

G- lambda
**Coordination of Grid and
GMPLS network**

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G- **lambda** project

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

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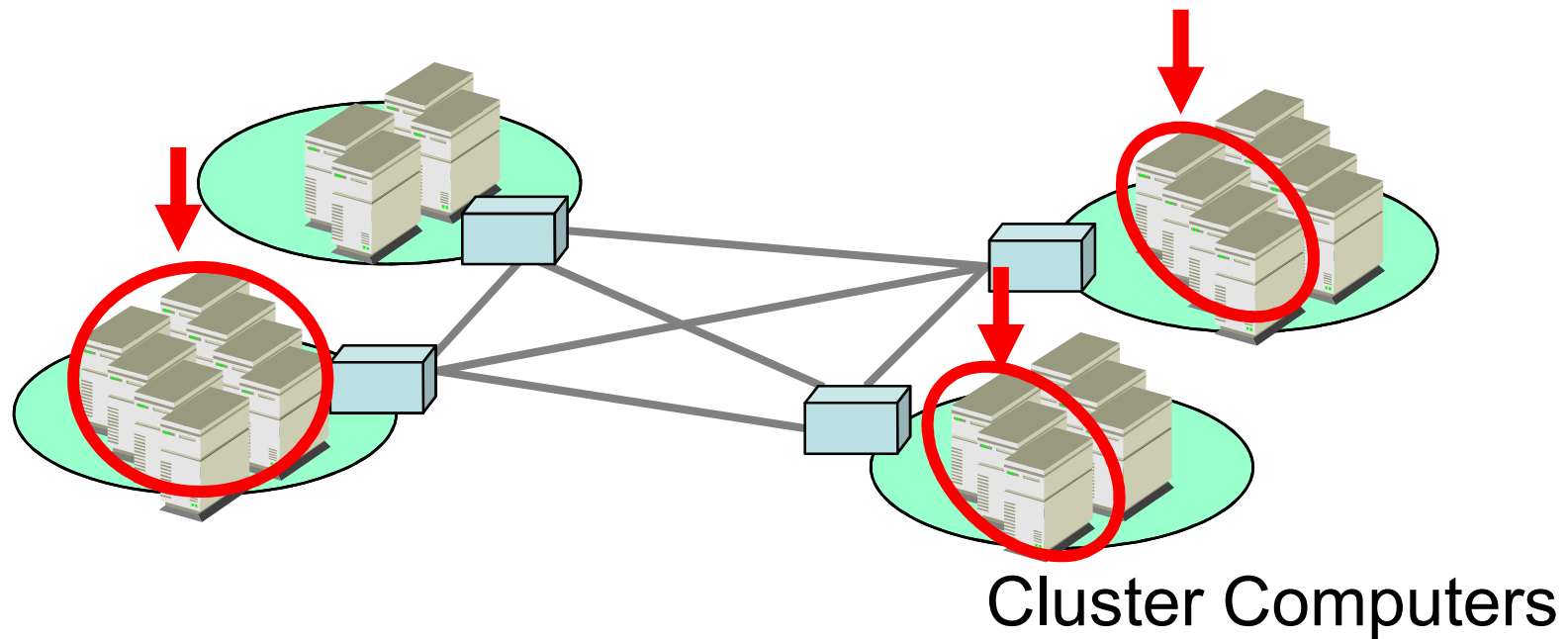
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Meta-computing on the Grid

- Require distributed computing resources provided by different organization simultaneously



Co-allocation of Grid resources

- Co-allocation of both network and computing resources from different domains is an essential issue for Grid
 - The current, best-effort Internet is unpredictable
 - While optical network can provide high quality communication, the provisioning is not automated
 - Co-allocation by "superscheduler" is premature
- Difficult to **guarantee performance** of user applications
- Requires '**human negotiations**' using e-mail or fax before the computation can take place.

Overview of the G- **lambda** project

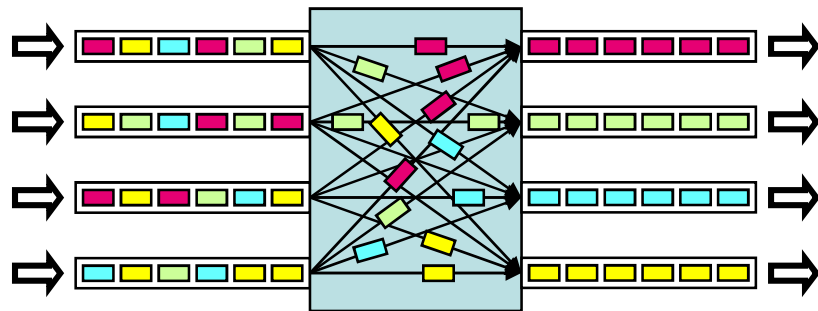
- We employ **lambda paths network** to guarantee performance
- We realize coordination of **Grid resource scheduler (GRS)** and **network resource management system (NRM)**
 - GRS based on WSRF negotiates with NRM and selects a suitable set of resources with **simultaneous advance reservation**
 - NRM provides a lambda-based grid network service (GNS) over a **GMPLS** network through web services interfaces
- We are establishing a **standard web services interface** between **GRS** and **NRM, GNS-WSI (Grid network service / WS interface)**
- Live Demonstration at iGrid2005 and SC|05

