



034115

PHOSPHORUS

Lambda User Controlled Infrastructure for European Research

Integrated Project

Strategic objective:  
Research Networking Testbeds



**Deliverable reference number: D.7.1.3**

## **Annual Report on Dissemination Activities**

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<b>CO</b>	Confidential, only for members of the consortium (including the Commission Services)	



## Annual Report on Dissemination Activities

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Project:	Phosphorus
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Document Code:	Phosphorus-WP7-D7.1.3



## Annual Report on Dissemination Activities

### Abstract

This deliverable provides a comprehensive report of all dissemination activities that took place during first year of the project. It reports on all events, conferences, journals and information material that ensure that the PHOSPHORUS project is well-known by the research community.

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



# Table of Contents

0	Executive Summary	6
1	Internal Dissemination Activities	7
2	Major External Dissemination Activities	10
2.1	Information Material	10
2.2	Demos and Booths	13
2.3	Workshops and Meetings	43
2.4	Conferences	51
2.5	Journal Papers	66
2.6	Book Chapters	68
3	Other External Dissemination Activities	69
3.1	References in the Press	69
3.2	Multi-media	69
3.3	Magazine Articles	69
4	Future Dissemination Activities	71
4.1	Future Events and Conferences	71
5	Acronyms	72
6	References	73



## List of Figures

<b>Figure 1-1:</b> Screenshot of the PHOSPHORUS wiki	8
<b>Figure 1-2:</b> 2 <sup>nd</sup> Plenary Meeting in Poland	9
<b>Figure 2-1:</b> Homepage of the update PHOSPHORUS website	11
<b>Figure 2-2:</b> Front and back pages of the PHOSPHORUS brochure	12
<b>Figure 2-3</b> PHOSPHORUS testbed at SC07	15
<b>Figure 2-4</b> Demo testbed topology at SC07	16
<b>Figure 2-5</b> PHOSPHORUS poster at SC07	17
<b>Figure 2-7:</b> Combined PHOSPHORUS – Internet2 DCN test-bed for SC 08	20
<b>Figure 2-12:</b> PHOSPHORUS poster at SC 08 Booth	26
<b>Figure 2-13:</b> Demo Scenario: Poster Map for TNC 08	27
<b>Figure 2-14:</b> Demo Scenario: WP1 domains involved in the TNC 08 demonstration	28
<b>Figure 2-15:</b> WP1 developments on-demand demonstration at the PHOSPHORUS booth (TNC 08)	28
<b>Figure 2-16:</b> PHOSPHORUS test-bed used at TNC 09 (Málaga, Spain, EU)	29
<b>Figure 2-17:</b> HSVO setup in TNC 09	30
<b>Figure 2-18:</b> HSVO working with Harmony in TNC 09 venue	31
<b>Figure 2-19:</b> HD video streamed from KISTI domain. TNC 09.	31
<b>Figure 2-20:</b> TBN-UvA demo within Phosphorus testbed	33
<b>Figure 2-21:</b> PHOSPHORUS test-bed used at ICT 08 (Lyon, France, EU)	34
<b>Figure 2-22:</b> PHOSPHORUS booth at ICT 08 (Lyon, France, EU)	35
<b>Figure 2-23:</b> PHOSPHORUS WP1 GUI demonstrator	36
<b>Figure 2-24:</b> PHOSPHORUS booth at GLIF07	38



## 0 Executive Summary

The ultimate goal of the PHOSPHORUS project is to disseminate procedures, toolkits and middleware to EU NRENS and their users to enable authorized end-to-end dynamic service provisioning across Europe and worldwide heterogeneous network infrastructure.

Successful dissemination activities such as the project website, newsletters, concertation and technical meetings, and through conferences and journals publications took place during the year. Information advertising material for the PHOSPHORUS project was distributed in many events.

All the dissemination activities that took place during the year are included in this deliverable.

Section 1, **Internal Dissemination**, presents a summary of the means that support internal dissemination within the project.

In section 2, **Major External Dissemination**, a description of all PHOSPHORUS advertisement materials that were prepared during the year for the purposes of spreading information about the project is provided. Also presented in this section are the events in which PHOSPHORUS was presented or advertised by means of testbed demos, booths, PHOSPHORUS posters, briefcase, brochure, sweets and T-shirts. The section details a short text describing the PHOSPHORUS presence at each event. A short description of each major activity that took place is detailed. The descriptions explicitly mention relevant details such as website addresses (URLs), dates and PHOSPHORUS partners involved in each activity. In this section, a list of all journal papers accepted for publications that relate to the project is provided.

Section 3, **Other External Dissemination**, lists other dissemination activities (conferences and journals) that acknowledge the PHOSPHORUS project.

Section 4, **Future Dissemination Activities**, concludes the deliverable. It list the dissemination activities still planned at the end of the project.

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



## 1 Internal Dissemination Activities

### 1.1.1 Project website (Private Section)

The project website contains a private section accessible through a valid login. The private section of the website presents a platform through which private documents can be downloaded, the wiki can be accessed and users can update their personal information. The private section of the website also contains a complete list of the contact details of all PHOSPHORUS members.

### 1.1.2 Project Wiki

A PHOSPHORUS wiki accessible with a valid login for members of the PHOSPHORUS consortium was developed. Members use the wiki as a platform to members can communicate within each work-package and between work-packages. Each work-package has its own section on the wiki. The wiki includes all official documents prepared within the PHOSPHORUS project including those in progress. It contains links to related projects websites such as BREAD, ePhoton/ONE, MUPBED, EGEE etc, a mailing list and events section detailing events for internal dissemination.

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



## Annual Report on Dissemination Activities

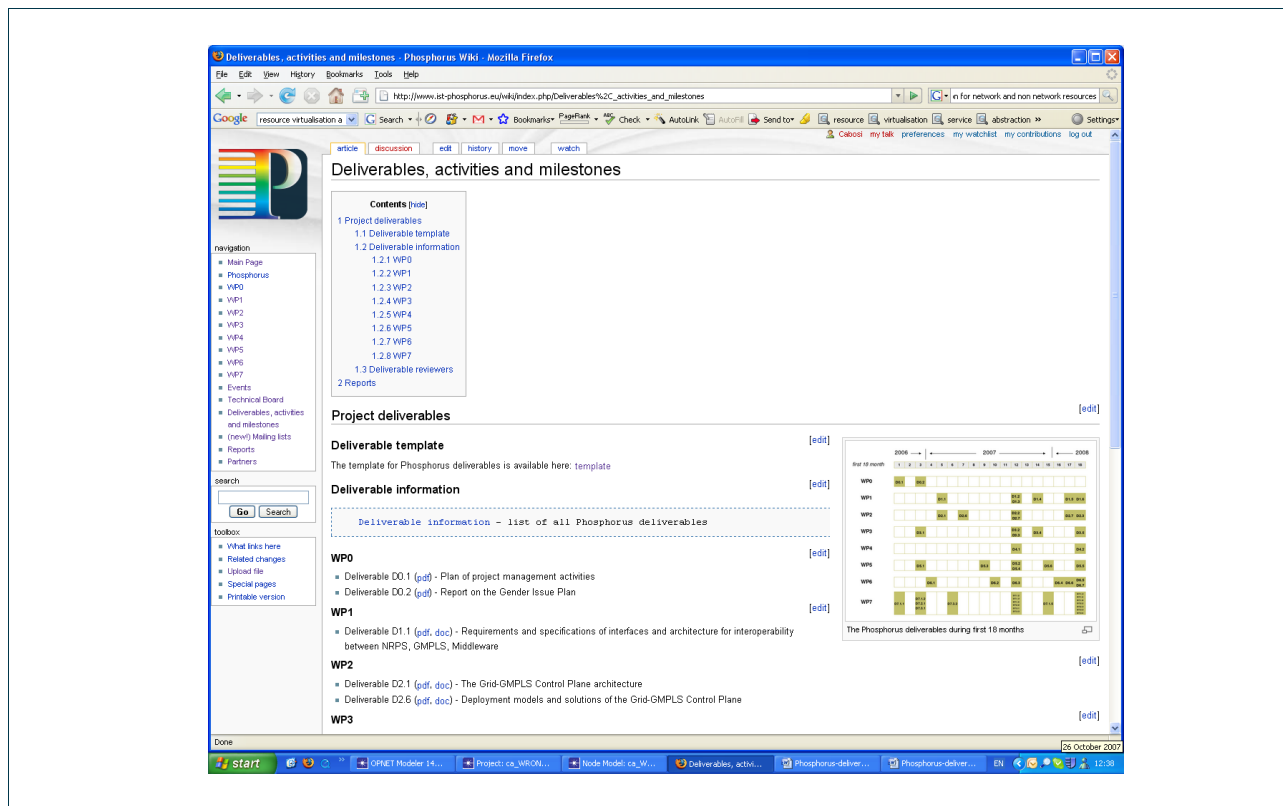


Figure 1-1: Screenshot of the PHOSPHORUS wiki

### 1.1.3 Project Meetings and Internal Collaborations

The projects progress is highlighted through a series of project meetings. The most important is the Plenary Meeting, which brings together all partners from all workpackages to a common location to discuss and plan for activities that require inter-workpackage collaborations during the year. All members of the Phosphorus consortium are encouraged to attend. During the duration of the project, four plenary meetings were successfully held. In addition to this, each work package organizes a series of teleconferences and physical meetings as they deem necessary. As part of the day-to-day activities, internal dissemination is also carried out via various types of electronic communication.

The final project plenary meeting was successfully held in May 2009.

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3





**Figure 1-2:** 2<sup>nd</sup> Plenary Meeting in Poland

#### 1.1.4 Mailing List

A mailing list for all work packages and for administrative purposes has also been established to support efficient internal communication. The list is accessible through the project wiki and has been in use since the start of the project.

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



## 2 Major External Dissemination Activities

### 2.1 Information Material

#### 2.1.1 Project Website

The website which was developed to act as a platform for public outputs such as publications, public deliverables, and public standardisation drafts was continuously updated during the duration of the project. The website presents a brief summary of the PHOSPHORUS project, all events that have taken place since the start of the project, an up-to-date news section and a comprehensive contact details list of all partners involved in the project.

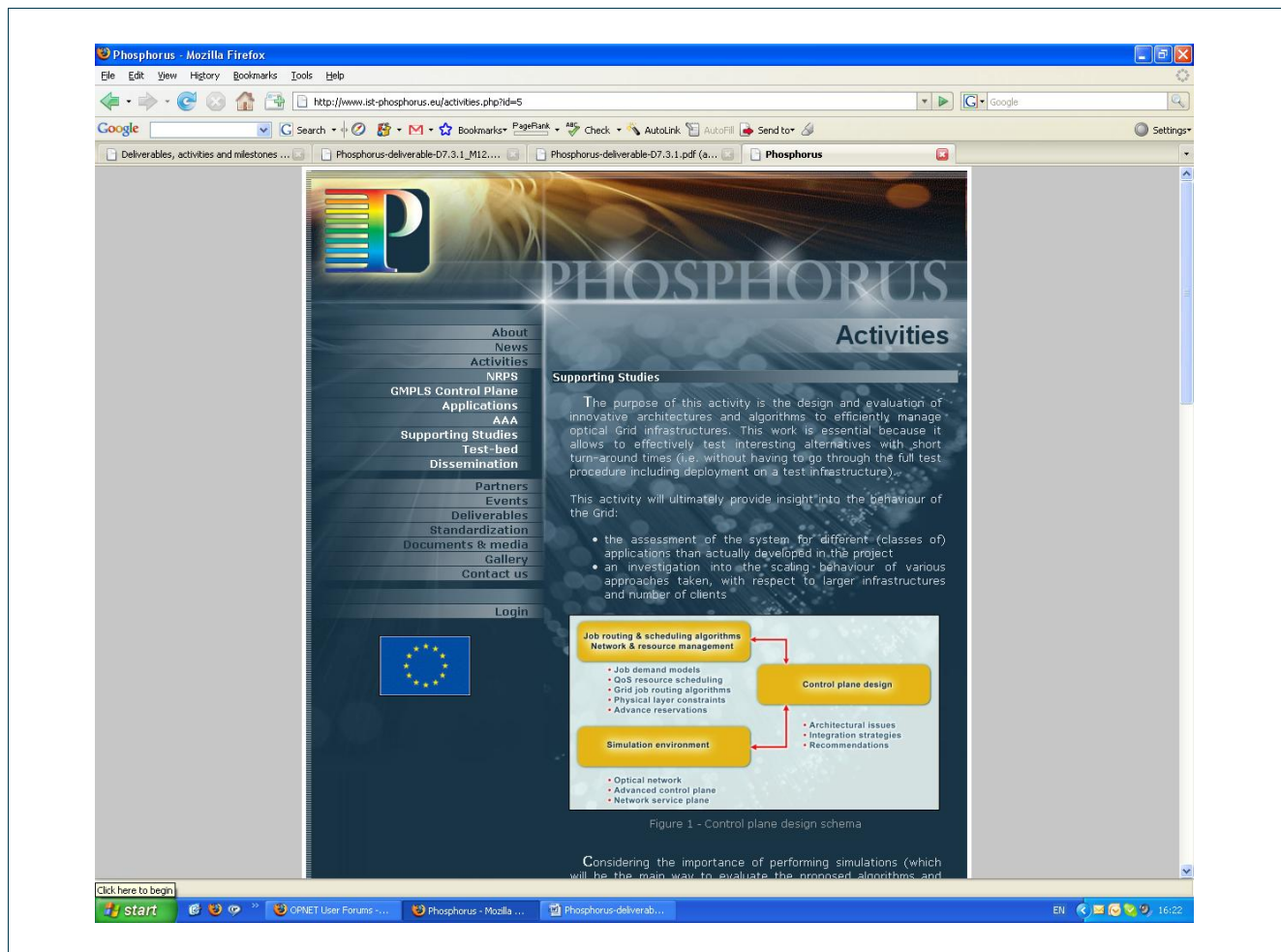
It also includes:

- an activities section which gives a concise summary of each activity area within the project
- a standardisation section that summarises all standardisation activities taking place within the project
- a full list of all public deliverables with links to each deliverable.
- a list of publications, including pdfs (where copyrights allow), authored by members of the Phosphorus consortium.
- a documents and media section containing the phosphorus video and all co-operation agreements
- a private photo gallery

In addition, it provides a private section restricted to PHOSPHORUS members permitting collaborations within the group and a link to the official PHOSPHORUS wiki.

The website can be accessed through <http://www.ist-phosphorus.eu>

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



**Figure 2-1:** Homepage of the update PHOSPHORUS website

## 2.1.2 Project Poster

An official PHOSPHORUS project wall poster template was prepared and printed by Poznan Supercomputing and Networking Centre (PSNC). It outlines the objectives, architecture, testbed, partners and the projects contact details. A smaller version (B1 format) of the wall poster and a detailed poster is also available. The detailed version of the poster details the collaboration between the EnLIGHTened, G-Lambda and PHOSPHORUS project. It presents the objectives, architecture and brief summary of each project. The posters have been distributed to all members of the PHOSPHORUS consortium for display. The poster is also presented at the events PHOSPHORUS participates in.

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



### 2.1.3 Project Presentation Slides

A general presentation that presents an overview of the PHOSPHORUS project and outlines the projects goals and technical objectives was prepared. The presentation has since evolved since its initial version and will continue to evolve with the project. The presentation can be accessed from the public section of the PHOSPHORUS website at [http://www.ist-phosphorus.eu/files/press/Phosphorus-general\\_presentation.pdf](http://www.ist-phosphorus.eu/files/press/Phosphorus-general_presentation.pdf)

### 2.1.4 Project Brochure

A finalised brochure, one page for each work-package, was prepared by PSNC. It presents a detailed summary of the project objectives and the objectives and activities of each work-package.



**Figure 2-2:** Front and back pages of the PHOSPHORUS brochure

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3





### 2.1.5 Project Briefcase

A summary of the PHOSPHORUS project, its objectives, technical approach and expected results are outlined in a PHOSPHORUS pamphlet / briefcase prepared by PSNC. The briefcase has been finalised.

### 2.1.6 Project VideoClip

Phosphorus ideas and objectives are described in a video. The full clip includes interviews with partners from the Phosphorus consortium, reports of Phosphorus activities during some workshops and presentation of promotion materials like posters and brochures. The first version of the clip has been completed.

### 2.1.7 Miscellaneous Information Material

Other information materials prepared by PHOSPHORUS for dissemination include white T-shirts, labels and stickers and sweets with the PHOSPHORUS logo on it.

## 2.2 Demos and Booths

This section details the conferences, meetings and/or workshop where the results of the Phosphorus project were shown by means of demonstrations. It also details the events in which PHOSPHORUS presented booths, presentation stands, and/or human presence, but did not present the achievement of the projects via individual presentation or paper.

### 2.2.1 Supercomputing Conference

The SuperComputing Conference (SC) is the premier international conference on high performance computing, networking and storage. It explores ways in which high performance computing, networking, storage and analysis lead to advances in research, education and commerce.

#### Summary of Participation

Phosphorus partners participated in SC'06, SC'07 and SC'08 and were showing a demonstration of the project's practical achievements. The demonstrations showed the usability of the Network Service Plane, developed by the members of the PHOSPHORUS consortium. The Network Service Plane, which allows interoperability in a seamless environment between different NRPSs (Network Resource Provisioning Systems), was verified in an environment composed of Argia/UCLP (User Controlled Light Paths), DRAC (Dynamic Resource Allocation Controller) and ARGON (Allocation and Reservation in Grid-enabled Optic Networks). In 2008, the testbed was expanded to three new domains: University of Essex (UESSEX, United

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



Kingdom), Poznan Supercomputing and Networking Centre (PSNC, Poland), Harmony-Internet2 gateway (HI-GW, Netherlands). In addition advanced bandwidth provisioning using a token switch was also demonstrated.

In 2006, University of Essex organised and chaired a BOF session, GHPN/GLIF: Delivery of Network Services across Heterogeneous Optical Domains during SC06. The BOF discussed solutions provided by the three research projects: PHOSPHORUS (EU), EnLIGHTened (US) and G-Lambda (JPN). All three projects are concerned with interoperability issues between heterogeneous network domains. The BOF targeted wider community awareness and participation in the main common technical challenges concerning these projects.

### 2.2.1.1 Year 1 : SC'06

In the first year of the project, SC06 took place in Tampa, Florida, USA from the 11<sup>th</sup> – 17<sup>th</sup> November 2006.

#### Description of Demo

SARA demonstrated TOPS (the application that is used in the PHOSPHORUS testbed under WP3) at SC06. Joint sessions were organised from the Dutch Research Consortium booth and with international partners at the exhibition floor, using lambda networks.

#### Booth Participation

SARA presented the Network Description Language by means of a poster. The PHOSPHORUS goals were explained to visitors at the Dutch Booth, using the PHOSPHORUS poster.

More information on the Supercomputing 2006 can be obtained online at <http://sc06.supercomputing.org>

### 2.2.1.2 Year 2 : SC'07

In 2007, SC07 took place on November 10-16 in Reno, USA. Further information is available at the events website <http://sc07.supercomputing.org/>.

PSNC with other project partners (i2CAT, CRC, SURFNET and FHG) prepared three demonstrations showing practical results achieved during the first year of the project. All demonstrations presented the usability of the Network Service Plane for the scientists and their applications. The Network Service Plane, which allows interoperability in a seamless environment between different NRPSs, was verified in an environment composed of UCLP, DRAC and ARGON. The first demonstration was aimed at presenting the KoDaVis application in a distributed environment. The second one showed High Definition video streaming sent across the PHOSPHORUS test-bed.

