



034115

PHOSPHORUS

Lambda User Controlled Infrastructure for European Research

Integrated Project

Strategic objective:
Research Networking Testbeds



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Plan for Using and Exploiting the Knowledge

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Abstract

The PHOSPHORUS project is expected to provide an improvement of the partners' know-how in the areas of design and integration of multi-service and multi-technologies optical networks with a particular focus on Grid application and related middleware. Therefore, accurate tracking and registration of the knowledge produced, as well as appropriate dissemination and identification of the exploitable results will be needed during the project execution. This deliverable reports the plans and efforts to disseminate and exploit the knowledge produced throughout the project's duration.

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0 Executive Summary

Dissemination is crucial for any EU funded research work and as such, one of the objectives of the PHOSPHORUS project is to disseminate procedures, toolkits and middleware to EU National Research and Education Networks (NRENS) and their users to enable authorized end-to-end dynamic service provisioning across Europe and worldwide heterogeneous network infrastructure.

This report highlights all the second year activities that aim to fulfil this objective. The structure of the document is as follows:

The document comprises three sections, all of which have a standard format for all FP6 projects: Exploitable knowledge and its use, Dissemination of knowledge and Publishable results.

Section 1, **Exploitable knowledge and its use**, presents the project results which are classified as “knowledge having a potential for industrial or commercial application in research activities for developing, creating or marketing a product or process or for creating or providing a service”. An overview table is accompanied by text describing each exploitable result.

Section 2, **Dissemination of knowledge** presents the dissemination activities that occurred during the course of the year. An overview table of major dissemination activities is complemented with a list of all publications. The internal dissemination is briefly discussed.

Section 3, **Publishable results**, is the last section standard to FP6 projects. This section presents each publishable exploitable result the project has generated.

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1 Exploitable Knowledge and its Use

Taking into account the fact that the consortium consists of major research players in the fields of optical networking and Grid technologies, it is obvious that the exploitation of the results obtained in this research project through each partner organisation is the most desirable way to benefit from the work done. Each Party will enforce necessary measures to exploit project results at its level. In addition to the partners' level the Technical Board is looking for the possible co-operation with external bodies for results which are not handled by the Parties on their own.

This section provides a description of the exploitable results that are already being disseminated and those that are foreseen as possible exploitable results under the PHOSPHORUS project. The descriptions given below summarise the opportunity these results present as supportive tools to interested groups. Its aim is to highlight the relevance of the PHOSPHORUS results to their activities and the benefits that can be gained if they make use of them.

An overview list of foreseen exploitable knowledge is presented in the table below:

Exploitable Knowledge	Exploitable product(s) or measure(s)	Sector(s) of application	Timetable for Commercial use	Patent or other IPR protection	Owner and Other Partner(s) involved
Multi-domain, Multi-vendor Optical Network Resource Provisioning	Harmony system	e-Science applications Grid Middleware + Meta-scheduling Optical Network Service Providers Network Operators Academia Labs	Open Source	Public Domain	i2CAT, UniBonn, SURFnet, UVA, and CRC.



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Exploitable Knowledge	Exploitable product(s) or measure(s)	Sector(s) of application	Timetable for Commercial use	Patent or other IPR protection	Owner and Other Partner(s) involved
Grid-GMPLS architecture and prototypes	Consulting, training courses and seminars for network operators, manufacturers and service providers	1. ICT 2. Telecommunications	2007-2010	G ² MPLS architecture, protocols extensions and prototype design are public. G ² MPLS prototypes are public. G ² MPLS source code is a mix of open source (GPLv2, LGPL) and proprietary code.	NXW (owner), PSNC (owner) UESSEX (owner)
Simulation Environment	Simulation Environment	1. Network Operators 2. Network Consultants	2008-2010	None	IBBT (owner), Extra functionality supplied by RACTI, UniBonn, AIT, ULeeds
Resource Management and Job Routing Algorithms	Advanced Control Plane	Network Operators	2008-2010	None	IBBT, RACTI, AIT, UniBonn
Scheduling and Resource Management in Grid SOA Environments	MetaScheduling Service (MSS) supporting automatic resource allocation for annotated applications	Grid and SOA Applications	Open Source	None so far	FHG

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Exploitable Knowledge	Exploitable product(s) or measure(s)	Sector(s) of application	Timetable for Commercial use	Patent or other IPR protection	Owner and Other Partner(s) involved
Resource Management in Grid Middleware	UNICORE supporting resource co-allocation via MSS	Grid Middleware	Open Source	None so far	FZJ
Generic AAA Authorisation Architecture for multidomain Optical Network Resources Provisioning	<ul style="list-style-type: none"> * Network Resource Provisioning model/workflow * Pluggable GAAA toolkit library to support policy based access control in GMPLS and NPRS based optical networks * XACML-NRP policy and attribute profile * Network Resource Provisioning model/workflow 	<ul style="list-style-type: none"> * Optical network service providers * NRPS and GMPLS/G²MPLS systems developers * Grid middleware * Combined Grid and network resource management, 	Open Source, commercial value added services	Apache style license	UvA, UniBonn, I2CAT, NXW, SURFnet
GMPLS Gateway Router	Addition to an IETF FORCES architecture based router	IP (Campus) networks connecting to one or more GMPLS networks	Open Source, commercial value added services	Public Domain	UvA, Hitachi, RACTI

Table 1.1: Overview of Exploitable Results

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1.1 Exploitable Results

1.1.1 Multi-domain, Multi-technology, Advance Optical Network Resource Provisioning (Harmony system)

1.1.1.1 Summary of Exploitable Results

Harmony is the main outcome of the Phosphorus Work Package 1. Harmony is a network resource brokering system that provides co-allocation of heterogeneous optical network resources in multi-domain and multi-vendor environments with advance reservation functionalities.

The main objective of the Harmony system is to provide Users or Grid applications/middleware with the ability to create point-to-point connections using network resources from several domains in a transparent way. The solution proposed by Harmony speeds up the creation of complex resource reservations with advance booking features, involving several Network Resource Provisioning Systems (NRPS) or GMPLS control plane. As Harmony defines a common Network Service Plane (NSP) for all of them, interoperability between NRPS, GMPLS and Grid applications/middleware is seamlessly achieved.

As commented previously, Harmony allows domain interoperability by means of performing inter-domain network resource brokering over three distinct NRPS:

- **Argia/UCLP.** The Argia NRPS is provided by CRC, Inocybe, and i2CAT. It provides a network virtualization framework upon which communities of users can build their own services or applications. Articulated Private Networks (APNs) are presented as the first services. An APN can be considered as a next generation Virtual Private Network where a user can create a complex, multi-domain topology. Currently Argia is being used in KISTI, CRC, HSVO, i2CAT, PSNC, and UESSEX domains.
- **ARGON.** The Allocation and Reservation in Grid-enabled Optic Networks system was developed to manage resources of advanced network equipment as it is present in the German VIOLA test-bed. The advance reservation service of ARGON is able to operate on the GMPLS as well as on the MPLS level. It guarantees a certain QoS for applications for the requested time interval.
- **DRAC.** The Dynamic Resource Allocation Controller system was developed by NORTEL and it is a commercial-grade network abstraction and mediation middleware platform, acting as an agent for network clients to negotiate and reserve appropriate network resources on their behalf.

The common network service plane in Harmony is composed of Inter-Domain Broker (IDB) entities, and Harmony NRPS Adapters (HNA). All of them implement the so-called Harmony Service Interface (HSI), which defines the minimum set of web service calls and attributes for inter-domain path provisioning and resource scheduling, at inter- and intra-domain level at the same time.



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1.1.1.2 Exploitable Results Achieved

According to the WP1 development plan, the interface specification and implementation of the Harmony system has been the main exploitable result achieved. Thus, the main Harmony's features achieved during the development are:

- Network Service Plane implementation with flexible, configurable operating modes (centralised, hierarchical, distributed, among others)
- Inter-Domain Brokers and path computing elements for optical network resources
- Advance reservations for Grid applications.
- Grid Middleware integration with the NRPS or GMPLS.
- Topology abstraction and sharing among (administrative) domains.
- Secure intra-domain topology hiding, using resource abstraction techniques.
- Authentication and Authorisation Infrastructure integration with NRPS and GMPLS.
- WSDL description (OASIS WSRF v1.2 compliant) of the HSI for flexibility, portability and easy adaptation to new systems and/or applications.

Due to all these features, Harmony's test-bed has grown from a first basic scenario, involving five domains of four different countries to the current scenario, where there are ten domains of seven different countries. This growth shows how Harmony can connect independent domains (with distinct technology equipment) which are using any of the above mentioned NRPS and enable domain interoperability to the users or Grid middleware applications.

1.1.1.3 Further Exploitable Results

National Research and Education Network represent the most potential group of users of the Harmony system, since NREN are the ones which are using multi-technology, multi-vendor and heterogeneous local test-beds. The future exploitable results should focus on deploying Harmony in NREN's local test-beds, since Harmony fills the gap due to distinct technologies presents in the different test-beds. Moreover, any e-Science application which requires to transmit huge amounts of data during one determined interval of time can use Harmony's services to achieve their purposes.

1.1.1.4 Partners Involved in the Exploitation

i2CAT, UniBonn, SURFnet, UvA and CRC.

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1.1.2 Grid-GMPLS architecture and prototypes

1.1.2.1 Summary of Exploitable Results

Grid-enabled GMPLS Network Control Plane (G²MPLS) is an enhancement of the ASON/GMPLS Control Plane architecture that implements the concept of Grid Network Services (GNS). In the PHOSPHORUS project, the GNS is a service that allows the provisioning of network and Grid resources in a single-step, through a set of seamlessly integrated procedures.

G²MPLS is the main outcome to be delivered by Workpackage 2 in various forms: (a) architectural specification and deployment scenarios, (b) software design, (c) G²MPLS software, (d) public prototypes, and (e) experimental validation in the PHOSPHORUS testbed.

