

PHOSPHORUS

G²MPLS services

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On-demand Infrastructure Services Provisioning Workshop
Amsterdam, 2009



- **Grids & network in research networking**
- **G²MPLS overview**
- **G²MPLS features**
- **G²MPLS services**
- **G²MPLS software**





GRIDS & NETWORK IN RESEARCH NETWORKING

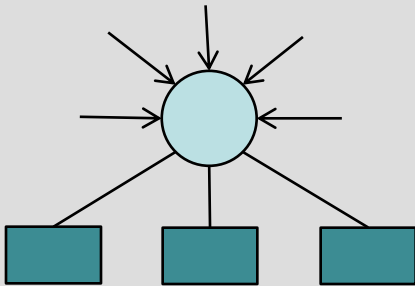


Grids & network in research networking [1]

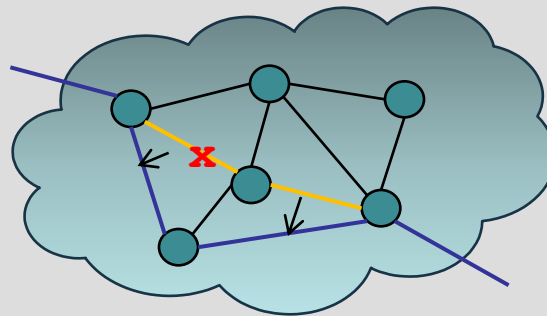


■ BoD systems in Research Networks

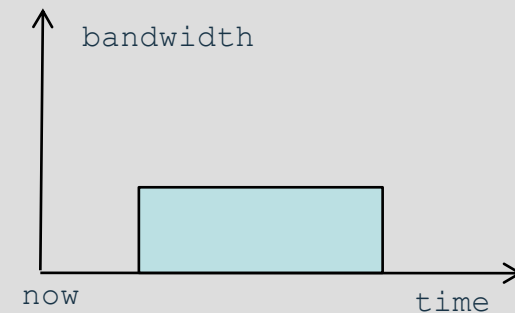
- e.g. EU-GN2 AutoBAHN, ESNET-OSCARS
- To provide dynamic connection services, e.g. for HPC/Grid centres
 - mostly WS-based & centralized – scalability problems
 - overlay-style approach for any BoD user
 - immediate and in-advance bandwidth reservations
 - No network recovery



Centralized



Recovery

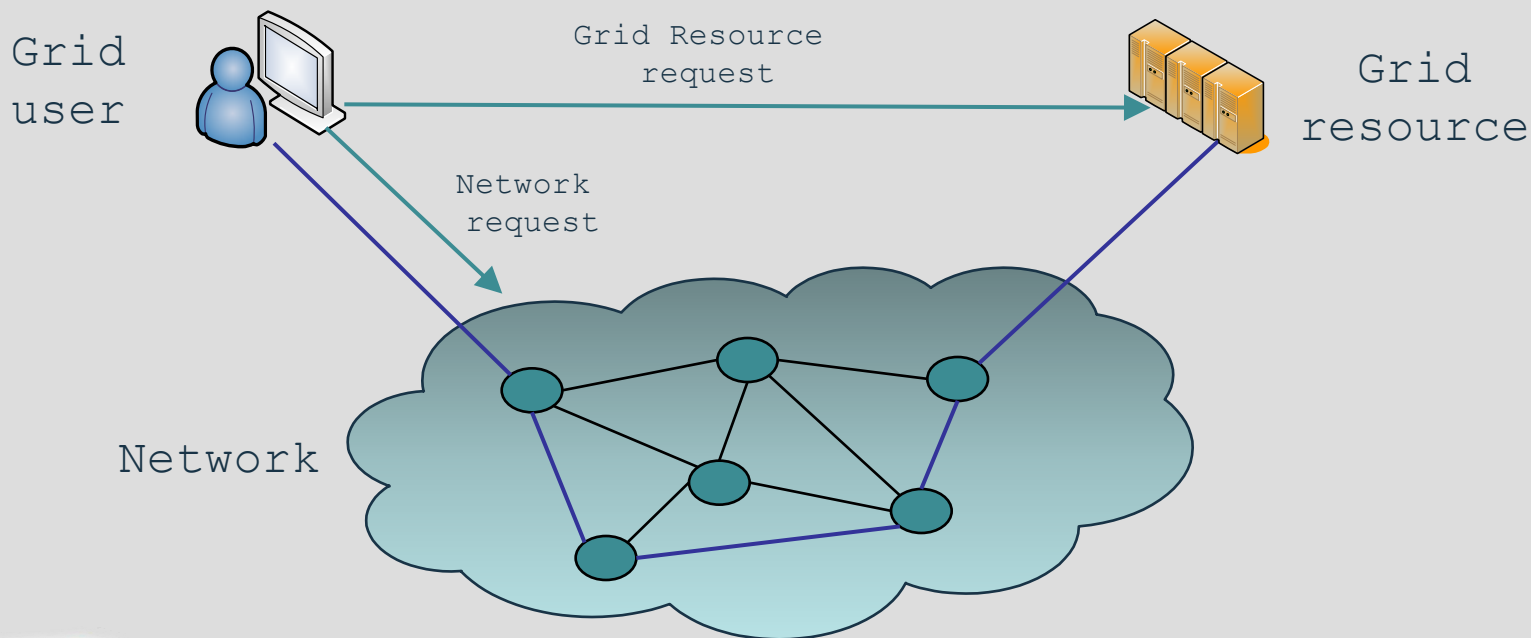


Advance reservation

Grids & network in research networking [2]



- Still difficult to have combined reservation of network & Grid resources
 - Most of the production Grid middlewares (GLOBUS, UNICORE, gLite, etc.) just play on the Grid layer
 - pre-established and QoS-guaranteed connections between Grid sites (tens of Gbps CBR, minimum jitter and delay, etc.)
 - The mutual unawareness between the decision-making entities in the Grid and in the network layers





G²MPLS OVERVIEW

- **Why G²MPLS?**
- **G²MPLS concept**
- **Interfacing with G²MPLS**
- **G²MPLS is still GMPLS**
- **Standards relation**
- **Co-operation with Grids**

Why G²MPLS?



- A major step forward
 - the **provisioning of network and Grid resources in a single-step**, through a set of seamlessly integrated procedures (Grid Network Service – GNS)

- The Control Plane activity („*Enhancements to the GMPLS Control Plane for Grid Network Services*”) of the Phosphorus project (EU IST project: 034115)

