

NAREGI Grid Middleware and the Operational Issues

Interoperability and Interoperation between
Europe, India and Asia,
OGF23, Barcelona, Spain

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Outline

■ introduction

■ NAREGI grid middleware

- overview
- lessons learned from beta version
- standards in the middleware

■ deployment

- Cyber Science Infrastructure (CSI)
- deployment plans
- Grid Operation

NAREGI Project Overview

- R&D project for grid middleware
 - funded by MEXT (Ministry of Education, Culture, Sports, Science and Technology)
FY2003 – FY2007
- collaboration of national labs, universities and industry in the R&D activities (IT and Nano-science Apps.)
- the Grid layer in the Cyber Science Infrastructure (CSI)

Project Goals

■ middleware development

- R&D in Grid Middleware and Upper Layer
- a prototype of future Grid Infrastructure for scientific research in Japan

■ testbed

- grid computing testbed for nano-science application

■ international collaboration

- OGF
- EGEE

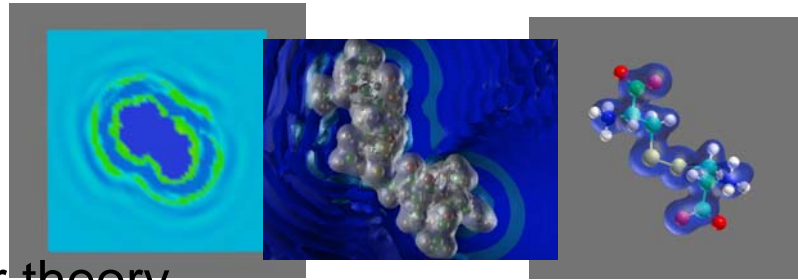
Nano-Science : coupled simulations on the Grid as the sole future for true scalability

... between Continuum & Quanta.

Material physics

(Infinite system)

- Fluid dynamics
- Statistical physics
- Condensed matter theory



Molecular Science

- Quantum chemistry
- Molecular Orbital method
- Molecular Dynamics

...

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Limit of
Idealization

Multi-Physics

Limit of
Computing
Capability

Old HPC environment:

- decoupled resources,
- limited users,
- special software, ...

Coordinates decoupled resources;

Meta-computing,
High throughput computing,
Multi-Physics simulation

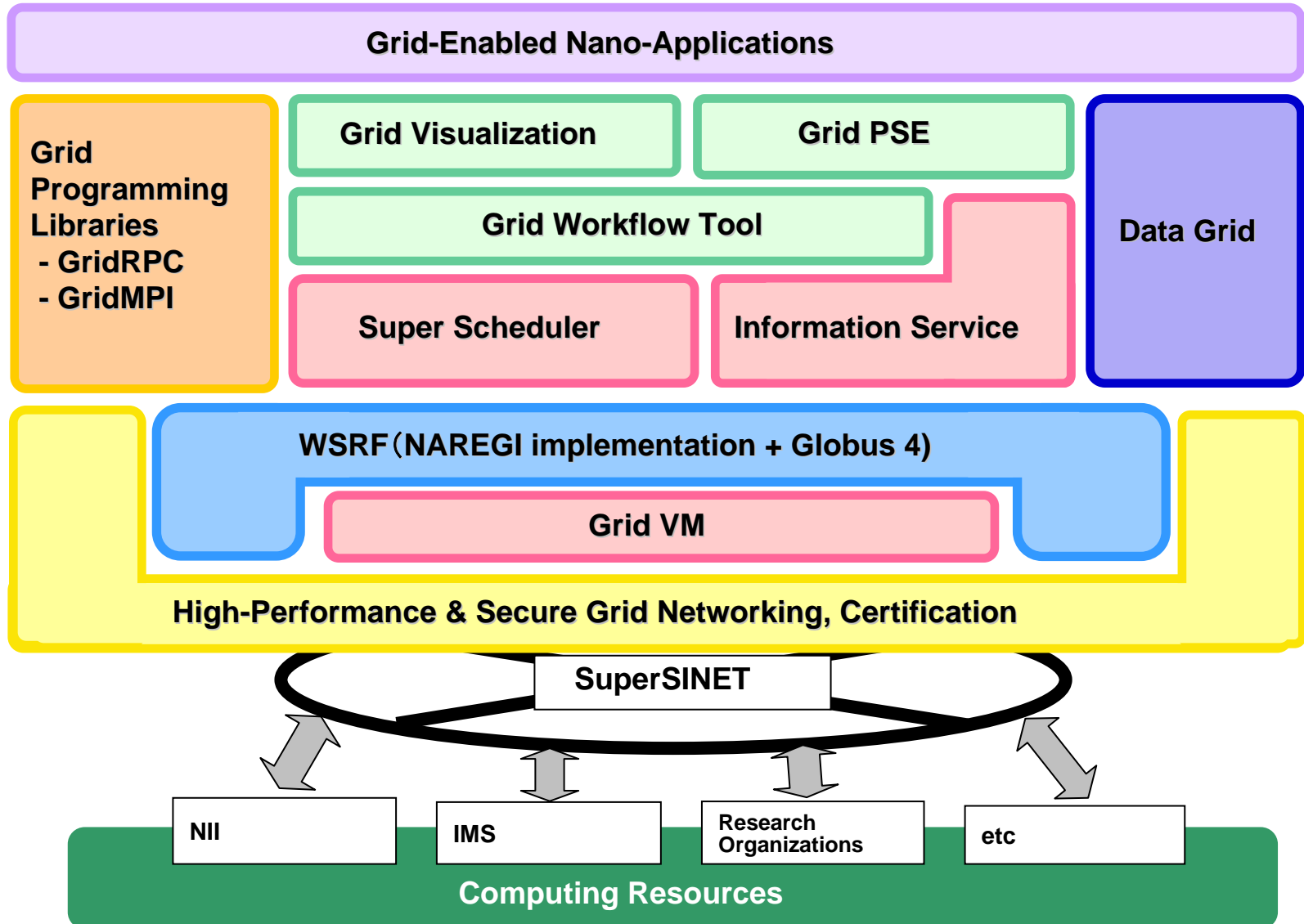
w/ components and data from different groups
within VO composed in real-time



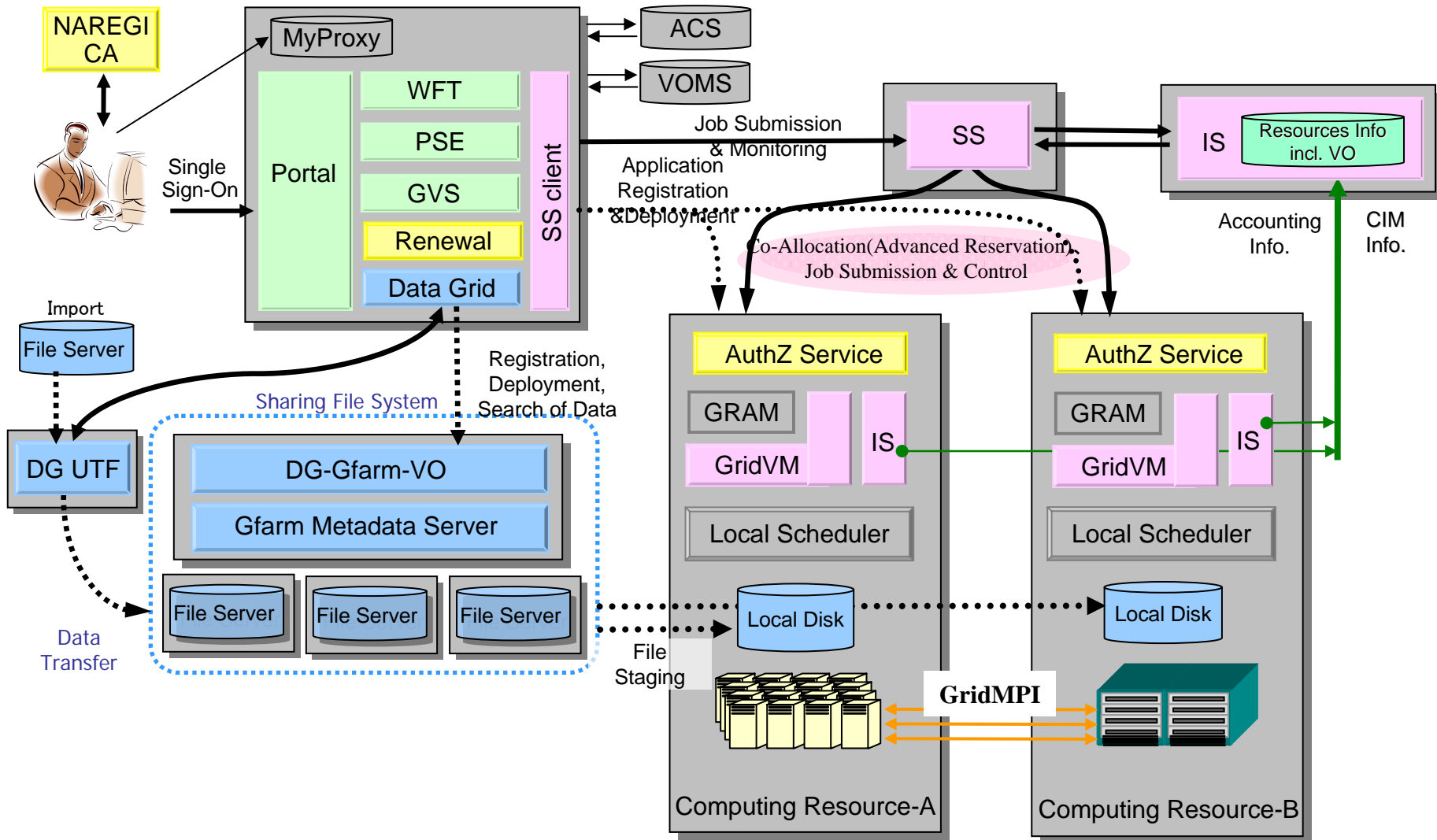
The only way to achieve true scalability!

