System Software Overview of China National Grid

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VEGA R&D Team,
Research Centre for Grid and Service Computing,
ICT, CAS
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Background

- Grid related research at ICT since 1999
  - PoC of Grid System Software
    - LDAP + batch system + CGI + Web server
- **CNGrid System Software** is supported by the China Ministry of Science and Technology 863 program (2002~2005)
- Other grid related research includes:
  - Information Grid
  - GSML Workshop
  - Web Service Based Workflow
  - Semantic Grid
  - …
Motivation

- **Need for Internet based grid system software**
  - Manage large scaled distributed resource effectively
  - Provide uniform approach accessing the heterogeneous resources in grid
  - Support Internet based resource sharing and collaborating

- **Need for Easy-to-used grid**
  - Low cost
    - Hiding interior details for programming and management user
    - Convenient for end user
  - Multiple access mode
    - Client/Server, Browser/Server and other modes
    - Batch mode and interactive mode
Goals

- Develop a virtualized *resource sharing mechanism and framework* on computing, data, software and combined resources
- Provide secured, uniformed and friendly interfaces accessing the scientific computing and information services
- Support multiple domain specific applications running on above
CNGrid System Software
--Design Principles

- Only focusing on functions that meet common requirement of grid application
  - Resource and user management
  - Policy management
  - Security mechanism
  - User interface to resources
  - File, metainfo, batch service and so on

- Using computer system architecture that combined with SOA
  - Logically divided into 3 layers
    - Core, System and Application layers
  - Taking system abstractions in traditional OS for reference
    - Address space
    - Process
  - Each individual module encapsulated by plain Web service

- Adopting matured standards and technologies
  - Hosting environment. Tomcat+axis, GT4, OMII...
  - WS-related standards and implementations, such as WS-I, WS-security...
  - File transfer. RFT, GridFTP
  - Job submission and management. GRAM, GridSAM
CNGrid System Software

--Architecture

Grid Portal, GSML suite and Grid Applications

- Core, System and App Level Services
- Axis Handlers for Message Level Security
- Tomcat(5.0.28) + Axis(1.2 rc2)
- J2SE(1.4.2_07), J2EE
- OS (Linux/ Unix/ Windows)

Intel or AMD based PC Server (Grid Server)
CNGrid System Software

--Components

Core layer

- Agora service
  - Functions: service, user and policy management locally
  - Interface: add, remove, search, update

- Grip service
  - Functions: create or delete a grip, manage a existing grip, use a grip accessing services in grid
  - Interface: create, bind, invoke, control, close

- Router service
  - Functions: Maintain mappings between real service and virtual service; provide global service locating by unique service id and provide SSIed service view based on linked router services
  - Interface: start, stop, dump, locate, link, unlink, ping

System layer

- Batch service
  - Accept batch job submission, status and cancel request; Forward batch job commands to backend batch system and get back results.

- File service
  - Based on local file system, organize plain files for user; Provide HTTP based file transfer.

- Dynamic deploy service
  - Dynamically deploy a service implementation (.jar) into its hosted service container as well as update and remove a existing service.

- Messaging service
  - Provide reliable messaging between peers by message queue, message subscribe and notification.

- General metainfo service, CA service, Database service and others are in developing

Application layer

- Grid Portal for management
- GSML workshop for end user programming
- Other domain specific applications
CNGrid System Software

--Features

- CNGrid system software and resource are encapsulated by service
  - Can provide uniformed interface and hide underlying resource heterogeneity
  - Easy for integration and expansion (WS stack, SOA, loosely/de coupled)

- Layered resource spaces for virtualization
  - Construct by Physical, virtual and effective resource layers (every upper layer is built on lower layer)
  - Separate resource and application so that application can keep still while resource changing
  - Functions such as resource selection, tolerance, authorization and access control can be made transparent to user

Effective-Virtual-Physical Service Addressing Model
Proposed several abstractions in grid system software

- “grip” is something like “grid process”
  - Maintaining the conversation between user and service at runtime
  - Holding necessary information of user and service, such as user proxy, resource binding address and so on
  - Providing a set of uniformed interface for accessing different services

- “agora” is kind of concrete implementation of “VO”
  - Aggregating and organizing user and resource locally
  - Establishing corresponding relationship across them, such as roles, service category, service selection and authorization policy

Grid security mechanism that support Web service

- PKI based authentication which is WS-Security compliant
- Separate authorization decision and implementation using SAML token
- Support multiple access control approaches by axis handler-chain mechanism
Programming interface

--Sample Code Using Grip

```java
//define effective resource name
String effective = "eres://agoral:MService";

//new a gripclient object
GripClient testgripclient = new GripClient();

//create a grip with user id, passwd and 
//agora name want to login
UserHandle griphandle = testgripclient.create("usr1", "usr1", "agoral");

//bind the effective resource
int index = testgripclient.bind(effective, griphandle);

//invoke the bound service by resource index and 
//pass the parameters required
Object retvalue = testgripclient.invoke(index, "list", 
    new Object[]{"/"}, 
    GripContainer.M_SYNCHRONIZED, griphandle);

...

//process the return value here
...

//close it, reclaim the resources used by grip
testgripclient.close(griphandle);
```
Application Scope

-- China National Grid

Grid Server
- Router service, Agora service and Grip service
- System and application level services
- Handlers used by security mechanism
- Grid portal based on Grid Portal Engine (optional)

Grid Client
- General Web Browser
- and/or GCS Admin Tools
- and/or GGS API Based Grid Application

ICT, XJTU and etc.
Application Scope

-- other apps in CNGrid

- File management aim to individual user
  - Upload, download files that stored in multiple grid nodes
- System monitoring aim to grid nodes in CNGrid
  - Record the running information of grid nodes, such as “uptime”, “loadavg”, utilization of “cpu”, “mem” and “hd”
Application Scope

-- service, user and policy administration
Application Scope

-- Grid Applications

Biological research

Simulation on manufacturing

Geological research

Aerographical research
Conclusion and Future Works

- CNGrid System Software can be summarized as follow
  - CNGrid system software is based on WS-I and OGSA standards
  - Utilizing computer system approach combined with loosely coupled SOA concept
  - Proposed several key abstractions, “address space”, “grip”, “agora”
  - Providing SS1ed resource sharing via address space virtualization
  - WS-Security compliant authentication and SAML token based authorization which is separated from WS implementation

- The next version of CNGrid system software will focus but not only on:
  - Key abstraction and core level service refinement, “address space”, “grip”, “agora”
  - System level service and functionality expanding, database, CA, metainfo service, grid data management and workflow
  - Application scope enlarging, from scientific area to general service computing area
Thanks!