NEXTWORKS
ENGINEERING FORWARD

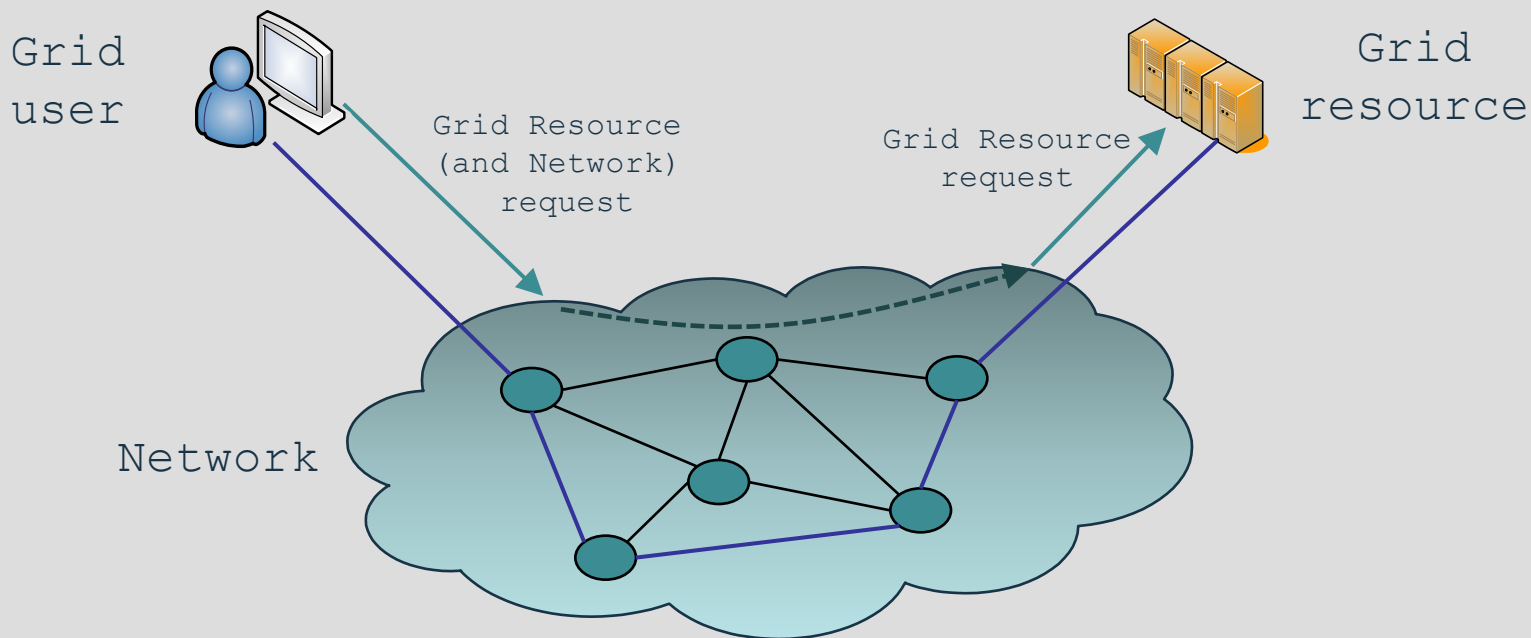


University of Essex



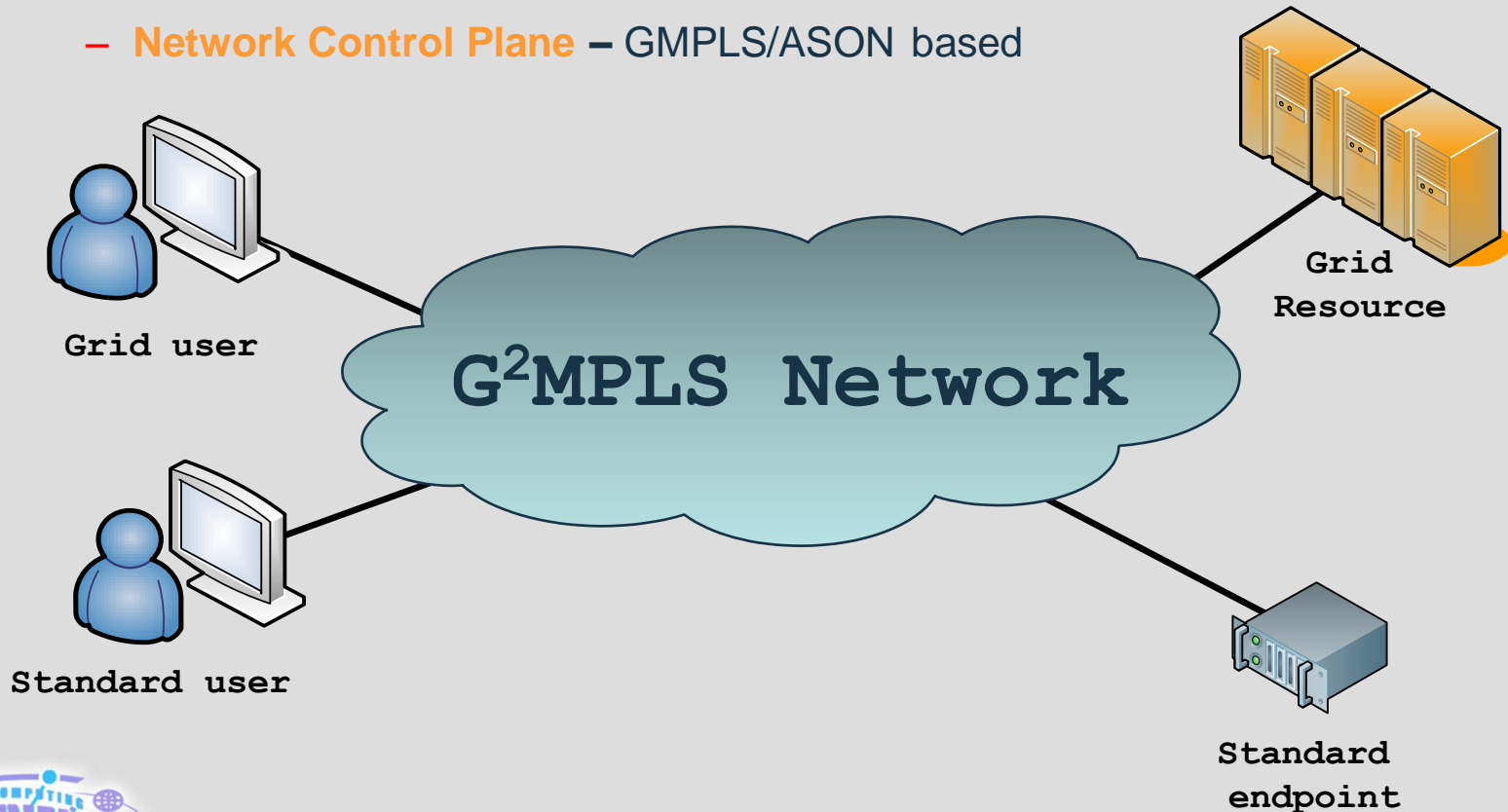
■ Grid Network Service

- **Network** is responsible for **co-allocation of Grid and network** resources
- **Network** uses its flooding mechanism for **transport Grid resource information** between Grid site and Grid user
- **Grid user** can ask **only for Grid resources** – Network determines proper Network resources

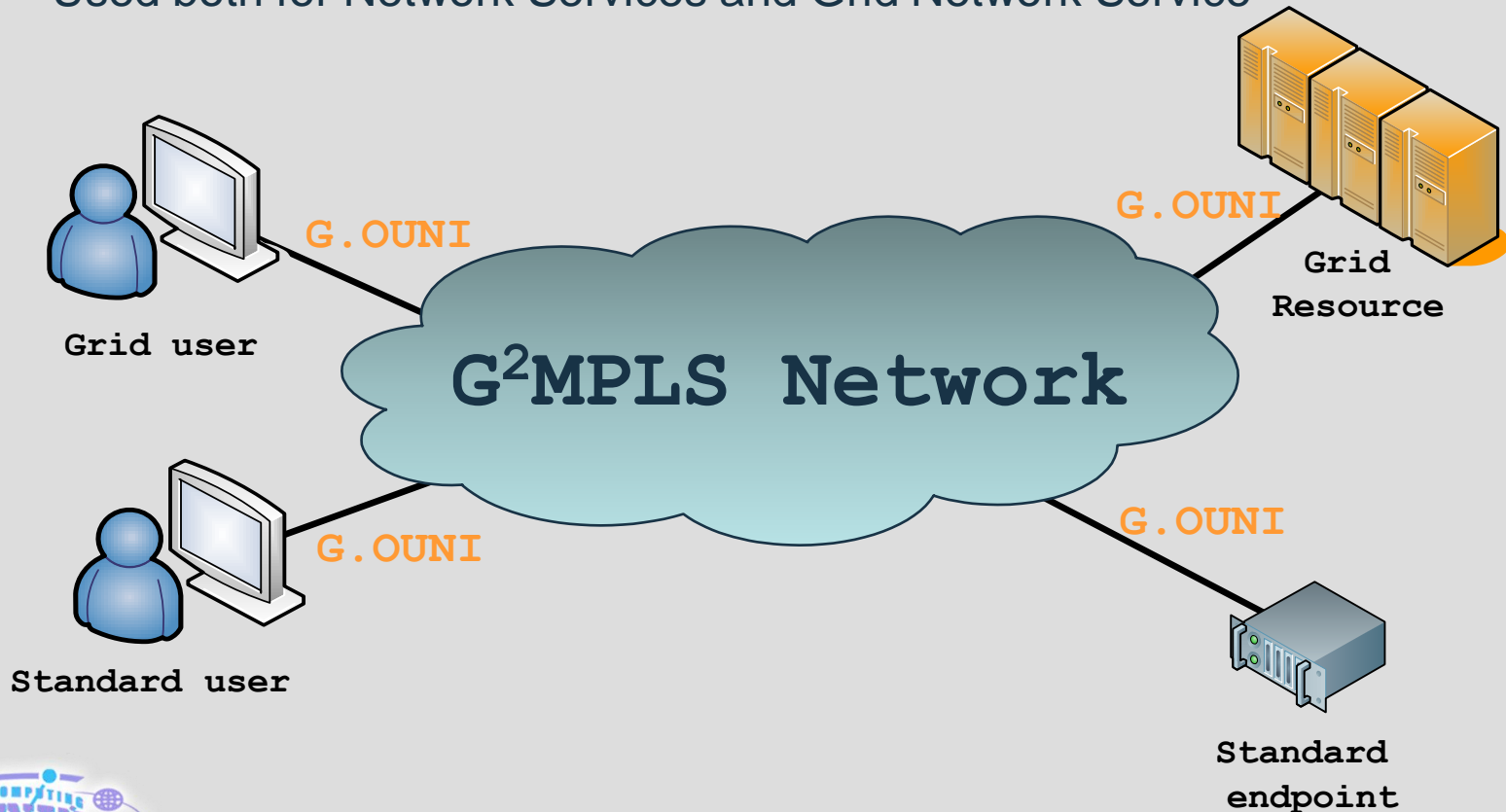




- **G²MPLS** is...
 - a Grid-enabled Network Control Plane
 - **Grid-enabled Network**
 - implements **Grid Network Services (GNS)** for Grid users
 - implements **Network Services (NS)** for standard users
 - **Network Control Plane** – GMPLS/ASON based

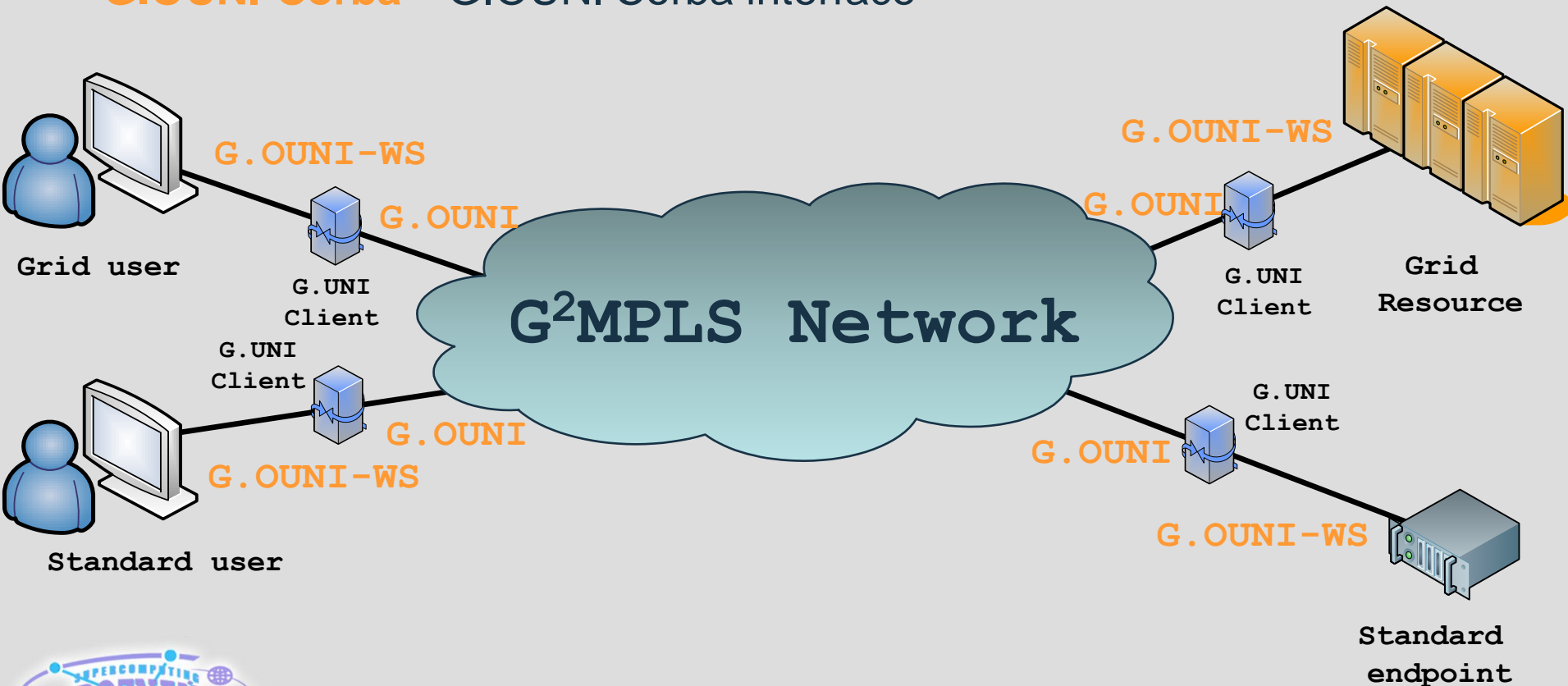


- **G.OUNI** – Unified Grid and network interface for each kind of user/application
 - Extension of the **GMPLS/ASON UNI** interface
 - Used both for Network Services and Grid Network Service





