Anatomy of NAREGI Middleware - The World’s First OGSA-EMS Incarnation

NAREGI Middleware Objectives

- Computing Resource Virtualization
- Complex, Coupled Job Support
- VO Support
- World’s First GGF OGSA-EMS Incarnation
- Open Source, Royalty-Free
- Alliances with Globus, Condor, Unicore, EGEE

NAREGI Middleware Objectives

Scenario for Heterogeneous Multi-site Coupled Simulation Execution with NAREGI Middleware

A RISM-FMO program performs coupled simulation that determines electronic structure for molecules in a solution. Before its execution,

1. The user submits the above workflow from WFT to Super Scheduler.
2. Super Scheduler requires Distributed Information Service to find adequate GridVMs (OGSA computation service containers) for jobs in the workflow. The figure exemplifies workflow specifying a coupled MPI job allocated across multiple sites and architectures.
3. Super Scheduler performs WS-agreement based negotiation with GridVMs to reserve resources so that it could co-schedule jobs across multiple sites, using JSDL as the common language.
4. If these GridVMs "agree" with the Super Scheduler, they reserve resources under the Local Schedulers (co-allocation).
5. When the reservation time arrives, an IMPI server is scheduled to run RISM-FMO on an SMP machine and FMO on a PC cluster, co-scheduled and communicating via GridMPI.
6. Subsequently, the RISM-FMO GridMPI job starts to execute.
7. The figure shows the case where RISM executes on an SMP machine and FMO on a PC cluster, co-scheduled and communicating via GridMPI.
8. The coupled GridMPI job is monitored in real-time through the Grid Visualization System.
9. The Network Information Service monitors traffic among sites. During and after the execution completes, its resource usage is recorded in Distribute Information Service according to the GGF-UR.

In this example of multi-physics analysis, a coupled simulation is performed on the electronic structure of a molecule in solution through coupled execution among heterogeneous components executing on heterogeneous architectures, federated through the NAREGI middleware, using OGSA-EMS based Web/Grid Services.

Features

- Resource and Execution Management
  - GGF OGSA-EMS based architecture
  - Automatic resource brokering and job scheduling
  - Reservation based co-allocation
  - VO and local policy based access control
  - Network traffic measurement and control
  - GGF JSDL based job description
  - DMTF-CIM based resource information model

- Data Grid
  - WSRF based grid-wide data sharing

- User-Level Tools
  - Web based portal
  - Workflow tool with NAREGI-WFML
  - Application contents and deployment service
  - Large-scale interactive grid visualization

- Grid Ready Programming Tools & Libraries
  - Standards compliant GridMPI and GridRPC
  - Bridge Method for Different Type Applications
  - VO Support
    - Production-quality CA, APGrid PMA
    - VOMS based VO user management

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