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NAREGI Software Stack



NAREGI Architecture



Programming

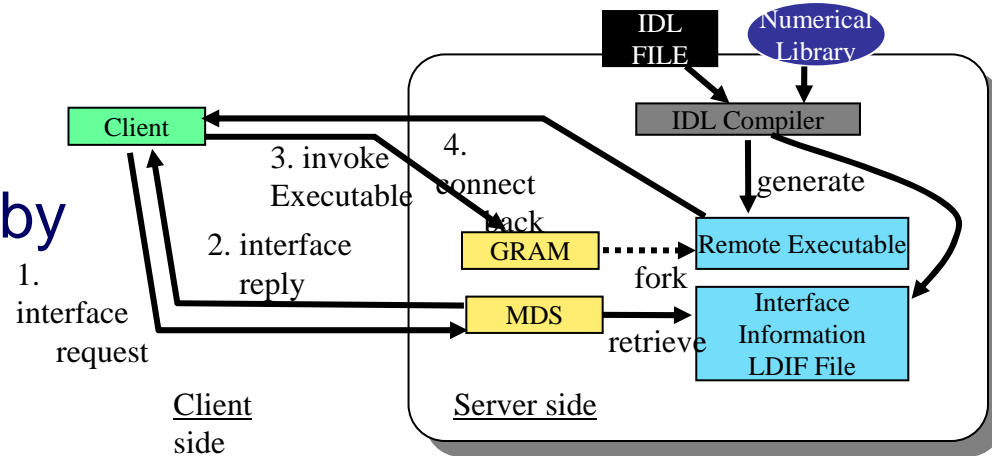
■ GridRPC

➤ RPC on the grid

- ✓ API standardization by OGF

➤ Ninf-G

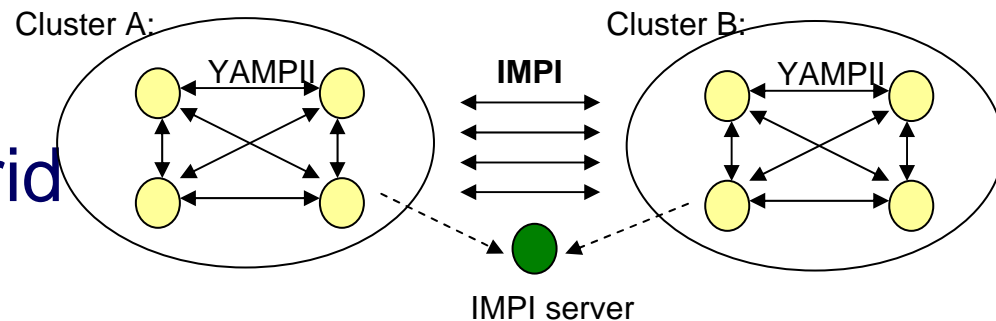
- ✓ a reference implementation of GridRPC API



■ GridMPI

➤ MPI library on the grid

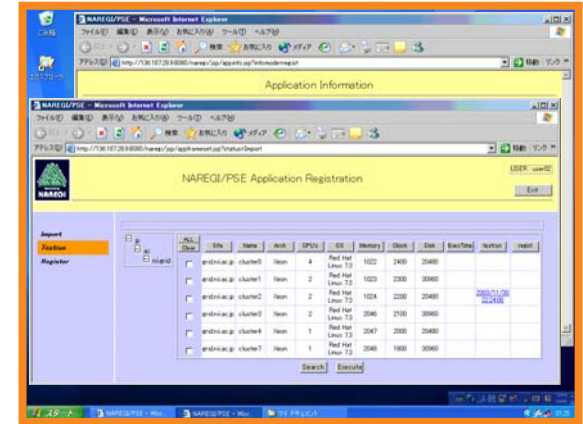
- ✓ MPI communication between parallel systems on the grid



User-Level Grid Tools & PSE

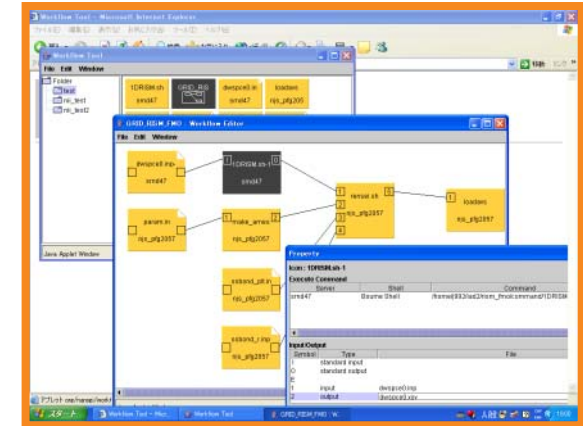
■ Grid PSE

- support for compilation and deployment
- application repository
- execution support

