Network service interface for Grid and application users, and an experiment over a GMPLS network

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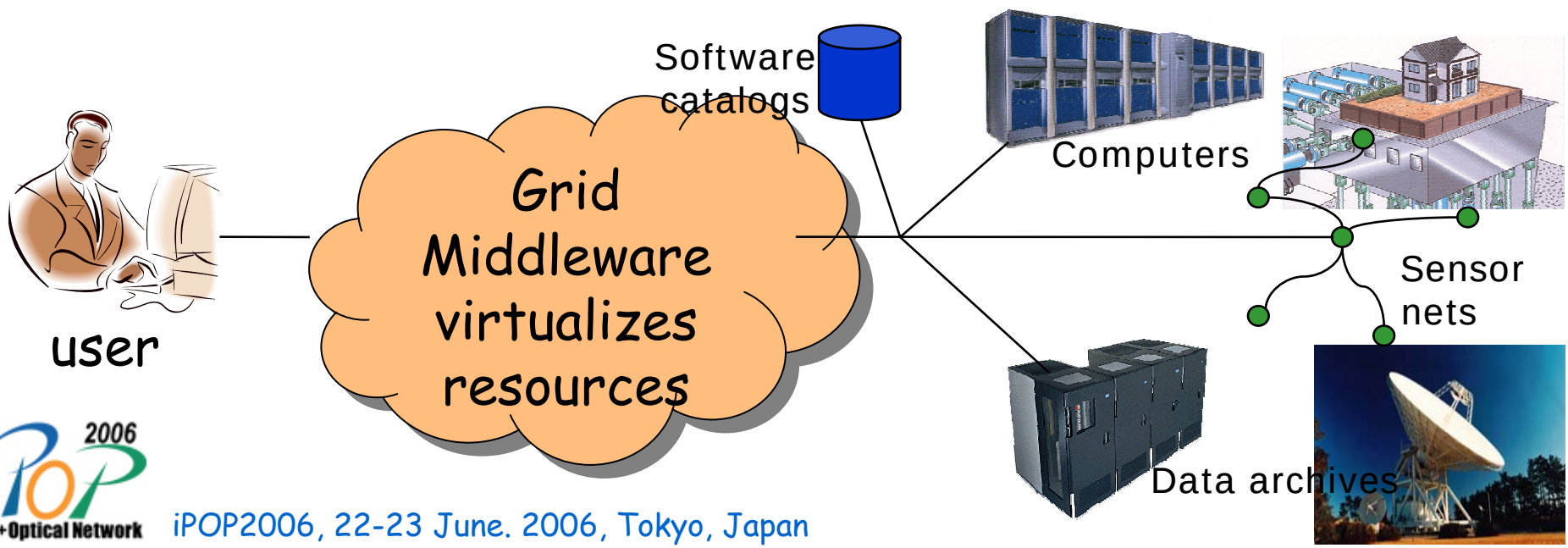
Outline

- **Network service for Grid**
  - **Grid and requirements for the network service**
  - **Web Services interface**
- **Introduction to the G- lambda project**
  - **G- lambda project overview**
  - **Demonstration replay**
- **Future Issues of Grid network service**

What is “Grid”?

- Grid provides a single system image to users by virtualization of service infrastructure such as computing, data and network resources of multiple domains.
- Users do not care about actual resources they are using. Grid middleware (such as planner, broker and scheduler) coordinates resources and provides virtual infrastructure.



Network service for Grid

- To realize such virtual infrastructure for Grid, resource management is one of key issues.
- Grid middleware should allocate appropriate resources, including network resources, according to user's request.
- Network resource manager should provide resource management service to Grid middleware.