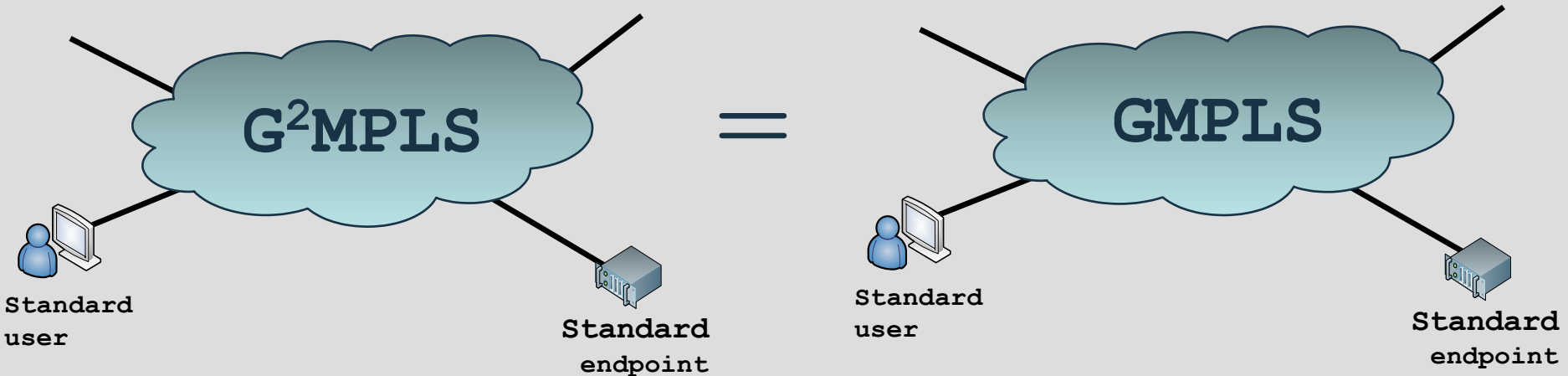
- **G.OUNI-WS** – G.OUNI Web Service interface
 - **G.OUNI** is binary protocol interface (RSVP-TE, OSPF-TE protocols)
 - Web Service is now a popular interfacing technology for applications
- **G.OUNI-Corba** – G.OUNI Corba interface



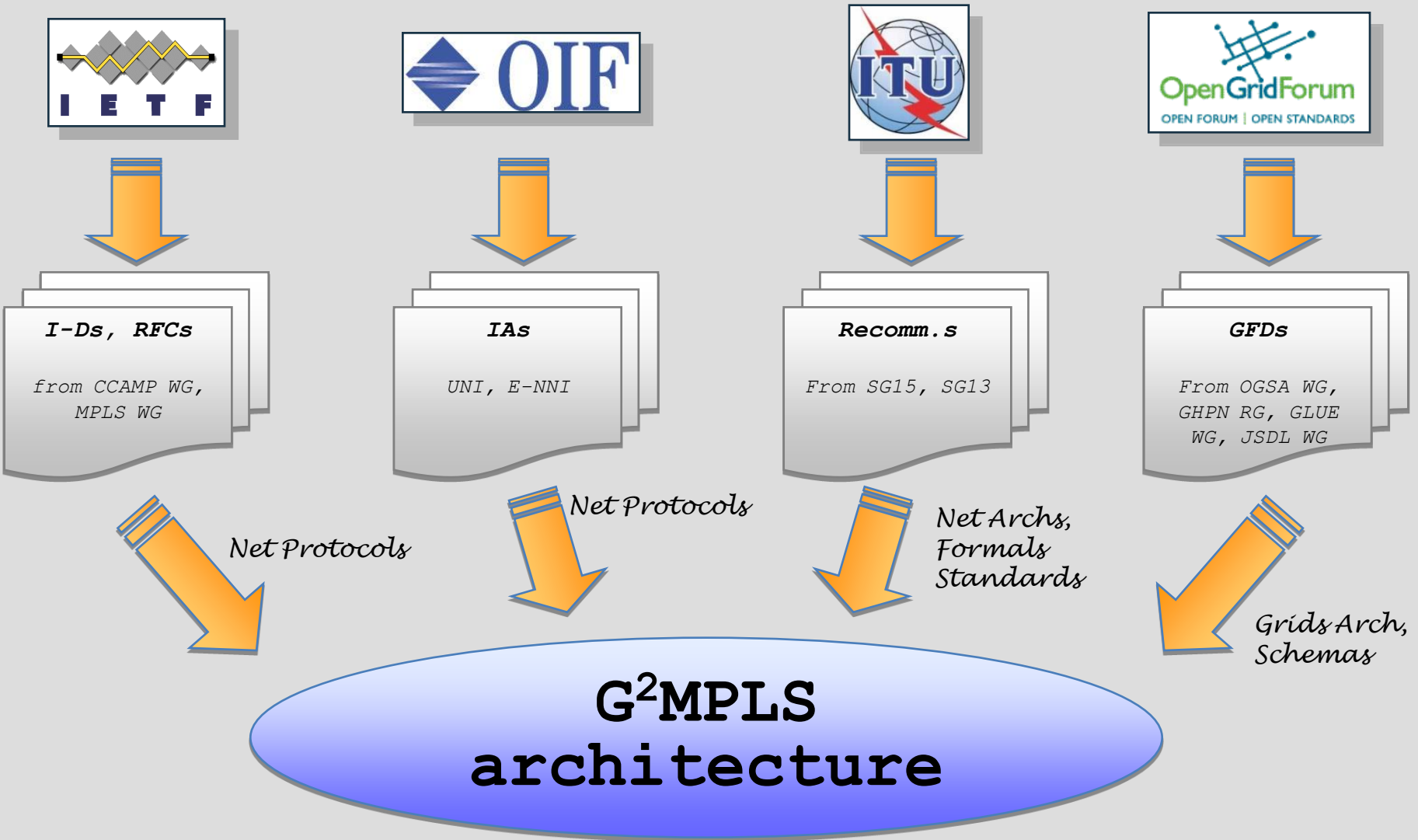
G²MPLS is still GMPLS



- G²MPLS behaves as GMPLS for standard users requesting pure Network Services
 - setup and teardown of the network path between two endpoints
- Additional features (not standardized in GMPLS/ASON yet)
 - **Advance reservation** (Grade of Service improvement)
 - Support of **Optical Impairments** (span length, available wavelength, amplifiers, BER, OSNR)



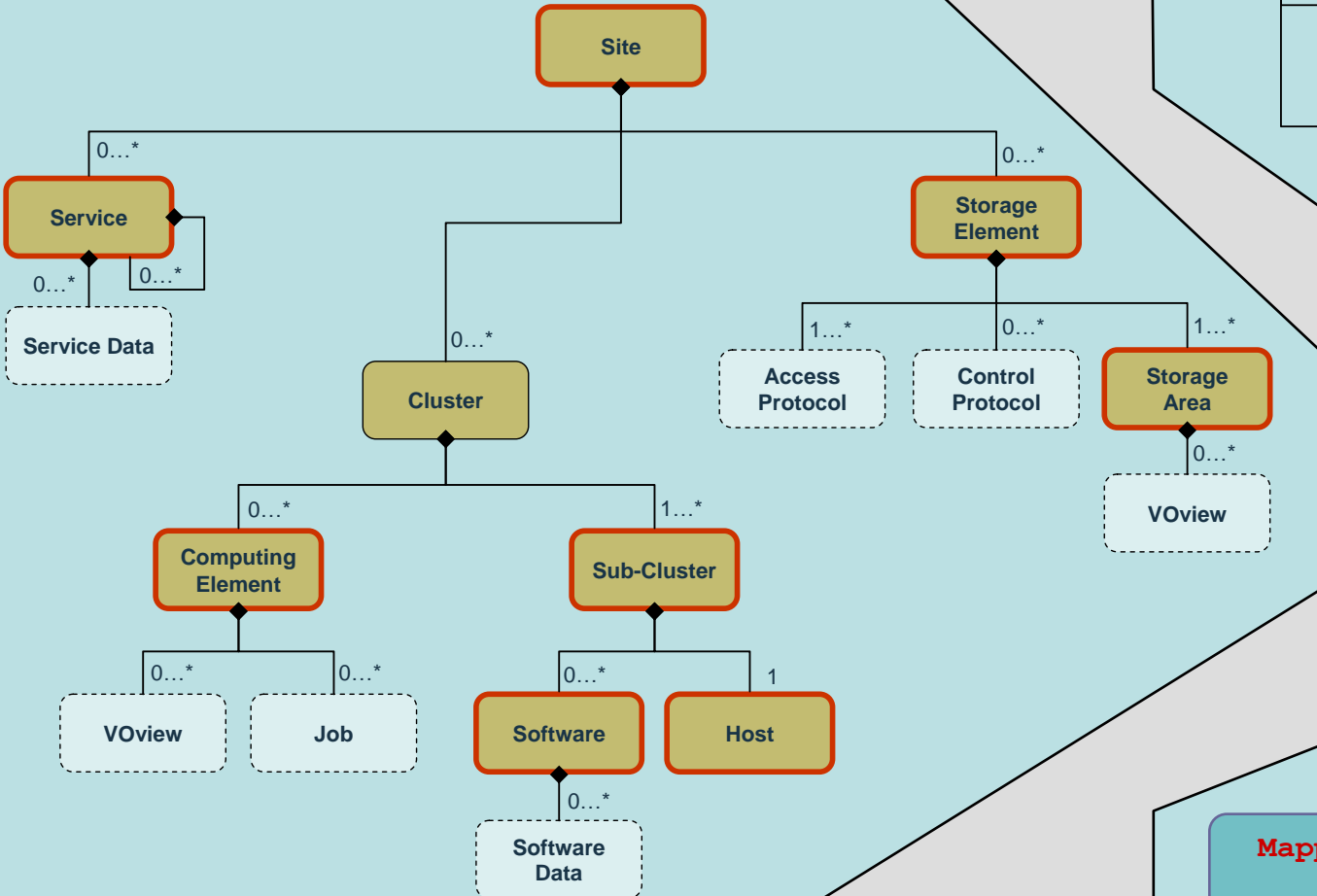
G²MPLS positioning w.r.t. standards



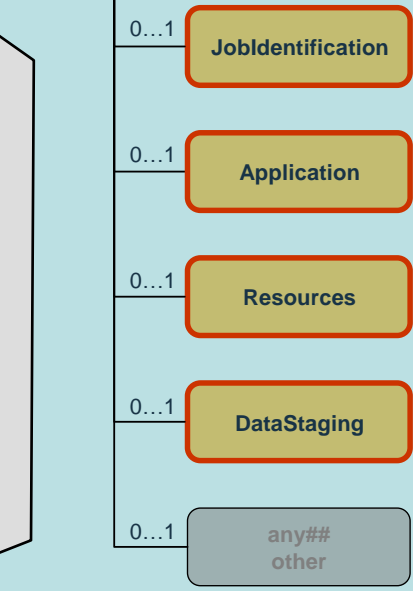
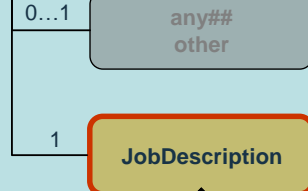
G²MPLS Grid site and job representations



