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
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CD-ROM NETWORKING IN LIBRARIES:  
AN INVESTIGATION

by

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A Master's dissertation, submitted in partial fulfilment  
of the requirements for the award of the Master of Science  
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## ABSTRACT

There is a growing awareness of the advantages of the applications of CD-ROM networking in libraries. The databases can be effectively shared among multi-users simultaneously or within the library or the organisation or several libraries.

The CD-ROM technology is discussed to provide basic understanding of the technology. This will further improve the understanding of CD-ROM networking. The CD-ROM networking technology is thoroughly discussed to provide an in-depth information of the technology. The cabling system; network topologies; CD-ROM network software; network operating system; case studies of its application in various libraries etc. are investigated.

## ACKNOWLEDGEMENTS

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Appreciation is given to all the information professional who participated in my interview sessions.

Finally, I wish to thank Institut Teknologi Mara for granting me the scholarship.

DEDICATION

To

My parents

Daud and Siti Bedah

My wife

Nona Murni

My children

Fahmi and Nurashikin

## ACRONYMS AND ABBREVIATIONS

CAV	Constant Angular Velocity
CD-ROM	Compact Disc Read Only Memory
CD-Server	Compact Disc Server
CLV	Constant Linear Velocity
CRT	Cathode Ray Tube
CSLAN	Client Server Local Area Network
ELD	Electroluminescent Displays
ELS	Entry Level System
ERIC	Educational Resources Information Centre
IEEE	Institute of Electrical and Electronic Engineers
IMD	International Management Development
ISO	International Standard Organisation
Kb	Kilobyte
Kbps	Kilobits per Second
LAN	Local Area Network
LCD	Liquid Crystal Displays
LISA	Library and Information Science Abstract
LITC	Library and Information Technology Centre
Mb	Megabyte
Mbps	Megabits per Second
MSCDEX	Microsoft Compact Disc Extension
ms	Milliseconds



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## CHAPTER 1

### INTRODUCTION

#### 1.1 Purpose for the study

Since its introduction in 1985 by Sony and Philips(1), publications on CD-ROM proliferates and have gained foothold in libraries(2). 250,000 CD-ROM drives were in operation worldwide by the end of 1988(3).

Both users and librarians are not comfortable with the single user per workstation system because its constant need to change discs from the drive and also users need to be physically present in the library to use the facilities.

The increasing number of users cause the long wait to use the system and hence develop frustrations and inconvenience. Solving problems by adding more dedicated workstations proved to be very costly and inefficient(4). The recent development of CD-ROM networking where CD-ROM drives can be linked together for simultaneous access have a major impact on libraries. The technology is proliferating and more

libraries are expected to adopt the system.

As part of computer peripherals, CD-ROM network is as ordinary as any other local area network(LAN). The main problem in CD-ROM network is its operating system. It has been originally developed as a single user per workstation. Therefore its operating system used a single user device driven by a single user operating system. It is believed that 95% of CD-ROM utilize PC-DOS as its operating system(5).

The recent development of jukebox by University Microfilm International(UMI) which has a capacity of 240 CD-ROM discs and can be accessed by multiple users (6) is practical and valuable to libraries.

But generally, most of the jukebox or drives available in the market can be daisy chained and attached to one workstation. But the real limitation is its incapability to provide multiple-access simultaneously although it allows access to multiple discs(7). A remote single PC-based user, can access the network.

As CD-ROMs usage getting popular and demands are increasing, therefore libraries begin to feel the pressure to meet the users' need. The present state

single user per workstation system need to be improved and upgraded. The best solution is thus to provide the multi-user and multi-discs facilities. CD-ROM network improves discs security against theft, abuse and also reduce constant discs handling. This may avoid libraries allocating more money to purchase new workstations when they need to add more databases.

## 1.2 Aims and objectives

The aim of this dissertation is to investigate the application of CD-ROM networks in libraries; the problems arise from the installation of the networks; the experience from its use; the various systems adopted and also its impact and potential on libraries. The general objectives and aims of the study is to find out the overall view of the technology and its implementation and also the most up-to-date view in this area. Below are guidelines of the study:

- a) To investigate the present state-of-the art in CD-ROM network technology used worldwide.
- b) To investigate the applications and reasons for the applications of CD-ROM networking currently used in libraries.

- c) To investigate the latest development of various software, hardware and research or any on-going projects by libraries, publishers, research institutions, software developers etc.
  
- d) To investigate the response and the attitudes of librarians and users towards CD-ROM networking technology.

### 1.3 Scope and limitations

The study is conducted hoping to give a thorough and comprehensive coverage of the subject. The scope of the study emphasise only microcomputers networking. Both minicomputers and mainframes are included but not extensive.

The review of literature are gathered from various sources in English only. The interview survey was conducted so as not to be entirely dependent on literature published and unpublished.

#### 1.4 Methodology

Most of the materials used in this study are published and unpublished. References for literature are obtained from various indexing and abstracting sources on CD-ROM such as ERIC, LISA, Book in Print Plus. Indexing and abstracting sources on printed form used are Information Science Abstract, LISA etc. Current periodicals on library and computer literatures were also scanned.