Network Service

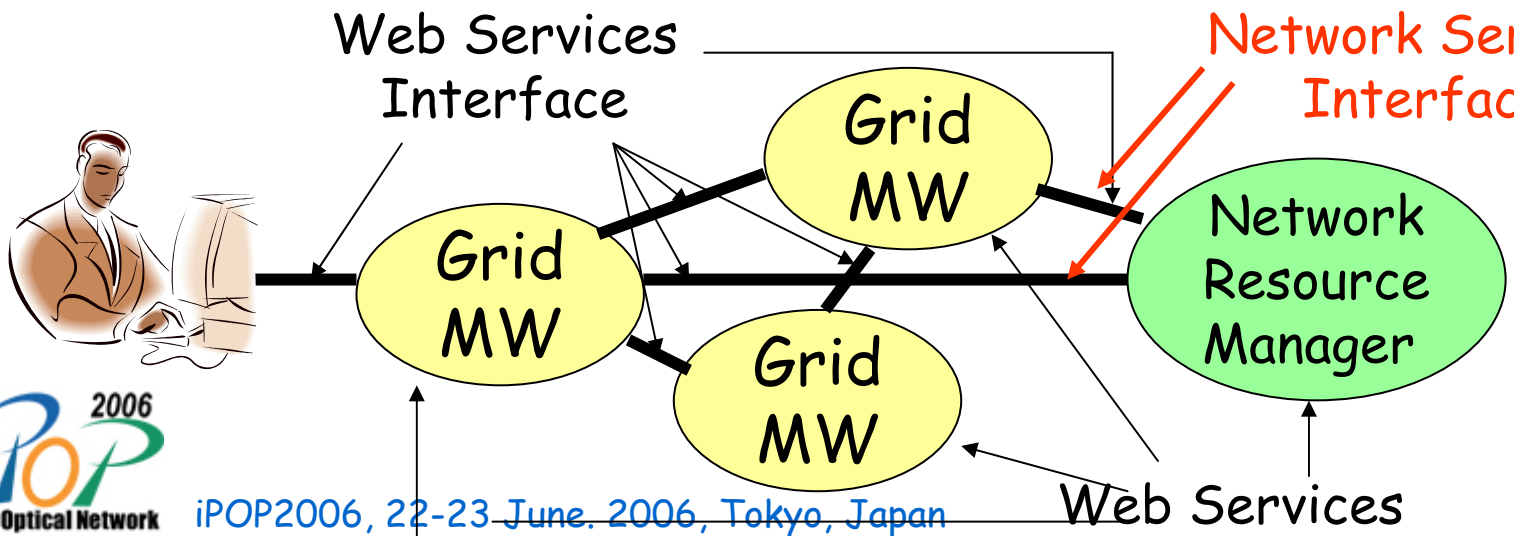
- A standard open interface between Grid middleware and network resource manager is required, but not yet established.

Requirements for the network service interface

- Web Service
  - Grid is being built based on web Services technology
  - Network service should be provided as a “Web Service”.
- SLA support
  - Bandwidth, latency etc.
- Advance reservation
  - Reserve bandwidth

What is “Web Services”?

- Application components which can be accessed thorough open standard web protocols (XML, SOAP, etc.).
- Web Services interface enables interaction between application components
  - Very high level interoperability among the components.
- A standard Web Services based open interface between Grid middleware and network resource manager is required



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G- lambda project overview

- The goal of this project is to establish a standard web services interface (GNS-WSI) between Grid resource manager and network resource manager provided by network operators.
- G-lambda project has been started in December 2004.
- Joint project of KDDI R&D labs., NTT, and AIST.
- We have defined a preliminary interface, and in cooperation with NICT, conducted a experiment using a JGN II GMPLS-based network test bed
  - Live Demonstration at iGrid2005 and SC|05

G- lambda project members

- *National Institute of Advanced Industrial Science and Technology (AIST):*

  Tomohiro Kudoh, Hidemoto Nakada, Atsuko Takefusa, Yoshio Tanaka, Fumihiro Okazaki, Satoshi Sekiguchi

- *KDDI R&D Laboratories.:*

  Masatoshi Suzuki, Hideaki Tanaka, Tomohiro Otani, Munefumi Tsurusawa, Michiaki Hayashi, Takahiro Miyamoto

- *NTT Network Innovation Laboratories:*

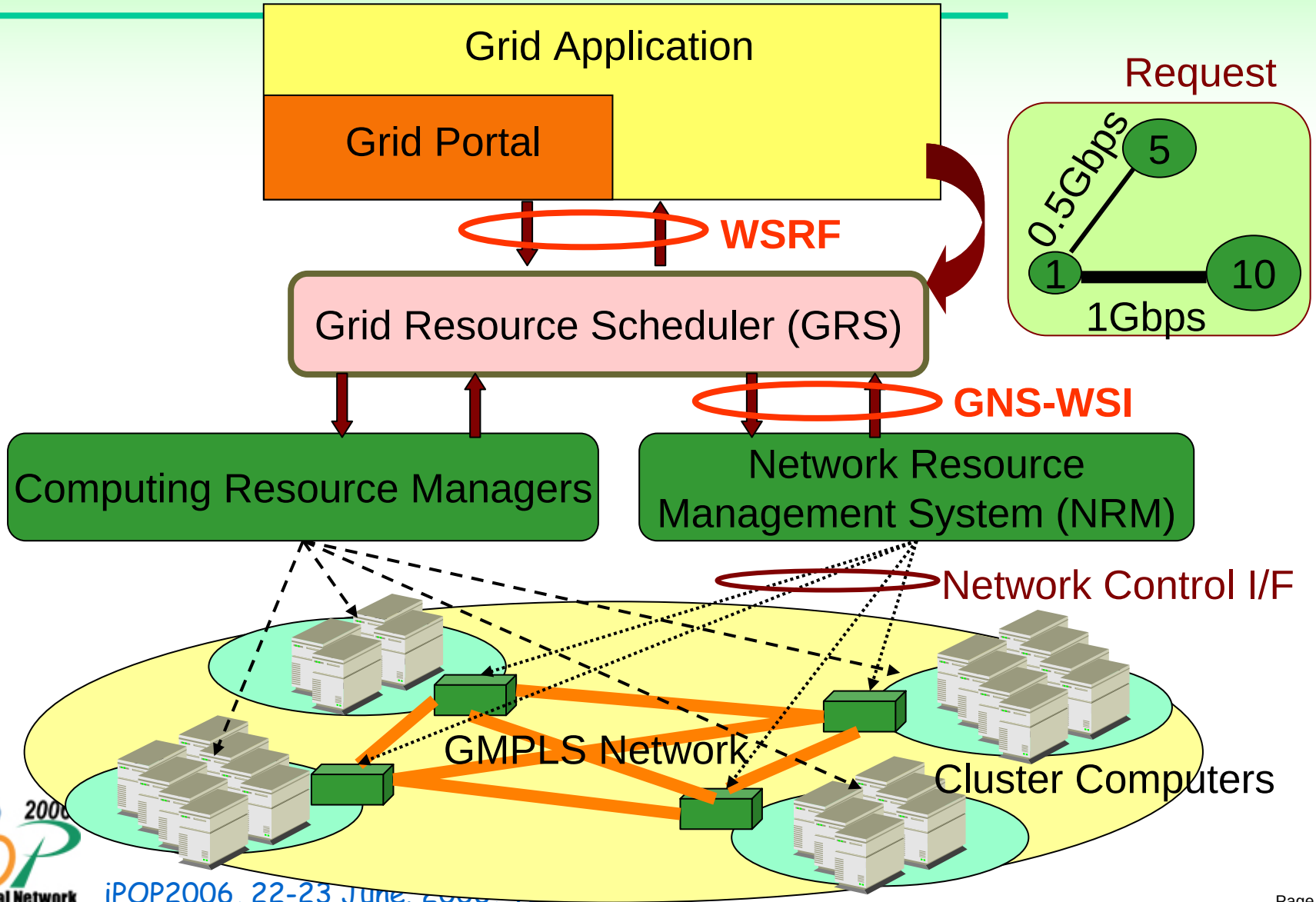
  Akira Hirano, Yasunori Sameshima, Wataru Imajuku, Takuya Ohara, Yukio Tsukishima, Atsushi Taniguchi, Masahiko Jinno, Yoshihiro Takigawa

