GN3plus Open Call:
Technical Annex C – GÉANT Bandwidth on Demand Service Description

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THE SEVENTH FRAMEWORK PROGRAMME
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0 Executive Summary

This technical annex is provided in support of the GN3plus Open Call. It provides a technical description of the GÉANT Bandwidth on Demand (BoD) service to support submissions to the following Open Call topics:

- Theme 1: Innovative Uses of GÉANT Network Facilities.
  - Topic 3: Novel uses of GÉANT Dynamic Circuits (Bandwidth on Demand).

This document describes the BoD service offered across multiple NREN networks within the GÉANT service area. The document is structured as two parts:

- A **general service description** which explains the service at a high level.
- A **service functionality description** which explains what is included in the service offering. This information is provided to help Open Call proposers understand how to connect to the service and initiate service requests.

1 General Service Description

The GÉANT bandwidth on demand (BoD) service is an end-to-end, point-to-point bi-directional connectivity service for data transport with access at Ethernet interfaces. The BoD service allows users to reserve bandwidth on demand between the end points participating in the BoD service. The data transport capacity dedicated to a connection can range from 1 Mbps up to 10 Gbps in steps of 1 Mbits/s.

The service is offered collaboratively by GÉANT and a set of adjacent domains (NRENs or external partners) that adhere to the requirements of the service. These cooperating networks form a multi-domain service area.

The service is designed to meet the needs of users who frequently transfer large data sets between two end points. The data transport capacity is negotiated on a per request basis and is either accepted or rejected once the request has been submitted. The service offers a higher level of security as the carried traffic is isolated from other traffic. It has to be noted that the traffic is isolated at the logical layer and not necessarily at the physical layer. This means that the core network will carry data from multiple users, but there will be no "crosstalk" between the traffic streams. From the users' perspective, each instance of the service is a virtual circuit between the two end points between which the traffic is exchanged in a manner isolated from other data flowing within the involved networks. The bandwidth offered by the service is not over-subscribed in any of the networks, making it possible to deliver deterministic throughput.

The service offers on-demand connections with short lead times. Please note that these short lead times are only possible once the BoD access port and last-mile connection are in place. At the time that a connection is reserved, the user must nominate the end points of the connection.

Connection requests can be initiated in one of two ways:

- Using the GÉANT web portal. This method is used when the connection is requested by a person.
- Using an API interface. Several APIs are supported. However applicants are encouraged to use the OGF NSI interface specification. Proposals for trials of NSI v2.0 are also of interest to the GÉANT community. For details of the NSI working group, see [NSIWG]. For details of NSI v1.1, see [NSIv1.1].

A monitoring tool that tracks the availability of the connections is provided for operations and monitoring purposes. In addition, a service support structure (Infrastructure Support Team, Service Desk) is established for problem resolution and maintenance support.

Figure 1.1 below shows a BoD circuit traversing three networks from end point “A” to end point “Z”. End users who are connected to an NREN that offers the BoD service will be able to make on-demand data transfers to other end users with similar capabilities. The connection to the NREN through regional or campus networks can be done using a static assigned connection (typically VLANs). This means that the end user will have to have one connection established permanently; hereafter the connections can be established on demand, i.e. dynamically.