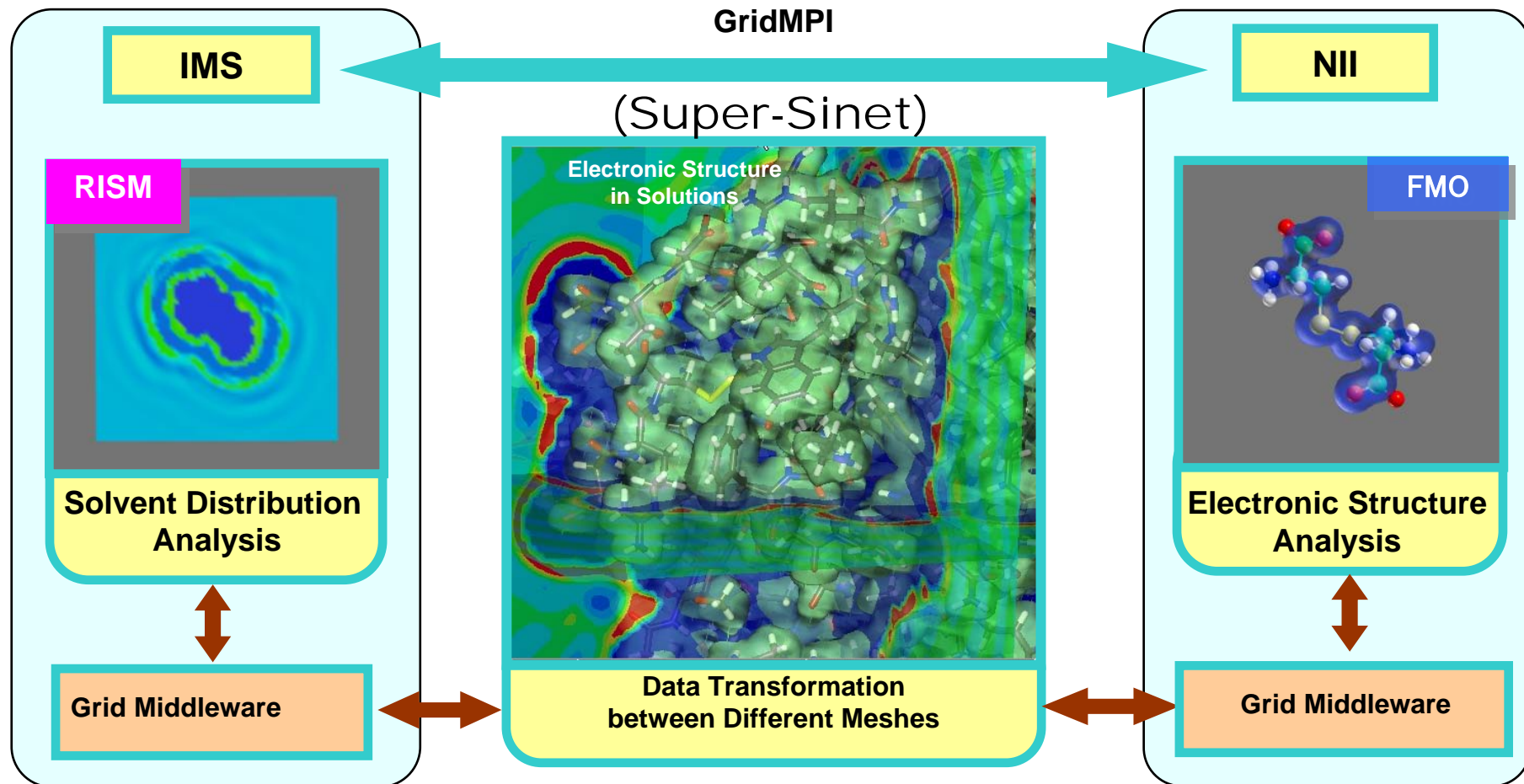


■ Grid Workflow

- workflow language
- GUI
- CUI



Adaptation of Nano-science Applications to Grid Environment



RISM

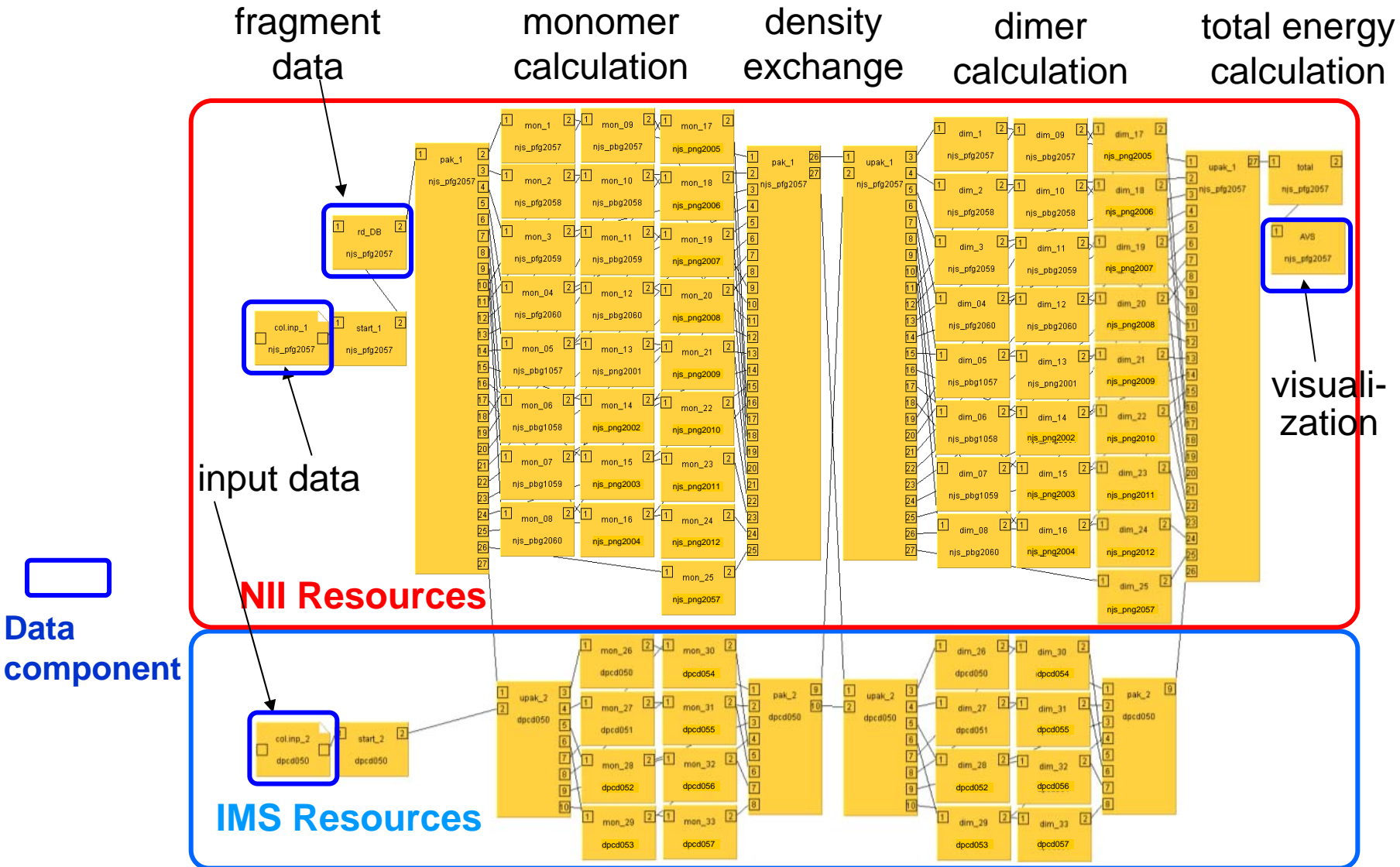
Reference Interaction Site Model

FMO

Fragment Molecular Orbital method

Workflow based Grid FMO

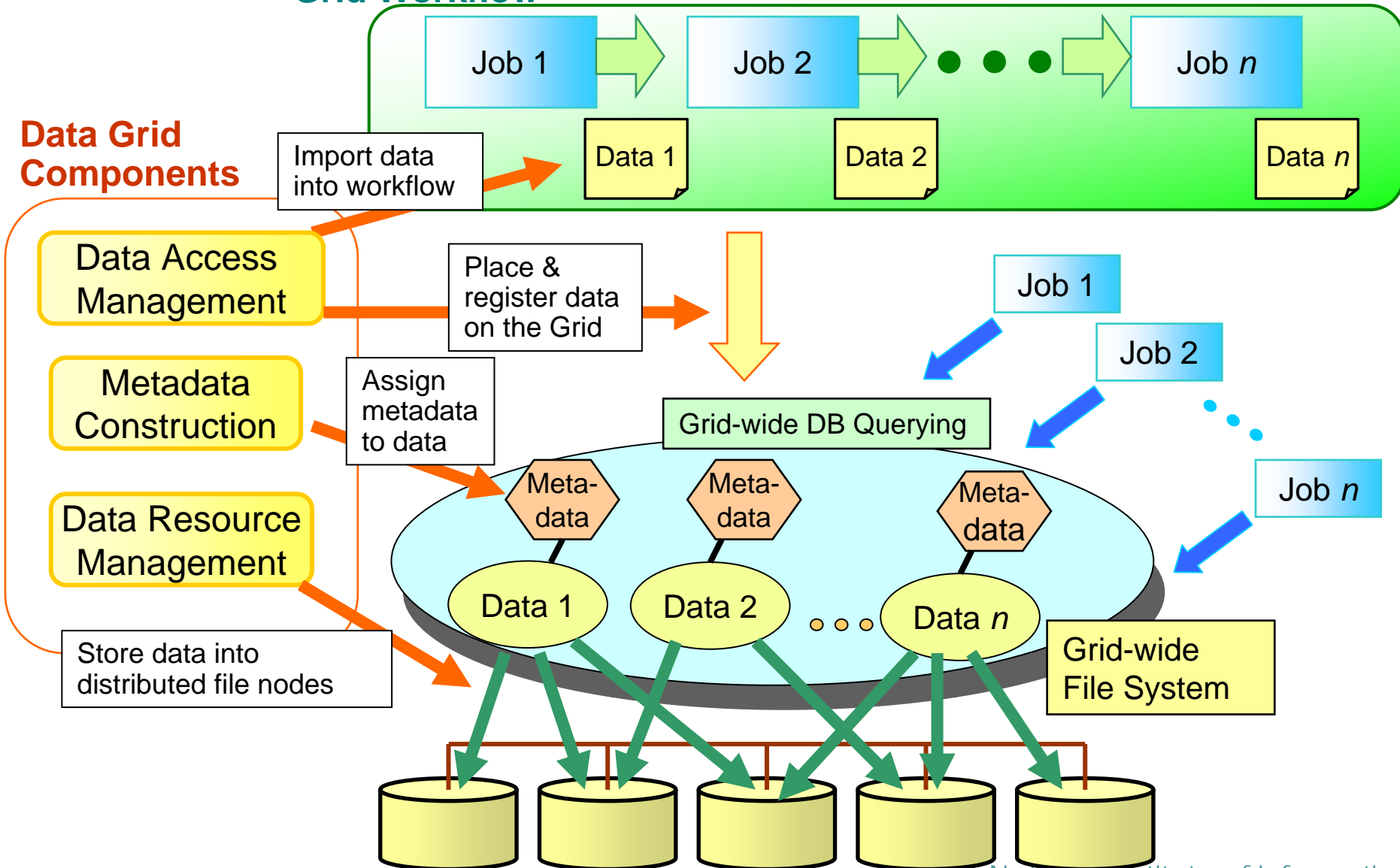
Simulations of Proteins



NAREGI Data Grid Environment

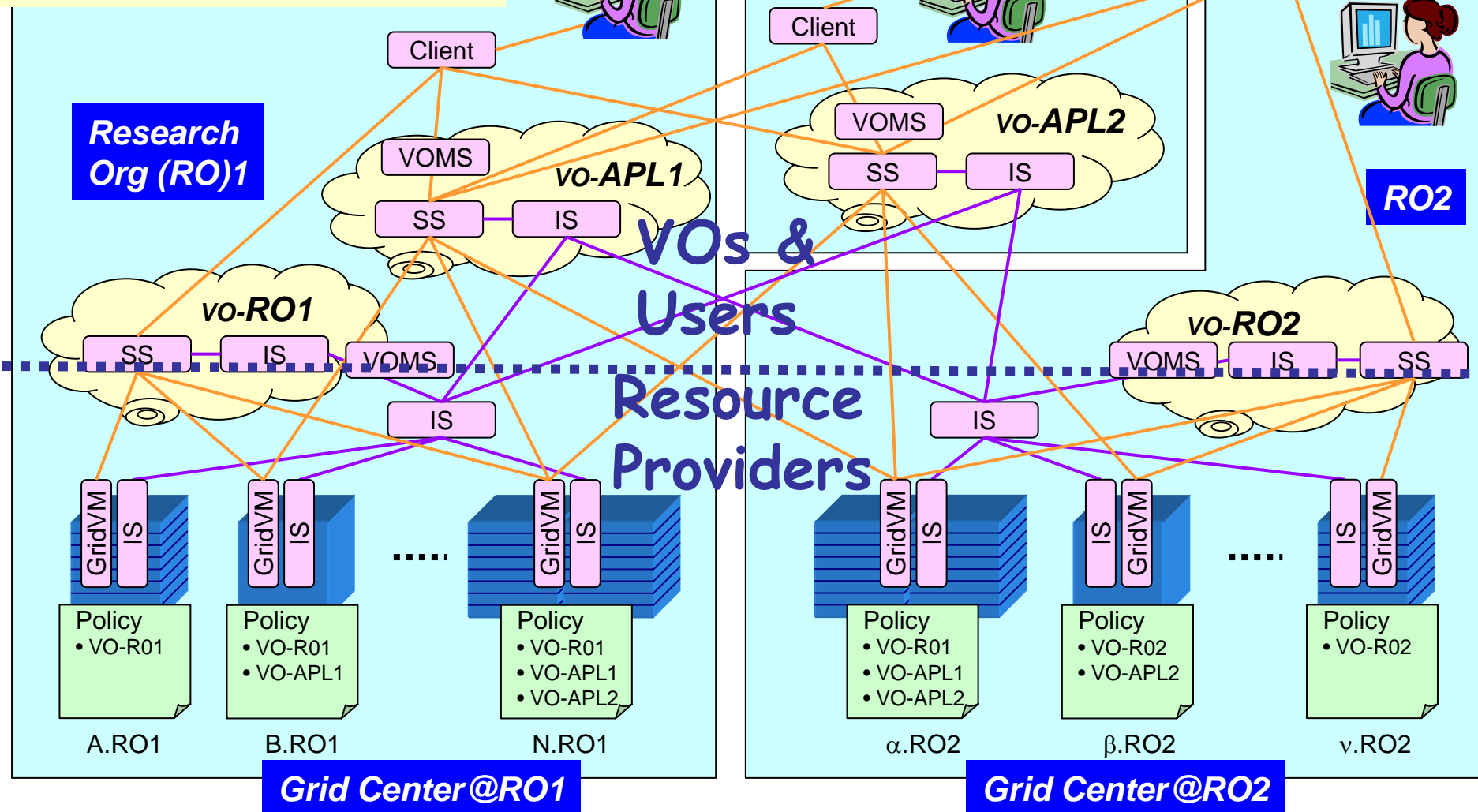
