

AN APPROACH FOR MULTI-USER ACCESS TO LIBRARY FULL-TEXT CD-ROM DATABASE VIA THE CAMPUS NETWORK

Ruey-Shun Chen¹ and Y.S. Yeh²

¹ Institute of Information Management and

² Institute of Computer Science and Information Engineering
National Chiao Tung University, Hsinchu, Taiwan, R.O.C.
rschen@cc.nctu.edu.tw

ABSTRACT

The Library CD-ROM jukebox with its enormous storage, retrieval capabilities and reasonable price is gradually replacing some of its counterparts. One of the greatest limitations in using the standalone CD-ROM jukebox is that only one user can access the CD-ROM jukebox database at a time. This paper describes the practical design and implementation of a microcomputer-based system with a Novell server that allows multi-user access to the library CD-ROM jukebox database via the campus network. Microcomputers are linked via standard network interfaces like Ethernet, high speed fibre networks and standard protocols (TCP/IP and IP tunnels) to login to a Novell server. Advantages of such a system includes, reduction in waiting time, improved access speed and reducing the damagethrough constant user handling of jukebox CD-ROM devices.

KEYWORDS: Distributed networks; CD-ROM jukebox; Campus network; Multiuser access.

INTRODUCTION

Library automation is a goal for many libraries. The utilisation of CD-ROM in library and information science goes back to 1985, when *Bibliofile* was launched by Library Corporation. The CD-ROM provides an enormous amount of data storage of about 600MB, efficient retrieval capabilities and is reasonably priced. It is gradually replacing some of its printed counterparts. A survey of libraries in Taiwan shows that currently 86% of academic libraries have CD-ROMs in their library collections (Shih, 1991).

Initially, one of the greatest limitations on the use of the standalone CD-ROM in the library was that only one database could be used at a time (Martin, 1990), but this problem has been solved through net-working. CD-ROM publishers have also improved their products by supplying a wide range of full-text databases such as *IEEE/IEE Publications Ondisc (IPO)*, *Business Publications Ondisc (BPO)*, *General Publications Ondisc (GPO)*. Providing access through net-working and the use of CD-ROM jukebox are possible solutions. The campus network offers other benefits, such as facilitating

searching of databases containing more than one disk (Ron, 1988). One such case is Dartmouth College Library which has developed a system that uses modem login to a file server via a campus-wide network linking Macintoshes, microcomputers and mainframe computers. Access to the network CD-ROM databases has increased the library's involvement in providing for CD-ROM based sources (Finnegan, 1990). Miami University libraries have an Ethernet local area network to provide for multi-user access to multiple CD-ROM databases through selected workstations in the libraries. Dial-up access is also available to users outside the library system (Chen, 1989). Multiplatter is a CD-ROM local area network that allows multiple user access to the same CD-ROM disc simultaneously and the first test site was Boston College. A computer network offers several advantages over single-processor system as it facilitates resource sharing, increased reliability, distributing the work load and expandability. As such, it

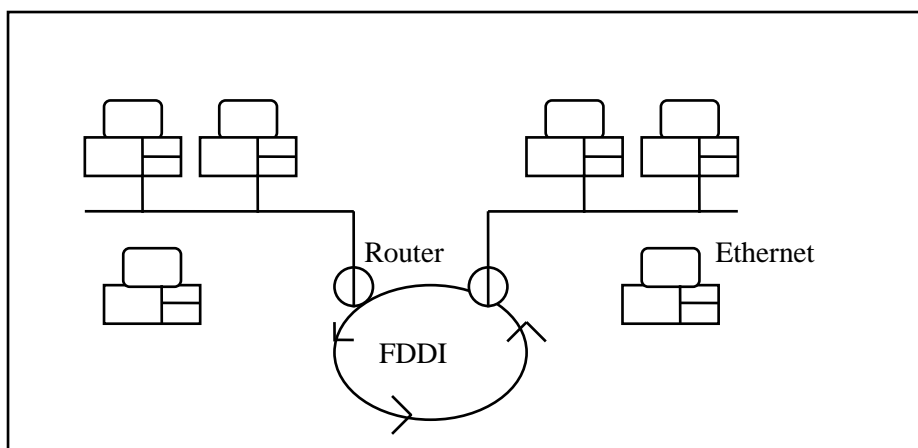
is important for a library to develop its collection of CD-ROM databases and make them available on the campus networking system, using standard network protocol (Ethernet, FDDI, TCP/IP) to implement a practical system in order to share CD-ROM resources with other institutions.