Mapping from GLUE
schema v1.3



JobDefinition



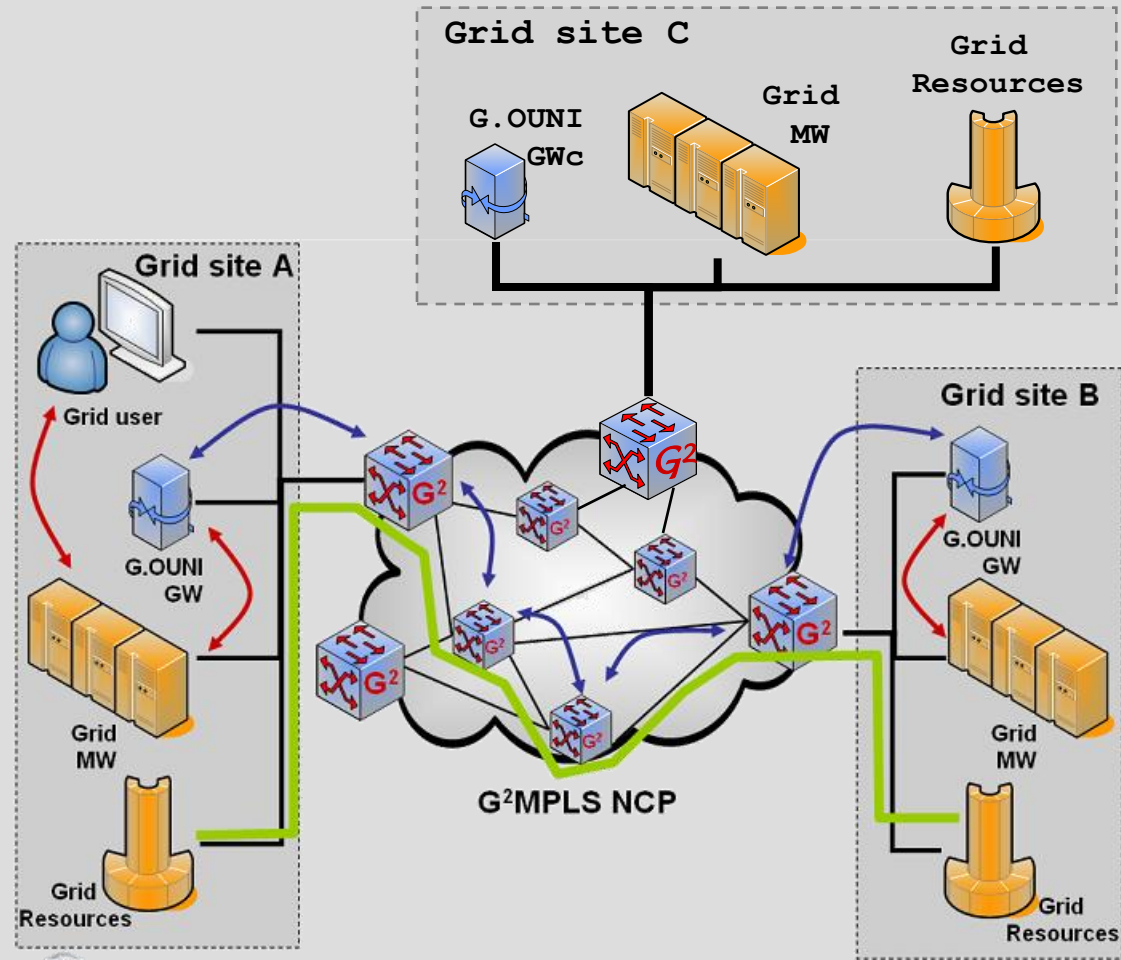
Mapping from JSDL schema
v1.3



G²MPLS co-operation with Grids



- **Grid Middleware**
 - **Unicore**
 - Via G.OUNI Gateway (Web-Service interface)
- **e-Science applications** integrated with G²MPLS
 - Distributed Data Storage Systems (**DDSS**)
 - Collaborative Data Visualisation (**KoDaVis**) for atmospheric simulations