#### Demo 1: Distributed application – KoDaVis

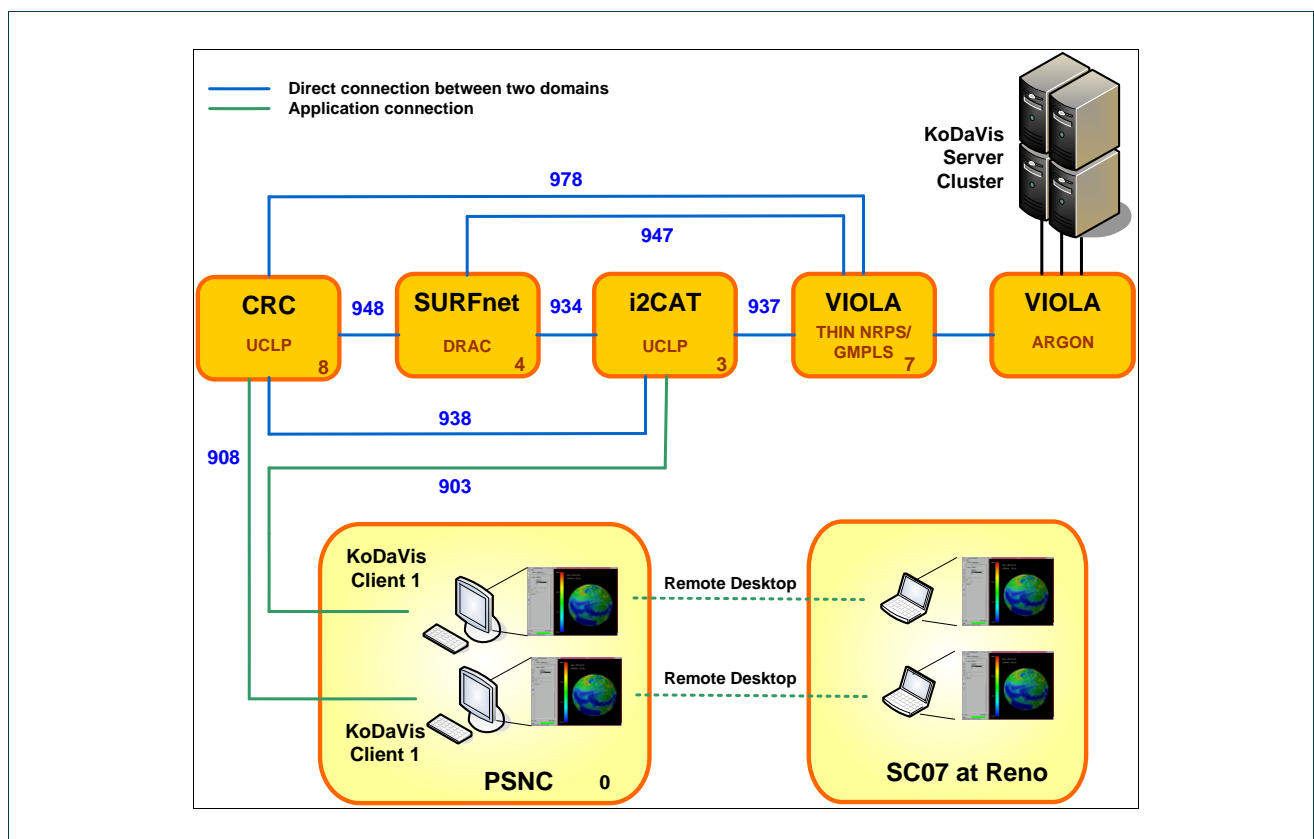
Collaborative Data Visualization (KoDaVis) is a distributed, collaborative visualization system with remote access to huge atmospheric simulation data originating from simulations of the transport of chemical tracers in

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



the troposphere. In a collaborative session, two or more visualization clients team up, each connects to the data server, and triggered by user interaction, fragments of the data are sent to all visualization systems on demand.

For the demonstration purposes KoDaVis data server was located at Forschungszentrum Jülich (Germany) and connected to VIOLA domain. The clients was located at PSNC and connected to the test-bed. From the laptops located at the SC07 facilities the KoDaVis clients was be managed and controlled using remote desktop software connected to the machines located at PSNC. The following figure presents the demo test-bed:



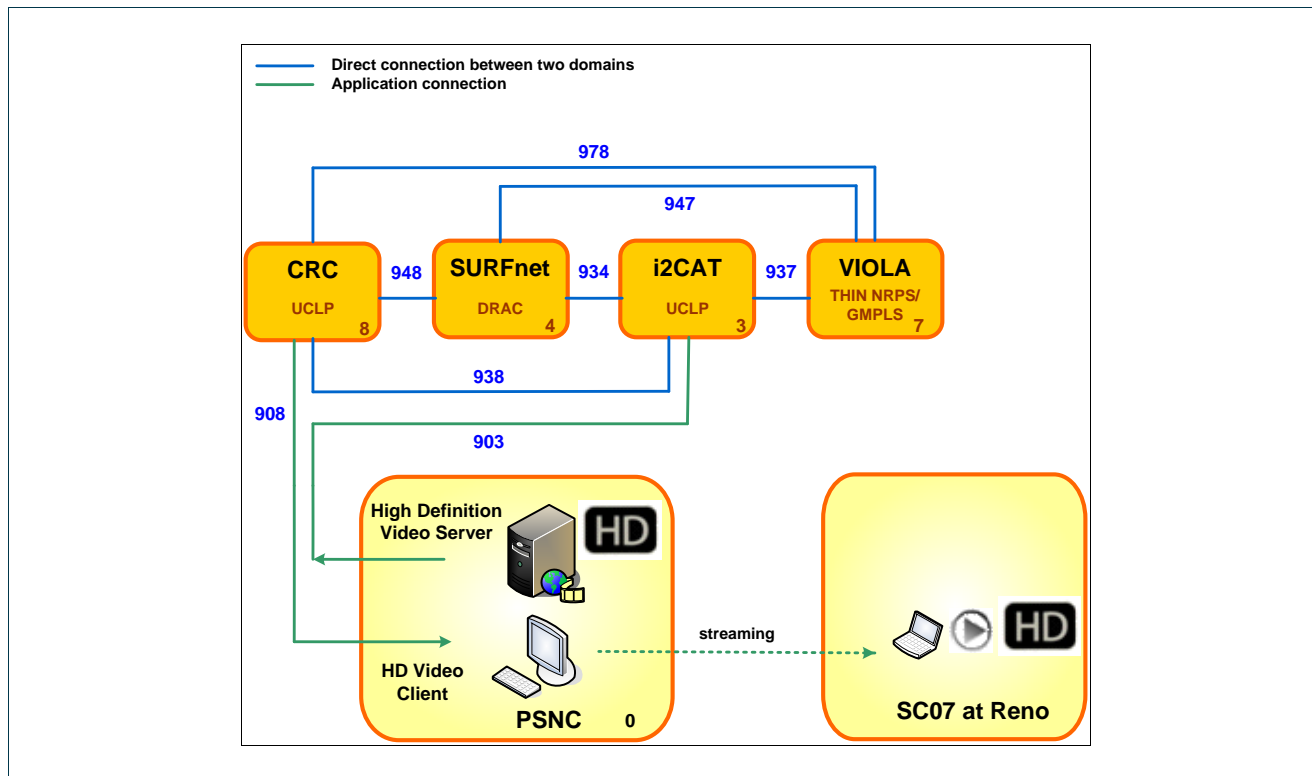
**Figure 2-3** PHOSPHORUS testbed at SC07

For reliable visualization sessions, the reservation of bandwidth between the data server and each of the clients is required. The demonstration was aimed at presenting how the Network Service Plane (NSP) manages the paths for the scientific application purposes. During the demo two network reservations was initiated by the NSP client and KoDaVis utilized the paths set up by the NSP.



## Demo 2: Media application – High Definition video streaming

This demo showed the creation of an end-to-end path to connect the two servers located at PSNC. One of them sent an HD video stream that will cross PHOSPHORUS domains along Europe and Canada. The stream then was presented on the laptop attached with its 1 Gig NIC to the venue facilities in Reno. The topology of the demonstration test-bed is depicted on the following figure:



**Figure 2-4** Demo testbed topology at SC07

For the demonstration purposes the Network Service Plane created one end-to-end connection path from CRC to i2CAT. The path computing element has the possibility of selecting among different multi-domain paths:

- CRC-VIOLA-SURFNET-i2CAT
- CRC-SURFNET-i2CAT
- CRC-VIOLA-i2CAT

The VideoLAN was launched on the server in PSNC and what was sent was viewed at SC07. The demo showed how the multi-domain path was being controlled by the Network Service Plane for the media streaming applications.





### Demo 3: Connecting UvA Phosphorus AAA testbed and Internet2 Dynamic Circuit Network (DCN)

The University of Amsterdam (UvA) in collaborating with Internet2 demonstrated inter-connection between Internet2 DCN and the Phosphorus AAA testbed implementing UvA's Token Based Authorization concepts integrated in the Internet2/DCN IDC protocol and software to enable secure authorized access of lightpaths and video content across multiple domains. This technology was used to enable streaming on demand CineGrid 1080p HD video from the University of Amsterdam across SURFnet, NetherLight and Internet2 networks terminating at the Dutch Pavilion at the SC07 conference. Stream CineGrid video from Amsterdam to the booth at an average 300 MBit/s bitrate provided extraordinary quality at full frame rate.

### Booth Participation

During the SC07 the PHOSPHORUS project was present in a booth run by PSNC.

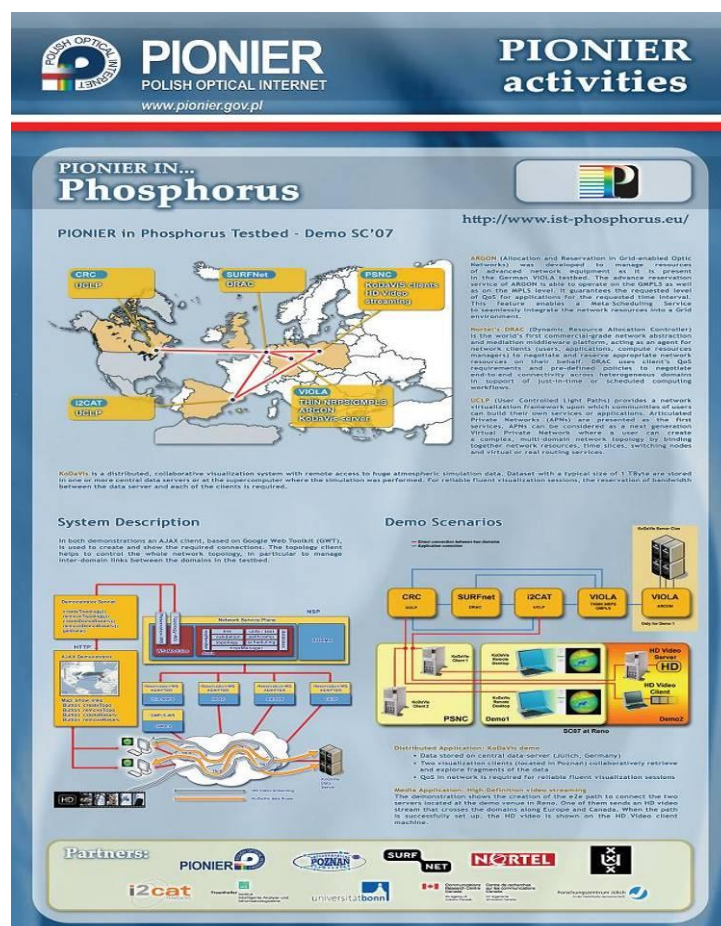


Figure 2-5 PHOSPHORUS poster at SC07

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



More information on the Supercomputing 2007 can be obtained online at <http://sc07.supercomputing.org>

### 2.2.1.3 Year 3 : SC '08

Supercomputing Conference is expanding the frontiers of HPC by challenging the combination of computation, networking, storage, and analysis and hosting an exceptional technical program, an expanded exhibits area, an exciting education program and much more. Supercomputing conference 08 was held in Austin, Texas, USA from 15 – 21 November 2008. Further information is available at the events website <http://sc08.supercomputing.org/>.

#### Description of Demo

##### Demo 1: The Harmony System

The PHOSPHORUS test-bed for this event contained three new domains:

- University of Essex (UESSEX, United Kingdom). This domain was controlled by Argia/UCLP NRPS and one Harmony adapter in order to register in the main Inter-domain Broker. The domain involved one Cisco Calient DiamondWave
- Poznan Supercomputing and Networking Centre (PSNC, Poland). This domain was controlled by Argia/UCLP NRPS and one Harmony adapter in order to register in the main Inter-domain Broker. The domain contained one Cisco Calient DiamondWave
- Harmony-Internet2 gateway (HI-GW, Netherlands). This domain was the gateway to inter-connect both Internet2 test-bed and Harmony test-bed.

The major achievements of the demonstrations performed in SuperComputing 08 can be divided into four main groups:

- Multi-domain advance reservation path setup. Here the demonstration workflow consisted in the creation of a transatlantic path between Canada (CRC domain) and Barcelona (i2CAT domain), passing through Germany (VIOLA domain).
- Integration with the Grid Middleware. Here the demonstration consisted in the applications from WP3, using the Meta-scheduling Service (MSS), which is enabled to access the advance reservation service.
- Inter-operability with other BoD projects. Inter-operability between Harmony system and the Internet2 IDC were performed by creating a path from Barcelona (i2CAT) to Internet2 domain, passing through University of Amsterdam domain; and sending a video from a PC in Barcelona to another one located in the conference venue (belonging to Internet2 domain).

##### Demo 2: Grid-GMPLS control plane

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3

The Grid-GMPLS control plane was implemented by WP2 researchers. The G2MPLS was integrated into a distributed storage grid application (Phosphorus DDSS). This was done with the G<sup>2</sup>MPLS Control Plane running on the optical Phosphorus pan-European testbed. This demonstration showed the transfer of large media contents in a remotely connected storage grid dynamically between UK (Univ. Essex labs) and Poland (PSNC labs). The underlying G<sup>2</sup>MPLS Control Plane implemented dynamically the anycasting connectivity service (i.e. with the dynamic selection of the optimal storage sink by Control Plane) on a DWDM optical infrastructure and GÉANT2 (<http://www.geant2.net>).

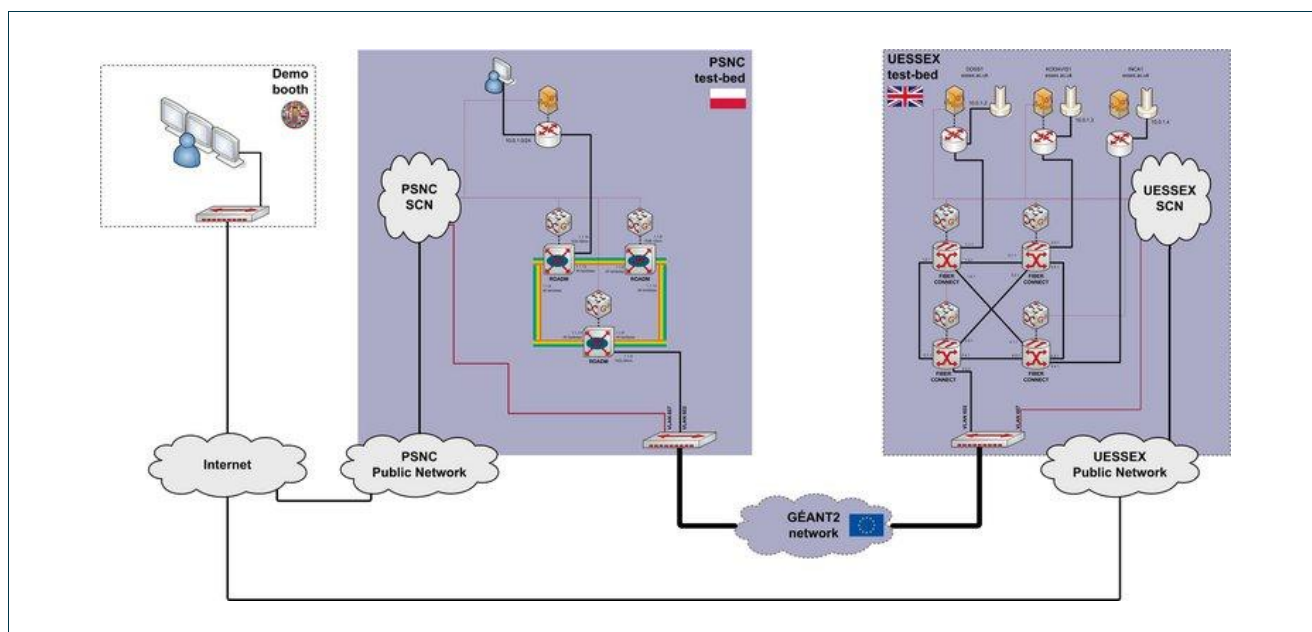
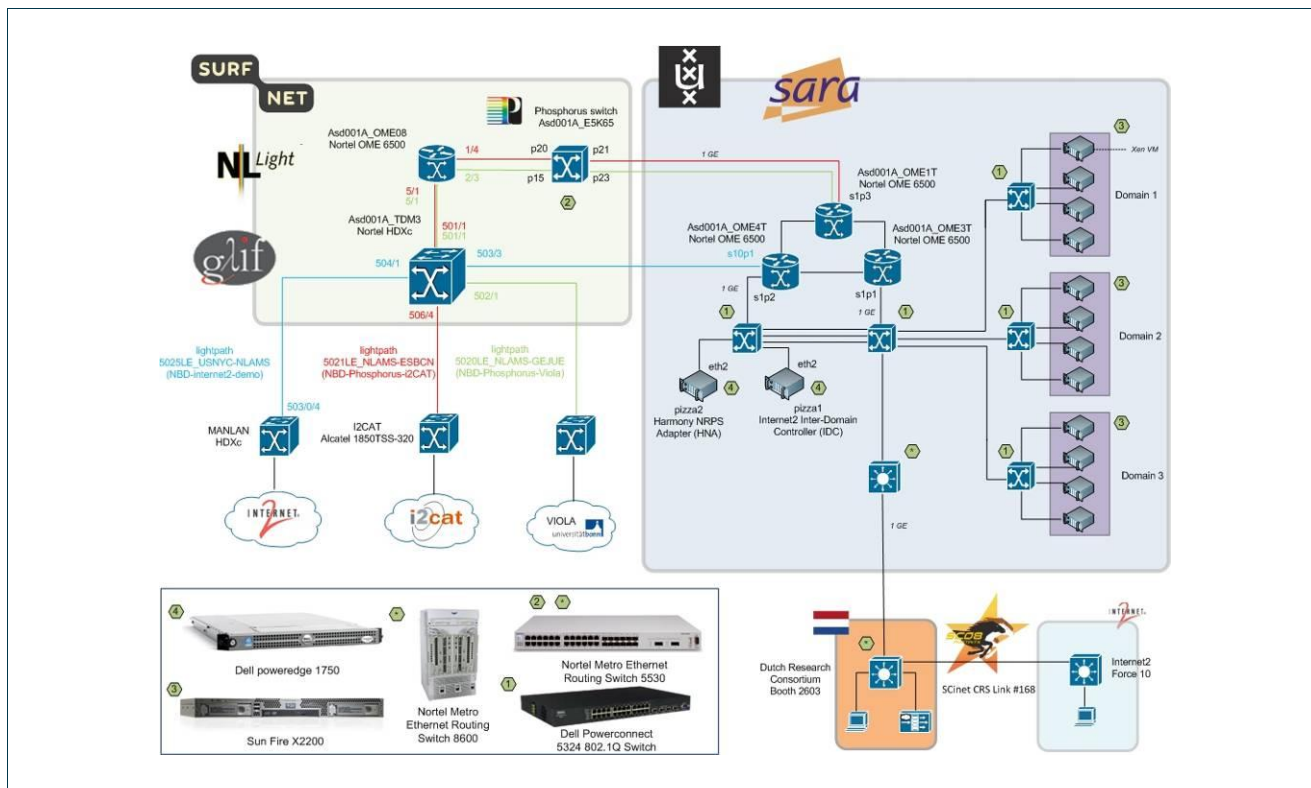


Figure 2-6 Grid-GMPLS Testbed

### Demo 3: Phosphorus - DCN Interoperability demonstration

The UvA testbed and SC08 demo setup, is depicted in Figure 2-7. The UvA testbed was integrated into the Harmony Network Service Plane (NSP), to enable the set up connections in the UvA testbed by requesting them from the Harmony NSP. To achieve interoperability with Internet2, an Inter-Domain Controller (IDC<sup>1</sup>) was deployed in the UvA testbed and a Harmony-IDC request translator was developed and deployed. This makes it possible to set up connections going through the Internet2 and Phosphorus domains by sending requests to the Harmony NSP. The Phosphorus-DCN interoperability which was shown at SC08, is described in more detail below.