TYPES OF LIBRARY CD-ROM JUKEBOX NETWORKING

Personal Computer Connected to a File Server

Figure 1 shows a library CD-ROM setup in a campus network environment. Communication within a building uses the ethernet protocol and the FDDI protocol is used to communicate between the buildings (Wan, 1991). The personal computer client in the network run the IPX software. The server is a Pentium PC and is connected to the CD server. This kind of configuration is suitable only for a LAN inside the library.

Figure 1: Using FDDI as a Backbone to Connect Ethernet LANs



Personal Computer Connected to Local Area Network

Figure 2 shows the usual configuration for a campus network. This is a common approach as most libraries already have the CD-ROM systems connected to a LAN. A LAN usually needs one file server, which is dedicated to nothing but running the CD-connection software. The LAN allows connection to more CD drives and a user can have simultaneous access to all drives. Figure 2 shows how DOS clients can utilise LAN workplace for DOS, IPX, TCP/IP and IP tunnel software through routers, to remote server and release IPX to CD-ROM file server. This is the design model adopted for the National Chiao Tung University library jukebox CD-ROM campus networking system.

LAN to LAN Connection

Some LANs can be used to build a large network through routers or bridges as shown in Figure 3. The advantage is that a large network has several file servers using TCP/IP protocol to communicate with each other. In a network environment with routers, each LAN's file server has a server program and a database is stored in each LAN. When another LAN database is needed, resource may be shared through the use of a router into another LAN's server. Figure 3 indicates this type of setup which can also be applied to the library CD-ROM campus network.

ACCESS TO THE LIBRARY CD-ROM JUKEBOX 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. The LAN software provides access to the CD-ROM juke-box (it performs a logical mount and will only do this for a "computer" not a "terminal"). If it is running MSCDEX.. EXE 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 for configuration (July, 1992).

PC Access to CD-ROM Jukebox Via Library LAN

This is the usual solution for a single library building where a PC uses IPX software and is connected to a Novell file server. Many users can be connected to the CD-ROM jukebox, but only one user can access it simultaneously at any one time.

CD-ROM Drives on SUN/UNIX Running NFS

NFS is a public domain networking software system. It has two parts: the server, which manages the CD-ROM jukebox, and the client which accesses the CD-ROM jukebox from the campus network. PCs connected to the network and running the client version of NFS can

