Japanese Grid Initiatives and Future Directions

18 Sept. 2008

Hiro Kishimoto, Ph.D.
Senior Research Fellow, Fujitsu Laboratories Ltd.
Visiting Professor, National Institute of Informatics
Member of the Board, Open Grid Forum
Outline

National Research Grid Initiative: NAREGI

Open Grid Services Architecture

Grid Computing for Financial Services
National Research Grid Initiative: NAREGI
R&D project funded by Ministry of Education, Culture, Sports, Science and Technology (MEXT)
- FY2003 ~ FY2007
- 2 B Yen (~17M US$) budget in FY2003

Collaboration of National Labs., Universities and Industry in the R&D activities
- IT and Nano-science Applications

Merged into the Next Generation Supercomputer Project: Petascale computing
- FY2006 ~
NAREGI Project Goals

- Develop a Grid Software System as the prototype of future Grid Infrastructure in scientific research in Japan
  - R&D in Grid Middleware and Upper Layer
- Provide a Testbed to prove that the High-end Grid Computing Environment can be practically utilized by the nano-science research community over the SINET3
- Participate in International collaboration/Interoperability among U.S., Europe, and Asian Pacific
  - Grid Interoperation Now Community Group (GIN-CG) in OGF
- Contribute to Standardization Activities
  - Open Grid Forum, OGSA-WG, JSDL-WG, GFS-WG, GLUE-WG, ACS-WG...
NAREGI Grid Middleware

Grid-Enabled Nano-Applications
- Grid Visualization
- Grid PSE
- ACS
- Grid Workflow Tool
- CIM
- Super Scheduler
- Information Service
- OGSA-EMS
- JSDL
- OGSA-DAI
- OGSA-RUS
- WSRF (NAREGI implementation + Globus 4)
- Grid VM
- High-Performance & Secure Grid Networking, Certification

SuperSINET
- GridMPI
- GridFTP
- GFS
- XKMS
- X.509
- VOMS
- JSDL
- ACS
- OGSA-EMS
- OGSA-DAI
- OGSA-RUS
- WSRF (NAREGI implementation + Globus 4)
- Grid VM
- High-Performance & Secure Grid Networking, Certification

Computing Resources
- NII
- IMS
- Research Organizations
- etc

Kento Aida, National Institute of Informatics
Job Execution Scenario

1: Submission

Application requirement definition

 MPI source
 Workflow

MPI starts

b: Deployment
c: Edit

PSE
WFT

Super Scheduler

GridVM
Local Scheduler
IMPI Server

GridMPI

Local Scheduler
RISM Job

Network monitor

Site β

MPI init.

7: MPI init.

Site α

RISM

Site μ

2: Monitoring

2: Resource discovery

3: Reservation (Co-Allocation)

4: Reservation

MP job starts

5: IMPI starts

6: MPI job starts

128 CPU

FMO

Input files

GVS

Output files

FMO

RISM

PC cluster

IMPI

GridMPI

Portal

VOMS

MyProxy

Proxy cert.
(User DN, VO)

User cert.

a: Sign-on

Application requirement definition

Input files

Output files

MyProxy

CA/RA

User cert.

Kento Aida, National Institute of Informatics
Grid PSE and Workflow Tool

- Grid Problem Solving Environment (PSE)
  - Support for compilation and deployment
  - Execution support

- Grid Workflow Tool

Kento Aida, National Institute of Informatics
Nano-science App: Electronic Structure in Solution

(Super-Sinet)

Electronic Structure in Solutions

Data Transformation between Different Meshes

source: Prof. Aoyagi (Kyushu Univ.)
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UNICORE-based R&amp;D Framework</strong></td>
<td><strong>OGSA/WSRF-based R&amp;D Framework</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Utilization of NAREGI NII-IMS Testbed</strong></td>
<td><strong>Utilization of NAREGI-Wide Area Testbed</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Prototyping NAREGI Middleware Components</strong></td>
<td><strong>Apply Component Technologies to Nano Apps and Evaluation</strong></td>
<td><strong>α Ver. (Internal)</strong></td>
<td><strong>β Ver. Release</strong></td>
<td><strong>Deployment of β Ver.</strong></td>
<td><strong>Version 1.0 Release</strong></td>
</tr>
<tr>
<td>Development and Integration of α Ver. Middleware</td>
<td>Evaluation of α Ver. in NII-IMS Testbed</td>
<td><strong>β Ver. (Internal)</strong></td>
<td>Evaluation on NAREGI Wide-area Testbed</td>
<td><strong>Evaluation of β Ver. By IMS and other Collaborating Institutes</strong></td>
<td></td>
</tr>
<tr>
<td>Development of OGSA-based Middleware</td>
<td><strong>Verification &amp; Evaluation Of Ver. 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Cyber Science Infrastructure Plan