Lambda paths network and GMPLS

- Lambda paths provide guaranteed network quality
 - Each lambda path connects two end-points
 - No intermediate equipments which may discard packets due to congestion

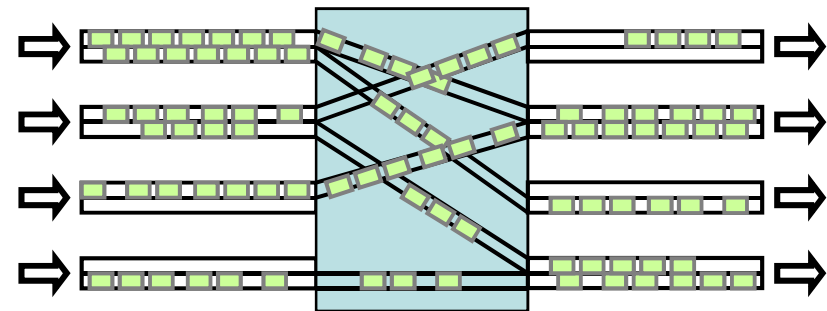
Packet network switching

→ Switching overhead, packet loss



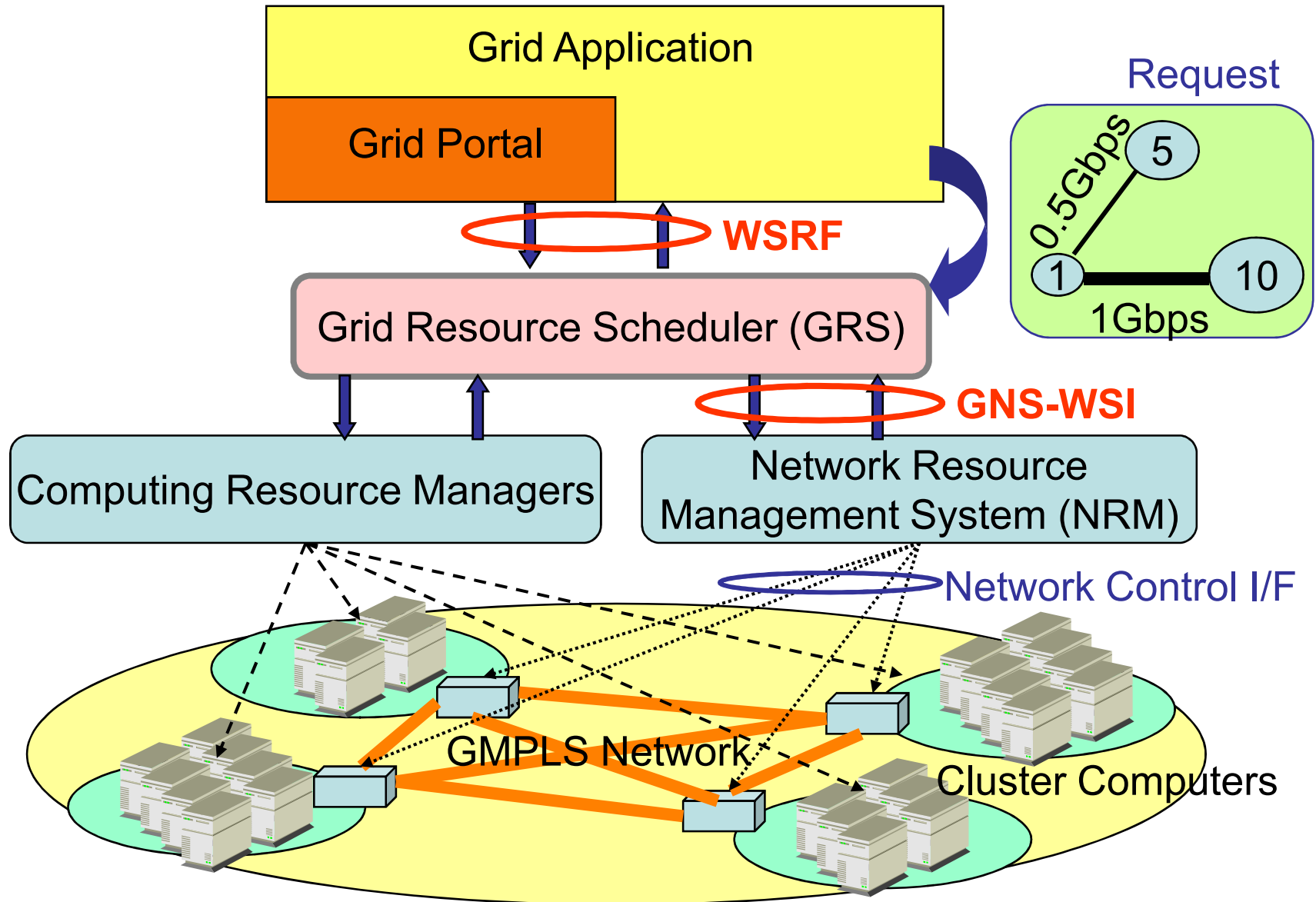
Lambda paths network switching

→ Low latency, no packet loss



- **GMPLS** (Generalized Multi-Protocol Label Switching) is one of the most viable protocols to control lambda paths network

System overview



Grid Resource Scheduler (GRS)

