A fault resolution process
for multi-domain Lightpaths networks

Preface

This document proposes a fault resolution process for multi-domain Lightpath network connections. This work is done in the context of the Global Lambda Integrated Facility (GLIF), whereby many research and education (R&E) networking organizations world-wide cooperate in the provisioning of end-end lightpaths across their shared network resources. This document specifically is a product of the collaboration in the GLIF Technical Issues Working Group (GLIF Tech), and currently serves as discussion document for the GLIF Tech meeting on February 8 and 9, 2006.

More information about GLIF can be found on the GLIF web site at http://www.glif.is/.

Introduction and purpose of this proposal

Many projects, such as those involved in data-intensive research, benefit from the use of Lightpaths between locations around the world.   Global scale end-end Lightpaths are created through the interconnection of smaller domain-specific Lightpaths necessitating inter-domain interaction between organisations. Today, inter-domain operations are performed on an ad hoc basis. As Lightpath demand increases and as more and more R&E networking infrastructures around the world start supporting Lightpath services, the need for a standard coordinated approach to Lightpath service contracting and Lightpath fault resolution becomes critical for both Lightpath End-Users and Lightpath service providers. This document proposes a process for the operational management of multi-domain Lightpaths across the GLIF.

Defining roles and terminology to effectively set up a Lightpath

A multi-domain Lightpath is an end-to-end path that runs through multiple network domains (Figure 1).
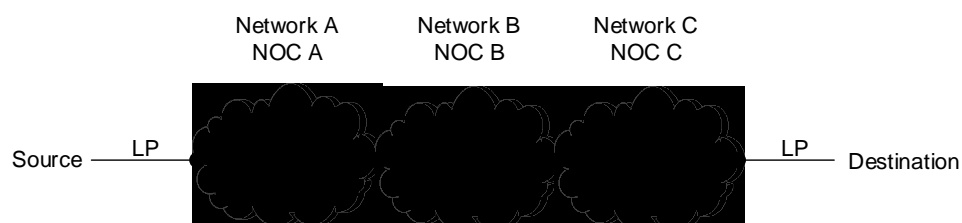

Figure 1: NOCs have overview and direct control overa Lightpath section only.

The Lightpath is build up out of several Lightpath *sections*. Each section is part of a different optical network domain and is managed by a different Network Operations Center (NOC). A Lightpath is a point-point connection. The ends can be defined as *source* and *destination*. The organisation that is given the responsibility by an End-User

to set up a Lightpath is called the sourcing organization. Responsibility is taken by this organization to identify the diffferent lightpath sections and get the Lightpath placed into service. It should be noted that the source and destination typically are network domains as well, mostly local network infrastructures such as a campus network. For purposes of this discussion we have limited the definition of source and destination to GLIF network resources.

For the various organisations involved their leading activities are identified as follows:

The Lightpath sourcing organization should take the lead to:
• understand the high level technical requirements of the End-User.

• formulate detailed technical requirements,
• find appropriate Lightpath sections from source to destination,
• contract or subcontract Lightpath sections,
• prepare the local infrastructure (Lightpath access),
• coordinate the implementation of the Lightpath,
•
• document the Lightpath service, and
• act as the single point of contact for Lightpath fault management to the End-User.

The Lightpath destination organization should take the lead to:
• prepare the local infrastructure (Lightpath access), and
• document the Lightpath service.

Creating an operations process that is coherent with the end-end Lightpath contracting process

The Lightpath sourcing organization has the task of finding an adequte path through the various networks worldwide. The sourcing organization can contract for all Lightpath sections with each seperate Lightpath section domain operator, or can contract for one or several Lightpath sections and allow subcontracting of the remaining sections. The contracting process is a bilateral one which results in one organization becoming responsible to the other for delivery of a good or service in exchange for something of value. It is therefore the contracting process which suggests a natural or intuitive way to look at operational responsibilities. Therefore, in order to respond to End-Users' desire for a single-point of contact for LightPath fault management, the operations process should be analogous with the relations created through the contracting process.

EXAMPLE 1: All individual Lightpath sections are contracted by the sourcing organization
Figure 2 shows that the sourcing organization has contracted all Lightpath sections directly. Every contract incorporates a Service Level Specification (SLS) in which the operations conditions are laid down.
The impact on operations of this contract structure is that Network A is formally in contact with Networks B for section B and Network C for sections C.
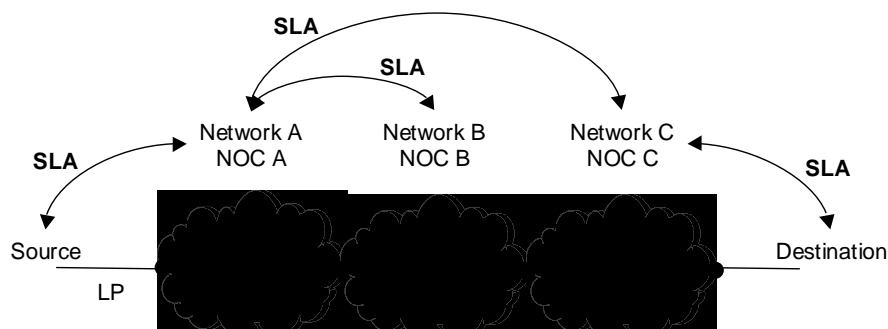
Figure 2: Network A is formally in contact with Networks B and C.

