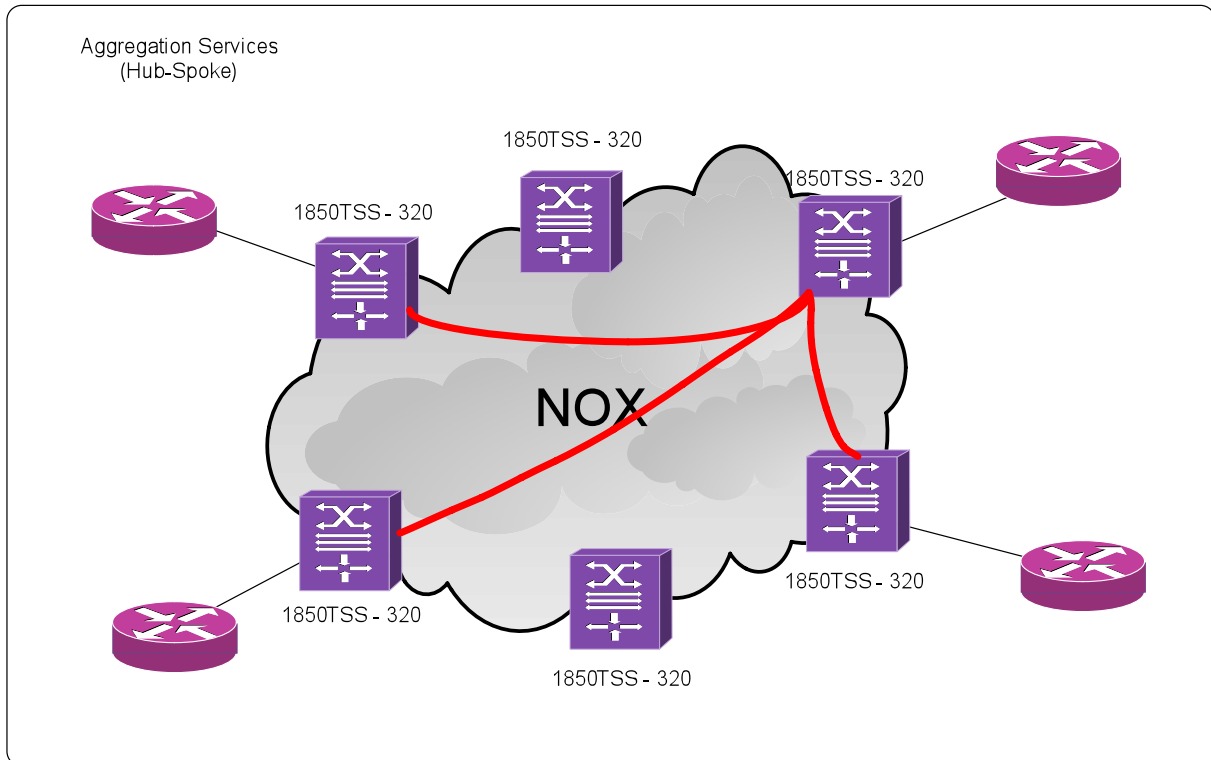
Ethernet Services summary:

Table 3 Ethernet Services

Topology	Services	Standard	Ethernet Service
	Private Line	MEF	E-Line
		ITU-T (G.8011)	EPL
		IETF	VPWS
	Virtual private line	MEF	E-Line
		ITU-T (G.8011)	EVPL
		IETF	VPWS
	Private LAN	MEF	E-LAN
		ITU-T (G.8011)	EPLAN
		IETF	VPLS
	Virtual Private LAN	MEF	E-LAN
		ITU-T (G.8011)	EPLAN
		IETF	VPLS
	Aggregation Service	MEF	N x E-Line
		ITU-T (G.8011)	EMAPL
		IETF	N x VPWS
	Virtual Aggregation Service	MEF	N x E-Line
		ITU-T (G.8011)	EMAVPL
		IETF	N x VPWS

3.3 Traffic differentiation (QoS)

NORDUnet offers three types of traffic classes giving the customer the possibility to prioritise specific traffic flows from other traffic less important.

