Grid Activities in Taiwan

Eric Yen
ASGC, Taiwan
ISGC 2006
2 May 2006
Academia Sinica Grid Computing Centre (ASGC)

- One of the major high performance computing and communication centers in Taiwan
- Provides Grid-based infrastructure, service, and e-Science application development for Academia Sinica and its collaborating institutes

Mission

- Establish new generation research infrastructure in AS
- Developing e-Science Applications and Services to support research
- Fostering Regional e-Science Collaborations and linking to the world
Strategy

- WLCG/EGEE and OSG as the major Grid/e-Science infrastructure of Taiwan
- Collaboration
- Take part in related standard activity and organization, such as GGF, OASIS, W3C, etc.
- Application Driven
- Build up the capability of
  - Operation and Management of large grid resources (thousands of CPU cluster, Petabyte storage, 10Gb international networking, Grid Deployment)
  - Operation & Monitoring support of regional and domestic sites
  - Fostering Grid applications
  - Facilitation international, regional and domestic collaborations
  - Grid Technology Development
Current Status

- ASGC/Taiwan is now a production grid environment
- ASGC is providing regional ROC/CIC/GGUS services
- Facilitating and Coordinating international collaboration in terms of regional (AP) federation
- Interoperation of Grids for flexible resource utilization
- Capturing generic middleware services from application requirements --> closely interaction with application communities to construct effective science services
Grid Networking of Taiwan
International R&E Networking of Taiwan
Grid Network in Asian Pacific

- High throughput via very long distance to T0 (~300ms RTT) and T1s (200ms ~ 400ms RTT)
- Expensive SDH submarine cable system (non-protected lambda is unusual)
  - sometimes has to share bandwidth with regular network traffics
- Regional Resource Centers/T2 in Asian Pacific
  - CN: IHEP, Beijing University, Shang-Dong Univ., Nanjing Univ., …
  - JP: KEK, University of Tokyo, …
  - KR: KNU
  - SG: Singapore Grid Office
  - TW: NTU, NCU, …
Plan for Taiwan Tier-1 Network

Backup Path to T0

Primary Path to T0 (plan to install 10GE in 2007)
AP Regional LCG Network (proposed)

- Solid lines between routers (circle) and switches (box) and networks are already exist.
- Solid lines between T2 and routers / switches /networks are already exist and/or proposed.
- Dashed line are currently planned by ASnet and will be installed in 2006/7.
- Type-2 is “direct-connect”

Type-1 is passing through 3rd party facility or 3rd party network
ASGC WLCG SC4 and Site Status
LAN/WAN connectivity

Max from LCG: 1922.4 Mb/s (96.1%)  Average from LCG: 208.7 Mb/s (10.4%)  Current from LCG: 1105.1 Mb/s (55.3%)
Max to LCG: 859.1 Mb/s (43.0%)   Average to LCG: 17.0 Mb/s (0.9%)    Current to LCG: 21.5 Mb/s (1.1%)

Max from LCG: 1241.0 Mb/s (62.0%)  Average from LCG: 289.7 Mb/s (14.5%)  Current from LCG: 1093.3 Mb/s (54.7%)
Max to LCG: 30.4 Mb/s (1.5%)      Average to LCG: 4111.9 kb/s (0.2%)     Current to LCG: 21.3 Mb/s (1.1%)
SC Castor throughput: GridView

- disk to disk nominal rate
  - currently ASGC have reached 120+ MB/s static throughput
  - Round robin SRM headnodes associate with 4 disk servers, each provide ~30 MB/s
  - debugging kernel/castor s/w issues early time of SC4 (reduction to 25% only, w/o further tuning)
## Tier-1 Accountings: Jan – Mar, 2006

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<thead>
<tr>
<th>Tier-1</th>
<th>Site</th>
<th>alice</th>
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</tbody>
</table>
OSG/LCG resource integration

- Mature tech help integrating resources
  - GCB introduced to help integrating with IPAS T2 computing resources
  - CDF/OSG users can submit jobs by gliding-in into GCB box
  - Access T1 computing resources from “twgrid” VO
- Customized UI to help accessing backend storage resources
  - Help local users not ready for grid
  - HEP users access T1 resources
Contributions of ASGC in WLCG