The information survey was an exploratory survey or experiential surveys(8) based on unstructured personal interviews conducted by the writer.

#### 1.5 Organisation of the thesis

The thesis begins with an introduction explaining the purpose for the study; aims and objective for the study; the methodology of the study; its scope and limitation and the organisational of the thesis.

The second chapter covers the basics of CD-ROM technology. The third chapter includes the present state of CD-ROM networking technology discussing various

type of LANs; network topologies; cabling system; network operating system etc.

The fourth chapter describes various type of network operating software available in the market. The fifth present the applications of CD-ROM networking in libraries. The result of information survey, conducted after interviewing two information professional are presented in chapter 6. Chapter 7 concludes the study with a review of findings.



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## CHAPTER 2

### THE BASICS OF CD-ROM TECHNOLOGY

#### 2.1 Definition and concepts

CD-ROM(Compact Disc Read Only Memory) is described by Heimburger as:

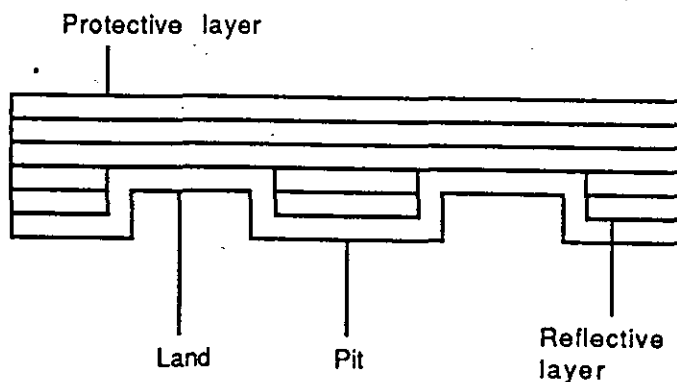
The silvery sheen CD-ROM disc is 120mm diameter and has a hole 15mm across in the centre. It is 1.2mm thick(1).

CD-ROM was introduced by Philips/SONY in 1985. The technology is basically an adaptation of commercial audio compact disc or CD-DA(Compact Disc digital Audio) used for stereo recording(2). CD-ROM is designed for digital data and can store text, images, audio, graphics and software but not motion, though it can store step animation(3). CD-ROM can store 550 Mb of data(4). But different literatures will provide different storage capacity between 550MB to 630Mb(5). According to Heimburger(6)CD-ROM storage capability can be any of the following:(a)75 minutes of music (b)275,000 pages of A4 text (c)1,500 5.75-inch floppy disks (d)18,000 pages of

computer graphics (e)9,000 pages graphics and 8-bit stereo audio (f)1,800 digitized images; 200 dots per inch; 12:1 compression (g) 4,500 hours of digitized voice(16KBS) (h) an entire text of 20 volumes of encyclopedia with an index to every word occupying only 25 per cent of the total space on the disk.

The reading and retrieval of information in CD-ROM is based on the laser beam used in the drive. The surface of the CD-ROM disc is coated with lacquer which protect the reflective metal layer. The function of the lacquer coating is to coat the information surface of the disk. The information track on the surface of the CD-ROM disc is made up of microscopical 'pits' and 'lands'. There is almost 1 billion pits in a disc. Pits are the valleys whereas lands are the flat planes(7) as shown in figure 1.

Figure 1. Information Storage on CD-ROM



The laser beam will be focused on the 'pits' which is then scattered or diffracted as the disc rotates. But light focused on the 'lands' will be reflected into the lens or the photo detector which produces a current, proportional to the light intensity. Each time the laser beam focuses from a land to a pit or otherwise the reflected light signals will be changed. The varying light signal is thus converted to digital data which will produce information(8).

## 2.2 Constant Linear Velocity

Unlike the magnetic disk, which spins at CAV(Constant Angular Velocity), the CD-ROM disc employs CLV(Constant Linear Velocity). The CAV spread the data concentrating more on the outer rings resulting in less data on the disk surface. Thus CAV technique makes locating of data much faster and easier as the data are not organized sequentially. In the CLV technique, the reading of the inner sectors make the CD-ROM disc spins faster but reading of the outer sector make the discs spins very much slower. The disc spins at 200 round per minute at the outer sectors in contrast with 530 round per minute at the inner sectors. In the CLV, sectors are having the same length and this increase the storage capacity by allowing more data to be at the outer rings

where the circumference is larger. The main disadvantage is obviously a reduction in access time due to the inability of the long spiral track to locate individual sectors(9). But its enormous data storage capacity compensate the slow access time in comparison with the magnetic disk.

### 2.3 Error correction

The inevitable of errors in CD-ROM has created the CD-ROM standard to include the error correction scheme. The error correction scheme will ensure the reliability of data produced by the CD-ROM disk. Errors can be caused by the microscopic defects. The error correction scheme is done by employing two Reed-Solomon Codes(10) used a specially designed algorithm to correct the error in the database.

