Application of Computing Grid to High Energy Collider Experiments and Development of Distributed Analysis Infrastructure in Japan

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• Deployment of LCG in Japan
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• Analysis Infrastructure – Possible View
High Energy Physics in Asian/Pacific Region

- Programs in Asia
  - KEK-B Belle
  - SuperKamiokande/K2K
  - BEPC BES

- International Collaboration
  - LHC ATLAS/CMS/Alice/LHC-b
  - Tevatron CDF/D0
  - PEP-II Babar
Super KEK-B

- $L = 10^{35}\text{cm}^{-2}\text{s}^{-1}$ in 2007?
- Data rate $\sim 250\text{MB/s}$
K2K now upgrading to T2K

Materials and Life Science Experimental Facility

Nuclear and Particle Experimental Facility

Nuclear Transmutation

Linac (350m)

3 GeV Synchrotron (25 Hz, 1MW)

Neutrino to Kamiokande

50 GeV Synchrotron (0.75 MW)

J-PARC = Japan Proton Accelerator Research Complex
T2K (Tokai to Kamioka)

- Bland new 50GeV PS
- 100 times intense neutrino beam
  - High trigger rate at the near detector
- Operational in 2007
LHC-ATLAS

• Japanese contribution
  – Semiconductor Tracker
  – Endcap Muon Trigger System
  – Muon Readout Electronics
  – Superconducting Solenoid
  – DAQ system
  – Regional Analysis Facility
LCG MW Deployment in Japan

- ICEPP, the University of Tokyo
  - Regional analysis center for ATLAS
- RC Pilot Model System
  - Since 2002
  - LCG testbed. Now LCG2_1_1
- Regional Center Facility
  - Will be introduced in JFY2006
  - Aiming “Tier1” size resource
Collaboration on Grid

- KEK-ICEPP Joint R&D for Regional Center
  - PC farms in KEK and ICEPP
  - 1GbE dedicated connection
- Grid Data Farm (G-Farm) made in Japan
  - AIST/TIT/KEK/U.Tsukuba
  - Osamu’s talk on 27th
WAN Performance Measurement

“A” setting
TCP 479Mbps -P 1 -t 1200 -w 128KB
TCP 925Mbps -P 2 -t 1200 -w 128KB
TCP 931Mbps -P 4 -t 1200 -w 128KB
UDP 953Mbps -b 1000MB -t 1200 -w 128KB

“B” setting
TCP 922Mbps -P 1 -t 1200 -w 4096KB
UDP 954Mbps -b 1000MB -t 1200 -w 4096KB

"A" setting: 104.9MB/s
"B" setting: 110.2MB/s
GRID testbed environment with HPSS through GbE-WAN

NorduGrid
- grid-manager
- gridftp-server
Globus-mds
Globus-replica
PBS server

ICEPP

0.2TB
6 CPUs
PBS clients

KEK

~ 60km

HPSS servers

HPSS 120TB

NorduGrid
- grid-manager
- gridftp-server
Globus-mds
PBS server

User PCs

100 CPUs
PBS clients

1Gbps
100Mbps
Client disk speed @ KEK = 48MB/s
Client disk speed @ ICEPP = 33MB/s

Aggregate Transfer speed (MB/s)

# of file transfer in parallel

Pftp → pftp
HPSS mover disk → Client disk

KEK client (LAN)
ICEPP client (WAN)

Ftp buffer = 64MB

client disk speed 35-45MB/s

- **Transparent access to dispersed file data in a Grid**
  - POSIX I/O APIs, and native Gfarm APIs for extended file view semantics and replications
  - Map from virtual directory tree to physical file
  - Automatic and transparent replica access for fault tolerance and access-concentration avoidance

Diagram:
- Virtual Directory Tree
  - /grid
  - ggf
  - aist
  - gtrc
  - File system metadata
  - file1
  - file2
  - file3
  - file4
  - mapping
  - File replica creation

Gfarm File System

National Institute of Advanced Industrial Science and Technology
Application of Grid Data Farm


- Installed in Pilot Model System
  - File system meta server, gridFTP server, 8 File system nodes

- Application : Atlas simulation (DC2)
  - Try to run ATLAS binary distribution.
  - Fast simulation : OK
  - Full simulation (Geant4) : A small trick necessary = Problem identified.
Analysis Infrastructure
Possible View

• HEPNET-J
  – Long history of dedicated network for high energy physics society in Japan.
  – Functionality is changing.
  – MPLS-VPN for HEP society

• HEPGRID-J?
  – Collaboration among experiments
  – Discussion just started
Composition Figure (Japan Map)

- Super SINET: 10Gbps
- International line: Approximately 5Gbps
- Domestic Circuit: 30-100Mbps

Super SINET node
SINET node

2003 Super SINET Plan (New Node) from October 2003
- NII (Hitotsubashi)
- Japan Advanced Institute of Science and Technology
- Institute of Statistical Mathematics
- Hiroshima University
- Keio University (Hiyoshi campus)

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High Bandwidth Experiments

• LHC (2007~)
• J-PARC (Japan Proton Accelerator Research Complex) (2007~)
  – Neutrino long baseline experiment (T2K)
• Super KEK-B(2007?)
  – Toward $L = 10^{35} \text{ cm}^{-2}\text{s}^{-1}$
  – Same order of data size with LHC experiments ~ 250MB/s
Status of Japanese Institutes

• Each institute is relatively small
  – A unit ~ one senior, one middle-age, a few young staff
    + graduate students
  – Difficult to allocate experts to all of them
    • Role of National Lab.

• High bandwidth connection is available
  – Remote control/connection desirable
  – Still O(10ms) RTT to KEK or Tokyo. Frustration in an interactive session

• A computing model is necessary for nation-wide analysis infrastructure
Summary

• Demands on Computing Grid
  – Rush of experiments ~ 2007
  – Considerable bandwidth on network
  – PC farms everywhere

• Grid Deployment Just Started
  – Production started on LCG
  – Still evaluation phase for other experiments

• Need a Blueprint for HEP analysis network/grid in Japan
  – Collaborative work necessary