- A WSRF based Grid scheduler developed by AIST
 - WSRF is an interface for an open framework for modeling and accessing stateful resources using Web services
 - Implemented using GT4 (Globus Toolkit 4)
- According to users' request, reserve 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)

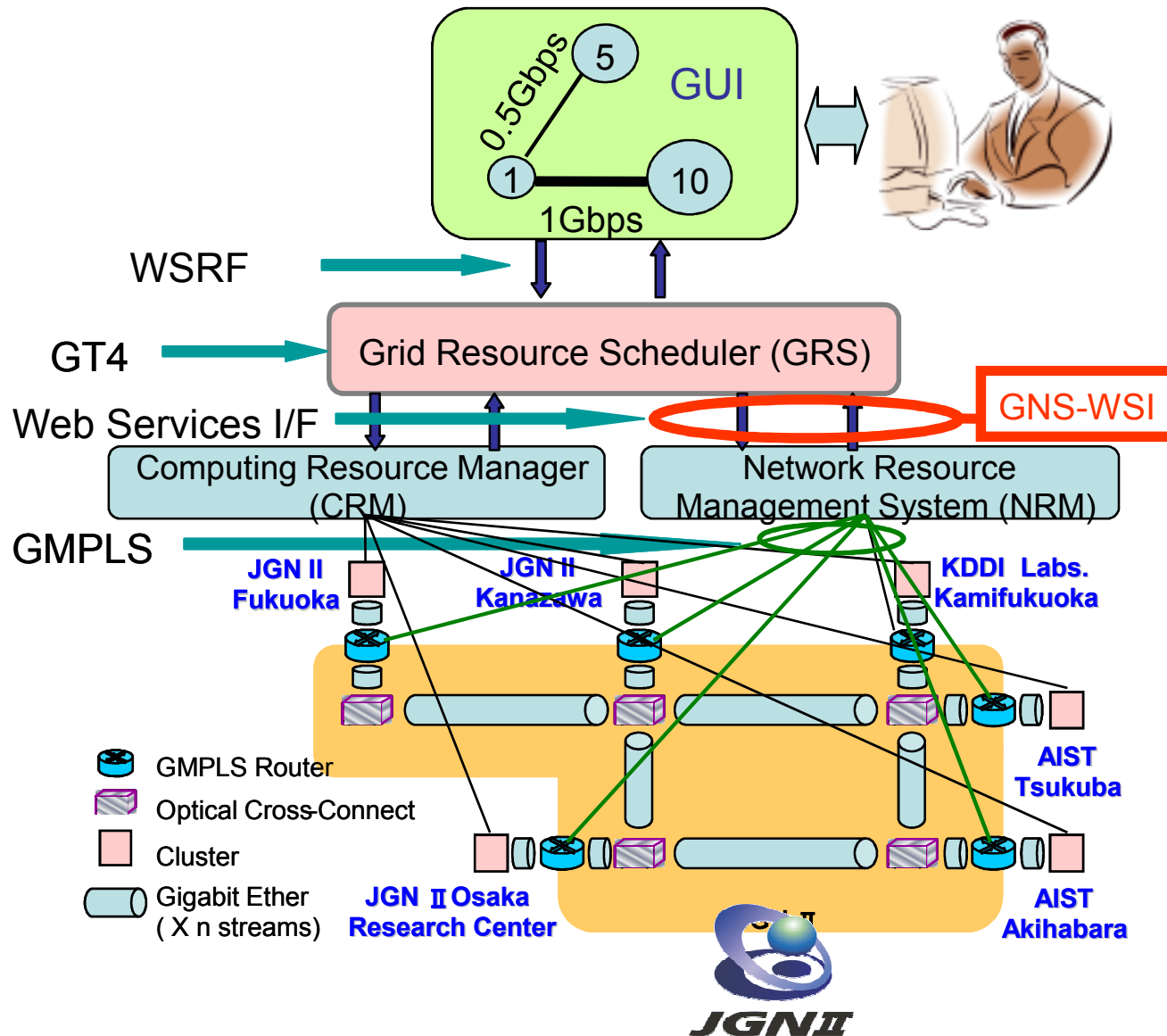
Network Resource Management System (NRM)

- 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 Service 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

