



25-03-2010

## Deliverable DN4.2.1: GÉANT Service Portfolio



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Contractual Date:	31-03-2010
Actual Date:	25-03-2010
Grant Agreement No.:	238875
Activity:	NA4
Task Item:	Task 2
Nature of Deliverable:	R (Report)
Dissemination Level:	RE (Restricted)
Lead Partner:	DANTE
Document Code:	GN3-10-040v2
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### Abstract

This portfolio document provides an up-to-date snapshot of the connectivity services offered on the GÉANT backbone, and online resources to provide information, facilitate requests and assist in ongoing management.

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## Executive Summary

This deliverable provides an overview of the following GÉANT connectivity services, which the GN3 project provides to the GÉANT National Research and Education Networks (NRENs) as part of the GÉANT Services portfolio:

- GÉANT IP
- GÉANT Plus
- GÉANT Lambda

The document describes the basic and additional features that are available for each service, service access and service fees. The information provided includes online resources that NRENs can access to order, track and manage services, and to receive support.

By clearly defining the available services, this document aims to make the service offering more transparent, and improve the service ordering process.

# 1 Introduction

This deliverable provides an overview of the GÉANT connectivity services that are available to NRENS:

- **GÉANT IP**  
The GÉANT IP service provides high bandwidth international Internet connectivity.
- **GÉANT Plus**  
The GÉANT Plus service provides access to point-to-point circuits across an existing network of pre-provisioned links.
- **GÉANT Lambda**  
The GÉANT Lambda service provides subscribed NRENS with private, transparent wavelengths to any other NREN connected to the GÉANT dark fibre cloud.

The document includes information on the basic and additional features of each service. It also details how NRENS can request services and track their subscriptions.

## 2 GÉANT IP Service

The GÉANT IP service offers access to the shared European Research and Education IP backbone. This allows transit for IP traffic from European NRENs to one another and between European NRENs and associated networks globally.

The IP service can be accessed by members of the GÉANT consortium and is co-funded by the payment of an annual subscription. Access is available to non-consortium NRENs only by special agreement.

### 2.1 Basic Features

The basic GÉANT IP service is defined as follows:

- An NREN will be provided with a standard “best-effort” IP service, i.e. with no bandwidth or performance guarantee between any communicating pair of addresses.
- DANTE will specify the following in order to set up the IP service:
  - IP addresses to be used in the GÉANT and on the NREN access router.
  - IP address space to be used for the access link.
  - AS number of GÉANT.
  - DNS record corresponding to GÉANT address space.
  - MD5 password for the BGP session (unless the NREN prefers not to use MD5).
- GÉANT will announce a routing table of the GÉANT connected networks.
- The NREN must specify:
  - AS number of customer NREN.
  - RIPE DB as-set (as-macro) to be accepted by GÉANT.
- Delivery times for IP capacity upgrades vary according to location and connectivity type, but will typically be months. It is recommended that NRENs discuss requirements with the GÉANT partner relations team [GPART] at an early stage.
- The rights and responsibilities of both parties during the setup and life time of the IP peering are described in the NREN Operational Procedures [OPSPROC].

## 2.2 Additional Features

In addition to the basic features, the GÉANT IP service provides the following optional features:

- IPv6
- Multicast
- Layer 2 Virtual Private Networks – MPLS

### 2.2.1 IPv6

IPv6 is the Internet protocol designed to replace IPv4, which is in common use across today's Internet. IPv6 resolves in particular the problem of the limited number of available IPv4 addresses.

The IPv6 capability is defined as follows:

- GÉANT operates a dual-stack (IPv4 and IPv6) core backbone based on packet-switching routers.
- IPv6 Multicast is enabled on the GÉANT network using an embedded Rendezvous Point.
- GÉANT currently provides international access over the backbone to IPv6 gateways. This may be subject to review if traffic levels increase significantly.

### 2.2.2 Multicast

Multicast delivers traffic both when data must be sent from a single source to multiple users (one-to-many) and from multiple sources to multiple users (many-to-many), by sending traffic only to interested parties that have requested the data. Routers in multicast-enabled networks build distribution trees, thus making the network responsible for replicating the data where necessary.

GÉANT offers a transit multicast service to subscribing NRENs, allowing them to:

- Advertise and transit traffic relating to a specific multicast group to other NRENs.
- Join multicast groups advertised by other NRENs.
- Advertise and transit traffic relating to a specific multicast group to other research networks such as ESNET, Internet2, NLR, Canarie and TEIN3.
- Advertise and transit traffic relating to a specific multicast group to other research entities such as ESNET, Internet2, NLR, Canarie and TEIN3.
- Join multicast groups advertised by other research entities.
- NRENs who are users of the DANTE World Service (DWS) can also:
- Advertise and transit traffic relating to a specific multicast group to the global Internet.
- Join multicast groups advertised by DWS peers.



### 2.2.3 Layer 2 Virtual Private Networks – MPLS

A virtual private network (VPN) is a network linking two sites that is built on the common IP infrastructure, yet appears to the user as a dedicated circuit. VPNs combine the privacy of a private circuit with the cost efficiency and robustness of the Internet.

