The Grid in China

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Agenda

• CNGrid
  (China National Grid)
• ChinaGrid
  (China Education and Research Grid)
• CROWN
  (China Research and development environment Over Wide-area Network)
• HEP Grid/WLCG
Major Grid Projects in China

- **China National Grid**
  - Supported by the National High-tech R&D Program

- **ChinaGrid**
  - Supported by the Ministry of Education

- **CROWN**
  - Supported by the National Science Foundation of China
China National Grid (CNGrid)
Overview of CNGrid

• **Key project supported by the National High-Tech R&D Program**

• **4-year effort**
  - **May 2002 to Dec. 2005**
  - **100 million RMB government funding from the MoST**
  - **More than 2X associated funds from local government, application organizations, and industry**
Major tasks of the project

• Developing a test-bed for the new information infrastructure—China National Grid (CNGrid)
• Developing a 4TFlops high performance computer for the grid
• Developing a set of grid software to support grid applications and grid operation and management
• Developing several application grids
  • Productive systems
  • Demonstration of the future grid applications
CNGrid infrastructure

- **Major nodes:**
  - CNIC, CAS, Beijing
  - Shanghai Supercomputer Center, Shanghai

- **Standard nodes:**
  - Tsinghua University, Beijing
  - Institute of Applied Physics and computational Mathematics, Beijing
  - University of Science and Technology of China, Hefei
  - Xi’an Jiaotong University, Xi’an
  - NUDT, Changsha
  - Hong Kong University, Hongkong

- **CNGrid Operation Center**
  - The CNGrid Operation Center, CNIC, CAS
CNGrid nodes locations

- Beijing
- Xi’an
- Shanghai
- Hefei
- Changsha
- Hong Kong
## CNGrid GOS Architecture

### Grid Apps
- **Grid Portal**
  - Application Logic by Web Pages
  - Build-in Utility Collection
  - Extended Utilities
  - Servlet Based Scalable Grid Portal Engine

### User APIs
- **System and Application Libraries**
  - Core Based Functional APIs and Exception Handling

#### User Customized Applications
- Batch Service
- GIS Service
- Workflow Service
- etc.

### System Level Services
- **Information (MetaX) Services**
  - MetaFile Service
    - Naming
    - Replica Mgmt.
    - File AC Mgmt.
  - MetaInfo Mgmt.
  - Quota Mgmt.
  - MetaSys Service
  - etc.

#### Core APIs
- **Base Services**
  - System Monitoring Service
  - Logging & Auditing Service
  - Messaging Service
  - File Service
  - Database Service
  - Dynamic Deploy Service

### Core Level Services
- **Agora Service**
  - User Mgmt. Engine
    - Profile
    - Acct. Authentication
    - Auth. Cert.
    - Acct. Approve
    - Role Based Acct. Mgmt.
  - Resource Mgmt. Engine
    - Service Addr. and PortType Mapping
    - Service Info Mgmt.
    - Multi-Grained Resource AC Policy Mgmt.

#### Core Libraries
- **Grip Service**
  - Grip Container
    - Result Caching
    - User Interaction
    - Grip State Mgmt.
    - Grip Ctrl. Structure
    - Addr. Trans.
  - Core Exceptions
  - Service Invocation

### GOS Hosting Env.
- **Tomcat (Apache)**
- **OMII**
- **GT4 (Globus)**
- **WebSphere (IBM)**
- **WebLogic (BEA)**
- **.NET (Microsoft)**

### Java J2SE, J2EE/Microsoft Windows
Support applications

Bioinformatics

Geosurvey

Manufature & Simulation

Weather Forecast
CNGrid Applications

• Applications from selected areas
  • Resource and Environment
    ▪ NGG: National Geological Survey Grid
    ▪ DFG: Digital Forestry Grid
    ▪ SeisGrid: Petroleum Seismic Exploration
  • Research
    ▪ SDG: Scientific Data Grid
    ▪ BAGrid: Bioinformatics Applied Grid
    ▪ DDG: Drug Discovery Grid
  • Services
    ▪ CMAG: China Meteorological Application Grid
    ▪ TIG: Traffic Information Grid
  • Manufacturing
    ▪ AviGrid: Aviation Grid
    ▪ SimGrid
NGG

• Undertaken by China National Geological Survey Bureau
  • Nation-wide productive grid
  • Data exchange and sharing by services
  • Grid-enabled resource evaluation

• Shorten the evaluation time from 3 years to 3 months

• Achievements
  • North China ground water resources evaluation
  • Mineral resources evaluation
CNGrid (2006-2010)

- **HPC Systems**
  - 100 Tflop/s by 2008,
  - Pflop/s by 2010

- **Grid Software: CNGrid GOS**
  - Merge with international efforts
  - Emphasize matureness

- **CNGrid Environment**
  - Nodes, Centers, mgt

- **Applications**
  - Research
  - Resource & Environment
  - Manufacturing
  - Services
China Education and Research Grid (ChinaGrid)
ChinaGrid

- Funded by Ministry of Education
- Based on CERNET (China Education and Research Network)
- First Phase
  - 2003-2005
  - 12 key universities as initiative
  - More than 6Tflops w/60TB
  - 20 key universities by the end of 2004
ChinaGrid Supporting Platform