### 2.4 Access time and data transfer rate

The access time means the time required to locate an information in the CD-ROM disc. It involves the seek time, the settling time and the rotational delay(12). The time required to position the head assembly on a specific sector can be described as the seek time; whereas the time required to settle the

head on a particular sector is described as a settling time and the time the disk should rotate to a specific sector to locate a particular information can be referred to as rotational delay. The average access time for a Cd-ROM disc drive is usually between 400ms(millisecond) to 1 sec.(second).

The data transfer rate (14) can be defined as the speed a workstation reads data from a disc once the data is located. Any error will interrupt the transfer rate. After the error is corrected then only the drive will begin to read and locate the data again. The CD-ROM data transfer rate is approximately 150Kb/sec. transferring 2048 bytes per sector. The data transfer rate for magnetic disk is 31Kb/sec. while 625Kb/sec. for the hard disk.

## 2.5 CD-ROM equipment

The basic components of a standalone workstation will require at least 512K RAM with one 5.25inch or 3.5inch floppy disk. But now most of the CD-ROM products require 640K RAM. The microcomputer can be IBM-PC/XT, IBM-PC/AT or compatible, Macintosh or Apple II versions. For a better response times, a microprocessor such as 286, 386 or 486 can be used. Some CD-ROM products

are developed taking up a tremendous RAM. The hard disk of between 1 Mb to 7 Mb may be needed. The CD-ROM does require a device driver or controller card which can be fixed in the expansion slot on the board. Besides the device driver, SCSI (Small Computer System Interface) host adapter is essential to support various devices such as CD-ROM drives, printers etc. The advantage of having a larger hard disk is the increase in the speed of searching.

## 2.6 CD-ROM drives

There are various types of drives available in the market. The standalone is widely used in the libraries. Another types of drives are the built-in drive, multi-drives, portable drives and the jukebox.

### a) Standalone

The standalone drive is linked to the microcomputer using separate power supplies. An interface card or a device driver is required to be inserted before the system can be used.

#### b) Built-in drives

The built-in drive is placed inside the microcomputer taking the space of the floppy disk drive.

#### c) Multidrives

Multi-drives are standalone units which are daisy-chained together and connected by cables and linked to the microcomputer. Specially designed multi-drives are available too e.g. the minichanger. An interface card will be needed to support four drives using the first and second generation of drives. But an interface card can support eight latest version of drives such as Hitachi 3600.

#### d) Jukebox

A CD-ROM jukebox basically has the same working principle as the phonographs records jukebox. The UMI(University Film International) has a total of 240 dics in a jukebox which is equivalent to 1.5 million full page image or 158 gigabytes. Currently the UMI jukebox is under beta testing in School of Business Administration, University of Michigan, Ann Arbor(15)



## 2.7 CD-ROM software

Basically they are three types of software used for for CD-ROM; the device drivers software; the search and retrieval software and finally the installation software.

### a) Device driver software

The function of the device driver is to inform the microcomputer about the presence of the CD-ROM drive. When CD-ROM was introduced every CD-ROM products come with different type of device drivers which are not compatible with one another. But now most of device drivers conform to the ISO 9660 format. The introduction of MSCDEX tremendously standardized the usage of device drivers. MSCDEX too help expanding the file size or the partition limit of MS-DOS which has the restriction of 32 Mb.

### b) Search and retrieval software

To date there is no standardization of retrieval software. The main unction of the retrieval software is to present the content of the CD-ROM disc in an attractive way. The images, data, and graphics can

then be easily used by the users. Generally, all the presentation is user-friendly, menu-driven and attractive even the computer will be able to use it without much assistance.

### c) Installation software

There are many types of software described above which are used in CD-ROM. The installation software basically are the installation of various software so the system can be operational. The installation software is to allow the installer to configure to tailor their own needs such as the type of printers used, the passwords to control type of users if any which need to be addressed. The working knowledge of MS-DOS is helpful especially when the installation involves config.sys file, the autoexec.bat file and also to install MSCDEX to provide a larger file size or partition limit of the existing 32 MB used in the MS-DOS.

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## CHAPTER 3

### CD-ROM NETWORKING TECHNOLOGY

#### 3.1 Introduction

This chapter presents a review of literature of the present state of CD-ROM networking technology. The purpose of the chapter is to present the application of CD-ROM networking in libraries, provide the relevant information and assess the potential of the technology.

The various systems used were studied and the on-going projects and developments were also investigated. (The future development of products in CD-ROM network technology is also included.)

#### 3.2 Definition and concepts

Leggot defined the term network "as two or more computers connected together by some form of communication medium". The network may consist of cabling or traditional wire or using the advanced technology wireless networking such as infrared beams of

light or radiowaves(1). CD-ROM networking is defined by Pesch as "software that allows workstations on a local area network to access CD-ROM players on another computer(the CD-ROM server) on the same network"(2).

Whitsed states:

The popularity of CD-ROM services often leads to a demand which quickly outgrows the single workstation environment. When this happens decisions will have to be made about the best way of providing access to the various CD-ROM databases(3).