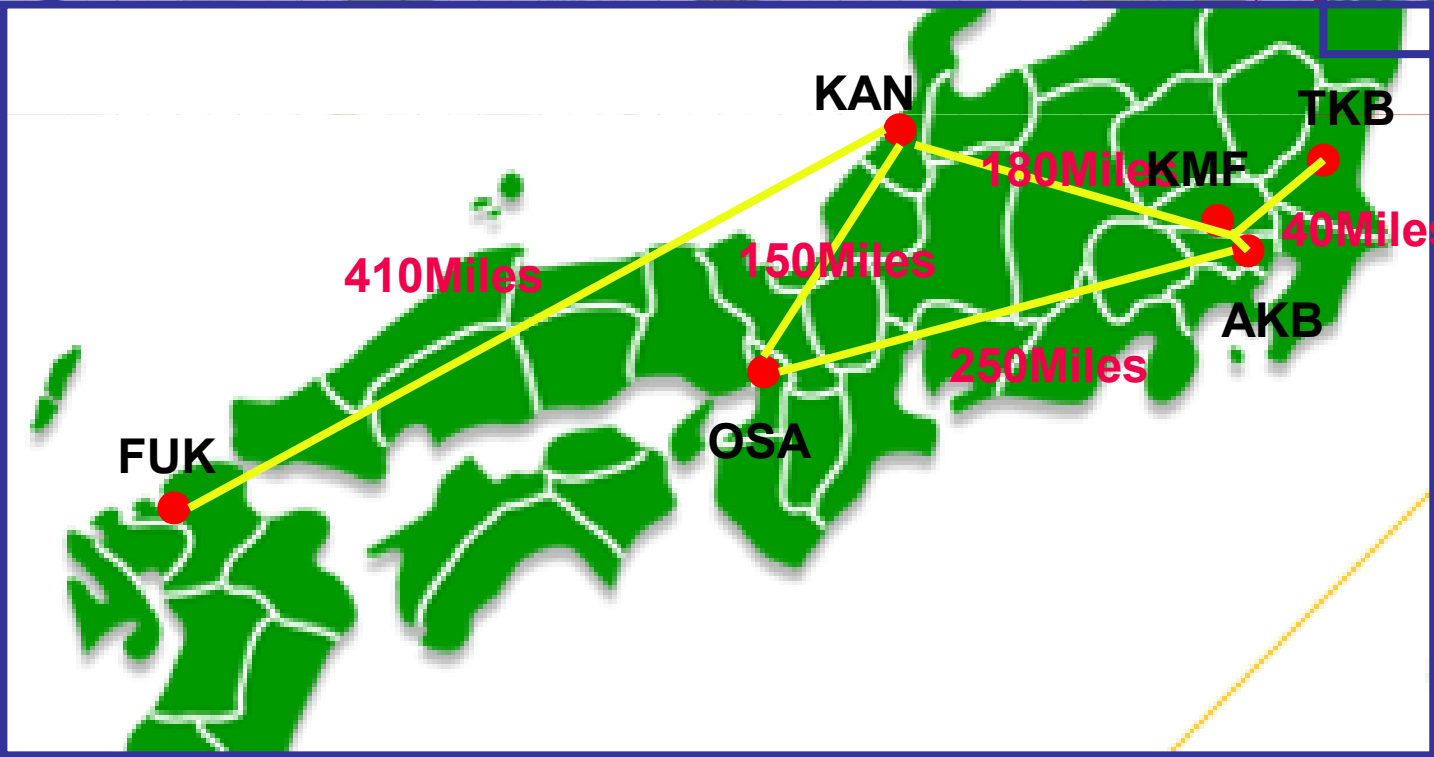
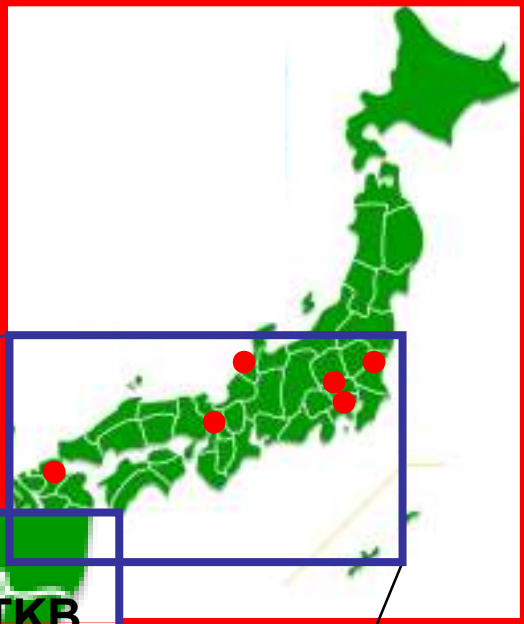
Overview of Demonstration



