Optical Network Infrastructure for Grid

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- **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 BW will be allocated on demand or by user/application driven scheduled reservation

- **Optical Technologies are well suited to fulfil these requirements:**
  - Offer huge capacity and relatively low latency
  - WDM & tunable optical technologies in combination with optical switching can provide dynamic control of bandwidth at the fibre, wavelength-band, wavelength or sub-wavelength level
    - Can offer the capability to provide BW services dynamically controlled by individual users/application

- **This draft aims:**
  - To suggest solutions towards an efficient and intelligent network infrastructure for Grid taking advantage of recent developments in optical technologies

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- **Why optical networking for the Grid**
  - Factors supporting the need for optical infrastructure
    - Application requirements
    - Network limitations for data-intensive applications (i.e. packet switching, end-to-end and new transport protocols)

- **Photonic Grid network characteristics**
  - Network topology
  - Optical switching technology & transport format
    - Wavelength switching
    - Hybrid router/wavelength switching
    - Optical burst switching

- **Optical network elements for the Grid**
  - Optical switching nodes
  - Multicasting in photonic elements
  - Grid User Network Interface (GUNI)

- **Optical network control and signalling**
  - Generic proposal
    - GMPLS in combination with OBGP or other multi-domain protocols
  - Optical Grid networks serving well defined scientific communities and/or high volume users
    - Shared optical switched cloud
    - Fixed point-to-point links + automatic fibre patch panel switching
  - Access issues
  - Framing protocols

- **Optical networks as Grid service environment**
  - How optical resources (i.e. λ, optical switches) can be encapsulated in a Grid service in the same way as processing or storage

- **Security**
  - Specific strengths, treats & design options associated with the deployment of optical network technologies

Topics for Further Consideration & New Topics I

- **Grid applications and their need for optical infrastructure**
  - 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
  - What will be the demand for "anonymous" large file transfers?
  - SAN growth & evolution in SAN network architecture
  - Application scenarios such as high bandwidth interactive applications, data visualisation applications, application that require bandwidth to reduce latency have been mentioned
  - 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

Topics for Further Consideration & New Topics II

- Need for network scalability

  - Will optical Grids only serve well defined specialised communities or will be wider deployed to serve a growing number of high BW "anonymous" users?

  - What will be the growth pattern of such networks?

  - There has been strong support for scalable solutions
    - Scalability is an inherent attribute of the Grid vision-enables the creation of ad-hoc VOs
    - The topic needs further justification and discussion
    - Scalability considerations will play an important role in any design and engineering decisions concerning optical Grids

Topics for Further Consideration & New Topics III

- 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

- Optical packet switching
  - Comments on the role (if any) of this technology in future photonic Grid networks

- Comparison of different transport formats & switching technologies
  - Discuss the relevant merits of wavelength and optical burst switching for Grid network deployment

- **GUNI**

  - Further detail on the GUNI functionality and how it relates to OIF UNI

  - Examples of implementation architectures

- **Network control and signalling**

  - Alternative approaches to OBGP, i.e. ONNI and various control plane gateway solutions

    - An overview of the relevant OIF/IETF optical networking standards has been suggested (John Strand). The OIF 12-vendor UNI/NNI interoperability demonstration at OFC 2003 could give a good source of information

    - A comparison with OBGP solutions will be useful

- **Quality monitoring**

- **Redundancy & survivability**

Topics for Further Consideration & New Topics V

- Encapsulating optical networks resources in the Grid service
  - Optical network resources need to be scheduled in a similar manner as computing and storage resources
    - i.e. Globus Resource Allocation Manager (GRAM) should perform λ-allocation
    - For resource optimisation a richer, OGSI compliant interface need to be defined?
  - We need further detail on resource scheduling/interfacing issues and some recommendations on extensions to the existing solutions

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- Reevaluate the case for optical networking as Grid service infrastructure
  - Application requirements
  - Scalability
  - Deployment roadmap

- Incorporate the suggested amendments and additions into the next version of the draft before the deadline for GGF10

- Leverage on other groups work GGF, IETF, OIF

- Seek wider exposure of this work (outside GGF) in order to get the views of the broader community & establish this document as reference for future work in the field (publications, conference presentations, dedicated workshop, collaboration with photonic technology roadmap initiatives (i.e. OPTIMIST, BREAD))

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Further Suggestions?

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