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## Deliverable DS4.0.2: Global Network Operational Procedures



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### Abstract

This deliverable reports on the efforts to create a global network operational framework to enable the GÉANT2 NOC to interact with NOCs in other world regions in a more efficient manner and in particular with regards to the deployment of dedicated, point-to-point connectivity.

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## 0 Executive Summary

There are new and emerging issues involved in the development of global operations. The gradual enhancement of the service portfolio provided by research and education networks, particularly associated with the provision of point-to-point services is leading to new challenges for network operations. Work is underway to improve co-operation among operations teams on a global basis to improve user support and refine operational processes. Recognising this, Europe took the initiative in 2006 to improve the co-operation among the major world network operations centres. This document sets out a statement of work in progress as well as future objectives.

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# 1 Introduction

Historically, global operations have been a matter of informal co-operation. Although there are a number of interconnection agreements between GÉANT2 and Research Networks in other world regions, these have concentrated on the provision of a best efforts IP service. The agreements have not focussed on the detail of operational co-operation. Communication among NOC's has been organised on a bi-lateral basis without any Service Level Agreements. This approach has proved acceptable, in the context of the basic IP service although it has long been recognised that there is room for improvement. With the introduction of a richer service portfolio, this simple model of operational co-operation has been significantly challenged. The development of point-to-point circuits, multi-domain performance monitoring, and the need to provide better global support for these activities, has encouraged the development of improved inter-NOC co-operation.

In December 2006, at DANTE's initiative, a meeting was held in Chicago to develop a work programme to improve operational co-operation among the leading world Network Operations centres. Representatives from Europe, Asia Pacific and North America agreed a program of work to develop better procedures and a more formalised approach to global service. A key aim of the Chicago meeting was to trigger discussions based on the idea of providing an operational day-to-day support to layer1/layer2 circuits crossing multiple domains. In parallel work has continued in the technical development co-operation between Europe and North America for the deployment of a consistent multi-domain monitoring infrastructure (PerfSONAR).

This deliverable summarises the activities identified and describes the co-operative work done to improve global operations. It also identifies the ongoing tasks that require further effort.

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## 2 Implementation of Point to Point Links across Multiple Management Domains

A significant challenge, resulting from the greater significance of hybrid networking, has been the need, on a global scale, to provision dedicated capacity to be exploited by individual end-user sites. The operational co-operation, required by such requirements, is very much work in progress. Some development technicians tend to assume that operational and implementation issue will be a trivial result of implementation of hybrid technology. Practical experience shows, however, that this is a simplistic view of the world that does not scale beyond the odd, high profile demonstration.

During the last few months several GigabitEthernet (GE) connections have been established between IN2P3 (National Institute of Nuclear and Particle Physics) in France and Fermilab (Fermi National Accelerator Laboratory) in US, as well as between PSNC (Poznań Supercomputing and Networking Centre) in Poland and CRC (Communications Research Centre) in Canada. These GE connections were implemented across the following independent management domains:

IN2P3 – Renater – GEANT2 – Abilene – Esnet –Fermi

PSNC – GÉANT2 – Abilene- Ca\*net - CRC

The following practical operational steps have been taken to seek to routinise the implementation and management of point-to-point links.

### Administration of the Point-to-Point Link Request

Since the relationship between networks in different continents such as Abilene and GÉANT2 is a peer-to-peer relationship the administrative/financial issues need to be solved separately on each side of the Atlantic.

The main factors are:

- Coordination between the upstream networks that receive the request. Users, not unreasonably, do not understand the operational implications of their requests. Indeed, even between the two ends of a point-to-point connection, there may be as lack of co-ordination between end-sites. This raises a very practical question regarding the co-ordination of implementation. If only Abilene or GÉANT2 (upstream

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networks) receive the request, should this network asks the end user in side A to contact end user in side B and forward the request to the upstream network, or should one upstream network contact the peer upstream network to confirm that the service delivery is feasible?

- Cost issues, where there are charges that need to be paid separately in the USA and in Europe since these facilities are dedicated for individual use and, as such may attract charges.

### Design and Set up of the Point-to-Point Link

The multi-domain and multi-technology environment makes the set up of the point-to-point links a challenge. Traditionally, when setting up network services (basically best efforts IP) a domain was only responsible for providing and setting up its own network resources. Additional work is required in the case of point-to-point link provisioning. Extra coordination is required to ensure:

- Technical compatibility between neighbouring domains (i.e. a domain may use Ethernet as their transport network while the neighbouring one may use IP over MPLS)
- testing and debugging in the pre-production stage

To ensure this, a technical co-ordinator is appointed for each project. The main role of the coordinator will be to facilitate communication between the different domains and ensure delivery of the point-to-point circuit in a timely manner. To help in the provisioning the co-ordinator will make use of a set of tools agreed by the parties.