Grid Workflow

Data Grid Components

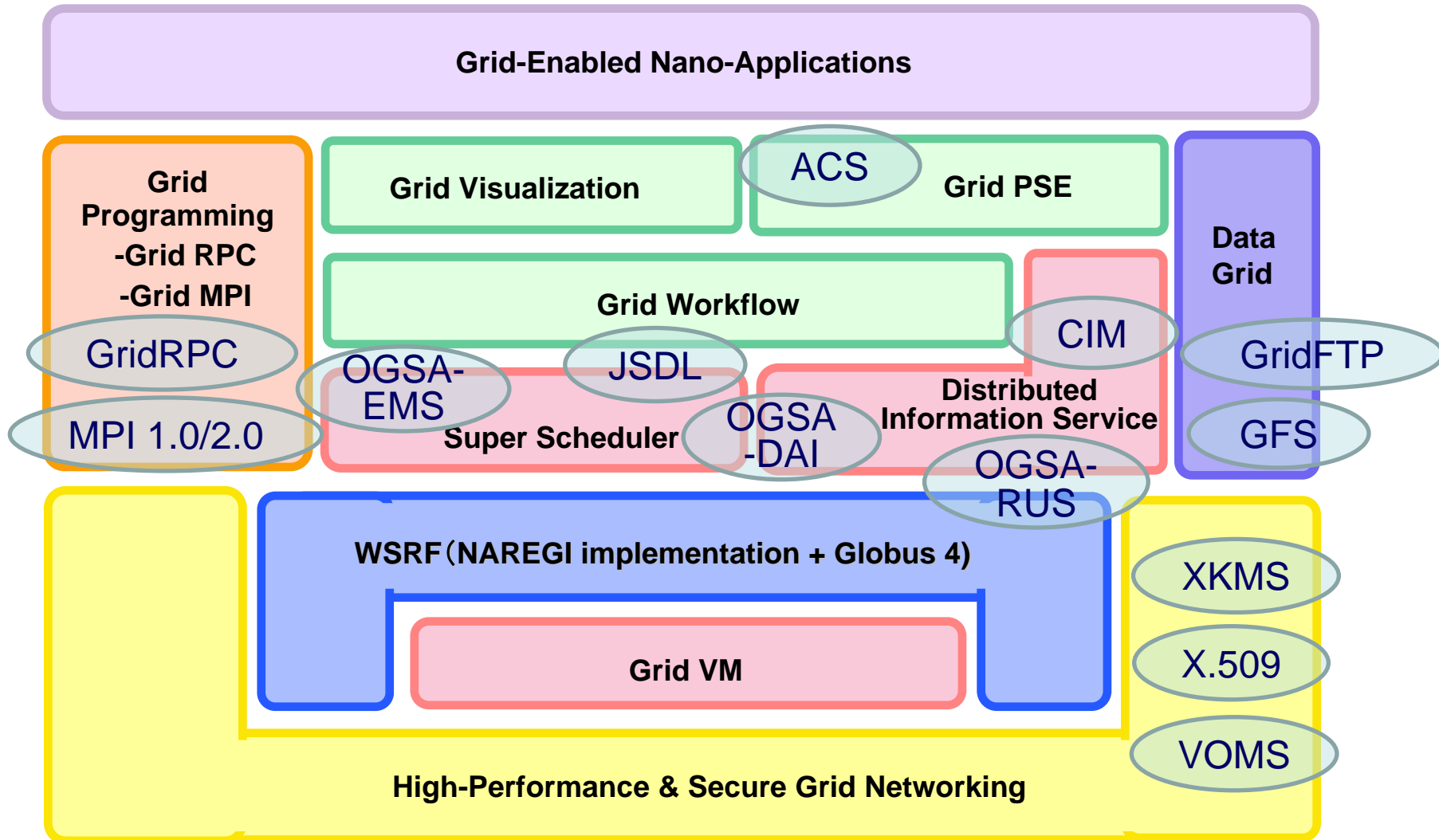


VO Service

Decoupling VOs and Resource Providers



Standards in NAREGI



WSRF : web service modules

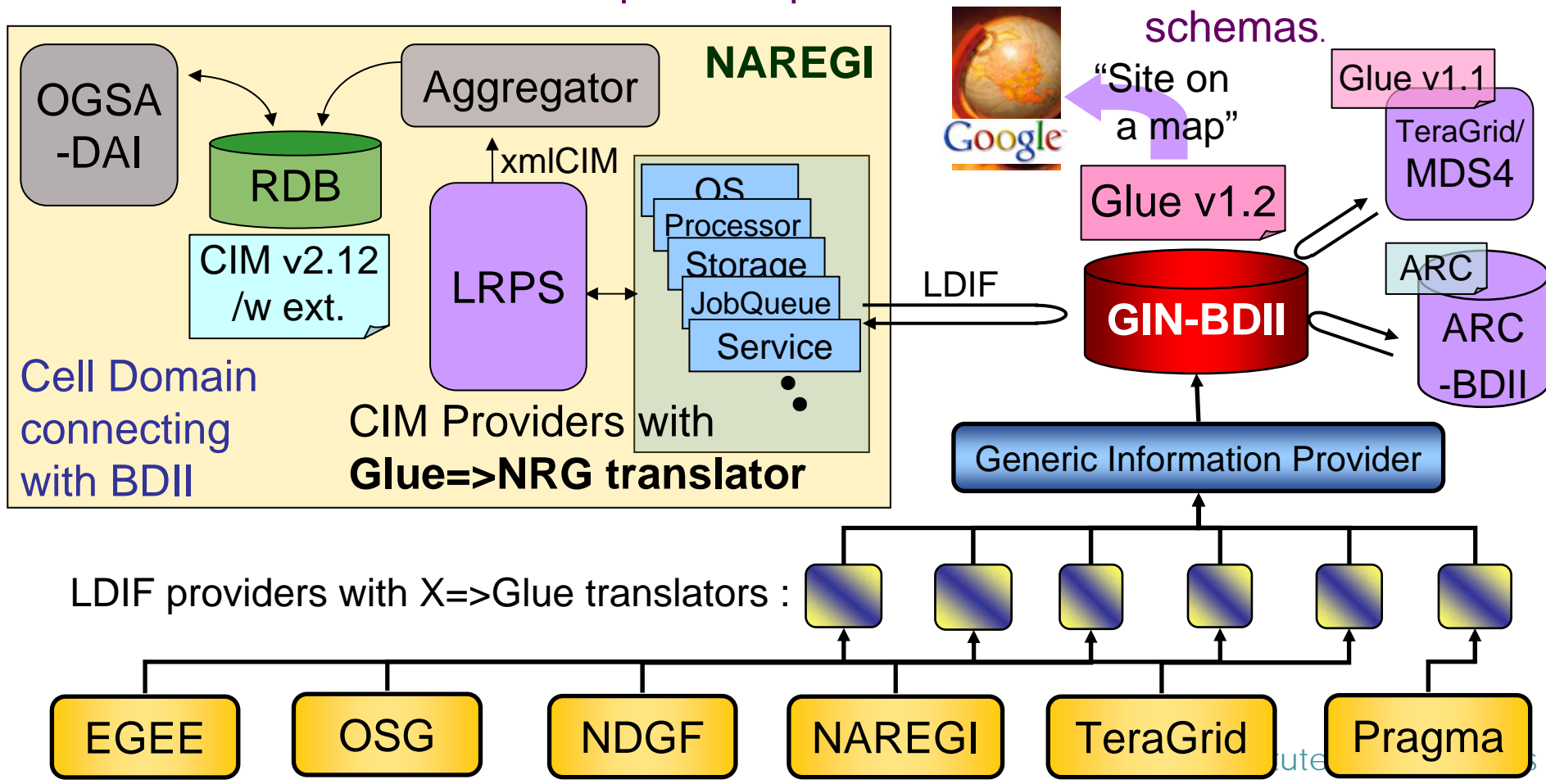
Lessons Learned from NAREGI Beta

- NAREGI developed EGEE-NAREGI island as an activity of GIN
 - ✓ Bilateral information exchange
 - ✓ Bilateral job submission
 - ✓ Bilateral file exchange