Due to its heavy usage, the application of single user workstation is inefficient, costly and insufficient. There is an urgent need for migration from a single dedicated workstation per database on CD-ROM to a multi-user workstations. Many users find CD-ROM as a single workstation as unattractive(4). A single workstation allows only one user to use it at a time. This will normally results in having a long queue or the library need to devise a booking system which tend to limit the time each user can use a workstation. Another common problem with a single workstation is it involves discs handling. It can be subjected to theft, scratches

or even misplaced. It also requires a regular assistance from library staff to change each time different users need a particular database. Some libraries even need to provide a full time staff to look after the CD-ROM. This proves to be too costly and time-consuming for the library.

### 3.3 CD-ROM Network Technology

Both local area network(LAN) and wide area network(WAN) on CD-ROM networking are covered. But the emphasis will be on CD-ROM LAN.

#### 3.3.1 Local Area Networks

The Project 802 Committee of the Institute of Electrical and Electronic Engineers(IEEE) cites the characteristics of LAN must be within limited geographic coverage. The IEEE defined LAN "as a data communication system for independent devices capable of autonomous operation and intercommunication(5).

### 3.3.1.1 Types of LANs

There are 3 types of LANs used for CD-ROM networking. They are Zero Slot LAN(ZSLAN), Peer-to-Peer LAN(PPLAN) and Client-Server LAN(CSLAN).

#### a) Zero Slot LAN

ZSLANs do not require a special card to be installed in every computer in the network as in the other two types of LANs. In ZSLAN, printers, CD-ROM drives and other computer peripherals can be shared. ZSLAN allows access to files between nodes in the network. Files can be freely transferred without interruption among all nodes.

But ZSLANs are slow because spare serial ports are used. Parallel ports can also be used to connect the nodes. The response for CD-ROM networking on ZSLANs will be extremely slow due to the slow speed of the serial ports.

ZSLANs would operate at the speed of 115,200 bps(bits per second) whereas the ordinary LANs speed is 2 to 16Mbs(megabits per second) (6).



## b) Peer-to-Peer LAN

PPLANS is not really designed for heavily used network. PPLAN is meant for small network which consist of not more than 10 nodes. Each node is capable to access the CD-ROM drives, provide and share the common resources in the network without interrupting any nodes in the network. But as more nodes begin to access the resources or the CD-ROM drives simultaneously, the response time begin to degrade. But PPLANS may not be effective CD-ROM network because of its poor speed. The poor speed of CD-ROM drives couple with the poor speed of the networks may be inconvenience to the users. (7) Therefore PPLANS is not a good alternative for the networking.

CD-ROM server(8) network utilise the multiple CD-ROM drives tower where all the workstations are connected to it. The Southern Maryland Regional Library in the United States is an example of a library which used an Artisoft LANTastic network using LANTastic NOS. Figure 2 shows the CD-ROM server network.

No dedicated server network(9) are a network where workstations are connected to one another with a several drives or multiple drives attached to one or

more workstations. An example of this kind of network is Novell's Entry Level System I(ELS 1). Network operating system in non-dedicated mode and Fresh Technology Group's MAP Assist to provide CD-ROM access. This network is shown in figure 3.

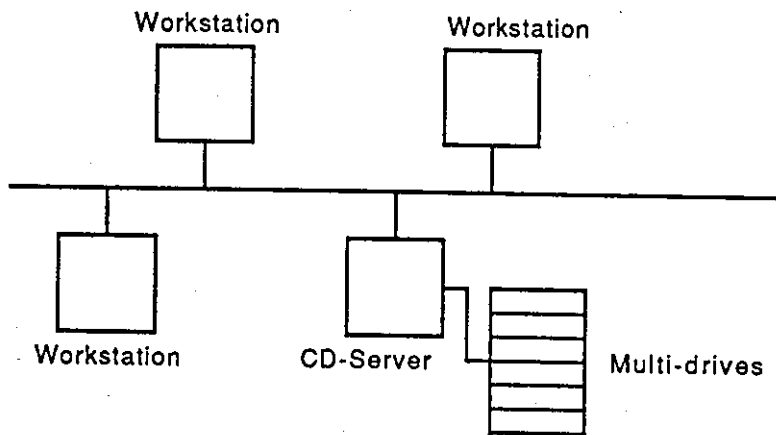


Figure 2. CD-Server Only

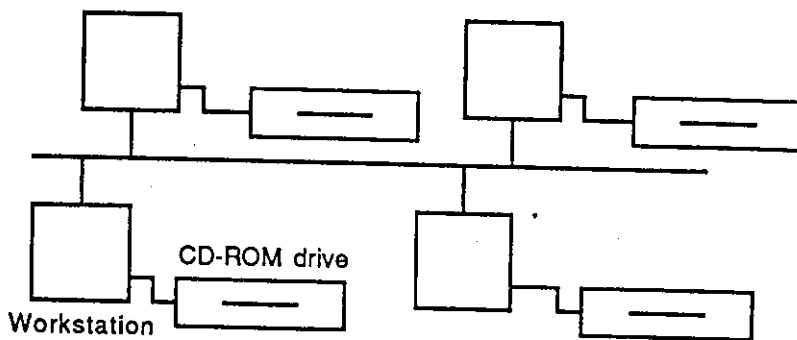


Figure 3. No Dedicated Server Network

c) Client-Server LAN(CSLAN)

Servers allow other nodes in the networks to access specific resources. Dedicated servers perform no other functions but totally processing request from clients. Print server provide access to printers or other output peripherals. They receive print request from clients and direct the request to appropriate devices for printing.