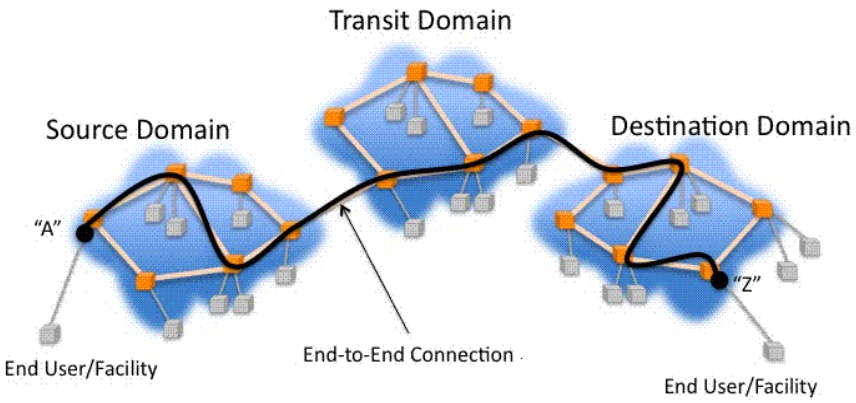

Figure 1.1: End-to-end multi-domain architecture of Bod

2 Service Functionality Description

The BoD service is a dynamic service based on end-user requests (end users are defined as the direct customers of the federation of the domains that provide the BoD service). The end user specifies the two end points (Service Demarcation Points – SDPs) of the service, located at the edges of the federated domain. Depending on the configuration and capabilities of the selected SDPs, the user may select to transport 802.3 frames (untagged Ethernet) or 802.1q frames. Also, depending on the capabilities of the SDPs, VLAN rewrite or VLAN stripping may be allowed. The user also specifies other parameters such as the capacity and the start/stop time of the request, etc. The user request is authenticated and, if authorised, the appropriate network resources in an appropriate path between the two end points of the circuit are allocated. The allocation of the resources is done in a way that both meets the service request parameters and adheres to the Service Level Specification (SLS) of the service. The latter specifies the standards and limits of the provided service that cannot be exceeded in order to keep the service at a satisfactory level for the user.

2.1 Transport Modes

During the reservation process, the user is presented with a list of service demarcation points (SDPs) and their capabilities. By choosing an SDP, the user implicitly also chooses the transport mode for the specific service instance. The transport mode defines the different types of Ethernet frames which can be transmitted. Note that the end user will not select the transport mode directly. The transport mode reflects combination of allowed end-point configurations. The available transport modes are presented in Table 2.1 below. Each is described in more detail in the sections that follow.

Transport Mode	SDP A	SDP B	Service Payload	Traffic direction	Service delimiter	Transparent
ETS-Untagged	Access 802.3	Access 802.3	Untagged Frame	Upstream (A->B)	None (accept all 802.3 frames)	• Payload • Source MAC • Destination MAC
				Downstream (B->A)	None (accept all 802.3 frames)	
ETS-VLAN	Trunk 802.1Q	Trunk 802.1Q	Tagged Frame (802.1q with appropriate VID)	Upstream (A->B)	VID (accept only specific VLAN tag in SDP A, if needed change VLAN tag)	• Payload • Source MAC • Destination MAC
				Downstream (B->A)	VID (Accept only specific VLAN tag in SDP B, if needed change VLAN tag)	
ETS-Port-Transparent	Trunk 802.1Q	Trunk 802.1Q	Any frame	Upstream (A->B)	None	• Payload • Source MAC • Destination MAC • 802.1Q header (VLAN tag)
				Downstream (B->A)	None	
ETS-VLAN-To-Untagged	Trunk 802.1Q	Access 802.3	Untagged frame (at one SDP frame will get defined tag)	Upstream (A->B)	VID (Accept only specific VLAN tag in SDP A, remove 802.1q header)	• Payload • Source MAC • Destination MAC
				Downstream (B->A)	None (Accept all 802.3 frames in SDP B, add 802.1q header)	

Table 2.1: Overview of the transport nnodes available for GÉANT BoD service

2.1.1 ETS-Untagged: Transport of Untagged Ethernet Frames

In the simplest form of the service, the service transports 802.3 Ethernet frames between the two SDPs.

The two physical ports that correspond to the two SDPs must be configured as “access” ports so as to be able to receive and send only untagged 802.3 frames. Each frame is delivered with its payload and size intact; however, the delivery order of the packets may be changed (although, whenever possible, this will not happen). The header fields of the packet, including the source and destination MAC address and length fields, will also be delivered intact to the egress SDP.

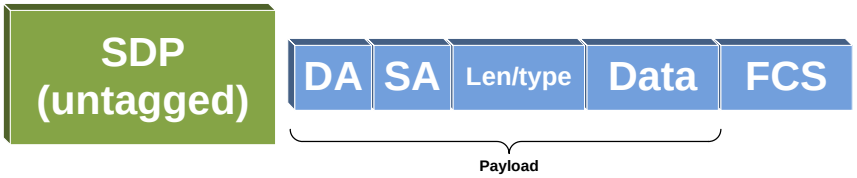

Figure 2.1: ETS-Untagged transport mode

2.1.2 ETS-VLAN: Transport of VLAN Payload (with/without VLAN Rewrite)

In the ETS-VLAN mode, the service transports 802.1q frames that are received on an ingress port with a specific VLAN tag and delivers them on an egress 802.1q port. The frame, upon delivery, can maintain its VLAN tag or change it to another specified value (VLAN rewrite).

