



034115

PHOSPHORUS

Lambda User Controlled Infrastructure for European Research

Integrated Project

Strategic objective:
Research Networking Testbeds



Deliverable D6.6 Plan of testing

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Abstract

Phosphorus addresses some of the key technical challenges to enable on-demand e2e network services across multiple domains. The Phosphorus network concept will make applications aware of their complete Grid resources (computational and networking) environment and capabilities, and able to make dynamic, adaptive and optimized use of heterogeneous network infrastructures connecting various high-end resources. Phosphorus will enhance and demonstrate solutions that facilitate vertical and horizontal communication among applications middleware, existing Network Resource Provisioning Systems, and the proposed Grid-GMPLS Control Plane.

One of the main assumptions of Phosphorus is that the project propositions and developments should be validated and demonstrated in a real advanced optical network. To achieve this, the project has built a distributed testbed in which the project outcome will be demonstrated with a set of real scientific applications in a set of real-life scenarios.

This document summarises the plan of testing of the PHOSPHORUS developments. An initial version of the testplan was included in the Description of Work. The plan shown in this document is an updated version of the testplan adjusted to the current schedule of the work in other workpackages.

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0 Executive Summary

Phosphorus addresses some of the key technical challenges to enable on-demand e2e network services across multiple domains. The Phosphorus network concept will make applications aware of their complete Grid resources (computational and networking) environment and capabilities, and able to make dynamic, adaptive and optimized use of heterogeneous network infrastructures connecting various high-end resources. Phosphorus will enhance and demonstrate solutions that facilitate vertical and horizontal communication among applications middleware, existing Network Resource Provisioning Systems, and the proposed Grid-GMPLS Control Plane.

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This document summarises the plan of testing of the PHOSPHORUS developments. An initial version of the testplan was included in the Description of Work. The plan shown in this document is an updated version of the testplan adjusted to the current schedule of the work in other workpackages.

The PHOSPHORUS developments which will be tested in the test-bed come from different PHOSPHORUS activities. Tests which refer to developments of each workpackage are described in separate chapters.

For each set of tests the local test-beds in which the tests will be performed are indicated in this deliverable.

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1 NRPS experiments – WP1

The WP1 developments aim to provide with the required interfaces (south/northbound, east/west) in order to provide full interoperability and interworking between different NRPSs, the middleware and the GMPLS Control Plane. NRPS functionalities will be integrated within the Network Service Plane, that will provide a transparent layer between the NRPS and the service layer of the middleware to allow users provisioning connections through different domains using different NRPSs. At the lower level, the G²MPLS control plane developed at the WP2, will be the responsible to provide grid services discovery capabilities and dynamic performance to the NRPS.

The experiments that will be carried out to validate the developments done along the WP1, will be related to NRPS interoperability through the NSP, its integrations with the middleware at the upper layers, and the southbound interfaces performance with the G²MPLS control plane.

Phase 1:

Performance of interfaces functionalities for NRPSs interoperability, and its interworking with the middleware and the standard GMPLS Control Plane

- **Objective:** To test NRPS interoperability, in first place connections will be set-up and tear-down manually from each NRPS, performing a loop-back by crossing other domains with different NRPS. In second place, the same provisioning service will be established, but using the developed NSP instead manually, in order to validate and test its performance. Finally, joint tests with the Middleware will be performed. To test the interface with a standard GMPLS Control Plane, a provisioning service launched by the NRPSs will be tested. The tests with the G²MPLS prototype will be performed in the second phase of the project.
- **Expected execution.** M10–M18, in the framework of Task 6.3, A6.3.2 – “Configuration of GNRPS and its integration with control planes” and A6.3.3 – “Testing of these applications to verify that they are working correctly”
- **Expected feedbacks.** These tests are expected to provide feedback to WP1 team on:
 - Identification of bugs and faulty operations of the NRPS interfaces to be fixed.
 - Development of the standard interfaces for the NRPSs and the NSP.
 - Performance of the enhanced interfaces for interoperability between the NRPSs, the NSP, the Middleware and GMPLS.

Phase 2:

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Integration of AAA functionalities between the NRPSs, and its full interoperability with the G²MPLS Control Plane. Enhancements of the NSP.

