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Networking With China[*]

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Abstract

This paper presents the history and current status of computer networking between IHEP in Beijing, China and the rest of the world, starting with no links at the beginning of 1987 thru X.25 public networks and dial up links, to the installing, in March 1993, of one of the first dedicated 64 kbps satellite computer links between China and the outside world. In May 1994, IHEP became the first Chinese institution to have a fully operational world-wide Internet connection. Experience with this dedicated link between SLAC and IHEP will be presented together with future plans to add a land line between KEK and IHEP and to extend the links within China.

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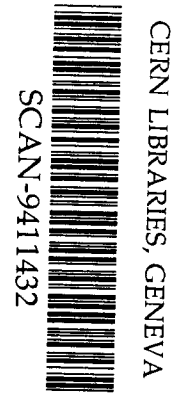
Contributed to the Conference on Computing in High Energy Physics
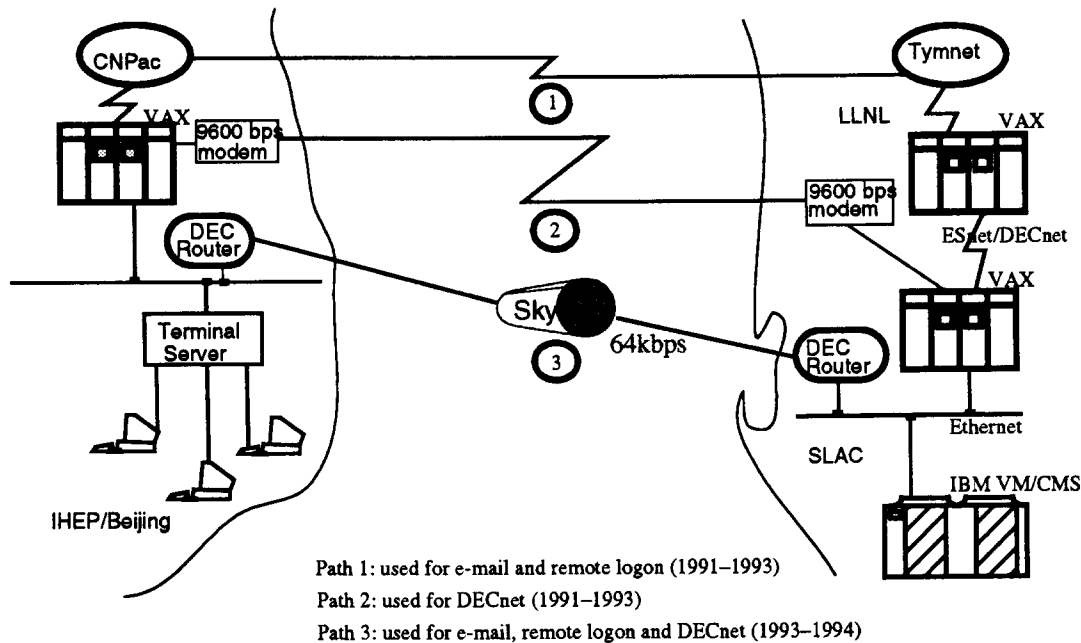*San Francisco, CA, April 21–27, 1994*

Early History

Computer networking at the Institute of High Energy Physics (IHEP) in Beijing, China was started in 1987. One computer, named BEPC2 (VAX785) at IHEP, was remotely linked with CERN via the packet switched data network (PSDN), then in May of 1990 it was changed to CNPac (X.25 with a speed of 4.8 kbps) provided by the Ministry of Telecommunication of China. CERN worked with IHEP to provide PSI and EAN (X.400) e-mail connectivity to IHEP via CERN. Scientists at IHEP then could send and receive e-mail with the outside world via the VXCERN node at CERN, Geneva, Switzerland.

The decision to set up extensive network communications between IHEP and SLAC (Stanford Linear Accelerator Center in California, United States) was made in 1991 by the Beijing Electron-Positron Spectrometer (BES) collaboration group. At this time, IHEP had one phone line capable of making international calls. This line was in the International Relations department and was mainly used for FAXes.