 - ✓ Interoperable security properties
- toward production use
 - coexistence of multi-type jobs
 - ✓ reservation/non-reservation/local batch jobs
 - ✓ bulk jobs
 - ease of installation
 - stability... interoperability

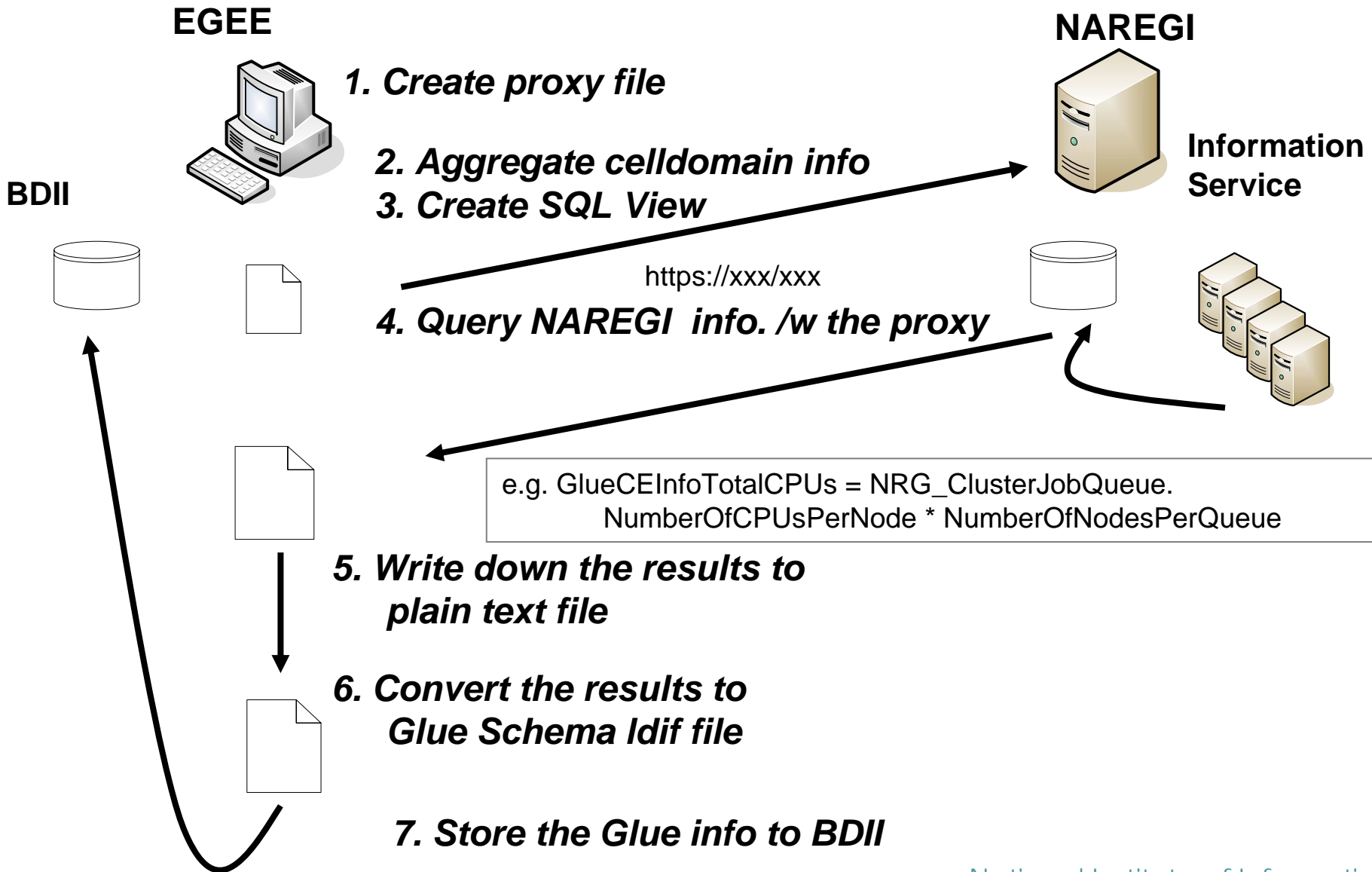
Information Exchange: Architecture

All of grid information can be retrieved by each of grid in its fashion WRT resource description schema, data format, query language, client API, ...

