EGEE

OPERATIONAL INTERFACE BETWEEN EGEE AND GEANT/NRENS

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Abstract: This document describes the interface between EGEE and GEANT/NRENs. Entities involved in communication process and operational procedures between these entities are defined here.

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CONTENT

1. INTRODUCTION

1.1. PURPOSE

Network infrastructure available to EGEE is served by a set of National Research and Education Networks (NRENs) via a high-speed pan-European backbone, the GEANT network. Reliable network resource provision to GRID infrastructure highly depends on coherent collaboration between a large numbers of different parties both from NREN/GEANT and EGEE sides. To provide such coherent collaboration it is vital to define an operational interface including clear description of parties involved in network provisioning (and consuming), their roles and operational procedures between them.

This document attempts to define a model of a network operational interface between EGEE and GEANT/NRENs. It is organized as follows:

- In section 3, we briefly broaches the problem;
- In section 4, a NREN NOCs study is summarized;
- In section 5, we propose a general approach of operational interface definition, define parties involved in network operations;
- In section 6, we focus on the formal procedures of the day-to-day running of the network inside EGEE. It can be fault troubleshooting, installation/modification/removal of some service, planned network operations;
- In section 7, we give the first elements for network usage reporting;
- In section 8, the conclusion gives the perspectives for the 2nd year of EGEE.

1.2. APPLICATION AREA

This document applies to all people involved in EGEE operational activities just as GN2 and NRENs.

1.3. REFERENCES

[R1] M. Campanella, M. Przybylski, R. Roth, A. Sevasti, N. Simar, Multidomain End-to-End IP QoS and SLA, Proceedings of the Second International Workshop on Quality of Service in Multiservice IP Networks, pp. 171-184 (2003).	
[R2] Institution of SLAs and appropriate policies, DSA2.2	https://edms.cern.ch/document/565447
[R3] RFC 1297, NOC Internal Integrated Trouble Ticket System Functional Specification Wishlist	
[R4]Specification of Interfaces for Network Performance Monitoring, DJRA4.2	https://edms.cern.ch/document/533215
[R5] NOC survey	https://edms.cern.ch/document/503527

1.4. DOCUMENT EVOLUTION PROCEDURE

This document can be amended by the SA2 Team (http://egee-sa2.web.cern.ch/egee-sa2/About/team.html). Proposals for amendments can also be sent to SA2 (project-eu-egee-sa2@cern.ch) with a brief description of the proposed change and its benefits. Minor changes, such as

spelling corrections, content formatting or minor text reorganization not affecting the content and meaning of the document can be applied by the authors without review. Other changes must be submitted for review by the SA2 team.

1.5. TERMINOLOGY

Definitions

TTM	Front-end that receives "users" requests, registers it (as Trouble Ticket), classifies and dispatches the problem.
ENOC	Operational infrastructure for solving EGEE-related network problems.
User	Entity acting as consumer of network services and reporting problems with requested service. It can be an Authorized user, ROC/RC staff member, ENOC
RC DB	Central storage with information about EGEE-related networks and its interconnections.
SLA DB	Central storage with information about SLAs, at least its technical parts.
PERT detection	The GN2 entry point which identify the NOC to address
GEANT/NREN NOC	The provider entry point for related network actions

Glossary

ALO	Admistrative Level Object (1st SLA part)
BAR	Bandwidth Allocation and Reservation
CE	Computer Element
CIC	Core Infrastructure Centre
DS	Deployment Support
EGEE-JRA4	EGEE Network services development activity
EGEE-SA1	EGEE European Grid Support, Operation and Management activity
EGEE-SA2	EGEE Network resource provision activity
ENOC	EGEE Network Operations Centre
ESUS	Experiment Specific User Support
GEANT	Pan-European multi-gigabit research network
GEANT2	Next generation of pan-European multi-gigabit research network
GEANT2-SA3	GEANT2 End-to-End Quality of Service activity
GGUS	Global Grid User Support
GOCDB	The GOCDB is a web based interface to the GOC core database. Grid Operations Centre DataBase
LCG	LHC Computing Grid
NOC	Network Operations Centre
NREN	National Research and Education Network

NSAP	Network Service Access Point
OMC	Operations Management Centre
PERT	GEANT2 Performance Enhancement and Response Team
QoS	Quality of Service
RC	Resource Centre
ROC	Regional Operation Centre
SE	Storage Element
SLA	Service Level Agreement
SLO	Service Level Object (2nd SLA part)
TNLC	Technical Network Liaison Committee
TTM	Trouble Ticket Manager
TTS	Trouble Ticket System
VO	Virtual Organization

2. EXECUTIVE SUMMARY

The network resources are as important for Grid operations as its computing and storage resources. So, the interface between the Grid Operations and the GEANT/NRENs network operation centres is critical. The information flow from day to day operations must be controlled, organized for management review of the EGEE network service:

- To trace, diagnose and resolve problems;
- To provide quality indicators.

To setup an operational interface between EGEE and GEANT/NRENs we have worked with the prospect of having a single point of contact in EGEE taking into account the network related issues and a convenient interface with GEANT/NRENs. The solution was elaborated in close collaboration between many parties, including:

- EGEE-SA2, Network Resource Provision;
- EGEE-SA1, Grid Operations;
- EGEE-JRA4, Network Services Development for network performance monitoring issues;
- GEANT2-SA3, dealing with the provisioning of the end-to-end quality of service, performance trouble tickets chain and Performance Enhancement and Response Team (PERT) operation;
- GEANT/NREN NOCs, more than twenty Network Operation Centres are involved today in the “EGEE Network”.

The work started from scratch during Autumn 2004 with a survey of the NREN Network Operations Centres. The main results are:

- NRENs agree to signal their network problems to EGEE;
- The assumption that EGEE, as a customer, can signal a problem is generally well received. .

The diversity of network information, the number of open tickets and the distinctive features of each Trouble Ticket System remain open issues for a generalized implementation.

The operational interface deals with the network problems troubleshooting, notifications from the NRENs, network Service Level Agreement (SLA) installation and monitoring |R2], network usage reporting. The model and the associated procedures taking into account all these components must be kept as simple as possible in order to remain feasible.

We introduce two functional entities inside the EGEE Operations:

1. An EGEE Network Operations Centre (ENOC) which is the counterpart of a NREN NOC for EGEE, it is in charge of the “EGEE network” operations.
2. A network Trouble Ticket Manager (TTM) dealing with the notifications about network problems. These notifications come from GEANT/NRENs and EGEE users.