In March 1991, three direct dial phone lines with international access were installed at the IHEP computer center. They were used with Telebit T2500 modems to provide logon connectivity between SLAC and IHEP (Figure 1, Path 2). The effective transmission rate was 700–900 bps. Cost was $1/min if initiated from SLAC and $3/min if initiated from IHEP. For 1991 the typical bill was about $4,000/month. After some experimenting the use of these dial up links was extended to support an asynchronous dynamic DECnet between SLAC and IHEP, and IHEP was moved into the SLAC HEP DECnet area. The effective transmission rate was 400 bps. The line was noisy and difficult to use. Often connections could not be made when no international lines were available, and there were frequent disconnects in mid-session.

Concurrently, X.25 connectivity between SLAC and IHEP was arranged via LLNL/Tymnet and CNPac (Figure 1, Path 1). The connection cost was about $100/hour. It was used for e-mail, which cost about $1/mail item, and for remote logon. By September 1991 it was being used to send about 5–10 mail items/day, and between 5 and 20 mins for remote logon. This connection was satisfactory for e-mail, but very sluggish for interactive use, with typically a 1.5 sec response time and transfer rates of a few hundred bits/sec. The cost of these services during 1991 was about $3,000–5,000/month for the US end and $7,000/month for the Chinese end.

Figure 1: SLAC-IHEP Connectivity Paths 1991–1994

Path 1: used for e-mail and remote logon (1991–1993)
Path 2: used for DECnet (1991–1993)
Path 3: used for e-mail, remote logon and DECnet (1993–1994)

SLAC-IHEP Satellite Link

Starting in 1991 SLAC and IHEP started pursuing the feasibility of installing a dedicated link. Interest in the Department of Energy (DOE) high-energy physics (HEP) community was solicited and expressed by several High-

Energy Physics, Nuclear Physics, and Basic Energy Science communities, and the National Science Foundation (NSF) expressed interest. Various options were investigated including services via KEK, Cable & Wireless and AT&T SkyNet.

Approval for installation of a dedicated 64 kbps link, to be funded in the US by the DOE, SLAC, and the Super Conducting Collider, with SLAC taking the lead, was received from DOE in late 1991. Based on costs and schedules proposed, an AT&T SkyNet satellite link was chosen (Figure 1, Path 3). The contract with AT&T was signed in January 1992. The US cost was about $5,500 installation and $5,000/month. IHEP pays a similar amount in Chinese currency for the Beijing end of the link.

Figure 2: Link from IHEP to Beijing Airport
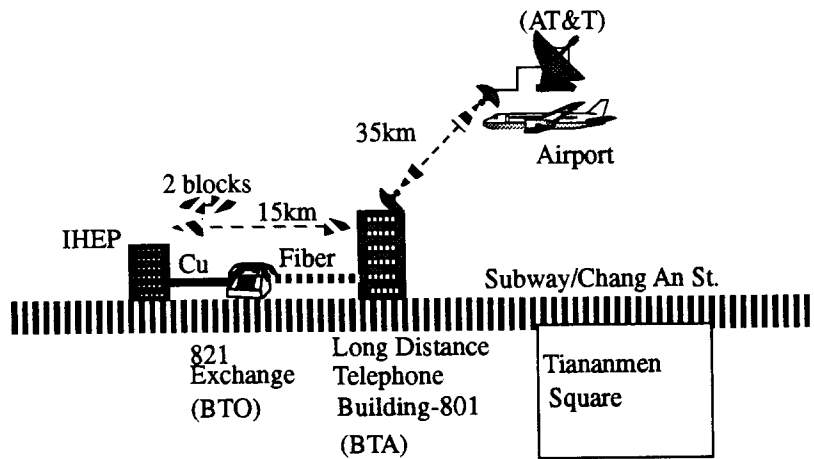
Considerable problems were encountered getting the link from the Beijing airport to IHEP between January 1992 and March 1993. The paths involved in this link are shown in Figure 2. The original plan was to use 64 kbps microwave modems between IHEP and the local 821 phone exchange. However, these were not able to deliver satisfactory service. Instead it was decided to try existing copper links. Then there were problems interfacing between the copper and optical fibers running from the local phone exchange to the satellite earth station located at the Beijing airport. Early in 1993 the Beijing telephone companies succeeded in getting acceptable error rates, and the link was handed over to IHEP on March 1st 1993 at 15:19 PST. Seconds later a monitor program showed node 44.393 (the SLAC DECrouter) adjacent to IHEP.