Demonstration collaborator

- *National Institute of Information and Communications Technologies (NICT):*

  Shuichi Okamoto Shinji Shimojo Toyokazu Akiyama

System overview



Grid Resource Scheduler (GRS)

- A Grid scheduler developed by AIST
  - Implemented using GT4 (Globus Toolkit 4)
- According to users' request, reserves computing and network resources (lambda paths) in advance
  - Accepts requests which specify required # of clusters, # of CPUs at each clusters, and the bandwidth between clusters.
  - GRS selects appropriate clusters by interworking between the NRM and multiple CRMs (Computing Resource Manager)

Globus Toolkit 4 (GT4)

- Globus Toolkit (GT) is one of most popular open source software toolkit for Grid.
- GT supports functions including communication, user authentication, resource management.
- Globus Toolkit 4 (GT4) is the latest version which uses Web Services technology

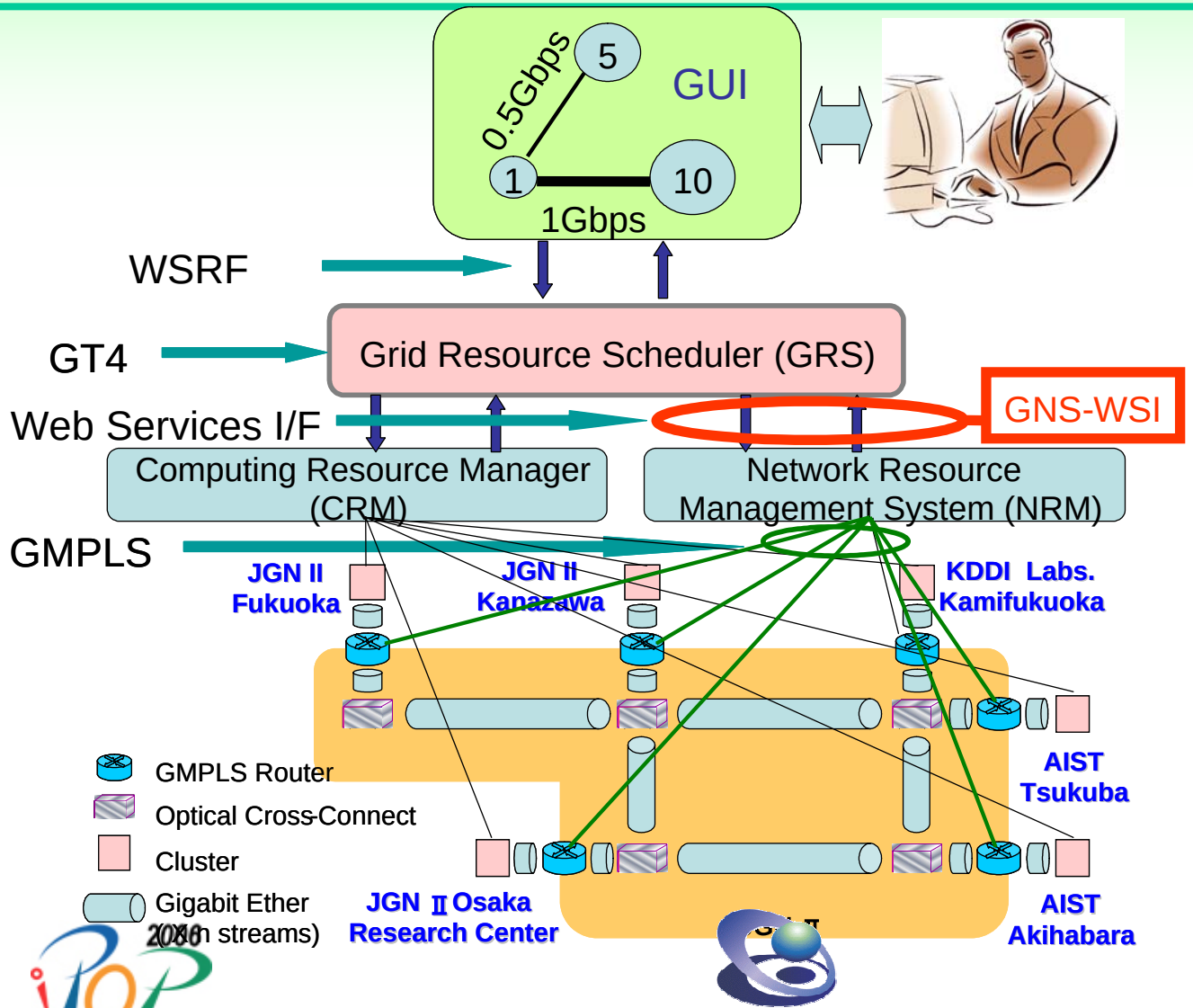
Network Resource Management System (NRM)

