Solving End-to-End connectivity with GMPLS

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Phosphorus project

- European and Global alliance of partners to develop advanced solution of application-level middleware and underlying management and control plane technologies

Project Vision and Mission

- The project will address some of the key technical challenges in enabling on-demand end-to-end network services across multiple heterogenous domains
- In the Phosphorus' implementation the underlying network will be treated as first class Grid resource
- Phosphorus will demonstrate solutions and functionalities across a test-bed involving European NRENs, GÈANT2, Cross Border Dark Fibre and GLIF
Phosphorus partners

- **NRENs & RON:**
  - CESNET
  - PSNC
  - SURFnet
  - MCNC
- **Manufacturers:**
  - ADVA Optical Networking
  - Hitachi Europe Ltd.
  - NORTEL
- **SMEs:**
  - Nextworks

- **Universities and Research Institutions:**
  - Communication Research Centre
  - Fraunhofer-Gesellschaft
  - Fundació I2CAT
  - Forschungszentrum Jülich
  - Interdisciplinair instituut voor BreedBand Technologie
  - Research Academic Computer Technology Institute
  - Research and Education Society in Information Technology
  - SARA Computing and Networking Services
  - University of Bonn
  - University of Amsterdam
  - University of Essex
  - University of Leeds
Phosphorus Key Features

- Demonstrate on demand service delivery across multi-domain/multi-vendor research network test-beds on a European and Worldwide scale. The test-bed will include:
  - EU NRENs: SURFnet, CESNET, PIONIER as well national test-beds (VIOLA, OptiCAT, UKLight)
  - GN2, GLIF and Cross Border Dark Fibre connectivity infrastructure
  - GMPLS, UCLP, DRAC and ARGON control and management planes
  - Multi-vendor equipment environment (ADVA, HITACHI, NORTEL, Vendor’s equipment in the participating NREN infrastructure)
Phosphorus Key Features

- Develop integration between application middleware and transport networks, based on three planes:
  - Service plane:
    - Middleware extensions and APIs to expose network and Grid resources and make reservations of those resources
    - Policy mechanisms (AAA) for networks participating in a global hybrid network infrastructure, allowing both network resource owners and applications to have a stake in the decision to allocate specific network resources
  - Network Resource Provisioning plane:
    - Adaptation of existing Network Resource Provisioning Systems (NRPS) to support the framework of the project
    - Implementation of interfaces between different NRPS to allow multi-domain interoperability with Phosphorus’ resource reservation system
  - Control plane:
    - Enhancements of the GMPLS Control Plane (G²MPLS) to provide optical network resources as first-class Grid resource
    - Interworking of GMPLS-controlled network domains with NRPS-based domains, i.e. interoperability between G2MPLS and UCLP, DRAC and ARGON
Phosphorus Key Features

- Studies to investigate and evaluate further the project outcomes:
  - Study resource management and job scheduling algorithms incorporating network-awareness, constraint based routing and advance reservation techniques
  - Develop a simulation environment, supporting the Phosphorus network scenario
- Disseminate the project experience and outcomes, toolkits and middleware to NRENs and their users, such as Supercomputing centres
PHOSPHORUS ARCHITECTURE

The different domains of the Phosphorus test-bed will have:

- Grid middleware
  - UNICORE as a reference point
  - AAA policies

- Three types of NRPS:
  - UCLP
  - DRAC
  - ARGON

- Two “flavours” of GMPLS
  - Standard (Ph. 1)
  - Grid-enabled (Ph. 2)
System overview

A) Northbound IF:
It receives the reservation requests from the GRID Middleware.

B) East-West IF:
It is in charge of the communication between NRPSs.

C) Topological IF:
It is used to indicate to the NSP which are the resources under control (NRPSs, endpoints, links).

D) Southbound IF:
It Communicates the NRPSs and the lower layers (GMPLS or transport layer).