The L2 VPN – MPLS feature is defined as follows:

- Traffic engineered L2 VPN paths can be configured on all routers on the GÉANT backbone using multi-protocol label-switching (MPLS).
- For multi-domain L2 VPNs, the setup can be offered in two different ways:
  - Extension of LSPs.

DANTE could stitch together the LSP received from the NRENs via their access link to an LSP in the GÉANT network. Stitching will be done at the edge of the GÉANT domain, where the NREN access link is connected. The LSPs will be terminated in the NREN's domain. NRENs will need to configure the relevant VLAN within their domain to terminate the L2VPN.
  - VLAN based L2VPN.

NRENs access link interfaces will need to be Gigabit Ethernet (GE). DANTE will configure VLANs on the NREN access interface and provide L2VPN using MPLS LSPs between the two GÉANT routers. The LSPs will be transparent to the end points.

If an NREN access has an SDH/SONET interface and wants to set up an L2 VPN with another NREN with a GE access interface, DANTE could stitch the LSP received from the NREN with SDH/SONET interface and create a VLAN on the other end to provide the L2VPN circuit. In this case, the NREN with the SDH/SONET interface will need to configure a VLAN within their domain to terminate the L2VPN.
- Bandwidth reservation is not guaranteed for MPLS-L2VPNs.
- The delivery timescale for a L2 VPN is 1 week.

### 2.2.4 IP Peering

Transit for IP traffic is offered to a defined set of NRENs and networks beyond the GÉANT service area. For a list of these networks, see *List of Peering Networks* on page 19.

## 2.3 Access to the IP Network

NRENs access the GÉANT IP network at an agreed bandwidth, at a mutually agreed location. This section explains rules, responsibilities and available options for GÉANT IP access.

### 2.3.1 Basic IP Access

GÉANT maintains Points of Presence (PoPs) in the NREN partner countries (see *List of Peering Networks* on page 19). DANTE will provide primary access to the GÉANT IP network from a router at one of these sites.

The rate of access will depend upon NREN requirements:

- GÉANT IP access is available at capacities of up to 20Gbps, subject to technical and commercial considerations.
- The standard physical interface type can be from T3 (34Mbps) to STM-64/10GE (10Gbps). Appropriate interface types can be discussed with the DANTE Operations team [OPS].
- For 20Gbps subscriptions, the standard presentation will be on 2 x 10GE or 2 x STM-64, but 40Gbps may be specified at extra cost.

### 2.3.2 Inclusive IP Backup Access

Included in the basic IP subscription, GÉANT provides protection against circuit failure:

- For PoPs which host a GÉANT router, an additional port will be provided on that router.
- For PoPs without a GÉANT router but on the fibre cloud, a diverse circuit will be provided to a neighbouring GÉANT PoP with a router.
- For NRENs without a GÉANT PoP, the NREN will be dually connected with leased circuits.

In all cases, backup capacity will be provided at up to the full subscribed bandwidth on an appropriate interface (the interface type is subject to agreement with DANTE Operations [OPS]).

In rare cases where a backup solution may not be available for technical, financial or infrastructure reasons, GÉANT provides a single IP connection and an adjustment is made to the annual IP subscription fee.

As an alternative, GÉANT can provide an inclusive backup interface on another GÉANT router. However, in this case, the NREN would be responsible for backhauling the capacity. See *Service Availability* on page 8 for more details.

### 2.3.3 Demarcation Point and Types of Access

In general, it is the NREN's responsibility to provide the physical connection to the GÉANT equipment. The demarcation point is thus at the GÉANT equipment wherever possible. More specifically:

- If the NREN is not in the fibre cloud and the local GÉANT PoP does not contain a router:  
The management boundary between DANTE and the NREN is the GÉANT interface on the NREN router.

- For all other cases:

The management boundary between DANTE and the NREN is a port in active or passive equipment located in the GÉANT PoP. The exact port should be specified as soon as the connection is agreed. It will typically be the connector on the access port on the GÉANT router or a connector on the patch panel before the GÉANT transmission equipment.

For a generic diagram of a GÉANT PoP, see *GÉANT PoP Access Options* on page 20.

## 2.4 Alternative IP Backup

To provide greater resiliency, NRENs connected to the GÉANT Plus circuit network may request or set up a single dedicated backup circuit to a router in an adjacent GÉANT PoP. The following options are available:

- Backup capacity of 1Gbps can be provided on a 1GE interface or 2.5Gbps on a STM-16 interface. In addition capacities of up to 5Gbps can be provided, as a VLAN on the primary GÉANT Plus interface (a 10Gbps interface).
- For higher capacity, a dedicated 10Gbps Lambda can be provided (as described in section 2). This can be presented on a 10GE or STM-64 interface, as required.
- Similarly, if a full backup is required for a 20Gbps access, it will be provided on two 10Gbps circuits, connecting to interfaces on one appropriate GÉANT router.

(Note that in all the above cases, the GÉANT infrastructure will be used to extend the connection to the adjacent GÉANT PoP. The demarcation point will be defined at the GÉANT PoP where the NREN is accessing the GÉANT circuit network.)