- Current implementation was developed by KDDI R&D Labs.
- Response to the requests from GRS through GNS-WSI
- Hide detailed path implementation. Provide a path between end points. (Path virtualization)
- Schedule and manage lambda paths. When the reserved time arrives, activate paths using GMPLS protocol.

GNS-WSI (Grid Network Service / Web Services Interface)

- Web services interface between GRS and NRM
- KDDI R&D Labs, NTT and AIST are working together to define the specification of the interface.
  - Standardization
- Preliminary interface has been defined
- Polling-based operations
  - Advance reservation of a path between end points
  - Modification of reservation (i.e. reservation time or duration)
  - Query of reservation status
  - Cancellation of reservation

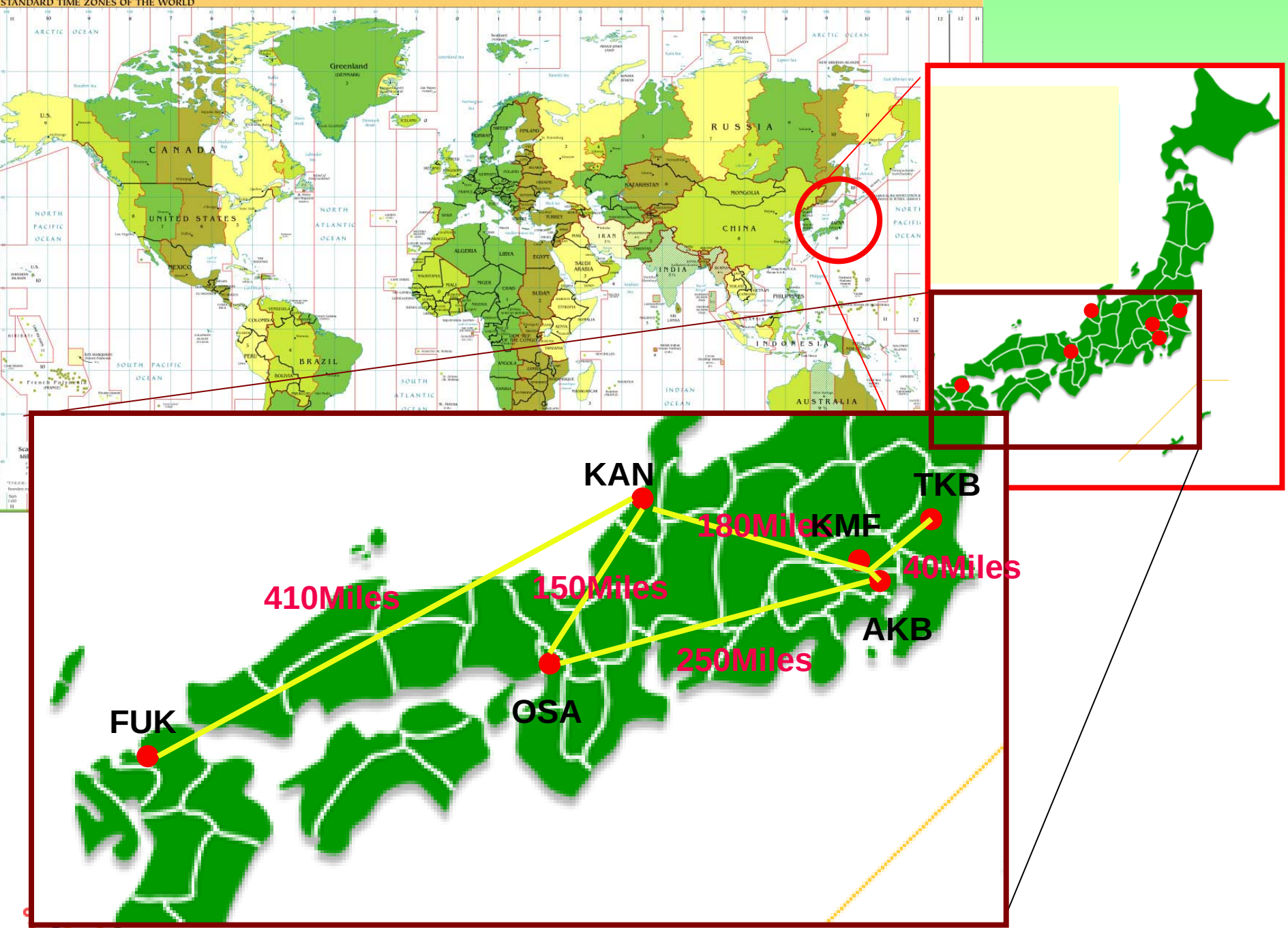
Overview of Demonstration



① User requests service via GUI, specifying the required number of computers and the network bandwidth needed

②The computing resources and GMPLS network resources are reserved as the result of interworking between the GRS and NRM using GNS-WSI (Grid Network Service / Web Services Interface)

③ A molecular dynamics simulation is executed using the reserved computers and lambda paths. Ninf-G2 and Globus Toolkit 2 (GT2) are used at each cluster.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TKB
KMF
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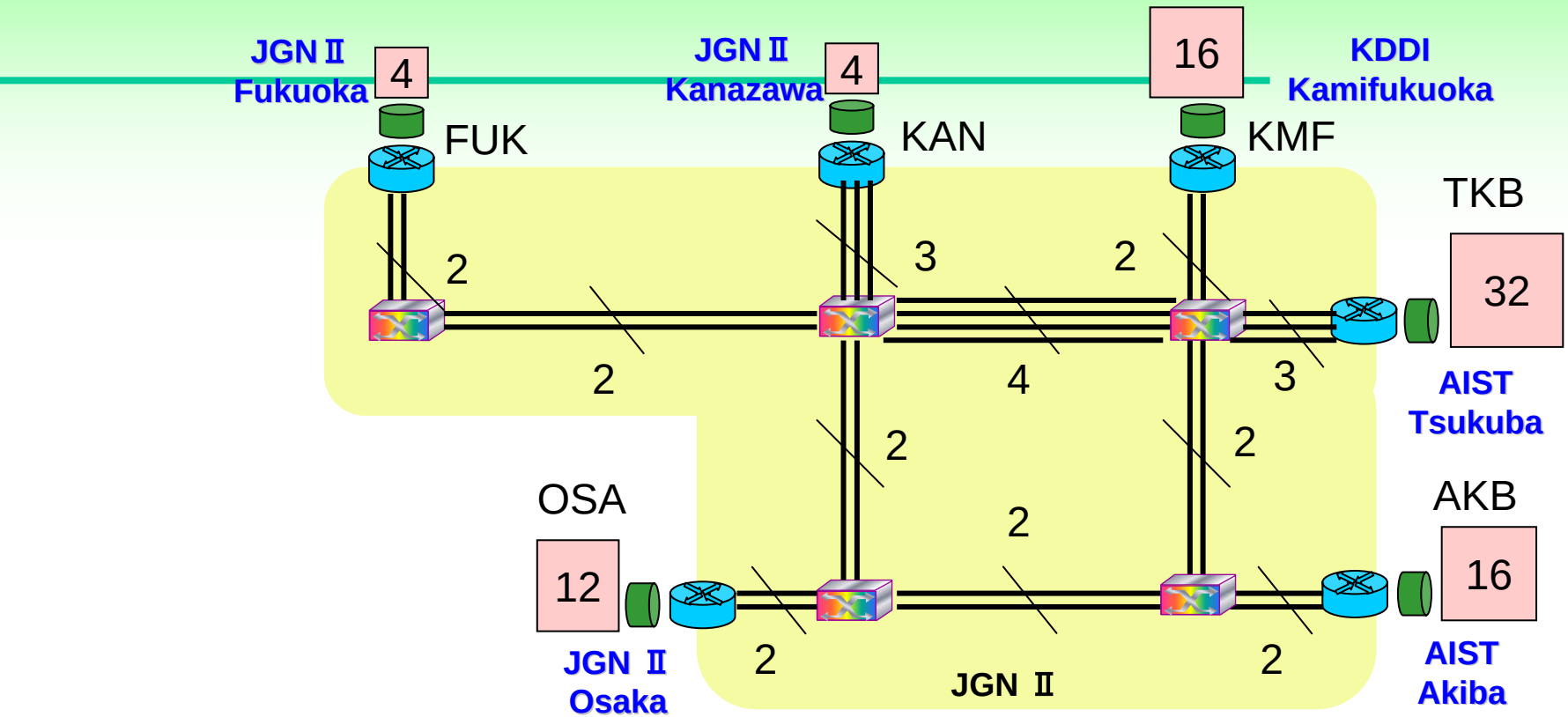
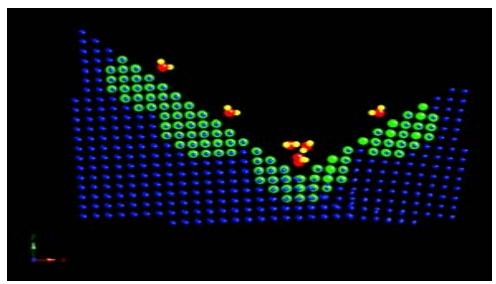
Demo Environment