- Bronze: This is reserved for best effort or low priority traffic that tolerates large r delay.
- Silver: It is reserved for medium priority traffic.
- Gold: It is reserved for high priority traffic with low tolerance to delay and packet lost.

NORDUnet can provide a QoS design suggestion so the customer can get the best performance and functionality out of its network.

3.4 Link aggregation

Higher bandwidths than 1 GE or 10 GE are available by using link aggregation protocol. NORDUnet's equipment complies with standard IEEE 802.3ad being able to provide several parallel interfaces working as a single logical interface.

Another benefit from this technology is link redundancy. However there is only redundancy if there is available bandwidth in the remaining links.

3.5 Network redundancy

Due to the fact that Ethernet traffic is carried over SDH infrastructure, redundancy is provided at the physical layer. Refer to the SDH Service Delivery documentation for more information.

4 Future services

NORDUnet as part of its policy is developing and evolving the network constantly. For this reason NORDUnet's NOX will be T-MPLS enabled in the near future. T-MPLS is a connection oriented packet transport technology based on MPLS frame format. T-MPLS standard defines OAM capabilities comparable to the SDH and OTN technologies including protection switching (50 ms) and restoration mechanisms.

T-MPLS allows as well network provisioning via a centralised management in combination with GMPLS. This will give the customer the possibility to control net work resources over the provider's network.

For more information please contact NORDUnet.

Figure 4 T-MPLS technology
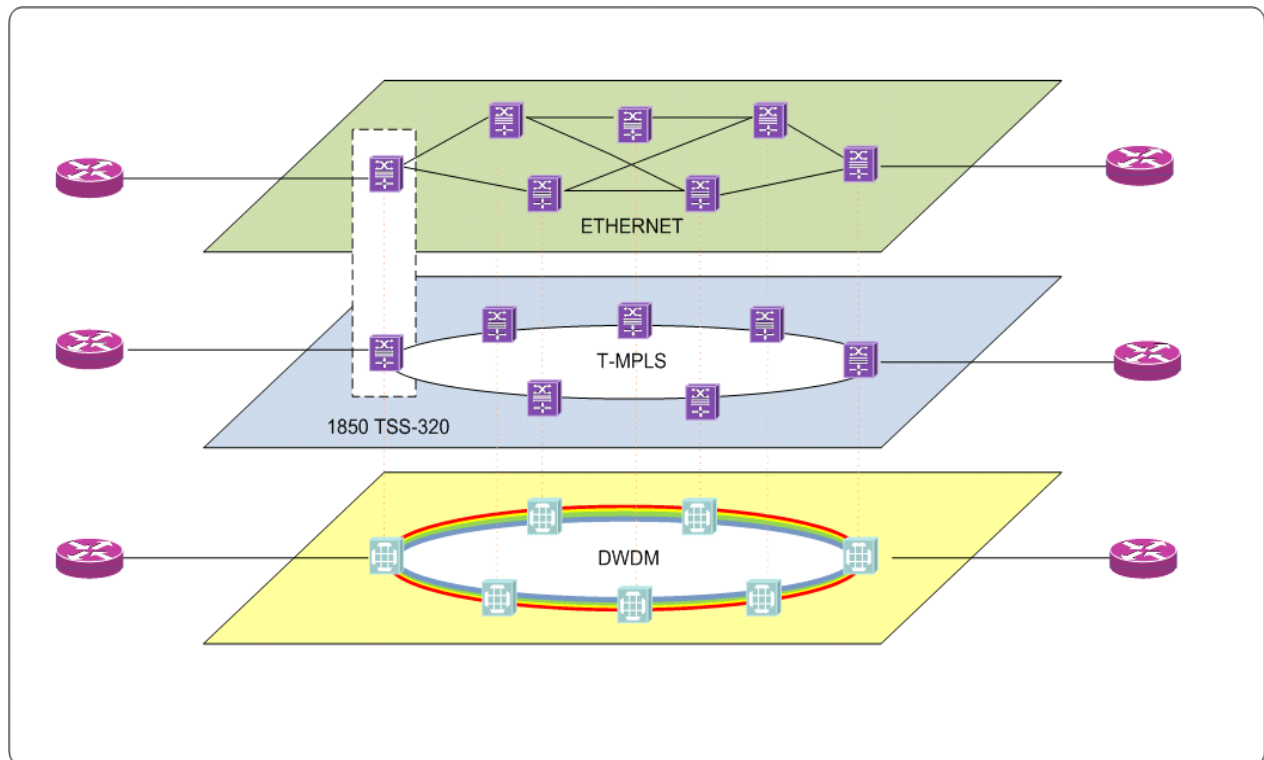
4.1 Telecommunications Management Network TMN