The two physical ports that correspond to the two SDPs must be configured with 802.1q encapsulation so as to be capable of receiving and sending tagged 802.1q frames. All ingress frames that match Ethertype 0x8100 and the specified VLAN tag are transported and delivered to the egress SDP. Each frame is delivered with its payload and size intact; however, the delivery order of the packets may be changed (although, whenever possible, this will not happen). With regard to the header fields of the packet, the source and destination MAC address, the Ethertype and the length fields are delivered intact. The VLAN field may remain intact or may be rewritten, depending on whether the user has chosen the same VLAN ID on the two SDPs or not.

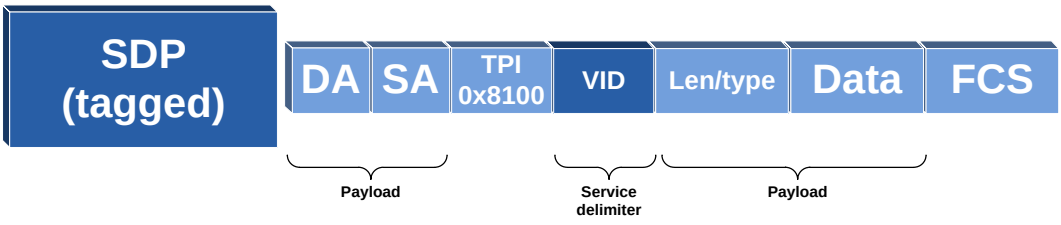

Figure 2.2: ETS-VLAN transport mode

2.1.3 ETS-Port-Transparent: Transport of Tagged Ethernet Frames

In the ETS-Port-Transparent mode, the service transports all frames (802.1q and 802.3) received on an ingress port to an egress 802.1q port.

The two physical ports that correspond to the two SPDs must be configured so as to be capable of tunnelling 802.1q frames generated by the end user. In most cases this is done by changing the Tag Protocol Identifier (TPID) value for the interface to a value other than 0x8100 and configuring an untagged service instance on it. All ingress frames that are untagged (802.3) or tagged with Tag Protocol Identifier ("Ethertype") 0x8100 are transported and delivered to the egress SDP. Each frame is delivered with its payload and size intact; however, the delivery order of the packets may be changed (although, whenever possible, this will not happen). The header fields of the packet, source and destination MAC address, length and, in 802.1q, Ethertype and VLAN fields are delivered intact.

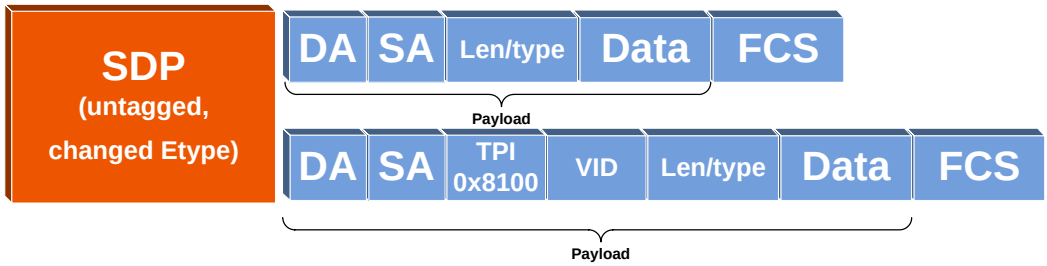

Figure 2.3: ETS-Port-Transparent transport mode

2.1.4 ETS-VLAN-To-Untagged: Transport of Tagged Ethernet Frames to Untagged Port

In the ETS-VLAN-To-Untagged mode, the service transports 802.1q frames that are received on an ingress port with a specific VLAN tag to an untagged 802.3 egress port; and vice-versa.

In this mode, the port that corresponds to the one end point must be configured as 802.1q "trunk" and the other as "access". All frames received on the 802.1q SDP that match Ethertype 0x8100 and the specified VLAN tag are transported and delivered to the egress 802.3 SDP and vice versa. Each frame is delivered with its payload and size intact; however, the delivery order of the packets may be changed (although, whenever possible, this will not happen). With regard to the header fields of the packet, the source and destination MAC address and the length fields are delivered intact. The Ethertype and VLAN fields are stripped or added (depending on the direction), in order to form the appropriate egress frame.