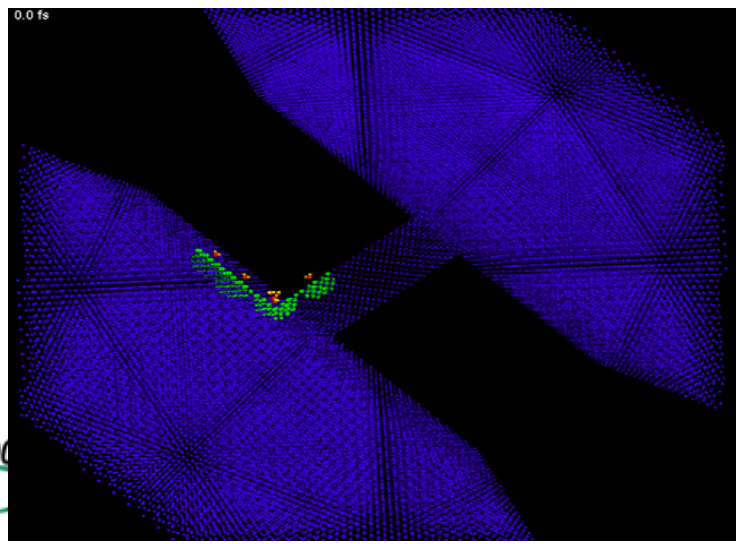


Clusters distributed over six locations in Japan are connected over GMPLS network test-bed deployed by JGN II

Overview of the Demo Application

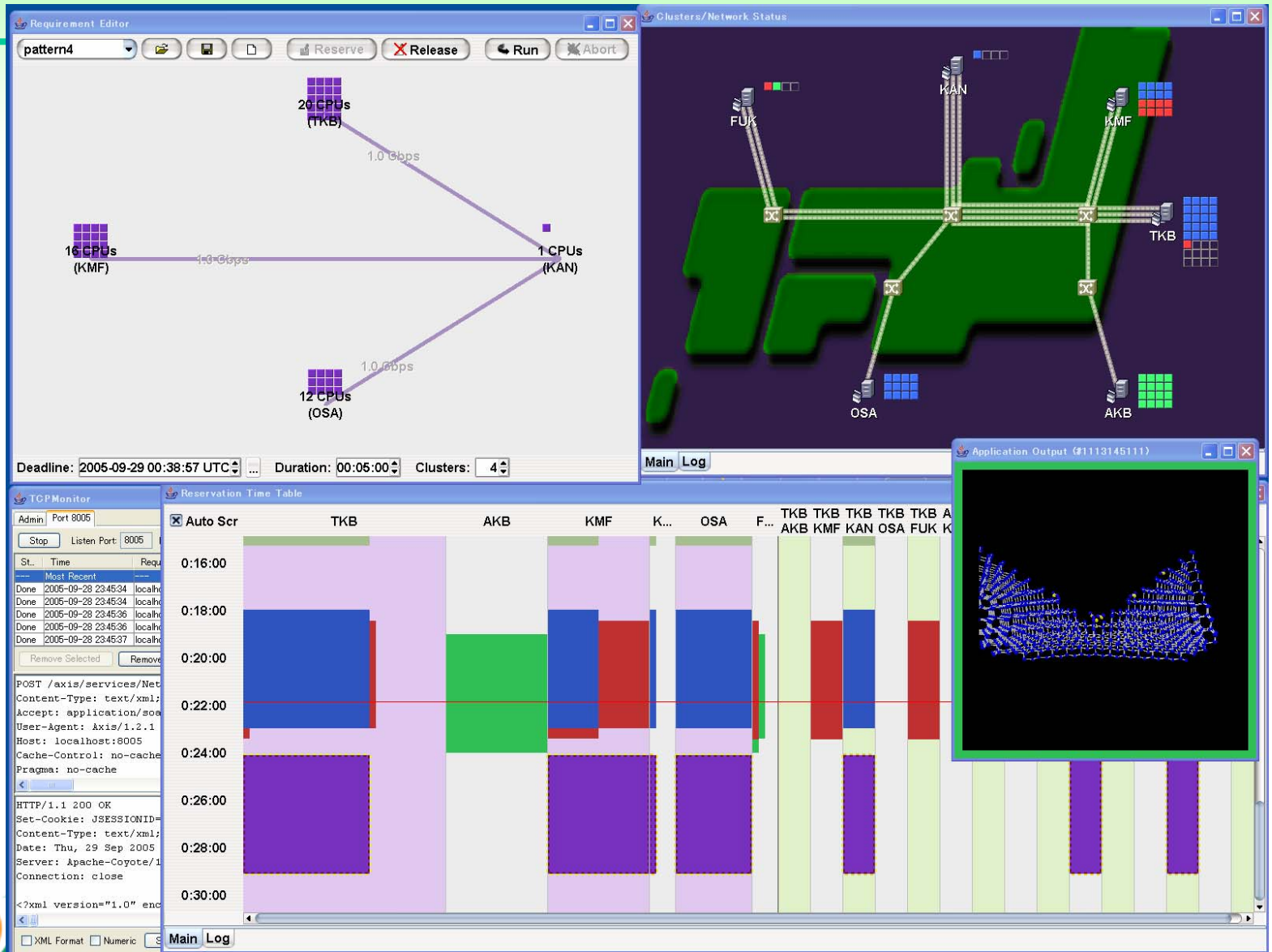
- A molecular dynamics simulation implemented with a Grid Middleware called Ninf-G2, that is developed by AIST, Japan
  - Ninf-G2 conforms the GridRPC API, a Global Grid Forum standard programming API for Grid
  - Uses Globus Toolkit 2 for job invocation and communication
- Simulation Scenario
  - Silicon and water reaction under stress