The file copy rate was measured at ~42 kbps (VAXstation 2000-VAX 780) which was 10 times better than before; the echo time was better than 1 second; and the error rate was ~ 2.3E-7. The daily utilization is seen in Figure 3. It has peaked at nearly 100% of capacity over a 24 hour period during a conference held at IHEP. Typically about 40 MBytes/day (see Figure 3) are transferred. Typical hourly peaks are 6 MBytes/hour. There are about 1 to 2 unscheduled outages of several hours/month in addition to some scheduled outages twice per year when the sun is directly in line with the satellite. AT&T switched to a new satellite in Jan 1994, and the connection from IHEP to the local 821 exchange was changed to DDN (Digital Data Network) in March 1994 in order to increase reliability of the link.

Figure 3: Daily Utilization of the SLAC-IHEP Satellite Link (1993–1994)
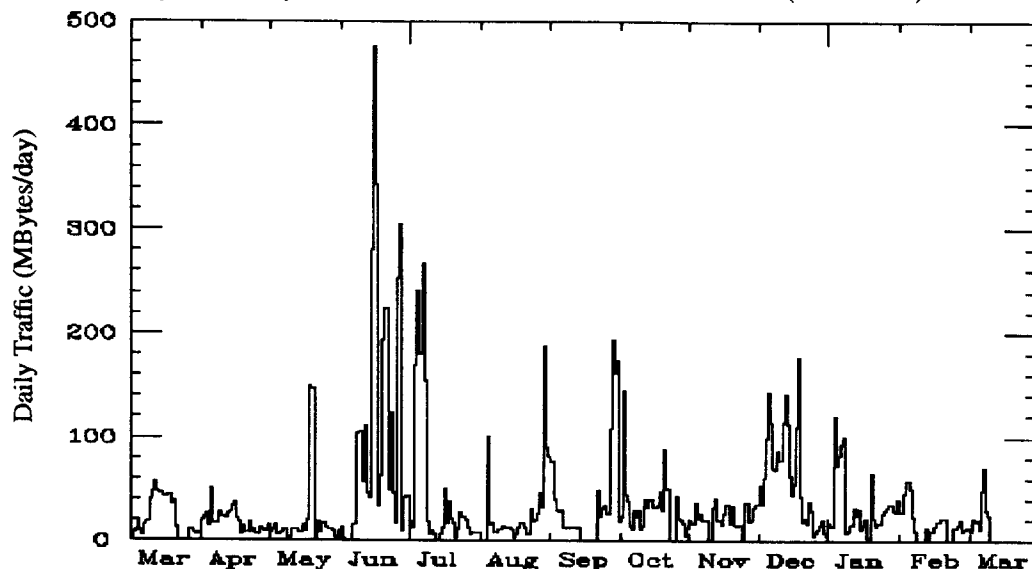
The link is currently mainly used for:

1. Transferring samples of the detector data each day to check remotely that the detector is functioning correctly. When the experiment is taking data, this consists of one file/day of up to 200 Mbytes (the contents of a 3480 cartridge) taking about 6 hours to transfer;

2. About 2500 e-mail items are exchanged daily with over 400 sites in over 21 countries. About 10% of the e-mail is via DECnet. The remainder is gatewayed at SLAC between China and the Internet via PMDF/MX mailers. Typically there are about 20 e-mail messages/day destined for China that need manual intervention due to incorrect addresses;