To provide an operational service we recommend for TTM to use the Global Grid User Support (GGUS), which is a support structure dedicated to EGEE and LCG. The ENOC is the specific support entity for network problems that is in charge of maintain the contact with GEANT/NREN NOCs.. Minimal extra work is really asked from GEANT/NREN NOCs.

In conjunction with SA1 we have planned a trial during Summer 2005 to assess the capability of the proposed model and procedures to provide the expected services.

3. NETWORK OPERATIONAL INTERFACE PROBLEM

The main issue of a network operational interface organization is that a problem resolution may affect several parties. Moreover, the exact number of parties involved in some problem may not be determined in advance. For example the failure of a data transfer between two EGEE sites may be the consequence of a fault in any NREN along the network path between these sites. Thus one of the main issues of operational interface is the organization of the coordination and management schemes between different parties involved in a network problem resolution.

Network provision for GRID purpose in EGEE requires close collaboration of EGEE representatives with GEANT and NRENs. While defining detailed procedures of such a collaboration we should take into account certain features and limitations of a classic NOC:

- A classic NOC is responsible for network operations inside its administrative domain. We cannot take *a priori* that each NOC will be responsible for all problems (including QoS-related) for traffic passing through its administrative domain (transit traffic). For example in a situation where the NOC receives a network fault alert and finds out that the origin of this fault lies inside another administrative domain we cannot hope that this NOC will take the role of mediator to interact with all the involved administrative domains and solve the problem. For a “recursive” problem resolution special agreements between NOCs are needed.
- A classic NOC has its own user interface (phone, e-mails, Trouble Ticketing system), and some established set of operational procedures. We can not *a priori* rely on that it would be possible to unify operational procedures and interface between EGEE and all the NREN NOCs. Experiments for building an automated exchange of operational information between different operations centres are currently conducted. We know about one experiment of such kind between GGUS (FZK) and INFN trouble ticketing systems. This is a very useful experience but we cannot believe any NREN NOC to follow it.

The EGEE networking area which is Europe is a main issue:

- EGEE is not a direct GEANT/NREN customer, the RCs and ROCs are the actual users of the network. Nevertheless EGEE should deal with network providers that are GEANT (the pan-European network) the NRENs (the National networks) but also possibly regional, metropolitan networks and/or Campus networks depending on the connection of the specific end-sites;
- All the NRENs have their own operational model, the dialog is generally in the native country language.

The main challenge is to create a network support structure inside EGEE which will be the EGEE network operation centre, ENOC in this document, and to define the associated network operational procedures. These procedures must be validated by GEANT/NRENS with the prospect of having a single user support entry point in EGEE for network related issues and a convenient interface with GEANT/NRENs.

4. NOC OPERATIONS SURVEY

There are twenty one NRENs serving about one hundred EGEE sites in Europe [Annex 2]. This number shows that before developing a model of interaction between EGEE and NREN NOCs we have to obtain a clear picture of NOC operations methodology.

For this purpose we have prepared a questionnaire [Annex 1]. The questionnaire consisted of several groups of questions. The first group of questions was aimed at finding out who should be contacted when a particular problem arise (e.g. connectivity problem or network service problem) and to identify an approximate response time for each kind of network problems. Another group of questions in the questionnaire was dedicated to problem notification: we need to know how NRENs can signal network problems to its customers and to EGEE. The rest of questions was devoted to trouble ticketing system used in NOC and its compliance to RFC-1297 which describes general functions and specification of a Trouble Ticket system designed for Network Operations Centres. It is important to ascertain if EGEE can have access to NREN trouble ticketing system and the kind of information we can get.

The questionnaire was sent out to selected NRENS/NOCs: GARR (Italy), DFN (Germany), GRNET (Greece), PIONER (Poland), RENATER (France), SWITCH (Switzerland), JANET (Great Britain), SURFNET (Netherlands), RBNet (Russia) We have received seven responses from NRENs.

EGEE had a meeting in Paris with the GEANT NOC in February 2004; two Russian providers, RBNet and RUNNet which connect all the Russian RCs were studied at the end of 2004 by RCC KI.

We have contacted eleven NOCs (meeting, questionnaire), we got information from nine.

4.1. RESULTS

All NRENs provide a user support even there is a difference at the service level [R5].

4.1.1. Trouble Ticket Systems usage

Not all NRENs use a Trouble Ticket System (TTS) in their domain of responsibility. Even if this lack of TTS would be marginal, it could be a problem for EGEE and some action should be envisaged to go deeper into this situation. All the Trouble Ticket Systems are proprietary, the tickets are written in the country language.

Generally there are two or three kinds of tickets with difference in header attributes, lifetime, status (Problem tickets, Information ticket, Maintenance ticket). The user interface is e-mail and web, only the NOC staff can create a ticket.

4.1.2. Notification for EGEE

Most NRENs agree to signal their network problems to EGEE by sending a copy of each ticket they send to their customers; those we met (GEANT, Renater) require that EGEE have a single dedicated email address as a contact, it will certainly be also a requirement from the others. GEANT and Renater have specified that they manage between 20 and 40 incidents per month and about 50 actions of maintenance. The assumption that EGEE can signal a network problem directly to an NREN NOC was not rejected, as an example GEANT agrees with that.

4.1.3. Open issues

The main challenge for EGEE when dealing with NOCs is the diversity of network information provided by different NRENs and the number of tickets sent. Each NREN uses its own ticketing system. Every trouble ticketing system has its own characteristics (different fields, different keywords) and is written in the country language, so it seems mostly impractical to construct a system which will perform an automated information exchange with a large number of different NRENs, more than twenty.

5. OPERATIONAL INTERFACE

In this section we detail the functions and the organization of the Network Operational Interface

5.1. FUNCTIONS OF THE OPERATIONAL INTERFACE

We assume that EGEE-GEANT/NREN interface must be responsible for the following issues:

- Network problems troubleshooting.
  - Detection and resolution of problems;
  - Notification of problem;
  - Handling of notifications from NRENs describing network infrastructure changes, detected failures or foreseen maintenance;
  - Network monitoring.
- Network SLA
  - Installation (Provisioning of network service);
  - SLA monitoring which deals with network SLA violations
  - Maintenance of SLA information.
- Maintenance of a database containing information on RCs and their network connections;
- Reporting on network usage.

