Design and Implementation of GEO Grid Security

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What is the GEO Grid?

The GEO (Global Earth Observation) Grid is aiming at providing an *E-Science Infrastructure* for worldwide Earth Sciences communities to accelerate GEO sciences based on the concept that relevant data and computation are *virtually integrated* with a certain *access control* and ease-of-use interface those are enabled by a set of Grid and Web service technologies.

- **Satellite Data**
  - Map
  - Geo* Contents
  - GIS data
  - Field data
- **Grid Technologies**
- **Resources**
- **Applications**
  - Geology
  - Environment
  - Disaster mitigation

AIST: OGF Gold sponsor (a founding member)
AIST: OGC Associate member (since 2007)
GEO Grid

Applications
- Disaster mitigation
  - Land slides, flood
- Environment monitoring
  - Global warming, CO₂ flux estimation
- Natural resource exploration
  - Oil, Gas
  - Full L0 ASTER on disk
  - MODIS on disk (East Asia)
  - Japan, SE Asia
  - AsiaFlux, Field server

Contents
- Satellite Imagery
- Geology archives
- Sensors

IT Infrastructure
- Software
  - Security, data access, service registry, resource mgmt., Weg GIS, Workflow, U/I Portal, etc.
- Hardware
  - Storage, Servers
  - Cluster computers
A Workflow example “Disaster prevention and mitigation (Volcano)”

- Monitoring of crustal deformation by PALSAR
- In-situ observations e.g. growth of a lava dome
- Hazard Map for Evacuation planning
- High resolution DEM provided from ASTER
- Simulation of lava and/or pyroclastic flow on GEO Grid
Functional requirements for the IT infrastructure

- Size scalability in near-real-time data handling and distribution
  - Need to manage hundreds tera-bytes to peta-byte of data.
  - Such data will be made available with minimum time delay and at minimum cost.

- Handling wide diversification of data types, associated metadata, products and services.
  - Research communities wish to integrate various data according to their interests.

- IT infrastructure must support
  - the creation of user groups which represent various types of virtual research/business communities
  - Federation of distributed and heterogeneous data resources which is shared in such communities
Functional requirements for the IT infrastructure (cont’d)

- Respecting data owner’s publication policies
  - Some data are not freely accessible.
    - E.g. commercial data.
  - IT infrastructure must provide a security infrastructure which supports flexible publication policies for both data and computing service providers.

- Smooth interaction and loose coupling between data services and computing services
  - A desirable IT architectural style would achieve loose coupling among interacting software agents to allow users both to create services independently, and to produce new application from them.
  - IT infrastructure must support sharing, coordination, and configuration of environments for application programs and resources, depending on the user’s requirements.
Functional requirements for the IT infrastructure (cont’d)

Ease of use

- End users should be able to access data and computing resources without the burden of installing special software and taking care of security issues (e.g. certificate mgmt.).
- Data and service providers should be able to easily make their resources available as services with desired access control.
- Administrators and leaders of communities should be able to create virtual communities easily by configuring appropriate access control.
- We must provide an ease-of-use framework for publishing services and user interfaces.
Design Policy

- Introduces a concept of VO (Virtual Organization)
- Data and computation are provided as “services” via standard protocols and APIs.
- A VO is created dynamically by integrating available services and resources according to the interests and requirements of the VO.
- User-level Authentication and VO-level Authorization
  - User’s right is managed (assigned) by an administrator of his belonging VO.
  - Access control to a service is configured by the service provider according to the publication policy. There are some options of the access control
    - VO-level, Group/Role-based, User-level, etc.
  - Scalable architecture for the number of users.
Overview and usage model of the GEO Grid system

- VO Registration
- Service Registration
- Service Search

Virtual Organization

Web Portal

Data Service

Processing Service

MODIS

BEMS

Satellite data processing

GEO Grid Administrator

Portal & VO Manager

End-Users

Data or Processing Provider
Key Technologies: GSI and VOMS

Grid Security Infrastructure (GSI) is standard security technology used in the current Grid communities.

- Based on Public Key Infrastructure (PKI) and X.509 Certificates.

Virtual Organization Membership Services (VOMS) is a software for creating/managing VOs.

- Developed by European Communities
- Based on GSI

End users of GEO Grid may not be required to understand GSI, VOMS, etc, but project (VO) admin should understand these technologies correctly.
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Access Control by Account Mapping

- All members are mapped to a single account
- Users are mapped to local account based on groups (and role)
- Users are mapped to pool account based on groups (and role)
GAMA architecture

Portal server 1
- gama
- gridportlets
- GridSphere
- Servlet container
- Java keystore

Portal server 2
- Stand-alone applications

create user
import user
retrieve credential
retrieve credential

Servlet container
Java keystore
GAMA server

AXIS Web Services wrapper
- CACL
- MyProxy
- CAS
- ...

Stand-alone applications

Servlet container
Java keystore
Portal v.s. Accounts v.s. VO
Current status of evaluation, integration, and developments

- Deployed and tested
  - GAMA, VOMS server
  - Pre-WS GRAM w/ VOMS
  - WS GRAM w/ VOMS
  - GridFTP w/ VOMS
  - Apache w/ VOMS
  - OGSA-DAI w/ VOMS

- Authorization using VOMS
  - Different levels of AuthZ
    - VO, Group, Role, User
  - Different method for account mapping
    - Single account, pool account, account for individual user

- Developed two functions for integrating GAMA and VOMS
  - GAMA Portal accesses VOMRS (VO Management Registration Service) to register a new user with the VO when the account is activated.
  - GAMA Portal generate a VOMS proxy from a proxy credential from the MyProxy server.
  - Credential Portlet
Demo Environments - SIMS (ASTER+MODIS+Formsat2)

SIMS portlet
- query data
- create web page which shows thumbnail images

OGSA-DAI
Globus
SQL
w/ JDBC

Database Server (Sybase)
FORMOSAT-2

Application Server
OGSA-DAI

Java Program
Integration Framework with OGSA-DAI
OGSA-DAI Client

Database Server (PostgreSQL)

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