A new approach to design and implementation of IBM PC for accessing Library CD-ROM database via campus network

Ruey-Shun Chen, D. J. Chen AND Y. S. YEH
Institute of Computer Science and Information Engineering,
National Chiao Tung University.
Hsinchu, Taiwan, R.O.C.

ABSTRACT

Library CD-ROM with its enormous storage, retrieval capabilities and reasonable price, has been gradually replacing some of its printed counterpartS. One of the greatest limitations on the use of stand-alone CD-ROM workstations, however, is that only one user can access the CD-ROM database at a time. This paper proposes a new approach to solving this problem. A case study is presented that describes the practical design and implementation of an IBM PC-based system that allows multiuser access library CD-ROM database via campus network. The method use personal computer via standard network interfaces like Ethernet, high speed fiber networks, and standard protocols TCP/IP, andIP-tunnel. Its advantages are that it reduces redundant CD-ROM purchases, reduces waiting time, improve access speed, reduces the damage incurred by handing CD-ROM devices in and out, and allows many users to access the same CD-ROM disk from microcomputers simultaneously.

1. Introduction

Library automation is a goal for many libraries the utilization of CD-ROM in the library and information science area goes back to 1985, when Bibiofile was announced by the library corporation. CD-ROM provides enormous storage of about 600MB, retrieval capacities, and reasonable price. It has been gradually replacing some of its printed counterparts. Most of European and American universities have used CD-ROM databases since 1987. A survey of libraries in Taiwan has shown that currently 86% of academic libraries have CD-ROMs in their library collection [1].

In fact, one of the greatest limitations is on the use of library stand-alone CD-ROM database at a time [2], CD-ROM campus networks can solve it, and offer other benefits, such as facilitating searching of databases containing more than one disk[3]. A library can access its CD-ROM database only locally. Abroad, CD-ROM network software is expensive and techniques are unavailable. Dartmouth College Library has developed a

system that uses modem login to file server access an on-line database via a campus-wide network of Macintoshs, Microcomputers and Mainframe computers. The access network database has restricted the library's involvement in CD-ROM and the latter has been effectively leapfrogged in favour of the network [4]. Miami University libraries have an Ethernet local area network to provide multiuser access to multiple CD-ROM database through selected workstations in the libraries. Dial-up access will be available to users outside the libraries [5]. Multiplatter is a CD-ROM local area network that allows multiple users to access the same CD-ROM disc simultaneously. The first test site was Boston College. So it is important to develop a library CD-ROM campus networking system and to use standard network protocol (Ethernet, FDDI and TCP/IP) to implementation a practical system to share CD-ROM resources.

In this paper, we proposes a method that allows endusers to use personal computers (PCs) to access a library CD-ROM database remote through Ethernet, FDDI, TCP/IP protocol and routers. In section 2, we introduce the types of library CD-ROM network. In section 3, we show how to provide access to the LAN from the campus network. In section 4, we design a library CD-ROM campus networking system for use at National Chiao-Tung University in Taiwan. In section 5, performance evaluation and discussions of this CD-ROM campus networkare presented. In the last section, we make a short conclusion.

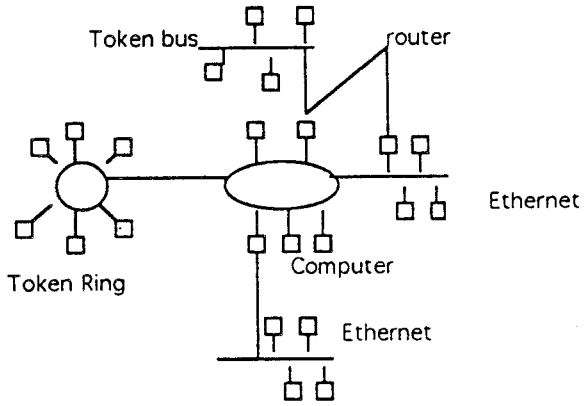

Fig.1 Using FDDI as a backbone to connect Ethernet LANs.

2. The types of library CD-ROM networking

Fig.1 shows a library CD-ROM campus network environment PCs or PC-LANs use Ethernet and FDDI network protocol to communicate with each other. The following shows some kinds of communication modules [12].

2.1 *Personal computer to personal computer*

PCs in the client part run ipx CD-ROM software. The server part runs on a 386 PC and manages the CD drive server. This set-upnis suitable only for a LAN inside the library.

