Lamda User Controlled Infrastructure for European Research

Manos Varvarigos

Research Academic Computer Technology Institute
(RACTI)

LUCIFER overview

- EU Research Networking Test-beds IST program
- 30 months IP project, to begin May 2006
- A European and Global alliance of partners to develop advanced middleware solutions and underlying management and control plane technologies

Project Vision and Mission

- On demand end-to-end network services across multiple domains
- In the LUCIFER implementation the underlying network will be treated as first class Grid resource.
- LUCIFER will demonstrate solutions and functionalities across a test-bed involving NRENs, GÉANT2, and Cross Border Dark Fibre

Partners

1. PSNC, Poland	**12.** SARA, Netherlands
2. ADVA Optical Networking, Germany	**13.** SURFnet, Netherlands
3. CESNET Czech Republic	**14.** Univ. Bonn, Germany
4. Nextworks, Italy	**15.** University van Amsterdam, Netherlands
5. Fraunhofer, Germany	**16.** University of Essex, UK
6. i2CAT, Spain	**17.** Universiy of Wales, UK
7. HFZJ, Germany	**18.** NORTEL, USA
8. HITACHI Europe, France	**19.** MCNC, USA
9. IBBT, Belgium	**20.** Center for Computation & Technology at LSU, USA
10. RACTI, Greece	**21.** Communications Research Centre Canada, Canada
11. RESIT, Greece	

Objective 1

- Demonstrate on demand service delivery across multi-domain/multi-vendor research network test-beds on a European and Worldwide scale.
- The testbed will include:
- EU NRENs: SURFnet, CESNET, PIONIER
- National test-beds (VIOLA,OptiCAT, UKLight)
- GN2, and Cross Border Dark Fibre connectivity infrastructure
- GMPLS, UCLP, DRAC and ARGON control and management planes
- Multi-vendor equipment environment (ADVA, HITACHI, NORTEL, equipment in participating NRENs)
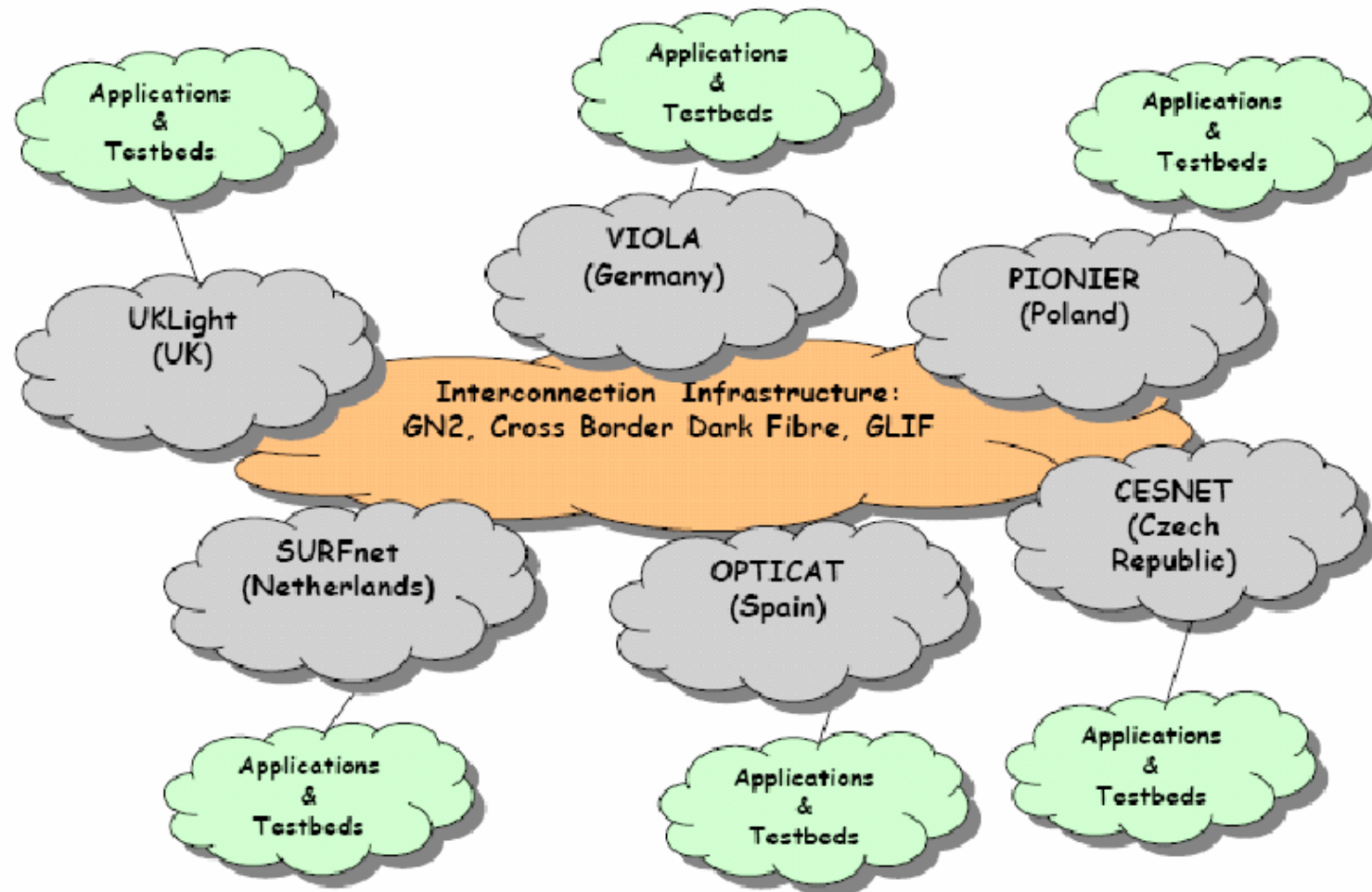
Objective 2