This set of tools includes forms that operators at each domain need to fill in, in order to acquire the information necessary for the circuit to be set up. The information in these forms is then used by a coordinator to put together the design of the P2P path and it will help him to identify potential issues that may affect the implementation.

A unique form has been developed in the European side and forwarded to Abilene and ESnet NOCs for comments. The form has been used in Europe to coordinate the set up of the latest P2P link between Poland and Canada where DANTE fulfilled the role of coordinator. As part of the process all the information collected is archived in a GN2 wiki page and is made accessible to all the parties involved in the set up.

## 3 Operation of Point-to-Point Links

### 3.1 Monitoring and Maintenance

In Europe there is a significant interest in using the perfSONAR/JRA4 framework to monitor links end-to-end. Many NRENs and GÉANT2 have invested in this technology. In the US, Esnet and, more recently, Internet2 have installed the tools developed by perfSONAR/JRA4 for L1/L2 links monitoring.

In addition, an End to End Coordination Unit (E2ECU) has been established in Europe to manage the information flow and coordinate the resolution of inter domain problems. E2ECU makes use of the perfSONAR/JRA4 monitoring to have a global view of the connectivity, opens trouble tickets when faults are noticed and keeps direct contact with all the domains involved in the point-to-point circuit.

Some users, particularly the Large Hadron Collider (LHC) project, have been asking for a 24x7 service to be provided by the Coordination Unit. GÉANT2 have proposed that a good solution would be to share this role with Internet2, thus having a virtual Coordination Unit located in Europe during European office hours and located in US during US office hours. Little progress has been made on this topic to date.

### 3.2 Common Database and Trouble Ticket System

Other important aspects of point-to-point operations are a multi domain database and a standard Trouble Tickets system distributed across the domains.

A common database will allow to all the operators in different domains to have real-time information about the network topology, contact information and procedures set up across different domains for each point-to-point link. A new initiative to create a common network information system (cNIS) is being launched in Europe. This is an obvious area of future collaboration with North America.

Currently, each domain used its own Trouble Ticket System hence communication between all the entities involved in a point-to-point link that presents a fault becomes difficult. Standardising trouble tickets formats has been identified as an area of future work. However, to date little progress has been yet done in standardising

these formats on a global scale. They are an embedded part of day-to-day operations of all regional Network Operations Centres and progress is therefore slow.

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## 4 Security

There are many aspects to coordinate in this area. It is true that for the moment Internet2 and GN2 are looking at different aspects in security. In Europe, the JRA2 activity of GN2 looks more at creating global policies and making sure that national CERT teams are created in Europe according to a consistent set of principles, whereas Internet2 is looking more to end sites, universities in the context of the US concerns about national security, driven to some serious extent by the agenda of the Department of Homeland Security. Ideas have been exchanged, but this is an area where “domestic” political agendas dominate in terms of United States thinking.

An AAI infrastructure is being developed in Europe and North America. There has been limited communication on this to date, but it is an area of activity for future collaboration. This infrastructure will become crucial at the time of sharing resources such as the already mentioned database information or collected link statistics.

## 5 Conclusions

The development of a richer service portfolio on a pan-European footprint leads to operational challenges on a global scale. Other Research and Education networks, particularly in North America, have recognised similar operational problems within their world region. Operational co-operation has been initiated to build a common framework which will simplify and encourage the creation of a pervasive service support environment. To date the results of this co-operation have been limited. There is a general issue that network technologists underestimate the difficulties of translating technology into service. Operational co-operation is more problematic than technical co-operation because operational expertise is generally tied up in solving day-to-day problems. A set of operational co-operation issues has been identified. To date, limited success has been achieved in building a robust global framework.

## 6 Acronyms

<b>AAI</b>	Authorisation and Authentication Infrastructure
<b>CERT</b>	Computer Emergency Response Team
<b>cNIS</b>	Common Network Information System (Database)
<b>E2ECU</b>	End to End Coordination Unit
<b>GE</b>	Gigabit Ethernet
<b>IN2P3</b>	National Institute of Nuclear and Particle Physics (France)
<b>LHC</b>	Large Hadron Collider (CERN)
<b>MPLS</b>	Multi Protocol Label Switching
<b>NOC</b>	Network Operations Centre
<b>P2P</b>	Point-to-point
<b>PerfSONAR</b>	PERformance Service-Oriented Network monitoring ARchitecture
<b>PSNC</b>	Poznań Supercomputing and Networking Centre (Poland)
<b>CRC</b>	Communications Research Centre
<b>[ACRONYM]</b>	[Definition]