National Leadership System
(Next-generation Supercomputer)

Grid

Grid Interoperability and International Collaboration
- EGEE
- Teragrid

National Infrastructure (Institute, University)

Infrastructural middleware
(GRID, Infrastructure for certification, etc.)

Industry-university joint research VO

University/interuniversity research institutes VO

Project VO

Virtual research environment for various fields

Development and Application of Advanced High-performance Supercomputer Project

NAREGI Grid Middleware
UPKI
(Inter-University Public Key Infrastructure)
(National Institute of Informatics)
Future Directions of NAREGI

- Access to **Petascale computing**
- **National SC Grid** by **Cyber Science Infrastructure**
- **Laboratory Level** by **E-Science Grid project**
e-Science Grid Project

- Share and collaborate among National Infrastructure Systems and Laboratory Level Systems to form research VOs
- Started Sept. 2008
Open Grid Services Architecture
Numerous grid projects are implementing OGSA components.
The Open Grid Services Architecture

- An open, service-oriented architecture (SOA)
  - Resources as first-class entities
  - Dynamic service/resource creation and destruction
- Built on a Web services infrastructure
- Resource virtualization to hide complexities
- Build grids from small number of standards-based components
  - Replaceable, coarse-grained
  - e.g. brokers, scheduler
- Customizable
  - Support for dynamic, domain-specific content…
  - …within the same standardized framework
SOA & Web Services: Key Benefits

**SOA**
- Flexible
  - Locate services on any server
  - Relocate as necessary
  - Prospective clients find services using registries
- Scalable
  - Add & remove services as demand varies
- Replaceable
  - Update implementations without disruption to users
- Fault-tolerant
  - On failure, clients query registry for alternate services

**Web Services**
- Interoperable
  - Growing number of industry standards
- Strong industry support
- Reduce time-to-value
  - Harness robust development tools for Web services
  - Decrease learning & implementation time
- Embrace and extend
  - Leverage effort in developing and driving consensus on standards
  - Focus limited resources on augmenting & adding standards as needed
Virtualizing Resources

- Access
  - Type-specific interfaces
  - Common Interfaces
    - Computers
    - Storage
    - Sensors
    - Applications
    - Information
  - Resource-specific Interfaces
    - Web services
    - Resources
OGSA Capabilities

Execution Management
- Job description & submission
- Scheduling
- Resource provisioning

Data Services
- Common access facilities
- Efficient & reliable transport
- Replication services

Security
- AuthN & AuthZ
- Cross-organizational users
- Credential mapping

Information Services
- Poll and Push
- Registry & directory
- Logging/auditing

Resource Management
- Info & data modeling
- Discovery
- Monitoring & Control

Self-Management
- Self-configuration
- Self-optimization
- Self-healing

Resource Management
- Info & data modeling
- Discovery
- Monitoring & Control

OGSA Capabilities

OGSA “profiles”

Web services foundation
OGSA Document Structure

Base document

OGSA Use Cases

OGSA Architecture

OGSA Roadmap

Scenario

Service Description

Consistent

Profile

Candidate Profile

Guidelines

Profile Definition

Modeling guidelines

Documents produced by other GGF WGs or other SDOs

Actual specs

Information models

Inform and guide

Inform and guide

Feedback

Proposed recommendation

Informational

OGSA-WG documents

References
### Published OGSA Documents

<table>
<thead>
<tr>
<th>Year</th>
<th>Base Document</th>
<th>Guideline</th>
<th>Service Description</th>
<th>Profile</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>✓</td>
<td>✓ Modeling (GFD.118) ✓</td>
<td>✓</td>
<td>✓ Basic SecurityProfiles V1.0 (GFD-R-P.86, 99) ✓ V2.0 (GFD.138) ✓</td>
<td>✓ ByteIO (GFD-R-P.87) ✓</td>
</tr>
<tr>
<td>2006</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>2007</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>2008</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Phase #1 of OGSA-WG Activities

- Gather key GRID usecases and develop high level architecture
- Too abstract, no interoperability among implementations
Phase #2 of OGSA-WG Activities

- Develop multiple basic & tangible component specifications in parallel
- Value of specs is not visible to end users
Phase #3 of OGSA-WG Activities

- Describe how to use OGSA specs by Independent Software Vendors (ISV)
- Promote OGSA specs adoption by Grid middleware Projects
Core set of established interoperable specs.

