KEK GRID for ILC Experiments
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The LCG GRID system is the indispensable infrastructure for large scale computing required for ILC experiments. It had been used extensively for ILD LOI studies and its use will be further increased in coming DBD studies. Experiences during the LOI era and plan towards DBD study in KEK are presented.

1 Introduction

International Linear Collider (ILC) is a global project and a good network connection among participant members through Internet is a crucial infrastructure for the success. A GRID system is constructed on the Internet and it provides not only CPU and storage for large scale computing required for ILC experiments, but also sharing of data among ILC experimentalists.

Software bases studies in International Large Detector concept (ILD) has utilized LCG GRID; It had been used extensively during an era of LOI for Monte Carlo production and sharing of produced data among members. Especially, there was a strong need in Japan to access MC DST samples of about 5 TB placed in Europe. LCG GRID had been used for file transfers successfully.

Experiences during this period are described in the following sections, after describing the GRID system in KEK. A plan towards Detector Baseline Design is described subsequently.

2 Network feature

A wide-band backbone network has been constructed for HEP community in Japan, which connects Japanese universities and laboratories participating HEP projects such as Belle, J-PARC, ATLAS, ILC, and so on. In addition, the network covers non-HEP users such as material science, bio-chemistry, synchrotron light source and neutron source. KEK is playing a major role in supporting network services for these activities, including a GRID deployment and operation.

The network is connected to the outside of Japan though SINET3. The SINET3 provides a connection to Hong Kong and Singapore then to European network such as GEANT, however the band width to Asian countries is limited to about less than 1 Gbps.

The trans-Pacific network from Japan to US has an order wider bandwidth. Thus the network packet between Japan and Europe go through North America, though the actual path length is longer than a route through Eurasian Continent.

Long distance between Japan and Europe is the limiting factor of fast transfer of network packets. Typically, we observed a round trip time of packets from KEK to IHEP and KISTI, which are institutes in China and Korea, to be about 100 msec. On the other hand, those to FNAL in US is about 200 msec and to DESY/IN2P3 in Germany/France is about 300 msec. The round trip time is a pedestal time required for every network data transfer, independent of a packet size, thus it is not efficient to send and receive small files.
3 GRID system in KEK and experiences in LOI period

KEK Computing Center is supporting two GRID system, LCG/glite and RENKEI/NAREGI. LCG has been used not only by LHC groups but also other HEP groups such as Belle, J-PARC and ILC. RENKEI(REsources liNKage for E-science) is a research to link resources among communities of e-sciences in Japan. It is developing NAREGI GRID middleware.

For ILC activities, two VOs have been used; CALICE-VO and ILC-VO, which use LCG GRID middleware. CALICE-VO has been used by CALICE group for their test beam data analysis and Monte Carlo simulation. ILC-VO provided CPU resources required for ILD LOI studies. In Japan, KEK, Kobe university and Tohoku university are joining ILC-VO. During the LOI study period, CPU resources in Japanese GRID sites were very small; It was less than two order of magnitude smaller than those available at European institutes and GRID in Japan had been used mainly for transfers of files produced at European institutes or at KEK local batch servers.

For ILD LOI studies, about 70 TB data samples were produced mainly at DESY and IN2P3 site. Sample consisted of simulated, reconstructed and DST samples produced by processing ILC LOI benchmark processes and Standard Model processes at 500 and 250 GeV center of mass energies. The data size were placed on GRID SEs for international and inter-regional data accesses. In the period of LOI studies, the time from the production of MC samples to the completion of data analysis was limited, thus only DST samples were transferred during the period of about 3 months, except some samples. The file transfers were mainly from Europe to Japan but also partially from Japan to Europe.

In total, about 5 TB data have been transferred with a typical transfer rate of about 200 kB/sec/port. Due to a limited transfer speed, we experienced a frequent time out of transfer, which made it difficult to transfer of files with size exceeding 2 GB. The problem had been cured by removing the time out limit in file copy.

Large round trip time also imposed an overhead on accesses to the GRID file catalog located at DESY. File sizes of ILD DST files are typically in the order of 10 MB or less. It is limited by a CPU time limit of a job for simulation. In order to transfer many small size file to KEK, a tools was developed, which runs at a host of SE and merge many small DSTs into a compressed single file, then copied it to KEK.

A typical instantaneous transfer rate during the LOI period were shown in Fig. The data is a summary of about 3 days transfer using the lcg-cp command in December 2008, which is in the middle of the LOI study period. The most of the entries at 0 transfer rate is the idle time before the actual start of the transfer. We used 10 ports for the transfer, thus the transfer speed of about 4Mbytes/sec had been achieved.

Fig.2 is the scatter plot of the transfer time and the file size of each file. Each point corresponds to a transfer of each file. A cluster of points at about 2100 MB file size is because of the file size limit set at about 2100 MBytes. Even with file size close to 0 MB, there are about 20 to 50 seconds pedal in file transfer time, which was mainly caused by the long RTT for access to the catalog information. From the figure, we see that the file size should be at least a few Mbytes or more for efficient file transfer. Since the speed is limited by RTT, it is important to minimize the catalog access at remote site.
Figure 1: A typical distribution of instantaneous transfer rate of file transfers from Europe to Japan during the period of ILD LOI studies.

Figure 2: Scatter plot of file transfer time in sec (vertical axis) and file size in MBytes (horizontal axis).

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4 Updates after the LOI period

CPU resources in KEK were about 0.3 MSI2k (Milion Spec Int2000) during the LOI era. Thus MC production using KEK GRID resources were limited. The MC production at KEK site had been performed mainly using local batch server systems. However, it has been extended significantly since the end of the LOI studies. There are 5 computing elements (CE) are operating; about 1600 cores of about 400 CPUs with about 6M SI2K in total. We hope that more MC production can be performed using KEK GRID resources in coming studies for ILC re-baselining and DBD.

Storage element in KEK has been increased as well. It is using DPM as a SRM. Backend storage device is IBM HPSS, TS3500. In maximum, 3TB data can be stored, which are shared by other VOs and batch server users, and actual storage space for ILC VO depends on actual amount of tapes installed. But, we expect the system provides a sufficient storage capacity for coming DBD studies.

5 Summary

In summary, KEK GRID had been used successfully during the LOI era. Especially, GRID played the indispensable role for data transfer between Japan and Europe. In past 12 months, GRID resources in KEK has been increased significantly. We hope to be able to contribute significantly in coming MC productions towards DBD studies.

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