E) Phase 2 IF:
It provides interoperability between the NSP and the G²MPLS CP or other projects.
Reservation Handling in Phosphorus

GRID APPLICATIONS & MIDDLEWARE

Network Service Plane

RESV WS IF

RESV WS CLIENT (PROXY)

Resv. WSDL

Adapter

Adapter

Adapter

ARGON

DRAC

UCLPv2

Network Resource Provisioning Systems

NRPS Specific Interfaces (WS, JMS, others)

GMPLS

Transport Network

Transport Network

CreateReservationUCLP(...)  
- ServiceID  
- TypeOfReservation (‘fixed’ by default)  
- Connection<List>:  
  · ConnectionID  
  · MinBW, MaxBW  
  · MaxDelay  
  · DataAmount  
  · Source, Target  
  · Directionality  
- Constraints<List>:  
  · Start-time  
  · Duration  
  · Deadline

CreateReservation(...)  
+ JobID  
+ ServiceDataType<List>:  
  - ServiceID  
  - TypeOfReservation  
  - Connection<List>:  
    · ConnectionID  
    · MinBW, MaxBW  
    · MaxDelay  
    · DataAmount  
    · Source, Target  
    · Directionality  
- Constraints<List>:  
  · Start-time  
  · Duration  
  · Deadline

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Thin NRPS: is a network resource provisioning system for domains with a GMPLS control plane. It is a NRPS with restricted functionality.

- Provides a reservation web service to reserve, create and delete network connections via the GMPLS driver.
- Provides advance reservation services (checking end points availability and possible overlapping reservations).
- Provides notifications receiver interface.
- Acts as a client of the Topology manager WS of the NSP.
- Acts as a client of the GMPLS driver.
- Domain registering.
- Handles reservation request from NSP.
The GMPLS Driver

**GMPLS driver:** an interface between NRPS and the GMPLS CP. It is a general WS to create, delete and monitor paths for different GMPLS implementations, provides a WEB interface for testing the WEB service, Internal data base containing topology, path and status information, modules for accessing vendor specific GMPLS control planes (e.g. Alcatel-Lucent or Nortel) and G(²)MPLS interface to GMPLS

**GMPLS driver services:**
- Path creation
- Path termination
- Path monitoring
- Path discovery
- Endpoint discovery
- Registration service
- Path delete notification
- EndPoint update notification
G²MPLS Control Plane models

- Two models for the layering between Grid and Network resources

**G²MPLS overlay model**

**G²MPLS integrated model**

different scope with respect to the IETF GMPLS Overlay & Peer

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Example of direct invocation

G²MPLS NCP

Grid site A

Grid user

G.OUNI GW

Grid MW

Grid Resources

Grid site B

G.OUNI GW

Grid MW

Grid Resources
Example of direct invocation
Example of direct invocation

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Phosphorus multi-domain testbed
The demonstration shows the creation of the e2e path to connect the two servers, one located in PSNC (Poland), and the second one in VIOLA (Germany).

One of them sends an HD video stream that crosses the domains along Europe and Canada. When the path is successfully set up, the HD video is shown on the HD Video client machine.
SC07 demos

- Data stored on **central data-server** (Jülich, Germany)
- Two visualization clients (located in Reno) **collaboratively retrieve and explore** fragments of the data
- **QoS** in network is required for reliable fluent visualization

**KoDaVis** - distributed, collaborative visualization system with remote access to huge atmospheric simulation data.

**SC07 at Reno**
FEDERICA and Phosphorus workshop

- Federica-Phosphorus tutorial and workshop (TNC2008)
  - 18th May 2008, Bruges (Brugge), Belgium
  - Associated with TERENA conference 2008
  - Scope:
    - Discuss architectural solutions for network and IT service integration over high speed network infrastructure
    - Present various implementations of network control and service plane architectures to support the emerging infrastructure-as-a-service model
    - Share collective experiences gained by major research projects and initiatives around the globe and explore common vision, outcomes and synergies
The End

Thank you for your attention