Each of these forms has provided a substantial degree of innovation with respect to the state of the art, with various opportunities for exploitation. The main players in this context are the partners directly involved in the production of this foreground knowledge, both in the terms of architecture design and prototypes, i.e. NXW, PSNC and UESSEX.

1.1.2.2 Achieved Exploitable Results

According to the WP2 development plan, the architectural definition of G²MPLS has been the main result delivered during the project Y1 (M1-M12), and included:

- the definition of G²MPLS architecture and functional decomposition,
- the specification of the network interfaces (G.OUNI, G.I-NNI, G.E-NNI);
- the specification of the protocol extensions for Grid-aware routing and signalling;
- an analysis of appropriate deployment scenarios for its integration in NRENs infrastructures.

During Y2 (M13-M24), this set has been significantly improved and complemented with the planned software developments and their integration into prototypes, including:

- the definition of a detailed high-level software design, according to a top-down approach from the prototype package to its components;
- the skeleton for GMPLS stack with basic functionalities for Control Plane resource inventorying, routing, signalling and communications across the SCN;
- an abstraction layer for the transport network resources with specific plug-ins for the equipments used in Phosphorus G²MPLS test-beds (i.e. ADVA FSP3000RE-II ROADM and Calient DiamondWave FiberConnect)
- the G²MPLS Call Controller for the coordination of the overall call signalling phases at the various external reference points of Control Plane domain
- the G²MPLS Recovery Controller for the coordination of the signalling and recovery phases of the domain-internal connections (i.e. Labelled Switched Paths (LSPs)) related to a G²MPLS Call
- the Grid-aware Path Computation module for the execution of the routing algorithm and the computation of explicit routes
- the G.UNI Gateway for the translation of WS-based GNS job requests and Grid resource advertisements into G²MPLS protocol actions and vice versa



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- the G²MPLS-Harmony Gateway for the interworking of the G²MPLS protocols and decision entities with the Harmony system delivered by WP1
- the PEP Gateway for interfacing the G²MPLS stack with the Grid AAA layer mediated by the WP4 GAAA-Toolkit.

In the last execution months (M25-M33), the G²MPLS stack has been further consolidated and improved with additional features, including:

- some mechanisms for the G²MPLS stack resilience, to limit the impact on Data Traffic of any possible failures at Control Plane level (e.g. restart of controllers or disconnected SCN)
- other specific plug-ins for new equipments used in Phosphorus G²MPLS test-beds (Ethernet switches)
- some tools for Control Plane activity visualization, to show the status of some network resources and the installed network transport services (i.e. G²MPLS Calls and LSPs)
- some tools for the easy access and operation of G²MPLS modules.

All these developments have been integrated into G²MPLS prototypes at different dates, at M22 (D2.5), M27 (D2.10) and M33 (D2.11). All these prototypes are public and can be configured to implement:

- a G²MPLS core controller
- a G²MPLS edge controller (i.e. border node with G.UNI)
- a G²MPLS border controller (i.e. border node with G.E-NNI), optionally with G²MPLS-Harmony gateway
- a G.UNI Client controller (i.e. node with G.UNI-C and gateway functionality towards WS-based layers)

These G²MPLS prototypes have been used in public demonstrations (SC'08, ICT'08 and TNC'09 conferences) [**Phosphorus-D7.1.3**], with an increasing set of advanced features successfully demonstrated both on the pan-European Phosphorus test-bed and on ad-hoc demo sets at events locations.

The achievement of all the aforementioned results has contributed to many dissemination initiatives, which contributed to a public and wider assessment of the G²MPLS concepts by the research community (ref. events, conference and publications section **2.1.2**). Moreover, the architectural work assisted by the software development has definitely fed some standardization activities in Open Grid Forum (OGF), with contributions to Grid High Performance Networking (GHPN) Research Group on the G.OUNI interface (<https://forge.gridforum.org/sf/go/doc15126?nav=1>) and the kick-start of a dedicated OGF working group on the specification of the Network Services Interface for Grids (NSI-WG, http://www.ogf.org/gf/group_info/view.php?group=nsi-wg).

1.1.2.3 Partners Involved in the Exploitation

NXW, as WP2 leader and main responsible for the architecture and software developments, is the main beneficiary of the G²MPLS Network Control Plane design and implementation. Other partners actively involved in the achievement of aforementioned results are PSNC and UESSEX in their twofold role of G²MPLS developers and physical test-bed owners.

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1.1.2.4 How the Results Were Exploited

The activities on G²MPLS and the cited results allowed NXW, PSNC and UESSEX staff to:

- keep the pace of the most recent GMPLS standardization activities (mainly CCAMP and ITU for what concerns the GMPLS control of Wavelength Switched Optical Networks, Transport Ethernet and emerging technologies like Transport MPLS),
- improve the knowledge of Grids, their middleware and distributed applications
- discuss and promote the G²MPLS concept in renowned research communities

Concerning NXW, these exploitation channels have all directly contributed and opened new business opportunities in terms of:

- Experienced consulting to equipment manufacturers¹ about:
 - Architectural evaluation of GMPLS protocol suites (for SDH)
 - GMPLS system proving (control plane stack debugging and assessment of standard compliance), by defining:
 - testing guidelines,
 - revision of test cases for, and
 - on-site support in tests execution
 - support to the activities of integration of commercial GMPLS stacks in Multiservice TDM/Ethernet equipments
 - design and development of a Transport MPLS (T-MPLS) controller for Multiservice TDM/Ethernet equipments
- Training on ASON/GMPLS, with a target audience of specialized technicians in the SDH field. The levels of the courses have been:
 - Advanced tutorial on ASON/GMPLS
 - Courses on specific parts of the GMPLS protocol suite (e.g. organized according to the targeted network reference points – UNI, E-NNI or just I-NNI – or according to protocols): detailed review of the applicable standards, design and implementation issues.

Moreover, the dissemination and standardization dimensions implicitly improved and promoted the NXW position of skilled research-performing SME at an international level, thus further improving the business contacts and opportunities for the company.

1.1.2.5 Socio Economic Impact

The Grid-GMPLS architecture will have a strong impact on the way researchers access and use the transport networks, and will improve and optimize the network usage by advanced applications. The expected range of availability of operational services based on this paradigm is 3-5 years, and will influence the “classical” environments of remote and collaborative research, but especially the “newer” demanding services such as Grid applications, Collaborative Caves, Shared Virtual Reality spaces and TV broadcasting, news distribution. The success in terms of audience and follow-ups of the G²MPLS public demonstration events clearly shows the initial occurrence of this impact.

¹ Customers cannot be disclosed for NDA obligations.

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1.1.2.6 Commercial Exploitable Results: Grid-GMPLS Network Control Plane

The delivery of the G²MPLS prototypes and their public demonstrations at international events [**Phosphorus-D7.1.3**] have raised a wide awareness on the Phosphorus Control Plane approach to the Grid Network Services. New contacts with industry representatives (e.g. Alcatel-Lucent, SAP, etc.) and international researchers (e.g. BUCT-China and INFN-Italy) derived from the publication of the G²MPLS deliverables, and reinforced the R&D partnerships of the main G²MPLS developers, especially for NXW.

G²MPLS is turning into a platform for the easy take-up by Grid-users and NRENs willing to deploy Grid Network Services. There are plans in NXW for reusing the G²MPLS stack as a training platform for NRENs or commercial operators on G⁽²⁾MPLS features and issues.

Moreover, a further reuse of the G²MPLS foreground knowledge is occurring in other R&D initiatives on the themes of the FP7 Future Internetworking. In this case, the G²MPLS standard-compliance and openness is acting as a common and shareable ground for further research on Control Plane issues, with a proactive involvement of big industry players (both vendors and operators). NXW is directly exploiting these R&D opportunities, thus broadening the scope of its investigation on networking and, consequently, the business relationships with the main European actors in this sector.

1.1.3 Simulation Environment

1.1.3.1 Summary of Exploitable Results

The exploitable *result* is a set of software tools and a simulator, which allow optimisation of multi-domain, optical Grid networks in terms of routing/scheduling algorithms, network technologies, topologies and characteristics by network dimensioning/planning and performance analysis.

1.1.3.2 Exploitable Results Achieved

A software tool which allows for the simulation and optimisation of multi-domain, optical Grid Networks has been developed under the PHOSPHORUS project. This simulation tool allows for optimisation in terms of routing/scheduling algorithms, network topologies, technologies and characteristics by network dimensioning/planning and performance analysis.

The simulation tool allows for the user to configure simulations in two ways. One way of setting up a new simulation requires the user to adapt the main function of the simulator. This requires the user to write some Java-code to create and initialize all the nodes and links in the network as well as setting all their parameters. The second may allow a user to make use of a Graphical User Interface (GUI) which has been developed for the simulator. The GUI approach to setting up a simulation is easier and less error-prone. Each simulation can contain a network (containing all nodes, delays and link speeds) and a list of resources (applications and datasets) on the resource nodes of the network.

The figure below (Figure 1) shows the Graphical User Interface of the developed simulator.

