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Grid High-Performance Networking Research Group

Optical Network Infrastructure for Grid

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Optical Network Draft

- Optical network draft focuses on deployment of phonic network infrastructure for Grid applications
- Motivation:
  - Predictions for deployment of data-intensive Grid applications that will require transfers of Terabytes or even Petabytes of data
  - These applications will require a high bandwidth network environment where bandwidth will be allocated on demand or by user/application driven scheduled reservation
- This draft aims:
  - To suggest solutions towards an efficient and intelligent network infrastructure for Grid taking advantage of recent developments in optical technologies
  - A solution to support high-demand application with potential to support all types of Grid application

Progress in Optical Network Draft Since GGF9…

- New section on
  - Quality Of Service for Grid optical transport

- Further contributions on :
  - Grid applications and their requirements for high-speed, high-bandwidth infrastructures
  - Optical switching technology and transport format
  - Optical network control and signalling
  - Grid user network interface
  - Optical networks as a Grid service environment
  - Security considerations

Efforts to establish this document as reference….

- We have tried to provide wider exposure of this work outside of GGF in order to establish this document as reference for future work in the field:
  - IEEE Globecom 2004 Workshop on “Optical Networking for Grid Applications”
  - ECOC 2004 Workshop on “Optical Networking for Grid Services”

Topics for Further Consideration: *Grid applications*

- Current situation in the draft:
  - Mainly for data-intensive and/or long-lived applications
  - No widespread applications requiring lambda or optical Grids???
  - Today's applications with large BW requirements (i.e. high energy physic centres, radio-telescopes) belong to well defined communities of users and destinations with typically long lived persistent relationships
  - Application scenarios such as high bandwidth interactive applications, data visualisation applications, application that require bandwidth to reduce latency have been mentioned

- New issues for further considerations:
  - Further work is needed in order to dimension Grid applications in terms of their near and longer term BW demand, users characteristics, volume and behaviour
    - SAN growth & evolution in SAN network architecture
    - What will be the demand for "anonymous" large file transfers?
  - What will be the role for optical network in future Grid applications (i.e. short-lived applications , large number of anonymous and relatively small users)?

Topics for Further Consideration: Photonic Network Topology

- Current situation in the draft:
  - Users/applications will be offered control and management of the network resources
    - Limited contribution
  - Network topology will be based OVPN
    - Dedicated optical connection between well known VOs
  - OVPN in conjunction with user controlled optical network
    - Contribution??
- New issues for further considerations :
  - Don't forget that Grid services provide a technology and a strategy for telecom service providers to create a service oriented infrastructure
  - Network topology must support
    - Users can autonomously and independently create end-to-end connections across multiple domains
    - User can be empowered to cross connect and add-drop these connection independently
  - Need for network scalability
    - Will optical Grids only serve well defined specialised communities or will be wider deployed to serve a growing number of "anonymous" users?
    - What will be the growth pattern of such networks?

Topics for Further Consideration: Transport Format and Switching Technology

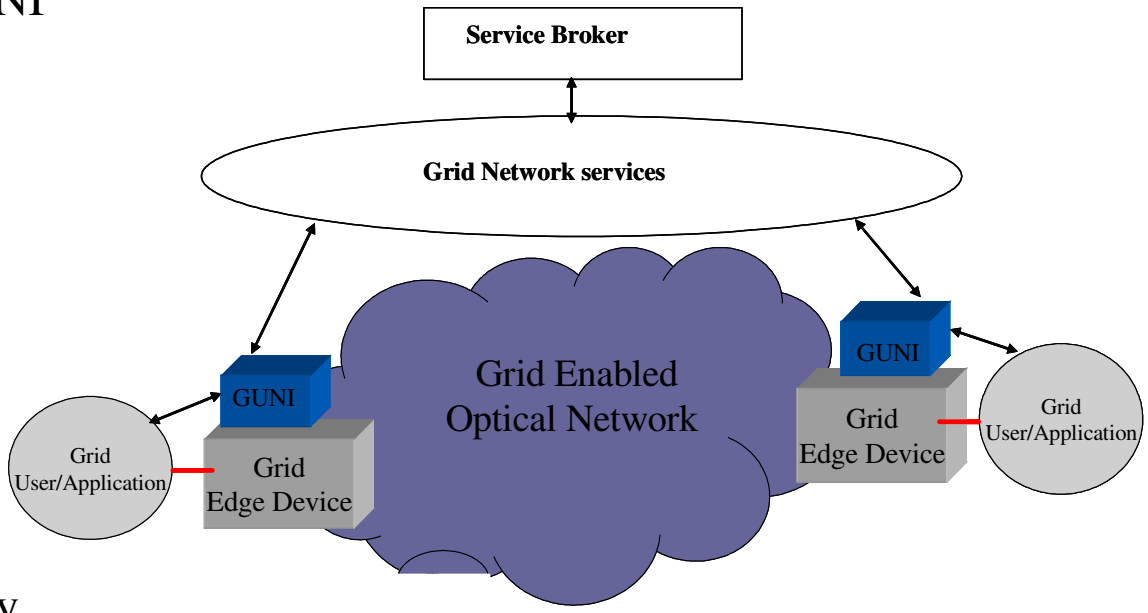
- Current situation in the draft:
  - Wavelength switching
  - Hybrid IP router/wavelength switching
  - Optical burst switching
- New issues for further considerations:
  - Further and more specific definition of the OBS scenario:
    - How the OBS technology, protocols and architecture can provide solutions for Grid environments
      - Evaluate resource reservation, scheduling and release OBS variants suitable for Grid applications (i.e. tell and wait & just enough time)
      - Provide examples of switch architectures optimised for OBS
  - Comparison of different transport formats & switching technologies
    - Discuss the relevant merits of wavelength and optical burst switching for Grid network deployment
  - Transport format & switching technology for optical GRID considerations:
    - Support data intensive and long-lived services requirements
    - Flexibility to accommodate and support future GRID services (short-lived & low bandwidth services)
    - Discuss whether in future OBS can support all of the Grid network requirements or a hybrid solution (i.e. WS and OBS) will be solution
  - Need for a switching technology schema