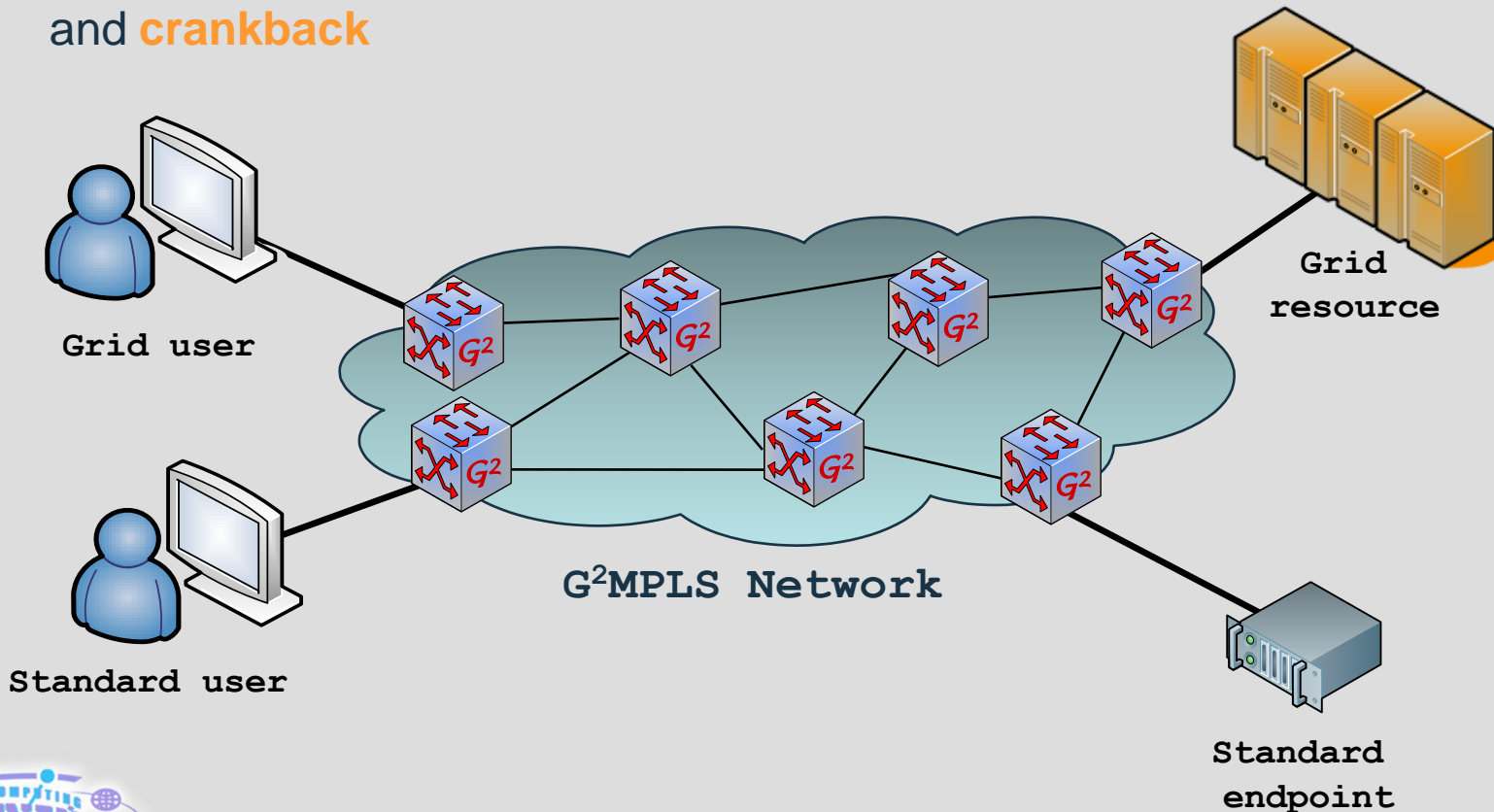
G²MPLS FEATURES

- **Distributed**
- **Multi-technology**
- **Multi-domain**
- **AAA**

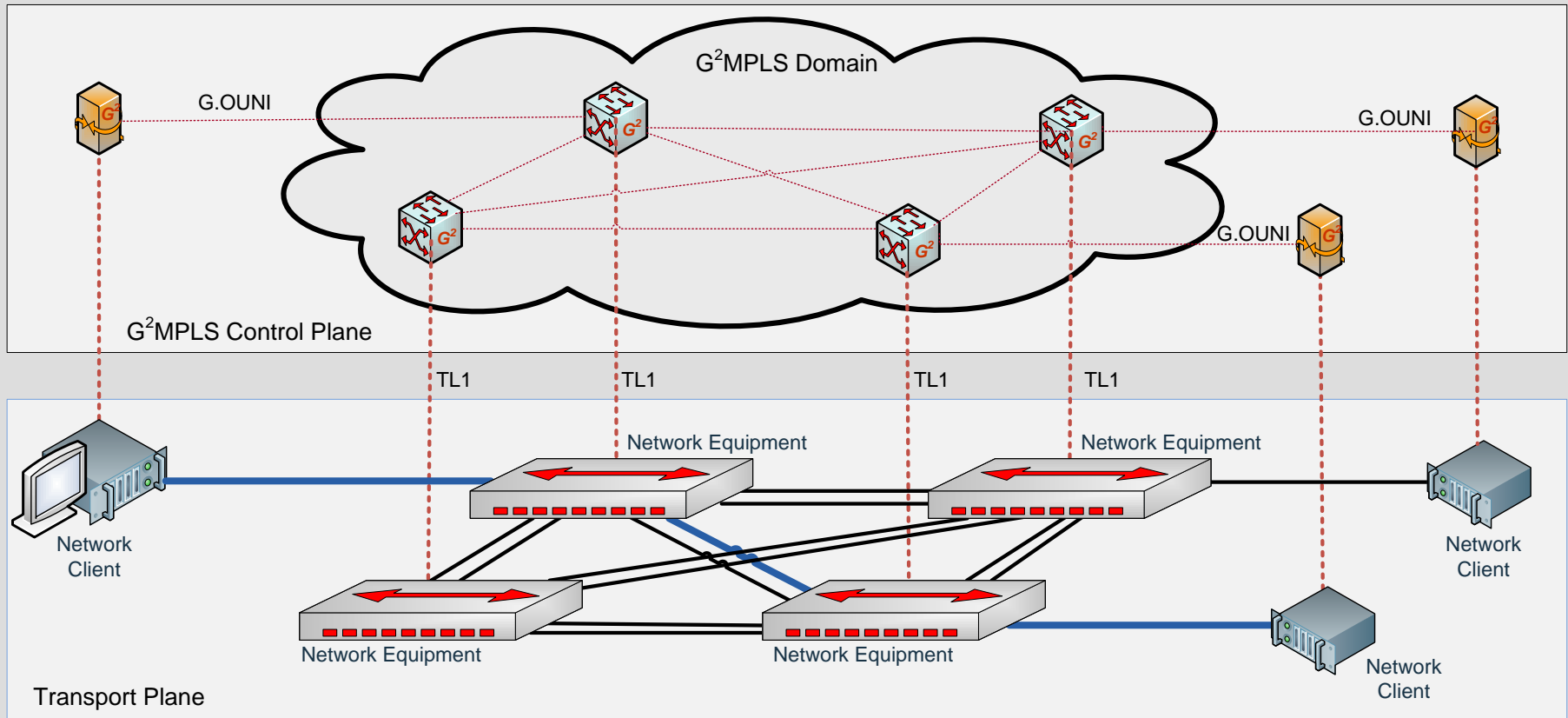


■ Fully Distributed

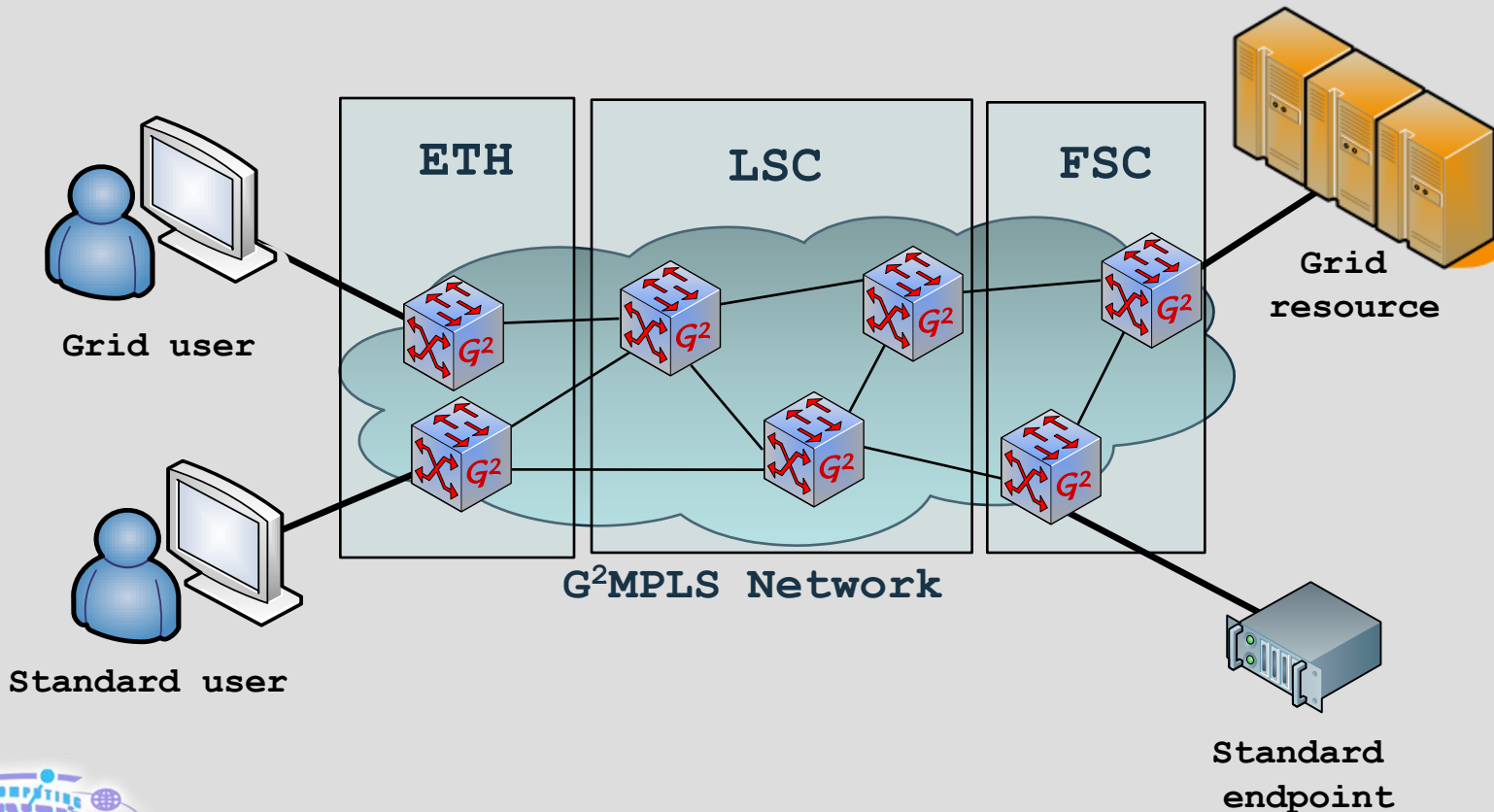
- Each G²MPLS Controller is managing a single Network Element
- **Topology distributed** to each controller by Routing Protocol (OSPF-TE)
- Service request is **signalized hop by hop** (RSVP-TE)
- adoption of well-established procedures for **traffic engineering, resiliency** and **crankback**



G²MPLS – Distributed Control Plane example



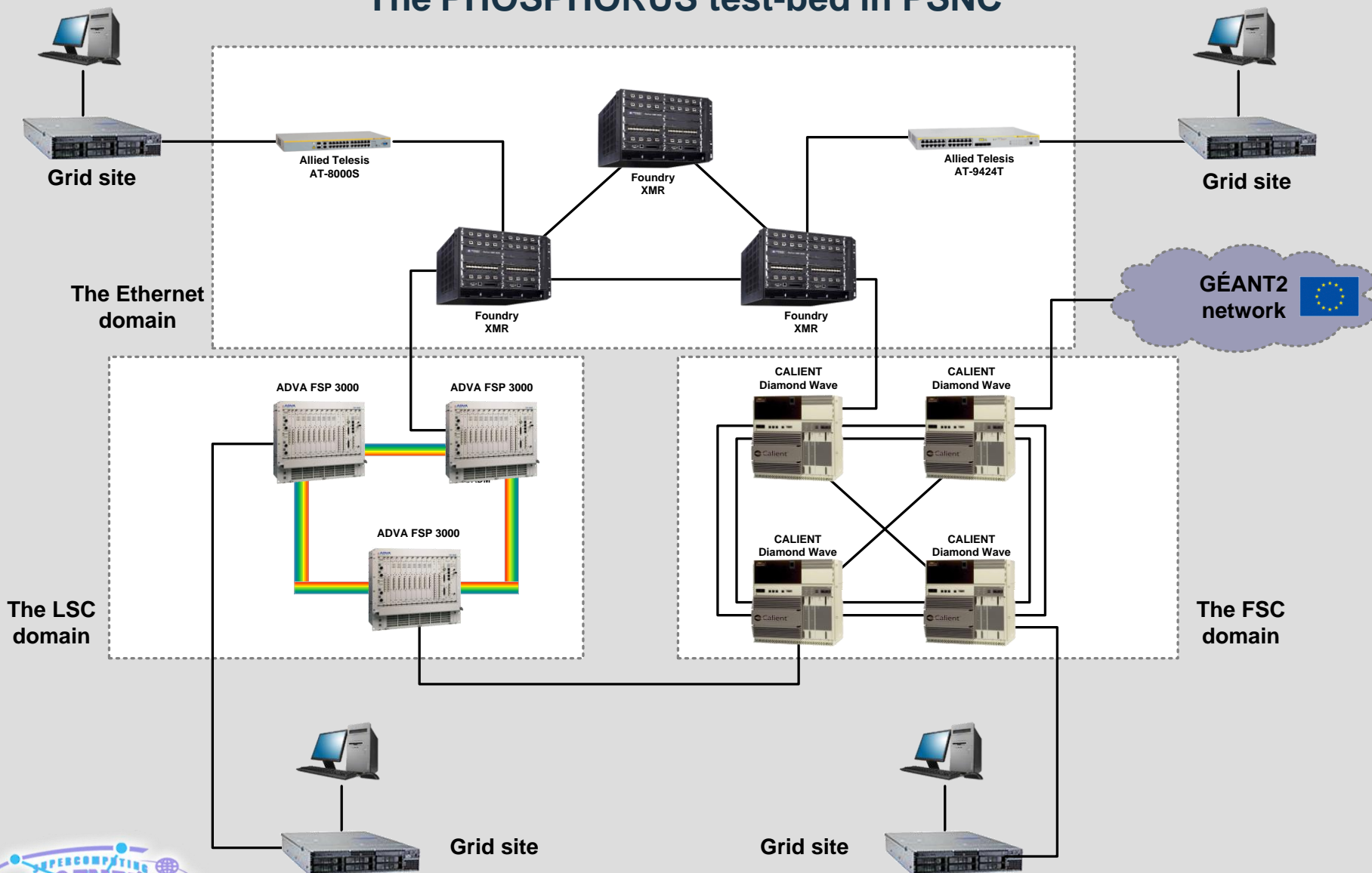
- Transport Network **technology stitching**:
 - One path signaling through **FSC, LSC, ETH** network segments
 - Path computation for **lambda networks** (WSON)
 - **VLAN path** in Ethernet network (port based)



G²MPLS – Technology stitching example



The PHOSPHORUS test-bed in PSNC



GÉANT2 





■ ADVA FSP 3000RE-II (Lambda Switch)

- 15 pass through ports
- 6 local ports
- 3 physical units



■ Calient Diamond Wave (Fibre Switch)

- 60 ports
- 1 physical unit / 4 logical units (switch virtualization)