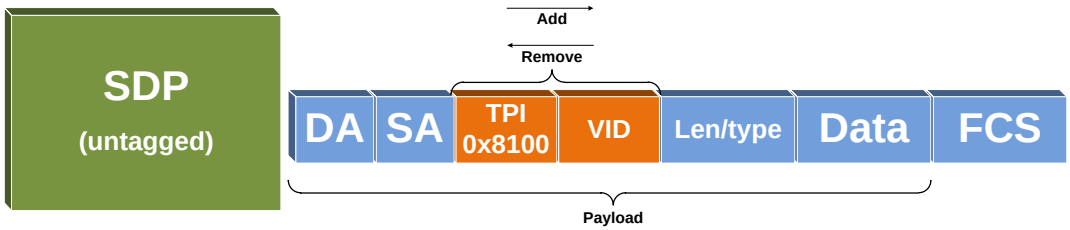

Figure 2.4: ETS-VLAN-To-Untagged transport mode

2.2 Transport Parameters

When requesting a service the user specifies the transport parameters that describe the details of the desired service. These transport parameters are described in the following sections.

2.2.1 Service Demarcation Points (SDPs) and Path

The most important parameters of the service request are the service end points. Each end point is comprised of the SDP and, if applicable, a service delimiter. By convention, the two SDPs are called “Ingress” and “Egress”, but since the service is bi-directional the SDPs are equivalent and they act as both ingress and egress. Depending on the capabilities of the SDPs, the user selects the appropriate transport mode (listed in Section 2.1) and service delimiter. The service delimiter allows differentiation of services on the same SDP. For example, on an SDP that corresponds to an Ethernet Port transporting tagged frames, the service delimiter is the VLAN ID number. The user may also want to influence the selected path by defining “domains” that should be included or excluded. However, this functionality will not be available on the first version of the service.

Parameter	Description	Value	Default
Ingress SDP	The Service Demarcation Point identifying the ingress of the traffic	*Ethernet input port* (must be a port within the ETS reachability database for the local network. A point in a remote network is acceptable if the service request and the remote service definition are compatible) URN identifier of port	*<none>* (i.e. this is required to be specified in the request)
Ingress Service Delimiter	The parameter allowing differentiation of services on the Ingress SDP	*VLAN ID (number)*	*<none>* (if not applicable)
Egress SDP	The Service Demarcation Point identifying the egress of the traffic	*Ethernet output port* (must be a port within the ETS reachability database for the local network. A point in a remote network is acceptable if the service request and the	*<none>* (i.e. required to be specified in the request.)

Parameter	Description	Value	Default
		remote service definition are compatible) URN identifier of port	
Egress Service Delimiter	The parameter allowing differentiation of services on the Egress SDP	*VLAN ID number*	*<none>* (if not applicable)
ETS-Port-Transparent	The parameter that sets SDP in “VID transparent” mode	*Enabled/Disabled*	Disabled
Path constraints	Path calculation constraints	*Domain list*	*<none>*

Table 2.2: GÉANT BoD service supported end-point parameters

2.2.2 Service Stitching Points (SSPs)

Service Stitching Points (SSPs) are the points where participating networks interconnect to support multi-domain services. SSPs form demarcation points between neighbouring domains (for example, NREN networks). It has to be noted that domains are free to use equipment and transport technologies of any kind, the only limitation being that they are able to transport end users’ Ethernet frames. This makes SSPs very sensitive to the type and characteristic of the transported traffic.

2.2.3 Conduit Parameters

The BoD service requires that some parameters remain unchanged across domains. These parameters include Maximum Transmission Unit (MTU) and Capacity.

Ethernet transmission does not allow segmentation and reassembly of transferred frames. Hence the multi-domain network must be able to carry entire Ethernet frames of the size required by the end user. This is required to guarantee that over the length of the service the MTU will not be smaller than the end-user frame.

The second conduit parameter is Capacity, which defines the maximum end-to-end data rate that is guaranteed to the user. In order to avoid buffering and even data loss, the capacity of a particular BoD service instance must be the same in all participating domains (or at least no less than the user request).

Parameter	Description	Value	Default
MTU	The requested Maximum Transmission Unit, including the header bytes (but not the preamble and the FCS)	9000 bytes (up to 9180 bytes if available)	By default the MTU will be presented to the end user as the maximum MTU size allowed in the domain that offers the lowest MTU among others participating in the service. The end user can also request a specific MTU. When this constraint cannot be met, the service

Parameter	Description	Value	Default
			request will be rejected. Minimum value should be 9000 bytes.
Capacity	The rate of bits that will be accepted at the ingress point, in terms of Mbps.	1 Mbps to 10 Gbps in 1 Mbps increments	*<100 Mbps>*

Table 2.3: GÉANT BoD service supported conduit parameters

2.2.4 Time Parameters

Advance reservation of connections is an important functionality of the BoD service. The functionality is not supported in the current release of the service.