Allows ISVs to build applications that:
- Can connect to any ‘standard’ infrastructure
- Run from mobile clients in network environments
Grid Computing for Financial Services
Grid Consortium Japan

- Promoting GRID technologies in Japan
  - Research results and industrial best practices
  - International GRID standards
- Established 2002, operational managed by AIST
  - President
    - Satoshi Sekiguchi, Director, Information Technology Research Institute, AIST
  - Vice President
    - Dr. Hiro Kishimoto, Fujitsu and Dr. Shinichi Mineo, RIKEN
- OGF regional affiliate organization
- 41 corporate members (vendors and users) and 104 individual members (academic)
- 4 workshops and 6 technical tutorials per year + Working group activity

AIST: Advanced Industrial Science and Technology
Financial Services Group

- Background
  - Most of FS firms in London & New York already deployed large Grid platforms and are in production
  - FS firms in Tokyo have very few GRID deployments
  - In order to gain world-class competitive edges and create business opportunities, Japanese FS firms come to Grid technologies

- Purpose
  - Help Japanese FS firms to advance their IT systems by sharing best practices of grid technologies in US and UK
  - Gather user requirements and develop generic reference model architecture of Grid for FS
  - Share case studies and hardware / software products/solution information
Group Activities

- **Group member**
  - Mega banks, Major securities companies, ...
  - System vendors, SIers, ISVs, ...

- **Topics**
  - Users show their IT system architecture (GRID and non-GRID)
  - Target application identification
    - Benchmark program development
  - Technology/solution workshop by vendors
  - Parallelization / Gridification of Applications

- **F2F meeting**
  - Once or twice per month
  - More than 30 attendees
Target Application Identification

- Risk analysis application
- Market data feed
- Retail transaction: Net trading & on-line banking
- Insurance rate making
Benchmark Program Development

- Risk analysis application
  - Define common application architecture
  - List up key parameters which determine output accuracy and execution performance

- Community Source Software
  - Java program
  - Grid Middleware
    - Scheduler: SGE+Condor, Platform Symphony, Data Synapses GridServer
    - Data services: Oracle Coherence, GigaSpaces
  - Run on real grid servers (400 core)
NAREGI middleware v1.0 is available and it will expand to reach Petascale, CSI, and LLS.

OGSA and OGF define multiple key specifications and they are implemented by major Grid Projects world-wide.

FS group is collaboratively developing cook-book and benchmark programs to promote GRID adoption in Japan.
Special Thanks

Gratefully acknowledge the contributions made to this slides presentation by

- Prof. Ken Miura, NII
- Prof. Kento Aida, NII
- Prof. Osamu Tatebe, Tsukuba U.
- Prof. Hideo Matsuda, Osaka U.
- Prof. Andrew Grimshaw, UVa
- Dr. Steven Newhouse, Microsoft
- Dr. Andreas Savva, Fujitsu
- Mr. Jay Unger
- Mr. Satoshi Sekiguchi, AIST
- Dr. Satoshi Ito, AIST
- Mr. Junichi Shirasaka, Nomura Securities
- Mr. Toshiaki Nomura, Nomura Securities
- Mr. Hajime Taniguchi, Mitsubishi UFJ Securities
- Mr. Fumiki Negishi, IBM Japan
Full Copyright Notice

Copyright (C) Open Grid Forum (2006-2008). All Rights Reserved.

This document and translations of it may be copied and furnished to others, and derivative works that comment on or otherwise explain it or assist in its implementation may be prepared, copied, published and distributed, in whole or in part, without restriction of any kind, provided that the above copyright notice and this paragraph are included on all such copies and derivative works.

The limited permissions granted above are perpetual and will not be revoked by the OGF or its successors or assignees.
Fujitsu

The possibilities are infinite