TIGRIS: K*Grid Infrastructure

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Motivation
Macro Trends in Science

- Science is becoming a team sport
  - Easy problems are solved, challenging problems require
    - Large resources, particularly human
    - Knowledge from many discipline
  - Amazing advances in IT (Information Technology)
    - Moore’s Law: advances in CPU, network, storage
    - Widespread use of IT in science
    - Computational science becomes the third way of science

IT-based Science Environment!
Example: Physics

- A field of physics pursues for fundamental constituents of matter and basic principles of interactions between them
  - Need giant accelerators
  - Deal with huge amount of data
  - Teams with many members form around detectors

**Distributed analysis of data**
Example: Physics

First Beams: Summer 2007
Physics Runs: from Fall 2007

*
**pp ⚘s =14 TeV L=10^{34} cm^{-2} s^{-1}**

* 27 km Tunnel in Switzerland & France

5000+ Physicists
250+ Institutes
60+ Countries

ALICE : HI
Atlas
LHCb: B-physics

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Example: Physics

Typical HEP Collaboration at Present

~700 Collaborators
~80 Institutions
18 Countries
Example: Physics

CERN/Outside Resource Ratio ~1:2
Tier0/(Σ Tier1)/(Σ Tier2) ~1:1:1

Tier 0 +1
CERN Center
PBs of Disk;
Tape Robot

Tier 1
10 - 40 Gbps
IN2P3 Center
RAL Center
INFN Center
FNAL Center

Tier 2
~1-10 Gbps
Tier2 Center
Physics data cache

Tier 3

Tier 4
1 to 10 Gbps
Workstations

Tens of Petabytes by 2007-8. An Exabyte ~5-7 Years later.

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Overview of K*Grid Project
Introduction to K*Grid Project

- Goal: Implementation of the Nation-wide Grid infrastructure in Korea
- Fund: Government level support by MIC (Ministry of Information and Communication)
- Period & Budget: 2002-2006 (5 yrs) & US 32M
- Leading organization: KISTI
- PI of K*Grid project: Dr. Jysoo Lee
- Partners: Various research partners selected from academia, industry and government lab. Through a public competition
Scopes of K*Grid Project (1/2)

- Construction of K*Grid infrastructure
  - Phase I (2002-2004): Experimental Grid testbed for the pilot K*Grid applications
  - Phase II (2005-2006, hereafter): Production-level Grid infrastructure for the national Grid research and development process (TIGRIS)

- Development of Grid middleware technology
  - KMI-R1 (K*Grid Middleware Initiative – Release 1): Integrated Grid middleware service package
  - MoreDream: OGSI-based Grid middleware toolkit

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Scopes of K*Grid Project(2/2)

- **Research on Grid Applications**
  - Phase I (2002-2004): Scientific application
    - Molecular simulation Grid
    - Grid-based remote services for high-tech scientific instruments (UHV-TEM)
  - Phase II (2005-2006): Business application
    - Online game server administration
    - Application Service Provider (ASP)

- **Grid Forum Korea (GFK)**
  - Outreach program for Korean Grid community and international collaboration for standardization process
  - Invited the 13th Global Grid Forum (GGF13) in Seoul, March 2005
TIGRIS: Tera-scale Infrastructure for K*GRID Services
Introduction to TIGRIS: Tera-scale Infrastructure for K*GRID Services

- Nation-wide sustainable Grid Infrastructure in Korea
- For providing production-level Grid services
- To national research and development process
- Open infrastructure with Grid services compatible with open standards
TIGRIS Architecture

SNU
- IBM SP Nighthawk-III (Power3-II,LoadLeveler)
- IBM BladeCenter JS20 (PPC970,LoadLeveler)

KISTI
- Linux cluster (Xeon,PBS)
- IBM eServer x335 (Xeon,PBSPro)

PNU
- SGI Altix 1350 (Itanium-II,PBSPro)

TIGRIS Portal

Map of South Korea with points labeled Seoul, Daejeon, and Pusan connected by dotted line with "KREONET" label.