Global Grid Forum:
A standardization body for grid related technologies
Globus Toolkit:
Infra-ware for the Grid

Demonstration replay



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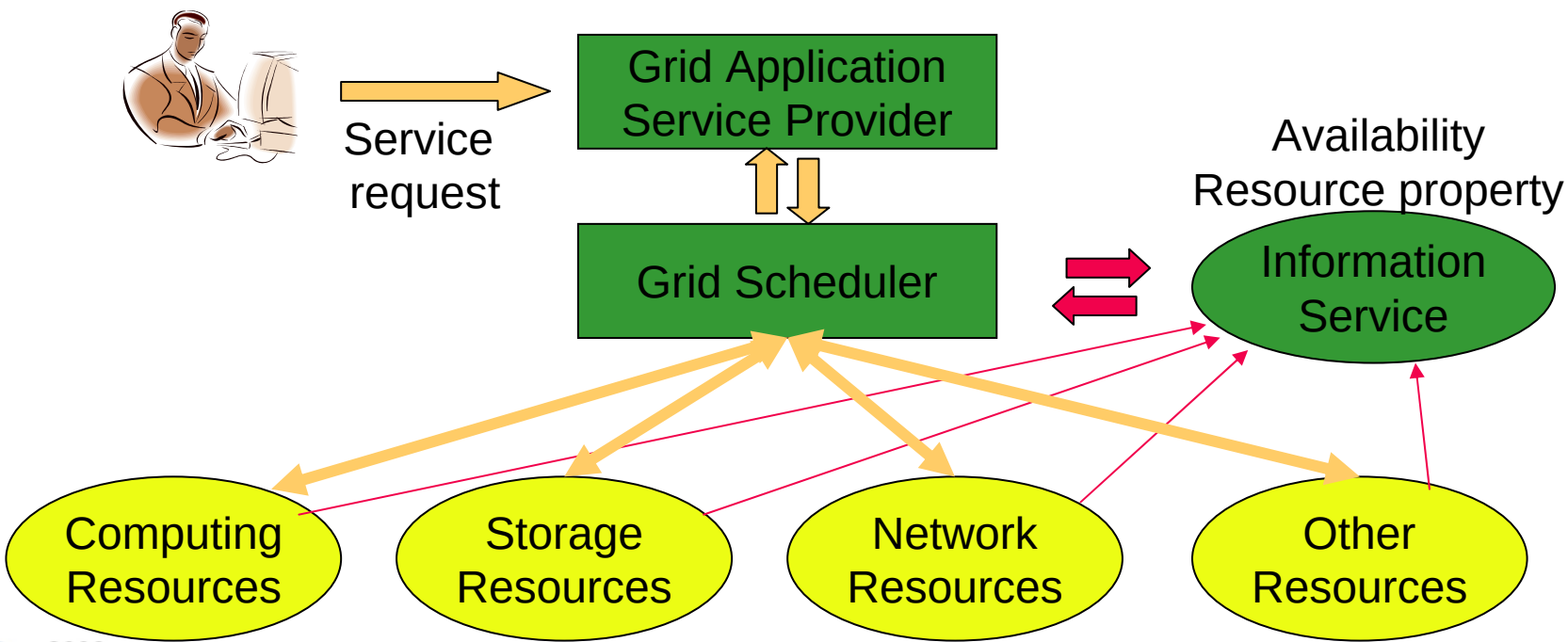
“Batch”, “On-demand ” and “Advance reservation”