- A backup 10Gbps interface (10GE or STM-64) may be provided on an alternative GÉANT router, the wavelength connecting this interface back to the NREN concerned being the responsibility of that NREN or its subcontractor. A possible scenario is that two NRENs provide this capacity over one another's networks and cross-border fibre. The demarcation point for this service will be the interface on the GÉANT router, regardless of the country in which that equipment is located. The provision of this backup interface will be included in the standard IP subscription.

### 2.4.1 NREN Provisioned IP Backup

In some circumstances it may be possible for NRENs to provide their own backup circuit to an alternative GÉANT PoP (using cross-border-fibre or a similar infrastructure). Such an arrangement has the advantage of full PoP diversity, where access is not dependent on any particular building/location remaining operational. In such cases:

- The backup infrastructure will not be the responsibility of GÉANT Operations, but of the NREN(s) concerned.
- The availability of service will be measured at the two (or more) GÉANT access interfaces used by the NREN.

## 2.5 Service Availability

Availability is defined as the proportion of time that the service is actually available for use by the NRENs within the agreed service time. Availability is calculated as a percentage. The service will be considered unavailable whenever the interface towards an NREN and/or the BGP peering over the NREN access circuit goes down, irrespective of whether the outage is located in the GÉANT domain or the NREN domain. The total availability of the IP service is measured by determining the availability of the primary IP access and the availability of the IP backup access.

However, defining this availability provides a significant challenge for a number of technical reasons. In particular, the service offered is not necessarily on a single technology platform. NRENs may receive the service at a PoP with or without a router, and backup may be provided via a GÉANT router, switch or on optical transmission equipment. Furthermore, the potential use of cross-border fibre for IP backup means that an important part of the resilient path may be outside of the direct operational control of GÉANT.

Notwithstanding the difficulty involved in providing service metrics, the GÉANT IP network offers a high level of availability and is operated on a best-effort basis.

Work is ongoing on defining and implementing a GÉANT IP service level target. It is expected that this target will be available in the next version of this document.

## 2.6 Fees

The pricing of all GÉANT services is detailed in *Pricing for GÉANT Services* on page 25. Note that:

- Subscription costs for the GÉANT IP backbone are determined by the Cost Sharing Committee and approved by the Exec and PC.
- Cost sharing is defined by the NRENs' cost-sharing model.
- There is no extra charge for configuring L2 VPN paths or premium IP over the GÉANT IP network
- For a dedicated backup capacity of up to 5Gbps (see *Alternative IP Backup* on page 7), the capacity of the backup circuit will be deducted from the NREN's GÉANT Plus subscription (see *GÉANT Plus Service* on page 9).
- There are fixed charges for dedicated 10Gbps backup and 20Gbps backup (see *Pricing for GÉANT Services* on page 25), except in cases where no local GÉANT router is provided (see *Inclusive IP Backup Access* on page 6).
- If a backup using NREN infrastructure is envisaged and serves as the sole GÉANT backup, then no extra charge will be made.
- If additional GÉANT interfaces are needed, they will be charged at the rate shown in *Pricing for GÉANT Services* on page 25.

## 3 GÉANT Plus Service

The GÉANT Plus service allows NRENs to request point-to-point circuits of between 155Mbps and 10Gbps across an existing network of pre-provisioned links. The GÉANT Plus service is paid for by an annual subscription providing a 10Gbps circuit capacity allocation to the NREN. Circuits can be configured at short notice and there is no additional charge for the configuration of a particular circuit.

### 3.1 Basic Features

The basic GÉANT Plus service is defined as follows:

- GÉANT provides dedicated sub-wavelength point-to-point circuits configured over a network of dark fibre links and TDM switches.
- Circuits can be provided to the NREN at a granularity of 155Mbps (VC4) up to a total of 10 Gbps (64 x VC4).
- Circuits can be established to any European NREN listed in *GÉANT NRENs with Circuit Access* on page 23.
- Each NREN subscribing to the circuit service is allocated 10Gbps of circuit capacity, which may be used flexibly for different services.
- The 10Gbps capacity allocation is fixed, regardless of the capacity of physical interfaces.
- NRENs are provided with access to these circuits on a single 10Gbps interface agreed by DANTE and the NREN.
- Circuits will be routed on a path across the GÉANT Plus network agreed with DANTE Operations.
- A circuit can be configured on an already existing GÉANT Plus interface within 5 working days of receipt of request, assuming that the capacity allocations of both NRENs are sufficient.

The use of non-standard interfaces or the exhaustion of capacity on an access interface can increase this to a maximum of 10 weeks (see *Additional GÉANT Plus Interfaces* on page 11).

- Circuits may be configured for any specified service period subject to compliance with delivery timescales and availability of subscribed capacity.

### 3.1.1 Circuits to Non-GÉANT Destinations

NRENs can also connect to non-GÉANT organisations/destinations, although in some circumstances it may be necessary to consult the GÉANT Executive Committee for guidance on the policy/funding implications of unconventional applications.