File servers allow all the clients in the network to access the storage space. File server can be equipped with CD-ROM drives. For excellent results servers must use high powerful microprocessors i.e. 80386 or 80486 on IBM compatible(10). An example of file sever/CD-ROM server is The Online Computer System OPTI-NET used in South Bank Polytechnic(11). Figure 4 shown the file-server and CD-ROM server environment.

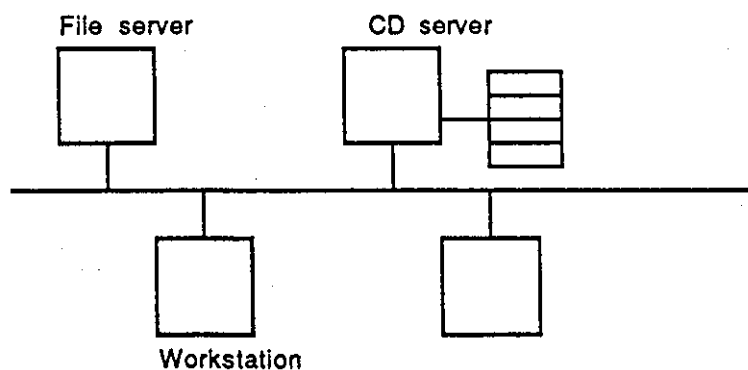


Figure 4. File-server and CD-ROM server network

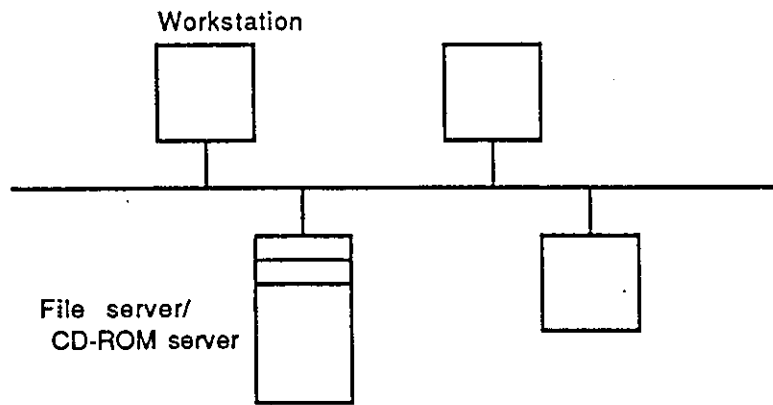


Figure 5. File Server/CD-ROM Server Combined

File server/CD-ROM server combination normally come in a tower. All the hardware and software must purchased in a total system. Unlike the OPTI-NET they can not use the existing equipment.

They can be either configured for Token Ring, Ethernet or Arcnet network. The network operating system can be Novell network software. An example of file server/CD-ROM server combination is CD-NET from Meridian Data, MultiPlatter from SilverPlatter and CD-Connection from CBIS. The MultiPlatter tower network server use a 286 processor and 2Mb RAM. The tower can accomodate 7 to 21 CD-ROM discs(12). The CD-NET consist

of tower with the file server and CD-ROM using either 286 or 386 processor. Every tower can accommodate eleven discs and any additional of discs may require a new integrated unit(13). G. Holmes Braddock Senior High School in Miami, Florida use the MultiPlatter in their media centre. Figure 5 shows an example of a combination of a file server and CD-ROM server.

The advantage of file server system as compared peer-to-peer system is its security , performance, stability, and cost(14). File server system eliminates discs handling from users as the CD-ROM server, drives can be hidden from users.

File server approach increase the performance of the network because it exploit the RAM, caching and CPU capacity to its fullest. In peer-to-peer approach, performance is affected and the capability is reduced as the CPU has to perform two tasks performing as a server and a search station at the same time.

Unlike peer-to-peer approach, nodes in file server are not affected even though user on a workstation turns off the drive.

Generally file-server systems are resilience to failure. Connolly(15) reports that the OPTI-NET network in South Bank Polytechnic crashed approximately three times within the year of operation. Meanwhile the maintenance has caused the down time only approximately three hours in the year.

### 3.3.1.2 Network Topologies

Saffady(16) describe a LANs' topology as "the physical wiring pattern that connects network nodes". Any kind of networks may use 3 types of cabling i.e. twisted-pair, coaxial or fibre optic media.

The 3 type of network topologies used in CD-ROM networking are:

#### a) Bus Topology

This is the most widely used topology in LANs. Generally, the coaxial cable is used for this kind of topology. However the twisted pair and the fibre optic media can be utilised too. A bus or a linear bus topology is a single or dual cable where every nodes in the networks are connected by stub or drop cable.(17)

In bus topology, signals travel from node to another. This may cause reflection across the network and create a lot of unnecessary confusion. To prevent reflection, a terminator is attached at both end of the cable.(18)

Any break in the cable may bring the whole system down. The system can not be easily diagnosed to trace the fault. The configuration is shown in figure 6.