- **Objective:** To perform the same testbed performed at Phase I but now involving the G²MPLS Control Plane and the AAA functionalities with a enhanced NSP.
- **Expected execution.** M16–M30, in the framework of Task 6.4, A6.4.2 – “Implementation of tests according to the plan” and A6.4.3 – “Interpretation of results and publication of test report”
- **Expected feedbacks.** These tests are expected to provide feedback to WP1 team on:
 - Identification of bugs and faulty operations of the NRPS and NSP interoperability with the G²MPLS Control Plane
 - Identification of bugs and faulty operations of the AAA mechanism interoperability between the NRPSs and the NSP.

Local test-beds involved:

- I2CAT (NRPS deployed – UCLP)
- SURFnet (NRPS deployed – DRAC)
- CRC (NRPS deployed – UCLP)
- VIOLA (NRPS deployed – ARGON)

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2 Control plane experiments – WP2

The WP2 developments are aimed to provide the Phosphorus test-bed with those enhanced CP prototypes implementing the adaptation of the GMPLS Control Plane to support Grid Network Services (G²MPLS). In this perspective, those experiments targeted to validate WP2 developments will focus on the assessment of the network control plane capability to enhance information flows, dynamics and performances in the provisioning of optical connections for Grid jobs running on the Phosphorus applications. Therefore, WP2 experiments on the Phosphorus test-bed will not directly rely on specific Grid applications, because their request for specific network resources will be masked by the enhanced Phosphorus Grid Middleware and/or NRPS, appropriately extended for the interaction with G²MPLS CP. The plans of G²MPLS prototypes delivery (ref. WP2 planning and milestones) allow scheduling two demonstration phases for the Network Control Plane:

Phase 1:

“Standard” GMPLS Control Plane prototype, which receives requests for optical connections setup/tear-down via O-UNI by the overlaying NRPS.

- **Objective.** The objective of these tests will be the demonstration of e2e user-controlled interaction of Grid-users with a world-wide distributed optical network infrastructure in the framework of two *mutually unaware* layers (Grid and NCP).
- **Expected execution.** M12–M18, in the framework of Task 6.3, A6.3.2 – “Configuration of GNRPS and its integration with control planes” and A6.3.3 – “Testing of these applications to verify that they are working correctly”
- **Expected feedbacks.** These tests are expected to provide feedback to WP2 team according to the following schedules:
 - M12-M16, identification of bugs and faulty operations of the provided Control Plane developments to be fixed.
 - M18, assessment of the research findings and proposed Control Plane models

Phase 2:

Full G²MPLS Control Plane prototype, which floods Grid resource information through the G²MPLS domains and receives requests for Grid/optical connections setup/tear-down via G.O-UNI by the overlaying Phosphorus Middleware and NRPS.

- **Objective.** The objective of these tests will be the demonstration of e2e Grid-controlled interaction of the enhanced Middleware and NRPS with a world-wide distributed optical network infrastructure in the framework of two *seamlessly integrated* layers (Grid and NCP).

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- **Expected execution.** M14–M30, in the framework of Task 6.4, A6.4.2 – “Implementation of tests according to the plan” and A6.4.3 – “Interpretation of results and publication of test report”
- **Expected feedbacks.** These tests are expected to provide feedback to WP2 team according to the following schedules:
 - M14-M22, identification of faulty operations of the preliminary G²MPLS Control Plane developments to be fixed.
 - M22-M24, identification of faulty operations of the preliminary G²MPLS Control Plane prototype to be fixed.
 - M24-M30, identification of faulty operations of the final G²MPLS Control Plane prototype to be fixed.
 - M24-M30, assessment of the overall WP2 research findings and proposed Control Plane models

Local test-beds involved:

- PSNC (supported switches: LSC – ADVA, FSC – CALIENT)
- UESSEX (supported switches: FSC – CALIENT)
- CESNET (supported switches: FSC – home-made)

The plan of G²MPLS control plane functional testing:

The Phosphorus testbeds in PSNC, UESSEX and CESNET provide equipment, connections middleware/applications for G²MPLS testing purposes, which enables intra-domain and inter-domain scenarios used to verify the G²MPLS prototype. The tests which need testbed infrastructure are described below.