Note that:

- Requests for connections to non-GÉANT destinations can only be fulfilled if GÉANT infrastructure exists to deliver the circuit to the proposed interconnection point.
- The responsibility of the GÉANT NOC stops at the declared demarcation point (see *Demarcation Point* on page 11). Patching beyond that point is the responsibility of the ordering NREN.
- If the circuit requires an additional interface (for example, at the remote end of the circuit), this can be supplied within the usual lead time (up to 10 weeks), at additional cost.
- The GÉANT Plus subscription also allows NRENs to request transatlantic circuits to Internet2, ESnet and Canarie.
- A dedicated port for circuits connecting to the Netherlight infrastructure is available in Amsterdam.
- Circuit requests to other networks globally will be considered on a case-by-case basis.
- The capacity of circuits to non-GÉANT destinations will be deducted from the total available subscribed capacity as with any other circuit – but note that the GÉANT NREN must bear the full cost. To establish the cost prior to the request being placed, the GÉANT partner relations team [GPART] can be contacted.

### 3.1.2 Circuit Routing

Unless otherwise requested, circuits will be configured on the shortest possible route between two GÉANT PoPs. On request, circuits may be routed on a path which is fully physically diverse from the primary route for the purpose of resiliency. These circuits will, by definition, take a longer path than the primary route.

### 3.1.3 Access to the Circuit Network

GÉANT Plus subscriptions are only available to NRENs where the GÉANT backbone infrastructure supports multiple wavelengths (usually at PoPs connected to the GÉANT fibre cloud). The GÉANT NRENs able to access the circuit network are listed in *GÉANT NRENs with Circuit Access* on page 23. For these NRENs, DANTE will provide access to the GÉANT IP network and an interface for GÉANT Plus connections.

Note that:

- The standard physical interface for accessing the GÉANT Plus network can be either 10GE or STM-64.
- Additional interfaces can be supplied subject to an agreement with DANTE.

### 3.1.3.1 Demarcation Point

The management boundary between DANTE and the NREN is a port on a DANTE-managed patch panel located in the GÉANT PoP. The NREN is responsible for the cabling between their equipment and this patch panel. The exact port will be specified by DANTE soon after the connection is agreed and the planning is complete. DANTE is responsible for the cabling between this patch panel and the GÉANT switching equipment, which would normally be installed by the GÉANT equipment supplier.

For details of the demarcation point at any GÉANT PoP, please contact the the GÉANT NOC, quoting your ticket number which will be given to you by the GÉANT partner relations team.

## 3.2 Additional Features

To supplement the standard GÉANT Plus package, NRENs can request additional:

- GÉANT Plus capacity.
- GÉANT Plus interfaces.

(Note that here 'capacity' describes the subscribed capacity available to the NREN on the GÉANT Plus network.)

### 3.2.1 Additional GÉANT Plus Capacity

NRENs can obtain increased capacity by requesting additional GÉANT Plus subscriptions:

- Additional subscriptions will provide a further 10Gbps of capacity on a new interface.
- The initial 10Gbps of GÉANT Plus capacity is included in the bundled package of connectivity. The cost is determined by the NRENs' cost-sharing model. Additional circuit capacity is provided at a fixed annual cost across Europe for all NRENs requesting it (i.e. not determined by the usual cost-sharing mechanism)
- The delivery timescale for additional circuit capacity is 10 weeks (determined by the interface required).

### 3.2.2 Additional GÉANT Plus Interfaces

If required, NRENs can request additional GÉANT Plus interfaces:

- The GÉANT Plus subscription includes a dedicated 10GE interface on the GÉANT equipment at the national GÉANT PoP.
- Should an NREN require existing GÉANT Plus capacity to be delivered on additional interfaces, these can be provided subject to availability and at extra cost. Since this involves additional hardware, delivery will typically be slower than for a circuit on an existing interface, typically up to 10 weeks.

- The capacity of the physical interfaces used may exceed the subscribed capacity purchased by the NREN (for example, if a GE interface is added to accommodate a particular GÉANT Plus circuit for operational reasons).

### 3.3 Accessing Internet Exchanges via GÉANT Plus

It is possible to use GÉANT Plus circuits to reach Internet exchanges and thus peer with co-located networks. In such cases, GÉANT will define a demarcation point and the NREN is responsible for patching through to the Internet exchange (IX) from that point. Typically this may be a meet-me room at the PoP (such as Telecitey or Interxion). DANTE will arrange patching to such a location.

Note that:

- Although the configuration of GÉANT Plus capacity will be completed within the usual timescale, the additional patching required for IX circuits may not be completed within this period.
- Because GÉANT is not responsible for the full path to the IX, end-to-end service levels cannot be guaranteed.
- Not all Internet exchanges will accept traffic bearing VLAN tags. Therefore, peering with an IX may not necessarily be possible with a GÉANT Plus circuit.