- 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 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 LUCIFER's 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 (interoperability between G²MPLS and UCLP, DRAC and ARGON)
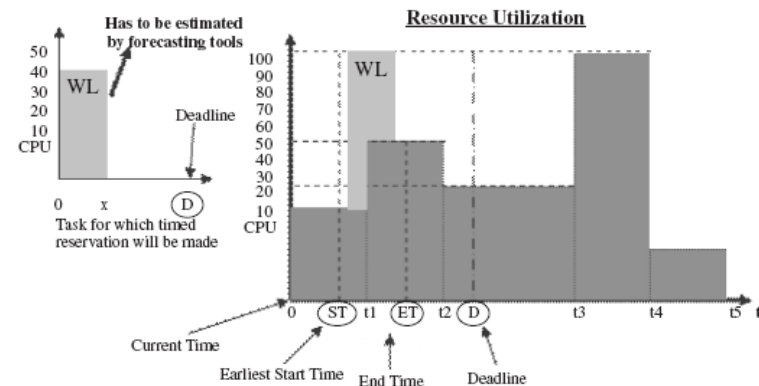
Objective 3

- Study resource management and job scheduling algorithms incorporating network-awareness, constraint based routing and advance reservation techniques
- Develop a simulation environment, supporting the LUCIFER network scenario
- Disseminate the project experience and outcomes, toolkits and middleware to EU NRENs and their users, such as Supercomputing centres

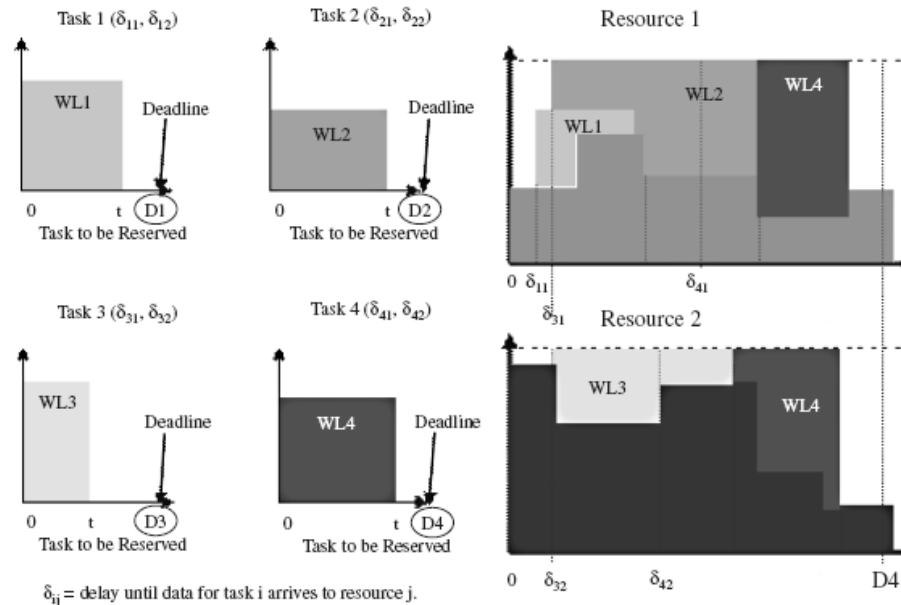# Joint Advance Reservations of Computation and Communication Resources