Parameter	Description	Value	Default
Start Time	The starting time of the service	*DateTime*	*<Now>* (implies "after certain lead time")
End Time	The ending time of the service	*DateTime*	*<Never>* (implies "until manually deleted")

Table 2.4: GÉANT BoD service supported time parameters

2.3 User Interface and Procedures

The user interface allows all necessary activities related to the management of the service to be performed. Two classes of user interface are supported:

- A dedicated web portal (for human users).
- A programmable API (for middleware and applications).

Both interfaces are based on a web service and support authorising and authenticating the user, processing the requests and providing some information about the service status. The web portal provides additional functionalities to allow problems to be reported to the Service Desk and to provide accounting information.

Each interface is described in more detail in the following sections.

2.3.1 Web Portal Interface

Access is provided to a dedicated web portal, where users can submit their dynamic requests for end-to-end (E2E) paths crossing multiple NREN domains.

For BoD services all related monitoring information is available either directly, through the web provisioning tool, or indirectly, through a set of additional plug-ins to existing monitoring services integrated with the provisioning tool. The portal includes clear descriptions of ingress/egress points for easy management of E2E paths.

To access all functions, the user will first have been successfully authenticated and authorised. The web portal interface allows users to manage their reservations (i.e. add, edit, remove and check status), provides monitoring information and also allows notifications to be sent to the Service Desk about potential problems with the service.

2.3.2 Programmable API Interface

Users may request dedicated access to the system through a programmable interface. This is especially important for computational applications that operate on a highly dynamic and intensive basis. For such applications a web-service-based API is available. The programmable interface follows the Standards, in particular those from the OGF's NSI and NML working groups. NSI v1.0 API is currently supported and NSI v2.0 trials may be supported on request.

2.4 Acceptable Use Policy (AUP)

This acceptable use policy (AUP) defines acceptable practices relating to the use of the BoD service provided over the joint network infrastructure by the end users that have gained access to the BoD through SDPs.

- By using the BoD service, the end user acknowledges that he/she is responsible for compliance with the AUP.
- The BoD service is designed to provide connectivity for non-profit activities. The BoD service should not be used for any commercial activity.
- The BoD shall not be used for any unlawful activities or in connection with any criminal or civil violation and the services shall in all cases be used in compliance with applicable law.
- An end user may not attempt to gain unauthorised access to, or attempt to interfere with or compromise the normal functioning, operation or security of, any portion of the joint network infrastructure.
- Users are entirely responsible for maintaining the confidentiality of password and account information.

Appendix A Location of BoD-Enabled GÉANT PoPs

PoP	Address
Vienna	InerXtion Louis-Häfliger-Gasse 10, Vienna 1210 Austria
Brussels	Level 3 Avenue Leon Grosjean 2 Evere Brussels 1140 Belgium
Sofia	Institute for Parallel Processing Bulgarian Academy of Sciences Acad. G. Bonchev St 25-A 1113 Sofia Bulgaria
Zagreb	SRCE Josipa Marohnica 5 Zagreb 10000 Croatia
Prague	CESNET Zikova 1905/4 PRAHA 6 Prague 160 00 Czech Republic
Copenhagen	Telia Sonera Rm 106/C 2nd Floor

PoP	Address
Riga	Data Networking Laboratory SigmaNET Raiņa bulvāris 29 Riga LV-1459 Latvia
Kaunas	Kauno 330 kV TP Pastotės g. Biruliškių km Kauno raj Kaunas LT 54469 Lithuania
Luxembourg	ITC 45 Boulevard Pierre Frieden L-1543 Luxembourg Luxembourg
Amsterdam	VANCIS B.V. RmS145 1st Floor Science Park 121 Amsterdam 1098 XG Netherlands
Poznan	Wieniawskiego 17/19 61-704 Poznan Poland
Lisbon	Av. do Brasil 101 1700-066 Lisbon

PoP	Address
	Metrovej 1 BLDG1 restad 2300 Denmark
London	Telecity 8-9 Harbour Exchange London E14 9GE England
Tallinn	Sõle 14, 10611 Tallinn Estonia
Paris	InterXion 45 Ave Victor Hugo Batiment 260 Aubervilliers Paris 93534 France
Frankfurt	InterXion Weismüllerstrasse 21-23 BUILDING FRA3 1st Floor Rm 2-1C Frankfurt 60314 Germany
Athens	Central Data Centre Ethniko Idryma Ereynon (NHRF) 48 Vasileos Konstantinou Avenue 11635 Athens Greece
Budapest	NIIF NIIF Institute 18-22 Victor Hugo Street