### 3.4 Fees

The pricing of all GÉANT services is detailed in *Pricing for GÉANT Services* on page 25. Note that:

- The GÉANT Plus subscription price for applicable NRENs is calculated using the NRENs' cost-sharing model, based upon infrastructure and equipment costs
- The service will be provided on a dedicated 10Gbps interface, the cost of which is included in the annual subscription fee.
- The capacity of any individual circuit ordered (as a number of VC4s) will be deducted from the available GÉANT Plus capacity allocation of both participating NRENs.
- For circuits terminating outside of the GÉANT service area, the NREN has funding responsibility for the whole circuit and therefore the capacity of the circuit provisioned will be counted twice against the GÉANT Plus subscription allowance of that NREN. Any extra interfaces necessary will be subject to a fixed one-off fee as described above.
- Circuits to Internet exchanges are treated in the same way as any other circuit which terminates outside of the GÉANT service area. The ordering NREN will also be expected to cover any charges levied by the telehouse and/or Internet exchange with respect to the connection or annual fee.
- Transatlantic GE circuits will be provided at no extra charge, but since they terminate outside of the GÉANT service area, the conditions in the two previous bullet points apply.



- The capacity of non-primary circuits (i.e. any circuit that does not use the shortest possible network path) will be double-counted against the total available capacity allocation for both participating NRENs. For example, a 1Gbps backup circuit will reduce each NRENs GÉANT Plus capacity by 2Gbps.
- Additional GÉANT Plus access is charged at a fixed cost for 10Gbps capacity. It includes an additional 10Gbps circuit access interface (see *Pricing for GÉANT Services* on page 25).

## 4 GÉANT Lambda Service

The GÉANT Lambda service provides private, transparent 10 Gbps wavelengths between any two GÉANT NRENs connected to the GÉANT dark fibre cloud. These services are used by Europe's most data intensive users.

### 4.1 Features

The GÉANT Lambda service is defined as follows:

- The service provides transparent 10Gbps wavelengths between transmission equipment in GÉANT PoPs.
- The service is only available to NRENs on the GÉANT dark fibre network (as shown on the GÉANT topology maps [MAPS]). For a list of possible routes for GÉANT Lambdas, see *GÉANT Routes Able to Support Lambda Services* on page 24.
- An extra charge is made to cover the cost of each Lambda requested.
- The implementation of GÉANT Lambdas requires additional transmission equipment to be installed at the GÉANT PoPs. The delivery timescale associated with ordering, installing and configuring equipment is 10 weeks.

### 4.2 Lambdas to Non-GÉANT Destinations

NRENs can also connect to non-GÉANT organisations/destinations, although in some circumstances it may be necessary to consult the GÉANT Executive Committee for guidance on the policy/funding implications of unconventional applications.

Note that:

- Requests for connections to non-GÉANT destinations can only be fulfilled if GÉANT infrastructure exists to deliver the circuit to the proposed interconnection point.
- The responsibility of the GÉANT NOC stops at the declared demarcation point (see *Demarcation Point* on page 15). Patching beyond that point is the responsibility of the ordering NREN.
- Circuit requests to other networks globally will be considered on a case-by-case basis.

- Transatlantic Lambdas will be available from quarter 2 2010 at additional cost (subject to Policy Committee approval).

## 4.3 Backup Lambdas

If protection against fibre cuts or equipment failure is required, a full backup Lambda can be provided on an alternative, resilient route. This secondary Lambda will be configured over a fully diverse path to the specified primary Lambda.

## 4.4 Access to Lambda Services

### 4.4.1 Demarcation Point

The management boundary between DANTE and the NREN is the connector on the GÉANT transmission equipment in the PoP to which the NREN's access circuit is connected. It is the NREN's responsibility to provide for the physical connection to the GÉANT equipment, irrespective of whether this requires local loops provided by a telecoms operator or not.

## 4.5 Fees

The pricing of all GÉANT services is detailed in *Pricing for GÉANT Services* on page 25. Note that there is an annual flat rate fee for GÉANT primary and backup lambdas regardless of the number of hops involved or the interface chosen.

## 5 Requesting and Tracking GÉANT Services

A new GÉANT Partner Portal Website is under development and is due to be launched at the end of Quarter 1 2010 [PORTAL]. This new site will inform NREN staff about the GÉANT services they have requested, and give a summary of the subscriptions held by their NREN. In addition to these features, the Portal will provide a means to order all of the GÉANT services listed in this document.

Note:

- Until the Portal is fully operational, GÉANT Plus and GÉANT Lambda services can be ordered online [STATS]. The Portal is expected to become fully operational in Q2 2010.
- All other services or subscription changes should be emailed to the GÉANT partner relations team [GPART].
- In addition to the Partner Portal status reporting, the progress of any particular request may be followed via the GÉANT Service Desk ticket system [TICKET].

### 5.1 Requests for GÉANT IP Services

The GÉANT Partner Portal will provide forms for ordering the GÉANT IP services:

- GÉANT IP capacity upgrade form.
- GÉANT IP L2VPN request form.
- GÉANT IP L2VPN cancellation form.

### 5.2 Requests for GÉANT Plus Services

The GÉANT Partner Portal will provide forms for GÉANT Plus circuit and capacity requests:

- GÉANT Plus circuit request form (also allows extra interfaces to be ordered when associated with a new circuit).
- GÉANT Plus circuit cancellation form.
- GÉANT Plus capacity request form.