1) Transport network resource configuration tests

Network resource configuration is provided by TNRC module which is responsible for abstracting the technology specific details of the transport network resources for control plane use. The main functionalities of the Transport Network Resource Controller are:

- translation and maintenance of the bindings between the technology specific name space for transport resources (e.g. in DWDM equipments: port, wavelength; in TDM: port, virtual container; in Ethernet: port, VLAN) and the G²MPLS name space (data-link, label)
- translation between the technology specific configurations for transport resources (e.g. cross-connections, protections, etc.) and the corresponding G²MPLS actions
- binding maintenance among the resources (e.g. cross-connections, bookings, protections/restorations, etc.).

The TNRC module functionalities to be tested include:

- providing device resource information (available data-links and labels)
- cross-connection reservation
- cross-connection unreservation
- cross-connection activation
- cross-connection deactivation
- cross-connection creation

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- cross-connection deletion
- alarm appearing and clearing notifications.

TNRC module will be tested with the different types of transport network devices available in the Phosphorus testbed:

- Calient DiamondWave Fiberconnect (FSC),
- ADVA FSP 3000RE-II (LSC),
- CzechLigth Switch (FSC),
- Foundry NetIron XMR (L2SC).

WP6 will provide access to these devices:

- access rules for IP addresses and TL1/CLI/SNMP/HTTP ports,
- enable access accounts (user and password) and verify test results by analyzing device configuration and status.

2) G2MPLS routing tests

The routing functionality is provided by the OSPF routing protocol extended with GMPLS TE and Grid-GMPLS extensions. The module implements:

- the routing instance for the G.I-NNI interface between G2MPLS nodes,
- some preliminary routing G.E-NNI extensions between inter-domain routing controllers,
- a discovery service of G.O-UNI interface for users and Grids

The planned tests of the module functionalities include:

- service capabilities and resource availability information retrieving from Grid Vsite by G.O-UNI interface and gateway
- network device resources retrieving from LRMD module in every G2MPLS controller
- network topology, data-links availability, GRID service capabilities and grid resources availability flooding using G.I-NNI and G.E-NNI interfaces to be accessible by G.O-UNI-N instance and Path Computing module
- providing global information about availability of GRID services and resources, and network resources to users by G.O-UNI interface

WP6 will provide:

- several PC computers to run G2MPLS Routing Controllers in various domains
- access to common network (Internet) for all G2MPLS Routing Controllers
- access for TNRC modules to network devices
- access for G2MPLS G.O-UNI gateway to Grid middleware managing Grid resources

WP6 will verify the test by analyzing information available in every G.O-UNI-C instance and provided by web-services of G.O-UNI gateway.

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3) G2MPLS signaling tests

The planned tests of the G.RSVP module functionalities include:

- network path reservation in one domain or in multiple domains
- network path activation
- network setup (reservation + activation)
- network path teardown
- network path recovery
- requesting the Grid resource reservation via G2MPLS gateway
- requesting the Grid resource configuration via G2MPLS gateway
- requesting the Grid resource deallocation via G2MPLS gateway

WP6 will provide:

- several PC computers to run G2MPLS Signalling Controllers in various domains,
- access to common network (Internet) for all G2MPLS Signaling Controllers,
- access for TNRC modules to network devices ,
- access for G2MPLS G.O-UNI gateway to Grid middleware managing Grid resources.

WP6 will verify the proper allocation, activation and deletion of the network and GRID resources.

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3 Middleware and applications experiments - WP3

The developments of WP3 are directly targeted to perform test-bed experiments. The middleware will make the Phosphorus network services accessible to applications and the applications are modified and enhanced to make use of those services. Following the two phases of the project developments, there will be two phases for middleware and application experiments. In those phases, the WP3 experiments will

- Test and evaluate the respective application and middleware enhancements and their interaction.
- Test and evaluate the interaction of middleware and the underlying services as provided by WP1 and WP2.
- Evaluate and demonstrate the benefit of the applications from the new services

The plans for the two phases are:

Phase 1:

Test of the application-level interfaces of the Grid infrastructure (UNICORE) needed to integrate the co-allocation of arbitrary resources like CPU, storage and network.

Test of the middleware integration into the Phosphorus architecture including interaction with the developments of WP1 and WP2 (NRPS, GMPLS and G²MPLS as available).