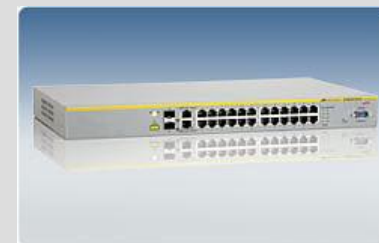
- Foundry XMR NetIron 8000 (Ethernet Switch)

- 2 x 4-port 10GE modules (XFP)
- 1 x 24-port 1GE module (SFP)
- 3 physical units



- Allied Telesis AT-8000/S (Fast Ethernet Switch)

- Low-cost managed stackable Fast Ethernet switch
- PoE connectivity at the edge for VoIP phones and wireless access points
- 10/100 TX x 24 ports



- Allied Telesis AT-9424T (Gigabit Ethernet Switch)

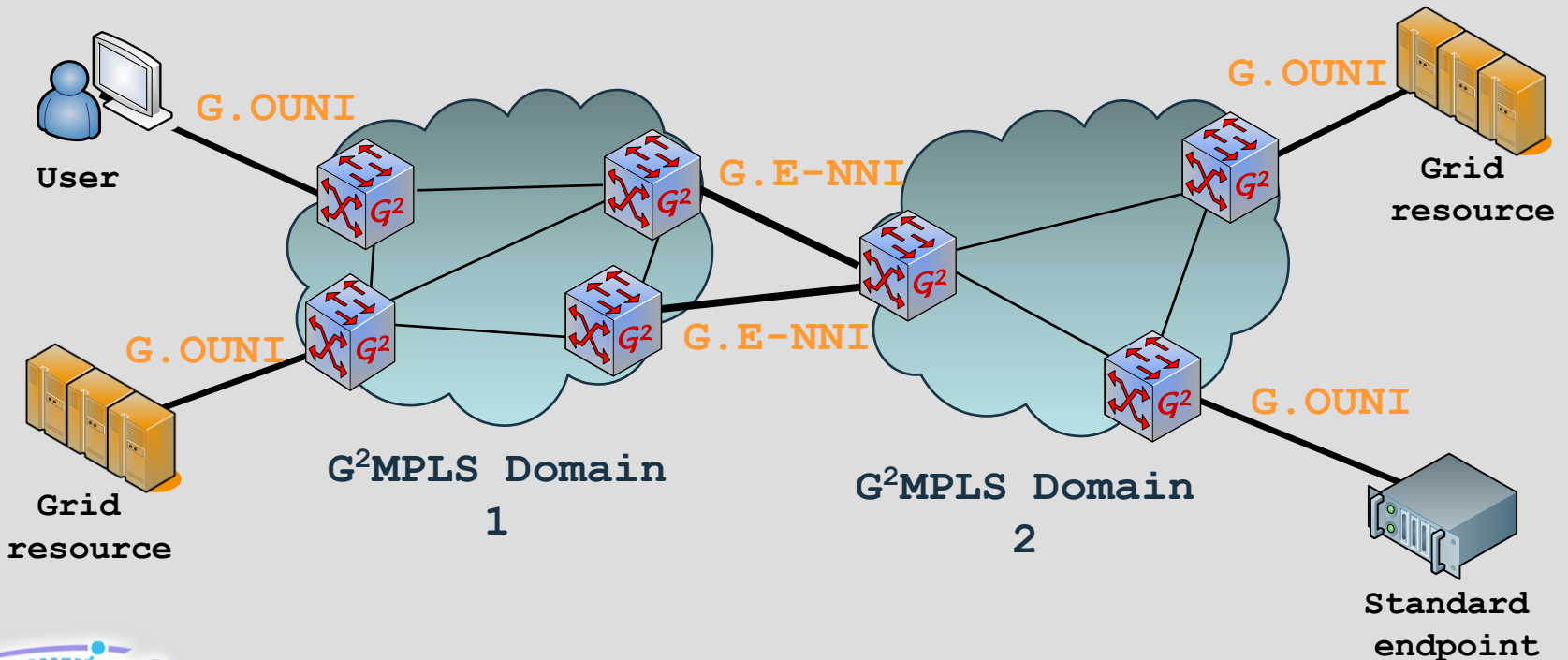
- 10/100/1000T x 24 ports
- 2 SFP bays





Multi-domain architecture

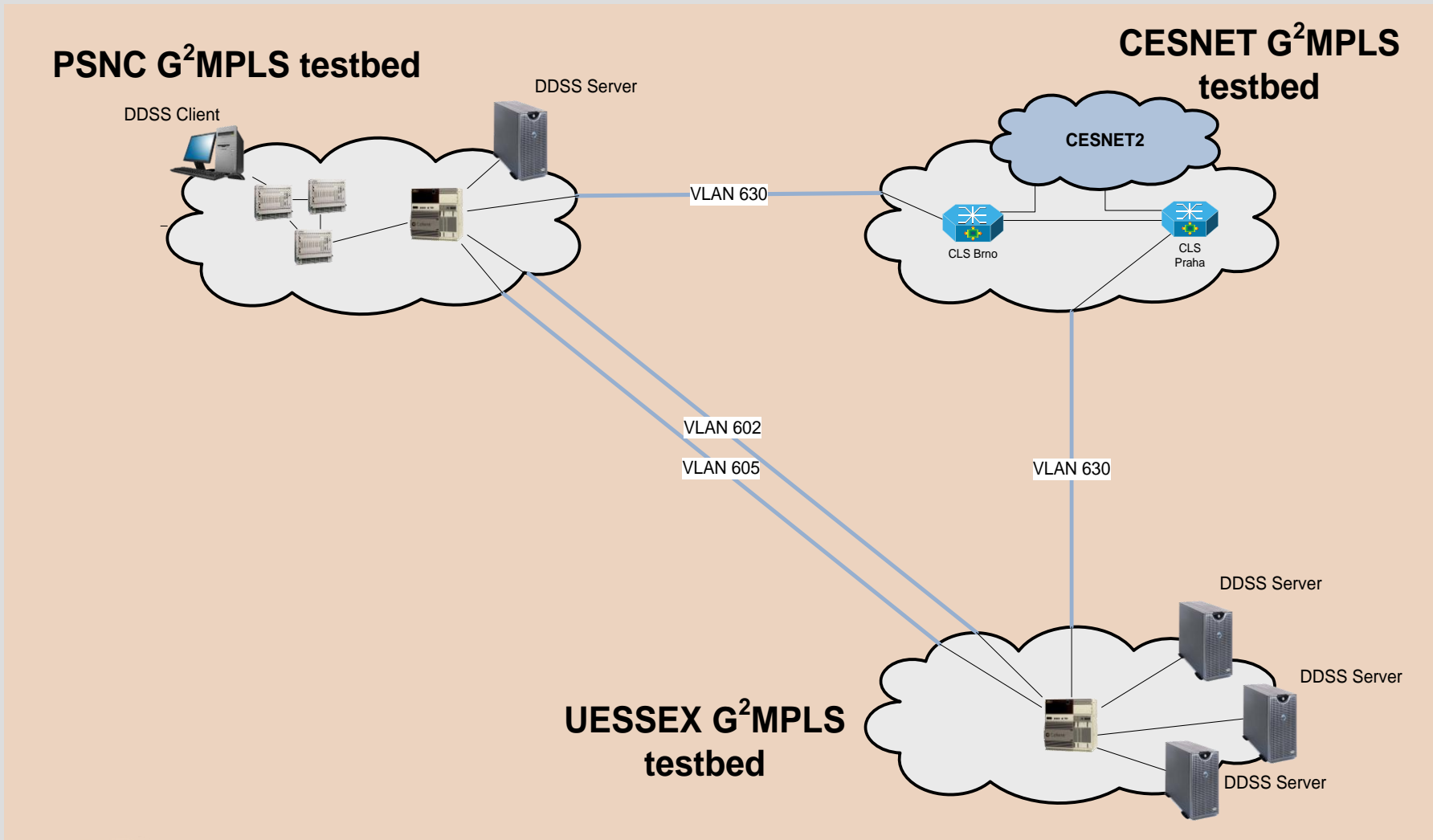
- **G.E-NNI** – extension of **GMPLS/ASON E-NNI** interface for inter-carrier communication
 - Network **abstract topology** exchange
 - **Grid Resource** information exchange
 - Accepting Grid Network Service requests



G²MPLS – Multi-domain example

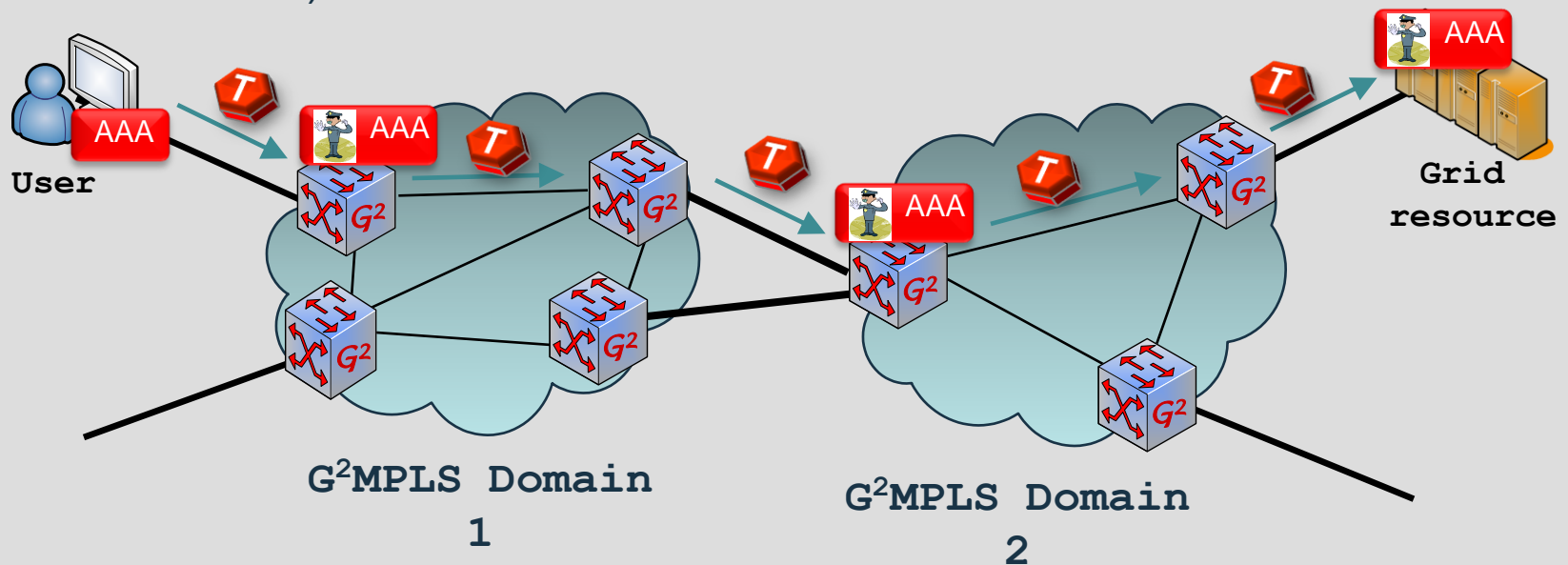


The PHOSPHORUS test-bed for DDSS demo





- **GAAA-AuthZ** (Generic AAA Authorization Infrastructure) supports policy based on-demand network and grid resource provisioning
 - Request contains **AAA Token**
 - Request can be passed only when AAA PEP (**Policy Enforcement Point**) accepts the token
 - **GAAA-AuthZ** was developed by Phosphorus AAA activity (University of Amsterdam)