## 5.3 Requests for GÉANT Lambdas

The GÉANT Partner Portal will provide forms for GÉANT Lambda requests:

- GÉANT Lambda request form.
- GÉANT Lambda cancellation form.

## 6 Conclusions

This document defines the services offered in GN3 by the GÉANT backbone network to the project's partner NRENS. It is hoped that by defining clearly the parameters of each service, greater transparency can be achieved whilst standardisation of service offerings will improve efficiency of delivery and administration.

In GN3 the principal improvements that have been made to the service portfolio are:

- The launch of the new GÉANT Partner Portal [PORTAL], a single portal for up-to-date per-NREN service summaries, request of services, service definitions and operational information.
- Improved options for backup arrangements for IP access.
- A GÉANT Plus-based service offering access to Internet exchanges.

The service portfolio is to be seen as a live document and subsequent editions will be produced as changes are made to the services offered. Readers should check the GÉANT Partner Portal for the latest version.

## Appendix A **List of Peering Networks**

- ANKABUT (United Arab Emirates)
- ASA / INIMA (Albania)
- BASNET (Belarus) \*
- BIHARNET (Bosnia & Herzegovina)
- Black Sea Interconnection (South Caucasus)
- CANARIE (Canada)
- ERNET (India)
- ESNET (USA)
- EUMEDCONNECT 2 (Mediterranean)
- Holy See Internet Office (Vatican City)
- Internet2 (USA)
- JSCC (Russia) \*
- National Lambda Rail (USA)
- NISN (North America)
- Qatar Foundation (Qatar)
- RedCLARA (Latin America)
- SINET (Japan)
- TEIN3 (Asia-Pacific)
- TWAREN (Taiwan)
- UBUNTUnet (South-eastern Africa)
- University of Andorra (Andorra)
- URAN (Ukraine) \*
- USLHCNet (North America)

\* GN3 Associate Partner

## Appendix B GÉANT PoP Access Options

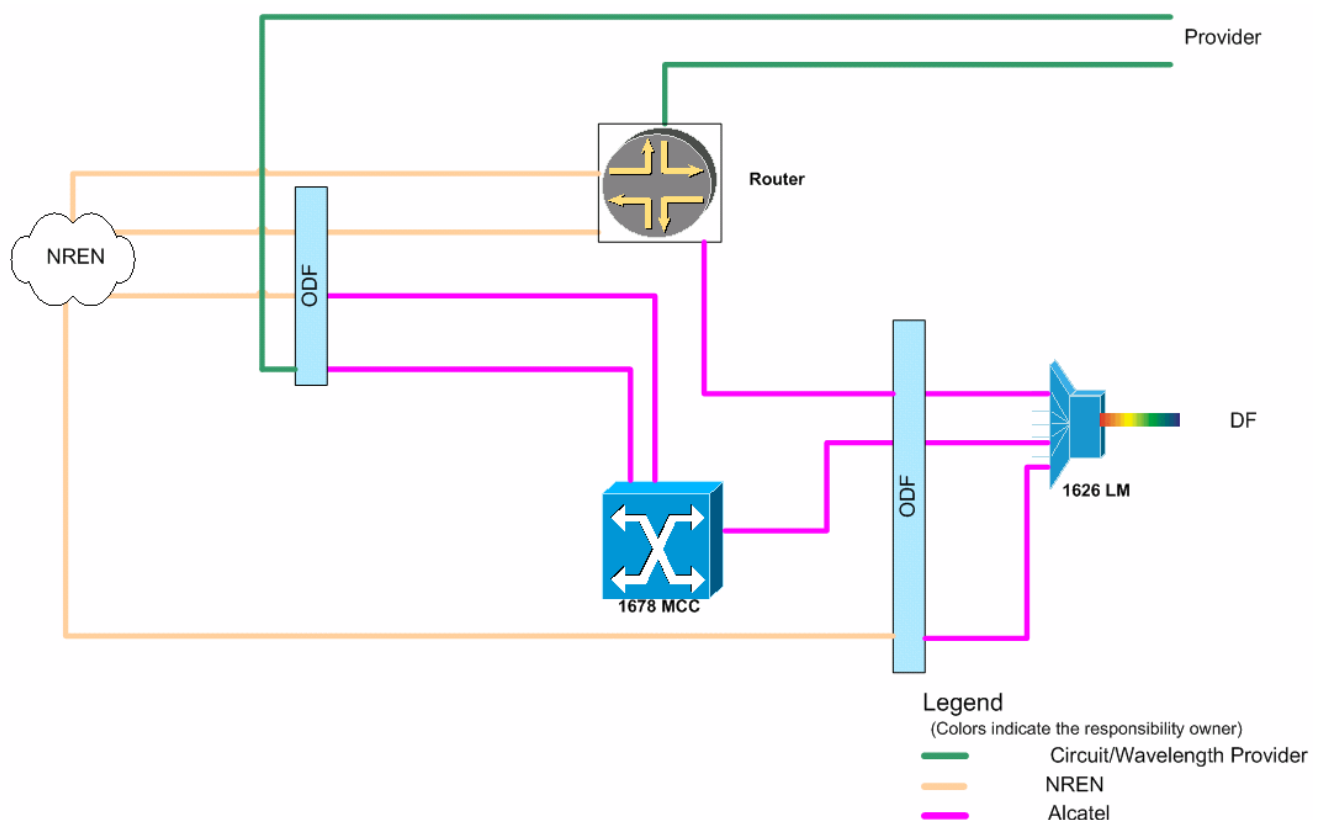


Figure B.1: GÉANT PoP access.