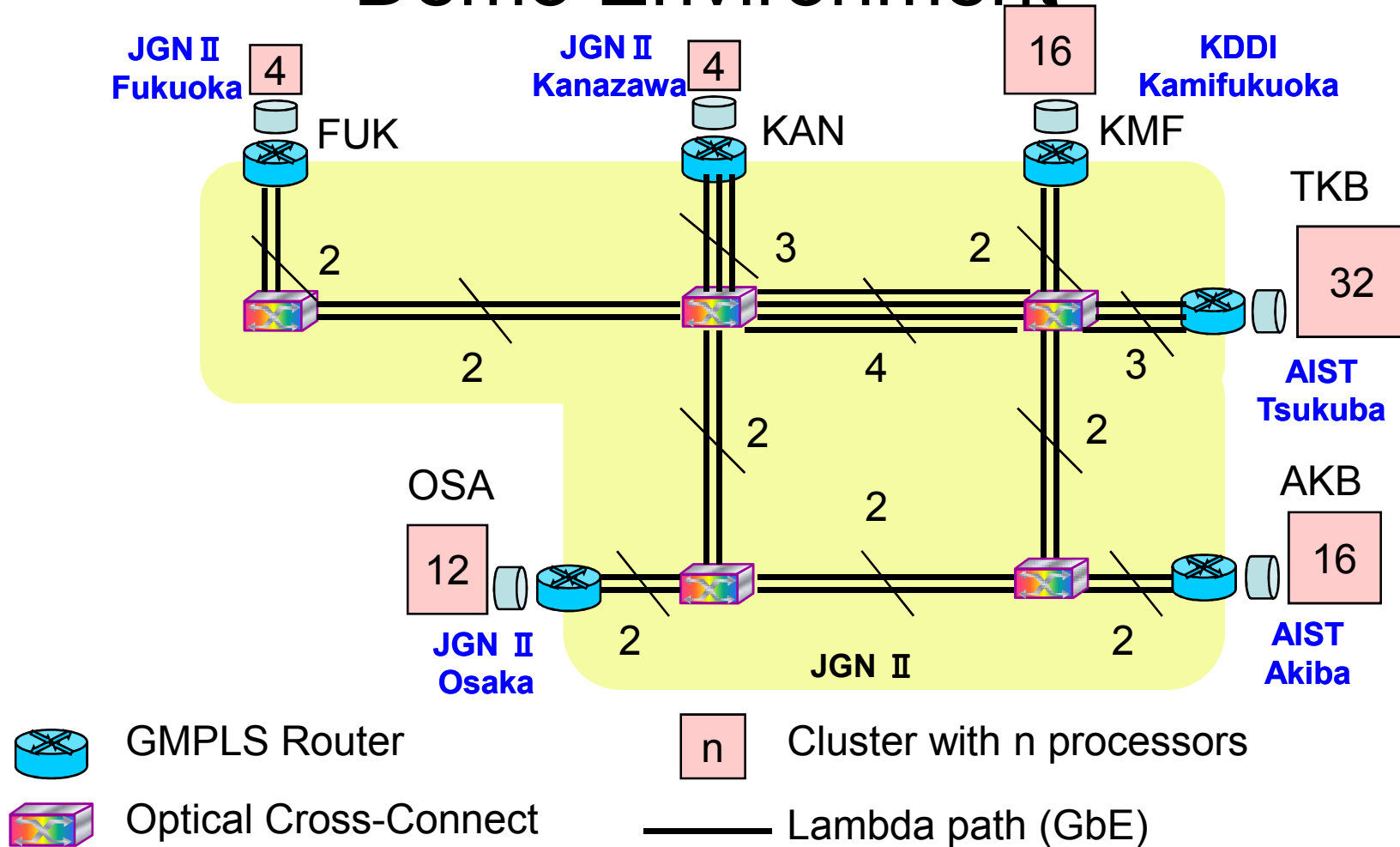
① User requests service via GUI, specifying the required number of computers and the network bandwidth needed

② The computing resources and GMPLS network resources are reserved as the result of interworking between the GRS and NRM using GNSWSI (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.



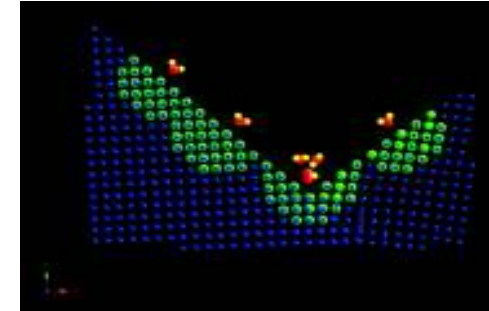
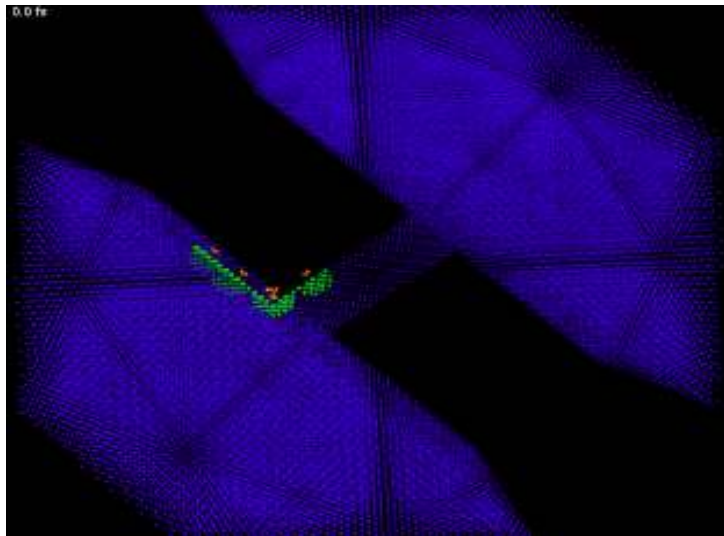
Demo Environment



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](#)



