

Workshop No. 2

Workshop on Optical Grids, Drivers & applications for high performance optical networks

**September 21st, 2008, 9:00 - 13:00
Brussels/Belgium**

Workshop Objectives

This Workshop on Optical Grids intends to bring together practitioners and researchers from both the high performance computing and networking fields. The main objective is to discuss the work on the emerging aspects related to advanced techniques, platforms, paradigms and models for the design, deployment and usage of high performance optical networks with a particular focus on Grid networks and applications.

Such optical Grids promise to offer cost and resource efficient delivery of geographically distributed network services with potentially high data rate, processing and storage demands, to a wide user base. To fulfill that promise, fundamental questions need to be addressed, including (re)designing the architecture of a flexible optical layer, dimensioning and routing/scheduling algorithms. Fundamental differences from 'classical' network designs are due to the fact that traffic volume is dependent on dimensions and locations of computational/storage resources, as well as the job scheduling algorithm, and the fact that Grid users generally do not care where their jobs are processed (i.e. unknown destinations, hence no clearly defined traffic matrix).

The workshop will present a carefully selected set of invited speakers, covering a broad scope of research questions in the optical Grid networking realm. The discussion will range from applications that call for Grid infrastructure (e.g. consumer-oriented applications such as data centers, and high performance computing mainly targeting the research communities), over control plane functionality enabling these Grid applications, down to the design and deployment of the optical network architecture and infrastructure to support them. The concurrent optimization (in terms of cost, performance, etc.) of optical networking and Grid resources to offer a scalable, efficient and cost-effective environment is of key interest. In addition, evaluation of next-generation optical technologies (e.g. optical packet or burst switching), high performance optical networks, as well as architectures for optical Grid applications is solicited.

This workshop is partially supported by the European commission through the IST FP6 Phosphorus project and the FP7 Bone project.

Organizers

- Prof. Chris Develder, Ghent University - IBBT, Belgium
- Prof. Dimitra Simeonidou, University of Essex, UK
- Prof. Chunming Qiao, SUNY Buffalo, USA

Registration

Registration for the workshop is free, but mandatory to get access to the session rooms. Registration can only be done through the ECOC2008 registration webpage

Contact:

Chris Develder, chris.develder@intec.ugent.be

Program

09:00-09:15: Welcome & programme overview (C. Develder and D. Simeonidou)

09:15-10:45: Invited talks, part I: Applications & requirements

Ralph Spencer (Univ. of Manchester, UK)
"High Performance Optical Networks in Radio Astronomy"

Ralph Niederberger (Forschungszentrum Jülich, Germany)
"The EU projects DEISA and PRACE - Network requirements for HPC applications"

Cees De Laat (Univ. of Amsterdam, The Netherlands)
"CineGrid, Digital Cinema on Photonic Networks"

10.45-11.15: Break

11.15-12.15: Invited talks, part II: Tools for realizing Grid services

Sergi Figuerola (I2Cat, Spain)
"The Infrastructure as a Service Framework"

Gino Carrozzo (Nextworks, Italy)
"Control Plane architectures for Grid Network Services: Issues for deployment in wide-area multi-domain agile optical networks"

12.15-12.45: Panel discussion (all invited speakers) on high performance optical networks, drivers and applications calling for high capacity optical networks, and the role and opportunities for optical Grids.

Details

“High Performance Optical Networks in Radio Astronomy”; R. Spencer

High sensitivity in radio astronomy demands high data rates between telescopes and a central processor in interferometer arrays. This inevitably places high demands on optical networks, with data rates of several 10's Gbps needed. Indeed radio astronomy places one of the highest demands on networks of any application. The new telescope arrays being built now use specially laid fibre networks, where wavelength division multiplexing of 10 Gbps channels can give cost effective solutions. However the Square Kilometre Array will need the staggering data rate of 16 Tbps or more per station, with several hundred stations being involved.

An innovative approach is needed. Optical time division multiplexing offers a more efficient use of fibre bandwidth, and the project "ADAPTNet" will be described which aims to achieve more than 100 Gbps on one wavelength, using integrated photonics to reduce cost.

“The EU projects DEISA and PRACE - Network requirements for HPC applications”; R. Niederberger

The EU projects DEISA and PRACE, which started in 2004 and 2008 respectively, are facilitating access to HPC systems for European Scientists. In the near future, these HPC systems will have equal capabilities or more than those available in the USA and Japan.

These supercomputer resources, providing Petaflops/s in the near future are useless, if they cannot be accessed via European-wide high speed networks, that allow scientists to interchange data between any of those systems.

The presentation will provide a short overview on both projects and will highlight some of the applications used within DEISA and PRACE. It will describe the impact on those applications, which is highly dependent on the available network infrastructure.

Furthermore, it will envision future infrastructure needs for HPC applications desirable and those indispensable.

“CineGrid, Digital Cinema on Photonic Networks”; C. De Laat

Movie production has moved from the celluloid carrier to a fully digital capture and processing. Nowadays many spectacular movies are for a substantial part computer generated. The production is a collaborative effort combining the skills of very specialized companies with expertises in color correction, sound dubbing, background fill in, etc. This collaboration screams for speedy networks. Distribution of 4k and higher resolution movies has moved from big reels to disk packs and may now very well use photonic networks. This presentation will outline the network requirements in digital cinema and give an overview of CineGrid.