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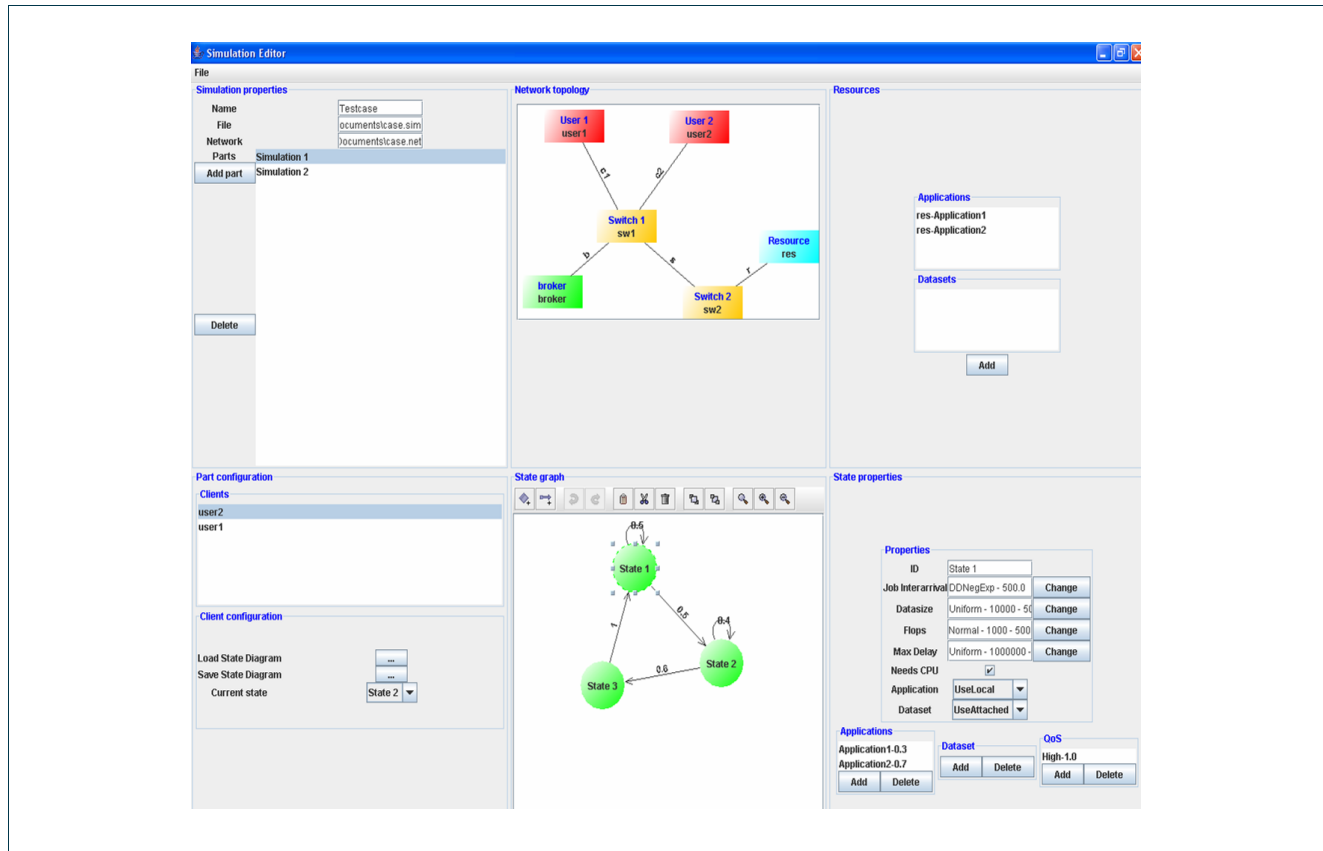


Figure 1.1: The Graphical User Interface of the Simulator

1.1.3.3 Partners Involved in the Exploitation

The main framework for the simulator was developed by IBBT – Ghent University. Other partners involved and who are responsible for extending the simulator are: RACTI (responsible for QoS resource scheduling and various resiliency techniques), AIT (responsible for constraint based routing including physical impairments), UniBonn (responsible for advance reservations) and ULeeds (developer of differentiated resiliency techniques).

1.1.3.4 Publishable Exploitable Results: Simulation Environment

1.1.4 Resource Management and Job Routing Algorithms

1.1.4.1 Summary of Exploitable Results

The exploitable result is a set of algorithms which perform advanced resource management and job routing functions. These include:

Grid job routing algorithms

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Support for network, resource and service related constraints, multiple domains and multiple costs

QoS-aware resource scheduling

Anycast routing, scheduling, joint network and resource assignment

Support for advance reservations in scheduling

Malleable reservations, centralized vs. distributed control

Grid network design

Dimensioning of network and Grid resource, capacity planning, network design, resource placement

Resilient Grid networks

Resiliency algorithms, protection and restoration strategies, network and resource backup planning, job checkpointing and duplication

1.1.4.2 Exploitable Results Achieved

A set of algorithms and models which permit and perform advance resource management and job routing functions have been developed.

Job Demand Models

Models and techniques to obtain model parameters from real world traces have been described, allowing for Grids to be studied without having to deploy them. This exploitable knowledge presents high-quality probabilistic models for the job arrival process and the job characteristics, and facilitates the design and dimensioning of Grid systems, the prediction of their performance, the evaluation of new scheduling strategies, and the design of a QoS framework for Grid users.

Grid Job Routing Algorithms

Grid job routing algorithms have been proposed which support network, resource and service-related constraints, anycast-based routing in multi-domain Grid networks allowing control plane scalability, support of any subset of parameters that are available to the routing protocol and system-wide optimisation of the Grid network.

QoS Aware Resource Scheduling

QoS-aware resource scheduling algorithms have been developed; these are able to allocate and coordinate the required resources, taking into consideration timing, order and control efficiency in order to satisfy the QoS requirements and provide fairness among users. The scheduling algorithms incorporate anycast routing and scheduling, and joint network and resource assignment.

Support for Advance Reservations in Scheduling

Different types of advance reservation approaches have been explored, including malleable reservations, centralised vs. distributed control, as well as policies for admission control.

Grid network design

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Algorithms for combined dimensioning of network and Grid resources have been designed and analyzed, considering sub-problems such as capacity planning, detailed network design including physical impairments, and resource placement. Finally, we have also investigated the role of optical switching techniques (OCS, OBS, OPS or hybrid approaches) and identified optimal usage scenarios for Grid networks.

Resilient Grid networks

We have designed and analyzed different approaches towards reliable Grid network operation. A comparison of protection and restoration strategies has been performed, and suitable network and resource backup planning have been proposed. Finally, to improve resource resiliency, we have studied job checkpointing and replication techniques, and assessed their impact in a networking environment.

1.1.4.3 Partners Involved in the Exploitation

The partners involved for the development of this exploitable knowledge are IBBT – Ghent University (lead developer), RACTI (responsible QoS resource scheduling), AIT (responsible for constraint based routing), UniBonn (responsible for advance reservations) and ULeeds (differentiated resiliency). These algorithms can be implemented and deployed in novel control/service plane solutions. Furthermore, the algorithms for Grid dimensioning and resiliency are developed by IBBT, AIT, RACTI and ULeeds.

1.1.4.4 Publishable Exploitable Results: Simulation Environment.

1.1.5 Scheduling and Resource Management in Grid and SOA Environments

1.1.5.1 Summary of Exploitable Results

The MetaScheduling Service (MSS) is offering possibility to automatically do resource allocation and scheduling for applications or services that are annotated with their resource requirements.

The MSS is currently an open source development, thus no commercial exploitation is planned.

Research is increasingly done through specialised, domain specific interoperating services instead of stand-alone (monolithic) applications. The MSS is a leading development to be used for orchestration of services in Grid based research and in follow-up research projects.

1.1.5.2 Exploitable Results Achieved

The MetaScheduling Service (MSS) developed in the VIOLA project was explored and extended within the PHOSPHORUS project during the first two years interoperating now with the network service plane and control plane.

A major result is the reservation and co-allocation capability using the interfaces of the underlying middleware, in PHOSPHORUS the UNICORE system.

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Besides extensions and consolidations on the middleware layer a new interface has been implemented allowing G²MPLS instances to directly communicate with the Grid Scheduler exchanging information on resource properties and availability as well as negotiate and perform reservations of Grid resources. The previously supported interface to the ARGON NRPS has been replaced by an interface with the HARMONY system allowing to interact now with several NRPS.

1.1.5.3 *Partners Involved in the Exploitation*

The partner involved in the development of this exploitable knowledge during the project's lifetime were FHG, FZJ and UniBonn.

1.1.6 Resource Management in Grid Middleware

1.1.6.1 *Exploitable Results Achieved*

UNICORE is a major European Grid middleware that is used in various e-Science projects and production environments worldwide. During the first year of the project, design changes and extensions to the UNICORE Grid middleware were defined. These extensions provide enhancements to provide coordinated reservation and allocation of network and compute resources by integration of the MSS to the middleware. The middleware has been implemented and deployed at FZJ.

Improved Integration of the MSS into UNICORE 5

An improved integration of the MSS with the UNICORE 5 middleware has been designed and implemented. This work is based on previously available prototype integration. The improved integration features a single adapter module to the UNICORE gateway allowing using the UNICORE Target System Interfaces (TSIs) to access the local scheduling systems. This has two major advantages: (i) the MSS adapters for the local scheduling systems used until now become obsolete, and (ii) the negotiation with the local scheduling now uses standard UNICORE mechanisms and the standard UNICORE gateway port. The latter allows the application of stricter firewall policies of the participating sites.

Migration to UNICORE 6

During the first year of the PHOSPHORUS project, the new Web-Service-based version 6 of the UNICORE middleware has been tested and finally released in August. The PHOSPHOSRUS project has provided the requirements and design of the MSS integration into UNICORE 6 at a very early stage of this process. This enables a natural and tight integration, which has been implemented and deployed at all UNICORE sites of the PHOSPHORUS testbed.

Adding co-allocation capabilities to the already available workflow support of UNICORE middleware enables new areas of application in Grid based research and in follow-up projects. As the changes have been implemented in the main stream UNICORE, which is an open source product, there will be no commercially

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exploitable results. However, FZJ will keep up the development of UNICORE and use PHOSPHORUS results in future projects and applications wherever applicable.

1.1.6.2 Partners Involved in the Exploitation

The partners involved for the development of this exploitable knowledge during the course of the project were FZJ and FHG.

1.1.6.3 Publishable Exploitable Results

The reservation interface, which was added to the UNICORE Grid middleware during the PHOSPHORUS project, is an outstanding feature of the middleware.