Demonstration of the applications selected to evaluate Phosphorus' Hybrid Research Infrastructure.

- **Objective.** Demonstration of the middleware co-allocation service communicating with the resources indirectly via the services provided by WP1. The implementation of the functionality, protocols and interfaces will be evaluated. Demonstration of the selected applications (docking simulation, distributed visualisation, streaming of ultra high resolution data sets, distributed data storage system)
- **Expected execution.** M12–M16, in the framework of Task 3.4
- **Expected feedbacks.** These tests are expected to provide feedback to the WP3 team on:
 - bugs and faulty operations of the provided middleware interface, protocols and functionality of the first prototype
 - quality of the interface to the NRPS and GMPLS via O-UNI
 - quality of the interface specifications between G²MPLS and the various resource management systems e.g. for the compute and storage,
 - the integration into the AAA provided by WP4

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- quality of the first adaptation of the selected applications to the first version of the middleware and underlying networking environment
- behavior and performance results running the applications in the Hybrid Research Infrastructure

Phase 2:

Test of the enhanced application-level interfaces of the Grid infrastructure needed to integrate the co-allocation of arbitrary resources like CPU, storage and network. This includes test of the semantic annotation of the service abstraction of the resources available in the test-bed to enable automatic, reasoning based request and selection of resources based on the requirements described by the user or exposed by the application.

Test of the middleware integration into the Full G²MPLS Control Plane prototype.

Demonstration of the applications selected to evaluate Phosphorus' Hybrid Research Infrastructure.

- **Objective.** Demonstration of the middleware co-allocation service communicating with the resources indirectly via the services provided by WP2. The implementation of the functionality, protocols and interfaces will be evaluated. Demonstration of the selected applications (docking simulation, distributed visualisation, streaming of ultra high resolution data sets, distributed data storage system)
- **Expected execution.** M20–M24, in the framework of Task 3.4
- **Expected feedbacks.** These tests are expected to provide feedback to the WP3 team on:
 - bugs and faulty operations of the second version middleware interface, protocols and functionality of the first prototype
 - quality of the interface full G²MPLS
 - quality of the interface between full G²MPLS and the various resource management systems e.g. for the compute and storage,
 - the full integration into the AAA provided by WP4
 - quality of the adaptation of the selected applications to benefit from the second version of the middleware and underlying network environment
 - behavior and performance results running the applications in the Hybrid Research Infrastructure

Local test-beds involved:

- PSNC (applications deployed: DDSS, WISDOM, KoDaVis)
- VIOLA (applications deployed: DDSS, WISDOM, KoDaVis, TOPS)
- UESSEX (applications deployed: DDSS, WISDOM, KoDaVis)
- SARA (applications deployed: TOPS)

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4 Authentication, Authorisation and Accounting experiments – WP4

The activities of WP4 include test-bed experiments. WP4 will collaborate with WP1, 2 and 3 to integrate AAA system components to test a number of different authorization scenarios. Following the two phases of the project developments, there will be two phases for AAA based experiments. In those phases, the WP4 experiments will

- Phase-1: Test and evaluate the integration of various AAA Authorisation and policy enforcement components in the Phosphorus test-bed.
- Phase-2: Expand the tests for multidomain scenarios and integrating AAA testbed with the international research networks such as Internet2 DCN and GÉANT2.

The plans for the two phases are:

Phase 1:

Evaluate different VO and federation based attribute services for Authentication and Authorization for multidomain Network Resource Provisioning (NRP) to be implemented in the testbed such as EduGAIN and Shibboleth used for federated network access in GÉANT2 JRA5 and VOMS used in major Grid middleware such as EGEE gLite and Globus Toolkit.

Based on input of WP1, 2 and 3 define and gradually implement required functionality into the Generic AAA Authorisation framework (GAAA-AuthZ). The proposed GAAA-AuthZ architecture and functionality will support the general Complex Resource Provisioning (CRP) model that extends the basic RFC2904 sequences to the multidomain network resource provisioning: agent, pull, push and combined that separates reservation, deployment and access stages.

The developed Generic AAA toolkit (GAAA-TK) functionality and components will allow to be used as a stand-alone inter-domain controller and as a pluggable components to existing NRPS or NSP systems. It will provide a basis for policy driven multi-domain scenarios. After definition of these scenarios, efforts will be made to develop and test these scenarios in the Phosphorus test-bed.