2.2 *Personal computer to local area network*

This is the most usual solution for campus networks. It is shown in Fig. 2. It is common because most libraries already have CD-ROM drives on PCs connected to a LAN. A LAN usually needs one PC for the LAN server, which is dedicated to nothing but running the CD software. The LAN will let you connect PCs which each have more CD drives , and each can access all of them. Fig. 2 shows how DOS-clients can use LAN-workplace for DOS , IPX, TCP/IP and IP-tunnel software through routers, to remote server and release IPX to CD-ROM driver server. This is our design model for a library CD-ROM campus networking system.

2.3 *Local area network to personal computer*

Any PC in the LAN communicates with remote PCs through the file server. That is they have dial-out or communicate-out ability. The application is like company sales sending a sheet of copy to a remote factory printer to print out .

2.4 *Local area network to local area network*

Some LANs can be used to build a large network through routers or bridges as shown in Fig.3. The advantage is that a large network has several file servers using TCP/IP protocol to communicate with each other. So in a network environment with router, each LAN's file server has a running program, and a database is stored in each LAN. When another LAN's database is needed,resource may be shared through a router into another LAN's server. Fig. 3 shows this idea and also appies it to library CD-ROM campus network.

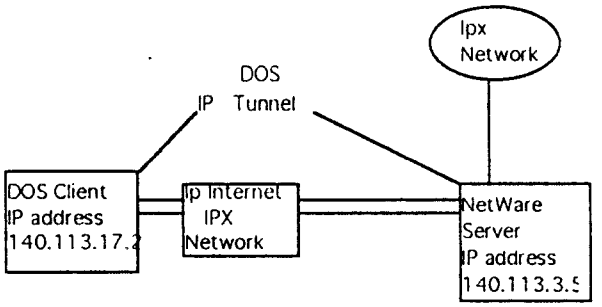

Fig. 2 DOS IP-Tunnel lets client PC connect to netware server on a remote IPX network.

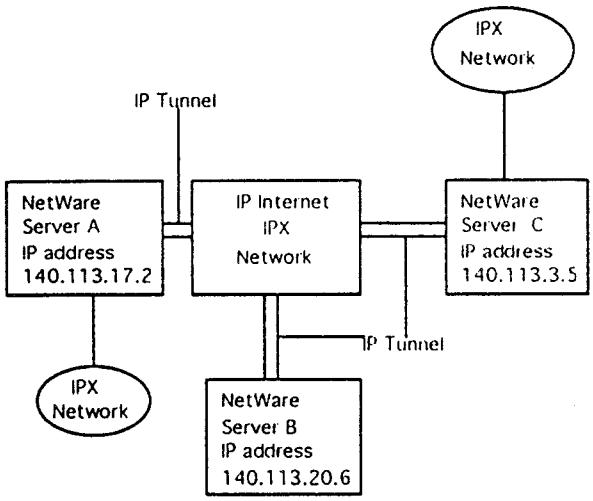

Fig. 3 Several IPX LANs connected to form a large network.

3. Providing access to the LAN from the campus network

Theoretically, if the LAN file server is connected to the Ethernet and defined as a node on the network, any remote PC with an Ethernet card running TCP/IP should be able to access it directly from the campus network, and via it, the CD drives. The LAN software will provide access to a drive for a PC (it performs a logical mount and will only do this for a "computer" not a "terminal"). If its running MSCDEX plus CD networking software, it can provide access to an optical drive just as it does to a magnetic drive. The following are some options [13].

3.1 *Personal computer access CD drives via local area network in library*

This is the most usual solution inside of a library. A PC is connected to the LAN. The CD drives are attached to it, and many users can access the CD-ROM simultaneously. It is suited for local area networks inside a single building.

3.2 *A PC CD-ROM server connected to a VAX using V-SERVER /Gateway*

This intended to enable a VAX terminal to access a DOS-based CD server. The connection to the VAX is actually a very short LAN, and the VAX machine needs additional hardware "V-Server/Gateway " from virtual microsystems. That contains four chips with one card. Up to four users can access the CD-ROM drives simultaneously. The maximum is four cards per VAX , so they can be only 16 simultaneous users per VAX. If VAX is on the campus network, any PC running vterm can login to it and access the library CD-ROM through the V-Server/Gateway system and thus the CD server. The VAX talks to V-Server via Dec-net; V-Server talks to the CD-server via IPX or NETBIOUS.