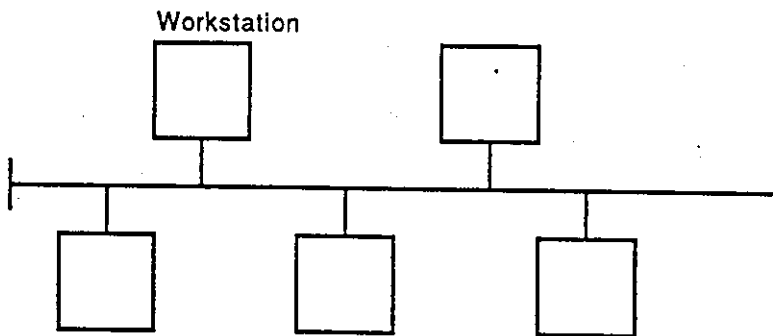


Figure 6. Bus Topology

## b) Star Topology

In star topology each node is connected to the hub. More cables are required because all the nodes must be connected to the hub. The expansion capacity depend on the size of the hub.

Star topology does not require protocol to control media access since no cables are shared. In this kind of topology, the break of cable may only affect the particular node. The system is not affected. But the failure of the hub may disrupt the entire system(19), The configuration is shown in figure 7.

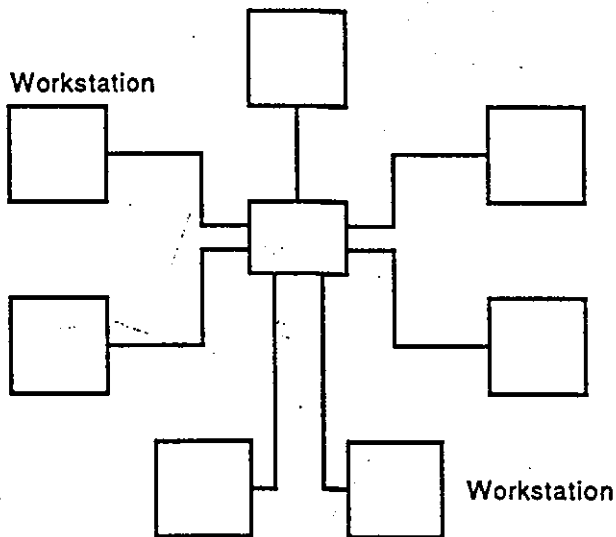


Figure 7. Star Topology



### c) Ring Topology

Normally the cable used for ring topology is the twisted-pair or fibre optic media. All nodes are connected to one another. In other words each node is connected to two other nodes. The last node must be connected to the first node. (20)

Ring topology require extra cable than bus topology because the necessity for the last node to be connected to the first node. The main advantage of the ring topology is its ability to diagnose the break or faulty in the cable. However the break in the cable will bring down the whole network. The configuration is shown in figure 8.

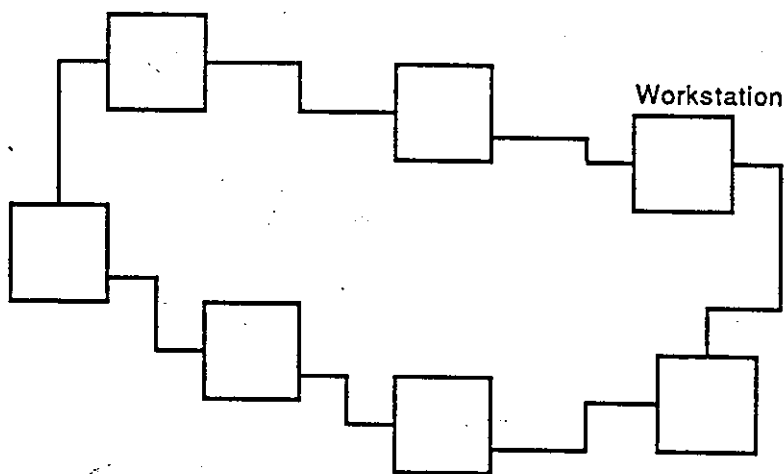


Figure 8. Ring Topology

### 2.3.1.3 LAN hardware and software

Cabling. The networks system are physically connected by cable. There are three types of cabling used in LANs; the coaxial cable, twisted-pair cable and fibre optic media.