1.1.7 Authentication, Authorisation and Accounting Architecture for Optical Network Resource Provisioning

1.1.7.1 Summary of Exploitable Results

The developed generic AAA Authorisation architecture for multidomain optical Network Resource Provisioning (GAAA-NRP) allows applying policy based access control at different networking layers: data plane, control plane and service plane, - using common security services and mechanisms that are implemented as a pluggable GAAA Toolkit library (GAAA-TK). The architecture is based on the general NRP model that includes the major stages of the whole network resource provisioning process: reservation, deployment, access, and de-commissioning. Such architecture allows using different security models and mechanisms at different stages, in particular, token based access control to the reserved resources that can be used transparently at different layers, although ensuring integrity of the whole provisioning process and consistent provisioning session based security context management.

The proposed architecture allows the GMPLS signalling using pilot tokens during reservation and deployment stage, that can also communicate interdomain security context, each individual domain can verify the validity of the token, and pass on the signalling to the next domain. Depending on the fact whether each domain wants to use the same or a different key, the token needs to be regenerated at each domain. Tokens can be also used to support an accounting process.

1.1.7.2 Exploitable Results Achieved

The proposed and implemented GAAA-NRP architecture supports the following major stages of the general optical Network Resource Provisioning (NRP): (1) resource reservation, (2) deployment (or activation), (3) the reserved resource access/consumption, and additionally (4) resource de-commissioning after it was used. In its

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own turn, the reservation stage includes three basic steps: (a) resource lookup, (b) complex resource composition (including alternatives), and (c) reservation of individual resources. The reservation stage may require the execution of complex procedures that may also request individual resources authorisation. Different provisioning models or sequences can be executed when composing a complex resource: chain, tree or polling, and agent.

The NRP model is considered as an important abstraction that allows both defining specific security models for different provisioning stages and providing a framework for integrating the NRP process into the higher level scientific workflows,

The proposed GAAA-NRP architecture extends the generic AAA Authorisation architecture described in the RFC2904 with the specific functionality for on-demand NRP and specifies the following access control mechanisms and components:

- Token Validation service to support tokens handling and validation.
- Access token used as policy enforcement mechanisms and pilot tokens used for interdomain signalling in the G²MPLS Control plane and in-band.
- AuthZ tickets with extended functionality to support AuthZ and provisioning session management, delegation and obligated policy decisions.
- XACML-NRP attributes and policy profile for NRP that define a common set of attributes used for policy definition in NRP.
- Policy Obligations Handling model to support usable/accountable resource access/usage and additionally global and local user account mapping widely used in Grid based applications and supercomputing.

Currently available GAAA Toolkit implementation in the form of the pluggable Java library implements all proposed access control mechanisms and functionality and provides a platform for further adaptation to different NRP provisioning scenarios and NRPS systems. The library allows natural integration with the Grid middleware.

1.1.7.3 *Spin Off*

Although the GAAA-TK library will be provide as an Open Source product under Apache style license the value added services on developing application and business specific profiles can be provided on the commercial or subscription base. This is intended for both networking and Grid projects.

1.1.7.4 *Further Research and Development*

Future research and developments will focus on the following issues: defining and implementing security model for token based signalling and access control in multidomain networks; general security model for the Token Based Networking (TBN); implementation of the XACML-NRP attributes and policy profile for NRP. This work will also provide a basis for the project contribution to the standard bodies such as OGF.

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The XACML-NRP attributes and policy profile has been proposed to wider networking community, in particular, Internet2 and GN2/GN3, as suggested common interoperability basis between different AAI systems.

1.1.7.5 *Partners Involved in the Exploitation*

UvA, UniBonn, I2CAT, G²MPLS developers Nextworks, SURFnet.

1.1.7.6 *Publishable Exploitable Results*

The results of the GAAA-NRP development have been presented at different conferences and workshops. The final results will be submitted to few future conferences such as GridNets2009, Grid2009. The suggested topics may include:

- Authorisation infrastructure for multidomain Optical network resource provisioning
- Defining security model for multi-domain complex network and Grid resource provisioning

1.1.8 **GMPLS Gateway Router**

1.1.8.1 *Summary of Exploitable Results*

PHOSPHORUS provided implementation of the modular router, that is used as a gateway between a regular connectionless IP (Campus) network and a connection-oriented GMPLS network of an Optical Network Service provider. The router re-uses an existing ForCES based router implementation proposed by HEL and extends it with additional modules that can recognize tokens inside IP packets and use these tokens subsequently to include them into the RSVP signalling message that opens an authorized optical path in the way described in the previous section. The token may be generated by an application, residing in the campus network and included into IP packets by using the IP options field.

1.1.8.2 *Exploitable Results Achieved*

Token Based Switch over IP traffic (TBS-IP) is a ForCES router designed and implemented in a prototype at UvA. Using specific encrypted tokens built-in the IP packets, TBS-IP allows connections between a regular connectionless IP (Campus) network and a connection-oriented GMPLS network of an Optical Network Service provider. The TBS-IP router provides a web-service configuration/set-up interface to a high level authorisation and accounting service (e.g., AAA servers from UvA, Harmony from UniBonn, OSCARS from Internet2). The TBS-IP router can be programmed for a number of reserved paths/service levels using an XML Authorization ticket proposed and implemented in the PHOSPHORUS AAA/AuthZ infrastructure.

The solution can be used to connect authorized applications, running on general campus network resources to a pre-authorized GMPLS connection, assuming that the performance of the campus network is high enough to

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not pose any bottleneck. The applications can negotiate with the GMPLS network authority (e.g., AAA server) to obtain the proper key material. The GMPLS network authority will provision the requestor application(s) and the TBS-IP gateway router to insert and recognize the tokens inside the IP packets, respectively. Besides the campus side provisioning, the GMPLS network authority will also subsequently setup and maintain the GMPLS connection at the other end.

1.1.8.3 Possible Future Developments

Current TBS-IP router implementation uses IXP2850 network processors that supports hardware encryption. The future research and development will be focused on using FPGA technology that will allow better performances for less energy consumption and lower costs.

In application area, the research will be focused on re-using current token mechanism in TBS-IP router for building programmable network architecture. The generalised Token –based Networking architecture (gTBN) will allow binding distributed applications with the dedicated network infrastructure, in particular sensor networks or data streaming applications. For instance, astronomers need to run their intensive processing application on Grids to correlate high throughput streams retrieved from radio-telescopes located around the world.

1.1.8.4 Partners Involved in the Exploitation

UvA, Hitachi and University of Patras.



2 Dissemination of Knowledge

The dissemination activities listed in the table below include all activities. This table is maintained and continuously updated by University of Essex which is charged with controlling the dissemination activities.

Actual Date	Type	Type of Audience	Countries Addressed	Size of Audience	Partner responsible/ involved
Information Material					
Oct 06	Project website	General	Any	Very large	PSNC
Nov 06	Project Poster	Research and Industry	Any	Large	PSNC, UESSEX
Dec 06	Project Presentation Slides	Research and Industry	Any	Large	PSNC, UESSEX
Dec 06	Project website forum	Research and Industry	Any	Potentially Large	PSNC
Sep 07	Project Brochure	Research and Industry	Any	Large	PSNC/ALL
Oct 07	Project Briefcase	Research and Industry	Any	Large	PSNC
Dec 06	Project wiki	Research and Industry	Any	<100	PSNC/ALL
Events and Conferences					
Oct 06	WOBS 06	Research	Any	Potentially Large	UESSEX
Oct 06	AGNM06	Research and Industry	Any	20-30	NXW
Nov 06	SuperComputing SC06	Research and Industry	Any	100s	UESSEX, SARA

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Nov 06	3 rd Conceration Meeting on e-Infrastructure	Research and Industry	EU	100s	PSNC
Dec 06	TERENA NRENs & Grids workshop	NRENs and Grid projects	EU	50	FHG
Jan 07	OptiPuter all Hands Meeting	Research and Industry	Any	<100	SARA
Jan 07	Collaboration of 3Continents Meeting	Research and Industry	Any	30	PSNC, UESSEX, UvA, NXW, FHG
Feb 07	4K Digital Cinema Streaming over Lightpaths Workshop	Research and Industry	Any	<100	SARA
Feb 07	GLIF and Internet2 Tech	Research, Industry, NRENS	Any	100s	SARA
Feb 07	TERENAs EFNIW	Research Networking Community	EU	<100	I2CAT
Mar 07	OFC/NFOEC 07	Research and Industry	Any	100s	UESSEX
Apr 07	ARES 07	Research and Industry	Any	100s	UvA
Apr 07	Internet2 Meeting	Research and Industry	Any (mostly USA)	100s	PSNC
Apr 07	Nortel Workshop	Research and Industry	Netherlands	30	SARA
May 07	IMAU Workshop (High Performance Visualisation Meeting)	Academia	Netherlands	30-40	SARA
May 07	GES 07	Research and Industry	Germany	<100	FZJ, FHG
May 07	IEEE CCGrid 07	Research and Industry	Any	100s	RACTI
May 07	IFIP International Conference on Networking	Research and Industry	Any	100s	UvA