Figure 2: DOS IP-Tunnel Lets Client PC Connect to Netware File Server

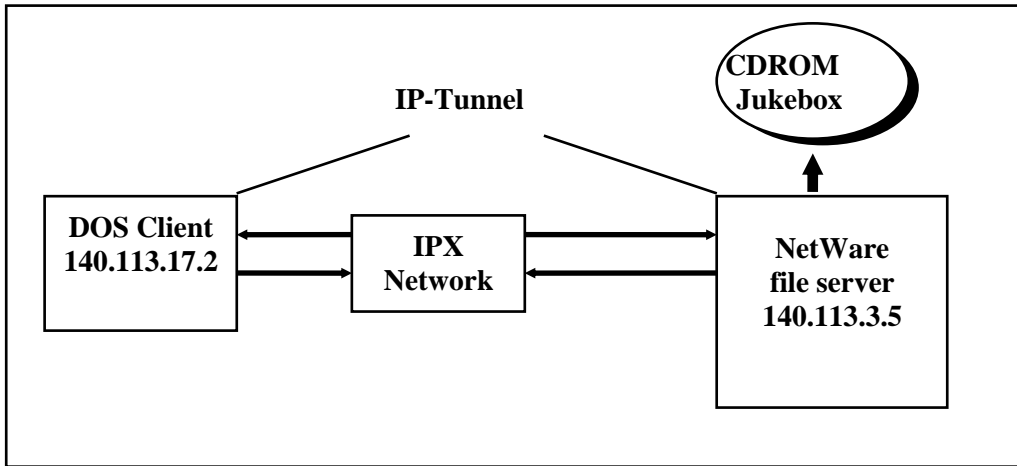
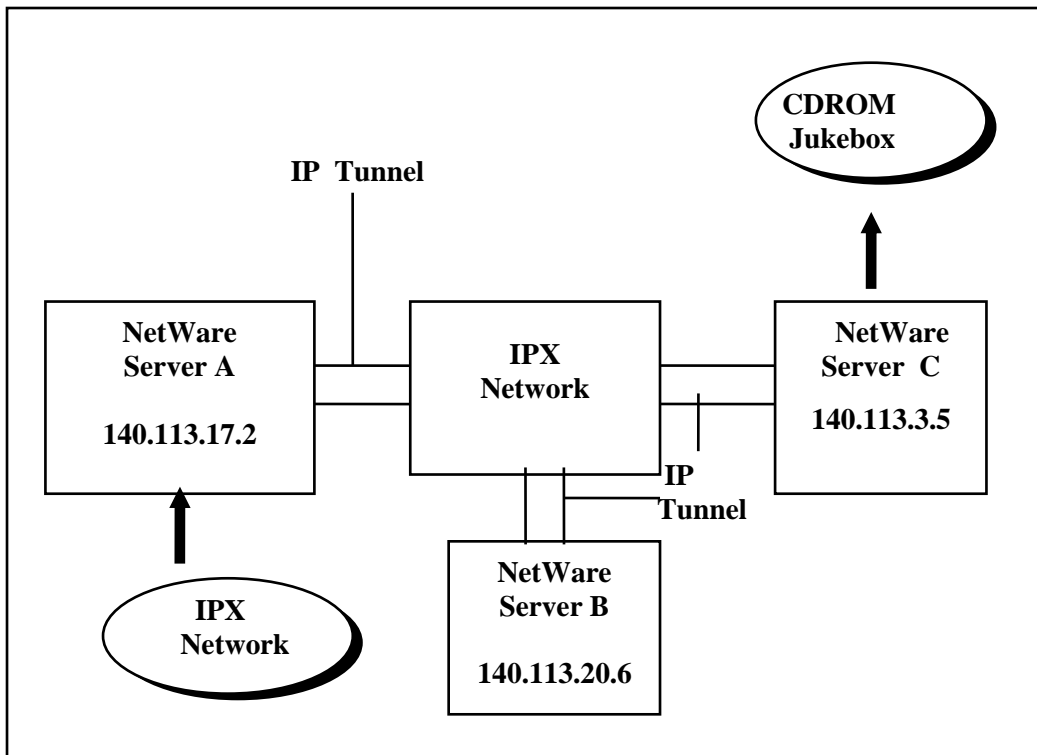


Figure 3: Several IPX LANs Connected to Form A Large Network



can access the CD-ROM jukebox, which is connected to the SUN/UNIX running the server part of the NFS.

PRACTICAL DESIGN STRUCTURE

Hardware Implementation

The network applies DOS-Client to Novell file server as indicated in Figure 2 and Novell file server to server as indicated in Figure 3 for the campus network system. Users must have a personal computer with an ethernet card and a LAN Workplace for DOS software to obtain connections. The mounted software maps any networked CD-ROM

jukebox to logical drives on the modulation with minimum memory usage. The CD-ROM jukebox archives network for patents and documents is shown in Figure 4 which also indicates the client/server components for printing, viewing and storing of documents. Users can gain access to one or more CD-ROM jukeboxes from the campus network. Simultaneous multi-user access to CD-ROM jukebox connected to the Novell file server is also possible.

The hardware configuration (Figure 5) shows the library CD-ROM campus network of National Chio Tung University in Taiwan.