<sup>1</sup> The DCN IDC is designed by a collaboration of ESnet, Internet2 and GEANT, and is deployed by these networks and others. The ESnet and Internet2 implementations are based on the OSCARS program developed and maintained in common, and GEANT version is developed and supported in the AutoBAHN network.



**Figure 2-7:** Combined PHOSPHORUS – Internet2 DCN test-bed for SC 08

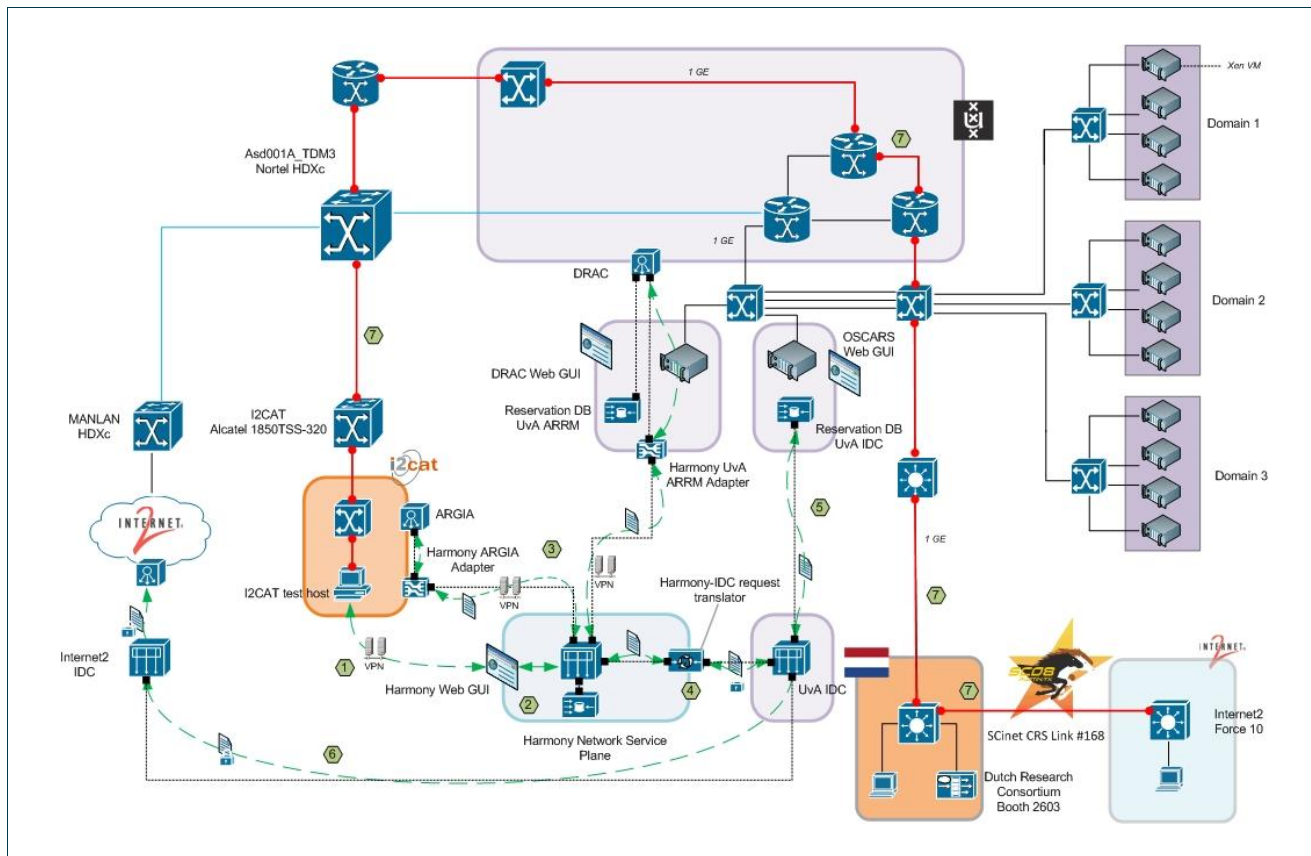
### Scenario Setup

The figure presented below depicts the demonstration scenario setup. The green arrows depict the flow of availability and reservation request messaging over the control channels (the black dotted lines). The red lines depict the data connections that are set up in an I2CAT-Internet2/SC08-showfloor demo scenario. The annotations refer to distinct steps in the demo scenario, and are explained below.

The combined Phosphorus/Internet2/SC08 setup including the combined service - and control planes is depicted in Figure 2-8. The following components can be distinguished:

- The Harmony Network Service Plane (NSP).
- The Harmony NSP Adapters (HNAs) and Domain Controllers (DCs) for the I2CAT and UvA/SURFnet domains, ARGIA and DRAC respectively.
- The Internet2 and UvA Inter-Domain Controllers (IDCs).
- The Harmony-IDC request translator.
- The Web-based GUIs for requesting reservations for paths and bandwidth, viz., the Harmony Web GUI (Harmony NSP), OSCARS (IDC) and the DRAC Web GUI.

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



**Figure 2-8** The combined Phosphorus/Internet2 service and control plane, request messaging and path provisioning of the SC08 demo setup

In one of the possible demo scenarios a path is requested from the Harmony NSP running from a host in the I2CAT domain to the demonstrator host on the SC08 showfloor. The steps involved in this scenario corresponding to the annotations in the diagram are described below.

1. A user requests a path reservation from the Harmony NSP using the Web GUI.
2. A check on the availability of the requested service is made.
3. A createReservation message is sent to the domain controllers involved in the requested path. In this case ARGIA and DRAC. The reservation is stored in the respective databases.
4. In scenarios in which the path ends in the Internet2 domain, the createReservation message is translated by the request translator. This process involves the mapping of elements present in the request to elements required in an IDC createReservation request that include elements such as start-



time, end-time and bandwidth. The IDC request is processed and the reservation is stored in the UvA IDC database.

5. The UvA IDC relays the request to the Internet2 IDC where the request is subsequently processed.
6. At usage time the path is set up. Currently path setup signalling is not implemented yet, so all reservations have to be made with the automatic activation feature enabled.

### ***The Demonstration***

The actual demo consisted of showing the setup of a path to a VIOLA, I2CAT and Internet2 host by making requests in the Harmony NSP web GUI. All hosts ran a VLC streamer, so that when a path was successfully set up, a specific video playing on the VLC streamer from that host would be shown on the screen (depicted in Figure 2-9).



**Figure 2-9** The Dutch research consortium booth where the actual demonstration was given

### ***Phosphorus - DCN Interoperability Team***

University of Bonn	Alexander Willner, Jan Gassen, Christian de Waal
I2CAT	Joan Antoni García Espín, Jordi Ferrer Riera
Internet2	Andy Lake, John Vollbrecht

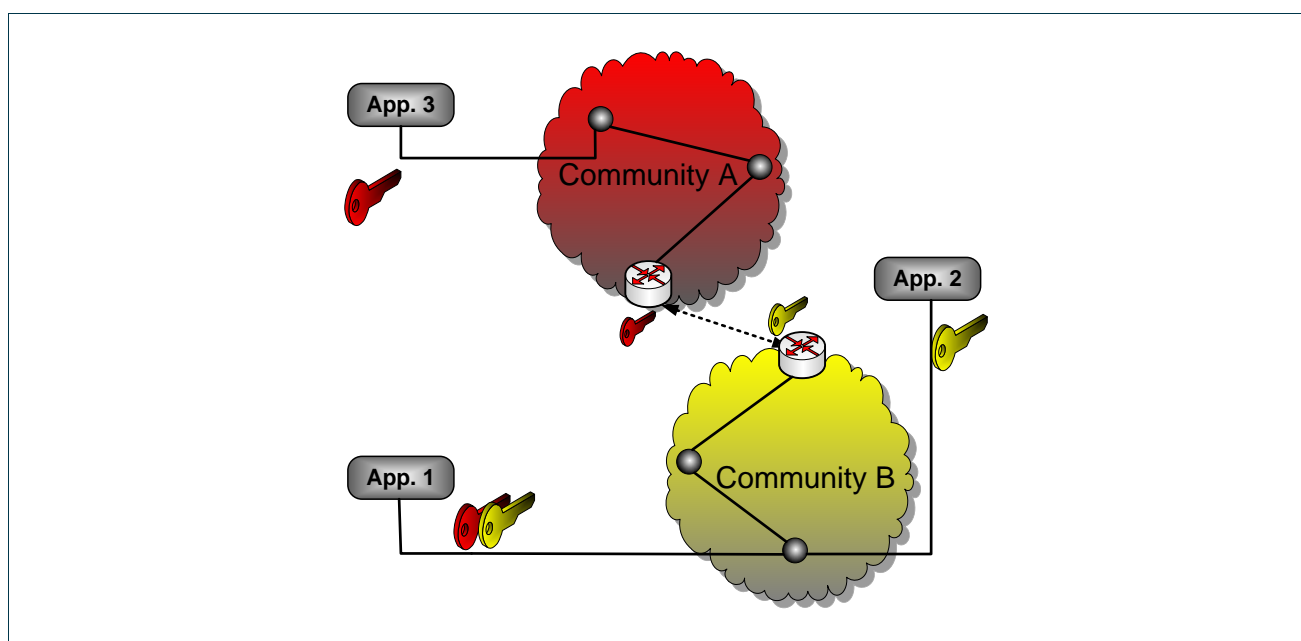
Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



UvA	Fred Wan, Jeroen Roodhart, Ralph Koning, JP Velders, Cees de Laat
SURFnet	Gerben van Malenstijn, Bram Peeters

#### Demo 4: Phosphorus generalised Token Based Networking (gTBN)

University of Amsterdam also demonstrated the generalised Token Based Networking (gTBN) architecture shown in Figure 2-10. This architecture enables dynamic binding of communities and their applications to specialised network services. gTBN uses protocol independent tokens to provide decoupling of authorisation from time of usage as well as identification of network traffic. The tokenised traffic allows specialised software components uploaded into network elements to execute services specific to communities.

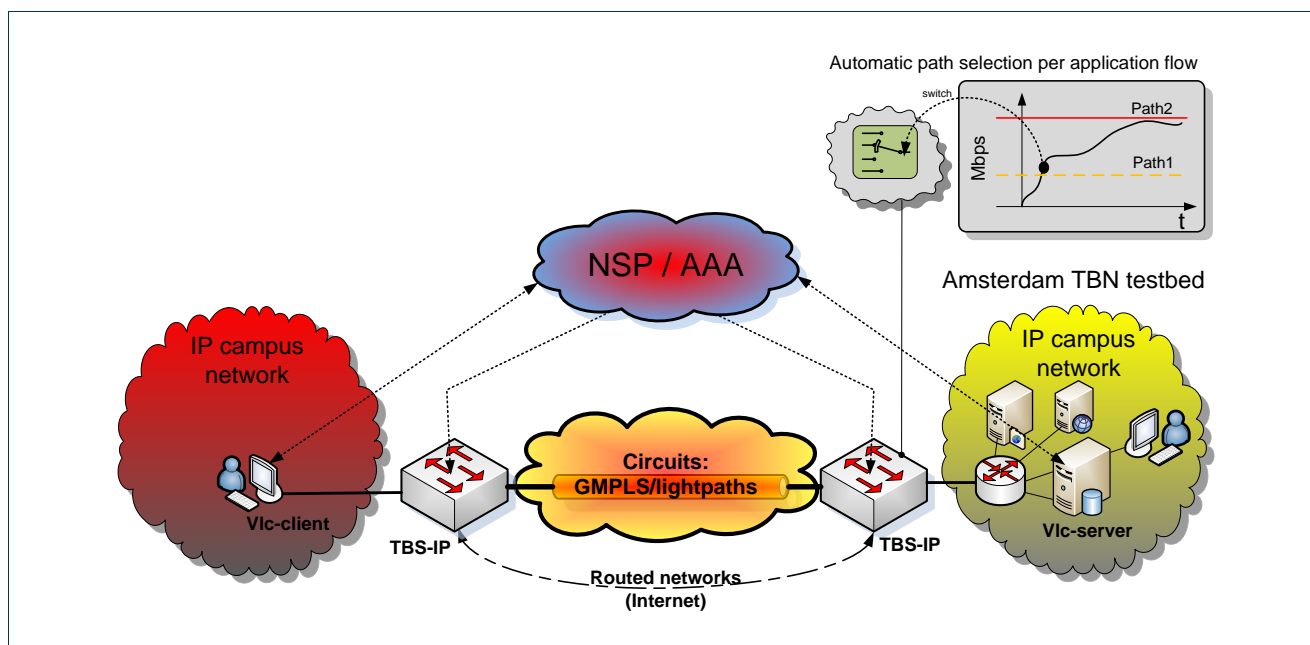


**Figure 2-10** gTBN architecture

Figure 2-10 shows an example application of gTBN. Two communities with its member applications are located on different network domains. For example, Application 1 and 2 belong to community B, and Application 3 belongs to community A. The two communities are each associated with a token, gray and white, respectively. Let us assume that the policy of a network domain is that only members of the communities are allowed to be routed through the network. Application~1 and Application~2 are both members of community~B and therefore, they can communicate. Correctly tokenised traffic will be routed using default IP mechanisms. However, to communicate with Application~3, Application~1 also needs credentials to access the resources of community~A. gTBN supports binding of multiple domain-specific services into a single token. This allows a member of both communities A and B to access each others network domains.

## Scenario Setup

The following three scenarios illustrate community-based network services. First, many scientists are allowed to access worldwide digital libraries on behalf of their academic organisation regardless of their location (network source address). Currently, this is only possible within the organisation domain. Second, large-scale experiments by scientific communities require data gathering from multiple sources such as high-throughput sensors, lab equipments, followed by data processing on multiple Grids under different ownership. This needs infrastructure support for sharing computational, storage and networking resources. Third, rules and laws of a country or organization may apply to communities of which their members are located worldwide and interconnected over public and private networks and hence, the network has to guarantee separation of these communities to support judicial territories. The three examples all require a form of traffic identification and control to provide specific services. However, the current Internet model offers only best-effort end-to-end connectivity. In this demo, we addressed network support for binding specialised, application-specific services to communities and their applications.



**Figure 2-11** The SC08 demo

## Results

- Contact with John Vollbrecht (Internet 2) and discussed on the options to extend the binding of IP campus networks to the circuits I2 controls by using gTBN technology;
- Discussions with Martin Swamy (University of Delaware) on the binding of applications to circuits used in his Phoebus project (<http://damsl.cis.udel.edu/projects/phoebus>). Although the socket hijacking mechanism is similarly used in both gTBN and Phoebus, Phoebus goal is to enhance the TCP performances on end-to-end paths;





- Started co-operation with OpenFlowSwitch consortium (<http://www.openflowswitch.org>) that proposed to manage virtual paths on existing networks by using a controller that can securely program certain vendor switches and routers. Although gTBN requires a fully programmable packet processing device in order to implement the finest granularity of traffic manipulation for applications, gTBN could program regular switches and routers in a similar way as OpenFlowSwitch. However, the integration between OpenFlowSwitch and gTBN would faster the promotion of the path creation on behalf of the applications for research networks. There is an option to use the recently built testbed of I2 and Phosphorus through UvA gateway for OpenFlowSwitch-gTBN aware applications.

### Demo 5: Harmony – G<sup>2</sup>MPLS interoperation

The feasibility of interconnecting heterogeneous domains (Argia, G<sup>2</sup>MPLS) controlled under the umbrella of Harmony was demonstrated. The demonstration shows the Health Services Virtual Organization (HSVO) application which consists in a remote server and visualization client. The client is locally deployed at TNC while the remote server is located in Sunnyvale, California. The computed path crosses multiple domains (CRC – Canada, PSNC – Poland, i2CAT – Barcelona, TNC – Malaga) controlled by its own provisioning system or control plane. Specifically, CRC and i2CAT domains use Argia (Harmony) and PSNC uses G<sup>2</sup>MPLS to control its Calient optical cross-connect.

When starting the HSVO client, it requests Harmony connectivity to the remote server. After the calculation of the path, Harmony sends individual requests to each domain (Canada, Poland, Spain) to setup the network provisioning systems and trigger the configuration of the physical layer. In case of G<sup>2</sup>MPLS, HG<sup>2</sup>-GW is used to translate Harmony requests into G<sup>2</sup>MPLS methods. These requests just specify the end points within the G<sup>2</sup>MPLS domain, the desired Bandwidth, the connection scheduling (start time, duration) and a Job identifier. Then, G<sup>2</sup>MPLS protocols perform the internal path computation and connection establishment. When the whole multi-domain path is established, the application client is notified and data can be transmitted.

The demonstration aims to show the interoperability between Harmony and G<sup>2</sup>MPLS by the developments done by WP1 and WP2 within the Phosphorus project. Thus, this demonstration covers one of the main achievements of the project, and, at the same time, shows how the developments of WP1 and WP2 can deal with heterogeneous, multi-domain, and multi-vendor realistic scenarios.

### Booth Participation

The booth was visited frequently and the feedback was positive. Although the discussions following the demo covered a number of topics, the common denominator was that further development of advanced querying functionality would be welcomed. It was seen as a drawback of reservation systems such as shown in the demo that too little information could be retrieved to be able to determine if the exact setup as required could be provided at the desired time in the future. This -, and all other comments, were expressed not so much as criticism but rather as an encouragement to continue with - and improve on what there is now.

