

NORDUnet Network Service Description

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1 Objective

The objective is to describe at a high level all network services offered by NORDUnet.

2 Target Group

The target group is NORDUnet's customers.

3 Introduction

The NORDUnet network offers the Nordic and International research and education community a range of opportunities for international collaboration. NORDUnet's single domain provides a hybrid network architecture which connects to international NREN partners forming multi domain hybrid network architecture free from the constraints inherent in a shared, routed infrastructure.

This document describes on a high level the NORDUnet service offering in cooperation with international NREN partners. The individual services are profoundly describe in these service descriptions

- SDH Service Description
- Ethernet Service Description
- OTN Service Description
- Hosting Service Description

Exceptions form this service description can be applied via negotiation with NORDUnet.

3.1 NORDUnet Network

Northern Light Optical Exchange is based on state of the art Alcatel-Lucent 1850 transport nodes which are interconnected via NORDUnet's world class pure optical network based on Alcatel-Lucent sophisticated Tuneable-ROADM 1626 LM and dark fiber delivered by Global Crossing and Telenor.

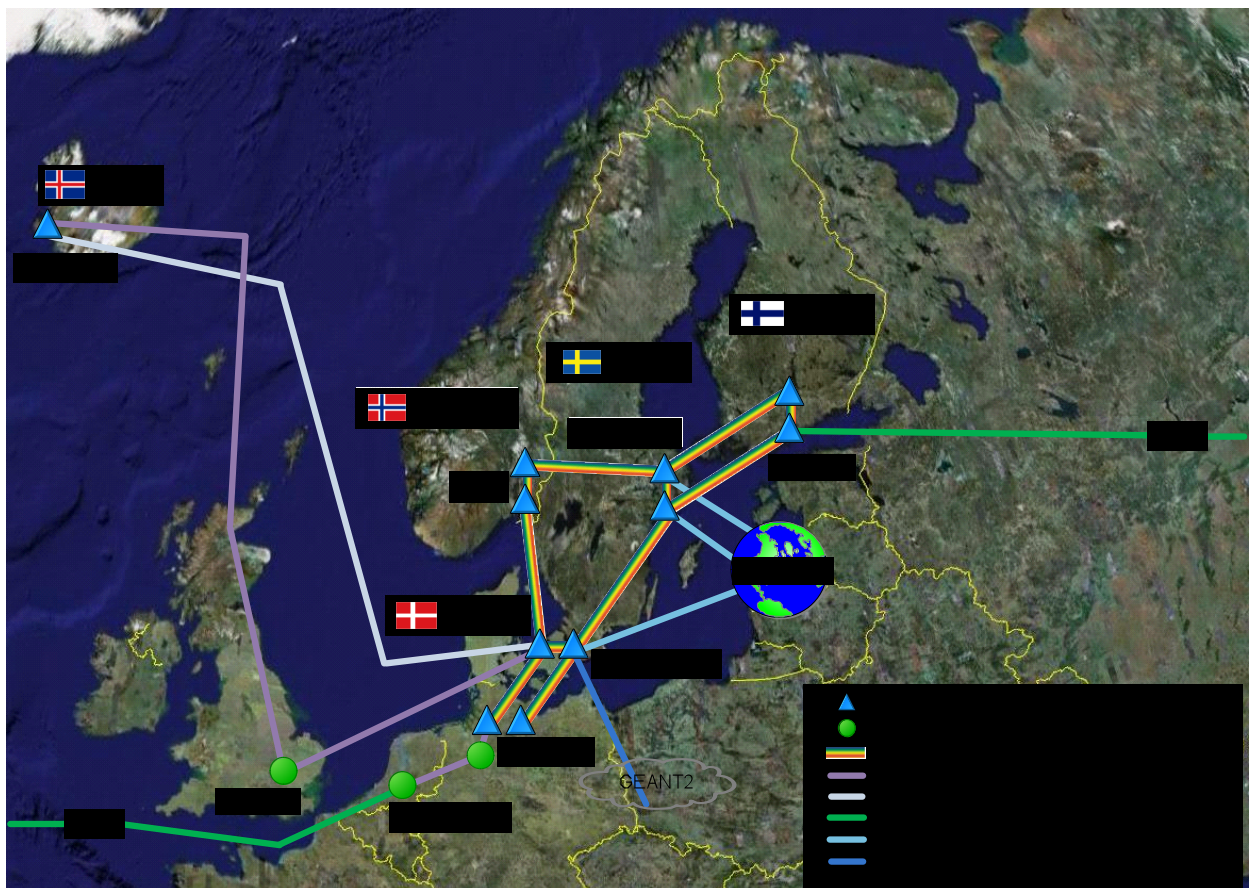
The NORDUnet network architecture interconnects multiple lambdas and Light paths between Nordic and International network facilities. It is specifically designed and built to carry and switch transport services like OTN, SDH, Ethernet and other bandwidth services. The meshed and diversified network has the built-in redundancy that is necessary to carry business critical traffic. As NORDUnet control and manage the network on every level – from the duct to the fibre to the transport layer – customers can be assured that NORDUnet have tight control over operational and maintenance without compromising quality.