The operational interface can be represented as a set of formalized step-by-step procedures to solve the issues listed above. Each procedure requires some type of interaction between involved parties. In this document we do not focus on technical background of information exchange. Here we provide working scenarios of interactions.

For proper communication with NRENs, EGEE should have a regularly updated information database of NRENs and RCs. This database will help identify all parties involved and provide contacts and network connectivity information when some network problem arises. Example situation: Some RC reports a connectivity problem with another RC. The database should help to identify all NRENs along the network path between these RCs and give contacts of NREN NOCs to report problem.

The SA1 Grid Operations Centre DataBase (GOCDB) is a good candidate for this purpose, this database (http://goc.grid-support.ac.uk/gridsite/gocdb/gocdb_ts.html) contains general information about participating EGEE and LCG sites. To set our own database will give more work and probably also will lead to more inaccurate or outdated data. We should find a methodology to include the main network information:

- Network connectivity (capacity, providers ...);
- Network services available.

5.1.1. Network problem notification

EGEE should present some general interfaces for all notifications coming from NRENs and users. We define entity inside EGEE providing such an interface as a Trouble Ticket Manager (TTM), a human and software interface. Its goal is to provide convenient interface for incoming notifications, to classify it and to dispatch it to proper destinations. TTM should provide ticket initiator with information on ticket status, request extra information from initiator when needed and report ticket resolution progress.

The use of an EGEE Trouble Ticketing System (EGEE TTS) is essential to provide the service. The main principles of a Trouble Ticketing System are stated in [R3]. TTS should provide a convenient

interface for the user to report a problem, and an interface for the operator to get user problem reports, to request user for additional information and to dispatch necessary information concerning the problem to the entities responsible for problem resolution. Also all involved parties should have means to track problem resolution status and escalation route. A particular TTS realization can be different. Interaction between entities can be based on web-interface, email or both.

EGEE TTS should have an automated information exchange with NREN NOC TTS when possible. The development of such an exchange is a serious issue because different NOCs have different TTS in different languages and it is not always possible to establish exports/imports of information from TTS.

When a NREN's representative needs to send some information to EGEE or to report some problem, he send a copy of his ticket to EGEE which will be dispatched to destinations in the EGEE Trouble Ticket System, depending on the trouble ticket information.

When dealing with network problems in EGEE the user always has an alternative whether to contact his network provider (traditional way) or to contact TTM. In complex cases, when it is clear that a network problem could affect several NRENs it would be more effective to use TTM while for local NREN problems NREN NOC support will be more efficient since there will be no redundant interactions. Because user can not always correctly identify problem scope, we believe that TTM should accept tickets on every problem and do a primary classification. When possible, TTM should use a more efficient way of problem resolution.

5.1.2. Network SLA management

We consider network SLA management as an essential part of operational interface between EGEE and GEANT/NRENs. The provision of QoS network services requires establishing end-to-end SLAs [R2]. Since QoS services are provisioned across independently managed domains, end-to-end SLAs will be based on SLAs inside each domain (domain SLAs) (Fig 1).

Establishing SLA between two end-points results in a chain of SLAs along the path of administrative domains between two points, EGEE deals only with end-to-end SLAs or border-to-border SLAs.

A single representative that acts as a SLA installation coordinator for the SLA creation is required. This function is provided by ENOC.

The SLAs management is operated by the ENOC. Actual information on established SLAs should be collected in a centralized database; it should be the GOCDB database. It will indeed be a great advantage to gather all the necessary information for the EGEE Operations in a single database

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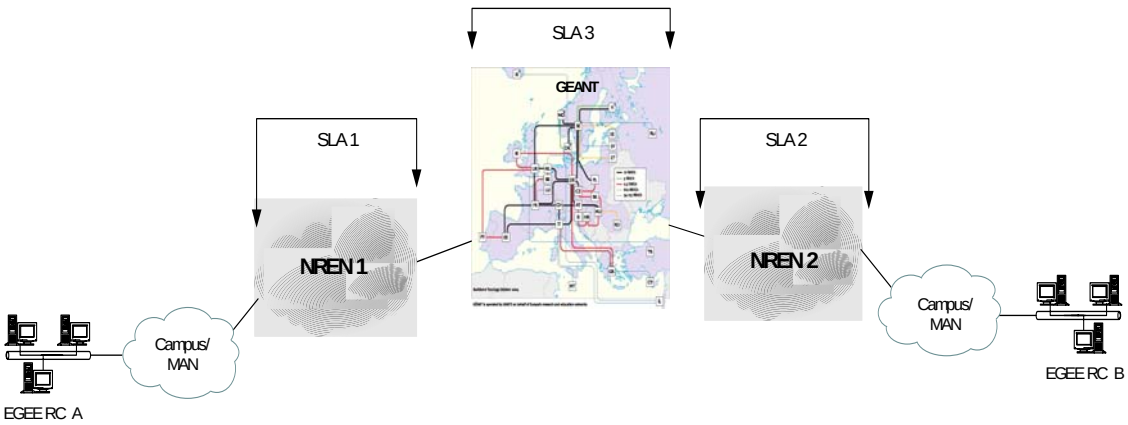

Figure 1. Per-domain SLAs along an end-to-end path

5.2. NETWORK OPERATIONAL INTERFACE ORGANIZATION

In this section the global organization and the relationships between the entities are examined in order to propose a coherent model. A summary of the involved entities and their relations is shown in Fig 2.