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May 07	Jülich-Karlsruhe Colloquium on Grid Computing	Grid Community, Academia	Germany	~30	FZJ
May 07	TERENA Networking Conference	Research Networking Community	EU	100s	SARA
May 07	ONDM 07	Research, Industry and Academia	Any	100s	RACI, IBBT, AIT
Jun 07	RELARN 07	Research and Academia	Russia	100s	UvA
Jun 07	IEEE POLICY 07	Research and Industry	Any	100s	UvA
Jun 07	ICNS 07	Research and Industry	Any	100s	RACI
Jun 07	GOBS	Research and Industry	Any	<100	UESSEX, IBBT
Jun 07	CineGrid Holland Festival	Research and Industry	Any	100s	SARA
Jun 07	TERENA NRENs & Grids workshop	NRENs and Grid projects	EU	50	FHG
Jun 07	International Supercomputing Conference ISC07	Research and Industry	Any	100s	PSNC, FHG
Jun 07	COINT-ACOF 07	Research and Industry	Any	100s	IBBT
Jul 07	2 nd OpenNet Workshop	Research	EU	20	NXW
Jul 07	ICTON 07	Research and Industry	Any	100s	AIT, NXW, UESSEX
Aug 07	CoreGRID Symposium	Research and Industry	EU	100s	UniBonn, FHG, FZJ, RACI
Sept 07	IEEE Broadnets 07	Research and Industry	Any	100s	IBBT, i2CAT
Sept 07	ECOC 2007	Research and Industry	Any	100s	UESSEX, PSNC, IBBT

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Sept 07	GLIF 2007	Research, Industry, NRENs	Any	120	PSNC, SARA, UvA
Sept 07	CEF Network Workshop 07	Research, Industry, NRENs	Any	50	PSNC, SARA, UvA
Sept 07	IMEKO 07	Research and Grid projects	Any	30	PSNC
Oct 07	IEEE LCN 07	Research and Industry	Any	100s	UniBonn, IBBT
Oct 07	GridNets	Research and Industry	Any	100	UESSEX, PSNC
Oct 07	Open Grid Forum	Research and Industry/ Grid Community	Any	100s	UvA, UESSEX, FHG, FZJ
Oct 07	EGEE 07	Research and Industry/ Grid Community	Any	100s	RACTI
Nov 07	APOC (Invited)	Research and Industry	Any	100	I2CAT, NXW, IBBT, UvA, FHG, PS NC
Nov 07	SuperComputing 07	Research and Grid projects	Any	100s	PSNC, UVA, SARA, FHG, I2CAT, CRC, SURFNET, UniBonn
Dec 07	4th Conceration Meeting on e-Infrastructure	Research and Industry	EU	100s	NXW
Dec 07	CineGrid	Research and Industry	Any	100s	UvA
Dec 07	eScience	Research and Industry	Any	100s	RACTI
Jan 08	GN2 Technical Workshop	Research, NRENs and Industry	EU	100s	NXW

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Feb 08	Open Grid Forum	Research and Industry/ Grid Community	Any	100s	UvA, UESSEX, FHG, FZJ
Feb 08	onVector Workshop	Research and Industry	USA, Japan, and Selected Rest of World	100s	UVA, SARA
Feb 08	OFC/NFOEC 08 (Invited)	Research and Industry	Any	100s	UESSEX, NXW, PSNC
Feb 08	IASTED-PDCN	Research and Industry/ Grid Community	Any	100s	UniBonn
Feb 08	Internet2 Joint Tech Meeting	Research Community	Any	100s	UvA
Feb 08	EGEE JRA1 All hands Meeting	Research and Industry/ Grid Community	EU	10s	UvA
Feb 08	FIRE Experts Group Meeting	Research and Industry/ Grid Community	EU	10s	UvA
Mar 08	ONDM 07	Research, Industry and Academia	Any	100s	I2CAT, UEssex, IBBT, CRC, SURFNET, UniBonn
Mar 08	SOS Workshop	Research and Industry	Any	100	FHG
Mar 08	Geant2 Meeting	Research and Industry	EU	100s	NXW
Apr 08	NGN 08	Research and Industry	Any	40s	PSNC
Apr 08	OpenNet 08	Research Community	Any	50s	I2CAT
Apr 08	Internet2Spring Members Meeting	Research Community	Any	100s	UvA
May 08	TERENA Networking Conference	Research Networking Community	EU	100s	I2CAT, FHG, PSNC, FZJ, SARA

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May 08	Phosphorus-Federica Tutorial and Workshop	Research and Industry	Any	50s	AIT, UEssex, PSNC, NXW, UvA, i2CAT
May 08	Workshop on High Performance Grid Networks	Research and Industry	Any	50s	AIT, UEssex, UniBonn
May 08	DFN Forum Communication Technologies	Research and Industry	Germany	100s	UniBonn
May 08	CCGrid	Research and Industry	Any	100s	FHG UniBonn, UEssex, AIT, PSNC, NXW
Jun 08	ISC 08	Research and Industry/ Grid Community	Any	>1000	PSNC, FHG
Jun 08	Grid 08	Research and Industry/ Grid Community	Any	100s	UvA
Jun 08	Open Grid Forum 23, Barcelona	Research and Industry/ Grid Community	Any	100s	FHG, UvA, FZJ, SARA, i2CAT
Jun 08	ICTON 07	Research and Industry	Any	100s	I2CAT
Jun 08	TAC08	Research Community	Spain	100s	I2CAT
Jun 08	Phosphorus-Carriocas Workshop	Research and Industry	EU	20s	UEssex, i2CAT
Aug 08	CoreGRID Symposium	Research and Industry	EU	100s	FHG
Aug 08	EuroPar	Research and Industry	Any	100s	FHG, RACTI
Sept 08	TERENA NRENs & Grids workshop	NRENs and Grid Community	EU	50	I2CAT
Sept 08	IEEE Broadnets 08	Research and Industry	Any	100s	AIT, i2CAT, NXW, IBBT

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Sept 08	Open Grid Forum 24	Research and Industry/ Grid Community	Any	100s	FHG, UvA, FZJ
Sept 08	Grid 08	Research and Grid Community	Any	100s	UvA
Sept 08	GOSP (BROADNETS) 08	Research and Industry	Any	100s	AIT,UESSEX
Sept 08	ONT 09	Research and Industry	Any	100s	UvA
Sept 08	ECOC08	Research, Industry, NRENs	Any	100s	UvA, UESSEX
Oct 08	GLIF	Research, Industry, NRENs	Any	120	UvA
Oct 08	NSI Interim Meeting	Research, Industry, NRENs	Any	100s	UESSEX, UvA, SARA
Oct 08	8th Annual Global LambdaGrid Workshop	Research, Industry, NRENs	Any	100s	UESSEX, SARA, UvA
Oct 08	GridNets	Research and Industry	Any	100	IBBT
Nov 08	ICT08	Research and Grid projects	Any	100s	PSNC, i2CAT, NxW, FHG, UESSEX, UvA, SARA
Nov 08	SuperComputing 08	Research and Grid projects	Any	100s	PSNC, i2CAT, NxW, FHG, UESSEX, UvA, SARA
Nov 08	IETF Meeting	Research, Academia and Industry	Any	1000s	SARA
Dec 08	TERENA TF-EMC2 Meeting	Research, Academia and Industry		100s	UvA

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Dec 08	Enlightened Your Research 2 Meeting	Research and Academia	Netherlands	10s	SARA
Dec 08	CineGrid	Research and Industry	Any	100s	SARA
Dec 08	1st E2E TERENA Workshop	NRENS	EU	100s	i2CAT, SARA
Dec 08	ServiceWave 08	Research, Academia and Industry	Any	100s	FHG
Jan 09	OGF Europe Cloud Workshop	Research and Industry/ Grid Community	EU	100s	FHG
Jan 09	SSOKU 09	Research, Academia and Industry	EU	100s	FHG
Feb 09	ONDM 09	Research, Academia and Industry	Any	100s	UESSEX, UvA
Feb 09	Spanish Network of Excellence	Research, Academia and Industry	Spain	100s	I2CAT
Mar 09	OGF25	Research and Industry/ Grid Community	Any	100s	FHG, UEssex, i2CAT
Mar 09	OFC/NFOEC 09	Research and Industry	Any	100s	UESSEX
Mar 09	SOS 13 Workshop	Research and Industry	Any	100	FHG
Mar 09	OGF Europe's 2nd International Event	Research and Industry/ Grid Community	EU	100s	FHG, UESSEX, i2CAT
Apr	ICNS 09	Research and Industry	Any	100s	IBBT
Apr 09	INGRID	Research, Industry, Grid Community	EU	100s	FHG
May 09	IFIP/TC6 09 Networking	Research and Industry	Any	100s	I2CAT
May 09	CCGrid 09	Research, Industry, Grid Community	Any	100s	RACIT

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Jun 09	NOC 09	Research, Academia, Industry	EU	100s	IBBT
Jun 09	ICTON 09	Research and Industry	Any	100s	UEssex, IBBT, AIT, UniBonn, i2CAT
Jun 09	HealthGrid	Research and Industry/ Grid Community	Any	100s	FHG
Jun 09	IM 09	Research and Industry	Any	100s	UvA

Table 2.1: Dissemination Activities Overview

2.1 External Dissemination

2.1.1 Informational Material

To disseminate the knowledge achieved during the duration of the project, the Phosphorus consortium made use of different informational material detailed in Deliverable D7.1.3, “Annual Report on Dissemination Activities”. These include the project website, poster, brochures, briefcase, and two video-clips. In addition, popular media such as magazine articles were published during the duration of the project.



Figure 2.1: Screenshot of the PHOSPHORUS website

The figure below illustrates the number of visitors to the webpage. It presents some indicative statistics of the interest generated by the project from the website visits during the past year (1025 visits per month on average).