PoP	Address
	Portugal
Bucharest	RoEduNet National NOC National Authority for Scientific Research Mendeleev 21-25 Sector 1 010362 Bucharest Romania
Moscow	Russia Academy of Science 32a Leninsky Prospekt Joint Supercomputer Center of the Russian Academy of Science Moscow 119991 Russia
Bratislava	SITEL PoP2 Sitel Kopcianska ul. 20c Bratislava 85101 Slovakia
Ljubljana	ARNES Jamova 39 Ljubljana 1000 Slovenia
Madrid	TELVENT Edificio Telvent Valgrande, 6 Poligono Industrial de Alcobendas 28108 Alcobendas - Madrid Spain
Geneva	CERN IT-CS Building 513 385 route de Meyrin

PoP	Address
	Grn Floor NIFF Computer Rm Budapest 1132 Hungary
Dublin	DANTE c/o HEAnet C/o Esat BT Application Hosting Unit 4029, National Digital Park City West Dublin Ireland

PoP	Address
	Geneva 23 1211 Switzerland

Appendix B BoD-Enabled NRENs

The following NRENs support the BoD service: PIONIER (Poland), HEAnet (Ireland), SURFnet (Netherlands), GRNET (Greece), CARNET (Croatia). For details about which locations the BoD service is available please email the Open Calls coordinator at **opencalls@geant.net**

The locations in Poland where the BoD service is available in PIONIER are listed in the table below.

Town	Address	Insititution
Białystok	ul. Wiejska 45A	Bialystok University of Technology
Bielsko-Biała	ul. Teodora Sixta 19	
Bydgoszcz	ul. Kordeckiego 20 B	University of Technology and Life Sciences in Bydgoszcz
Częstochowa	ul. Dąbrowskiego 73	Czestochowa University of Technology
Elbląg	ul. Wojska Polskiego 1	The State School of Higher Professional Education in Elbląg
Gdańsk	ul. Narutowicza 11/12	Gdańsk University of Technology
Gorzów Wlkp.	ul. Chopina 52	The State School of Higher Professional Education in Gorzów Wielkopolski

Town	Address	Insititution
Katowice	ul. Jordana 25	
Kielce	Al. Tysiąclecia Państwa Polskiego 5	Kielce University of Technology
Kraków	ul. Nawojki 11	Academic Computer Centre CYFRONET AGH
Lublin	Pl. Marii Curie-Skłodowskiej 1	Maria Curie-Skłodowska University in Lublin
Łódź	ul. Wólczańska 175	Lodz University of Technology
Olsztyn	ul. Heweliusza 8	University of Warmia and Mazury in Olsztyn
Opole	ul. Ozimska 46A	Opole University
Poznań	ul. Wieniawskiego 17/19	PSNC
Puławy	Al.. Królewska 17	Institute of Soil Science and Plant Cultivation
Radom	ul. Chrobrego 27	Kazimierz Pulaski University of Technology and Humanities in Radom
Suwałki	ul. Noniewicza 10	Higher Vocational School in Suwałki
Szczecin	Al.. Piastów 41 Akademickie Centrum Informatyki	West Pomeranian University of Technology in Szczecin
Toruń	ul. Szosa Chełmińska 17	
Warszawa	Plac Politechniki 1	Warsaw University of Technology
Zamość	ul. Akademicka 4	University of Management and Administration in Zamość
Zielona Góra	ul. Szafrana 2	University of Zielona Góra

References

[NSIv1.1] https://forge.ogf.org/sf/go/doc16045?nav=1

[NSIWG] https://redmine.ogf.org/projects/nsi-wg

Glossary

API	Application Programming Interface
AUP	Acceptable Use Policy
BoD	Bandwidth on Demand
E2E	End to End
ETS	Enhanced Transmission Selection
FCS	Frame Check Sequence
ID	Identifier
IP	Internet Protocol
MAC	Media AccessControl
MTU	Maximum Transmission Unit
NML	Network Markup Language
NREN	National Research and Education Network
NSI	Network Service Interface
OGF	Open Grid Forum
SDP	Service Demarcation Point
SLS	Service Level Specification
SSP	Service Stitching Point
TPID	Tag Protocol Identifier
URN	Uniform Resource Name
VLAN	Virtual Local Area Network