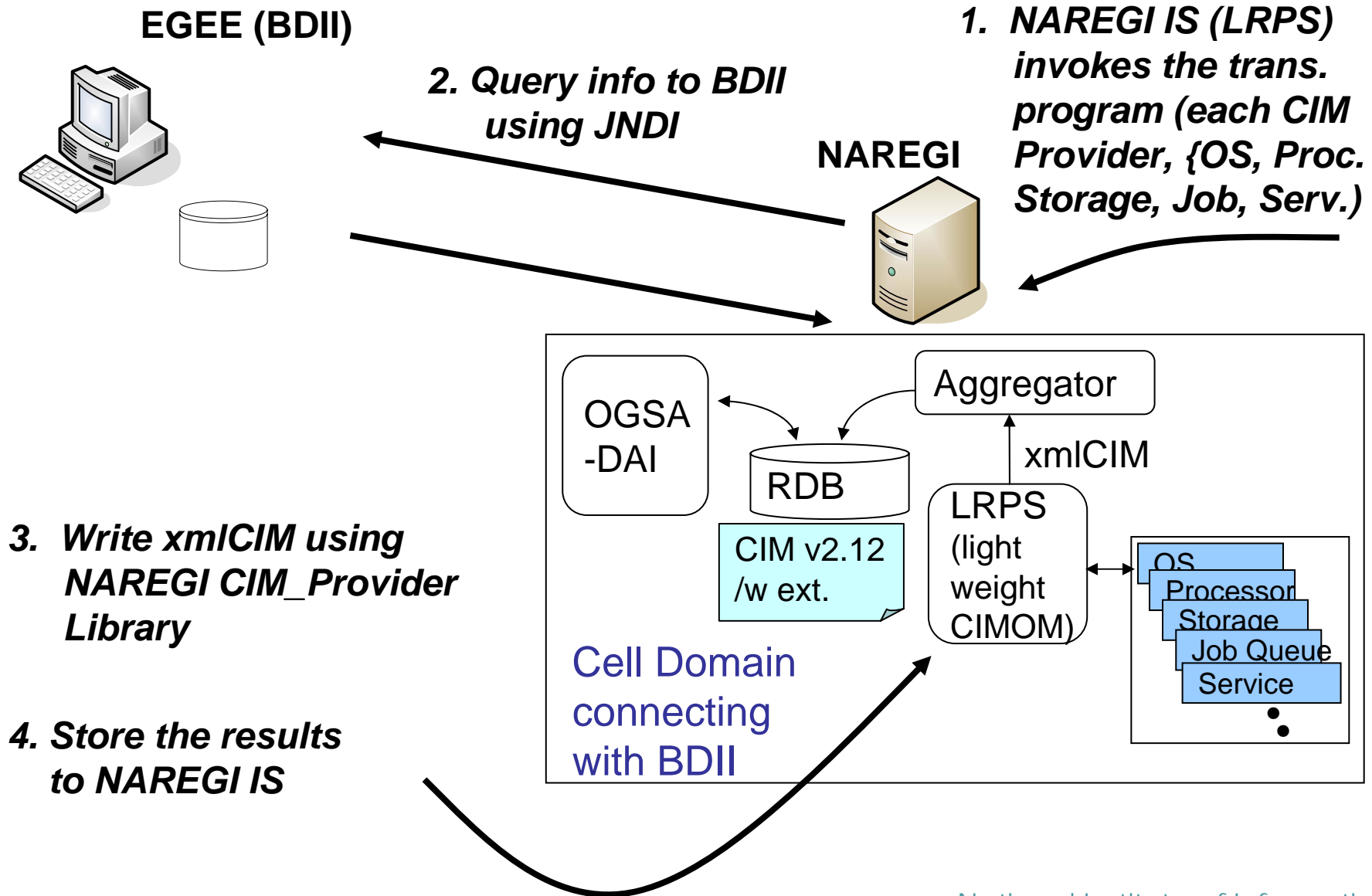
Each information service in grid acts as an information provider for the other and translator embedded in the provider performs conversion between different schemas.