#### a) Twisted-pair Cable(21)

Twisted-pair cables are insulated copper wires that are twisted together to reduce noise. There are two types of twisted-pair cables i.e. shielded and unshielded. The unshielded is the most widely used in LANs. But the main problems with unshielded cables are its susceptibility to electromagnetic interference, radio frequency interference, power cables etc. They are vulnerable to crosstalk if the cable are broken or leaked. Radiated harmonics need to be controlled to increase the communications speed of the cables. Radiated harmonics are produced by the increase in data flow or transmission. The rise may result in transmission errors. This problem is normally minimised by surrounding the cable in a braided metal shield. The common type of unshielded twisted-pair is known as IBM Type 1. This cable is widely used in IBM Token Ring network and also IBM PC network.

reputation of high performance and high speed more LANs are employing this kind of cabling. The thin strand of refractive glass or plastic is used as waveguides for beams of light that encode information. Crosstalks are avoided in fibre optic media, because the glass or plastic are surrounded by refractive cladding material. This material function by containing the light. They are non-electrical and not susceptible to electromagnetic, radio wave frequency or any kind of electrical interference. Their capability to produce uninterrupted transmission over long distances; their characteristics such as lightweight, durable make them an excellent choice compared to the twisted-pair and coaxial cables. They can be used not only for high speed LANs, but also for bridges and gateways. But the high cost of installation contribute a main barrier for fibre optic media to be used in LANs.

Pesch(25) states that three most common type of LANs used either the Ethernet, the Token Ring or the ARCnet.

a) Ethernet. Ethernet used bus topology and can also be configured in star topology. It conforms to IEEE 802.3 standard. Ethernet consist of of a network and a transmission protocol developed by Xerox Corporation and Digital Equipment Corporation. Ethernet

can use all the three type of cabling i.e. the coaxial, the twisted-pairs and the fibre optic media. The data transfer rate in Ethernet is normally 10Mbps(Megabits per second)(26).

b)IBM Token Ring. The IBM token rings are formed by linking network interface cards to a multistation access unit by using twisted-pair adapter cable. It conforms the IEEE 802.5 token-passing ring protocol standard. The data transfer rate are 4 Mbps or 16 Mbps. For 4 Mbps the recommended cable is the unshielded twisted-pair. But both 4 Mbps and 16 Mbps would operate on two individually shielded and unshielded pairs(27).

c)ARCnet. The ARCnet can be configured on either a bus or a star topology. The data transfer for ARCnet is 2.5Mbps. The cable used in ARCnet can be either the coaxial or the twisted-pairs. ARCnet normally require network interface cards(28).

### 3.4 Wide Area Network

"CD-ROM networks networks have been developed to offer the opportunity to distribute access over a wide area, either to other sites or branch libraries, or, by using

internal digital networks, direct to end users attached to the network". Such an installation will require the bridging between the library and the organization's LAN. Many libraries started to think on how the integrated library system can be linked with the CD-ROM LAN.(29)

Remote access can be achieved by Wide Area Network(WAN). The installation of CD-ROM drives on WAN or the installation of gateway between a WAN and a LAN can be done. A gateway interconnects the various networks using various communications protocols or different network operating system.(30)

Ohio State University Libraries has installed CD-ROM which are connected to WAN. The network consists of an ten CD-ROM drives using Meridian CD Net; an Ethernet running Novell NetWare. To support the remote users eight IBM PC/AT microprocessors are used. The microprocessors are connected to the campus network by 3Com gateway. The library users use the Macintosh II CX network which are connected to the campus network via a bridge and a gateway. The public access catalogues are able to access the online catalog and also the CD-ROM databases. The non-library users too can access the CD-ROM databases by dialling-up or direct connection

to the campus network.(31)

The InfoServer 100 from DEC can be connected to an existing DECnet WAN to provide 100 simultaneous users with access to the CD-ROM drives. The InforServer 100 from DEC is designed for VAXserver 3100 minicomputer, which has a 120MB hard disk and 4MB of RAM.(32)

The Polytechnic of Central London installed remote access software(pcANYWHERE) on their WAN. This enable any remote users to access the CD-ROM databases located centrally. Unfortunately, only a single user can access at a time.(33)

The solution used in Polytechnic of Central London in using the WAN depend largely on the use of the software, pcANYWHERE III which allows remote access on its 32 workstations configured with VT100 emulation. This is the standard workstations used for the polytechnic.(34)

### 3.5 Standardisation

Eaton, MacDonald and Saule(35) express that standard encourages competition in the optical industry. The competition in the industry will force the hardware

manufacturers, the software developers and disc producers to reduce cost and allow the greater flexibility among different type of products produced by different type of companies. This will reduce the real problem, the incompatibilities of the software and the equipment.

They describe the 3 type of standards, employed in the CD-ROM technology i.e. the disc standard, drive standard and interface standard(36). But software producers will not agree standard on retrieval software due to commercial interest to establish brand loyalty.

#### 2.5.1 Disc Standard(37)

There are 2 type of disc standards; the physical recording standards and logical organisation standards. The physical recording standard specify the number of data blocks; the length of data blocks and also the error and timing codes recorded. The Philips/Sony Red Book for the physical standard has been accepted for CD-ROM.

The Philip/Sony Yellow Book and the High Sierra Group standard specify the way the the CD-ROM files are

organised and reported to the drive and microcomputer operating system. The Yellow Book also specify CD-ROM volume and files structure which is the extension of the High Sierra Group and the N120(Z39) standard committee.

