



## ENGINEERING A CAMPUS NETWORK: IIT Kanpur



*IIT Kanpur's 1000-acre campus has a robust network of 5000 nodes on a fiber optic backbone and extends LAN connectivity to every hostel room. Its robust network architecture makes it an ideal example of campus networks for other educational institutes and large enterprises. The campus network infrastructure performs the mammoth task of supporting 3700 users which include around 2250 students, 300 faculty members, and other supporting staff*

Suppose you were to travel back in time to when you were in college. Picture this: you're sitting at a desk in your college hostel room with a desktop or laptop PC. Your job is to prepare and submit your in-house research project within a short deadline. With a few clicks you access the institute's central data repository and browse for white papers on the Web. And you also complain to your network administrator about a 1.5 MB e-mail attachment that took more than a minute to download.

Sadly, this is far from what really happened. We didn't have all that when we were in college. But IIT Kanpur has made this possible for the present generation of engineering students. It has engineered a campus network in its premises that is spread over 1000 acres. The network has 5000 nodes and supports 60 odd servers, routers, switches, hubs, and workstations. And every room in the hostel has a shared 10 Mbps connection. The college subscribes to a 2 MB leased line from DoT/VSNL to provide dedicated high-speed bandwidth.

The campus network infrastructure performs the mammoth task of supporting 3700 users which include around 2250 students, 300 faculty members, and other supporting staff. "It is one of the largest networks in the country in terms of the area covered and the number of nodes. You can be almost anywhere in the campus and access the network's resources," said Dr Sanjeev K. Agarwal, Professor-Department of Computer Science and Engineering, and Head, Computer Center. The network can also serve as a model for many large enterprises in India who want to wire its campuses to ensure constant connective and effective information flow for its personnel.



### **Through thick and thin**

The campus's legacy network comprised a mixture of ThickNet and ThinNet over an ATM backbone. ThickNet is a 10Base5 Ethernet standard which uses a thick coaxial cable. The network nodes are attached with transceivers that tap into the cable and provide a line to a 15-pin plug in the adapter card. ThinNet is a 10Base2 Ethernet standard that uses a thin coaxial cable. Network nodes are attached to the cable via T-type BNC connectors in the adapter cards. "The network was not very fast and there was frequent downtime," said Dr Agarwal. The passive components like cables and connectors were from Lucent Technologies.

As the number of students, faculty, and administrative staff grew it was necessary to upgrade the network. "We designed the network keeping in mind a number of factors. The network had to be easy to expand, upgrade, and have redundancy. Cost was an important consideration. But we did not compromise on quality to save costs. And we have also not invested in expensive technology or equipment without proper justification," Dr Agarwal pointed out.

The network was upgraded to a structured network over multimode fiber and UTP (Unshielded Twisted Pair) in 1997 using D-Link's Cat 5e components. "We found D-Link's passive components to have the best quality and the most reasonable price compared to any other vendor," said Dr Agarwal. The institute has also deployed redundant backbone fiber links for fault tolerance capabilities.

"A significant advantage of the campus network is that students can now use their PCs to access the internal servers and the Internet from their hostel rooms whenever they want. They don't need to visit the Computer Center for doing that anymore," said Agarwal.

### **Implementation**

The network has been upgraded in various phases and the network expansion still continues. About 1000 nodes were deployed in March 2000 followed by 2000 more nodes by June 2001. At the heart of the network is a Technology Center. The Technology Center has a server bank of over 17 servers and over hundred workstations. The server bank connects to a stack of backbone switches. The backbone switches distribute bandwidth to the Computer Center LAN and other areas of the campus like different engineering departments, laboratories, lecture halls, faculty buildings, offices, and hostels.

The LANs in each area of the network have 10/100 Mbps transmission capacity and are linked through fiber optic cables that are laid all over the campus. Bandwidth is distributed to the 5000 odd nodes in the campus with a combination of D-Link and Cisco switches, and D-Link hubs. A combination of a 2 MB leased line and dialup lines provide Internet access facilities to the LAN nodes. The users can connect to the Internet through a RAS (Remote Access Server) or a modem.

Datacraft was the integrator for the IP telephony network. The network was deployed in March 2001. "When this was deployed, we had many problems ranging from functionality and configuration for optimal usage. It took six months to stabilize," Singh observes. "We faced problems like no-ring back and high-processor utilization on the call manager, resulting in call dropping. Besides, the auto-attendant script was not fine-tuned.



## **Networking hardware**

“The 60-odd servers in the campus can be broadly categorized into application servers, compute servers, and Internet servers,” said Dr Agarwal. Out of these, three are database servers and eight are Web servers.

The campus has servers from multiple vendors. There are Intel PC-based servers, high-end RISC servers from SUN, IBM, HP, SGI, and Compaq. As expected of a university environment, the servers run a heterogeneous mix of OSs (Operating Systems) like Solaris, HP-UX (HP’s proprietary Unix variant), AIX (IBM’s proprietary Unix variant), IRIX (SGI’s proprietary Unix variant), True64 Unix (Compaq’s proprietary 64-bit UNIX variant), Linux, and Windows NT/2000. The servers have four to sixteen CPUs with 512 MB RAM per CPU. The total disk capacity of all the servers is approximately 3 TB.

“Network security is provided with restricted access lists programmed on the routers and Cisco PIX firewalls. All routers are by Cisco and have dual Fast Ethernet ports and V.35 ports. One LAN port connects to the internal network and the other to a DMZ (DeMilitarized Zone). Only the devices in the DMZ are visible on the Internet. Internet access is provided through proxy servers,” explained Dr Agarwal.

The switching architecture is layered in three tiers. The tiers comprise backbone or distribution switches, access switches, and hubs. The backbone/distribution switches are from Cisco, and the access switches and hubs are from D-Link.

“The choices of networking hardware were made after a careful evaluation process. Cisco was chosen for routers and backbone switches because the products are very reliable and have good management features. The access switches and hubs have been purchased from D-Link because they offer the best price-performance-service combination in this range of network devices,” said Dr Agarwal.

## **To the next level**

“The network is very scalable in terms of number of nodes and bandwidth. Any expansion or upgrades will only require us to add or upgrade the same active and passive components. We hope to improve the current network infrastructure in a couple of areas. We want to make the LAN connectivity more redundant and increase the amount of Internet bandwidth. This will match the expected growth in the next few years,” explained Agarwal.

## **The Institute**

IIT Kanpur has established itself as one of the finest educational institutes in India especially for IT and technology related studies. It has a 1000 acre (4.05 sq Km) campus and houses 2250 students, 300 faculty members, and other supporting staff.

## **The need**

The institute had to provide its students the necessary technology skills to upgrade or share their knowledge. There was a need for a robust campus network that provided every student access to internal servers and the Internet.



### **The solution**

With consultancy from D-Link the campus LAN of the institute now has strong router architecture, a three-tiered switching design, over 60 servers, and reliable backbone connectivity.

### **The benefits**

Every room in the hostel has a shared 10 Mbps LAN connection a student can use to access data repository servers and the Internet. The reliable LAN backbone allows information to be shared across all areas of the campus.

*Source - Network Magazine, April 2002*