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3

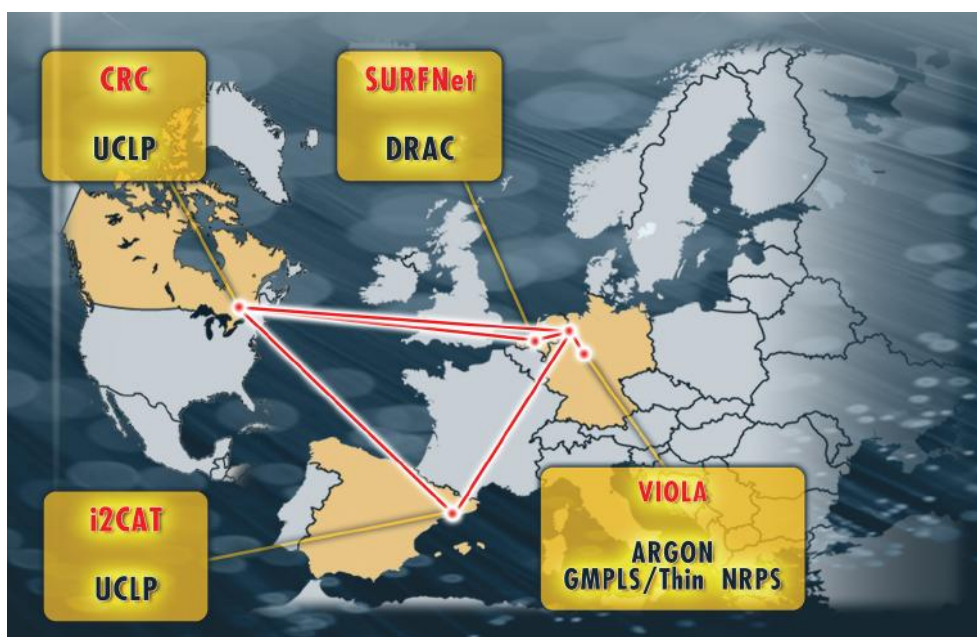


## 2.2.2 TERENA Networking Conference

### 2.2.2.1 Year 2: TNC 2008

TERENA Networking Conference 08 was organised by TENERA, the Trans-European Research and Education Networking Association, and hosted by BELNET, the Belgian national research and education network. It was held in Brugge (Belgium, EU) from 19<sup>th</sup> to 22<sup>nd</sup> May 2008. PHOSPHORUS was present in the conference by means of the project booth, where demonstrations on-demand were performed. More info at <http://tnc2008.terena.org>

#### Description of Demo



**Figure 2-13:** Demo Scenario: Poster Map for TNC 08

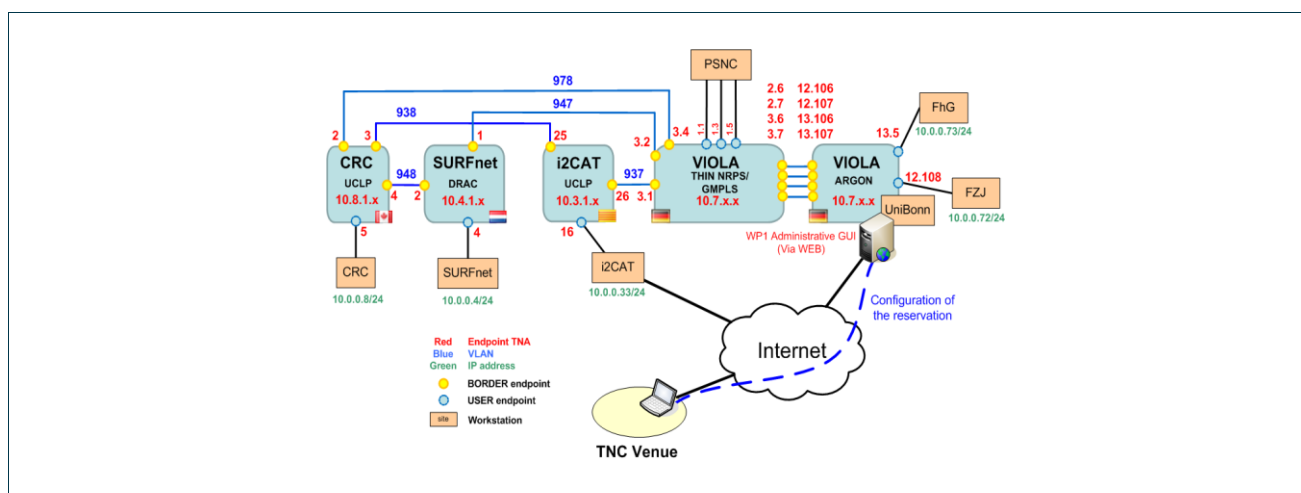
#### Demo 1: Phosphorus WP1 developments on demand

WP1 demonstrations: Joan A. García Espín was present in the PHOSPHORUS booth performing on-demand demonstrations of the WP1 developments.

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3

### Scenario Setup

The demonstration showed the advance reservation and creation of end-to-end paths to connect endpoints in different, independent domains of the test-bed or even at the conference venue with a server. A host connected to one of the endpoints sent an HD video stream that crossed the domains along Europe and Canada. When the path was successfully set up, the HD video was displayed at the HD video client machine connected to the other endpoint. Besides the HD video streaming, other applications such as ping, iperf, or traceroute were used in order to show connectivity between the endpoints.



**Figure 2-14:** Demo Scenario: WP1 domains involved in the TNC 08 demonstration



**Figure 2-15:** WP1 developments on-demand demonstration at the PHOSPHORUS booth (TNC 08)

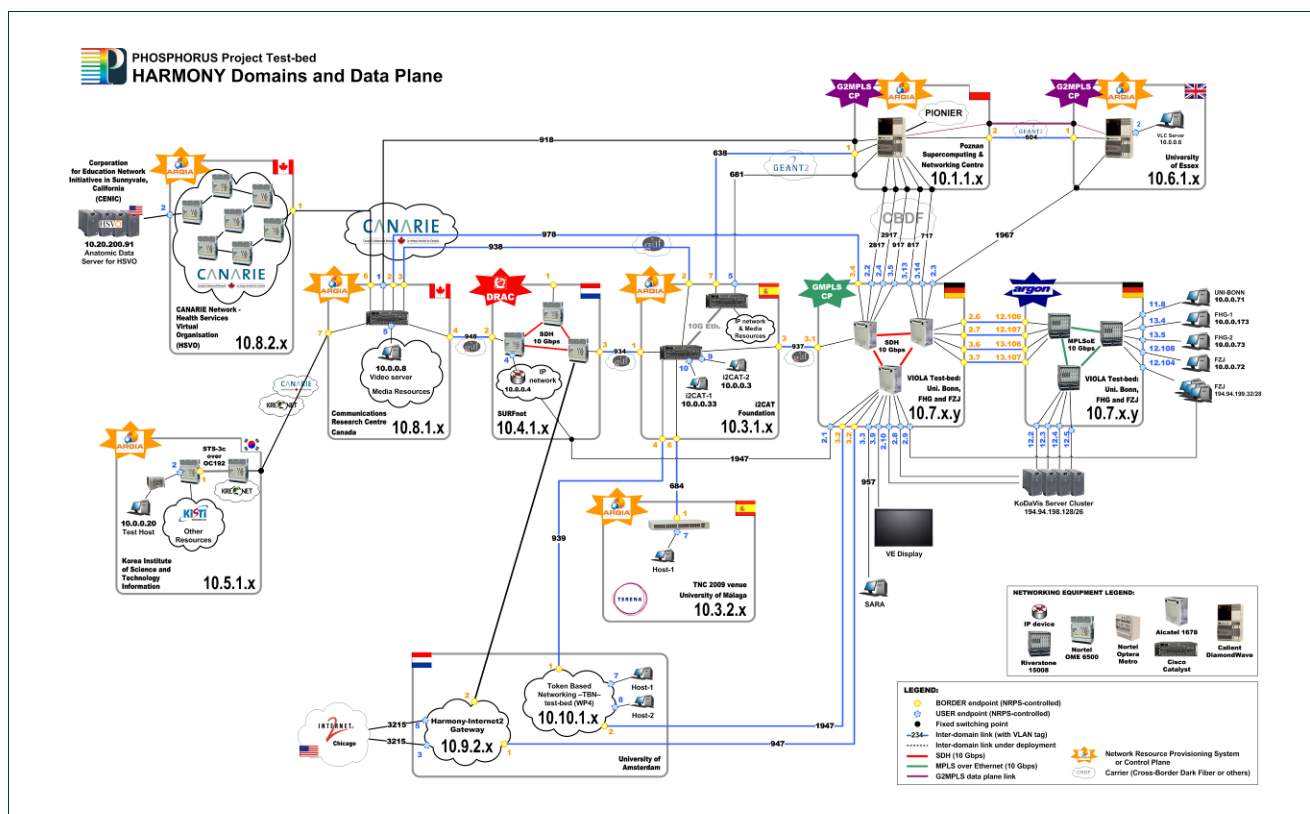
Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3

#### 2.2.2.2 Year 3 : TNC 2009

TERENA Networking Conference 09 was hosted by the University of Málaga and RedIRIS, the Spanish national research and education network and held in the beautiful Mediterranean city of Málaga from 8<sup>th</sup> to 11<sup>th</sup> June 2009. PHOSPHORUS participated in the conference by means of the organization of one workshop as well as with one booth in the conference venue where several on-demand demonstrations were performed.

## Description of Demo

## Demo 1: Phosphorus WP1 demos on demand



**Figure 2-16:** PHOSPHORUS test-bed used at TNC 09 (Málaga, Spain, EU)

## The Demonstration

The Harmony test-bed for the TNC included three new domains: HSWO, KISTI, and a new domain called TNC located at the venue which contained an Allied Tellesys switch located in the booth. As demonstration use case, an external application named Health Services Virtual Organization (HSVO), a Canadian initiative, which aims to send anatomical data for construction high resolution images remotely, has used the Harmony system

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



in order to provide a transatlantic light-path. HSVO client, located at the conference venue, communicated with Harmony Inter-Domain broker in order to schedule and provision the path. Once it had been created, HSVO server, located at SunnyVale (California, US) sent the data through all the domains involved to the client. The anatomical data was then displayed in the conference venue after international, multi-domain, high bandwidth path had been provisioned with a single mouse click in the end-user application.

This demonstration showed, on the one hand, the feasibility of integrating Harmony with e-Science applications in a successfully way; and on the other hand, it showed how Harmony capabilities can be used by the Grid Middleware for multi-domain path provisioning.

Apart from this demonstration use case, a typical workflow including the new Korean domain was demonstrated, where HD video was streamed from Korea (KISTI) towards the conference venue.

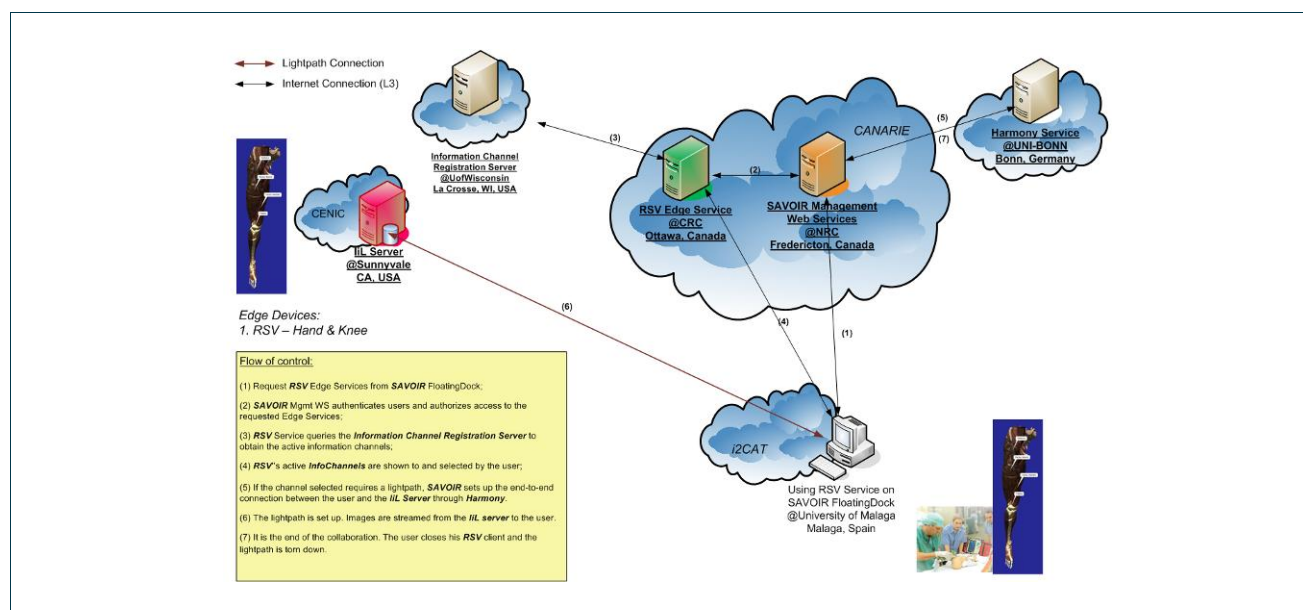
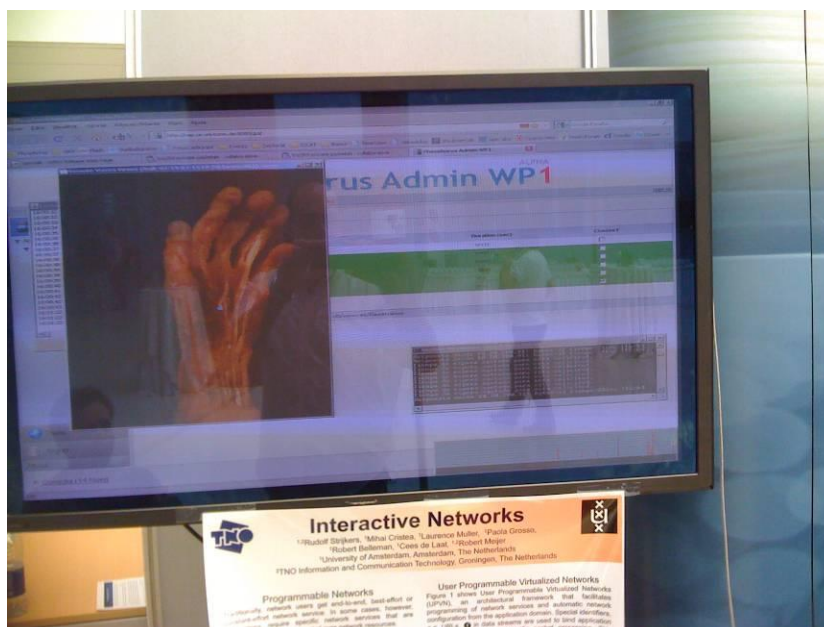


Figure 2-17: HSVO setup in TNC 09



**Figure 2-18:** HSVO working with Harmony in TNC 09 venue



**Figure 2-19:** HD video streamed from KISTI domain. TNC 09.

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



## Demo 2: Grid-GMPLS Control Plane

The capabilities of the Grid-GMPLS control plane was demonstrated in in two challenging scenarios:

- the remote and distributed storage of large media contents (Phosphorus DDSS) through the optical Phosphorus pan-European testbed;
- the simulation and visualization of complex physical and chemical processes in the atmosphere (KoDaVis application on top of the UNICORE middleware) through an onsite full Gigabit Ethernet testbed.

These two scenarios showed the G<sup>2</sup>MPLS Unicast and anycasting connectivity services (i.e. with the dynamic selection of the optimal storage sink or computational element automatically).

## Demo 3: TBN-UvA demo within Phosphorus testbed: Generalised Token Based Networking architecture

The generalised Token Based Networking (gTBN) architecture which was demonstrated at SuperComputing was also demonstrated at the TERENA conference. For this conference however, the use case illustrated a scenario in which multiple applications share a common network resources. gTBN supports binding of multiple domain-specific services into a single token. This allows a member of cooperating communities to access each other's network domains.

**Figure 2-20** shows an overview of how the TBN tesbed is plugged into the Phosphorus GMPLS testbed. The TBN testbed works as a separate network domain, located at University of Amsterdam (UvA-TBN), which interconnects an entire UvA IP campus network into the GMPLS testbed.





#### 2.2.3.1 Year 3: ICT 2008

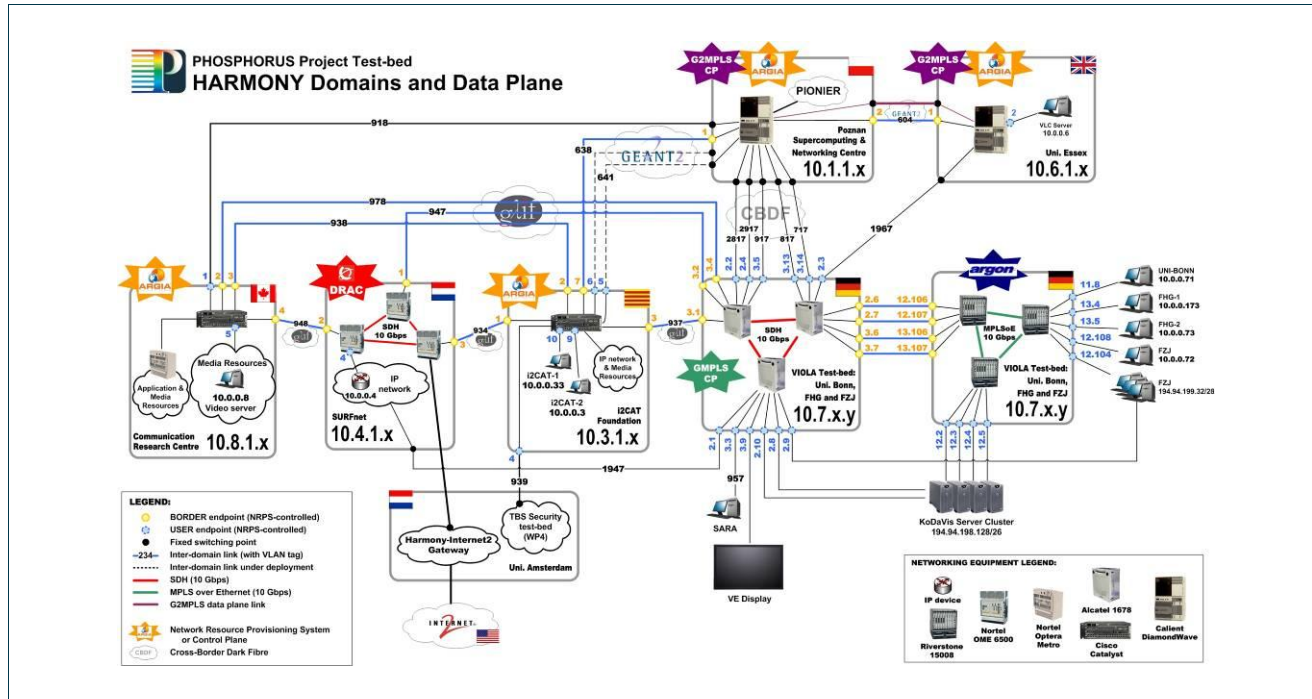
- Presents Europe's future priorities for research funding the ICT area
- Examines crucial issues of public policy for stimulating innovation through ICT development and uptake
- Creates opportunities to establish research and business partnerships and simply keep up to date in what is happening in various ICT research fields

PHOSPHORUS was present in the ICT Event (Lyon, France, EU) from 25 – 27 November 2008 by means of one booth where all the developments done under the project were demonstrated.