The NORDUnet network architecture provides multiple specialized international high-performance communication services in partnership with other advanced research networks.

From NORDUnet’s international 24/7 Network Operation Centre NUNOC all services are remotely set up and managed ensuring timely deliveries and the highest levels of availability. As business and research projects needs to evolve, destinations can be easily added or upgraded to meet future requirements.

NORDUnet is able to supervise their entire network using powerful Network Management solutions with flexible and scalable architecture.

The NORDUnet Network Schematic is outlined below



4 NORDUnet Service

The NORDUnet service is separated into a single domain service and a multi domain service.

4.1 Single Domain Service

The Single Domain Services are defined as a service where all endpoints are located in the Nordic NREN domain.

The Nordic NREN domain consists of FSKnet, FUNET, RHnet, SUNET and UNINETT.

NORDUnet has the opportunity to provide this service in two different ways.

1. NORDUnet Single Domain Service
2. Nordic Voluntary Collaboration Service

4.2 Multi Domain Service

The Multi domain Service is defined as a service where at least one endpoint is located in a Nordic NREN domain and at least one endpoint is located outside the Nordic NREN domain.

NORDUnet has the opportunity to provide the Multi Domain Service in three different ways.

1. GÉANT2 Collaboration Services - only valid for European NRENS
2. International Partners Service
3. International Voluntary Collaboration Service

5 Single Domain Service

5.1 NORDUnet Single Domain Service

The NORDUnet Single Domain Service is a carrier grade hybrid redundant network providing a non-stop service offering. Additionally NORDUnet can provide hosting service on selected points of presence.

NORDUnet can provide OTH, SDH and Ethernet service thereby making it possible to deliver a Point to Point service or a Virtual Private Network within the Nordic region.

All services can be delivered with capacities ranging up to 40 Gbps per entry point.

The cost structure is based on NORDUnet's general service pricing. Please contact NORDUnet for further information.

5.1.1 Point to Point

Point to Point service is a dedicated path from POP to POP which is a dedicated circuit configured between two points within a single network domain, with the opportunity for different types of traffic classification and prioritization.

5.1.2 Virtual Private Network

Virtual Private Network service provides the customer the possibility to interconnecting several locations like they were in the same LAN. The traffic can be segmented into several Virtual Private Networks if required and different quality of service can be applied to each Virtual Private Network or to specific traffic inside.

5.1.3 Colocation Service

NORDUnet can offer Telco grade Colocation Service on selected points of present. The two locations are site Orestaden in Copenhagen Denmark and site Tulegatan in Stockholm Sweden.

NORDUnet can assist in acquiring hosting at other locations. Please contact NORDUnet for further information

5.2 Nordic Voluntary Collaboration Service

Together with Nordic NREN Partners NORDUnet can take the leading role in providing network services as described in the previous sections on a low cost or free of charge basis for a limited period of time and based on a best effort service agreement – this service is denoted Nordic Voluntary Collaboration Service

The following requirements applies in order to request a Voluntary Collaboration Service

- The service shall be used in relation to a science or research project. Justification must be submitted in writing.
- The service termination date shall be specified
- NORDUnet cannot guarantee the delivery time – best effort is applied
- The service is subjected to a best effort service agreement

