Grid Initiatives in India

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BARC started development of Parallel & Cluster Computing to meet computing demands of in-house users with the aim to provide inexpensive high-end computing since 1990-91.

Have built so far 16 different models using varying CPU and networking technologies.

Today Clusters are the primary IT infrastructure.
Cluster based Systems

Clustering is replacing all traditional Computing platforms and can be configured depending on the method and applied areas

- **LB Cluster** - *Network load distribution and LB*
- **HA Cluster** - *Increase the Availability of systems*
- **HPC Cluster (Scientific Cluster)** - *Computation-intensive*
- **Web farms** - *Increase HTTP/SEC*
- **Rendering Cluster** – *Increase Graphics speed*

HPC Environment at BARC

Pre-processing  Solver  Post-processing

Front-end

Supercomputing Cluster
1.7 TF HPL

Multiple Graphics HW

Tiled display giving very high resolution (20Mpixel), high-speed rendering needed for scientific visualization.
Software Development

• **Program Development Tools**
  – Libraries, Debuggers, Profilers etc.

• **System Software**
  – Communication drivers, monitors, firmware
  – Job submission and queuing system
  – Cluster file system

• **Management and Monitoring tools**
  – Automatic installation
  – Cluster Monitoring System
  – Accounting System
  – SMART – Self Diagnosis and Correction system
Difficulties in today’s systems

- Major organizations have their own computer systems, thus idle when no load but not available to outsiders.
- For operating computer centre 75% cost come from environment upkeep, staffing, operation and maintenance; why every one should do this?
- As digital data is growing high-speed connectivity is essential; bandwidth & data sharing is an issue.
- Supercomputers, Visual systems and Networks are not tightly coupled by software; difficult for users to use it.
e-Science" and “e-Research

• Collaborative research that is made possible by sharing across the Internet of resources (data, instruments, computation, people’s expertise...)
  – Crosses organisational boundaries
  – Often very compute intensive
  – Often very data intensive
  – Sometimes large-scale collaboration

• Owning Vs Sharing the resources

• Today you can’t submit jobs on the Internet
Data Grid at CERN

Tier 0
- CERN Computer Centre
- Tier 0
  - ~100 MBytes/sec

Tier 1
- France Regional Centre
- Germany Regional Centre
- Italy Regional Centre
- FermiLab ~4 TIPS

Tier 2
- Caltech ~1 TIPS
- Tier 2 Centre ~1 TIPS
- Tier 2 Centre ~1 TIPS
- Tier 2 Centre ~1 TIPS
- Tier 2 Centre ~1 TIPS

Tier 3
- Institute ~0.25 TIPS
- Institute ~0.25 TIPS
- Institute ~0.25 TIPS

Tier 4
- Physics data cache
- Physicist workstations

Online System
- ~100 MBytes/sec

Offline Processor Farm
- ~20 TIPS

Physics data cache
- ~1 MBytes/sec

Physicists work on analysis "channels".
Each institute will have ~10 physicists working on one or more channels; data for these channels should be cached by the institute server.

March 27, 2007
ISGC 07, Sinica, Taiwan
DAE-CERN Collaboration

• DAE-CERN Protocol agreement on Grid computing for software development for WLCG.
• DAE developed software is deployed at WLCG, CERN
  - Co-relation Engine, Fabric management
  - Problem Tracking System (SHIVA)
  - Grid Monitoring (GRID VIEW)
  - Quattor toolkit enhancements
  - Data Base Management
  - Fortran Library conversion
Regional LCG Tier-2 in India

Tier 0/1 Centre

CERN/EU-IndiaGrid

Tier 2 Centre and CMS users

TIFR

Uses WLCG tools

45/622/1000 Mbps

34/622 Mbps

34/100 Mbps

Tier 3 and CMS Users

Tier 2 Centre

BARC

34/622 Mbps

34/100 Mbps

CMS: Universities & Institutes Tier 3

Univ Pune

NCBS

Garuda Grid

POP in Mumbai

VECC

34/100 Mbps

2/10 Mbps

Tier 2 and Alice users

Tier 2/3 Centers in India

ALICE: Universities & Institutes Tier 3

DAE/DST/ERNET: Geant link operational since August 2006
Monitoring and Visualization Tool for LCG

Data Transfer | Job Status | Service Availability

(Version: gridview-3.0.2, Installation Date: Jan 08, 2007)