33



## Description of Demo



**Figure 2-21:** PHOSPHORUS test-bed used at ICT 08 (Lyon, France, EU)

## Demo 1: Harmony System Developments

Harmony system developments were demonstrated at the PHOSPHORUS booth. Joan A. García Espín performed demonstrations on-demand in the booth. The demonstration workflow consisted basically in the creation of one transatlantic path. There were two main options:

- Canada (CRC) – Barcelona (i2CAT) – Poland (PSNC) – United Kingdom (Essex)
- Canada (CRC) – Germany (VIOLA) – Barcelona (i2CAT)

This demonstration showed the multi-domain advance reservation feature of the Harmony system.

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3

## Booth Participation



**Figure 2-22:** PHOSPHORUS booth at ICT 08 (Lyon, France, EU)

### 2.2.4 Optical Networks Design and Modelling Conference

The 12th International Conference on Optical Networking Design and Modeling - ONDM 2008 - was held in Vilanova i la Geltrú, Catalonia, Spain, on March 12-14, 2008. ONDM is a major European conference focusing on the area of optical networking. The main conference topics indeed range almost all relevant areas in optical networking and communications. From many years the ONDM conference is a meeting point for people coming from the leading industry and from the research and academic side willing to spread and update their knowledge in the conference technical areas.

#### Summary of Participation

Sergi Figuerola, Eduard Escalona and Marc De Leenheer presented WP1, WP2 and WP5 overviews respectively.

#### Description of Demo

Joan Antoni García and Angel Sánchez (i2CAT) presented a demonstration of the WP1 prototype of the first phase of the project with remote support of other partners of WP1 (University of Bonn, SURFnet and CRC).

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



The demonstration consisted on the establishment of advance reservations through the domains of WP1 partners (i2CAT-VIOLA-CRC-SURFnet) and the demonstration of the connectivity using several tools (ping, iperf and video streaming).

More information on the ONDM 2008 can be obtained online at <http://www.ondm2008.cat>

## 2.2.5 Open Grid Forum

The 23<sup>rd</sup> Open Grid Forum (OGF 23) took place in Barcelona from June 2<sup>nd</sup> to 6<sup>th</sup> 2008. It was hosted by the Barcelona Supercomputing Center. OGF 23 aimed to show how Grids have become a key enabling technology in a broad spectrum of IT environments. OGF 23 also aimed to provide a unique forum for discussion on how grids form a necessary underpinning for emerging technologies such as virtualization and clouds.

### Summary of Participation

PHOSPHORUS was present in OGF 23, where Sergi Figuerola made a speech presenting WP1 developments (Harmony brand name was launched at this event) and Joan A. García made a demonstration of the Harmony system.

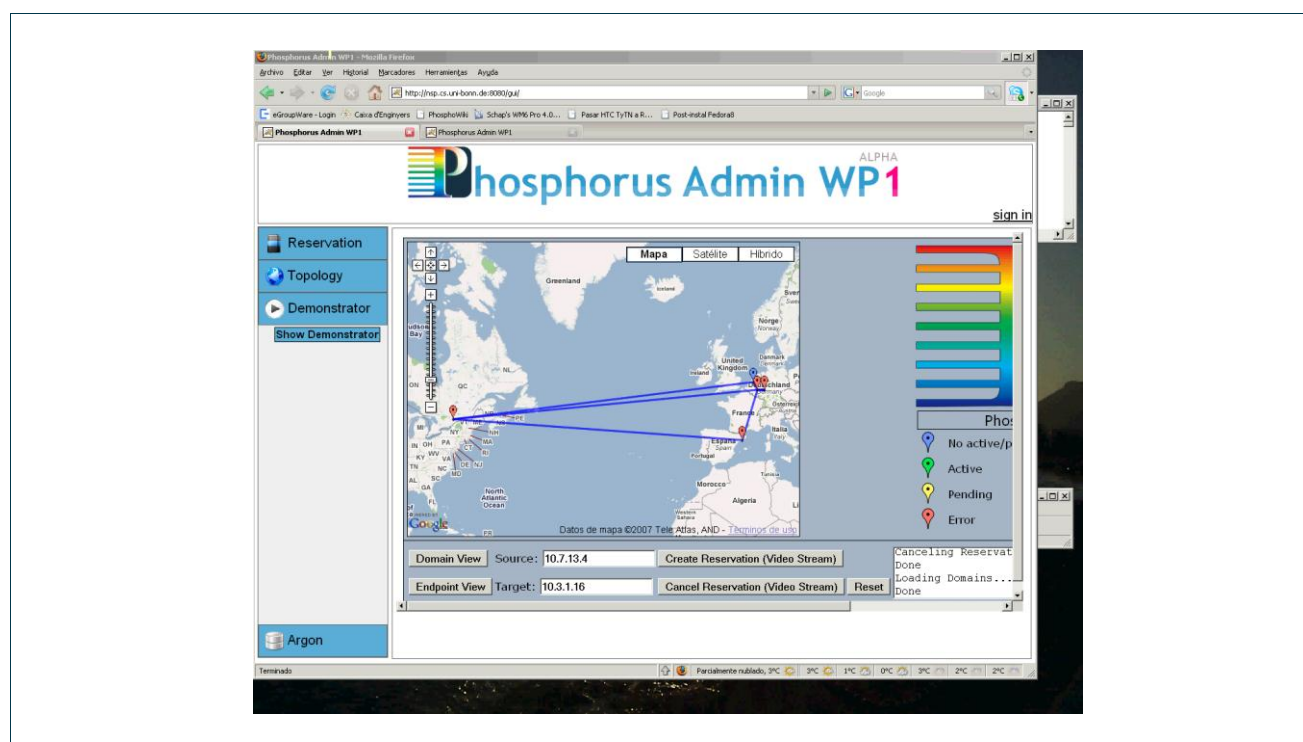


Figure 2-23: PHOSPHORUS WP1 GUI demonstrator

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



### Description of Demo

The demonstration workflow consisted in the creation of a transatlantic path from Canada (CRC domain) to Barcelona (i2CAT domain), going through Germany (VIOLA domains). Once the path was created by Harmony, an HD video was streamed from one PC directly connected at the endpoint in Canada to another client PC connected at the endpoint in Barcelona.

### 2.2.6 Global Lambdagrid Workshop (GLIF)

Established in Iceland in 2003, GLIF, the Global Lambda Integrated Facility, is an international virtual organisation that promotes the paradigm of lambda networking. Its participants include National Research and Education Networks (NRENs), consortia and institutions working with lambdas. Each year, it organises a LamdaGrid workshop as a platform for engineers, managers, researchers and developers to share experiences and discuss issues related to optical networking. This year, it was held in Prague, Czech Republic on 17-18 September 2007.

#### Summary of Participation

PHOSPHORUS was represented at GLIF'07 by PSNC and SARA. PSNC participated by coordinating the booth at this event, while SARA participated by a demonstration

#### Description of Demo

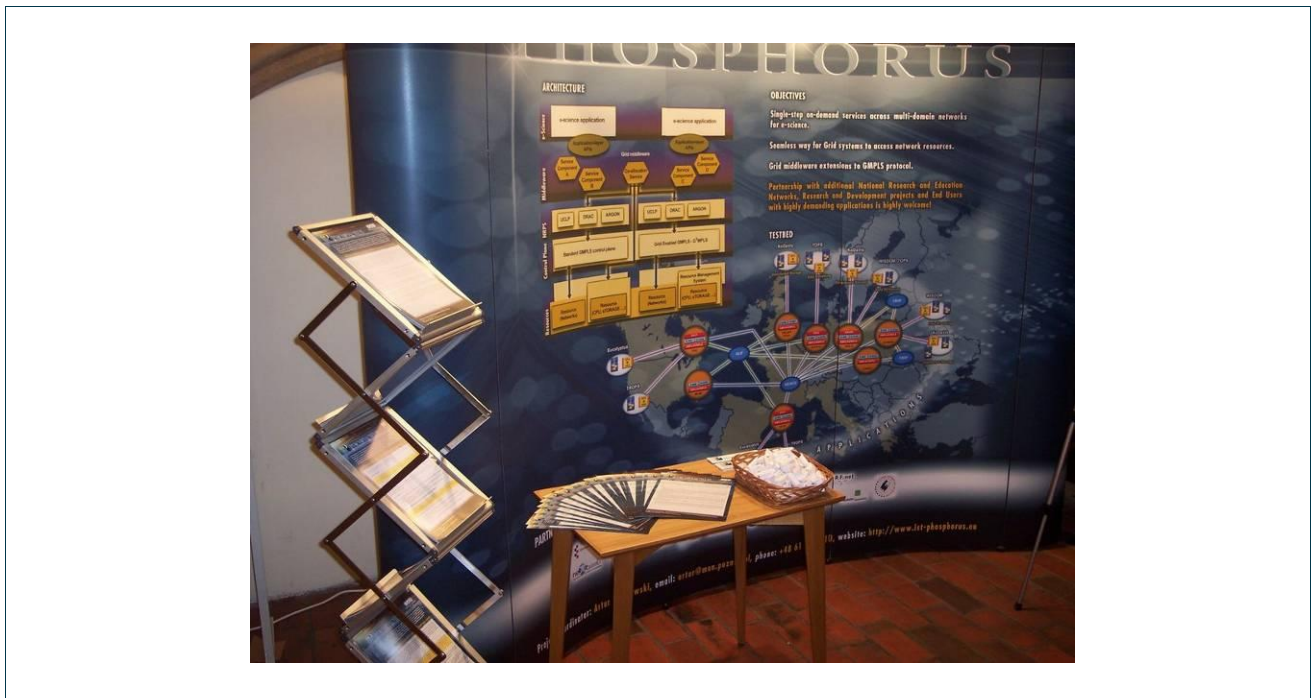
PSNC represented PHOSPHORUS at GLIF'07 by providing a demo of 4K streaming from Amsterdam to Prague and another demo of International High Performance Digital Media with Optical Multicast.

#### Booth Participation

PSNC represented PHOSPHORUS at GLIF'07 by providing the PHOSPHORUS presentation stand with posters, folders, leaflets and sweets with PHOSPHORUS logo on them.

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3





**Figure 2-24:** PHOSPHORUS booth at GLIF07

More information on GLIF'07 can be obtained online at <http://www.ces.net/glif2007/> and <http://www.glif.is>

### 2.2.7 OptiPuter all Hands Meeting and Open House

The OptiPuter, stands for **O**ptical networking, **I**nternet **P**rotocol, **c**omputer storage, processing and visualization technologies. Its vision is to develop an infrastructure that will tightly couple computational resources over parallel optical networks using the IP communication mechanism, with optical networks creating "supernetworks". The new architecture will enable scientists who generate terabytes and petabytes of data to interactively visualize, analyze, and correlate their data from multiple storage sites connected to optical networks.

The all hands meeting and open house was held in California USA from January 21 - 23, 2007.

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



### Description of Demo

SARA represented PHOSPHORUS by Private communication to OptiPuter partners and a demo of 4K streaming from Amsterdam to San Diego using TOPS.

More information on the OptiPuter all Hands Meeting and Open House can be obtained online at [http://www.optiputer.net/events/presentation\\_temp.php?id=26](http://www.optiputer.net/events/presentation_temp.php?id=26)

### 2.2.8 Workshop on 4K digital Cinema Streaming over Lightpaths

A workshop was organized on 4K digital Cinema Streaming over Lightpaths, using TOPS. The workshop took place in Amsterdam, Netherlands on February 14, 2007.

PHOSPHORUS was represented by SARA.

#### Summary of Participation (Demo and Booth)

SARA built the first 4K visualization setup on which highly detailed movies can be shown using TOPS. SARA has recently demonstrated this facility to the early adopters of 4K cinema in the Netherlands. SARA represented PHOSPHORUS with presentations and a demo on Tiled Panel with TOPS. More information can be found online at [http://www.sara.nl/news/press/20070214/4K\\_dig\\_cinematetechniek\\_eng.html](http://www.sara.nl/news/press/20070214/4K_dig_cinematetechniek_eng.html)

### 2.2.9 High Performance Visualization Meeting

PHOSPHORUS was represented at the High Performance Visualisation meeting by SARA.

#### Description of Demo

SARA demonstrated TOPS to Dutch Scientists. More information on the High performance visualisation meeting can be obtained online at <http://www.sara.nl>

### 2.2.10 CineGrid Holland Festival Amsterdam

The CineGrid Holland Festival Amsterdam was held on June 20, 2007. PHOSPHORUS was represented at the High Performance Visualisation meeting by SARA.

#### Description of Demo

The CineGrid festival demonstrated the first successful trans-Atlantic streaming over photonics IP networks. The demonstration showed very high quality digital media running over very high speed digital networks. SARA contributed to "the making of" as part of "Era la Notte" live 4K cinema streaming to USA, Japan, Europe.

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



More information on the CineGrid Holland Festival can be obtained online at <http://www.cinegrid.nl>, and <http://www.youtube.com/watch?v=moL2tl0mlkw>

### 2.2.11 TERENA's European Future Networking Initiatives Workshop

The objective of the workshop is to exchange information and raise awareness about the many discussions and initiatives world-wide to develop a new, 'clean slate' architecture for the Internet, and to discuss how the European research networking community will want to participate in these developments.

The workshop took place on 22 February in Amsterdam. PHOSPHORUS was represented at TERENA's European Future Networking Initiatives Workshop 2007 by I2CAT.

#### Booth Participation

I2CAT represented PHOSPHORUS by holding a booth and presentation stand. More information on the workshop can be obtained online at <http://www.terena.org/activities/efniw/>

### 2.2.12 European Conference and Exhibition on Optical Communication (ECOC)

ECOC is the largest conference on optical communication in Europe, and one of the most respected and long-standing events of its kind in the world. 2007 saw ECOC into its 32<sup>nd</sup> edition, signifying the stability and attractiveness of this conference as one of the world's recurring major events, providing the forum for leading developments and results in optical communication and networks.

PHOSPHORUS was represented at ECOC'07 by PSNC, University of Essex, Ghent University-IBBT, and AIT.

#### Booth Participation

PSNC represented PHOSPHORUS at ECOC'07 by providing the PHOSPHORUS booth with posters, folders, leaflets and sweets with PHOSPHORUS logo on them.

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3





**Figure 2-25** PHOSPHORUS presence at ECOC'07

More information on ECOC'07 can be obtained online at <http://www.ecocexhibition.com/modules/serve.cgi>

### 2.2.13 CEF Network Workshop (CEF)

The CEF Workshop recognizes the growing discipline of the Customer Empowered Networks and provides a platform for the exchange of experience and to support further effort in deployment of the Customer Empowered Networks concept. This year, it was held in Prague, Czech Republic on 19-20 September 2007.

PHOSPHORUS was represented at CEF'07 by PSNC.

#### Booth Participation

PSNC represented PHOSPHORUS at CEF'07 by providing the PHOSPHORUS presentation stand with posters, folders, leaflets and sweets with PHOSPHORUS logo on them.

More information on CEF'07 can be obtained online at <http://www.ces.net/doc/seminars/cef2007/>

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



### **2.2.14 3rd Technical Meeting on Remote Instrumentation in Next-generation Grids (IMEKO)**

The 3rd Technical Meeting on Remote Instrumentation in Next-generation Grids (IMEKO'07) was held in Iasi, Romania on 20 - 21 September 2007.

PHOSPHORUS was represented at IMEKO'07 by PSNC.

#### **Booth Participation**

PSNC represented PHOSPHORUS at IMEKO'07 by providing the presentation posters, folders, and leaflets. More information on IMEKO'07 can be obtained online at <http://www.imeko2007.ee.tuiasi.ro/>

### **2.2.15 Nortel Workshop**

PHOSPHORUS was represented at the Nortel Workshop by SARA.

#### **Summary of Participation**

SARA presented on TOPS, lightpath monitoring and DRAC. More information on the Nortel Workshop can be obtained online at <http://www.sara.nl>

### **2.2.16 Internet2 Meeting**

The Internet2 meeting took place on 23-25 April 2007 at Arlington, Virginia, USA. PHOSPHORUS was represented at Internet2 by PSNC.

#### **Summary of Participation**

PSNC presented the PHOSPHORUS project using the PHOSPHORUS official slides. More information on the Internet2 Meeting can be obtained online at <http://events.internet2.edu/2007/spring-mm/>

### **2.2.17 International Supercomputing Conference**

The ISC brings together world renowned speakers from industry and academia to share their experiences and visions and to discuss issues trends and results that are poised to shape the future of high performance computing and networking. In 2007, the conference took place on 26 – 29 June 2007 in Dresden Germany.

PHOSPHORUS was represented at ISC'07 by PSNC and FHG.

#### **Summary of Participation**

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



PSNC represented PHOSPHORUS by presenting a poster at this event. FHG represented PHOSPHORUS by organising a BoF session on Service Level Agreements for resource management and presenting the PHOSPHORUS MetaScheduling Service developments at this event.

More information on the International Supercomputing Conference, '07 can be obtained online at <http://www.supercomp.de/isc2007/>

## 2.3 Workshops and Meetings

### 2.3.1 Year 1: (October 2006 – September 2007)

#### 2.3.1.1 TERENA NRENS and GRID Workshop

TERENA NRENS and GRID workshop brings together researchers from academia and industry involved in Grid projects to discuss and evaluate the implications of Grid Services on network provisioning. The workshop, through the discussions, aims to highlight common issues for these communities and to seek agreements and recommendations.

The conference took place on 6<sup>th</sup> – 7<sup>th</sup> December 2006 in Amsterdam, Netherlands. A second workshop took place on the 11-12<sup>th</sup> June 2007 in Paris, France. FHG were representatives from PHOSPHORUS at the workshop.

More information on the TERENA NRENS and GRID workshop can be obtained online at <http://www.terena.org/activities/nrens-n-grids/>

#### 2.3.1.2 Collaboration of Three Continents Meeting

G-Lambda, PHOSPHORUS and EnLIGHTened Computing research teams met together to formulate an action plan for collaboration of optical networks and grid middleware across three continents. The collaboration was hosted by MCNC and was attended by videoconference by NSF in Washington DC; Bonn, Germany; Barcelona Spain and Pisa, Italy. The conference took place at Research Triangle Park, USA, from 31 January – 2 February 2007 and there the PHOSPHORUS project provided the following list of presentations:

- A Binczewski “PHOSPHORUS Introduction and Strategy” Presentation, **PSNC**
- M Garstka “Overview of PHOSPHORUS Testbeds and Grid Resources”, Presentation, **PSNC**

More information can be found at <http://www.mcnc.org/events/continentalcollaboration/>

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



### 2.3.1.3 GLIF meeting and Internet2 Joint Tech

Established in Iceland in 2003, GLIF, the Global Lambda Integrated Facility, is an international virtual organisation that promotes the paradigm of lambda networking. Its participants include National Research and Education Networks (NRENs), consortia and institutions working with lambdas. Each year, it organises a LambdaGrid workshop as a platform for engineers, managers, researchers and developers to share experiences and discuss issues related to optical networking. The winter working group meeting took place from 14 – 15 February 2007 in Minnesota, USA with PHOSPHORUS represented with the following presentation:

- R. van der Pol, “Lightpath monitoring in NetherLight” Presentation, **SARA**

More information can be found <http://www.glif.is/meetings/2007/winter/>

### 2.3.1.4 Jülich - Karlsruhe Colloquium on Grid Computing

PHOSPHORUS was represented at the Jülich - Karlsruhe Colloquium on Grid Computing by giving a presentation on the 22<sup>nd</sup> of May 2007. The presentation was given by the following partners:

- T. Eickermann, “Network Research and Provisioning - Current and future projects of ZAM”, Presentation, **FZJ**

### 2.3.1.5 IEEE Workshop on Policies for Distributed Systems and Networks (POLICY)

Established in 1999, the POLICY series of workshops that present a stage for leading researchers and industry experts to get together and discuss problems, solutions and experiences in developing policy-based systems. In 2007, the workshop focused on the Semantic web and the effect of applying semantic web policy frameworks to various applications. The POLICY conference took place in Bologna, Italy, from 13-15 June 2007. PHOSPHORUS was represented with:

- Y. Demchenko, L. Gommans, C. de Laat, “Using SAML and XACML for Complex Resource Provisioning in Grid based Applications”, Paper, UvA.