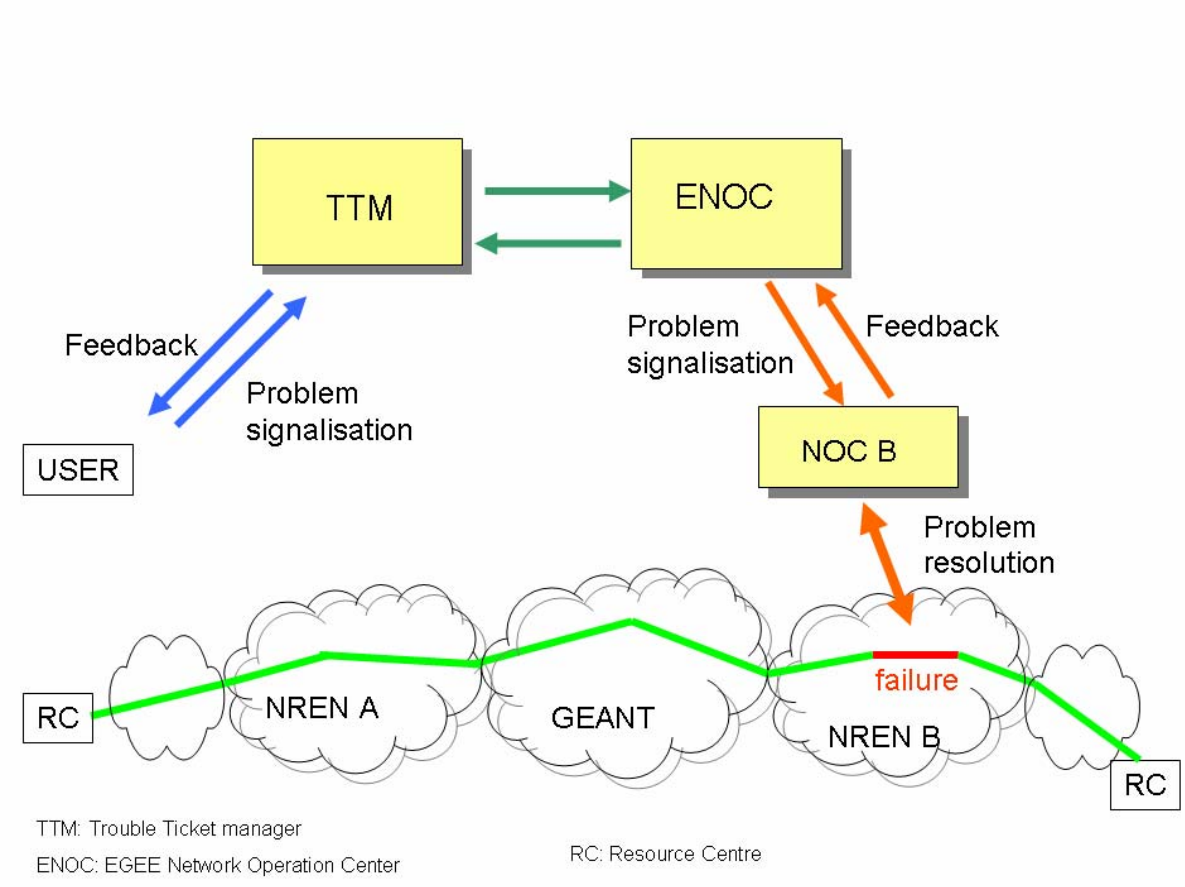

Figure 2. Summary of interactions between involved entities

5.2.1. TTM and ENOC inside EGEE

EGEE SA1 User Support task force has a wide experience of user support in different GRID projects (LCG and EGEE) through the Global Grid User Support (GGUS). The tools are developed mainly by Forchungszentrum Karlsruhe (FZK).

In the GGUS architecture three actors are identified (Fig3):

1. The user which signals a problem;
2. GGUS itself;
3. The support units, ENOC will be the support unit which will deal with the network issues.

The aim of GGUS is to provide a first line user support for all problems GRID user can encounter. GGUS is a single point of contact and information for GRID related questions. Today the network component is not at all taken into account in GGUS, GGUS provides a web-based Trouble Ticketing System which can be accessed via GGUS web-portal (http://www.ggus.org/).

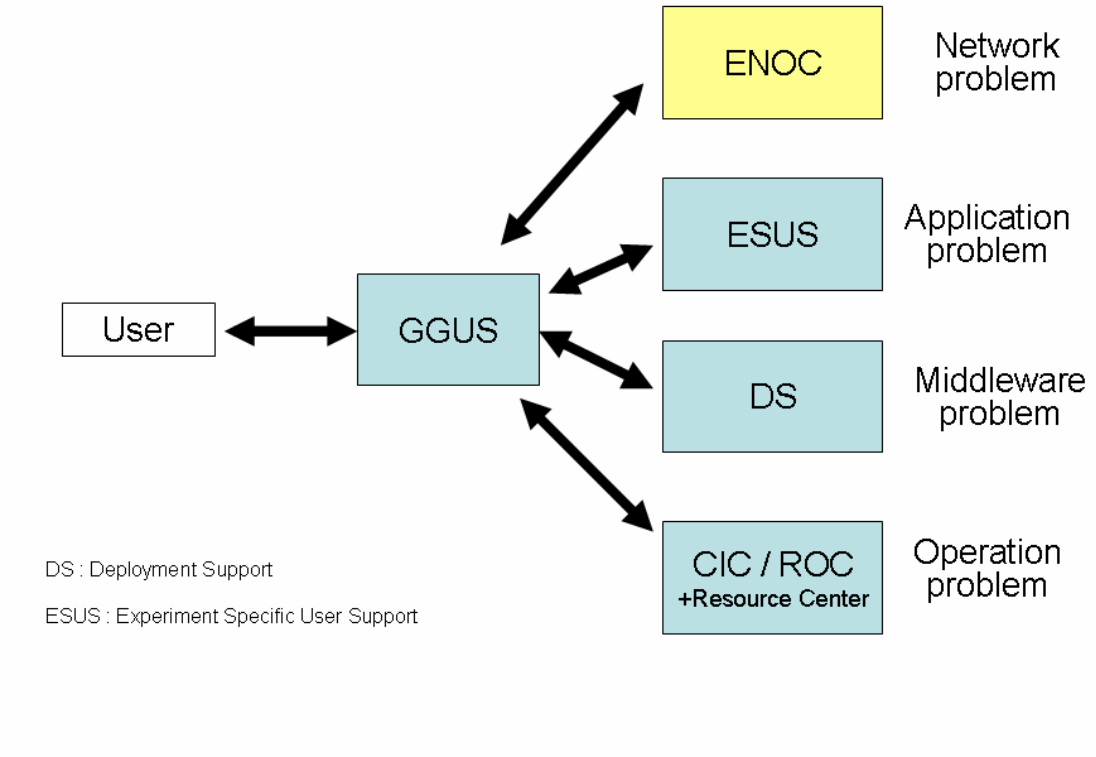

Figure 3. User support workflow in GGUS including the network

One can see that GGUS receives support requests from users, makes request classification, dispatches support requests to the Support Unit depending on the request characteristics. When the problem is solved, GGUS sends a feedback and solution to the user. GGUS operation completely coincides with the operation of Trouble Ticket Manager (TTM), so it is worth discussing the possibility for GGUS to undertake the TTM functions defined in this document.