Information Exchange: NAREGI → EGEE

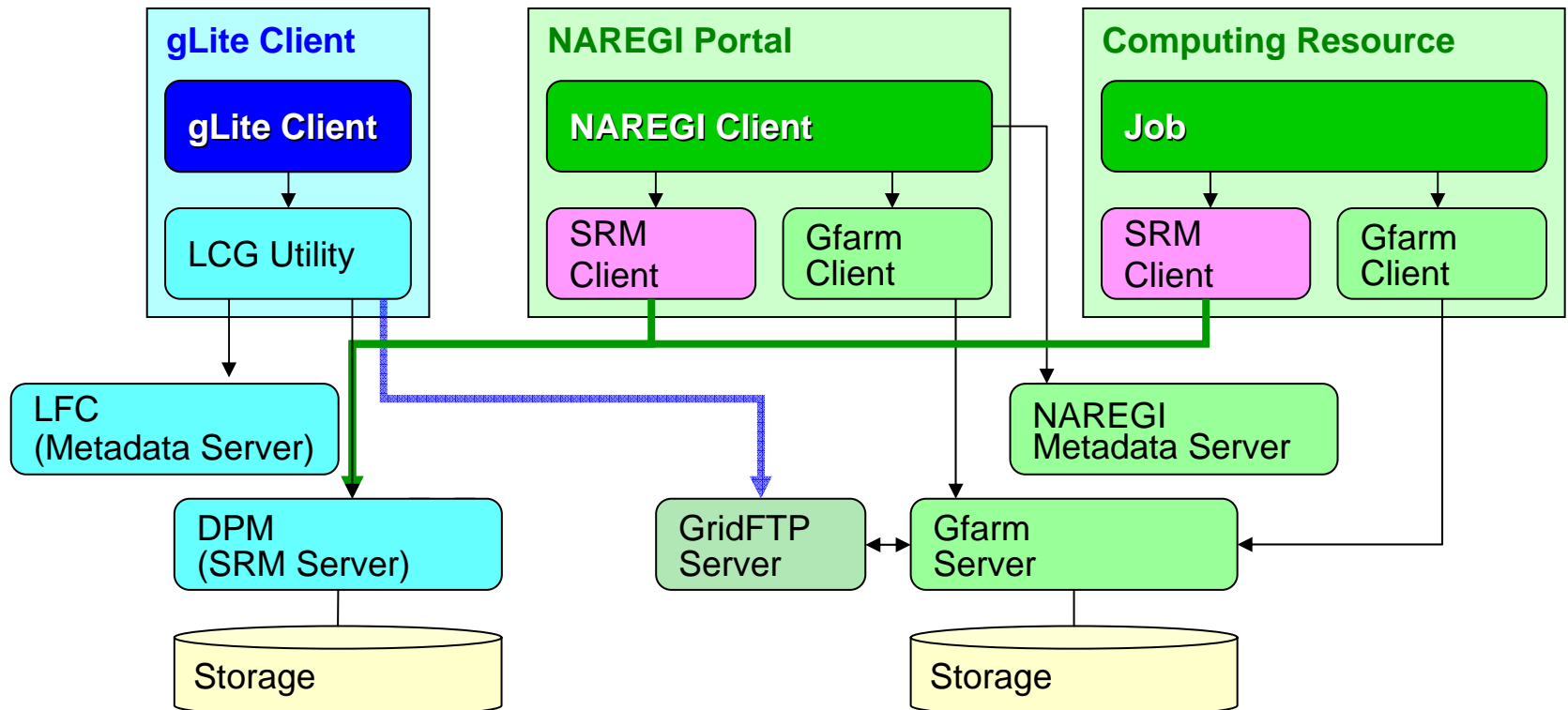


Information Exchange: EGEE → NAREGI



Data Exchange: Architecture in β Release

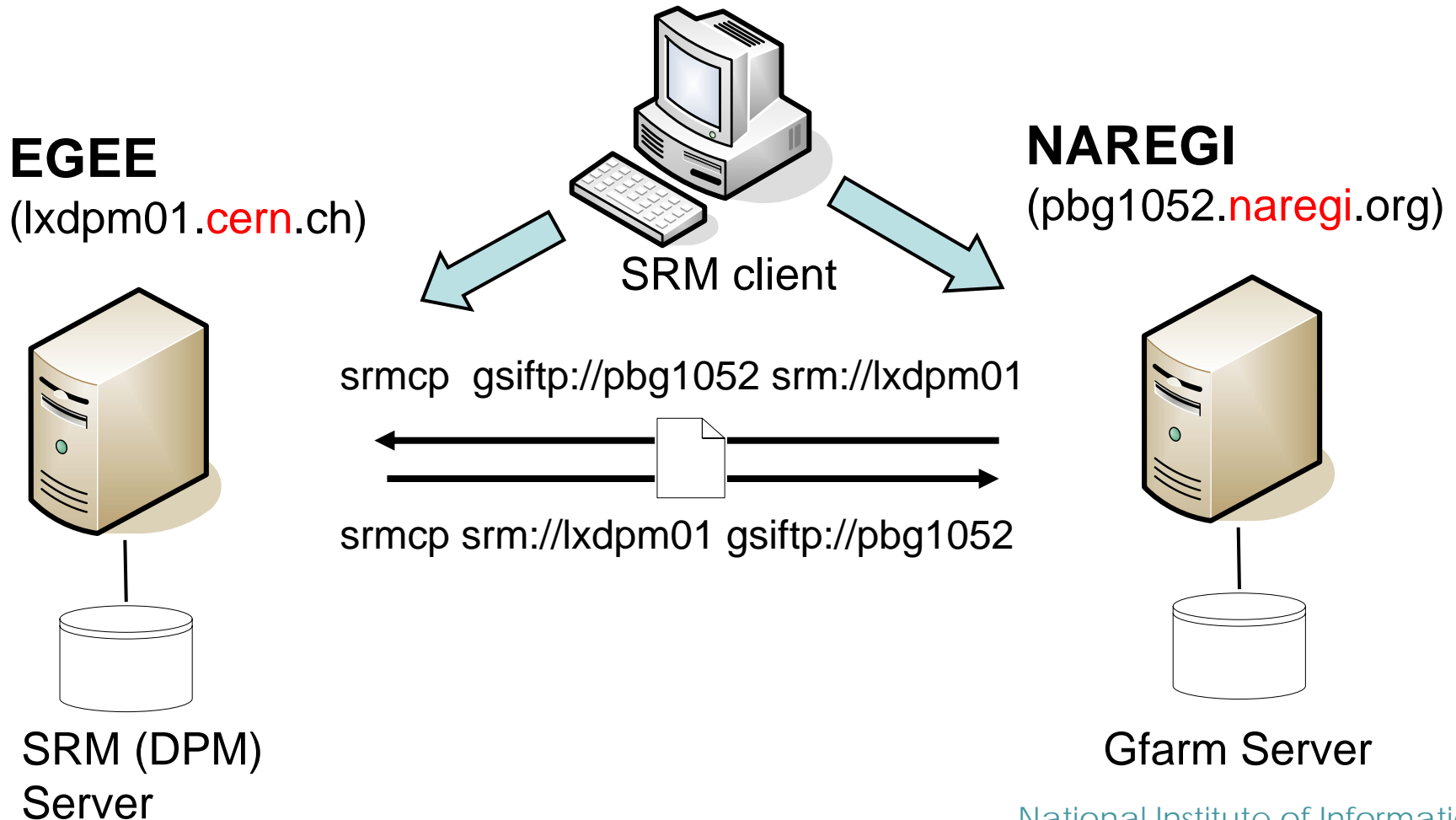
- NAREGI and EGEE gLite clients can access to both data resources (e.g., bi-directional file copy) using SRM interface.
- GridFTP is used as its underlying file transfer protocol.
- File catalog (metadata) exchange is planned.



Data Exchange: SC06 Demonstration

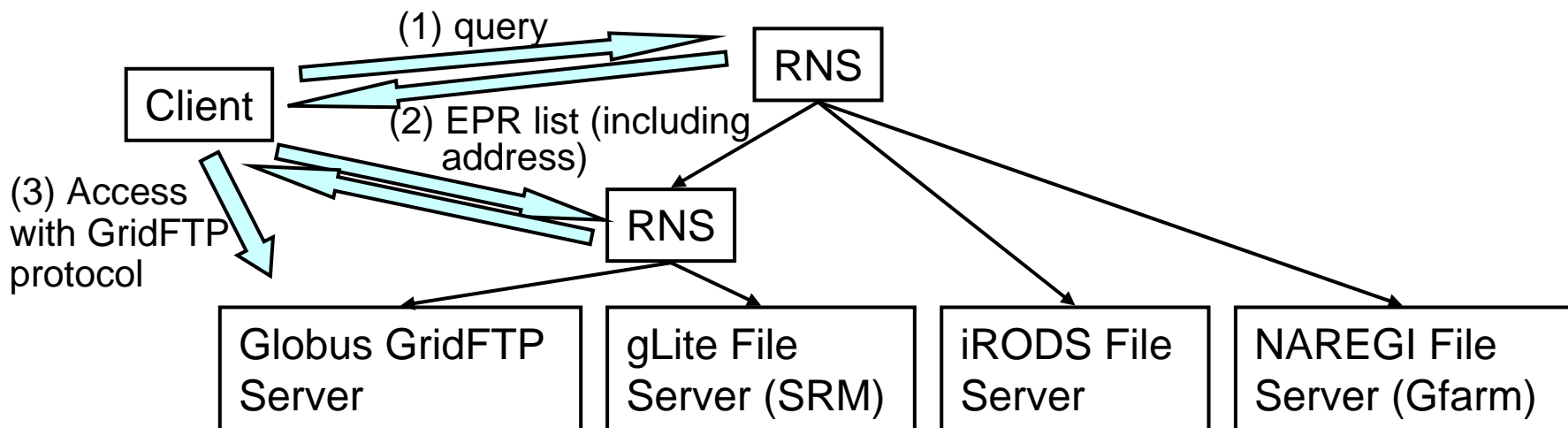
(NAREGI → EGEE and EGEE → NAREGI File Copy)

SRM copy (srmcp) command was ported in NAREGI.
Bi-directional file copy can be performed by srmcp.



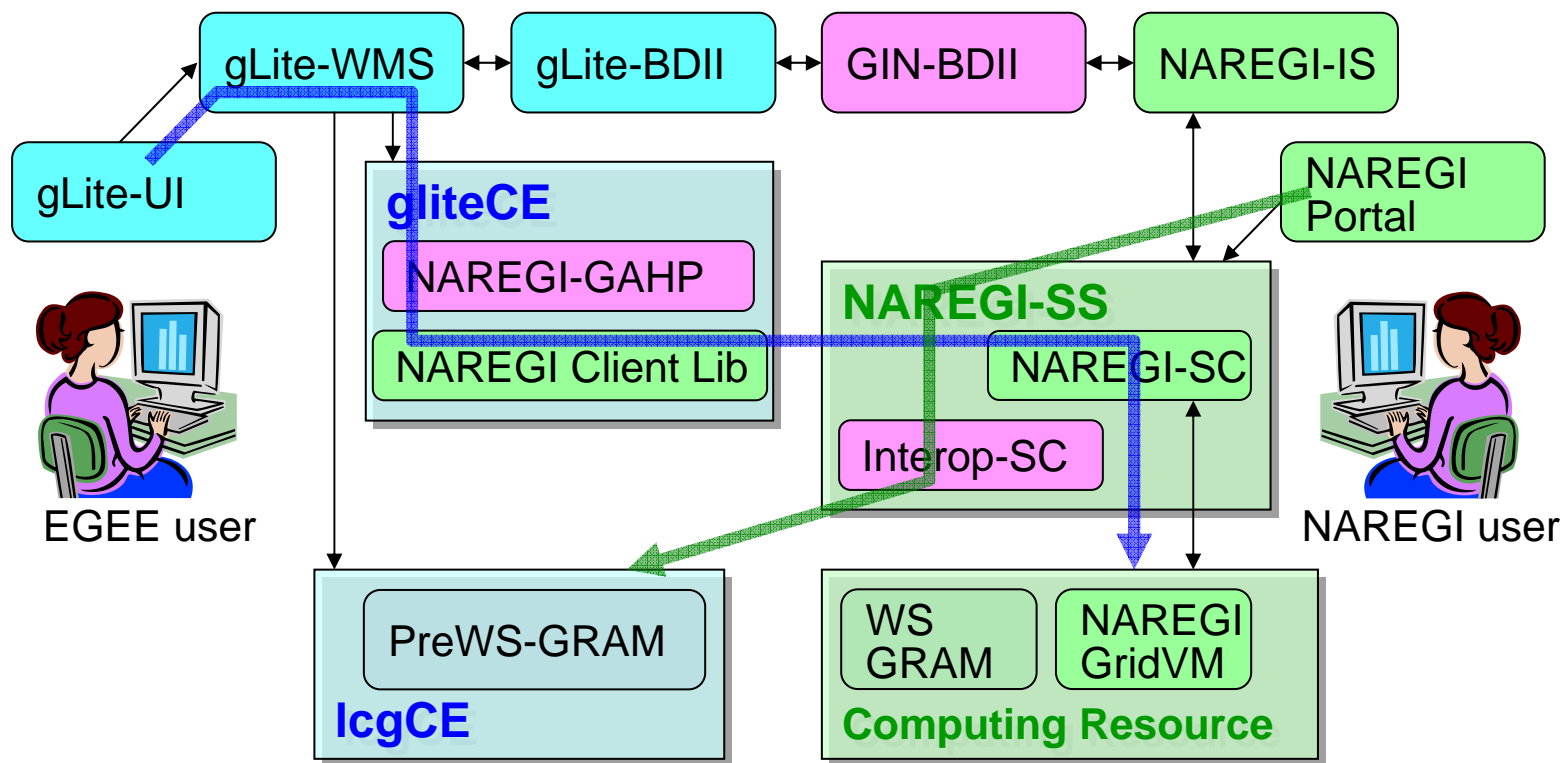
Data Grid Federation using RNS (Plan)