More information on the conference can be found at <http://lia.deis.unibo.it/confs/policy2007/>

### 2.3.1.6 First International Workshop on GRID over Optical Burst Switching Networks (GOBS2007)

Grids offer a uniform interface to a distributed collection of heterogeneous computational, storage and network resources. Optical burst switching enables these features while offering the necessary network flexibility demanded by future Grid applications. The first GOBS workshop was held in 2007 and brought together practitioners and researchers for discussion and work on further development, deployment and validation of Grid applications. In addition work on the emerging aspects pertaining to advanced techniques, platforms,

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



paradigms, theories, and techniques for designing and deployment of Grid over optical burst switching networks was discussed. The conference took place in Athens, Greece, from 19 - 25 June 2007 as part of the ICNS2007 with the following paper by PHOSPHORUS:

- G. Zervas, R. Nejabati, D. Simeonidou, "Grid-empowered Optical Burst Switched Network: Architecture, Protocols and Testbed", Paper, **University of Essex**.
- M. De Leenheer, C. Develder, F. De Turck, B. Dhoedt, P. Demeester, "Erlang Reduced Load Model for Optical Burst Switched Grids", Paper, **IBBT**.

The paper can be accessed from <http://users.atlantis.ugent.be/mdleenhe/pdf/erlang-gobs0z7.pdf>

More information on GOBS 2007 be found at <http://www.iaria.org/conferences2007/GOBS.html>

### 2.3.1.7 2<sup>nd</sup> OpenNet Workshop

The 2<sup>nd</sup> OpenNet Workshop took place in Nice, France, on July 4<sup>th</sup>, 2007. Its main purpose was to initiate and steer a discussion on the opportunity to federate a number of test-beds from running or completed EU-funded projects (mainly from FP6), around a number of agreed research topics. The workshop was centred on a two level set of presentations and following discussion:

- Research topics targeted by a number of EU-funded projects (among others: OpenNet, NetQoS, EuQoS, PHOSPHORUS)
- Research test-bed and experimental platforms available, and opportunity and challenges in their clustering.

PHOSPHORUS was represented with the following paper:

- N. Ciulli, G. Carrozzo, "PHOSPHORUS: introduction and considerations on test-beds federation", Paper, **Nextworks**

Details of the workshop can be seen at <http://www.ist-opennet.eu/events.php?idevent=6>.

### 2.3.1.8 CoreGRID Symposium

The CoreGRID Symposium aims at being the premiere European event on Grid Computing for the dissemination of the results from European and member states initiatives as well as other international projects in Grid research and technologies. It is organized jointly with the Euro-Par 2007 conference. The CoreGRID Symposium will focus on all aspects of Grid computing including service infrastructures and as such will bring together participants from Research and Industry. The conference took place in Rennes, France, from August 27 - 28 2007.

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



PHOSPHORUS was represented by contributing two papers. One paper is part of the CoreGRID Series, "Towards Next Generation Grids". The other was for the CoreGRID Workshop on Grid Programming Model, Grid and P2P Systems Architecture, Grid Systems, Tools and Environments. They were contributed by the following partners.

- C Barz, M Pilz, O. Wäldrich, W. Ziegler, T. Eickermann, L. Westphal, "Co-Allocating Compute and Network Resources - Bandwidth on Demand in the VIOLA Testbed", Paper, **University of Bonn, SCAI/FHG, FZJ**
- P Kokkinos, E Varvarigos, "Resources Configurations for providing Quality of Service in Grid Computing", Paper, **RACI**.

Details of the conference can be found at <http://www.coregrid.net/>

### 2.3.1.9 *Networks for IT: A new Opportunity for Optical Network Technologies Workshop @ ECOC'07*

University of Essex, Ghent University-IBBT and Athens Information Technology collaborated to co-organise a workshop at ECOC'07. The workshop, "Networks for IT: A new opportunity for optical network technologies" was co-organised with e-Photon-One. It was chaired by Dimitra Simeonidou ([dsimeo@essex.ac.uk](mailto:dsimeo@essex.ac.uk)) of University of Essex. Co-chairs for the event were Mario Pickavet ([mario.pickavet@intec.ugent.be](mailto:mario.pickavet@intec.ugent.be)), Ghent University – IBBT, Anna Tzanakaki, ([atza@ait.edu.gr](mailto:atza@ait.edu.gr)), Athens Information Technology and Ioannis Tomkos, ([itomkos@ait.edu.gr](mailto:itomkos@ait.edu.gr)), Athens Information Technology.

The workshops stemmed from the well known realization that networks increasingly deal with managing and adapting distributed computing and associated data management resources (PCs, servers, supercomputers, clusters) and storage systems. Due to potentially very high aggregated demands for networked IT, a paradigm shift in the optical network architecture may be needed to enable dynamic and distributed IT services at large scale. This workshop offered a unique opportunity for optical network researchers and practitioners to exchange ideas and experiences on problems, challenges, solutions and future research and development issues concerning the deployment of optical networks for providing IT services. In addition to invited paper presentations, the workshop provided an intimate setting for discussion and debate.

The agenda and a summary of the workshop can be found in a special section on the PHOSPHORUS website at [http://www.ist-phosphorus.eu/event\\_03.php](http://www.ist-phosphorus.eu/event_03.php)

More information on the Network for IT workshop at ECOC'07 can be obtained online at [http://www.vde.com/Conferences\\_en/ECOC+2007/Workshops/](http://www.vde.com/Conferences_en/ECOC+2007/Workshops/)

More information on ECOC'07 can be obtained online at <http://www.ecocexhibition.com/modules/serve.cgi>

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3





### 2.3.1.10 GLIF Technical Working Group Meeting (GLIF'07)

Established in Iceland in 2003, GLIF, the Global Lambda Integrated Facility, is an international virtual organisation that promotes the paradigm of lambda networking. Its participants include National Research and Education Networks (NRENs), consortia and institutions working with lambdas. Each year, it organises a LambdaGrid workshop as a platform for engineers, managers, researchers and developers to share experiences and discuss issues related to optical networking. This year the GLIF technical working group meeting workshop, it was held in Prague, Czech Republic on 17-18 September 2007. PHOSPHORUS was represented by giving the following presentations:

- Artur Binczewski, "The infrastructure of the PHOSPHORUS project", Presentation, **PSNC**
- R. van der Pol "TL1-Toolkit", Presentation, **SARA**.
- R. van der Pol "Interdomain Monitoring Requirements", Presentation, **SARA**.
- R. van der Pol "Experiences with the ordering and fault resolution process for multi-domain Lightpaths across hybrid networks", Presentation, **SARA**.
- L. Gommas, "GMPLS token mechanisms" Presentation **UvA**
- I. Monga, B. Peeters, "PHOSPHORUS and Dragon methods of interdomain path setup" Presentation **Nortel, SURFnet**

Open discussions about networks control planes architectures in different projects from Europe, North America and Asia were the very interesting part of GLIF meeting.

More information on GLIF'07 can be obtained online at <http://www.ces.net/glif2007/> and <http://www.glif.is>

### 2.3.1.11 CEF Network Workshop (CEF'07)

The CEF Workshop recognizes the growing discipline of the Customer Empowered Networks and provides a platform for the exchange of experience and to support further effort in deployment of the Customer Empowered Networks concept. This year, it was held in Prague, Czech Republic on 19-20 September 2007. PHOSPHORUS was represented at CEF'07 with:

- R. van der Pol, "Lightpaths monitoring in SURFnet6 and NetherLight" Presentation **SARA**
- R. van der Pol, A. Toonk, "Lightpath Planning and Monitoring Tool", Poster **SARA**

More information on CEF'07 can be obtained online at <http://www.ces.net/doc/seminars/cef2007/>



## 2.3.2 Year 2 (October 2007 – September 2008)

### 2.3.2.1 Open Grid Forum (OGF)

The Open Grid Forum (OGF) is a community of users, developers, and vendors that aim to accelerate GRID adoption by providing an open forum for grid innovation and developing open standards for grid software interoperability. The OGF is currently leading the global standardization effort for grid computing. The OGF community consists of thousands of individuals in industry and research, representing over 400 organizations in more than 50 countries ([http://www.ogf.org/About/abt\\_overview.php](http://www.ogf.org/About/abt_overview.php)).

**OGF21** took place on October 15 – 19 2007 in Seattle, USA.

The GRAAP session was chaired by FHG. FHG participated in GSA-RG, JSDL-WG, RSS-WG, NML-WG sessions. They were joined with UvA members at GHPN session.

**OGF22** took place in Boston, USA from 25 – 29 February 2008. The GHPN-RG, NML-WG and FI-RG sessions were chaired by UvA. UEssex co-chaired the GHPN-RG session.

- The GUNI draft was presented by University of Essex. The GUNI document suggests a set of functionalities for a Grid Optical User Network Interface (G.OUNI) to serve distributed heterogeneous, dynamic Grid network environments.

### 2.3.2.2 4<sup>th</sup> Concertation meeting on e-Infrastructure

The 4<sup>th</sup> Concertation Meeting on e-infrastructure was held in ETSI Headquarters at Sophia Antipolis (France) on Dec. 5<sup>th</sup>-6<sup>th</sup> 2007. The meeting was focused on the standardization issues identified by EC-funded research projects and the Phosphorus project promoted its standardization efforts for 2007 and plans for 2008.

NXW represented the PHOSPHORUS project.

More information can be accessed by visiting the link below:

<http://www.etsi.org/WebSite/NewsandEvents/ECConcertation/ECConcertationDaysHome.aspx>

### 2.3.2.3 CINEGRID Meeting

The CineGrid meeting took place from December 2 – 5 2007.

UvA represented PHOSPHORUS by participating in the CineGrid meeting in San Diego and organised working groups in which they presented networking tutorials and tutorials on grid and networks for CineGrid.

- C. de Laat "CineGrid Grids & Networking", Presentation UvA

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



- C. de Laat "CineGrid Working Groups Intro", [Presentation UvA](#)
- C. de Laat "CineGrid Networking.", [Presentation UvA](#)

The talks can be found on [www.science.uva.nl/~delaat](http://www.science.uva.nl/~delaat)

More information about CineGrid can be found on their website: <http://www.cinegrid.org/>

#### 2.3.2.4 GN2 Technical Workshop

The 5<sup>th</sup> GN2 Technical Workshop took place in Rome (Italy) on Jan. 23<sup>rd</sup> 2008.

NXW represented PHOSPHORUS by participating in the workshop. A dedicated meeting between PHOSPHORUS WP2 team and GN2-AutoBAHN team took place with the main objective to discuss the architectural approaches and solutions for the interoperation of G<sup>2</sup>MPLS and AutoBAHN. As a result of this meeting, many commonalities in terms of procedures and models were found between the two systems and a preliminary solution of interoperability between AutoBAHN and G<sup>2</sup>MPLS domains has been sketched.

#### 2.3.2.5 Workshop on High Performance Grid Networks

The Workshop on High Performance Grid Networks took place in Lyon, France in May 2008. The main objective of the workshop was to discuss and work on the emerging aspects related to advanced techniques, platforms, paradigms and models for the design, deployment and usage of high performance Grid networks. The workshop was co-supported by PHOSPHORUS and co-located with CCGRID2008.

PHOSHPORUS partners presented the following paper:

- Christoph Barz, Markus Pilz, Andre Wichmann, "Temporal Routing Metrics for Networks with Advance Reservations" Workshop on High Performance Grid Networks, co-located with CCGrid, May 2008

More information about the workshop can be found here: <http://hpng.intec.ugent.be/index.php>

#### 2.3.2.6 DFN-Forum

DFN – Deutsches Forschungsnetz – is Germany's National Research and Education Network. It provides a high-performance infrastructure for the German Research and Education Community. DFN connects universities and research institutions and supports the development of innovative applications. Since 2006 the national backbone of DFN is the X-WiN. Being connected to the European Backbone GÉANT, X-WiN is an integral part of the worldwide community of research and education networks. Based on contracts and peering agreements X-WiN is connected to the Global Internet as well.

The X-WiN is operated by the DFN-Verein (Verein zur Förderung eines Deutschen Forschungsnetzes e.V.) which guarantees its further use and development. DFN-Verein is a non-profit association established by

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



research, development and education sector in Germany to promote computer-based communication and information services.

The 1st DFN-Forum for Communication Technologies is meant as a platform for the discussion of recent research and development activities in the field of new network infrastructure, Grid-Technologies. It was held in Germany, May 2008

- Christoph Barz, Uli Bornhauser, Peter Martini, Christian de Waal, Alexander Willner,, "ARGON: Reservation in Grid-enabled Networks", Paper, **UniBonn**

#### **2.3.2.7 Third International Workshop on Guaranteed Optical Service Provisioning**

The GOSP '08 workshop took place in London, United Kingdom, from 8 – 11 September 2008 as part of the BROADNETS 2008 conference with the following paper by PHOSPHORUS:

- George Markidis and Anna Tzanakaki, "Routing and wavelength assignment algorithms in survivable WDM networks under physical layer constraints", Paper. **AIT**

More information on GOSP 2008 be found at <http://www.wgosp.org/>

#### **2.3.2.8 TERENA Task Force on European Middleware Coordination and Collaboration (TF-EMC2)**

The goal of TF-EMC2 is to promote the development and deployment of open and interoperable middleware infrastructures among national and regional research and education networking organisations and academic and research institutions. In 2008, TF-EMC2 was held in December 2008. PHOSPHORUS partners participated with:

- Y. Demchenko, "XACML-Grid and XACML-NRP Attributes and Policy Profiles and Policy Obligations Handling", Presentation **UvA**.

More information on TF-EMC2 be found at <http://www.terena.org/activities/tf-emc2/>

#### **2.3.2.9 International Workshop on Middleware for Grid Computing (MGC 2008)**

The MGC conference acts as a platform to bring together researches in middleware, and categorized into three tracks. Applications; Conceptual Views/Theory; and Development Techniques-Technologies. In 2008, the conference was held in Leuven, Belgium from 1-5 December 2008. The workshop was held in conjunction with the International Middleware Conference 2008. PHOSPHORUS partners contributed to the workshop by presenting the following papers:

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



- Y. Demchenko, C. de Laat, O. Koeroo, H. Sagehaug, "Extending XACML Authorisation Model to Support Policy Obligations Handling in Distributed Applications", 6th International Workshop on Middleware for Grid Computing (MGC 2008), December 2008.

More information can be found at <http://mgc2008.lncc.br/>

### 2.3.2.10 *Spanish Network of Excellence*

The Spanish Network of Excellence meeting was held in Vilanova I la Geltrú, Spain. PHOSPHORUS partners contributed to the workshop by presenting the following papers:

- S. Figueurola "i2CAT networking expertise in the Phosphorus project", Presentation, **i2CAT**.

### 2.3.2.11 *Workshop on Collaboration and Security (COLSEC'09)*

COLSEC 09 was held as part of the 2009 International Symposium on Collaborative Technologies and Systems (CTS'09). Its aim was to foster closer interactions among researchers and users communities, providing an excellent opportunity for them to meet and discuss their ideas. It addressed specifically relationships between collaborative systems and security. COLSEC 09 was held in Maryland, USA from 18- 22 May 2009.

The following paper was presented by PHOSPHORUS partners:

- Demchenko, Y., C. de Laat, T. Denys, C. Toinard, "Authorisation Session Management in On-Demand Resource Provisioning in Collaborative Applications". Paper **Uva**.

## 2.4 **Conferences**

### 2.4.1 **Year 1 (October 2006 – September 2007)**

#### 2.4.1.1 *International Conference on Optical Burst/Packet Switched Networks (WOBS06)*

Since 2003, the International Workshop for Optical Burst Switching (WOBS) has been an event bringing together leading researchers in Optical Burst and Packet Switching and related technologies. It provides a forum to address and fostering the exchange and discussion of ideas and visions related to design, implementation and application issues. It thus contributes to the advancement, development and awareness of OBS within the telecommunication and networking industry as a practical architecture for next-generation of optical networks.

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



The conference took place at San Jose, USA, on October 2, 2006 and the PHOSPHORUS project provided the paper:

- D. Simeonidou, G. Zervas, R. Nejabati "Design considerations for photonic routers supporting application-driven bandwidth reservations at sub-wavelength granularity" Paper, **University of Essex**

More information can be found at <http://www.obsmeeting.org/2006/cfp.shtml>

#### **2.4.1.2 IEEE/IFIP International Workshop on Autonomic Grid Networking and Management (AGNM2006)**

AGNM 2006 was a one-day workshop that offered a unique opportunity for researchers and practitioners to exchange ideas and experiences on problems, challenges, solutions and potential future research and development issues in this new field of Autonomic Grid Networking and Management. In addition to paper presentations, the workshop provided an intimate setting for discussion and debate through panels and group work. The conference took place in Dublin Ireland, from 26 – 27 October 2006.

The PHOSPHORUS project provided the following paper.

- N Ciulli, G Carrozzo, "Making sense of Grid on IP Control Plane" Paper, **Nextworks**

#### **Summary on the Outcome of the Workshop**

The presentation was carried out in the panel of Technical Session 5 "Making sense of Grid on IP Control Plane"). The panel was chaired by Wayne Clark (Cisco Systems), and was organized as a debate among three different points of view about the main statement: "*do we really need a Control Plane for Grid applications*"?

The three panelists were selected in order to express different viewpoints with respect to that statement:

- Nicola Ciulli (Nextworks) expressed a strong positive position in favour of the need of an evolved, intelligent Control Plane to make Grid services manageable and operational for research and commercial services;
- Michael Welzl (University of Innsbruck) positioned at the very opposite end and stated that, with a number of assumptions (e.g. overprovisioning of transport plane resources) networks can support any advanced service or application (e.g. Grids) without the need of any intelligence for dynamic service provisioning;
- Rama Ati (Cisco Systems) tried to support an intermediate point of view, and provided an insight of current related activities in Cisco, which were very much in line with Control Plane architectures and modules.

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3





The three panel presentation generated a very lively discussion soon after, which extended for nearly 1 hour, up to the end of the session (which coincided with the overall end of AGNM'06); in other words, the discussion had to be closed mainly due to time limits.

A very large part of the audience (20+ people) intervened in the discussion and expressed their positions, most of which agreed that some form of Control Plane intelligence is actually needed for any kind of application service, and Grids in particular. The positions diverged on the role and "power" to be attributed to the Control Plane: either an overall controller/enabler of any transaction involved in the specific application (some even introduced the extreme idea of a "Peer-to-peer GMPLS" beyond the "Grid-GMPLS" in PHOSPHORUS), or just a controller of the transport network resources involved.