- Most of the schedulers for computing resources use batch model
  - Make a queue of jobs with priority, and execute jobs in the order
  - Good for resources managed by a single scheduler
- For resources provided by multiple, and sometimes commercial providers, advance reservation is suitable
  - Each provider can control its own resources with a reservation table
- On the other hand, GMPLS does not support advance reservation.
  - The routing function of GMPLS assumes on-demand provisioning of paths

Information service

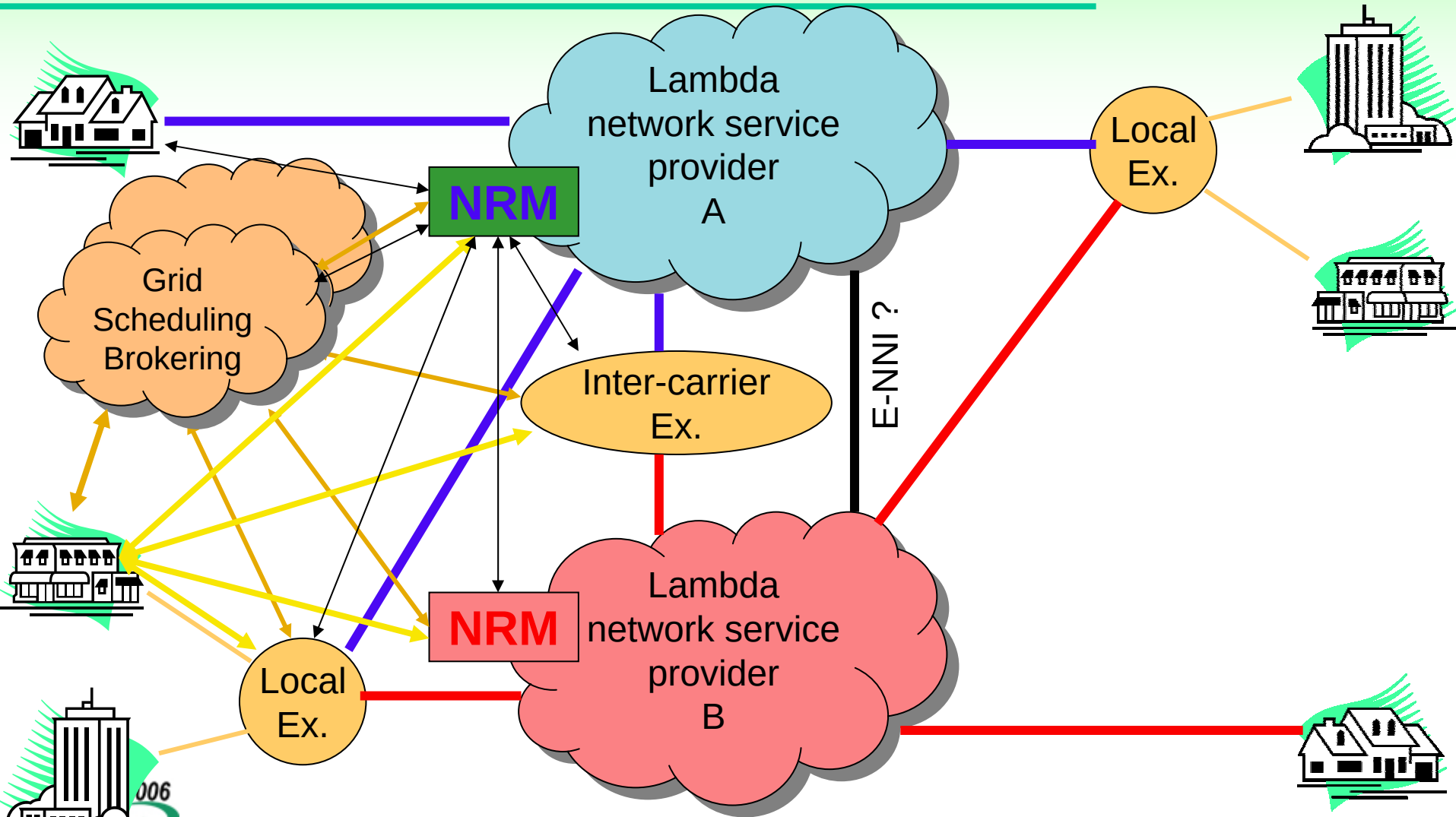
- Grid virtualizes resources.
  - Users do not care about the exact resource they will use. Grid middle ware (application service provider, broker, planner…) will select appropriate resources.



Multi-domain issues

- How inter-domain control can be realized?
  - Inter-domain control
    - GMPLS (E-NNI…)
      - GMPLS manages everything
    - NRM layer interworking
      - NRM hides implementations. GRS (or user) don't have to care about multiple network domains.
      - Can handle network domains with different control protocols.
      - Requires inter-NRM interface and agreement
    - GRS layer interworking
      - GRS (or user) directly specifies inter-domain exchange point

Future model of network service



Thank you

G- lambda project

http://www.g-lambda.net/