Figure 4: CD-ROM Archive Network for Patents and Documents

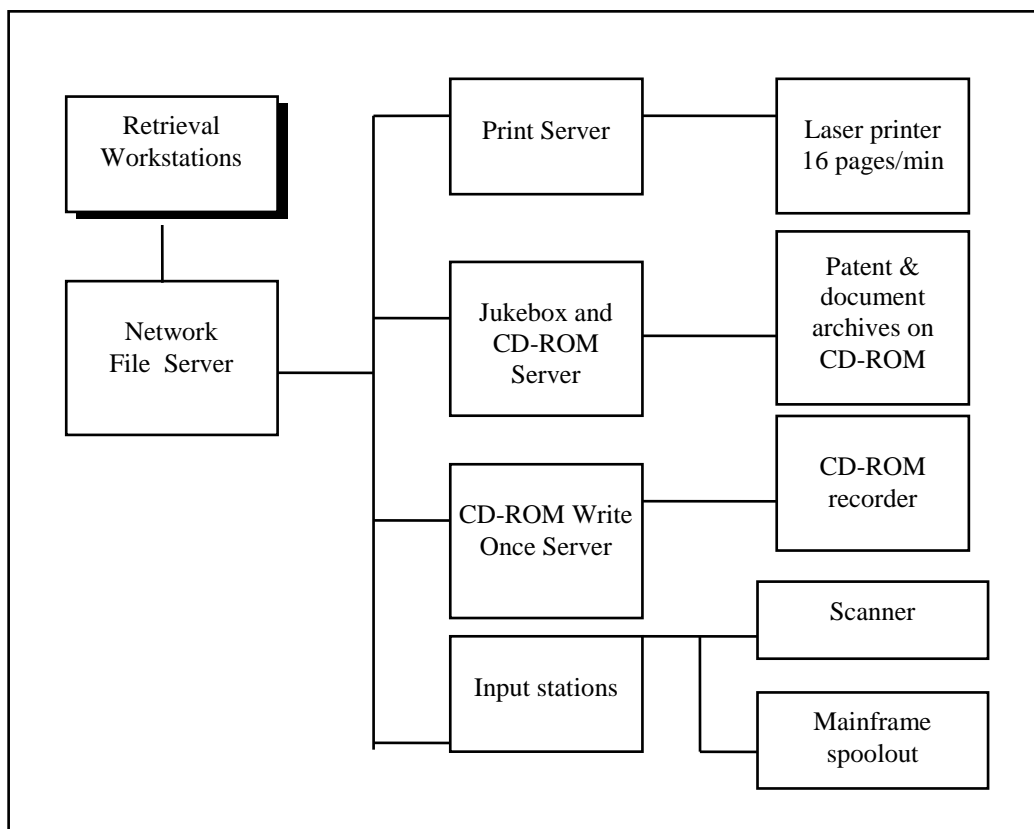
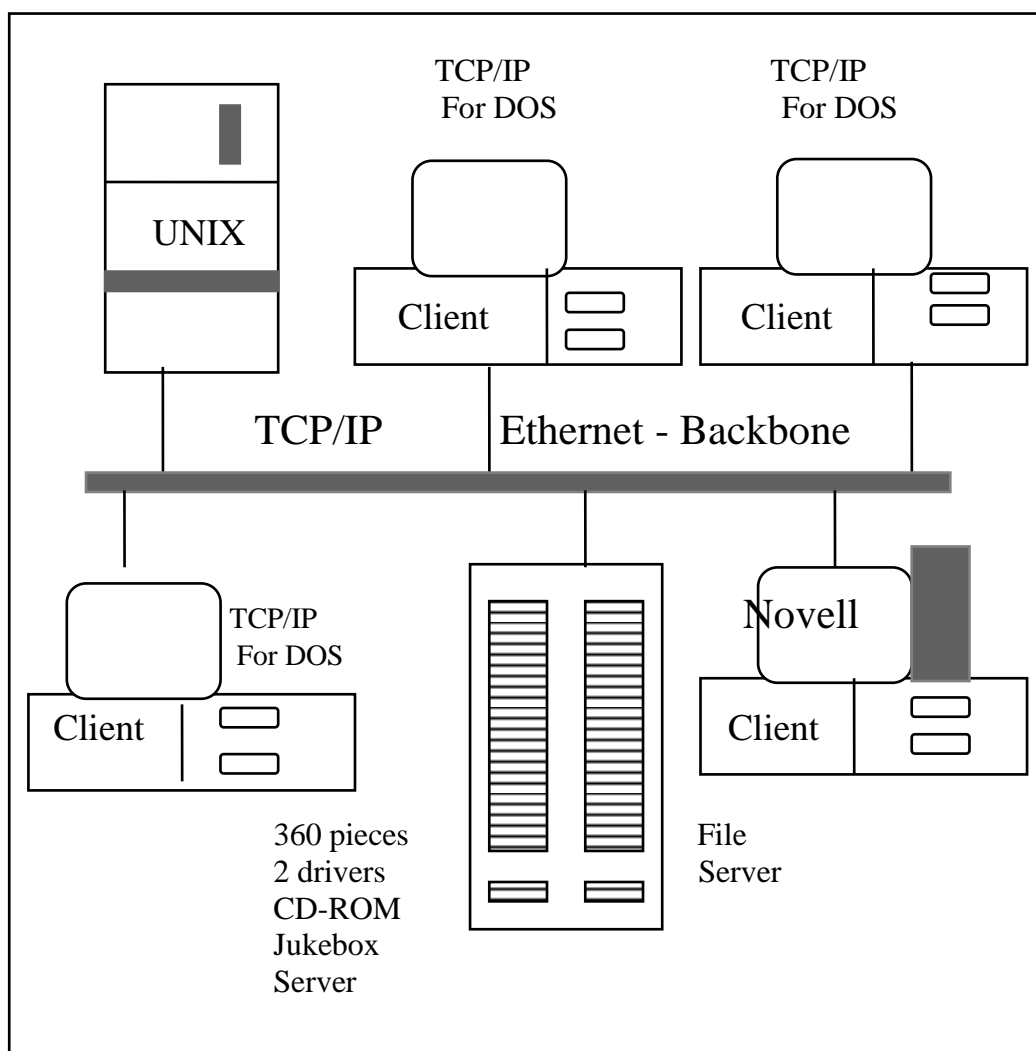