More information can be found at <http://www.manweek2006.org/agnm/agnm.php>

#### **2.4.1.3 Optical Fibre Communication Conference and Exposition and the National Fibre Optic Engineers Conference (OFC/NFOEC07)**

OFC/NFOEC is the largest conference and exhibition event in the Optical Communications and Networking community. It brings together international experts from industry and academia to discuss and demonstrate their research activities and ideas. It includes live demonstrations, interactive displays, news in the making and the opportunity to talk to the experts. The conference took place from 25 - 29 March 2007 in Anaheim, California, USA. PHOSPHORUS was represented by the following with:

- G Zervas, R Nejabati, Z Wang, D Simeonidou, S Yu, M O'Mahony, "A Fully Functional Application-Aware Optical Burst Switched Network Test-Bed" Paper, **University of Essex**
- D Simeonidou, R Nejabati, G Zervas "Optical Networks Supporting IT Services" Presentation, **University of Essex**

More information can be found at [http://www.ofcnfoec.org/about\\_ofc/Archive/OFC\\_NFOEC\\_2007.aspx](http://www.ofcnfoec.org/about_ofc/Archive/OFC_NFOEC_2007.aspx) and <http://cse.buffallo.edu/~qiao/workshop/FON2/>

#### **2.4.1.4 The Second International Conference on Availability, Reliability and Security (ARES 2007)**

The objective of the Second International Conference on Availability, Reliability and Security (ARES 2007) is to provide a platform for researches to discuss issues of dependability as an integrative concept that covers amongst others availability, safety, confidentiality, integrity, maintainability and security in the different fields of applications. It also provides a facility for the researchers to critically research and examine the challenges of the various aspects of Dependable Computing and the definition of a future road map.

The conference took place from 10-13 April 2007 in Vienna, Austria. With representation by PHOSPHORUS:

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



- Y. Demchenko, L. Gommans, C. de Laat, “Using SAML and XACML for Complex Authorisation Scenarios in Dynamic Resource Provisioning” Paper, **UvA**

More information can be found at <http://www.ares-conference.eu/>

#### 2.4.1.5 German E-Science Conference (GES2007)

The German national e-Science framework is a German Ministry of Education and Research funded framework. It aims to provide coordination and collaboration between different research areas which are involved and interested in e-Science. It creates a forum, the German e-Science Conference (GES), for partners of the German e-Science community to present their results on Grid computing, knowledge networking, e-Learning and open access. GES achieves this through a series of talks, posters and by demos. GES 2007 was held from 2 – 4 May 2007 in Baden-Baden Germany with the following paper published by PHOSPHORUS:

- Riedel, M.; Frings, W.; Dominiczak, S.; Eickermann, T.; Düssel, T.; Gibbon, P.; Mallmann, D.; Wolf F.; Schiffmann, W. “Requirements and Design of a Collaborative Online Visualization and Steering Framework for Grid and e-Science infrastructures” Paper **FZJ**
- T. Eickermann, W. Frings, O. Wäldrich, P. Wieder, W. Ziegler, “Co-allocation of MPI Jobs with the VIOLA Grid MetaScheduling Framework” Paper, **FHG**

More information can be found at <http://www.ges2007.de/papers/>

#### 2.4.1.6 IEEE International Symposium on Cluster Computing and the Grid (CCGrid '07)

The CCGrid series of conference has been part of the effort in the realization of Grid Computing and its promise to deliver unprecedented levels of parallelism to high-performance applications by crossing administrative boundaries. The CCGrid Symposia acts as a platform to bring together researchers and practitioners. It enables them to share their insight, results, and experience in the multi-faceted areas of Grid and Cluster computing. CCGRID2007 was the first of the series to be held in South America and took place in Rio de Janeiro, Brazil from 14 – 17 May 2007 with the following paper published by PHOSPHORUS

- Michael Oikonomakos, Kostas Christodoulopoulos, Emmanouel Varvarigos, “Profiling Computation Jobs in Grid Systems” Paper, **RACIT**

More information can be found at <http://ccgrid07.incc.br/>

#### 2.4.1.7 IFIP - International Conference on Networking 2007

Networking 2007 is one of the conferences sponsored by the IFIP Technical Committee on Communication Systems. Networking 2007 aimed at providing a platform for researchers and industry experts to discuss recent advances in the broad and fast-evolving field of telecommunications. It accomplished this by means of series of

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



technical sessions, keynote talks and tutorials offered by invited experts. It aimed to also highlight key-issues, identify trends and refresh vision in the field of telecommunications.

IFIP 2007 conference took place from 14 – 18 May 2007 in Atlanta, GA, USA. The following paper was presented by PHOSPHORUS

- M. Cristea, L. Gommans, L. Xu, H. Bos, “ The Token Based Switch: Per-Packet Access Authorisation to Optical Shortcuts” Paper **UvA**

More information can be found at <http://networking2007.uncc.edu/>

#### 2.4.1.8 TERENA Networking Conference 2007

The TERENA Networking Conference is the EU organization in the forefront of Internet development. TERENA brings together NRENs from across Europe to exchange information between themselves and with representatives from industry, academia, research institutions and the government. The TERENA Networking Conference 2007 was held in Lyngby, Denmark from May 21-24, 2007. PHOSPHORUS was represented at TERENA Networking Conference 2007 by the following presentations:

- R. van der Pol, “Lightpaths monitoring in SURFnet6 and NetherLight” Presentation, SARA.
- R. van der Pol, A. Toonk, “Lightpath Planning and Monitoring Tool”, Poster, SARA.

More information on the Terena 2007 can be obtained online at <http://tnc2007.terena.org/>

#### 2.4.1.9 Optical Networks Design and Modelling (ONDM2007)

The ONDM conference is a series of conference that covers all aspects of optical networking. In particular it covers the recent advanced in the design, modeling and implementation. It brings together invited experts from industry and academia from around the world to present and discuss their view and research work. The conference took place in Athens, Greece, from 29 - 31 May 2007. The following papers from PHOSPHORUS:

- K. Christodouloupoulos, M. Varvarigos, C. Develder, M. De Leenheer, B. Dhoedt, “Job Demand Models for Optical Grid Research”, Paper, **RACTI, IBBT**  
The paper can be accessed from <http://users.atlantis.ugent.be/mdleenhe/pdf/jobdemands-ondm07.pdf>
- G. Markidis, S. Sygletos, A. Tzanakaki, I. Tomkos, “Job Impairment Aware based Routing and Wavelength Assignment in Transparent Long Haul Networks”, Paper, **AIT**

More information can be found at <http://www.ondm2007.gr/pdf/Program.pdf>



#### 2.4.1.10 *RELARN 2007*

The RELARN 2007 conference took place from 6 – 9 June 2007 in Nizhny Novgorod – Moscow. PHOSPHORUS was represented by the following partner.

- Y. Demchenko, K. Wierenga, “Modern Technologies of the Federated Access to Research and Education Networks (Russian) (“Современные Технологии Федеративного Доступа к Ресурсам Научных и Университетских Сетей”)", Paper, **UvA**

More information can be found at [http://www.relarn.ru/conf/conf2007/list\\_tez.html](http://www.relarn.ru/conf/conf2007/list_tez.html)

#### 2.4.1.11 *International Conference on Networking and Services (ICNS2007)*

The International Conference on Networking and Services is a series of conferences that covers fundamentals on networking and services, and highlights new challenging industrial and research topics. These topics include Ubiquitous services, GRID networks and service and next generation networks. The ICNS2007 was held in June from the 19<sup>th</sup> – 25<sup>th</sup> in Athens, Greece. The paper was presented by PHOSPHORUS:

- K. Christodouloupoulos, V. Gkamas, E. Varvarigos, “Delay Components of Job Processing in a Grid: Statistical Analysis and Modelling”, Paper, **RACTI**

More information can be found at <http://www.iaria.org/conferences2007/ICNS07.html>

#### 2.4.1.12 *The International Conference on the Optical Internet and the Australian Conference on Optical Fibre Technology (COINT-ACOFT2007)*

The COIN-ACOFT International conference provides a platform for practitioners and researchers in academia and industry to partake in the discussion and development of physical layer photonic hardware, networking and traffic engineering technologies. COIN-ACOFT2007 was held in Melbourne, Australia from 24-27 June 2007. PHOSPHORUS presented the following paper:

- C. Develder, M. De Leenheer, T. Stevens, B. Dhoedt, F. De Turck, P. Demeester, “Scheduling in Optical Grids: A Dimensioning Point of View”, Paper, **IBBT**

More information can be found at <http://www.coinacoft2007.com.au/index.php>

#### 2.4.1.13 *International Conference on Transparent Optical Networks (ICTON 2007)*

Since its inception in 1999, ICTON has been an aggregative element worldwide in the area of Telecommunications. During these nine years the emerging trends in optical networks and next generation

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



services facilitating technologies have been included in the conferences and now ICTON topics cover all fields composing Transparent Networks, from the backbone to distribution/access network up to the End User.

Every year hundreds of leading researchers in the scientific educational and industrial participate in the conference. The scope of the Conference is concentrated on the applications of transparent and all-optical technologies in broadband telecommunication networks, systems and components. The technical areas covered are intended to monitor the technology, theory, and modelling advances within the field with emphasis on optical signal processing for telecommunication applications; review the progress in all-optical switching and routing devices, networking aspects, and traffic engineering and address the convergence of wireless and optical communication technologies for next-generation networks and services. The conference took place in Rome, Italy from 1-5 July 2007 and PHOSPHORUS presented the following paper:

- G. Markidis, A.Tzanakaki, N. Ciulli, G. Carrozzo, D.Simeonidou, R. Nejabati, G. Zervas, “EU Integrated Project PHOSPHORUS: Grid-GMPLS Control Plane for the Support of Grid Network Services”, Paper, **AIT, Nextworks, University of Essex**

More information can be found at <http://www.itl.waw.pl/konf/icton/2007/invited.html>

#### 2.4.1.14 *IEEE International Conference on Broadband Communication, Networks and Systems (BROADNETS2007)*

IEEE BROADNETS 2007 is an international conference focusing on broadband communications, networks, and systems. It covers the entire range of next generation networks, communications systems, applications and services including wireless and optical communications, networking and systems as well as theory and algorithms of networking. The conference took place in Raleigh, North Carolina USA, from 10 – 14 September 2007. PHOSPHORUS was represented by:

- M. De Leenheer, C. Develder, B. Dhoedt, M. Pickavet, P. Demeester, “Design and Control of Optical Grid Networks”, Paper, **IBBT**.

The paper can be accessed from <http://users.atlantis.ugent.be/mdleenhe/pdf/ogrid-broadnets07.pdf>

More information on BROADNETS can be found at <http://www.broadnets.org/2007/index.html>

#### 2.4.1.15 *European Conference and Exhibition on Optical Communication'07 (ECOC'07)*

The ECOC is the largest conference on optical communication in Europe, and one of the most respected and long-standing events of its kind in the world. In 2007, the conference took place at Berlin, Germany, from 16-20 September 2007 with PHOSPHORUS presence:

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



- A. Binczewski, "The PHOSPHORUS project - new face of bandwidth on demand services", Presentation **PSNC**.
- C. Develder, M. De Leenheer, B. Dhoedt, "Evaluation of Optical Grid Scheduling Through Dimensioning", Paper, **IBBT**

More information can be found at <http://www.ecocexhibition.com/modules/serve.cgi>

## 2.4.2 Year 2 (October 2007 – September 2008)

### 2.4.2.1 Enabling Grids with E-Science (EGEE2007)

EGEE'07 is a prestigious conference for the international Grid user community. It provides a platform for its attendees to share insight, results, and experiences in the multi-faceted areas of world-class Grid technologies and collaborate with different community users and related projects. EGEE 2007 took place from 1-5 October 2007 in Budapest, Hungary. PHOSPHORUS was presented two posters:

- Kostas Christodouloupoulos, Emmanouel Varvarigos, "Statistical analysis of the workload and modeling of the time a job spends at different states in the EGEE environment", Poster **RACI**
- Panagiotis Kokkinos, Kostas Koumantaros, Emmanouel Varvarigos, "A Framework for Providing Hard Delay Guarantees in the EGEE", Poster **RACI**.

More information can be found <http://www.eu-egee.org/egee07/home.html>

### 2.4.2.2 IEEE Local Computer Networks Conference (LCN2007)

As one of the networking industry's oldest, continuously running conferences. The LCN2007 is the 32<sup>nd</sup> meeting in the series and focuses on practical, leading-edge applications and research in the area of computer networks. It has an informal, workshop-style atmosphere, offering significant opportunity for international speakers, panellists, and attendees from industry and academia to spend unstructured time together. LCN2007 was held on 16 October 2007 in Dublin, Ireland. PHOSPHORUS was represented by the following partners with:

- C. Barz, P. Martini, M. Pilz, F. Purnhagen, "Experiments on Network Services for the Grid", Paper **University of Bonn**.
- T. Stevens, J. Vermeir, M. De Leenheer, C. Develder, F. De Turck, B. Dhoedt, P. Demeester, "Distributed Service Provisioning Using Stateful Anycast Communications", Paper, **IBBT**.

More information can be found at <http://www.ieeeln.org/>

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3





### 2.4.2.3 GridNets 2007

This year the GridNets conference was held in Lyon France from 19 – 20 October 2007. The GridNets conference provides a focused and highly interactive forum where researchers and technologists have the opportunity to present and discuss leading research, developments, and future directions in the Grid networking area. PHOSPHORUS was represented by presentations authored by the following partners at GridNets under the “Utility Computing enhanced with High Bit Rate networks: Opportunity and Requirements” workshop organized by CARRIOCAS project:

- D. Simeonidou, A. Binczewski, G. Zervas, “The IST PHOSPHORUS project: A new model for integrating applications and transport network resources”, Presentation **University of Essex, PSNC**.

More information can be found at <http://gridnets.org/2007/>

### 2.4.2.4 Asia-Pacific Optical Communications (APOC2007)

APOC is Asia’s premier conference in Optical Communications and the world’s third largest conference in the field of Optical Communications. It took place from 1-5 November 2007 in Wuhan, China. I2CAT, NXW, IBBT, UvA, FHG and PSNC represented PHOSPHORUS at APOC by presenting an invited paper. I2CAT gave the presentation on behalf of the PHOSPHORUS consortium about PHOSPHORUS on the scope of “Network Architecture, Management and Applications

More information on the conference can be found at <http://wnlo.hust.edu.cn/APOC-2007.htm>.

- S. Figuerola, N Ciullo, M de Leenheer, Y. Demchenko, W. Zielger, A. Binczewski, “PHOSPHORUS: Single-step on-demand services across multi-domain networks for e-science” Invited Paper, **I2CAT, NXW, IBBT, UvA, FHG, PSNC**

### 2.4.2.5 Supercomputing 2007 (SC07)

Supercomputing is the premier international conference on high performance computing, networking and storage. It explores ways in which high performance computing, networking, storage and analysis lead to advances in research, education and commerce. It took place on November 10-16 in Reno, USA. Further information is available at the events website <http://sc07.supercomputing.org/>.

PHOSPHORUS was represented by a presentation by UvA.

- C. de Laat " Beyond Hybrid Networking", Presentation **UvA**

The talk can be found on <http://staff.science.uva.nl/~delaat/talks/cdl-2007-10-24.pdf>

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



#### 2.4.2.6 *International Conference on e-Science and Grid Computing*

Serving as a platform for the presentation of results of the latest research and tools in e-science and Grid computing, the e-Science 2007 conference is designed to bring together developers and users of e-Science applications and enabling IT technologies from leading international and interdisciplinary research communities. In 2007, the conference was held in Bangalore, India from 10 – 13 December.

PHOSPHORUS was represented by a paper presentation by RACTI.

- P. Kokkinos, E. Varvarigos and N. Doulamis, “A Framework for Providing Hard Delay Guarantees in Grid Computing”, Paper RACTI

The talk can be found on <http://www.escience2007.org/index.asp>

#### 2.4.2.7 *Parallel and Distributed Computing and Networks 2008 (IASTED- PDCN)*

This conference acts as an international forum for researchers and practitioners interested in the advances in and applications of parallel and distributed computing and networks. It is part of the 26th IASTED International Multi-Conference on applied Informatics. The conference took place from 12 – 14 February 2008 in Innsbruck, Austria.

- Christoph Barz, Uli Bornhauser, Peter Martini, Markus Pilz, “Timeslot-based Resource Management in Grid Environments”, Paper UniBonn

More information can be found at <http://www.iasted.org/conferences/home-631.html>

#### 2.4.2.8 *Optical Fibre Communication Conference and Exposition and the National Fibre Optic Engineers Conference (OFC/NFOEC08)*

OFC/NFOEC 2008 took place from 24 – 28 February 2008 in San Diego, California, USA. PHOSPHORUS was represented by an Invited Paper which was presented by UEssex on behalf of the consortium.