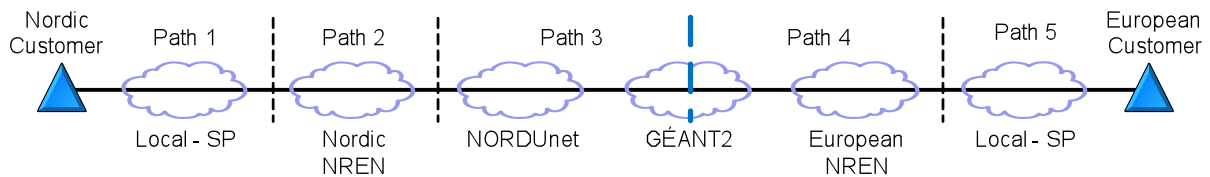
6 Multi Domain Service

6.1 GÉANT2 Collaboration Service

NORDUnet can in cooperation with DANTE and European NRENs offer two distinct classes of End to End services to Nordic NRENs and European NRENs. Both offered services are composed service as outlined below.

- Hybrid Service
 - GÉANT+ service combine with NorthernLight Optical Exchange service and an equivalent European NREN service
- Wavelength Service
 - GÉANT Full wavelength services combine with NORDUnet wavelength service and equivalent European NREN service

The End to End service schematic is outlined below showing the path from a Nordic customer to a European NREN customer.



Normally the cost structure is based on a shared cost between NORDUnet and the European NREN for the GÉANT2 service as outlined above. However, it is possible that either NORDUnet or the European NREN pays for the entire GÉANT2 service.

6.1.1 Hybrid Service

Hybrid service can be delivered as an End to End service, outlined as a dedicated path over multiple network domains each segment composed as point to point service. The Point to Point service is a dedicated circuit configured between two points over a single network domain with the opportunity for different types of traffic classification and prioritization. The end points can be delivered as:

- Gigabit Ethernet with and without rate limiting
- STM-1, STM-4 and STM-16

The delivery time is normally 2 weeks from confirmation of an order.

6.1.2 Full Wavelength Services

The full wavelength service can be delivered as an End to End wavelength as a dedicated path over multiple network domains. The demarcation points for the single domain are utilizing optical to electrical to optical conversion at the entry points and the Point to Point wavelength service within the domain is a transparent wavelength. The end points can be delivered as:

- STM-64
- OTU-2
- LAN 10GBase-LR
- Optional – 40G wavelength service. Please contact NORDUnet for further information

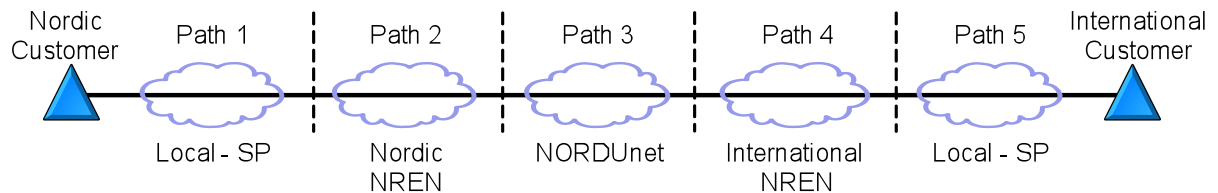
The delivery time is depending on the GÉANT2 delivery time which is normally 14 weeks from confirmation of an order.

6.2 International Partner Service

NORDUnet can provide OTH, SDH and Ethernet service in cooperation with International NREN Partners across the world. Thereby making it possible to deliver a End to End service or a Virtual Private Network from the Nordic region to anywhere in the world.

Both services can be delivered with capacities ranging up to 40 Gbps per entry point.

The service schematic is outlined below showing the path from a Nordic customer to an International Customer.



Normally the cost structure is based on a setup where NORDUnet handles path 3 to 5 in order to provide a single point of contact for the Nordic NREN or path 1 to 3 if it is viewed from the International NREN Partner.

6.2.1 End to End

End to End service is a dedicated path over multiple network domains each segment comprising a point to point service. The Point to Point service is a dedicated circuit configured between two points over a single network domain with the opportunity for different types of traffic classification and prioritization.