Need: without reservations there can be no QoS guarantees
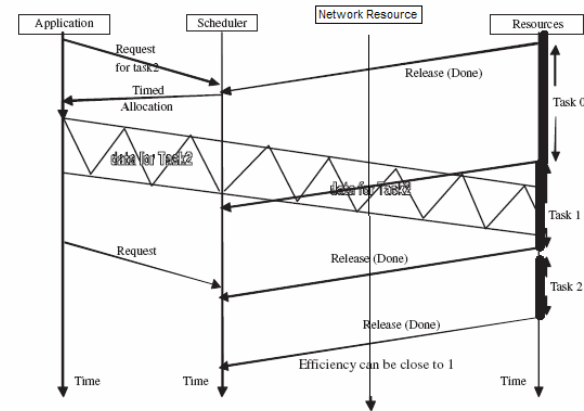
Key idea: Computation and communication resources are reserved only for the time interval they are actually used, and are available to be used by other users for the remaining time

Burst Routing Problem

Find the best path to transfer the burst in minimum time
Our Approach: Multicost routing

$$\hat{C}_{ABC} = \hat{C}_{AB} \oplus \hat{C}_{BC} =$$

$$= \hat{C}_{AB} \, \& \, LSH_{d_{AB}} (\hat{C}_{BC}(A)) =$$

$$= \hat{C}_{AB} \, \& \, LSH_{2d_{AB}} (\hat{C}_{BC})$$
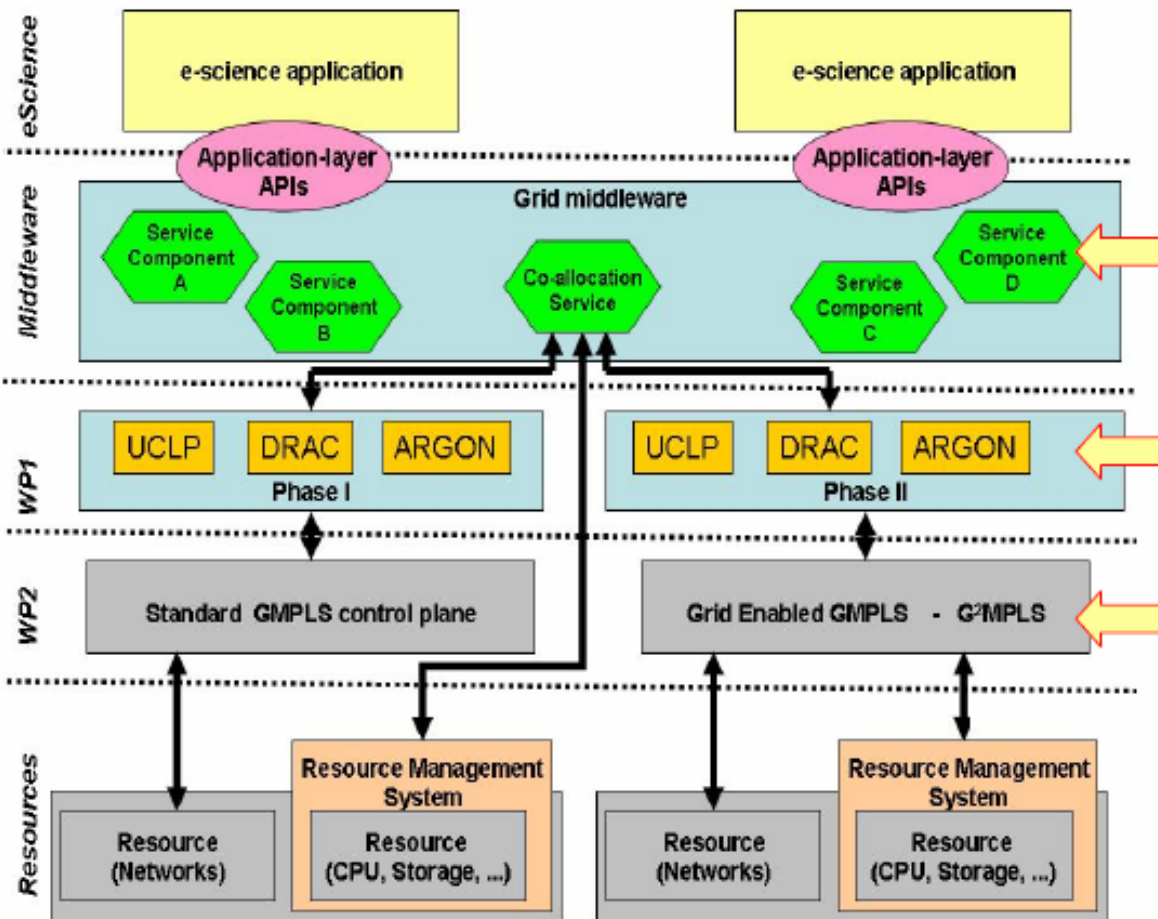
QoS Scheduling

QoS for us means:
a) Within deadline
b) Max-min fairness

Also need workload prediction, job modeling, simulation

Inter-domain issues and solutions

The different domains of th
LUCIFER 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*)