To ensure 24/7 support, GGUS has three teams in different time zones. GGUS started off at Forschungszentrum Karlsruhe in Germany in 2003 and has had a partner group at Academia Sinica in Taiwan since April 2004. A third partner in North America will complete the 24 hours cycle.

5.2.2. EGEE NOC term of reference

The EGEE NOC is the user support for events linked to the networks, its area of competences is mainly the network problems troubleshooting and the SLAs management.

It is in charge of:

- resolving network problem but it is out the scope of its activity to configure network equipments;
- managing the SLA in coordination with VO;
- having contacts with GEANT/NRENs and their NOCs for operational purpose through procedures. ENOC can propose the improvements of the procedures described later in the document and envisage new procedures;
- being the EGEE interface with respect to other network domains, like LAN (local area network), MAN (Metropolitan area network) or campus network. This function is out the scope of this document, but could be take in consideration later.
- being involved in the network reporting process;
- monitoring the network performance;
- taking part in the TTM task i.e. notification filtering, automation of the exchanges between EGEE TTS and GEANT/NRENs TTS.

The ENOC team can be localized in two ways:

- people distributed in ROCs;
- people gathered in the same location

The number of people providing a 9h-17h, Monday to Friday service should be three or four. The choice between a distributed ENOC and a centralized ENOC is not made today but we are thinking that for the second year of EGEE it will be difficult to find people in a unique place.

5.2.3. ENOC and GEANT/NREN NOCs

More than twenty NRENs are involved in the datapaths between the EGEE Resource Centres, all with their own local operational interface. If we assume that there will never be a consensus around a unique interface then EGEE must accommodate with all NRENs interfaces in order to get relevant information from the “EGEE network”.

The main conclusions to implement a convenient interface between EGEE and GEANT/NRENs are:

- It is not conceivable for GEANT/NREN NOCs to create an EGEE TTM trouble ticket (TT) for each network event. However, what should be possible is for the ENOC/TTM to be e-mailed a copy of the GEANT/NRENs TT that is created for each network event.
- ENOC will have the choice to contact either a NREN NOC, the GEANT NOC or the GEANT2 Performance Enhancement and Response Team (PERT). It is recommended the ENOC contacts a NREN NOC when the problem is a known, hard failure which needs to be addressed quickly. But if the location of the problem is not obvious, or it is not a hard failure but a performance issue, then it is more appropriate to contact the PERT who will identify the problem and its location.
- When requesting the PERT’s assistance, ENOC will need to create a ticket in the PERT ticket system (PTS) and will have to ask GEANT/NREN to create a ticket on their behalf..
- When requesting the NREN NOC’s assistance, ENOC will need to create a ticket close to this NOC in the NREN’s TTS.

About the knowledge of the networks topology, the activity manager of GEANT2-SA3 proposes an interesting possibility: “As far as the GEANT topology is concerned it should be possible (but cannot personally confirm) that EGEE can be regularly sent (say once a month) the GEANT topology in diagrammatic format. To provide something more sophisticated may be possible but would have to be agreed by the DANTE Ops Manager. Note that in the long term it should be possible to give EGEE access to the topologies of those domains which take part in GN2 PIP, because each such domain should keep its topology in a database and make it available as the Network Information Service”.

EGEE has to obtain the GEANT topology which will be useful to ENOC in detection problem in the border-to-border perspective with the knowledge of the NREN NOC to contact (§ 5.4 Fig 7).

5.3. SUMMARY ENTITIES

In the table below we define a one-to-one mapping between the elements of our model and the possible actors which always exist.

Entity	Description	Possible actors
TTM	Front-end that receives “users” requests, registers it (as TT), classifies and dispatches the problem.	GGUS
ENOC	Operational infrastructure for solving EGEE-related network problems.	Network representatives in ROCs (distributed team) or a centralized team somewhere.
User	Entity acting as consumer of network services and reporting problems with requested service.	EGEE end user, RC/ROC staffs, ENOC
RC DB	Central storage with information about EGEE-related networks and its interconnections.	GOCDB
SLA DB	Central storage with information about SLAs, at least its technical parts.	GOCDB
PERT	The GEANT2 entry point which identify the NOC to address	GEANT2 PERT
GEANT/NREN TTS	The provider entry point for related network actions	GEANT/NREN NOC

Figure 4. Mapping between the network operational interface entities and the possible actors

6. OPERATIONAL PROCEDURES

In this section we develop the following operational procedures to be realized in EGEE-NREN interface:

- RC information database maintenance;
- SLA related procedures:
  - SLA installation;
  - SLA monitoring and troubleshooting;
- NREN notification;
- Network problems resolution.

6.1. RC INFORMATION DATABASE MAINTENANCE

To perform operational interactions with RCs and GEANT/NRENs it is essential for ENOC to have a topological map of RCs network connections. ENOC needs to know networks service providers of each RCs, available network services and needs to be aware of whom should be contacted with in each RC when a particular problem arise. In this subsection we present an operational procedure to gather and maintain RC information database (RC DB). We assume that this information can be obtained either from RC directly or from ROC serving this RC.

It is not impossible that ENOC get information from GEANT/NRENs on an individual agreement basis.

The procedure:

a) RC/ROC registers to ENOC the actual information concerning RC network connections (which include the chain of network service providers until the NREN, the type and speed of network connection, available network services) and RC contacts to interact with when particular problems arise;
b) ENOC routinely sends requests to RC/ROC to ensure that database information is up to date via mailing list;
c) RC/ROC notifies ENOC when some change of database information takes place.