Current Status
(VO-wise Data Transfer From All Sites To All Sites)

Averaged Throughput during the last 24 hrs (25/02 - 26/02)

VO-wise Data Transfer From All Sites To All Sites

(OTHERS: VOs giving throughput less than 1% of max, [link to names])
Resource sharing and coordinated problem solving in dynamic, multiple R&D units

DAE Grid (Private)

IGCAR: wide-area Data dissemination

BARC: Computing with shared controls

CAT: archival storage

VECC: real-time Data collection

Uses WLCG tools

4 Mbps Link

4 Mbps Link
National Grid Initiative - GARUDA

• Department of Information Technology (DIT), Govt. of India, has funded C-DAC (Centre for Development of Advanced Computing) to deploy nationwide computational grid named GARUDA.

• Currently in its Proof of Concept phase.

• It will connect 45 institutes in 17 cities in the country at 10/100 Mbps bandwidth.
Garuda - Deliverables

- Grid tools and services to provide an integrated infrastructure to applications and higher-level layers.
- A Pan-Indian communication fabric to provide seamless and high-speed access to resources.
- Aggregation of resources including compute clusters, storage and scientific instruments.
- Creation of a consortium to collaborate on grid computing and contribute towards the aggregation of resources.
- Grid enablement and deployment of select applications of national importance requiring aggregation of distributed resources.
Garuda – Network Connectivity

Legend
- Connected
- Not Connected

Connectivity Summary
Total number of Institutions: 45
Institutions Connected: 44
The EU-IndiaGrid Project Joining European and Indian grids for e-science

- To support the interconnection and interoperability of the prominent European Grid infrastructure (EGEE) with the Indian Grid infrastructure for the benefit of eScience applications
- Two year project started from Oct 2006 with BUDGET of 1208 k-EUR total fund out of which 1015.9 k-EUR from European Commission (5 Europe & 9 Indian partners)
- Person months
  - 353.3 PM total
  - 226.4 PM funded from European Commission
- First kickoff meeting in ICTP Italy during 18-20 Oct, 2006
- Workshop WLCG & EU-IndiaGrid at TIFR during 1-4 Dec, 2006
- Belief Conference in New Delhi from 13-15 Dec 2006
PARTNERS

EUROPE
• INFN (project coordinator),
• Metaware SpA,
• Italian Academic and Research Network (GARR)
• Cambridge University

INTERNATIONAL
• Abdu Salam International Centre for Theoretical Physics (ICTP)

INDIA
• Indian Education and Research Network (ERNET),
• University of Pune,
• SAHA Institute of Nuclear Physics, Kolkata (SINP) & VECC,
• Centre for Development of Advanced Computing (C-DAC),
• Bhabha Atomic Research Centre, Mumbai (BARC)
• TATA Institute for Fundamental Research (Mumbay) (TIFR)
  National Centre for Biological Sciences, Bangalore (NCBS)
EU-IndiaGrid Status

GEANT-ERNET Milan-Mumbai 45 Mb/s link opened since August 2006
– WLCG Tier-II CMS & ALICE centres and 10 Universities are interconnected
– 50 Research laboratories and educational institutes situated in 17 major Indian
cities are interconnected within the GARUDA National Grid Initiative through ERNET
from Jan 2007

Key issues,
– Certification Authority
– Creation of a pilot test bed
– Interoperability between gLite & GT

Cooperation with Academia Sinica (Regional Operation Centre for Asia) allowed:
– To established Registration Authorities at each site in order to ensure
immediate grid access worldwide to Indian users
– Set the necessary steps for an Internationally recognized Indian Certification
Authority (Responsibility taken by C-DAC)
Other Grids in India

- ERNET’s partnership with GÉANT2 is supported by the EUIndiaGrid initiative, a project that aims to interconnect European Grid infrastructures with related projects in India.

- BARC MOU with INFN, Italy to establish Grid research Hub in India and Italy

- 11th five year plan proposals for E_infrastructure and Grid for S&T applications submitted to GOI with possibility for Weather, Bio and e-Governance
Summary

• Grids presents a single & unified resources for solving large-scale compute & data-intensive appln.

  – Owning Vs Sharing

• Providing affordable (free) access to national as well as international resources to the Universities, Schools & Colleges may bring innovative leadership to India

• India can make great contribution in developing global HPC applications (modeling & Simulation software), model verification & validations, tools development, evaluations & testing etc
THANK YOU