6.2.2 Virtual Private Network

Virtual Private Network service provides the customer the possibility to interconnecting several locations like they were in the same LAN. The traffic can be segmented into several Virtual Private Networks if required and different quality of service can be applied to each Virtual Private Network or to specific traffic inside.

6.3 International Voluntary Collaboration Service

Together with International NREN Partners across the world NORDUnet can take the leading role in providing network services as described in the previous sections on a low cost or free of charge basis for a limited period of time and based on a best effort service agreement – this service is denoted International Voluntary Collaboration Service

The following requirements applies in order to request a International Voluntary Collaboration Service

- The service shall be used in relation to a science or research project. Justification must be submitted in writing.
- The service termination date shall be specified
- NORDUnet cannot guarantee the delivery time – best effort is applied
- The service is subjected to a best effort service agreement

7 Enquiry and Order Procedure

This section describes the enquiry and order procedure for all NORDUnet Network Services.

Please note that the enquiry and order procedure are similar for all services.

7.1 Enquiry Procedure

The procedure for requesting a quote for a service is outlined below

1. Customer submits a service request to its local NREN. Information required:
 - a. Contact information
 - b. Service Type
 - c. Service capacity
 - d. Interface type
 - e. Local Nordic termination address
 - f. Foreign country termination address
 - g. Short description of the application using the service
 - h. Optional - Local loop provider
2. NREN submits the request from the Customer to NORDUnet
3. NORDUnet will within 15 working days reply with a proposal on the requested service containing
 - a. Price for path 3 – see section 2.1 or 2.2
 - b. NORDUnet local Nordic interconnect point
 - c. NORDUnet contact information
 - d. NORDUnet project reference number
4. The NREN can submit a distinctive proposal to the Customer based on NORDUnet's proposal
5. The Customer can now evaluate the proposal submitted by the NREN

In a case where NORDUnet only can provide a proposal covering some domains the counterpart NREN and customer must conduct the same enquiry process towards their supplier and thereby making the proposal complete for the End to End service. NORDUnet can assist in contact information and other technical and commercial matters in order to solve this issue.

7.2 Order Procedure

The procedure outlined below describes how a Customer can order a service

1. The Customer submits an order to its local NREN
2. NORDUnet's service order form is fill in by the NREN before submitting it to NORDUnet
3. The order is processed and NORDUnet will ensure that the service is ordered in corporation with partners

4. NORDUnet will submit the following documents to the NREN
 - a. Welcome letter as a order receipt
 - b. Service contract
 - c. Service agreement
 - d. Service level agreement
5. NORDUnet will receive a ready for service document from its partners when the service is ready for use
6. NORDUnet submits a service delivery report to the NREN when the service is ready for use
7. The NREN informs the Customer that the requested service is ready for use

NORDUnet will provide service performance reporting according to the agreed service level agreement which is a part of the NORDUnet service management.

8 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

9 Glossary of Terms

| | |
|------------|---|
| APM | Access Point Manager – A person at the NREN site who is responsible for the liaison between the NREN and the GEANT2 NOC / E2ECU regarding the Access Point and services across it. Each APM assigns a backup APM. |
| DWDM | Dense Wavelength Division Multiplexing |
| 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 |
| JRA | Joint research activity |
| LAN | Local Area Network |
| 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 |
| OAM | Operation, Administration, and Maintenance |
| OPN | Optical private network |
| 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 |
| ROADM | A reconfigurable optical add-drop multiplexer (ROADM) is a form of optical add-drop multiplexer that adds the ability to remotely switch traffic from a WDM system at the wavelength layer. This allows individual wavelengths carrying data channels to be added and dropped from a transport fiber without the need to convert the signals on all of the WDM channels to electronic signals and back again to optical signals |
| SDH | Synchronous Digital Hierarchy |
| 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 | Swedish University Network |
| Tier 0,1,2 | The LHC sends its research data to Tier 0 organisations to enable analysis. These Tier 0s then send data to Tier 1s, who send data to Tier 2s. The LHC OPN facilitates this large data transfer. |
| T-MPLS | Transport Multiprotocol Label Switching |
| T-ROADM | Tunable-ROADM |
| TT | Trouble Ticket |
| UNINETT | University Network Norway |
| WAN | Wide Area Network |

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