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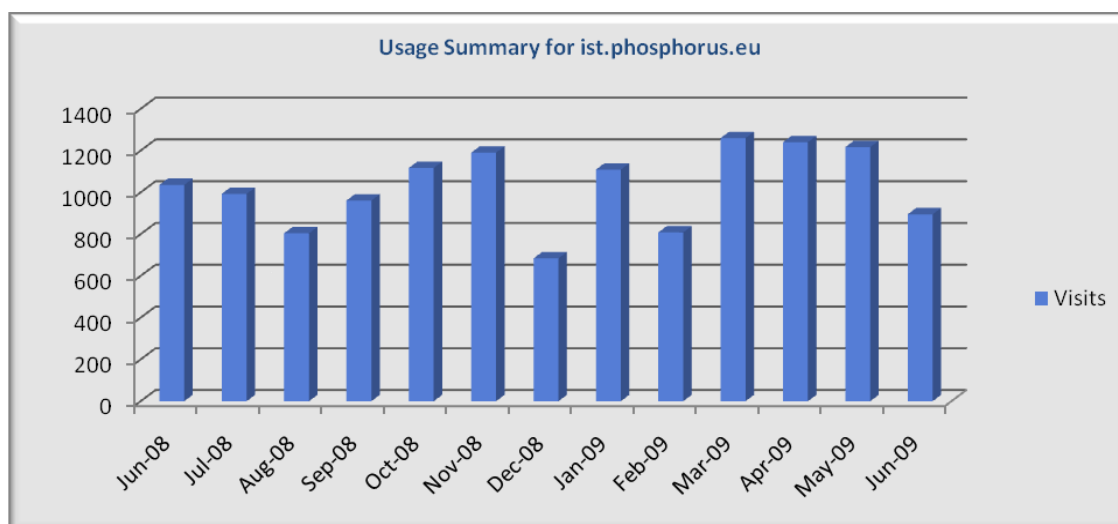


Figure 2.2: PHOSPHORUS website usage statistics for the last 12 months

2.1.2 Workshop, Meetings and Conference Publications

The partners have attended numerous events where either the PHOSPHORUS project was presented or advertised by means of testbed demos, booths and PHOSPHORUS posters, briefcase, brochure, sweets and T-shirts. These events are listed in Table 2.1: Dissemination Activities Overview Table. Also listed in the table are conferences where the partners disseminated results (presentations, papers, posters) of the project. The publications, presentations and posters of the conferences, events and journals are listed below.

2.1.2.1 Workshops and Meeting Publications

1. C. de Laat, "Lambda Grid Projects", OptiPuter All Hands Meeting and Open House, *Presentation* January 2007.
2. A. Binczewski, "PHOSPHORUS: Introduction and Strategy" Collaboration of Three Continents Meeting, *Presentation*, February 2007.
3. M. Garstka, "Overview of PHOSPHORUS Testbeds and Grid Resources" Collaboration of Three Continents Meeting, *Presentation*, February 2007.
4. R. van der Pol, "Lightpath monitoring in NetherLight" GLIF meeting and Internet2 Joint Tech, *Presentation*, February 2007.



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5. S. Figuerola. "Experimental Networking Infrastructures: PHOSPHORUS" TERENA's European Future Networking Initiatives Workshop. *Presentation* February 2007.
6. A. Binczewski, "PHOSPHORUS - Lambda User Controlled Infrastructure for European Research" Internet2 Member Meeting, *Presentation*, April 2007.
7. S. Šíma, "Open Photonic Devices in CEF Networks", The Quilt's 2007 Spring Meeting, *Presentation*, April 2007.
8. T. Eickermann, "Network Research and Provisioning - Current and future projects of ZAM" Jülich-Karlsruhe Colloquium on Grid Computing, *Presentation*, May 2007
9. R. van der Pol, A. Toonk, "Lightpath Planning and Monitoring Tool", CEF network Workshop, *Poster* May 2007.
10. Y. Demchenko, L. Gommans, C. de Laat, "Using SAML and XACML for Complex Resource Provisioning in Grid based Applications", IEEE Workshop on Policies for Distributed Systems and Networks (POLICY 2007) June 2007.
11. G. Zervas, R. Nejabati, D. Simeonidou, "Grid-empowered Optical Burst Switched Network: Architecture, Protocols and Testbed", First International Workshop on GRID over Optical Burst Switching Networks (GOBS2007), June 2007.
12. M. De Leenheer, C. Develder, F. De Turck, B. Dhoedt, P. Demeester, "Erlang Reduced Load Model for Optical Burst Switched Grids", First International Workshop on GRID over Optical Burst Switching Networks (GOBS2007), June 2007.
13. N. Ciulli, G. Carrozzo, "PHOSPHORUS: introduction and considerations on test-beds federation", 2nd OpenNet Workshop, July 2007.
14. 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", CoreGRID Symposium, August 2007.
15. P. Kokkinos, E. Varvarigos, "Resources Configurations for providing Quality of Service in Grid Computing", CoreGRID Symposium, August 2007.
16. A. Binczewski, "The infrastructure of the PHOSPHORUS project", GLIF Technical Working Group Meeting (GLIF'07), *Presentation*, September 2007.
17. R. van der Pol "TL1-Toolkit", GLIF Technical Working Group Meeting (GLIF'07), *Presentation*, September 2007.

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18. R. van der Pol "Interdomain Monitoring Requirements", GLIF Technical Working Group Meeting (GLIF'07), *Presentation*, September 2007.
19. R. van der Pol "Experiences with the ordering and fault resolution process for multi-domain Lightpaths across hybrid networks", GLIF Technical Working Group Meeting (GLIF'07), *Presentation*, September 2007.
20. L. Gommas, "GMPLS token mechanisms" GLIF Technical Working Group Meeting (GLIF'07), *Presentation*, September 2007.
21. I. Monga, B. Peeters, "PHOSPHORUS and Dragon methods of interdomain path setup" GLIF Technical Working Group Meeting (GLIF'07), *Presentation*, September 2007.
22. R. van der Pol, "Lightpaths monitoring in SURFnet6 and NetherLight" CEF Network Workshop, *Presentation* September 2007.
23. R. van der Pol, A. Toonk, "Lightpath Planning and Monitoring Tool", CEF Network Workshop, September 2007.
24. J. Radil, J. Vojtěch, M. Karásek, "Innovative devices for dark fibre networks", CEF Networks Workshop 2007, *Presentation*, September 2007.
25. A. Binczewski, "The PHOSPHORUS project - the new face of Bandwidth on Demand services", Networks for IT: A New Opportunity for Optical Network Technologies, ECOC Workshop. *Presentation* September 2007.
- S. Šíma, J. Radil, "Research networking using programmable photonic devices", TERENA 1st NGN Workshop, *Presentation*, November 2007.
26. C. de Laat "CineGrid Grids & Networking", CineGrid Meeting, *Presentation* December 2007.
27. C. de Laat "CineGrid Working Groups Intro", CineGrid Meeting, *Presentation* December 2007.
28. C. de Laat "CineGrid Networking", CineGrid Meeting, *Presentation* December 2007.
29. J. Vojtěch, J. Radil, "Transparent all optical switching devices in CESNET", The APAN 25th Meeting, Lambda Networking BoF, *Presentation*, January 2008.
30. S. Figuerola. "FEDERICA and PHOSPHORUS" OpenNet Workshop. *Presentation* April 2008



31. C. Barz, U. Bornhauser, P. Martini, C. de Waal, A. Willner, "ARGON: Reservation in Grid-enabled Networks", 1. DFN-Forum 2008, Kaiserslautern, Germany, May 2008.
32. J.A. García-Espín. "PHOSPHORUS: Overview" TAC 08. *Presentation* June 2008
33. S. Figuerola, "Harmony System Interfaces: Multi-domain reservation and inter-operability" *Presentation* OGF 23, June 2008.
34. N.Ciulli, G.Carrozzo, "Augmented ASON/GMPLS Control Plane solutions in support of dynamic optical circuits for applications", BROADNETS '08 Panel #1: Dynamic Optical Circuits for applications, September 2008
35. G.Carrozzo, N.Ciulli, "Control Plane architectures for Grid Network Services: Issues for deployment in wide-area multidomain agile optical networks", *Presentation* ECOC 2008 - Workshop 2 on Optical Grids, Drivers & applications for high performance optical networks, September 2008.
36. S. Šíma, L. Altmannová, J. Vojtěch, M. Krsek, M. Lokajíček, J. Navrátil, V. Novák, P. Holub, M. Liška, M. Šárek, J. Radil, "LTTx: Lightpaths to the application From GOLEs to dispersed end users", GLIF meeting, *Presentation*, October 2008.
37. Y. Demchenko, "XACML-Grid and XACML-NRP Attributes and Policy Profiles and Policy Obligations Handling", *Presentation* TERENA TF-EMC2 meeting, December 2008.
38. S. Figuerola, "Harmony: Advance Reservations Features for Grid", *Presentation*, 1st E2E TERENA Workshop, December 2008
39. J. Radil, S. Šíma, "Customized Approaches to Fibre-based E2E Services", TERENA 1st E2E Workshop - Establishing Lightpaths, *Presentation*, December 2008.
40. 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.
41. S. Figueurola "i2CAT networking expertise in the Phosphorus project", *Presentation*, Multi-layer networks: IP over transport networks (Spanish Network of excellence, Vilanova I la Geltrú, Spain, EU), March 2009.
42. Y. Demchenko, C. de Laat, T. Denys, C. Toinard, "Authorisation Session Management in On-Demand Resource Provisioning in Collaborative Applications". COLSEC2009 Workshop, The 2009 International Symposium on Collaborative Technologies and Systems (CTS 2009), May 2009.



43. S. Šíma, "CEF Networks Research and Experimentation", CEF Networks Workshop 2009, *Presentation*, May 2009.
44. J. Radil, J. Vojtěch, M. Hůla, "Open Transmission and Switching Systems (CL Family)", CEF Networks Workshop 2009, *Presentation*, May 2009.
45. G. Bernini, N. Ciulli, G. Carrozzo, "Enabling Grid-Network Services via Control Plane: the Phosphorus G2MPLS way to the e-Infrastructures", *Presentation*, TNC2009 workshop On-demand network services for the Scientific Community, Malaga (ES), June 2009.
46. Joan Antoni Garcia Espin, "Lightpaths to the User using Harmony, a Phosphorus Approach for Multi-domain Resource Brokering" *Presentation*, TNC2009 workshop On-demand network services for the Scientific Community, Malaga (ES), June 2009.
47. B. Hagemeier and S. Mohammad, "Rapid Deployment of VS Workflows on PHOSPHORUS using Meta Scheduling Service" *Presentation*, TNC2009 workshop On-demand network services for the Scientific Community, Malaga (ES), June 2009.
48. Y. Demchenko, "Authorisation Infrastructure for on-demand Multidomain Optical Network Resource Provisioning" *Presentation*, TNC2009 workshop On-demand network services for the Scientific Community, Malaga (ES), June 2009.
49. M. De Leenheer, "Scalable Design of Resilient Optical Grids" *Presentation*, TNC2009 workshop On-demand network services for the Scientific Community, Malaga (ES), June 2009.
50. E. Escalona, "NSI: The Common Interface towards Network Services" *Presentation*, TNC2009 workshop On-demand network services for the Scientific Community, Malaga (ES), June 2009.