### Notes:

- Figure B.1 does not represent a particular GÉANT PoP, but indicates the types of access possible.
- The NREN may access the GÉANT IP network through a port on a patch panel (an ODF operated by DANTE) or on the router.
- The NREN will normally access GÉANT circuit services (GÉANT plus) through a 10Gbps port on the patch panel.
- The NREN will access wavelength services through a 10Gbps interface on a patch panel.



- Also illustrated are:
  - LM 1626: the GÉANT transmission equipment and dark fibre (DF).
  - MCC 1678: the GÉANT switch used to support GÉANT Plus circuit services.
  - The 'Provider' domain where leased circuits or wavelengths are connected into the router or switch (1678 MCC) to form part of the IP network or circuit network.

## Appendix C List of GÉANT PoPs

- NL Amsterdam
- GR Athens
- SK Bratislava
- BE Brussels
- RO Bucharest
- HU Budapest
- DK Copenhagen
- IE Dublin
- DE Frankfurt
- CH Geneva
- LT Kaunas
- PT Lisbon
- SI Ljubljana
- UK London
- LU Luxembourg
- ES Madrid
- IT Milan
- US New York
- FR Paris
- IL Petach Tikva
- PL Poznan
- CZ Prague
- LV Riga
- BG Sofia
- EE Tallinn
- AT Vienna
- HR Zagreb

## Appendix D **GÉANT NRENs with Circuit Access**

- ACONET
- ARNES
- BELNET
- CARNet
- CESNET
- DFN
- FCCN
- GARR
- GRNET
- HEAnet
- JANET
- NIIF
- NORDUnet
- PSNC
- RedIRIS
- RENATER
- SANET
- SURFnet
- SWITCH

## Appendix E **GÉANT Routes Able to Support Lambda Services**

- UK-IE
- UK-BE
- UK-FR
- BE-NL
- FR-ES
- FR-CH
- ES-CH
- NL-DK
- NL-DE
- DE-CH
- CH-IT
- DE-CZ
- DE-DK
- IT-AT
- AT-SK
- CZ-SK
- AT-SI
- SI-HR
- SK-HU
- HU-HR

## Appendix F Pricing for GÉANT Services

### F.1 GÉANT IP Service Pricing

Category	Service	Capacity	Price (€P.A unless otherwise stated)	Reference	Status
IP	Basic IP access	Various Up to 10Gbps	per Subscription Table (see Table G.1)	GN2-08-001	Approved
IP	Basic IP access	20 Gbps upgrade	Depends on cost sharing model calculation based on multiplier of 1.28 times 10 Gbps multiplier	GN2-08-169v2	Approved
IP	Dedicated IP Backup on GÉANT plus	Up to 5 Gbps	Deducted from GÉANT PLUS capacity allocation	GN2-08-169v2	Approved
IP	Dedicated IP Backup	10Gbps	€40k	GN2-08-169v2	Approved
IP	Dedicated IP Backup	20Gbps	€80k	GN2-08-169v2	Approved

Table F.1: GÉANT IP service pricing.

## F.2 GÉANT Plus Service Pricing

Category	Service	Capacity	Price (€P.A unless otherwise stated)	Reference	Status
Circuit services	GÉANT plus	10Gbps	capacity per Subscription Table	GN2-08-001	Approved
Circuit services	Additional GÉANT plus	10Gbps	€80k per additional port	GN2-06-111v2	Approved
Circuit services	GÉANT plus circuit with one end outside GÉANT service area (including transatlantic connections and connections to IXs)	Up to allocation limit	Capacity double counted against requesting the NREN's GÉANT PLUS capacity allocation	GN2-08-169v2	Approved
Circuit services	GÉANT plus circuit on diverse route to primary route	Up to allocation limit	Capacity double counted against both requesting NRENs' GÉANT PLUS capacity allocations	GN2-08-169v2	Approved
Circuit services	Additional interface ports	GE 10 GE STM-16 STM-64	€1500 one off fee €8500 one off fee €3500 one off fee €8000 one off fee	GN2-08-169v2	Approved

Table F.2: GÉANT Plus service pricing.