- WLCG Tier1 Centre -- Collaborating ATLAS & CMS Teams (NCU, NTU, IPAS) in Taiwan
- Regional Operation Centre and Core Infrastructure Centre
- Production CA Services
- LCG Technology Development
  - Data Management
  - Grid Technology
  - Certification & Testing
  - Application Software
  - ARDA (Distributed Analysis)
  - 3D (Distributed Deployment of Database)
  - Operation and Management
- Dissemination and Outreach
ARDA

- Goal: Coordinate to prototype distributed analysis systems for the LHC experiments using a grid.
- ARDA-ASGC Collaboration: since mid 2003
  - Building push/pull model prototype (2003)
  - Integrate Atlas/LHCb analysis tool to gLite (2004)
  - CMS monitoring system development (2005)
    - Monitoring system to integrate RGMA & MonaLisa
    - ARDA/CMS Analysis Prototype: Dashboard
- ARDA Taiwan Team: http://lcg.web.cern.ch/LCG/activities/arda/team.html
- 4 FTEs participated: 2 FTEs at CERN, the other 2 are in Taiwan
EGEE Participation of ASGC

- Join EGEE as a non-funded member from Dec. 2004
- NA3: Training and Induction
- NA4: Applications in HEP and Biomed
- SA1: Support and Operation Management, AP CIC/ROC
- JRA1: Middleware Re-engineering
  - gLite Pre-production site
  - gLite Testbed
APROC Introduction

- **APROC Goal**
  - Provide deployment support facilitating Grid expansion
  - Maximize the availability of Grid services

- **APROC established in April 2005**

- **Supports EGEE sites in Asia Pacific**
  - 9 sites, 7 countries, > 400 CPUs
    - Australia  Japan  India
    - Korea  Pakistan  Singapore  Taiwan

- **EGEE CIC**
  - CIC-on-duty rotation: EGEE global operations
  - Monitoring tool development: GStat and GGUS Search
  - Centralized services

- **EGEE ROC**
  - Monitoring, Diagnosis and Problem tracking support
  - Security Coordination
  - Portal and documentation
• Production CA Services: production service from July 2003
• AP CIC/ROC: 9 sites 7 countries, > 400 CPUs
• VO Infrastructure Support: APeSci and TWGrid
• WLCG/EGEE Site Registration and Certification
• Middleware and Operation Support
• User Support: APROC Portal (www.twgrid.org/aproc)
• MW and technology development
• Application Development
• Education and Training
• Promotion and Outreach
• Scientific Linux Mirroring and Services
# Education and Training

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
<th>Attendant</th>
<th>Venue</th>
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<td>China Grid LCG Training</td>
<td>16-18 May 2004</td>
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<td>Beijing, China</td>
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<tr>
<td>ISGC 2004 Tutorial</td>
<td>26 July 2004</td>
<td>50</td>
<td>AS, Taiwan</td>
</tr>
<tr>
<td>Grid Workshop</td>
<td>16-18 Aug. 2004</td>
<td>50</td>
<td>Shang-Dong, China</td>
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<td>NTHU</td>
<td>22-23 Dec. 2004</td>
<td>110</td>
<td>Shin-Chu, Taiwan</td>
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<tr>
<td>NCKU</td>
<td>9-10 Mar. 2005</td>
<td>80</td>
<td>Tainan, Taiwan</td>
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<td>ISGC 2005 Tutorial</td>
<td>25 Apr. 2005</td>
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<tr>
<td>Tung-Hai Univ.</td>
<td>June 2005</td>
<td>100</td>
<td>Tai-chung, Taiwan</td>
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<tr>
<td>EGEE Workshop</td>
<td>Aug. 2005</td>
<td>80</td>
<td>20th APAN, Taiwan</td>
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<tr>
<td>EGEE Administrator Workshop</td>
<td>Mar. 2006</td>
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<tr>
<td>EGEE Tutorial and ISGC</td>
<td>1 May, 2006</td>
<td>73</td>
<td>AS, Taiwan</td>
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</table>

Note: gLite and the development of EGEE were introduced in all the events which are run by ASGC
The Asia Pacific Federation
LCG and EGEE Grid Sites in the Asia-Pacific Region

4 LCG sites in Taiwan
12 LCG sites in Asia/Pacific

Academia Sinica Grid Computing Centre

-- Tier-1 Centre for the LHC Computing Grid (LCG)
-- Asian Operations Centre for LCG and EGEE
-- Coordinator of the Asia/Pacific Federation in EGEE