G²MPLS SERVICES

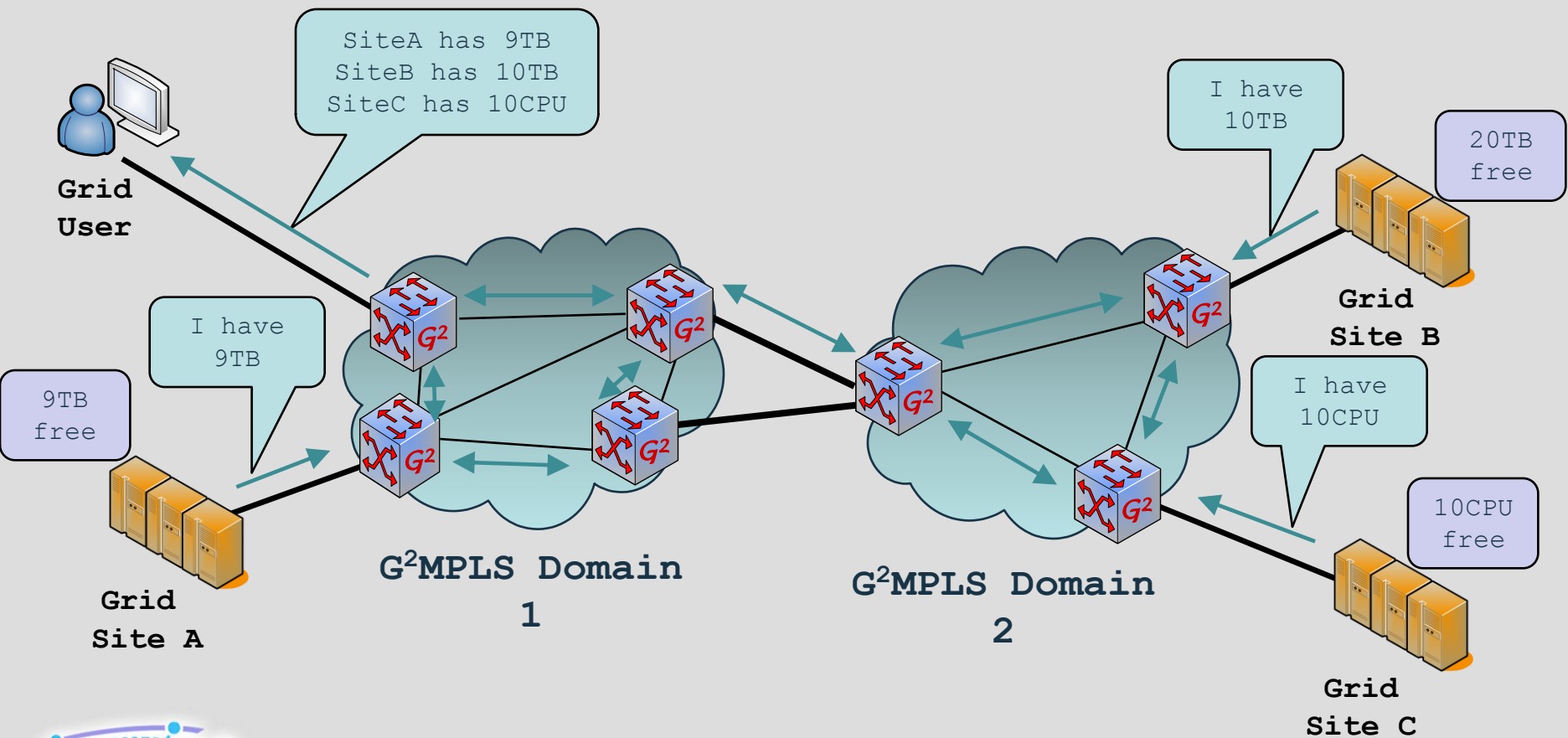
- **Grid Discovery**
- **Unicast GNS**
- **Anycast GNS**
- **Direct call**
- **Indirect call**



G²MPLS - Discovery of Grid resources



- Grid sites publish its **Grid resources capabilities and availabilities**
- Grid resources **information are flooded** within G²MPLS network
- User is informed about all **Grid resources available in network**

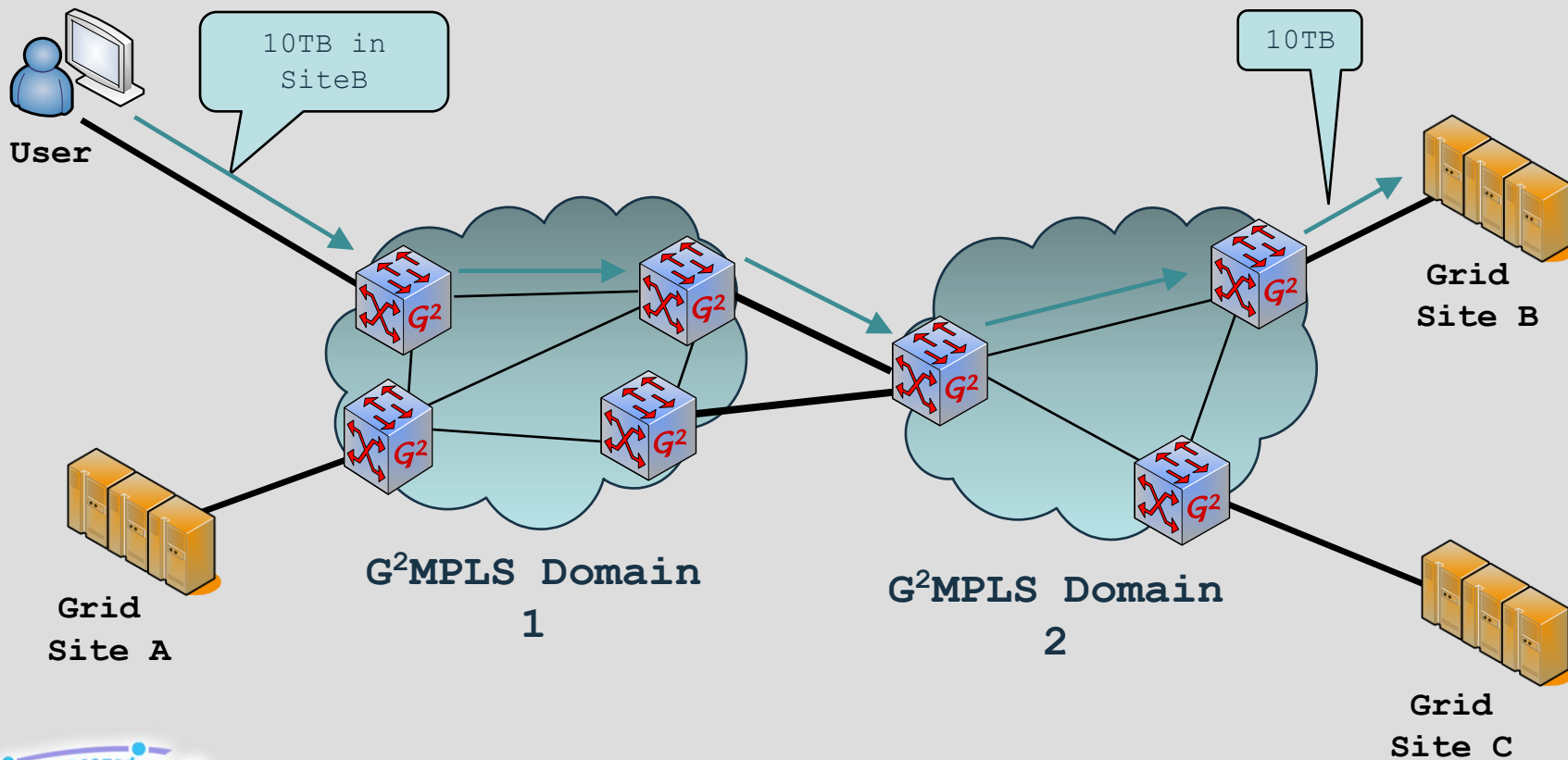


G²MPLS GNS service types - Unicast



Unicasting

- GNS request A → B specified by Grid user
- G²MPLS setup of the e2e call/connection
- G²MPLS piggybacking of Grid information (resource and job)