2.1.2.2 Conference Publications

1. D. Simeonidou, G. Zervas, R. Nejabati, "Design considerations for photonic routers supporting application-driven bandwidth reservations at sub-wavelength granularity", International Conference on Optical Burst/Package Switched Networks (WOBS06) October 2006
2. N. Ciulli, G. Carrozzo, "Control Plane architectures for Grid Network Services Issues for deployment in wide-area multi-domain advanced optical networks" IEEE/IFIP International Workshop on Autonomic Grid Networking and Management (AGNM2006), October 2006.
3. G. Zervas, R. Nejabati, Z. Wang, D. Simeonidou, S. Yu, M. O'Mahony, "A Fully Functional Application-Aware Optical Burst Switched Network Test-Bed", Optical Fibre Communication Conference and Exposition and the National Fibre Optic Engineers Conference (OFC/NFOEC07), March 2007.

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4. D. Simeonidou, R. Nejabati, G. Zervas, "Optical Networks Supporting IT Services" Optical Fibre Communication Conference and Exposition and the National Fibre Optic Engineers Conference (OFC/NFOEC07), *Presentation*, March 2007.
5. Y. Demchenko, L. Gommans, C. de Laat, "Using SAML and XACML for Complex Authorisation Scenarios in Dynamic Resource Provisioning" The Second International Conference on Availability, Reliability and Security (ARES 2007) April 2007.
6. M. Riedel, W. Frings, S. Dominiczak, T. Eickermann, T. Düssel, P. Gibbon, D. Mallmann, F. Wolf W. Schiffmann, "Requirements and Design of a Collaborative Online Visualization and Steering Framework for Grid and e-Science infrastructures" German E-Science Conference (GES2007) May 2007.
7. T. Eickermann, W. Frings, O. Wäldrich, O. P. Wieder, W. Ziegler, "Co-allocation of MPI Jobs with the VIOLA Grid MetaScheduling Framework", German E-Science Conference (GES2007) May 2007.
8. M. Oikonomakos, K. Christodouloupoulos, E. Varvarigos, "Profiling Computation Jobs in Grid Systems", IEEE International Symposium on Cluster Computing and the Grid (CCGrid '07), May 2007.
9. M. Cristea, L. Gommans, L. Xu, H. Bos, "The Token Based Switch: Per-Packet Access Authorisation to Optical Shortcuts" IFIP - International Conference on Networking 2007, May 2007
10. R. van der Pol, "Lightpaths monitoring in SURFnet6 and NetherLight" TERENA Networking Conference, *Presentation* May 2007.
11. R. van der Pol, A. Toonk, "Lightpath Planning and Monitoring Tool", TERENA Networking Conference, *Poster* May 2007.
12. K. Christodouloupoulos, M. Varvarigos, C. Develder, M. De Leenheer, B. Dhoedt, "Job Demand Models for Optical Grid Research", Optical Networks Design and Modelling (ONDM2007), May 2007.
13. G. Markidis, S. Sygletos, A. Tzanakaki, I. Tomkos, "Job Impairment Aware based Routing and Wavelength Assignment in Transparent Long Haul Networks", Optical Networks Design and Modelling (ONDM2007), May 2007 .
14. G. Zervas, R. Nejabati, D. Simeonidou "SIP Based OBS networks for Grid Computing", Optical Networks Design and Modelling (ONDM2007), May 2007.



15. 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")", RELARN 2007, June 2007
16. K. Christodouloupoulos, V. Gkamas, E. Varvarigos, "Delay Components of Job Processing in a Grid: Statistical Analysis and Modelling", International Conference on Networking and Services (ICNS2007), June 2007
17. C. Develder, M. De Leenheer, T. Stevens, B. Dhoedt, F. De Turck, P. Demeester, "Scheduling in Optical Grids: A Dimensioning Point of View", The International Conference on the Optical Internet and the Australian Conference on Optical Fibre Technology (COINT-ACOFT2007), June 2007.
18. 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", International Conference on Transparent Optical Networks (ICTON 2007), July 2007.
19. M. De Leenheer, C. Develder, B. Dhoedt, M. Pickavet, P. Demeester, "Design and Control of Optical Grid Networks", IEEE International Conference on Broadband Communication, Networks and Systems (BROADNETS2007) September 2007.
20. A. Binczewski, "The PHOSPHORUS project - new face of bandwidth on demand services", European Conference and Exhibition on Optical Communication'07 (ECOC'07), *Presentation* September 2007.
21. C. Develder, M. De Leenheer, B. Dhoedt, "Evaluation of Optical Grid Scheduling Through Dimensioning", European Conference and Exhibition on Optical Communication'07 (ECOC'07), September 2007.
22. C. Barz, P. Martini, M. Pilz, F. Purnhagen, "Experiments on Network Services for the Grid", IEEE Local Computer Networks Conference (LCN2007), October 2007.
23. T. Stevens, J. Vermeir, M. De Leenheer, C. Develder, F. De Turck, B. Dhoedt, P. Demeester, "Distributed Service Provisioning Using Stateful Anycast Communications", IEEE Local Computer Networks Conference (LCN2007), October 2007.
24. D. Simeonidou, A. Binczewski, G. Zervas, "The IST PHOSPHORUS project: A new model for integrating applications and transport network resources", *Presentation* GridNets 2007, October 2007.
25. K. Christodouloupoulos, E. Varvarigos, "Statistical analysis of the workload and modeling of the time a job spends at different states in the EGEE environment", *Poster* EGEE2007 October 2007
26. P. Kokkinos, K. Koumantaros, E. Varvarigos, "A Framework for Providing Hard Delay Guarantees in the EGEE", *Poster* EGEE2007, October 2007.

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27. S. Figuerola, N. Ciulli, M. de Leenheer, Y. Demchenko, W. Zielger, A. Binczewski, "PHOSPHORUS: Single-step on-demand services across multi-domain networks for e-science" *Invited Paper*, APOC2007, November 2007.
28. C. de Laat "Beyond Hybrid Networking", *Presentation SuperComputing 2007* November 2007
29. P. Kokkinos, E. Varvarigos and N. Doulamis, "A Framework for Providing Hard Delay Guarantees in Grid Computing", *Paper E-Science07* December 2007
30. C. Barz, U. Bornhauser, P. Martini, M. Pilz, "Timeslot-based Resource Management in Grid Environments", *Paper IASTED-PDCN*, February08
31. 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*, OFC/NFOEC, February 2008
32. M. De Leenheer, C. Develder, J. Vermeir, J. Buysse, F. De Turck, B. Dhoedt, and P. Demeester "Performance Analysis of a Hybrid Optical Switch", ONDM, March 2008.
33. K. Seklou, E. A. Varvarigos, "Fast Reservation Protocols for Latency Reduction in Optical Burst-Switched Networks Based on Predictions", ICN'08, April 2008.
34. E. Escalona, G. Zervas, R. Nejabati, D. Simeonidou, G. Markidis, A. Tzanakaki, G. Carrozzo, N. Ciulli, B. Belter, A. Binczewski. "Deployment and Interoperability of the Phosphorus Grid Enabled GMPLS (G2MPLS) Control Plane", CCGRID, May 2008.
35. K. Christodoulopoulos, N. D. Doulamis, E. A. Varvarigos, "Joint Communication and Computation Task Scheduling in Grids", CCGRID, May 2008.
36. P. C. Kokkinos, K. Christodoulopoulos, A. Kretsis, E. A. Varvarigos, "Data Consolidation: A Task Scheduling and Data Migration Technique for Grid Networks" CCGRID, May 2008.
37. C. Barz, M. Pilz, A. Wichmann, "Temporal Routing Metrics for Networks with Advance Reservations" Workshop on High Performance Grid Networks, co-located with CCGrid, May 2008
38. I. M. Llorente, R. Koning, D. Marchal, "Making GRID Applications happen", *Presentation*, TNC, May 2008.
39. B. Belter, K. Whitaker, F. Dijkstra "Matching Applications Requirements", *Presentation*, TNC, May 2008.