Figure 5: Hardware Structure of Library CD-ROM Campus Network



Software Implementation

Access principle is through the end user's personal computer which runs on a LAN Workplace for DOS IP tunnel software through the campus network router into the library Novell file server.

A CD-ROM jukebox retrieval program which calls the robot arm that picks the CD-ROMs into the jukebox driver, uses the program needed to retrieve image files from the Novell file server into end users' personal computer hard disk.

The Network Running Program used operates on the following steps (Figure 6)

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

The algorithm for the CD-ROM jukebox access program is as follows;

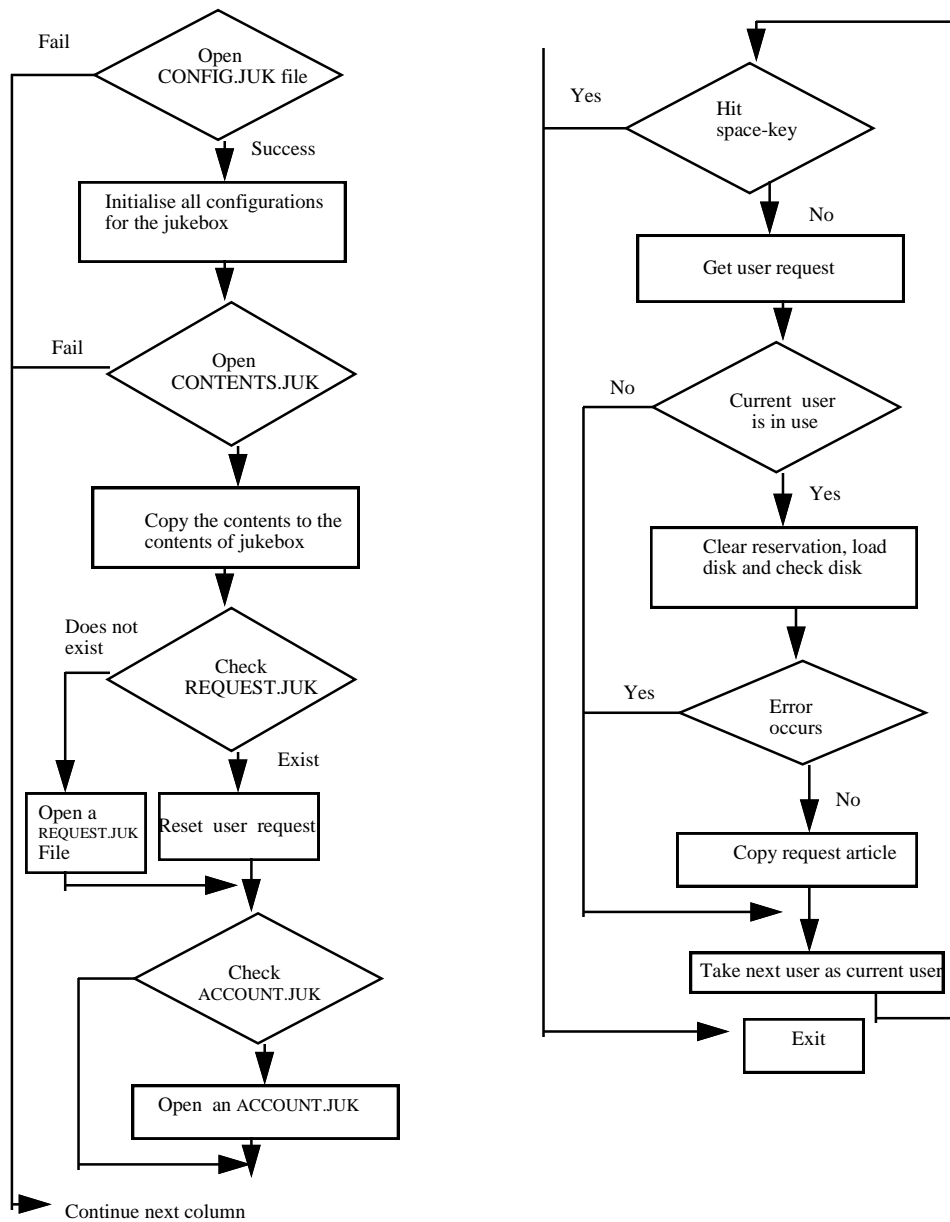
- Step 1: Open CONFIG.JUK file and initialise all the configuration for the jukebox. If this fails, then go to Step 8.
- Step 2: Open CONTENTS.JUK file and initialise all the contents of the jukebox. If this fails, go to Step 8.
- Step 3: Check REQUEST.JUK and ACCOUNT.JUK files and open it.
- Step 4: Get user requests, and write the requests into REQUEST.JUK file and make reservation for the next user.
- Step 5: Clear the reservation of the current user, load disk and check disk for the current user. If any error occur, then report error, and go to Step 7.
- Step 6: Copy requested article for the current user.
- Step 7: Take next user as current user. Then go to step 4
- Step 8: Exit.