From NORDUnet's international Network Operation Centre NUNOC the Ethernet services is remotely set up and manage between NORDUnet's various PoP's, ensuring timely deliveries and the highest levels of availability.

NORDUnet is supervising and managing the entire network using powerful Network Management solutions with flexible and scalable architecture.

5 NORDUnet

NORDUnet is the Nordic Infrastructure for Research and Education and provides the Nordic backbone to the Global Infrastructure for Research and Education.

NORDUnet has its roots in the NORDUNET programme which was financed by the Nordic Council of Ministers.

NORDUnet is a Danish limited company owned by the governments or government institutions in Denmark, Finland, Iceland, Norway and Sweden.

NORDUnet is based on next generation research network that provides the Nordic research and education community with a high bandwidth Optical Private Network, Northern Light Optical Exchange which is a part of the Global Optical Light Exchange

and a Pan Nordic IP network. NORDUnet will ensure adequate capacity both for e-Science, e-Engineering, and e-Business requirements for the foreseeable future.

Further information can be found on www.nordu.net

The history of NORDUnet can be found on www.nordu.net/history

6 Glossary of Terms

DWDM	Dense Wavelength Division Multiplexing
E2E	End-to-end (a dedicated path over multiple network domains each segment comprising a P2P circuit)
End to End	An end-to-end circuit will use a point to point circuit pr single domain. The E2E circuit terminates with the responsibility of the customer demarcation point.
FSKnet	Forskningsnettet
FUNET	Finnish University Network
GbE	Gigabit Ethernet
Gbps	Gigabit per second
GFP	Ethernet is map into SDH framing by using GFP (Generic Frame Protocol, ITU-T G.7041)
GMPLS	Generalized Multiprotocol Label Switching
LAN	Local Area Network
LCG	LHC Computing Grid
LHC	Large Hadron Collider – A physics experiment at CERN, Switzerland.
MAN	Metropolitan Area Networks
MPLS	Multiprotocol Label Switching
NMS	Network Management System
NOC	Network Operations Centre
NORDUnet	Nordic University Network
NOX	Northern Light Optical Exchange
NREN	National research and education network
NSAP	Network Service Access Point som er en AESA
OAM	Operation, Administration, and Maintenance
ODR	Optical Distribution Rack
OPN	Optical private network
OSI	Open System Interconnection – seven layer model
OSS	Operation and Support System
OTH	Optical Transport Hierarchy
OTN	ITU Standard G.709 is commonly called Optical Transport Network (OTN) or digital wrapper technology. OTN is currently offered in three rates, OTU1,OTU2 and OTU3.
Point to Point	Point-to-point (a dedicated circuit configured between two points over a single network domain)
PoP	Point of presence
QoS	Quality of Service
RM/BM	Management software
SDH	Synchronous Digital Hierarchy
SNMP	Simple Network Management Protocol

STM-x	The STM-1 (Synchronous Transport Module) is the basic rate of transmission of the SDH ITU-T fiber optic network transmission standard. It has a bit rate of 155.52 Mbit/s. The other levels are STM 4, STM 16 and STM 64.
SUNET	Sweden University Network
T-MPLS	Transport Multiprotocol Label Switching
T-ROADM	Tuneable-ROADM
TT	Trouble Ticket
UBR	Unspecified Bit Rate
UNI	User Network Interface
UNINETT	University Network Norway
WAN	Wide Area Network

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