AP Federation now shares the e-Infrastructure with WLCG
(Informal) Asia Collaboration Board

- Formation of informal Asia Collaboration Board on 1 December 2005 during LCG Service Challenge meeting in Taipei
  - Attendees: Australia, China, Japan, Korea, Singapore, Taiwan

- Mission
  - Enable researchers to leverage Grid technologies
  - Foster collaboration in Asia and the rest of the world

- Virtual Organization
  - APDG: Asia-Pacific Data Grid
    - VO for deployment testing and training
  - APESCI: Asia-Pacific e-Science
    - Production VO to incubate early Grid communities
Plan of AP Federation

- **VO Services**: deployed from April 2005 in Taiwan (APROC)
  - LCG: ATLAS, CMS
  - BioInformatics, BioMed
  - Geant4
  - APeSci: for collaboration general e-Science services in Asia Pacific Areas
  - APDG: for testing and testbed only
  - TWGRID: established for local services in Taiwan

- **Potential Applications**
  - LCG, Belle, nano, biomed, digital archive, earthquake, GeoGrid, astronomy, Atmospheric Science
Service Challenge Plan for T1/T2 in Asia

- T1-T2 test plan
  - what services/functionality need to test
  - recommendation for T2 sites, checklist
  - What have to be done before join SC
  - Communication methods, and how to improve if needed
  - Scheduling of the plans, candidates of sites
  - Timeline for the testing
  - SRM + FTS functionality testing
  - Network performance tuning (jumbo framing!?)

- T1 expansion plan
  - Computing power/storage
  - storage management, e.g. CASTOR2 + SRM
  - Network improvement
OSG Status
e-Science Applications in Taiwan

- High Energy Physics: WLCG
- Bioinformatics: mpiBLAST-g2
- Biomedicine: Distributing AutoDock tasks on the Grid using DIANE
- Digital Archive: Data Grid for Digital Archive Long-term preservation
- Atmospheric Science
- Geoscience: GeoGrid for data management and hazards mitigation
- Ecology Research and Monitoring: EcoGrid
- BioPortal
- e-Science Application Framework Development
Bio-Computing Applications
EGEE Biomed DC II – Large Scale Virtual Screening of Drug Design on the Grid

• Biomedical goal
  • accelerating the discovery of novel potent inhibitors thru minimizing non-productive trial-and-error approaches
  • improving the efficiency of high throughput screening

• Grid goal
  • aspect of massive throughput: reproducing a grid-enabled in silico process (exercised in DC I) with a shorter time of preparation
  • aspect of interactive feedback: evaluating an alternative light-weight grid application framework (DIANE)

• Grid Resources
  • AuverGrid, BioinfoGrid, EGEE-II, Embrace, & TWGrid

• Problem Size: around 300 K compounds from ZINC database and a chemical combinatorial library, need ~ 137 CPU years in 4 weeks

⇒ a world-wide infrastructure providing over than 5,000 CPUs
Development and deployment efforts of DIANE

- Development efforts
  - The Autodock adopter for DC2 is around 500 lines of python codes

- Deployment efforts
  - The DIANE framework and Autodock adaptor are installed on-the-fly on the Grid nodes
  - Targets and compound databases can be prepared on the UI or pre-stored on the Grid storages
  - Output are returned to the UI interactively
mpiBLAST-g2
ASGC, Taiwan and PRAGMA http://bits.sinica.edu.tw/mpiBlast/index_en.php

- A GT2-enabled parallel BLAST runs on Grid
  - GT2 GASSCOPY API
  - MPICH-g2
- The enhancement from mpiBLAST by ASGC
- Performing cross cluster scheme of job execution
- Performing remote database sharing
- Help Tools for
  - database replication
  - automatic resource specification and job submission (with static resource table)
  - multi-query job splitting and result merging
- Close link with mpiBLAST development team
  - The new patches of mpiBLAST can be quickly applied in mpiBLAST-g2
DataGrid for Digital Archives
Requirements

- **Long-Term Preservation and Data Curation**
  - preserving ability to read (physically) and understand (logically)

- **Full Spectrum and Precise Metadata in Collection, Object and Management Level**

- **Workflow Support: Digital Information Life-Cycle**
  - Create --> Content Analysis & Annotation --> IPR Protection --> Re-purposing --> Multi-modal/Integrative Search --> Archive

- **Data Exploration across Institutional and Disciplinary Domains**

- **Petabyte Scale Storage Management with Performance**

- **User Applications by Disciplinary and Role**
  - Data analysis, Visualization, Operation & Management, etc.