Start

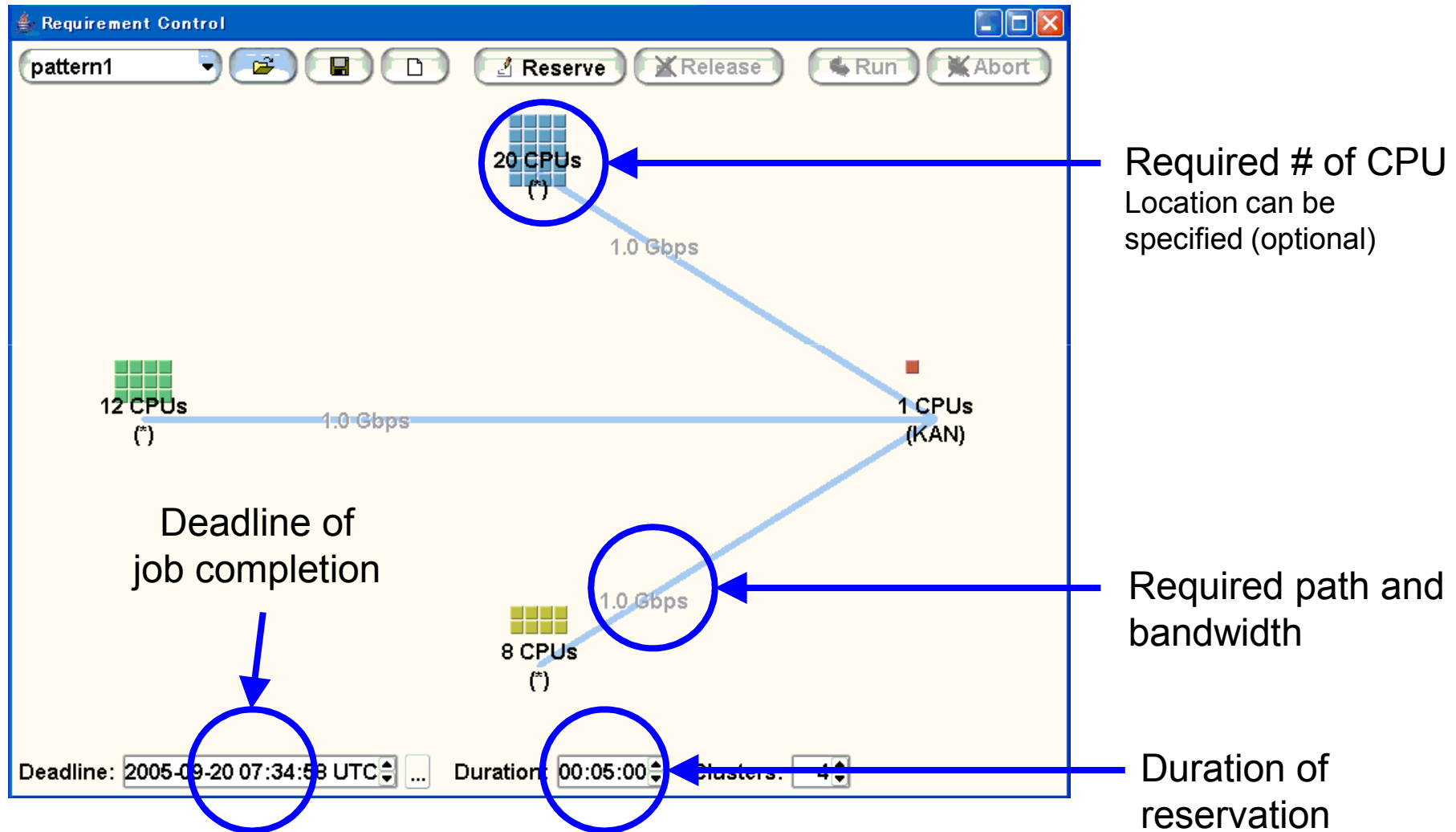
Global Grid Forum:

A standardization body for grid related technologies

Globus Toolkit:

Infra-ware for the Grid

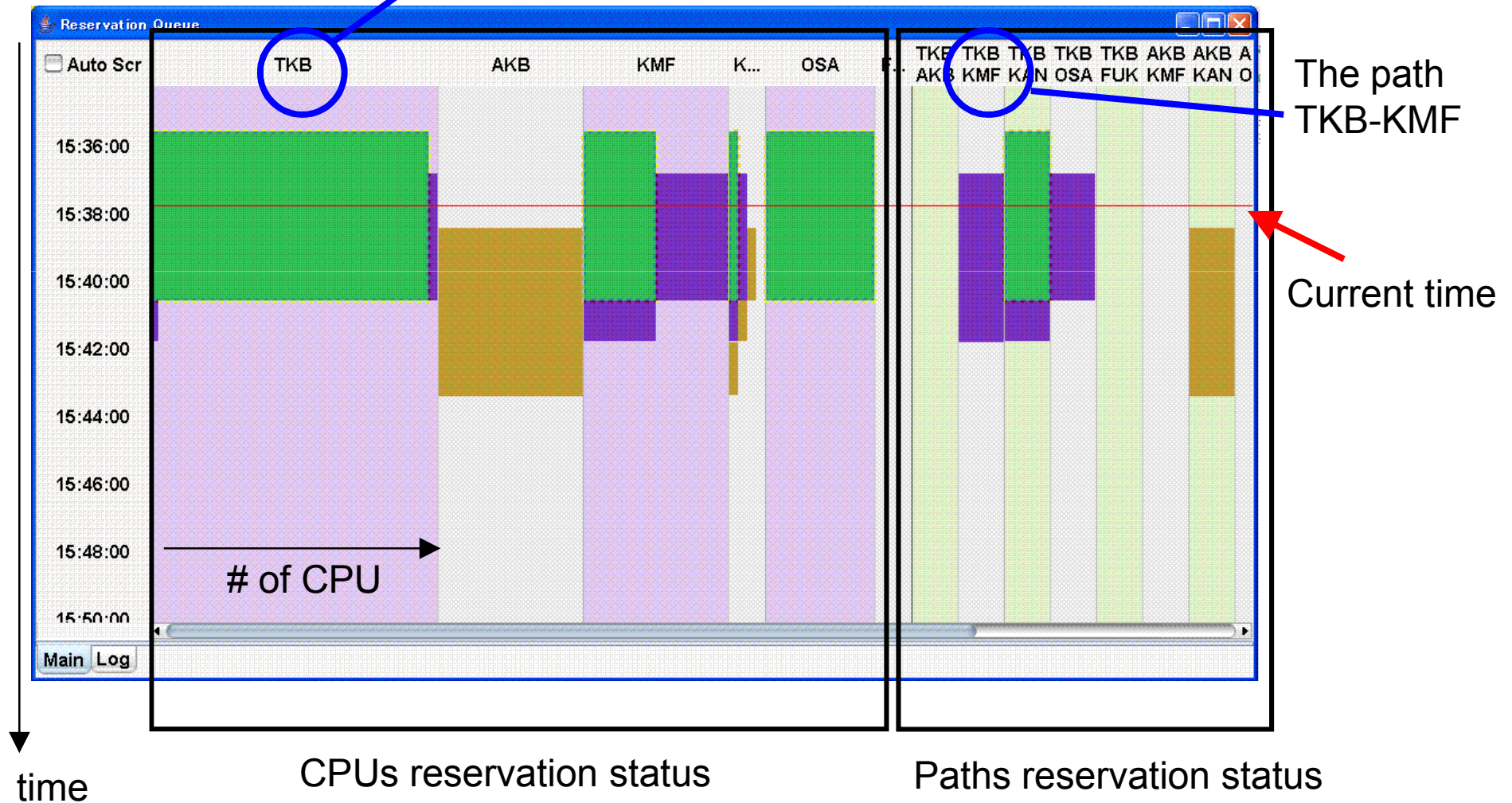
Request computers and bandwidth



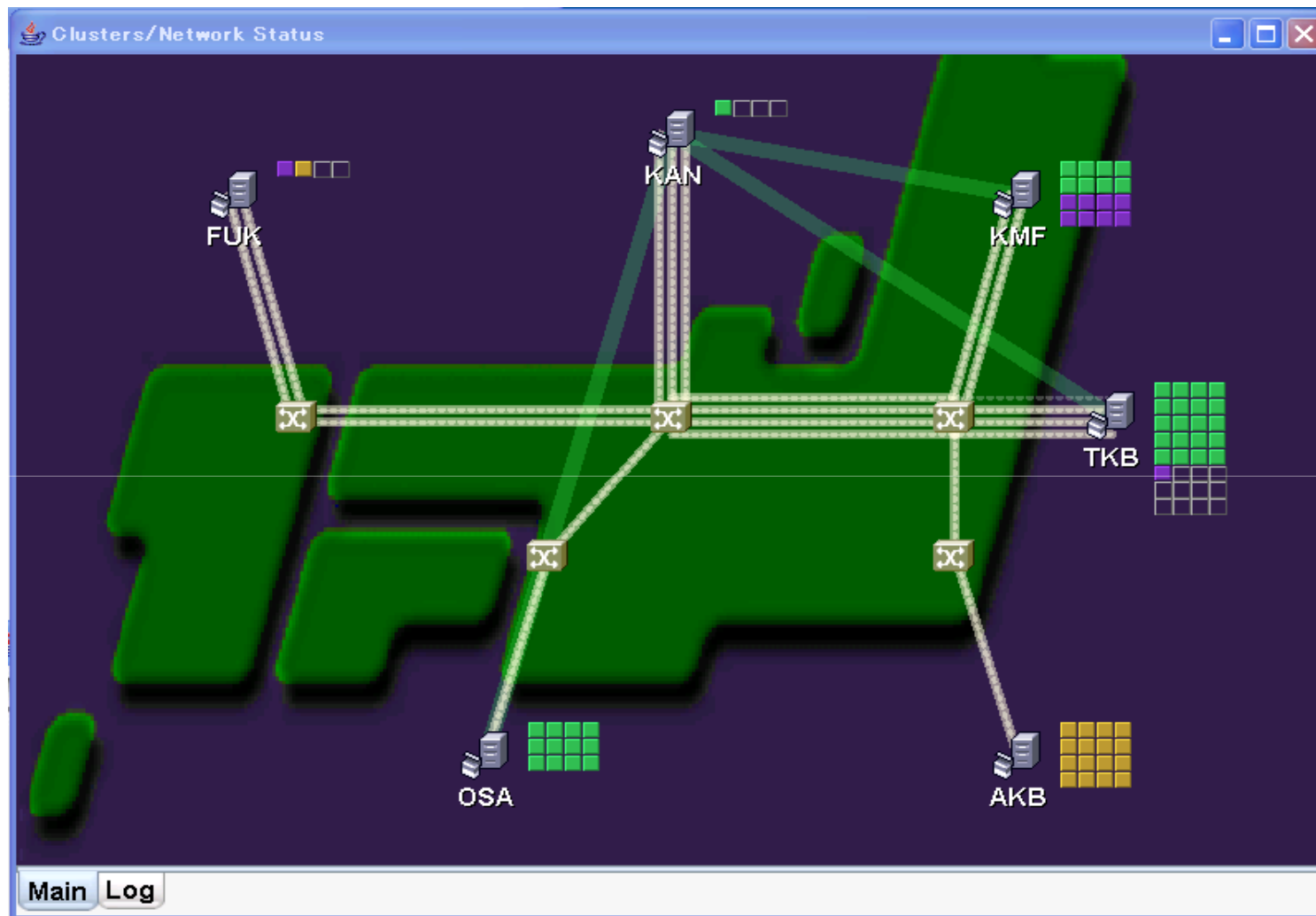
A total of 37 CPUs at 4 locations and star shaped paths are requested