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Special attention will be paid to developing and testing the major principles and components of the Token Based Networking (TBN) that implements ForCES architecture being developed at IETF with contribution from the Phosphorus project members. UvA has established TBN testbed and has demonstrated ForCES Token Based Switch together with UoP at the IETF73 meeting.

The GAAA-TK functionality and implementation includes a special module Token Validation Service (TVS) that can be used as a pluggable component to support token based policy enforcement and access control at all three networking layers: data plane, control plane, and service plane.

Phase 2:

In the phase 2 WP4 will focus more closely on cooperation with WP1 to integrate GAAA-TK components to ensure future integration compatibility issues between different domain and inter-domain controller implementation and smooth interoperation between AuthZ services at different networking layers: dataflow, control plane and service plane. Cooperation with WP2 will focus on adding GAAA-AuthZ functionality to the G-GMPLS control plane by integrating GAAA-TK components with G-GMPLS middleware.

Suggested solutions and GAAA-TK components will be implemented in the UvA AAA testbed and tested in cooperation with Phosphorus partners and other cooperating networks such as Internet2 DCN and GÉANT2. The tests will focus on demonstrating use of common AAA/AuthZ mechanisms to ensure interdomain interoperability and multidomain policy based network resource provisioning, addressing path discovery, advance reservation, deployment and access control enforcement. Interoperability between different user attributes typically used in NREN and Grid oriented networks will be addressed.

Local test-beds involved:

- UvA
- I2CAT, UoB, SURFNET, CRC (integration between AAA/AuthZ and NRPSes)
- UESSEX, PSNC (integration between AAA/AuthZ and control plane)

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5 Other testbed activities

One of the tasks in workpackage 6 will deal with new types of optical resources used in pure optical networks (networks without OEO conversion). The new types of resources are e.g. optical switches, semiconductor optical amplifiers, wavelengths converters, optical multicast devices and tunable lasers. Development of resource management systems should be aware of future pure optical network or subnetworks and allow for gradual extension in order to be able to manage the new resources.

- **Objective.** Demonstration of an interaction between a network resource provisioning system (NRPS) and the new optical resources available in the testbed.
- **Expected execution.** M19–M30, in the framework of Task 6.6.
- **Expected feedbacks.** These tests are expected to provide feedback to the WP6 team on:
 - the interfaces between an NRPS and the new optical resources
 - the interaction between an NRPS and the new optical resources

Local test-beds involved:

- CESNET
- PSNC

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6 Conclusions

The deliverable shows an updated plan of testing of the PHOSPHORUS developments. The developments of other PHOSPHORUS workpackages will be tested in the distributed testbed which was built and is being maintained by Workpackage 6.

The tests of PHOSPHORUS developments have already started and will be continued until the end of the project. The aim of these tests is to validate and demonstrate the PHOSPHORUS ideas and developments in a real optical network with a set of demanding scientific applications.

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7 References

EGEE	www.eu-egee.org
Globus	www.globus.org
IETF73	www.ietf.org
Internet2	www.internet2.edu

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8 Acronyms

AAA	Authentication, Authorisation and Accounting
AuthZ	Authorization
CP	Control Plane
EGEE	Enabling Grids for E-science (European Grid Project)
GAAA-AuthZ	Generic AAA Authorisation Framework
G.O-UNI	GRID Optical User to Network Interface
GÉANT2	Pan-European Gigabit Research Network
gLite	EGEE Grid middleware
GMPLS	Generalized MPLS (MultiProtocol Label Switching)
G ² MPLS	Grid-GMPLS (enhancements to GMPLS for Grid support)
NCP	Network Control Plane
NRPS	Network Resource Provisioning System
O-UNI	Optical User to Network Interface
ONL	Optical Networking Laboratory
TBN	Token Based Networking
TOPS	Technology for Optical Pixel Streaming
TSM	Tivoli Storage Manager, a commercial backup/archive software by Tivoli, formerly known as IBM's ADSM)
UCLP	User Controlled Light Paths
UNI	User to Network Interface
VO	Virtual Organization
VOMS	Virtual Organization Membership Service



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