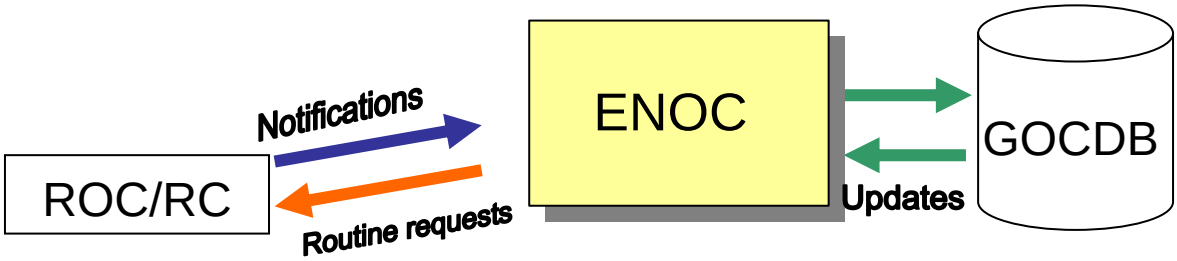

Figure 5. Sample diagram depicting interactions between RC/ROC,ENOC, GOCDB

6.2. SLA RELATED PROCEDURES

Two identified procedures are devoted to SLAs:

1. Creation;
2. Monitoring and troubleshooting.

The following chart shows the global SLA processing as defined in [R2]

6.2.1. SLA creation

The SLA institution processing between two EGEE end points is described in [R2], here we only detail the steps in which ENOC and TTM are involved .

It can be the creation of an end-to-end SLA or a border-to-border SLA; the demand can be initiated by a VO but the initiator is an open issue.

Initiator: EGEE SLA contractor

1 Initiator sends a SLA creation request to TTM, where it specifies SLA; SLA definition developed in [R2] will be used.

2 TTM dispatches SLA installation request to appropriate contact person from ENOC.

3 ENOC can identify all administrative domains involved in the end-to-end SLA and constructs a chain of domain SLAs but it is not mandatory. It must identify at least the first administrative domain the applicant RC is depending. We assume that NRENs have procedures to spread the request without a direct ENOC intervention to each NREN. The ENOC contacts:

   a. separately the NOC of each domain involved in the end-to-end path that is NOT part of the GEANT/NREN cloud;

   b. the NOC of the first NREN domain along the border-to-border part of the path between the involved contractors.

4 The first NREN has the responsibility to check if the new SLA can be provided in the GEANT/NRENs cloud:

   a. If check succeeds then:

      i) ENOC analyzes the answer;

      ii) A new SLA is registered in SLA database (GOCDB) with the status “Pending”;

      iii) A notification is send to initiator to inform that new SLA can be established;

      iv) Formalization by contract of the new SLA by the SLA contractor;

      v) The status of the SLA changes to “Established” in the SLA database.

   b. If check fails then:

      i) ENOC analyzes the reasons of the negative answer to see if a modification of the request could modify this one;

      ii) A notification is sent to initiator to inform that new SLA can not be established; ENOC gives the conclusion of its analysis, the initiator can take this conclusion into account to modify his request.

6.2.2. End-to-end SLA monitoring

In EGEE the monitoring will be done by the Network Performance Monitoring tool (NPM) developed by EGEE-JRA4. NPM will have the capability to exploit data gathered in the GEANT/NRENs domains and data from EGEE tools.

It is left to the EGEE VO/RCs involved in a SLA to verify the performance of the end-to-end path [R2]. It is also possible that ENOC provided this service.

6.2.3. End-to-end SLA troubleshooting

In case of faults or degradation of performance, usually perceived by the involved VOs/RCs people, the problem must be directly reported to the ENOC [R2].

Initiator: User

1. When a problem arises initiator opens a ticket in TTM;
2. ENOC contacts the GEANT2-PERT if the problem location is unknown, otherwise it contact GEANT/NREN NOC (point 4)
3. ENOC interacts with PERT which identifies the problem and the location;
4. ENOC interacts with responsible NOC;
5. When the problem is solved a notification is sent to initiator.

6.3. NRENS NOTIFICATION

Network service providers should notify their customers about planned network maintenance, failures and any other actions and events which can influence the functionality of network services or connectivity status. In this section we will describe operational procedures connected with handling notifications from network providers. The most widespread and convenient method of notifications is mailing list. Here we will describe organization and management of mail-notification workflow.

6.3.1. Preliminaries

To organize mail-notification workflow several actions are assumed:

1. Single e-mail box for incoming notifications is configured;
2. This e-mail box is subscribed to NREN mailing lists.

As soon as these actions are done, ENOC will be able to receive the tickets, will process tickets and dispatch them into GGUS.

6.3.2. Procedure of handling incoming notifications

Procedure of handling incoming notifications is performed by one or more ENOC representatives and includes following steps:

1. *Initial filtering*. One must keep in mind that NREN mailing lists may include excessive information about internal NREN actions which do not necessarily affect network services provided to clients. Moreover, even in cases when NREN notifies that some clients will be affected it does not necessarily mean that this notification will affect EGEE sites. That is why the flow of NREN notifications should be filtered and messages which do not concern EGEE sites should be ignored.
2. *Associating message with network origin*. NREN notifications have custom format which may vary with different NRENs. While processing NREN notification one should convert NREN message into common *"EGEE"* format. *"EGEE"* message format should be capable to store problem scope and bind it to a network origin using NREN ids.
3. *Creation of a trouble ticket in GGUS.* Trouble ticket should be created on the final step. Detailed ticket template should be defined as a result of future work of SA2 in collaboration with GGUS.

6.4. NETWORK PROBLEMS RESOLUTION

In this section we define network problem resolution procedures. There can be two different kinds of problem initiators: users (ROC, ENOC) and network monitoring tools. According the approach developed by JRA4 [R4], network diagnostic and monitoring tools should provide users, NRENs and middleware with information on network performance. This information will allow to detect network problems, to identify problem scope and involved parties. Moreover, the network diagnostic tools can send fault alerts when some problem is detected. The person who received the alert reporst to TTM if necessary.

A general operational procedure including six steps is proposed. The Trouble Ticket workflow is presented in Fig. 7:

1 User (RC/VO) using TTM web-interface or email opens a ticket and gives a problem description.

2 TTM representative receives notification of a new ticket receipt (using e-mail or some other means), makes problem classification, requests user for more information when needed.

3 If problem is qualified as a network problem, TTM makes a request assignment to ENOC and ENOC representative receives the corresponding notification.

4 ENOC starts problem resolution, interacting with GEANT2-PERT and NREN NOCs. When needed, ENOC requests problem initiator for more information.

5 A clear escalation route for ticket processing should be defined. The escalation route depends on ENOC internal realization inside EGEE, a common EGEE escalation route based on the three support and management layers in EGEE can be implemented (ROC -> CIC -> OMC).

6 When problem is solved, ENOC representative closes trouble ticket. After that corresponding notifications are sent to initiator and TTM. TTM notifies user that problem is solved. If the problem could not be solved in a given time (Time To be Resolved), TTM notifies user about planned time for problem resolution.