40. R. Arak, D. Davies, C. de Laat, D. Lopez, M. Nowlan, L. Ribeiro "GÉANT2 Exposed", *Presentation*, TNC, May 2008
41. K. Christodoulopoulos, E. Varvarigos, "Routing and Scheduling in Grids", *invited paper* ICTON 2008, June 2008.
42. A. Tzanakaki, G. Markidis, K. Katrinis, Supporting differentiated survivability services in WDM optical networks, *invited paper*, ICTON 2008, June 2008
43. 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*, ICTON 2008, June 2008
44. N. Doulamis, P. Kokkinos, E. A. Varvarigos, "Spectral Clustering Scheduling Techniques for Tasks with Strict QoS Requirements," Euro-Par 2008, August, 2008
45. E. Dafouli, P. Kokkinos, E. Varvarigos, "Fair Execution Time Estimation Scheduling in Computational Grids", 7th International Conference on Distributed and Parallel Systems (DapSys), September 2008.
46. G. Markidis and A. Tzanakaki, "Routing and wavelength assignment algorithms in survivable WDM networks under physical layer constraints", GOPS 2008, Broadnets 2008, September 2008.
47. M. De Leenheer, C. Develder, J. Buysse, B. Dhoedt, P. Demeester, "Dimensioning of combined OBS/OCS networks", Broadnets 2008, September 2008.
48. Y. Demchenko, A. Wan, M. Cristea, C. de Laat, "Authorisation Infrastructure for On-Demand Network Resource Provisioning", 9th IEEE/ACM International Conference on Grid Computing (Grid 2008), September 2008.
49. C. Develder, M. Pickavet, B. Dhoedt, and P. Demeester, "A Power-Saving Strategy for Grids" GridNets 2008, October 2008.
50. Y. Demchenko, C. de Laat, O. Koeroo, D. Groep, "Rethinking Grid Security Architecture". Submitted to the 4th IEEE e-Science 2008 Conference, December 2008.
51. C. Abosi, R. Nejabati and D. Simeonidou, "A Service Plane Architecture for Future Optical Internet" *Poster* ONDM 2009, February 2009.
52. K. Katrinis, A. Tzanakaki and G. Markidis, Impairment-Aware WDM Network Dimensioning with Optimized Regenerator Placement, OFC/NFOEC 2009, March 2009.



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53. J. Buysse, M. De Leenheer, C. Develder, B. Dhoedt, P. Demeester, "Cost-Effective Burst-over-Circuit-Switching in a Hybrid Optical Network" ICNS 2009, April 2009.
54. J. Vojtěch, S. Šíma, J. Radil, L. Altmannová, "Dark Fibre Facilities for Research and Experimentation", TridentCom 2009, *Presentation & Proceeding*, April 2009.
55. W. Zeigler "Enabling Quality of Service through Service Level Agreements" INGRID 09 *Presentation*, April 2009
56. W. Zeigler "Networking SLAs: Traditional Approaches and Latest Developments" INGRID 09 *Presentation*, April 2009
57. P. Kokkinos, E. A. Varvarigos, "Resource Information Aggregation in Grid Networks", CCGRID 2009, May 2009.
58. A. Willner, C. Barz, J.A. García-Espín, J. Ferrer-Riera, S. Figuerola, Harmony "Advance Reservations in Heterogeneous Multi-domain Environments" IFIP Networking2009, May 2009.
59. S. Figuerola, J. A. García-Espín, J. Ferrer, and A. Willner: "Performance Analysis of Harmony, and Optical, Multi-domain Network Resource Broker". ICTON2009, June 2009.
60. A. Tzanakaki, K. Georgakilas and K. Katrinis, "Survivable services in WDM networks considering physical layer constraints", ICTON2009, June 2009.
61. C. Abosi, R. Nejabati and D. Simeonidou: "Design and Development of a Semantic Information Modelling Framework for a Service Oriented Optical Internet", *Invited Paper*, ICTON2009, June 2009.
62. T. E.H. El-Gorashi and J. M. H. Elmirghani "Differentiated resilience for anycast flows in MPLS networks," ICTON 2009, June 2009
63. T. E.H. El-Gorashi and J. M. H. Elmirghani "Differentiated resilience with dynamic traffic grooming for WDM mesh networks," ICTON 2009, June 2009.
64. W. Adlan, T. E.H. El-Gorashi and J. M. H. Elmirghani "Anycast routing in OBS based grid networks under heterogeneous traffic," ICTON 2009, June 2009
65. C. Develder, J. Buysse, M. De Leenheer, B. Dhoedt, "Dimensioning resilient optical Grids", ICTON2009, June 2009.
66. M. Shahid, M. Hofmann-Apitius, O. Wäldrich, W. Zielger, "A robust framework for rapid deployment of a virtual screening laboratory", HealthGrid, June 2009

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67. M. Cristea, R. Strijkers, D. Marchal, L. Gommans, C. de Laat, R. Meijer, "Supporting Communities in Programmable Grid Networks: gTBN", 11th IFIP/IEEE International Symposium on Integrated Network Management (IM 2009), June 2009
68. M. De Leenheer, J. Buysse, C. Develder, B. Dhoedt, P. Demeester "Design of Multi-Granular Optical Networks" *Invited paper* 14th European Conference on Networks and Optical Communications (NOC), Jun 2009.

2.1.2.3 Journal Publications

1. 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.
2. 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, Pages 674-686, June 2009.
3. 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, Pages 88-98, April 2009.
4. 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 (FGCS), Vol 25, Issue 2, February 2009.
5. L. Smarr, M. Brown, C. de Laat, Editorial: "Special Section: OptIPlanet - The OptIPuter Global Collaboratory", Future Generation Computer System (FGCS), Vol 25, Issue 2, February 2009, in press.
6. 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 (FGCS), Vol 25, Issue 2, February 2009, in press.
7. F. Dijkstra, J. J van der Ham, P. Grosso, C. de Laat, "A Path Finding Implementation for Multi-Layer Networks", Future Generation Computer System (FGCS), Vol 25, Issue 2, February 2009, in press.
8. 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.
9. N. Ciulli, G. Carrozzo, G. Giorgi, G. Zervas, E. Escalona, Y. Qin, R. Nejabati, D. Simeonidou, F. Callegati, A. Campi, W. Cerroni, B. Belter, A. Binczewski, M. Stroinski, A. Tzanakaki, G. 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.
10. 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
 11. 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.
 12. E. Grasa, A. Lopez, S. Figuerola, G. Junyent, M. Savoie, "UCLPv2: A Network Virtualization Framework Built on Web Services", IEEE Communication Magazine, Vol. 46, No. 3, pp. 126-134, March 2008
 13. 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.
 14. 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.
 15. S. Demeyer, M. De Leenheer, J. Baert, M. Pickavet, P. Demeester "Ant Colony Optimization for the Routing of Jobs in Optical Grid Networks" Journal of Optical Networking, 7(2):160-172, Jan 2008.
 16. 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)
 17. 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
 18. S. Figuerola, J. A. García-Espín, J. Ferrer, and A. Willner "Harmony: A multi-domain, multi-vendor network resource brokering system" IEEE Communication Magazine.
 19. 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". Submitted to special issue on Standardisation in Computer Standards & Interfaces (CSI) journal



20. E. Varvarigos, V. Sourlas, K. Christodoulopoulos, "Routing and Scheduling Connections in Networks that Support Advance Reservations", Elsevier Computer Networks, volume 52, pages 2988-3006, 2008.
21. K. Vlachos and A. Siokis, "A Hierarchical model for Service-Oriented Optical Network architectures", submitted to IEEE/OSA J. Lightwave Technology.
22. P. Kokkinos, K. Christodoulopoulos, E. A. Varvarigos, "Efficient Data Consolidation in Grid Networks and Performance Analysis", submitted to Journal of Parallel and Distributed Computing (JPDC).
23. K. Seklou, A. Sideri, E. Varvarigos, "New Assembly Techniques and Fast Reservation Protocols for Optical Burst Switched Networks Based on Traffic Prediction", submitted to Computer Communications.
24. K. Katrinis, A. Tzanakaki, "On the Dimensioning of WDM Optical Networks with Impairment-aware Regeneration", submitted to IEEE/ACM Transactions on Networking

2.2 Internal Dissemination

For the project to progress smoothly, a number of resources have been setup to aid in internal dissemination. These include a project wiki, frequent project and work-package meetings and mailing lists. In addition, various types of electronic communications aid in internal dissemination [Phosphorus-D7.1.3].



3 Publishable Results

During the duration of the project, the Phosphorus project successfully developed and implemented a number of exploitable results. These results are summarised within this deliverable. These results have been presented in a number of conferences, workshops and journals. The Phosphorus project partners are currently planning to publish these results in a special issue Elsevier and/or IEEE Journal.

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4 Acronyms

AAA	Authentication, Authorisation, and Accounting
AGNM	Autonomic Grid Networking and Management
APOC	Asia Pacific Optical Communications
ARES	Availability, Reliability and Security
BROADNETS	Broadband Communication, Networks and Systems
CCGrid	Cluster Computing and the Grid
COINT-ACOPT	Conference on the Optical Internet and the Australian Conference on Optical Fibre Technology
ECOC	European Conference and Exhibition on Optical Communication
EFNIW	European Future Networking Initiatives Workshop
EGEE	Enabling Grids for E-science
EU	European Union
GES	German E-Science
GLIF	Global Lmbdagrid
GOBS	GRID over Optical Burst Switching Networks
HPDC	High Performance Distributed Computing
ICNS	International Conference on Networking and Services
ICT	Information and Communication Technology Conference
ICTON	International Conference on Transparent Optical Networks
IETF	Internet Engineering Task Force
ISC	International Supercomputing Conference
LCN	Local Computer Networks Conference
MSS	MetaScheduling Service
NREN	National Research and Education Network
NRPS	Network Resource Provisioning System
OFC/NFOEC	Optical Fibre Communication Conference and Exposition and the National Fibre Optic Engineers Conference
OGF	Open Grid Forum
OGSA	Open Grid Services Architecture
ONDM	Optical Networks Design and Modelling
OSG	Open Science GRID
OSS	Open Source Software
PDCN	Parallel and Distributed Computing and Networks
POLICY	Policies for Distributed Systems and Networks
RSVP	Resource ReSerVation Protocol
SCN	Signalling Communication Network



Plan for Using and Exploiting the Knowledge

UNICORE	European Grid Middleware (UNliform Access to COmpute RESources)
WOBS	Workshop on Optical Burst/Packet Switching
WEBIST	Web Information Systems and Technologies
XACML	eXtensible Access Control Markup Language

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5 References

- [Phosphorus-D7.1.3]** C. Abosi, D. Simeonidou, R. Nejabati, D. Parniewicz “PHOSPHORUS deliverable D7.1.3: Annual Report on Dissemination Activities”, Project deliverable, European IST project PHOSPHORUS, June 2009