<u>EXAMPLE 2: Some Lightpath sections are subcontracted by a network organization in the path</u>

Figure 3 shows that the sourcing organization has contracted the operator of Network B for sections B and C. Network B contracted in turn Network C for section C. Perhaps the reason for this could be that Network A is not familiar with Network C.

The impact on operations of this contract structure is that Network A is formally in contact with Network B for sections B and C as a whole. Network B is on its turn formally in contact with Network C for section C.
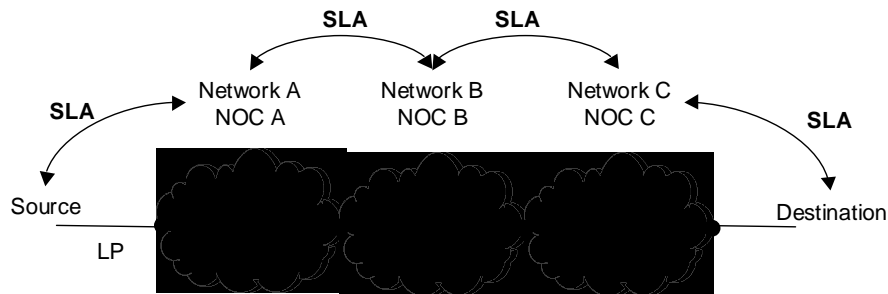

Figure 3: Network A is formally in contact with only Network B for sections B <u>and</u> C

Fault management process order of events:

1) A Lightpath outage is usually either first detected by one of the two Lightpath End-Users (source and destination) or by the LightPath sourcing organization

2) Ideally the End-Users will contact each other or their joint "project or application-layer helpdesk" to determine if the outage is caused by the application or local LANs, or if the outage is truly a lightpath fault.

3) Upon confirmation that the fault is a lightpath fault by the End-User or project helpdesk, a call should be placed to the Lightpath sourcing organization. to start-up a network resolution procedure.

4) If the Lightpath sourcing organization has not already detected and started up the Lightpath resolution process, it should do so upon receiving notification of the trouble. The Lightpath sourcing organization must take the lead in the fault resolution process from opening a trouble ticket to fault resolution to the End-User's satisfaction. It is the Lightpath sourcing organization that is responsible to inform and maintain urgency on all other Lightpath section providers all the way to the destination. The Lightpath sourcing organization can do this through the relationships created via the Lightpath contracting process.

Creating and maintaining an information flow for effective fault resolution

For a network fault resolution procedure to be effective, it must ensure that the various stakeholders, i.e. the source and destination End-Users, and NOCs of the various Lightpath section providers be informed of the problem, the resolution status and, finally, the fix.

Stakeholders can be kept up-to-date about the resolution process via an information flow which at a minimum follows the communication lines established through the contracting process (Figure 4) This information vehicle could be e.g. a Lightpath specific e-mail list, which would be created and maintained by the Lightpath sourcing organization, i.e. the organisation responsible to the End-User for the provisioning and good performance of the end-end Lightpath.
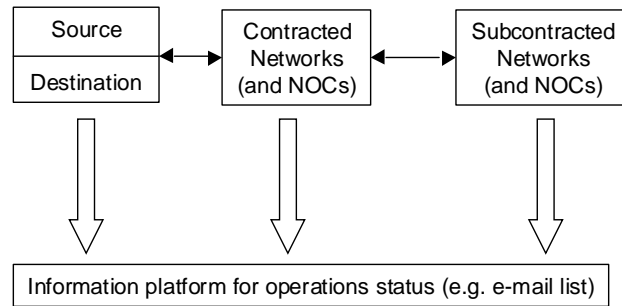
Figure 4: While organisations communicate only according to a formal procedure, status information is provided bilaterally.

In general, network problem resolution status within a subcontracted network domain should regularly be passed on to the contracting network domain. Network problem resolution status within a contracted domain (including subcontracted domains) should be passed on to the sourcing network domain. Network problem resolution status should be passed on from there to the End-User.

Clearly, the sourcing domain network operator has the critical role of passing the information to and from both the End-Users and the contracted networks.

Abbreviations and acronyms

NOC	Network Operations Centre
Source / Sourcing organisation	Organisation that is contracted by an End-User to provide an end-end Lightpath connection
Destination	Organisation at which the Lightpath terminates, prior to reaching the End-User destination
End-UserMember of the R&E application community contracting a Source for an end-end Lightpath or someone delegated to do so in his/her place. Can be a researcher, group of researchers, laboratory, university, campus IT and networking staff, etc.Lightpath	a high capacity circuit or QoS-supported virtual circuit, or the concatenation of several sections of these to form an end-end lightpath
Section	SIngle-domain portion of a multi-domain Lightpath