- ChinaGrid Portal
- ChinaGrid Specific Grid Applications
- Grid Problem Solving Environment
- Grid Information Service
  - Grid Resource Management and Job Scheduling
  - Grid Data Management
Main Research Tasks

• Campus grid platform
• Common platform for ChinaGrid
• Grid application platform and representative
• Grid applications
  • Image processing grid
  • Bioinformatics grid
  • Course on-line grid
  • Computational fluid dynamic grid
  • Large scale information processing grid
China Research and development environment Over Wide-area Network (CROWN)
The Research Program

- **NSFC_Grid**: (3yrs, 2004-2006)
  - Network-based R&D Environment (E-Science Project in China)
  - Beihang U., & ICT,CAS

- **CROWN**: China Research and Development Environment Over Wide-area Network
  - 2004 – 2006, National Science Foundation of China (NSFC)
  - By top 5 universities and institutes in China
  - Beihang U. is the team leader.

- **Goal**: Providing Grid-enabled research environment for scientists
  - Provide a middleware suit for Service-based Grid computing
  - Build a testbed for Grid technologies and Grid researcher
  - Provide an easy-to-use Service Repository for E-Science community in China
Basic Idea of CROWN

- Service Overlay Network
- Resource
- Service Provision & Resource Mgmt.
- Overlay-based Service Management
- QoS-enabling technology (Reservation and Agreement-based mgmt)
- Trustworthy computing
  - For distributed env.
- Service Composition & Workflow
- Applications
  - Job Mgmt, Matchmaking & Scheduling
- Programming modal & application integration
- Security
- CROWN
  - Basic Idea of CROWN
  - Quality of Service
  - Service Provision & Resource Mgmt.
  - Overlay-based Service Management
  - QoS-enabling technology
  - Trustworthy computing
  - For distributed env.
CROWN Portal

- Portal: A JSP-based Web Interface
  - User Registration
  - Application Integration & User Job Submission
CROWN Testbed (2005)
8 Sites, 4 Cities are connected using existing network infrastructure

Beihang University
CNIC, CAS
Peking University
Tsinghua University
LASG, CAS

Chongqing University

National University of Defense Technology

HKUST: Hong Kong University of Science & Technology
CROWN Testbed (2006)
Deploy CROWN onto CNGRID Nation wide Testbed

Beihang University
CNIC, CAS
Peking University
Tsinghua University
LASG, CAS

Xi’an Jiaotong University

Chongqing University

China University of Science & Technology

Shanghai Super Computing Centre
Shanghai Jiaotong University

National University of Defense Technology

HKUST: Hong Kong University of Science & Technology
Pilot Applications

• **Bioinformatics:**
  • BLAST: Basic Local Alignment Search Tool
  • Cap3: A DNA sequence assembly program
  • Genscan: Identification of complete gene structures in genomic DNA.
  • ...

• **Atmospheric applications**
  • Climate simulation for past **1000 years**
  • AREM
    • Regional Eta-coordinate numerical prediction model
    • Rain or storm predication
Rainfall Forecast

FCST(12–36H): 00Z15MAY2005 to 00Z16MAY2005
Pilot Applications

- **SDG: Scientific Data Grid**
  - Share scientific data from all institutes of CAS with China or even world scientists

- **UDMGrid: University Digital Museum Grid**
  - Provide an integrated UDM data sharing environment using grid technologies
  - Currently 4 UDMs are integrated
    - Beihang University
    - Yunnan University
    - Nanjing University
    - Shandong University
HEP Grid in China
LHC

- China is involved in all four LHC experiments.
- IHEP in CMS and ATLAS.
BEPCII/BESIII

BEPC: Beijing Electron Positron Collider
- 2~5GeV/C
- Being upgraded to Dual-Ring, (3~10)×10^{32} cm^{-2}s^{-1}
- 27 Universities and Institutes from Korea, US, UK, Japan, and China.
YBJ-ARGO/ASγ

- Italy, Japan–China cosmic ray observatories in Tibet.
- 200TB raw data per year.
- Data transferred to IHEP and processed with 400 CPUs.
- Rec. data accessible by collaborators.
More Applications

Members of International Collaborations: Huge computing demands.
LCG sites in China

PEK VO: CMS

SDU VO: ATLAS

CSTNET\CERNET
at IHEP
Networking - Gloriad
Networking - ORIENT/TEIN2

2.5Gbps

ORIENT/TEIN2 connectivity upgrade
Network Performance

Average Round Trip Time and Packet Loss (100 byte packets)
Measured from 202.122.32.59 to olrauvergridse01.in2p3.fr

Time interval in weeks starting from Tue Jun 12 0:03:00 2007
Network Performance

![Traffic Graph](image)

- **IHEP-Router - Traffic - Gil/0/26**
- **From 2008/02/26 02:29:23 To 2008/02/26 14:29:23**

**Inbound**
- Current: 457.75 M
- Average: 306.59 M
- Maximum: 617.62 M

**Outbound**
- Current: 24.32 M
- Average: 18.54 M
- Maximum: 87.89 M
gLite applications

- LHC, BESIII are running
  - Resources for LHC are limited, but ramping up
- Deploying ARGO to LCG
Conclusion

• **Many grid projects - may be too many!**
  - Invited to merge by government
  - Interoperability
    - gLite-GOS: presentation by Yaodong CHENG this afternoon

• **Many applications**
  - HEP, Astrophysics, Biology, Industry, ...
Thank you!