Topics for Further Consideration: Control Plane and Signalling

- Current situation in the draft:
  - OBGP in conjunction with the existing GMPLS standards
    - A shared optical "cloud" with rapid switching of lambdas between users
    - A fixed optical point to point (partial) mesh between users with slow "automatic fiber patch panel" switching (OBGP)New issues for further considerations
  - Control plane and signalling consider mainly (circuit) switching paradigm
- New issues for further considerations:
  - Policy related issues when OBGP is used to establish connection across multiple domains
    - local configuration of policy , Information hiding and choice of path
  - Control plane and signalling for application that they use dark fibre for connectivity
  - Control plane and signalling to support OBS

Topics for Further Consideration: Grid User Network Interface (GUNI)

- Current situation in the draft:
  - GUNI mainly a complimentary to OIF UNI
    - Indirect service invocation scenario
    - Overlay model control plane
- New issues for further considerations:
  - What will be the GUNI role and functionality In case of
    - Direct service invocation scenario
    - Peer model for control plane
  - The GUNI with the above complementary can be well fitted under control plane and signalling section
    - The GUNI define signalling mechanism and its requirement between Grid user and network
    - There are direct relations between GUNI and control plane architecture



Topics for Further Consideration: Optical Network as Grid Service

- Current situation in the draft:
  - GRAM for optical resource management
  - GARA for advance optical resource reservation
  - WS-agreement for optical resource scheduling
- New issues for further considerations:
  - Application-driven definition of optical service abstractions
    - Useful collections which match application paradigms and needs
  - How abstraction for encapsulating optical network resources can accommodate AAA and related policy issues across multiple domains
  - Optical bandwidth and optical NEs can be considered as two different types of services
    - Optical bandwidth can be managed by bandwidth on demand server based on the AAA,GARA and WS-agreement
    - Optical NEs (switches, ports) can be intelligent and considered as other Grid resources
- QoS for the Grid optical network can be well merged with the Grid network services

Next Step : Grid Resource-Network Interface (GRNI) I

- GRNI performs interoperable procedures between local Grid resource managers and optical network
- GRNI functionalities :
  - Support for existing agreements
    - Job submission
    - Advance reservation
  - Propagation state of the local resources (available storage/ processing resources)
  - Propagation of service related events
  - Flexible bandwidth allocation
    - Sending back results to source or multiple alternative destinations
- New section in the draft: Grid Resource-Network Interface
  - GRNI functionalities (signalling and transport)
    - Relation with GUNI (if a generic model can be used for both of them)
  - Relation with control and signalling plane

Next Step:
All Photonic Grid Networking Scenario I

- Grid networking scenario based on wavelength switching
  - Wavelength paths between well known VOs/users
  - To support large jobs / long lived, data-intensive applications
  - Small number of jobs are in this category
  - The scenario is not efficient for medium/small sized jobs
  - Centralised control, management and job scheduling
- Grid networking scenario based on optical burst switching in wavelength routed optical network
  - Wavelength paths between well known VOs/users
  - To support large or medium size, long-lived or short-lived jobs
  - Better network resource utilization
  - Centralised control, management and job scheduling
- Self-organised Grid networking scenario based on optical burst switching
  - The infrastructure will be aim to support large jobs, consisting of a (possibly large) number of (loosely) coupled medium size jobs as well as medium sized jobs
  - The solution will also support large jobs, which can not be parallelized into smaller jobs (mainly short lived) and serve traditional well defined communities of users of Grid resources
  - Dedicated optical Grid Infrastructure: the “grid cloud” interconnecting large number of users and traditional Grid resources
  - Distributed control, management and job scheduling

Next Step:
All Photonic Grid Networking Scenario II

- New section in the draft: Photonic Grid Networking Service schemas:
  - Grid networking scenario based on wavelength switching (OWS)
  - Grid networking scenario based on optical burst switching (OBS)
  - Grid networking scenario based on hybrid OBS/OWS
  - Self-organised Grid networking scenario based on OBS
- Networking scenarios must be differentiated in the draft for each category based on the :
  - Job submission phase
  - Resource request and allocation phase
  - Return process/path for sending back results

Further Suggestions?

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