- RNS can interconnect a reference to **any existing resource** into hierarchical namespace
 - Most of Grid middlewares have GridFTP for data transfer
- Use RNS as a metadata system for the federation of Data Grids. Use GridFTP URL “gsiftp://.../” as the address of Endpoint Reference.



Job Submission: Architecture in $\beta 2$

Architecture



- NAREGI → EGEE: using NAREGI Workflow
- EGEE → NAREGI: using glite WMS commands

Next Interoperation Step (Plan)

- Interoperation of $\beta 2$ release was just a prototype. NAREGI has a plan to move to production level interoperation with EGEE gLite.
 - BES based job submission
 - File catalog federation etc...

Cyber-Science Infrastructure for R & D

Cyber-Science Infrastructure (CSI)

NAREGI
Outputs

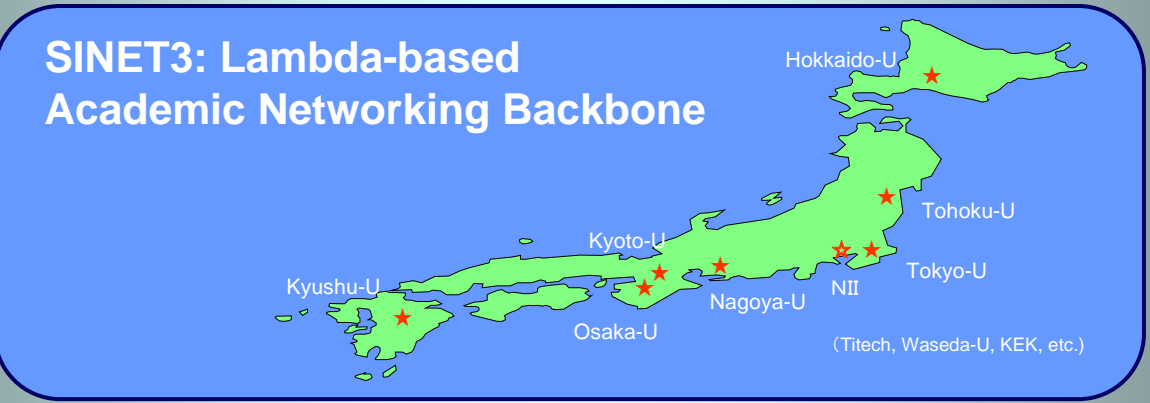
NII-REO (Repository of Electronic
Journals and Online Publications)

GeNii (Global Environment for
Networked Intellectual Information)

Virtual Labs
Live Collaborations

Deployment of NAREGI Middleware

UPKI: National Research PKI Infrastructure



Restructuring Univ. IT Research Resources
Extensive On-Line Publications of Results

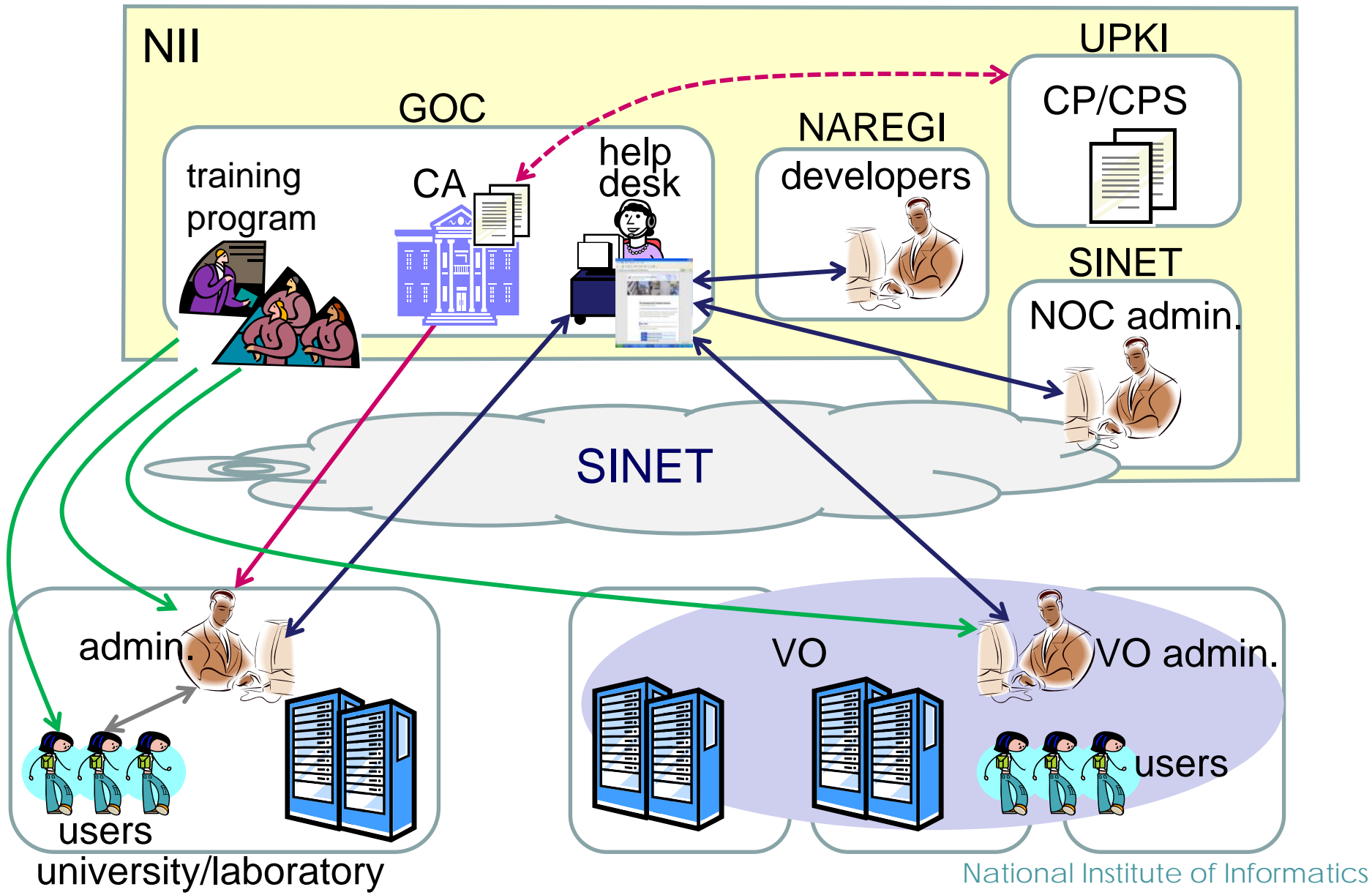
Industry/Societal Feedback

International Infrastructural Collaboration

Deployment Plan

- High Energy Accelerator Research Organization (KEK)
 - HEP application
- National Astronomical Observatory of Japan
 - virtual observatory
- Institute for Molecular Science
 - nano-science application
- Osaka University
 - computing service, certificate authority
- Tokyo Institute of Technology
 - computing service on TSUBAME

Grid Operation Center (plan)



Summary

■ NAREGI

- NAREGI middleware realizes to built a virtual single computing environment on geographically distributed and storage resources.
- NAREGI middleware ver.1 will be released in 2008 (2Q).

■ next step

- The NAREGI deployment phase is starting in 2008.
- NII plans to operate GOC.
- Production level interoperation with gLite

Thank you!