3. Usenet for local SLAC and IHEP news groups;

4. Coordinating collaboration activities, including travel, scheduling conferences, and regular phone calls.

5. Code management to keep BES software developed at multiple sites in the US and at IHEP in synchronization;

6. Copying files, remote login, and real-time communication (e.g., VMS PHONE).

Connecting to the Internet

Since the 64 kbps IHEP-SLAC line was established, several institutions in China have expressed interest in connecting with IHEP and getting international access to the Internet. The Institute of Scientific and Technical Information of China, the Computer Network Center of Academica Sinica and the Institute of Modern Physics of Academica Sinica have connected with IHEP by leased CNPAC or CHINAPAC (X.25) lines. In addition about 300 top scientists, professors, and Ph.Ds in China are allowed to access IHEP computers by dial-up phone line to communicate with collaborators around the world. Universities, like Tsinghua and Beijing in Beijing and some very important universities outside Beijing, including Fudan University in Shanghai and Nanjing University are considering leasing lines to IHEP. All these sites are especially interested in getting access to the Internet via the IHEP-SLAC line. Thus IHEP could soon become the first Chinese gateway to the Internet.

We have been working on adding IP connectivity to the existing DECnet connectivity between SLAC and IHEP. To do this we have replaced the DEC routers with Cisco routers at SLAC and IHEP. A Management Plan for Energy Sciences network (ESnet) Network Access to the People's Republic of China[*] was created by a task force of the ESnet Steering Committee, and as a result export licenses for Cisco routers to go to IHEP were obtained from the US Department of Commerce (DOC) at the end of 1993. The routers were received in Beijing in February 1994. The routers were installed in March replacing the DECnet routers, and DECnet connectivity was opened up to the worldwide HEPnet DECnet. At this time management of the link was turned over to ESnet. A visit to IHEP by US

[*] "Management Plan For ESnet Network Access To People's Republic of China," The China Connectivity Task Force of the ESSC, 7/19/93

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Congressman George Brown in December 1993 also increased interest in the link at higher US government levels. A meeting was held in January 1994, with attendees from universities and computing institutes in Beijing, to discuss and come up with a recommendation for domain naming in China. It was decided that IHEP nodes will appear as node.ihep.ac.cn. IHEP has been assigned two class C Internet address blocks by the Internet's regional registrar (APNIC). Agreement was obtained to allow the Internet to carry Chinese traffic contingent on some conditions being met. One major condition was to make a wide-area electronic mail announcement that the Internet will be carrying Chinese IP traffic. This announcement was made to ESnet sites on April 18, 1994 and stated that ESnet would begin to carry Chinese IP traffic on April 25, 1994. Opening of the link to full Internet connectivity happened on May 17, 1994 when a connection was established via ESnet from SLAC to FIX-West, which is the West Coast interconnection point for all of the major TCP/IP networks. IHEP thus became the first Chinese institution to have a fully operational world-wide networking connection.

Currently the cost of the US end of the link is about $50,000/year. This is borne by SLAC and the DOE High-Energy and Nuclear Physics Office. This will be transferred to ESnet. Plans to increase the speed of the link to 128 kbps are currently deferred until the traffic warrants it. This is expected to happen shortly after the link is opened up to the Internet.

There is also a need for a link to China from KEK in Japan to support many Chinese collaborators in TRISTAN experiments at KEK and for KEK-IHEP collaborations in R&D in constructing accelerators. There already exists a KEK-ESnet (US) 192 kbps terrestrial link, so work is in progress between KEK and IHEP to create a new IHEP-ESnet path via a 64 kbps terrestrial link from KEK to IHEP. This would replace the existing IHEP-SLAC satellite link. An optical cable between Japan and China was completed in December 1993 from Miyazaki in Japan to Shanghai in China. Domestic optical links within China, including a link from Shanghai to Beijing, were scheduled to be completed in the same time frame but are being delayed. A proposal was made to put in a temporary satellite link between KEK and IHEP until the land line cable is completed. This has been done, and the cut-over from the SLAC-IHEP to the KEK-IHEP link awaits a convenient time for the BES experiment at IHEP. On completion of the link, multi-protocol routers will be located at IHEP and KEK, and the link will be configured to carry both DECnet and IP traffic.

China is a huge country with enormous potential and ambitious plans to open up electronic communications. The HEP community should be proud to have pioneered one of the first direct electronic links from the outside world into China, helping to open it up to the global internet community.

Acknowledgments