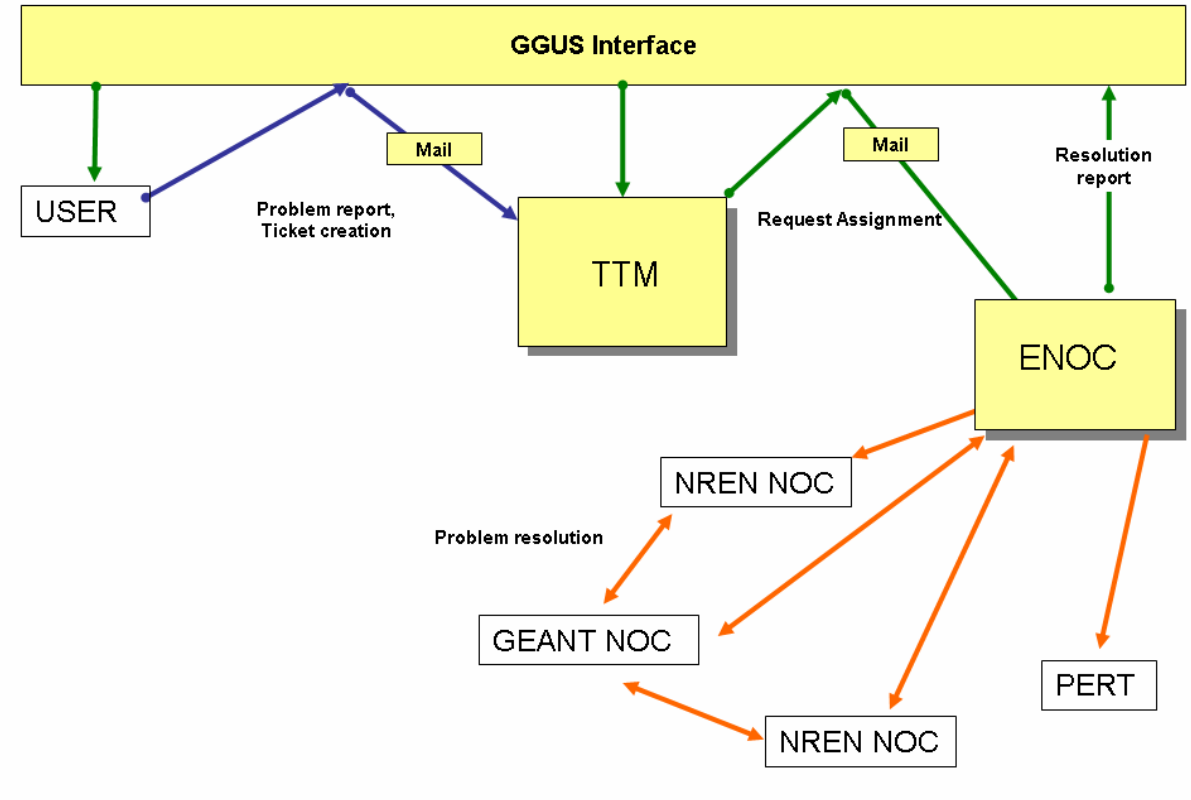

Figure 7. Trouble Ticket System workflow.

7. NETWORK USAGE REPORTING

In this section we define a set of procedures to gather information on network operations. By the network information we assume information on network load and network failures. Network information should include both the actual state of the network and historical performance data.

This information will be published in a monthly report it seems that it is an adequate frequency but the implementation will be confirm.

7.1.1. The aim

The aim is to provide to EGEE a set of informative elements on the "EGEE network":

- Relevant informations on network usage :
  - The reliability assessment;
  - The capability to access robust services.
- To allow the definition of indicators for the EGEE Quality Plan through the SA2 Quality Plan in the first phase of EGEE:
  - The number of network problems, their classification following the impact level, their duration.
- To contribute to the improvements of network services by the EGEE Technical Network Liaison Committee (TNLC):
  - Assessment of the network performance against SLAs;
  - Identification of network connectivity or performance problems and weak elements.

7.1.2. The means

The information gathering is done through two sources:

1. GGUS;
2. Network Performance Monitoring (NPM).

7.1.2.1. GGUS

GGUS is the central point for all service requests, it maintains a knowledge base for all grid related problems and their solution. To take into account the network in GGUS will provide a set of information about all which is related to the Trouble Ticket (i.e. total number of tickets, number of ticket by problem level) but is too early to define exactly the indicators.

7.1.2.2. NPM

To get accurate informative elements about the network requires having access to the following types of information:

1. Information about quality of connectivity between resource centres, which is measured by active network monitoring methods:
   a. Best Effort traffic connectivity quality information;
   b. Information about quality of connectivity for the guaranteed service traffic classes.
2. Information about integral network traffic, which is gathered by the passive network monitoring methods:
   a. Information about integral incoming and outgoing network traffic of resource centres as a function of time

⇒ detailed elaboration for separate service classes is desirable

b. Network exchange matrix between pairs of resource centres as a function of time
⇒ detailed elaboration for separate service classes is desirable

3. Statistical data for performance of network applications (GridFTP etc.)
4. Statistical data for network Service Requests execution.

Some performance information are currently supported by working monitoring tools and planned to be available through the unified JRA4 NPM interface, some others points e.g. 2 and 3 above are to be studied.

8. CONCLUSION

We have seen that the Network Operational Interface involves a great number of entities which are mainly a third party for EGEE, the NRENs and their NOCs; this impacts all the models we can envisage because we must take into account some particularities which cannot be changed in the NREN operational procedures such as the Trouble Ticket System and the fact that EGEE cannot be considered as a classical customer by all the NRENs We have tried to specify a model for a network operational interface for the first phase of EGEE with the knowledge we have today of the capabilities of all partners.

To introduce the network related issues in the EGEE user support scheme is certainly a heavy task because it requires manpower and development.

Consequently we try to keep our model and procedures as simple as possible in order to provide a practical operational service:

1. Use of Global Grid User Support (GGUS)
2. Setting up of the EGEE Network Operation Centre(ENOC)
3. Minimal extra work for the NREN NOCs

SA1 and SA2 have agreed that it will be possible to do a trial of interfacing GGUS to ENOC and ENOC to an NREN in summer 2005; to keep this simple it is decided to involve only one or two NRENs on a voluntary participation:

- SA1 will provide support:
  - Make ENOC a support unit within GGUS
  - Provide a shared mail box for NREN notifications
  - Provide training to SA2 in the use of GGUS
- SA2 will provide support:
  - Work with SA1 to verify that the arrangement being put into place for ENOC trail work satisfactorily,
  - Will ensure that notifications sent to ENOC are dealt with in a timely manner during the trail.