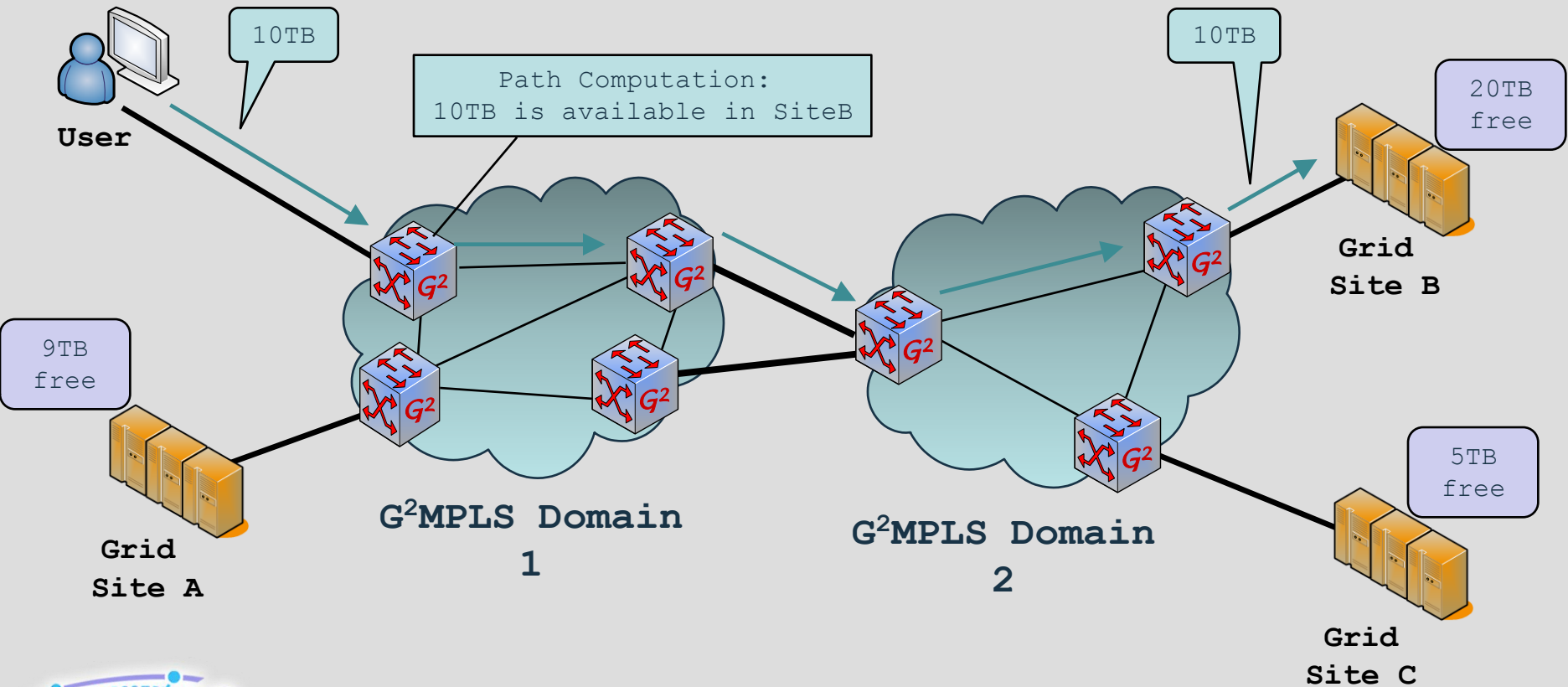


G²MPLS GNS service types - Anycast



■ Anycasting

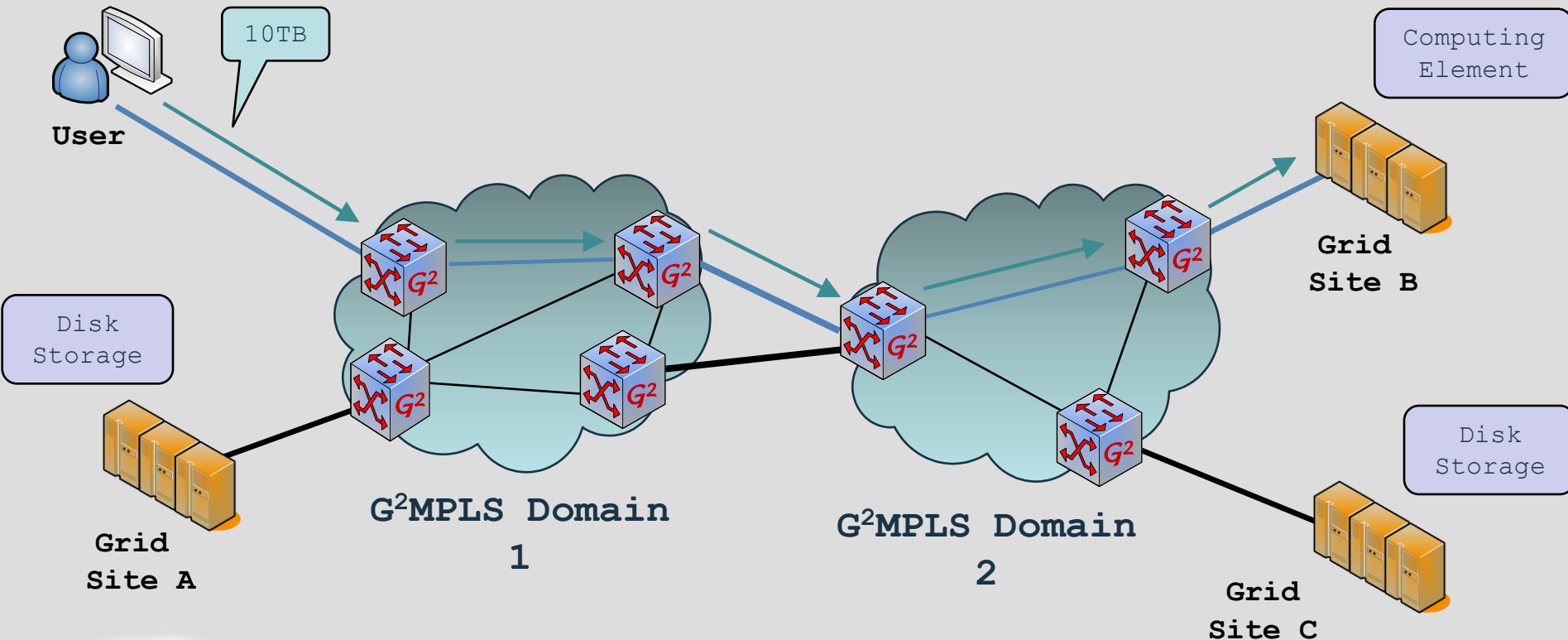
- GNS request A → any (e.g. an amount of storage, a number of CPU, etc)
- **G²MPLS chooses the “best” destination** (as viewed by routing topology) and setup the e2e call/connections





Direct call

- Ingress path endpoint is located **where user is connected** to the network
- This is **classical call** type

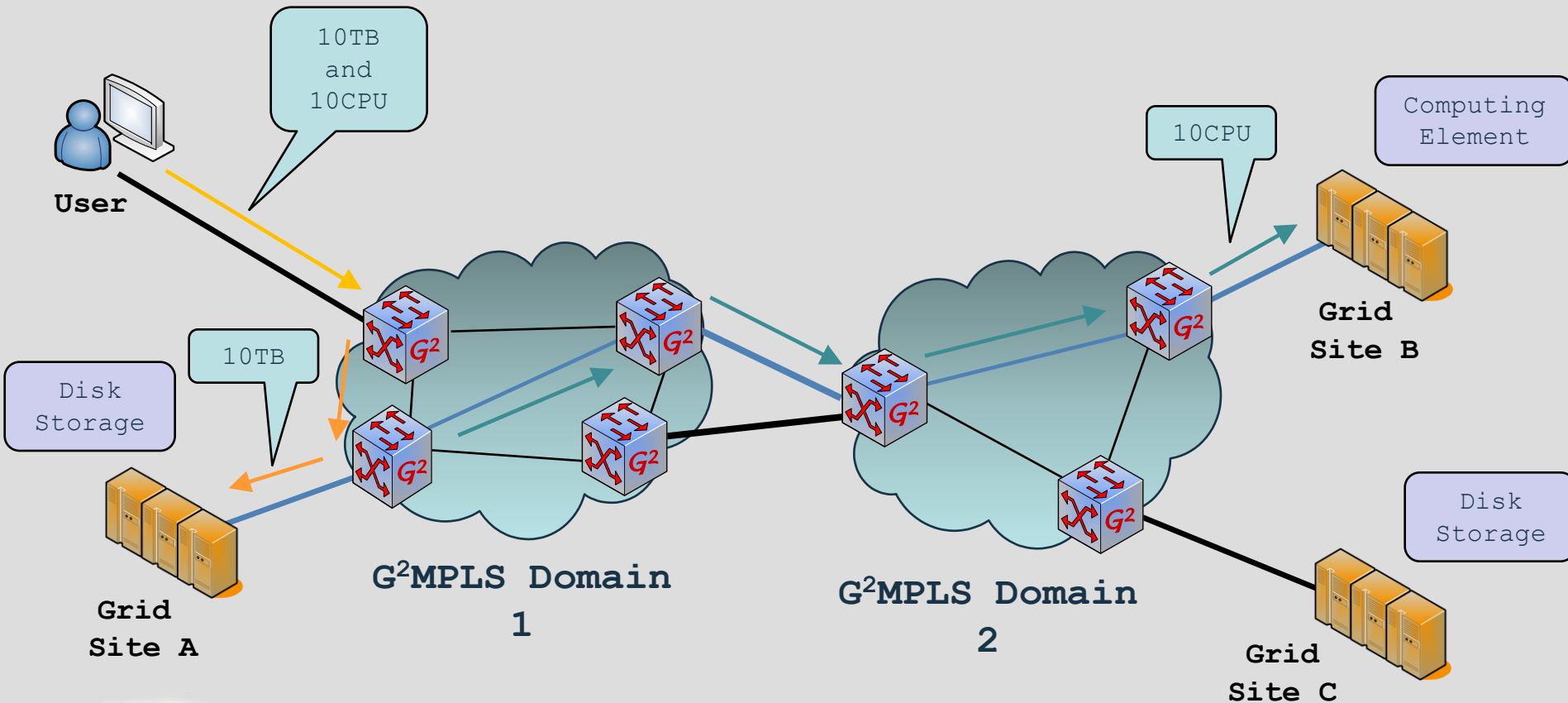


G²MPLS - Indirect Call



Indirect call

- Path endpoints between **any pair of network borders**
- **User** requesting the Indirect call is **outside** the path connection
- **Connecting two Grid resources** in Grid workflow





G²MPLS SOFTWARE

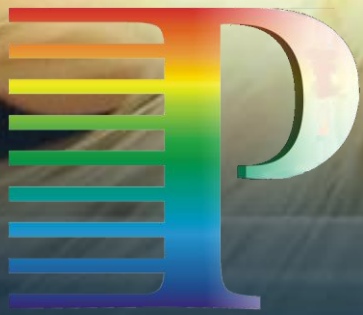


The G²MPLS controller software



- New components (protocols, modules) to **Quagga** protocol suite
- Released in the form of:
 - **a XEN virtual machine**
 - Gentoo with all the needed system packages (libs and apps)
 - a “**plug – configure – play**” approach for the user
 - **Open source code**
 - The G²MPLS common library (**LGPLv2.1**)
 - The G²MPLS protocols and modules (**GPLv2**)
 - The CORBA interfaces to the G²MPLS modules (**free**)
 - Binaries of Call controllers (**restricted**)
 - Available at the **PHOSPHORUS web-site**

<http://phosphorus.pl/software.php?id=g2mpls>



PHOSPHORUS

Thank you.

Questions?

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TERENA Networking Conference 2009

Malaga, Spain, June 8th – 11th 2009