3.3 *CD-ROM drives on a VAX/VMS or SUN/UNIX running NFS*

NFS is a public-domain networking software system. It has two parts: the server-part, which runs on the machine that manages the CD drive, and the client-part, which runs on the machine that's trying to access the drives from the campus network. Any PC connected to the network and running the client version of NFS can access the CD drives, which are connected to a VAX/VMS or SUN/UNIX running the server part of NFS.

3.4 *PC-anywhere3*

One PC of the LAN is connected to the campus network and runs PC-anywhere. Any PC runs terminal emulation software. Users can login to this PC and use it to access the CD-ROM on the LAN.

3.5 *Logicraft 386-ware connect inga PC-LAN with a VAX*

A PC LAN connected to a VAX , unlike V/server, will allow you access to a CD-LAN from a VAX. PCs on the LAN can continue to access the CD-ROM drives at the same time as the VAX does.

3.6 *Gandalf data to connect a PC LAN with Ethernet*

A PC LAN connects to Ethernet that accesses a CD-ROM LAN via TCP/IP. It requires CD-NET on the CD-ROM LAN. This is "PC-emulation software" for VT-100 type terminal. It works by letting a terminal come in from the network like a PC terminal and fooling the VAX into thinking it is being accessed by a PC [14][15].

4. Practical design structure

4.1 Hardware implementation

We applied DOS-client to server as in Fig. 2 and server to server as in Fig. 3 for campus network system. Each user must have a personal computer with Ethernet card hardware and a LAN work-place for DOS software. Mounted software maps any networked CD-ROM drive to logical drive on the modulation with minimum memory usage. The hardware structure in Fig.4 is the library CD-ROM campus network of National Chiao-Tung University in Taiwan.

4.2 Software implementation

Access principle is the enduser's personal computer runs LAN workplace for DOS Ip-tunnel software through the campus network router into the library file-server. Then a CD-ROM retrieval program is run to access the CD-ROM database [16]. In summary, the algorithm of the running program is giving below:

Step 1: Load LAN work-place for DOS

Step 2: Set parameters of Ethernet card and link driver.

Step 3: Load TCP/IP protocol.

Step 4: Load IP-tunnel protocol.

Step 5: Load IPXODI software.

Step 6: Execute NETX attach to server.

Step 7: Login file server and call CD-ROM running program.

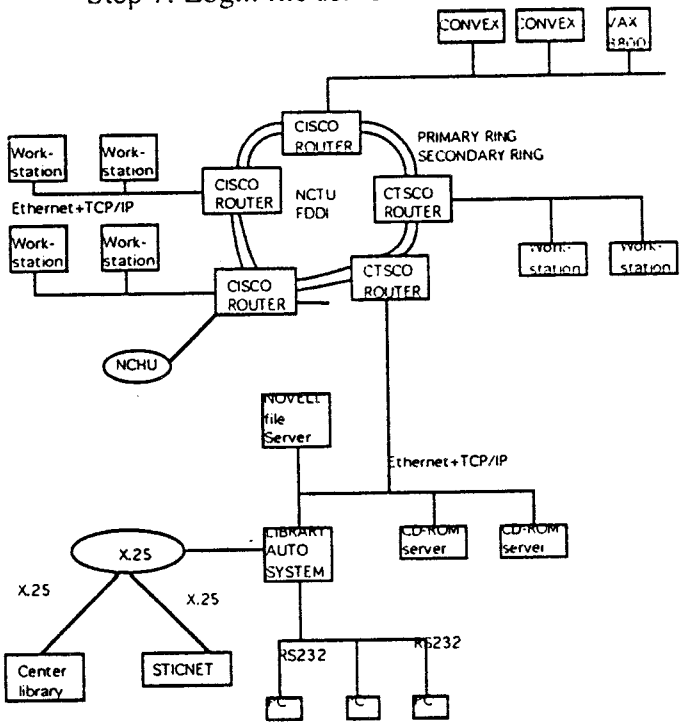

Fig.4 Hardware structure of library CD-ROM campus network of National Chiao-Tung University in Taiwan.