After the trial an assessment will be done and the conclusions will be discussed inside SA1 and SA2 at the end of September before to go forward; the model will certainly improve during the second year of EGEE.

An update of the document itself will be done by the end of the year after the experiment and its lessons.

ANNEXE 1: NOC QUESTIONNAIRE

1. General information:

    (a) NREN Name
    (b) Country
    (c) Website

2. Contact information.
    (?) Who should be contacted when a problem with network connectivity arises?
        Specify email, work phone, fax.
    (b) Who should be contacted when a problem with network services arises?
        Specify email, work phone, fax.
    (c) Who should be contacted when a security problem arises?
       Specify email, work phone, fax.
    (d) Whom is the problem referred to, when a NOC operator (or an engineer) can not resolve it on it's own?
    (e) Specify predicted email response time for each employee mentioned in
(a)-(d).
    (f) How do you signal problems (scheduled or not) to your customers?
    (g) Is it possible to signal problems directly to EGEE (even if we are not your direct customer)?

3. Do you keep statistical analysis of network problems? If "yes" then:
    (a) Specify fractions of problems concerned with: network links, network equipment, network services, network security.
    (b) What is the Mean Time Between Failure for core network functions?
    (c) What is the Mean Time to Repair for core network functions?
    (d) Can such statistics be available to EGEE in real-time?

4. How long will it take to replace key network equipment in a case of its failure?
    (a) Do you have a "hot" replacement option for your key network equipments?

5. Do you use a Trouble Ticket (TT) system? If YES then:
    (a) Specify its name
    (b) If TT system is your proprietary software describe its features.
    (c) Specify your TT system user interface (web, e-mail, other).
    (d) Specify your TT system operator interface (web, e-mail, other).
    (e) Who can create trouble tickets?
    (f) Can EGEE (which is not your direct customer) have access to your TT system?
   (g) If YES to (f), then which kind of access can we have?

ANNEXE 2 NRENS AND SITES

The table below is a synthesis of information provided by GOCDB (Grid Operation Centre DataBase) and the SA2 European network services survey.

ACOnet (Austria)				
HEPHY-UIBK				

CESNET (Czech Republic)				
Prague-CESNET	Prague-LCG2			

CyNet (Cyprus)				
CY01-LCG2				

DFN (Germany)				
DESYPRO	EKPLCG2	FZK-LCG2	GSI-LCG2	HU-BERLIN
ITWM	RWTH-Aachen-Test	SCAI	Uni-Wuppertal	

FCCN (Portugal)				
LIP-LCG2				

GARR (Italia)				
CNAF-T1	CNAF-LCG2	INFN-BARI	INFN-BOLOGNA	INFN-BOLOGNA-CMS
INFN-CAGLIARI	INFN-CATANIA	INFN-CNAF	INFN-FERRARA	INFN-FRASCATI
INFN-LNL-LCG	INFN-MILANO-LCG2	INFN-NAPOLI	INFN-NAPOLI-ATLAS	INFN-PADOVA
INFN-PERUGIA	INFN-PISA	INFN-ROMA1	INFN-ROMA1-VIRGO	INFN-ROMA2
INFN-TORINO-LCG2				

GRNet (Greece)		
GR-01-AUTH	GR-02-UoM	HG-01-GRNET

HEAnet (Ireland)				
csTCDie				

HUNGARNET (Hungary)				
BUDAPEST				

ISTF (Bulgaria)		
BG01-IPP	BG02-IM	BG-INRE

IUCC (Israel)	
TAU-LCG2	WEIZMANN-LCG2

PIONER (Poland)		
CYFRONET-LCG2	POZNAN-LCG2	WARSAW-LCG2

RBNet (Russia)				
RU-PSN-LCG2	JINR-LCG2	RU-Moscow-KIAM-LCG2	RU-Moscow-SINP-LCG2	ITEP
RU-PNPI-LCG2	RU-Protvino-IHEP	RU-Novgorod-NOVSU-LCG2		

RedIRIS (Spain)				
CESGA-EGEE	CIEMAT-LCG2	CNB-LCG2	IFAE	IFCA-LCG2
IFIC-LCG2	INTA-CAB	PIC	PIC-LCG2	UAM-LCG2
UB-LCG2	UPV-GRyCAP	USC-LCG2		

RENATER (France)				
CEA-DAPNIA-SACLAY	IN2P3-CC	IN2P3-CPPM	IN2P3-LAL	IN2P3-LAPP
IN2P3-LPC	IPSL-IPGP-LCG2			

RoEduNet (Romania)	
ROGRID-ICI	ROGRID-NIPNE-01

SANET (Slovakia)	
IEPSAS-Kosice	IISAS-Bratislava

SUNet (Sweden)	
HPC2N	NSC

SURFnet (Netherland)	
NIKHEF-ELPROD	SARA-LCG2

SWITCH (Switzerland)	
CERN-LCG2	CSCS-LCG2

UKERNA (UK)				
BHAM-LCG2	BITLab-LCG	CAVENDISH-LCG2	Durham	IC-LCG2
Lancs-LCG2	LivHEP-LCG2	ManHEP-LCG2	OXFORD-01-LCG2	QMUL-eScience
RAL-LCG2	RALPP-LCG	RHUL-LCG2	ScotGRID-Edinburgh	ScotGRID-gla
SHEFFIELD-LCG2	UCL-CCC	UCL-HEP		

Other Sites				
ALBERTA-LCG2	BEIJING-LCG2	BNL-LCG2	CARLETONU-LCG2	CGG-LCG2
FNAL-LCG2	GOG-Singapore	HPTC-LCG2	LCG_KNU	NCP-LCG2
PAKGRID-LCG2	Taiwan-IPAS-LCG2	Taiwan-LCG2	TIFR-LCG2	TOKYO-LCG2
TORONTO-LCG2	TRIUMF-GC-LCG2	TRIUMF-LCG2	TW-NCUHEP	UIOWA-LCG2
Umontreal-LCG2				