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# TIGRIS Major Resources

<table>
<thead>
<tr>
<th></th>
<th>SNU</th>
<th>PNU</th>
<th>KISTI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Linux cluster</td>
<td>CC-NUMA</td>
<td>Linux cluster</td>
</tr>
<tr>
<td><strong>Model</strong></td>
<td>IBM BladeCenter JS20</td>
<td>SGI Altix 1350</td>
<td>IBM eServer x335</td>
</tr>
<tr>
<td><strong>OS</strong></td>
<td>SLES 9.0</td>
<td>RHEL3AS + SGI ProPack3</td>
<td>Redhat 7.3</td>
</tr>
<tr>
<td><strong>CPU</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CPU</td>
<td>PPC970</td>
<td>Itanium-II</td>
<td>Xeon</td>
</tr>
<tr>
<td>Clock</td>
<td>2.2GHz</td>
<td>1.5GHz</td>
<td>2.8 GHz</td>
</tr>
<tr>
<td>#CPU / Node</td>
<td>2</td>
<td>16</td>
<td>2</td>
</tr>
<tr>
<td>#Node</td>
<td>480</td>
<td>7</td>
<td>256</td>
</tr>
<tr>
<td>Total</td>
<td>960</td>
<td>120</td>
<td>512</td>
</tr>
<tr>
<td><strong>RAM</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#RAM / Node</td>
<td>2 GB</td>
<td>16 GB</td>
<td>3 GB</td>
</tr>
<tr>
<td>Total</td>
<td>960 GB</td>
<td>120 GB</td>
<td>768 GB</td>
</tr>
<tr>
<td><strong>Disk</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#Disk / Node</td>
<td>23.5 GB</td>
<td>146 GB, 36 GB</td>
<td>36.4 GB</td>
</tr>
<tr>
<td>Total</td>
<td>11 TB + 10 TB</td>
<td>1 TB</td>
<td>9 TB + 10 TB</td>
</tr>
<tr>
<td>Performance (theoretical)</td>
<td>8 TF</td>
<td>0.7 TF</td>
<td>2.4 TF</td>
</tr>
</tbody>
</table>

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TIGRIS Network Infrastructure
TIGRIS Services Stack (1/2)

- Uses Globus Toolkit v4 as basic Grid middleware
- Will provide improved high-level Grid services on top of Globus Toolkit v4
  - Enhanced Grid job management
  - Grid file system
  - Extension of Grid-enabled MPICH
    - Fault tolerant job execution of MPI application
    - MPI communication between private IP clusters
TIGRIS Web Portal (1/2)

- Develops Grid portal system to provide easy-to-use user interface to support efficient Grid operations to Grid users
- Provides virtualized workspace on heterogeneous computing resources
  - Modularized batch job script generator
  - Application-dependent UI reconfiguration
- Provides integrated resource monitoring interfaces
  - Grid resource monitoring services based on Ganglia
- Provides integrated resource usage accounting on the Grid
  - Collection of resource usage accounting info based on GGF UR-WG
TIGRIS Web Portal (2/2)

- TIGRIS Portal Application
  - Sun Java System Portal Server 8.0
  - JDK 1.4.2

- Oracle 10g

- TIGRIS Portal
  - HTTP/GOAP

- TIGRIS Portal Agent
  - JWSOP 1.3
  - JDK 1.4.2

- Ganglia 3.0.1

- compute nodes

- queueing system

- Remote Server
  - large file transfer

- Internet

- User

- computing resources

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Quick Look at TIGRIS Web Portal
International Collaboration
PRAGMA Collaboration

PRAGMA Grid Testbed

30 Clusters from 27 institutions in 14 countries

Courtesy: Cindy Zheng from PRAGMA resource W/G

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EGEE Collaboration

- EGEE-II contracting partner
  - Unfunded partner in the EGEE project
  - Cooperating with CKSC team, another EGEE-II partner in Korea

- Participating area: SA1
  - In this year, focusing on having an experiences about EGEE Grid infrastructure collaboration between KISTI and EGEE-II

- Not production site yet
  - The work is under way

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Summary

- TIGRIS as national shared cyber-infrastructure in Korea

Source: NSF homepage
Republic of Korea
Thanks
USA
Grazie
Italy
China
Danke
Germany
Japan

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