5. Performance analysis and discussion

To analyze the performance of a CD-ROM campus networking system, we assume that the FDDI backbone's circumference is equal to the maximum distance, i.e., 200km. The FDDI backbone runs at 100bps and each of its Ethernet-like local area networks runs at 10 Mbps. The ordinary delay for one FDDI station is 600ns and the total delay for the 200 km long ring cable is 1.017 ms [10]. Theoretical analysis calls on each Ethernet-like LAN concurrently, but each Ethernet-like LAN has also a capacity limit on the number of remote PCs. By reducing this limit from 281 to 140, we can increase the maximum number of FDDI routers from 10 to 21 [11].

From the above data, the campus network can support 100 users accessing the library CD-ROM database concurrently. For normal testing, multiuser access the same library CD-ROM database from campus network is faster than using local stand-alone CD-

ROM workstations. Because the dedicated server is needed to overcome the slow access time of the CD-ROM drive and to allow multiple users is trying to access the same CD-ROM without appreciable delay, large cache memory capability is available thrugh the CD-ROM server, which reduces physical CD-ROM access and boosts access speed for remote users. Data can be read from all drives simultaneously, which dramatically increases performance during heavy usage. To improve retrieval time performance , CD-ROM disk caches are frequently used. Disk caching lowers overall retrieval time by transferring information from RAM instead of from CD-ROM.

When we compare the performance of a non-network workstation to the performance of a twenty-concurrent-users CD-ROM system, the worst case lag time for full screen VGA graphs was approximately double for CD-ROM system. In addition, through library CD-ROM campus network can increase retrieval speeds by running multiple copies of the same CD-ROM in different research rooms. This system offers high performance that allows multiple users to share a CD-ROM database.

6. Conclusion

Ethernet and FDDI are a high performance and high bankwith network system that can be used as the backbone of campus network. In this paper we design an Ethernet-Routher-FDDI for CD-ROM campus network system which can allow faculty and graduate students to access library CD-ROM database from their room. Theoretical analysis modules and practical design structure for a campus network are proposed for the system. The results and contributions of our library CD-ROM campus networking system are as follows:

(1) It offers a practical high performance way to provide multiple users with simultaneous access to the same data from the same CD-ROM application.
(2) It allows access to multiple CD-ROMs simultaneously .
(3) Campus network compatibility with most CD-ROM products .
(4) Multiuser access speed is faster than single-user CD-ROM drives.
(5) It allows access to multiple copies of the same disk for increased performance.

For further study, we may connect a group of universities using modems to build a wide area campus networking system that provides shared library CD-ROM resources .

Acknowledgments

The authors are grateful to all the staff at the library of National Chiao-Tung u University. This project was supported by the National Science Council, Taiwan, R.O.C., under grant NSC81-0301-H-009-507.

References

1. M.Y.Shih 1991. The utilization of CD-ROM in the Academic library in Taiwan. *Journal of Educational Media & library Science* V28. No.3 331-344.
2. K.Martin 1990.CD-ROM network. *Wilson-library-bulletin* 64(5),83-84.
3. Ron J.R 1988. Creation and distribution of CD-ROM Database for the library reference Desk. *Journal of American Society for information science* 37-p62.
4. G.A. Finnegan 1990. Wiring in information to a College campus : a port for every pillom. *online* 14(2) p37-40 .
5. C C Chen 1989. Beyond the online public access catalog: one step electric access to information. *proceeding of the 2nd pacific conference on new information technology for library* . 359-p364.
6. M A Grant 1989. The multiplotter CD-ROM network at boston college. *laserdisk professional* 2(5), 12-18.
7. W.E.BURR,1986. The FDDI Optical Data Link. *IEEE communication Magazine*,Vol.215.18-23.
8. F.E.Ross,1986. FDDI-A tutorial. *IEEE Commun magazine*, vol 24,10-15
9. E.Cheng,1991. WAN remote operation structure. *PC magazine Chinese education* Vol10,No.12,141-143.
10. 1986. FDDI-Token Ring Media Access Control *ANSIX3T9.*
11. C.S.Yu,1990. A protocal for Integrating Voice and data on FDDI/Ethernet Interconnect networks. *International telecommunication Symposium.*, 469-476.
12. C.C wan,1991. WAN. *remote operating magazine chinese version* , 141-143.
13. k.July,1992. Networking CD-ROM via a LAN. *CD-ROM professional*,83-90.
14. K. Maxwell,1991. DOS-based LAVs group up. *PC magazine*, 167-235.
15. E.D. Perratore,1991. Networking CD-ROM: The power of shared access. *PC magazine*,10,333-363.
16. M. Thompson,1990. Networking CD-ROM. *PC magazine9*,237-260.