PERFORMANCE ANALYSIS AND DISCUSSION

To analyse the performance of a CD-ROM campus networking system, it is assumed that the FDDI backbone's circumference is equal to the maximum distance, i.e. 200km. The FDDI backbone runs at 100 Mbps and each of its ethernet-like local area networks run at 10 Mbps. The ordinary delay for one FDDI station is 600 ms and the total delay for the 200 km long ring cable is 1.017 ms. Theoretical analysis calls on each ethernet-like LAN concurrently, and each ethernet-like LAN also has a capacity limit on the number of remote PCs it can handle. By reducing this limit from 281 to 140, the maximum number of FDDI routers can be increased from 10 to 21 (Yu, 1990).

From the above data, the campus network can support 100 users accessing the library CD-ROM jukebox database and access time averages 30 seconds for one user. The CD-ROM jukebox is popular among users since the dedicated server can overcome the slow access time of the CD-ROM drive allowing multiple user access to the same CD-ROM without appreciable delay. A large cache memory is available through the CD-ROM server, which boosts access speed for remote users. Data can be read from all drives simultaneously and this dramatically increases performance during heavy usage. CD-ROM disk caches are frequently used to improve retrieval time since information is transferred from RAM instead of from CD-ROM.

Figure 6: The Flow Chart of the Software Solution Steps



When comparing the performance of a non-network workstation to a network with twenty concurrent users, it is found that the worst case lag time for full screen VGA graphs was approximately double for the network CD-ROM system. The retrieval speed of the library's CD-ROM network can increase by running multiple copies of the same CD-ROM in different research rooms allowing multiple users to share the CD-ROM databases.

CONCLUSION

Ethernet and FDDI are high performance, high bandwidth network systems that can be used as the backbone of a campus network. This paper discusses the design of an Ethernet-Router-FDDI for CD-ROM campus network system which allows faculty and graduate students to access the library's CD-ROM database from their rooms. The theoretical analysis modules and practical design structure for a campus network are proposed for the system. From the outcome of the analysis, it is found that the current design is secure not only for the computer system but also for the users. The benefits of the library full image CD-ROM campus networking system are as follows.

- (1) It offers a practical high performance way for multi-user access to a full-text CD-ROM database.
- (2) Campus network compatibility with most CD-ROM products.
- (3) It allows access to multiple copies of the same CD-ROM for increased performance.

For further study, a group of universities using modems to build a wide area

campus networking system that provides the capability to share library CD-ROM resources may be connected.

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