### F.3 GÉANT Lambda Service Pricing

Category	Service	Capacity	Price (€P.A unless otherwise stated)	Reference	Status
Lambda	Lambda	10Gbps (Single circuit)	€60k	GN2-07-162v2	Approved
Lambda	Resilient Lambda	10Gbps (Single circuit)	€100k	GN2-07-162v2	Approved
Lambda	Lambda through MCC switch	10Gbps (Single circuit)	€80k	GN2-07-162v2	Approved
Lambda	Resilient Lambda through MCC switch	10Gbps (Single circuit)	€120k	GN2-07-162v2	Approved
Lambda	Lambda	40Gbps (Single circuit)	€120-150k	Not in service	Not approved

Table F.3: GÉANT Lambda service pricing.

## Appendix G GÉANT Subscription Summary

Table F.1 (from GN2-08-001) shows the final summary of subscriptions determined by the new model (with the current model as a reference). Subscription prices are in K€, access capacities in Mbps.

New Annual subscriptions starting Q3 2009				Current subscriptions (2008/2009)			
	IP access	GEANT+	Final combined IP and GEANT+ subscriptions	IP access	Pt2Pt	Final Combined adjusted IP & Pt2Pt subscriptions	% age diff with Recommended Subscriptions
ACONET	10000	10000	968	10000	10000	1,168	-17%
ARNES	10000	10000	826	10000	10000	1,000	-17%
BELNET	10000	10000	1,094	10000	10000	1,307	-16%
CARNET	10000	10000	893	10000	10000	1,126	-21%
CESNET	10000	10000	1,123	10000	10000	1,425	-21%
DFN	10000	10000	1,537	10000	10000	1,915	-20%
GARR	10000	10000	1,544	10000	10000	1,912	-19%
GRNet	10000	10000	1,915	10000	10000	2,384	-20%
HEANET	10000	10000	996	10000	10000	1,184	-16%
HUNGARN	10000	10000	1,169	10000	10000	1,474	-21%
NORDUNE	10000	10000	1,466	10000	10000	1,842	-20%
PIONIER	10000	10000	1,430	10000	10000	1,669	-14%
RED.ES	10000	10000	1,244	10000	10000	1,555	-20%
RENATER	10000	10000	1,544	10000	10000	1,937	-20%
SANET	10000	10000	410	10000	10000	501	-18%
SURFNET	10000	20000	1,472	10000	10000	1,653	-11%
SWITCH	10000	10000	1,400	10000	10000	1,801	-22%
JANET	10000	20000	1,633	10000		1,849	-12%
EENET	2500		374	2500		498	-25%
BREN	1000		248	1000		288	-14%
LATNET	2500		382	2500		443	-14%
LITNET	5000		700	5000		880	-20%
ROEDUNE	10000		872	10000		1,011	-14%
ULAKBIM	5000		1,241	5000		1,449	-14%
CYNET	465		398	310		502	-21%
FCCN	10000		844	10000		978	-14%
IUCC	2000		1,094	2000		1,279	-14%
JSCC	10000		929	2500		1,235	-25%
RESTENA	2500		313	2500		424	-26%
UOM	80		231	80		271	-14%
			30,292			36,960	-18%

Table G.1: Subscription summary.



## References

[GPART]	<a href="mailto:partner-relations@geant.net">partner-relations@geant.net</a>
[MAPS]	<a href="http://www.geant.net/Media_Centre/Media_Library/Pages/Maps.aspx">http://www.geant.net/Media_Centre/Media_Library/Pages/Maps.aspx</a>
[OPSPROC]	At the time of writing operational procedures are available at <a href="http://intranet.geant2.net/server/show/nav.922">http://intranet.geant2.net/server/show/nav.922</a> . This information will be moved to the GÉANT partner website (see [GPART]), once this site is live.
[OPS]	The DANTE Operations team can be reached via email using the address <a href="mailto:operations@dante.net">operations@dante.net</a> .
[PORTAL]	<a href="https://partner.geant.net">https://partner.geant.net</a>
[STATS]	<a href="http://stats.geant2.net/p2p/">http://stats.geant2.net/p2p/</a>
[TICKET]	<a href="http://tickets.noc.geant.net/helpdesk">http://tickets.noc.geant.net/helpdesk</a>

## Glossary

<b>AS</b>	Autonomous System
<b>BGP</b>	Border Gateway Protocol
<b>DB</b>	Database
<b>DNS</b>	Domain Name System
<b>DWS</b>	DANTE World Service
<b>Gbps</b>	Gigabit per second
<b>GE</b>	Gigabit Ethernet
<b>IP</b>	Internet Protocol
<b>IX</b>	Internet eXchange
<b>L</b>	Layer
<b>LSP</b>	Label Switched Path
<b>Mbps</b>	Megabits per second
<b>MD5</b>	Message-Digest Algorithm 5
<b>MPLS</b>	Multi-Protocol Label-Switching
<b>NOC</b>	Network Operations Center
<b>NREN</b>	National Research and Education Networks
<b>PC</b>	Policy Committee
<b>PoP</b>	Point of Presence
<b>SONET</b>	Synchronous Optical Network
<b>TDM</b>	Time-Division Multiplexing
<b>v</b>	Version
<b>VC</b>	Virtual Container
<b>VLAN</b>	Virtual Local Area Network
<b>VPN</b>	Virtual Private Network