- D Simeonidou, E Escalona, G Zervas, R Nejabati, S Spadaro, A Binczewski, G Carrozzo, N Ciulli “A Grid-Enabled Control Plane Architecture: The PHOSPHORUS Approach” Presentation, UEssex, PSNC, NxW

More information can be found at <http://www.ofcinfoec.org/>

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



#### 2.4.2.9 *International Conference on Transparent Optical Networks (ICTON 2008)*

The ICTON'08 conference took place in Athens, Greece from 22-26 June 2008 and PHOSHPORUS presented the following paper:

- K. Christodoulopoulos, E. Varvarigos, "Routing and Scheduling in Grids", invited paper **RACTI**.
- Anna Tzanakaki, George Markidis, Kostas Katrinis, Supporting differentiated survivability services in WDM optical networks, invited paper, **AIT**
- C. Develder, M. De Leenheer, T. Stevens, B. Dhoedt, G. Markidis and A. Tzanakaki, "Scalable Impairment-Aware Anycast Routing in Multi-Domain Optical Grid Networks", invited paper, **IBBT, AIT**

More information can be found at [http://www.itl.waw.pl/konf/icton/2008/invited\\_authors.html](http://www.itl.waw.pl/konf/icton/2008/invited_authors.html)

#### 2.4.2.10 *International Conference on Networking (ICN 2008)*

The ICN'08 conference took place in Cancun, Mexico from 13-18 April 2008 and PHOSHPORUS presented the following paper:

- Kyriaki Seklou, Emmanouel A. Varvarigos, "Fast Reservation Protocols for Latency Reduction in Optical Burst-Switched Networks Based on Predictions" Paper, **RACTI**

More information about the conference can be found at <http://www.iaria.org/conferences2008/ICN08.html>

#### 2.4.2.11 *IEEE International Symposium on Cluster Computing and the Grid (CCGrid '08)*

CCGRID2008 was the first of the series to be held in South America and took place in Lyon, France from 19 – 22 May 2008 with the following paper published by PHOSPHORUS:

- Kostas Christodoulopoulos, Nikolaos D. Doulamis, Emmanouel A. Varvarigos, "Joint Communication and Computation Task Scheduling in Grids" Paper, **RACTI**
- Panagiotis C. Kokkinos, Kostas Christodoulopoulos, A. Kretsis, Emmanouel A. Varvarigos, "Data Consolidation: A Task Scheduling and Data Migration Technique for Grid Networks" Paper, **RACTI**
- Eduard Escalona, Georgios Zervas, Reza Nejabati, Dimitra Simeonidou, George Markidis, Anna Tzanakaki, Gino Carrozzo, Nicola Ciulli, B Belter, Artur Binczewski. "Deployment and Interoperability of the Phosphorus Grid Enabled GMPLS (G2MPLS) Control Plane", Paper, **UEssex, AIT, NXW, PSNC**

More information can be found at <http://www.ens-lyon.fr/LIP/RESO/ccgrid2008/>

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



#### 2.4.2.12 *TERENA Networking Conference (TNC'08)*

TNC 08 was held in Bruges Belgium from 19 – 22 May 2008. The following presentations were given by PHOSPHORUS partners:

- Ignacio Martin Llorente, Ralph Koning, Damien Marchal, “Making GRID Applications happen” Presentation, **UvA**
- Bartosz Belter, Karen Whitaker, Freek Dijkstra “Matching Applications Requirements”, Presentation, **PSNC, UvA**
- Robin Arak, Dai Davies, Cees de Laat, Diego Lopez, Michael Nowlan, Ligia Ribeiro “GÉANT2 Exposed”, Presentation, **UvA**

More information can be found at <http://tnc2008.terena.org/>

#### 2.4.2.13 *Euro-Par 2008*

The Euro-par conference is dedicated to promoting the advancement of parallel and distributed computing. The objective of Euro-Par is to provide a platform through which industrial and academic participants can promote the development of parallel and distributed computing both as an industrial technique and an academic discipline, extending the frontier of both the state of the art and the state of the practice. The conference was held in Las Palmas de Gran Canaria (Spain) from 26 – 29 August 2008. PHOSPHORUS partners presented:

- Nikos Doulamis, Panagiotis Kokkinos, Emmanouel A. Varvarigos, “Spectral Clustering Scheduling Techniques for Tasks with Strict QoS Requirements” Paper, **RACTI**

More information can be found at <http://europar2008.caos.uab.es/>

#### 2.4.2.14 *International Conference on Distributed and Parallel Systems (DAPSYS '08)*

The International Conference on Distributed and Parallel Systems is an international biannual conference dedicated to all aspects of distributed and parallel computing. It provides a forum for researchers and academic to present their research in parallel and distributed computing including algorithms, models, software environments amongst others. In 2008, the conference was held in Debrecen, Hungary from 3-5 September 2008. At this conference, PHOSPHORUS partners contributed:

- Eleni Dafouli, Panagiotis Kokkinos, Emmanouel Varvarigos, “Fair Execution Time Estimation Scheduling in Computational Grids” Paper, **RACTI**

More information can be found at <http://www.lpds.sztaki.hu/dapsys/>



#### 2.4.2.15 *The IEEE/ACM International Conference on Grid Computing (Grid'08)*

Grid 2008 is an international conference addressed to members of the Grid community of researchers, developers, practitioners and users. The objective of the conference is to serve as both the premier venue for presenting foremost research results in the area and as a forum for introducing and exploring new concepts. In 2008, the conference was held in Tsukuba, Japan from 29 September – 1 October 2008. At this conference, PHOSPHORUS partners contributed:

- Demchenko Y, A. Wan, M. Cristea, C. de Laat, “Authorisation Infrastructure for On-Demand Network Resource Provisioning” Paper, **UvA**

More information can be found at <http://www.grid2008.org/>

#### 2.4.3 **Year 3 (October 2008 – June 2009)**

##### 2.4.3.1 *The IEEE International Conference on e-Science (e-Science'08)*

The e-Science 2008 conference is designed to bring together leading international and interdisciplinary research communities, developers, and users of e-Science applications and enabling IT technologies. The conference serves as a forum to present the results of the latest research and product/tool developments and to highlight related activities from around the world. The conference was held in Indiana, USA from 7-12 December 2008. PHOSPHORUS partners contributed the following paper:

- Yuri Demchenko, Cees de Laat, O. Koeroo, D. Groep, “Rethinking Grid Security Architecture” Paper, **UvA**

More information can be found at <http://escience2008.iu.edu/>

##### 2.4.3.2 *Optical Networks Modelling and Design (ONDM '09)*

ONDM was held Braunschweig, Germany, on February 18-20, 2009. PHOSPHORUS partners contributed the following paper:

- Chinwe Abosi, Reza Nejabati and Dimitra Simeonidou, “A Service Plane Architecture for Future Optical Internet” Poster **UESSEX**

More information can be found at <http://www.ida.ing.tu-bs.de/ondm2009/>

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



#### 2.4.3.3 Optical Fibre Communication Conference and Exposition and the National Fibre Optic Engineers Conference (OFC/NFOEC09)

OFC/NFOEC 2009 took place from 21 - 25 March 2009 in San Diego, California, USA. PHOSPHORUS was represented by the following papers.

- Kostas Georgakilas, George Markidis, Kostas Katrinis and Anna Tzanakaki, "Network Performance Improvement in Survivable WDM Networks under Physical Layer Constraints", Paper AIT
- Kostas Katrinis, Anna Tzanakaki and George Markidis, "Impairment-Aware WDM Network Dimensioning with Optimized Regenerator Placement", Paper AIT

More information can be found at <http://www.ofcnoec.org/>

#### 2.4.3.4 INGRID – Instrumenting the Grid

INGRID 2009 was held in Alghero, Sardegna, Italy, April 1-3 2009. The objective of this workshop is advancing the use of Grid technology for remote, collaborative instruments. In this context, the functionality of a grid architecture allows managing, maintaining and exploiting heterogeneous instrumentation and acquisition devices in a unified way, by providing standardized interfaces and common work environments to their users. This is achieved through the properties of isolation from the physical network and from the peculiarities of the instrumentation, granted by standard middleware, together with secure and flexible mechanisms to seek, access and aggregate distributed resources

A number of ongoing National and European projects are involved in the organization of this event. In particular, the EU-funded actions GRIDCC (<http://www.gridcc.org>) and RINGRID (<http://www.ringrid.eu>), and the National projects CRIMSON (<http://www.prin-crimson.org>) and VLAB (<http://vlab.psnc.pl>). The Workshop was structured in technical sessions, some of which have been organized by leading researchers in the field, and accommodated both invited and regular papers, selected on an open-call basis.

Wolfgang Ziegler (FHG) was invited to give a presentation in the Session "Enabling Quality of Service through Service Level Agreements". His talk "Networking SLAs: Traditional Approaches and Latest Developments" presented the approach for SLAs developed in the PHOSPHORUS project

#### 2.4.3.5 IEEE International Symposium on Cluster Computing and the Grid (CCGrid '09)

CCGRID2009 was the first of the series to be held in South America and took place in Shanghai, China from 18 – 21 May 2008 with the following paper published by PHOSPHORUS:

- P. Kokkinos, E. A. Varvarigos, "Resource Information Aggregation in Grid Networks", Paper, RACTI

More information can be found at <http://grid.sjtu.edu.cn/ccgrid2009/>

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3





#### 2.4.3.6 IFIP - International Conference on Networking 2009

IFIP Networking 2009 conference took place from 11-15 May 2009 in Aachen, Germany. The following paper was presented by PHOSPHORUS

- A. Willner, C. Barz, J.A. García-Espín, J. Ferrer-Riera, S. Figuerola, Harmony “Advance Reservations in Heterogeneous Multi-domain Environments” Paper, **UniBonn, I2CAT**.

More information can be found at <http://www.networking-2009.org/>

#### 2.4.3.7 International Conference on Transparent Optical Networks (ICTON 2009)

The ICTON'09 conference took place in Azores, Portugal from 28 June – 2 July 2009 and PHOSHPORUS presented the following paper:

- Sergi Figuerola, Joan A. García-Espín, Jordi Ferrer, and Alexander Willner: “Performance Analysis of Harmony, and Optical, Multi-domain Network Resource Broker”. Invited Paper, **I2CAT, UniBonn**.
- Anna Tzanakaki, Kostas Georgakilas and Kostas Katrinis, “Survivable services in WDM networks considering physical layer constraints”, Paper, **AIT**.
- Chinwe Abosi, Reza Nejabati and Dimitra Simeonidou: “Design and Development of a Semantic Information Modelling Framework for a Service Oriented Optical Internet”, Invited Paper, **UESSEX**

#### 2.4.3.8 IFIP/IEEE International Symposium on Integrated Network Management (IM 2009)

The IM series of conferences is held every odd-numbered years and has established itself as the main venue for original research in the area of management, operations and control of networks, networking services, networked applications, and distributed systems. IM 2009 was held on 1 - 5 June 2009 in New York, USA.

PHOSHPORUS partners presented the following paper:

- M. Cristea, R. Strijkers, D. Marchal, L. Gommans, C. de Laat, R. Meijer, "Supporting Communities in Programmable Grid Networks: gTBN", Paper, **UvA**



## 2.5 Journal Papers

The following Journal Papers have been authored by PHOSPHORUS partners:

### 2.5.1 Published

- C. Abosi, R. Nejabati, D. Simeonidou "A Novel Service Composition Mechanism for Future Optical Internet", Journal of Optical Communication & Networking, Vol. 1, Issue 2, pp. A106-A120 July 2009.
- P. Kokkinos, E. A. Varvarigos, "A Framework for Providing Hard Delay Guarantees and User Fairness in Grid Computing, Future Generation Computer Systems, Volume 25, Issue 6, June 2009, Pages 674-686
- M. De Leenheer, C. Develder, J. Buysse, B. Dhoedt, P. Demeester, "Performance Analysis and Dimensioning of Multi-Granular Optical Networks", Journal of Optical Switching and Networking Volume 6, Issue 2, April 2009, Pages 88-98
- P. Grosso, D. Marchal, J. Maassen, E. Bernier, C. Meertens, L. Xu, C. de Laat, "Dynamic Photonic Lightpaths in the StarPlane Network", Future Generation Computer System, Vol 25, Issue 2, February 2009, in press
- L. Smarr, M. Brown, C. de Laat, Editorial: "Special Section: OptIPlanet - The OptIPuter Global Collaboratory", Future Generation Computer System, Vol 25, Issue 2, February 2009, in press
- L.Gommans, L. Xu, F. Wan, Y. Demchenko, M. Cristea, R. Meijer, C. de Laat, "Multi-Domain Lightpath Authorization using Tokens", Future Generation Computer System, Vol 25, Issue 2, February 2009, in press
- F. Dijkstra, J. J van der Ham, P. Grosso, C. de Laat, "A Path Finding Implementation for Multi-Layer Networks", Future Generation Computer System, Vol 25, Issue 2, February 2009, in press
- G. Markidis and A. Tzanakaki, "Network Performance Improvement through Differentiated Survivability Services in WDM networks", Journal of Optical Networking, vol. 7, no 6, pp. 564-572, June 2008.
- Nicola Ciulli, Gino Carrozzo, Giodi Giorgi, Georgios Zervas, Eduard Escalona, Yixuan Qin, Reza Nejabati, Dimitra Simeonidou, Franco Callegati, Aldo Campi, Walter Cerroni, Bartosz Belter, Artur Binczewski, Maciej Strojnski, Anna Tzanakaki, George Markidis, "Architectural approaches for the integration of the service plane and control plane in optical networks", Optical Switching and Networking, issue 5, pp. 94-106, May 2008.



- G. Zervas, E. Escalona, R. Nejabati, D. Simeonidou, G. Carrozzo, N. Ciulli, B. Belter, A. Binczewski, M. Stroiński, A. Tzanakaki, G. Markidis, "Phosphorus Grid-enabled GMPLS Control Plane (G2MPLS): Architectures, Services and Interfaces". IEEE Communications Magazine under the Special call on "Multi-Domain Optical Networks: Issues and Challenges", May 2008
- K. Christodoulopoulos, V. Gkamas, E. Varvarigos, "Statistical Analysis and Modeling of Jobs in a Grid Environment", Springer Journal of Grid Computing, vol 6 No. 1, pp. 77 – 101 March 2008.
- E. Grasa, A. Lopez, Sergi Figuerola, Gabriel Junyent, Michel Savoie, "UCLPv2: A Network Virtualization Framework Built on Web Services", IEEE Communication Magazine, vol 46, no 3, pp. 126-134, March 2008
- B. Belter, A. Binczewski, G. Carrozzo, N. Ciulli, E. Escalona, G. Markidis, R. Nejabati, D. Simeonidou, M. Stroiński, A. Tzanakaki, G. Zervas, "Between GRIDs and Networks: GRID-enabled Network Control Planes" Campus-Wide Information Systems Journal, 2008.
- T. Stevens, M. De Leenheer, C. Develder, B. Dhoedt, K. Christodoulopoulos, P. Kokkinos, E. Varvarigos, "Multi-cost Job Routing and Scheduling in Grid Networks", Future Generation Computer Systems, Volume 25, Issue 8, September 2008, Pages 912-925
- E. Varvarigos, V. Sourlas, K. Christodoulopoulos, Routing and Scheduling Connections in Networks that Support Advance Reservations, in: Elsevier Computer Networks, volume 52, pages 2988-3006, 2008
- C. Develder, B. Dhoedt, B. Mukherjee, P. Demeester, "On Dimensioning Optical Grids and the Impact of Scheduling", published in Photonic Network Communications (online: <http://dx.doi.org/10.1007/s11107-008-0160-z>; print: to appear)
- T. Stevens, M. De Leenheer, C. Develder, F. De Turck, B. Dhoedt, P. Demeester, "ASTAS: Architecture for Scalable and Transparent Anycast services", Journal of Communications and Networks, December 2007, Vol. 9

## 2.5.2 Submitted for publication

- S. Figuerola, J. A. García-Espín, J. Ferrer, and A. Willner "Harmony: A multi-domain, multi-vendor network resource brokering system" IEEE Communication Magazine **I2CAT**, **UniBonn**
- Y. Demchenko, L. Gommans, C. de Laat, H. Sagehaug, V. Venturi, O. Koeroo, "Extending XACML Authorisation Handling Model to Support Policy Obligations in Distributed Applications", **UvA**. Submitted to special issue on Standardisation in Computer Standards & Interfaces (CSI) journal

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



## Annual Report on Dissemination Activities

- K. Vlachos and A. Siokis, "A Hierarchical model for Service-Oriented Optical Network architectures", **RACIT** Submitted to IEEE/OSA J. Lightwave Technology
- P. Kokkinos, K. Christodoulopoulos, E. A. Varvarigos, "Efficient Data Consolidation in Grid Networks and Performance Analysis", **RACIT**. Submitted to Journal of Parallel and Distributed Computing (JPDC).
- K. Seklou, A. Sideri, E. Varvarigos, "New Assembly Techniques and Fast Reservation Protocols for Optical Burst Switched Networks Based on Traffic Prediction", **RACIT** Submitted to Computer Communications.

## 2.6 Book Chapters

- K. Christodoulopoulos, N. Doulamis, P. Kokkinos, E. Varvarigos, Quality of Service Scheduling of Computation and Communication Resources in Grid Networks, to appear in "Grid Computing Research Progress." Nova publishers

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



### 3 Other External Dissemination Activities

#### 3.1 References in the Press

So far there have been three online press releases with explicit reference to the PHOSPHORUS project.

The first two articles report on the efforts of one of the partners of the PHOSPHORUS project, i2CAT. The articles reflect the developments of i2CAT and its liaison with Alcatel-Lucent and the GLIF project and are listed below:

- The article, *“Alcatel-Lucent completes the international interconnection to the experimental scientific networks of the Foundation i2CAT”* was released on 8th October 2007. It can be found in the online magazine, “The Economist” (“eleconomista.es”) and accessed at: <http://www.eleconomista.es/empresas-finanzas/noticias/291214/01/70/Alcatel-Lucent-completa-la-interconexion-internacional-a-las-redes-cientificas-experimentales-de-la-Fundacion-i2CAT.html>
- *“Alcatel-Lucent extends the capacities of interconnection of i2CAT with GLIF”* was published in the the World Communications online magazine on the 9th of October 2007. (<http://www.idg.es/comunicaciones/noticia.asp?id=61048&seccion=telecomunicaciones>)

A further press release was released from Internet2 regarding the Phosphorus-related demo. It can be accessed by visiting the following link: <https://mail.internet2.edu/www/arc/i2-news/2007-11/msg00002.html>

#### 3.2 Multi-media

The first version Phosphorus video clip was completed. The clip describes Phosphorus ideas and objectives. The full clip includes interviews with partners from the Phosphorus consortium, reports of Phosphorus activities during some workshops and presentation of promotion materials like posters and brochures.

#### 3.3 Magazine Articles

Phosphorus partners authored two magazine articles:

Project:	Phosphorus
Deliverable Number:	D.7.1.3
Date of Issue:	30/06/2009
EC Contract No.:	034115
Document Code:	Phosphorus-WP7-D7.1.3



#### Annual Report on Dissemination Activities

- “Enabling Grid-Network Services via Control Plane: the Phosphorus G2MPLS way to the e-Infrastructures” published in the April 2009 Issue of the Zero-In Magazine.
- “Empowering Grid users with improved services” published in the April 2008 Issue of the eStrategies magazine on Advanced Grid Technologies. The magazine covers a range of technical Research topics and enjoys a European wide audience in over 30 countries.

Project:	Phosphorus
Deliverable Number:	D.7.1.3
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## 4 Future Dissemination Activities

### 4.1 Future Events and Conferences

#### 4.1.1.1 *SuperComputing 2009*

Although the project has come to an end, PHOSPHORUS partners plan to have one final demo illustrating the full results and outcome of the project at SuperComputing 2009.

#### 4.1.1.2 *GridNets 2009*

Phosphorus Partners (I2CAT) have been invited to present the Harmony System at the GridNets 2009 conference. His paper and talk will focus on the network interfaces for Grid applications, functionalities and services. The GridNets conference will take place on September 7 – 9 2009 in Athens, Greece

#### 4.1.1.3 *ECOC 2009*

In addition, the following paper have been accepted for publication to ECOC 2009 conference:

- S. Figuerola, J. A. García-Espín, J. Ferrer, and A. Willner: Scalability Analysis and Evaluation of the Multi-domain, Optical Network Service Plane in Harmony. 35th European Conference on Optical Communication (ECOC 09).

The conference will take place 20-24 September 2009 in Vienna, Austria.



## 5 Acronyms

<b>APOC</b>	Asia Pacific Optical Communications
<b>ARGON</b>	Allocation and Reservation in Grid-enabled Optical Networks
<b>DRAC</b>	Dynamic Resource Allocation Controller
<b>FI-RG</b>	Firewall Issues Research Group
<b>GHPN-RG</b>	Grid High-Performance Networking Research Group
<b>GRAAP</b>	Grid Resource Allocation Agreement Protocol Working Group
<b>GSA-RG</b>	Grid Scheduling Architecture Research Group
<b>HSVO</b>	Health Services Virtual Organization
<b>JSDL-WG</b>	Job Submission Description Language Working Group
<b>KISTI</b>	Korean Institute of Science and Technology Information
<b>IDB</b>	Inter-Domain Broker
<b>NML-WG</b>	Network Mark-up Language Working Group
<b>NIC</b>	Network Interface Card
<b>NREN</b>	National Research and Education Network
<b>NRPS</b>	Network Resource Provisioning Systems
<b>NSP</b>	Network Service Plane
<b>OFC/INFOEC</b>	Optical Fibre Communication Conference and Exposition and the National Fibre Optic Engineers Conference
<b>OGF</b>	Open Grid Forum
<b>RSS-WG</b>	Resource Selection Services Working Group
<b>TERENA</b>	TransEuropean Research and Education Network Association
<b>TOPS</b>	Technology for Optical Pixel Streaming
<b>UCLP</b>	User Controlled LightPath



## 6 References

C. Abosi, D. Simeonidou, R. Nejabati, D. Parniewicz "PHOSPHORUS deliverable D7.1.2: Plan for Using and Disseminating the Knowledge", Project deliverable, European IST project PHOSPHORUS, Oct. 2007