“The Infrastructure as a Service Framework”; S. Figuerola

Virtualization is a current hot topic; a lot of research in virtualization related projects is being performed. However, the word virtualization may have different meanings to different people, so it is important to define what virtualization means in the context of the IaaS Framework. We define virtualization as a technique which represents a physical device or substrate as a software entity (for instance an object, a web service or a web service resource). This technique has been widely applied to PCs; tools like VMWare, Xen or others provide several virtual machines on the same hardware. PC Virtualization, which was originally used locally as a means to reduce data centres cost by maximizing the server usage, has been extended by companies like Amazon or BlueLock that are among the firsts to offer a new type of services called Infrastructure as a Service (or IaaS), by renting hardware using proprietary solutions. IaaS is the equivalent of Software as a Service (SaaS) for hardware devices, where users do not buy hardware but instead pay for the use of it to a third party (which is the real hardware owner). During the duration of the service, the user owns and controls the infrastructure as if he was the owner; this business model is targeted towards long term resource usage compared to on-demand services.

The IaaS Framework is a generalized approach to the outcome of years of research under the UCLP research programs funded by CANARIE. Beginning in 2001, two UCLP research projects were put in place to provide a virtualization solution for optical networks: UCLP initial goal was to provide end to end paths across domains; UCLPv2 goals were to create reusable and configurable network blocks. UCLPv2 concepts

have evolved into many different Physical to Virtual (P2V) products and research projects that are built on the IaaS Framework: Argia is the product for optical networks (TDM, WDM and Fiber technology), Ether will be the product for Ethernet and MPLS networks, MANTICORE is the research project for logical IP networks and, finally, the GRIM project performs research on applying virtualization to instruments and sensors.

***“Control Plane architectures for Grid Network Services: Issues for deployment in wide-area multi-domain agile optical networks”*; G. Carrozzo**

The deployment of next generation services in worldwide private/“commercial” and NRENs network infrastructures is mainly driven by the requirement to support advanced and demanding research activities based on Grids. The capability to spread and manage huge amounts of data across remote computing clusters (i.e. Virtual Organization), often distributed on a planetary scope, is the challenging new frontier in applied research and it raises strict issues for the underlying network infrastructure both in terms of the adopted technology for the Transport Plane (rapidly migrating to the agile all-optical paradigm) and, consequently, on the Control and Service Plane architectures used for it.

The state of the art architectures for Grid Service Plane and Network Control Planes can be currently deployed as two overlaid reciprocally unaware domains, in which the dynamics for the management of the resources are completely independent. Therefore, the network connections (lightpaths) and Grid (computational, storage) resources are provisioned in different timescales with completely uncorrelated procedures.

A step beyond this state of the art is the integrated control of Grid resources and optical network resources under the same Control Plane, in order to set-up network and Grid-specific resources – possibly at the same time – with a set of seamlessly integrated procedures across the different Control and Management domains of the network. This research objective is commonly referred to as Grid Network Service (GNS) and has been focused with different approaches by different collective research initiatives throughout the world, such as the European PHOSPHORUS project (<http://www.ist-phosphorus.org>), the US Enlightened Computing project (<http://www.enlightenedcomputing.org>), the Japanese G-Lambda project (<http://www.g-lambda.net>). Both Phosphorus and Enlightened projects have adopted a user-centric approach (the user can have knowledge and in some cases control of the network topology and resources), while the G-Lambda has adopted a network centric approach (only the network operator controls network topology and resources). Moreover, in the Phosphorus project different Control Plane approaches have been investigated, ranging from the Network Resource Provisioning Systems (NRPS, e.g. UCLP, D-RAC, ARGON) to the ASON/GMPLS.

In this framework a particularly innovative approach is the Phosphorus Grid-enabled GMPLS (a.k.a. G2MPLS), which is designed to provide part of the functionalities related to the selection, co-allocation and maintenance of both Grid and network resources by extending the ASON/GMPLS protocols and functionalities. G2MPLS results in a more powerful Control Plane solution than the standard ASON/GMPLS, because it complies with the needs for enhanced network and Grid services required by network “power” users/applications (i.e. the Grids), but can fall-back to the automatic setup and resiliency of the network connections required for bandwidth-on-demand services if needed. Moreover, G2MPLS can bring to an innovation in the field of co-allocation of Grid and network resources, because of its

- Faster dynamics for service setup in the same time-scale of the Network Control Plane ones
- Availability of well-established procedures for traffic engineering, resiliency and crankback
- Uniform interface for the Grid-user to trigger Grid & network transactions (Grid-Optical User Network Interface, G.OUNI) not natively dependent on a specific Grid middleware.

This talk will focus on these issues, by describing the different control plane approaches cited above in the light of users’ and network operators’ requirements. Main emphasis will be on the different declination of the GNS concept, their flexibility to support agile optical transport technologies and control automatically a multi-domain, inter-carrier infrastructure of Grids and Networks.