A New Information Infrastructure is Required!
Data Grid for Digital Archives
## System Monitoring

### Resources Usage

<table>
<thead>
<tr>
<th>Physical Resource</th>
<th>Host</th>
<th>Default Path</th>
<th>File Used</th>
<th>Disk Used (GB)</th>
<th>Disk Available (KB)</th>
<th>Disk Available (%)</th>
<th>Watermark</th>
<th>Status</th>
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</thead>
<tbody>
<tr>
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EGEE User Forum, Mar. 2006
### Table I. Size of Digital Contents of NDAP

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<th>2003</th>
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### Table II. Details of NDAP Production in 2005

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<th>Metadata Size(MB)</th>
<th>Metadata Records</th>
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<td>1,384,162</td>
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Grid for Taiwan Seismology

- Data Management of 地震觀測網與統計資料
- Data Portal of Taiwan Earthquake Center
- Analysis by Grid for Seismology
- Services
Taiwan GeoGrid

- Applications
  - Grid for Geoscience, Earth Science and Environmental Research and Applications
  - Land Use and Natural Resources Plan/Management
  - Hazards Mitigation
    - Typhoon
    - Earthquake
    - Flood
    - Coast line changes
    - Landslide/Debris flow

- On-the-fly overlay of base maps and thematic maps,
  - from distributed data sources (of variant resolution, types, and time) based on Grid Data Management
  - WebGIS/Google Earth based UI
  - Integration of Applications with Grid

Academia Sinica Grid Computing
EcoGrid

Ecogrid Scenario

- Ecologists
- Public Users
- Multidisciplinary researchers
- Knowledge Center
- Network Backbone
- Software & Modeling
- Visualization
- Computer
- Storage/Data
- NCHC

Wireless

- Reservoir
- Rainfall Gauge
- Data logger (CR10X, campbell)
- River Gauge
- soil Gauge
- Observation Station
- Mobile sensors

TERN Research Site

Courtesy from NCHC
Industrial Program

- **NSC-Quanta Collaboration**
  - To help Quanta Blade System have best performance for HPC and Grid Computing
  - Quanta is the largest Notebook manufacturer in the world
  - Participants: AS, NTU, NCTS, NTHU, NCHC
  - Scientific Research Disciplines: Material Science, Nano-Technology, Computational Chemistry, Bioinformatics, Engineering, etc.
  - Performance Tuning, Grid Benchmarking

- **ASGC-Microsoft**
  - To integrate Microsoft CCS into gLite middleware
    - To take advantage of Microsoft CCS computing power as the computing resources in gLite.
  - The scientific application porting plan
    - BLAST (Basic Local Alignment Search Tool)
ASGC e-Science Application Focus

- **Grid Portal**
  - common data sharing environment as a one stop shop to search for and access data from different administrative domains on heterogeneous systems in a UNIFORM way

- **Content Analysis & Management**
  - Metadata model, Content management framework, data federation

- **Security Framework**
  - PKI based authentication, authorization, accounting and encryption

- **Storage Resource Broker (collaborate with SDSC)**
  - pure distributed data management system, integration to Grid infrastructure, development of SRB-SRM

- **Long-Term Preservation (LTP) & Data Curation**
  - Persistent archive, Mass storage technology, sustainable operation/business model
Common Framework for Application Development

Web-Based Portal User Interface

Job repository

User/Grid Proxy Manager

Virtual Queuing System

DataBank/Storage Element

Data Management

Grid Agent

Grid Computing Element

Computing

Common Framework for Application Development
Summary

- Scientists need a new research infrastructure with deterministic and guaranteed quality for computing, data management, and bandwidth.
- Grid has been proved to be the most viable solution for the new infrastructure -- the e-infrastructure/cyberinfrastructure.
- Production Grid Application Environment has been available in Taiwan
  - ~80% system availability
  - Test job successful rate > 90%
- Diversity is the norm and healthy, but collaboration is essential on a worldwide scale
- Capturing generic middleware services from application requirements --> closely interaction with application communities to construct effective science services