Advance reservation status

Reservation status of
TKB cluster

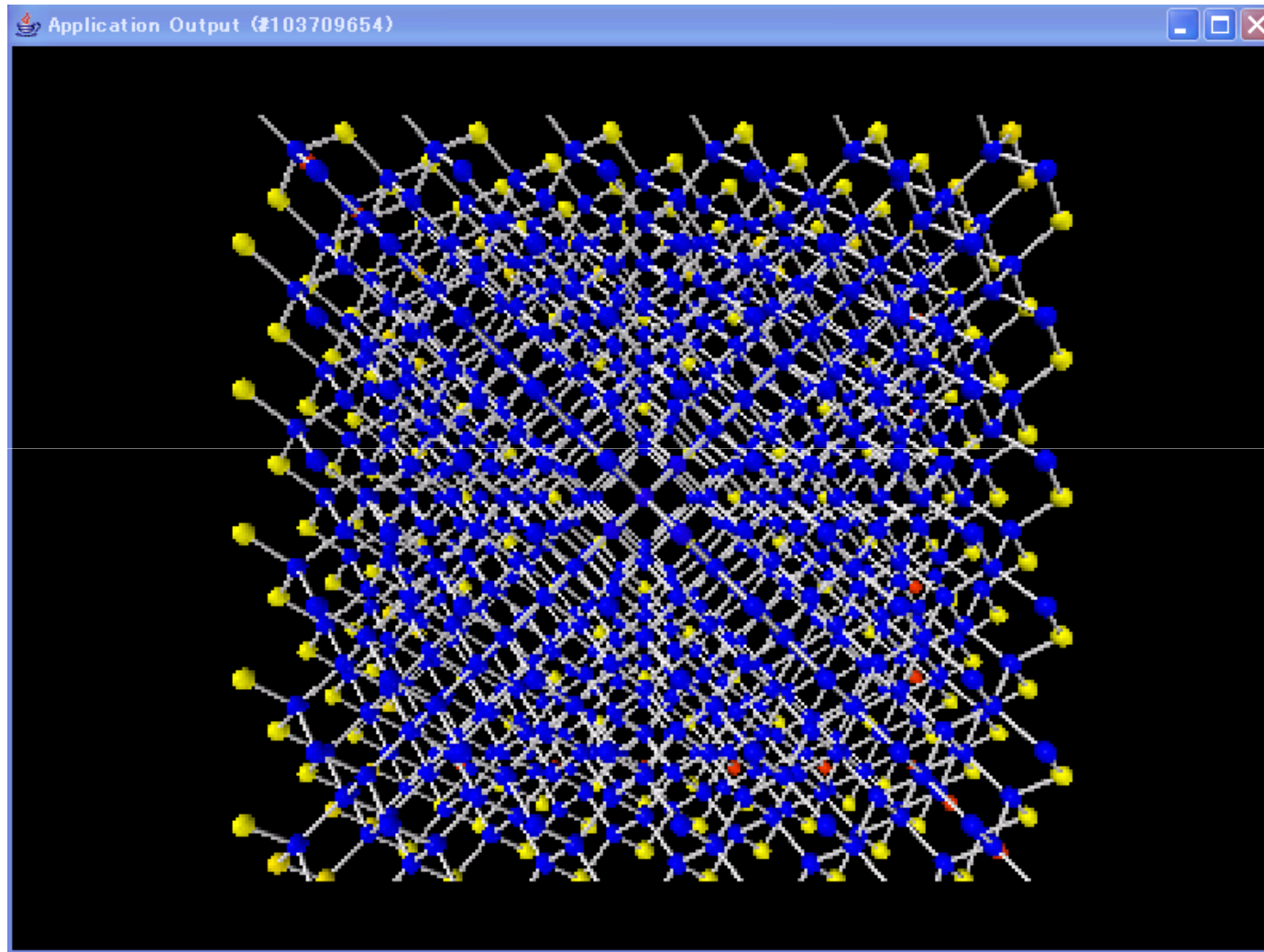


Current CPU and paths



Paths are displayed based on the information from GMPLS routers

Output of the simulation



Temperature of Molecules of Silicon

Conclusions

- Employed **lambda paths network** to guarantee performance
- **Realized coordination of both computing and network resources with advance reservation**
 - GRS negotiates with NRM and selects a suitable set of both network and computing resources
 - NRM provides virtualized network resources and manages GMPLS-based network
- Defined GNS-WSI, a Web services interface between GRS and NRM
- Live demonstration at iGrid2005 and SC|05

Future work

- GRS
 - More sophisticated co-allocation algorithms: priority, fairness
 - Fault tolerance of resource reservation
 - Scalability (multiple GRSs and multiple NRMs)
- NRM
 - GNS over multiple network domains
 - QoS awareness
- Extension of GNS-WSI considering more application's requirement
- We are going to establish a **standard web services interface** between **Grid** and **network**

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