### 3.5.2 Drive Standard(38)

The acceptance of the Red Book, the Yellow Book and the High Sierra Group standard make the drives manufacturers to conform to the discs standard. The discs should be able to operate in any drive produce by any manufacturers.

The drives standard requires the specification so that drives are able to interpret the disc formatted information. However the incompatibilities of the drives can be partly solved by using the Microsoft Extensions recommended by the High Sierra Group. The Microsoft Extension is designed to suit the widely used MS-DOS.

### 3.5.3 Interface Standard(39)

The interface standards specify the interface or the interconnection between the disc drive and the



microcomputer. SCSI has become a popular interface standard adopted for microcomputers and many computer peripherals.

### 3.6 Licences, copyright and data protection

This aspects need to be given particular attention. The growing and increasing use of CD-ROM and networking will increase the encroachment of the copyright copyright and data protection.

#### 3.6.1 Intellectual Property

The protection of software products become extremely difficult and hard to observe due to the ease of copying, distributing and reproducing on both hard copy and the magnetic discs.

The software products are protected not only by the copyright act but also by the patent and the trade secret law(40).

But the vague interpretation of the principle of fair use of electronic products compared to the usage of the literary works become increasingly complicated(41).

### 3.6.2 Lease, Licencing agreements and Pricing

The lease and licencing agreements are the results of the ambiguity of the copyright law. The database producers and software developers create the lease and licencing agreements as an added measure to protect their intellectual property.

In order to protect their loss of sale a result of networking, the pricing schemes are designed by publishers in many ways. It can be flat rate charge multiuser licence; it can charge based on the number of computers used; it can also be charged based on the number of users or based on the estimate of the potential users at a particular institutions or organisations.

The pricing schemes become very complicated. To solve this problem, the European Association of Information Services, has recommended the pricing principles to avoid the barrier to information access(42).

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## CHAPTER 4

### CD-ROM NETWORKING SYSTEMS

#### 4.1 Introduction

A number of major CD-ROM networking systems are available in the market with more new products emerging. But only the major systems will be reviewed. Some of the systems reviewed in this chapter are the OPTI-NET from Online Computer Services; the MultiPlatter developed by SilverPlatter; CD-NET developed by Meridian Data; CD-Connection by CBIS; LANTastic by Artisoft and SCSI Express by Micro Design International.

#### 4.2 OPTI-NET

##### 4.2.1 Operational aspects

OPTI-NET from the Online Computer System is widely used in the United Kingdom and the United States. Its flexibility by permitting the usage of the existing



equipment instead of purchasing new hardware make it a popular option. OPTI-NET will run on any NETBIOS compatible system, the IPX/SPX protocol and NFS(Network File System)(1). Any NETBIOS compatible will run on networks such as MS-NET, 3-COM Ethernet and Microsoft LAN Manager. In addition the IPX version will run on any network using the Novell Netware.

To support the OPTI-NET, a dedicated file-server must have a minimum RAM of 2 Mb. A file-server with 2 Mb RAM will serve four drives. Each drive may require at least 500K RAM. OPTI-NET can run on either Ethernet, Token Ring or Arcnet topologies. Before OPTI-NET can be fully operational, the network operating system must load it as a device driver with 65-70K RAM. Then only the system can be configured(3). In the OPTI-NET network, all the networks software and most of the search and retrieval software can be installed on the file-server(4). But not all CD-ROM products can be installed on the file-server. The Whitaker's Bookbank for example must be loaded separately on a local workstations.

There are four versions of Novell which can be used to run OPTI-NET. They are the ELS Netware Level 1 which can support eight users; the ELS Netware Level

II; Advanced Netware 2.15 which can support a maximum of 100 nodes and SFT Netware. The most suitable Novell products for OPTI-NET environment is the Advanced Netware 2.15. Apart from supporting 100 nodes it can also support other system and library housekeeping.

#### 4.2.2 Drives and servers

Two servers are required to run OPTI-NET i.e. the file-server and the CD-ROM server. The Novell Netware is loaded on the file-server while the OPTI-NET on the CD-ROM server. Both servers need at least 286 processor machine with 2 Mb RAM. PCs with 386 processor will definitely increase the speed and the performance of the network.

The latest version of drives require only one interface card for every eight drives. But four drives are daisy-chained together. The older version of drives can only be daisy-chained together with one interface card supporting four drives. OPTI-NET has the capability to support 64 drives per CD-ROM server. But there will be a degradation in response time. A CD-ROM server supporting 32 drives is recommended and additional of a CD-ROM server for another 32 drives will be a better

approach if the response time and the overall performance is not to be affected(5).

#### 4.2.3 Advantages of OPTI-NET

As discussed earlier the main advantage of the OPTI-NET is its flexibility allowing the existing hardware be used for the network. The cost-saving is great since no new hardware need to be purchased. Another advantage is its caching ability. When a search is made, all the results will be stored in CD-ROM server's RAM. This eliminates a repetition if the same search is done again. Information already on cache RAM will be displayed quickly. Even multi-user access using the same disc at the same do not degrade the response time. This is especially true if the application software are installed in local workstations. But when the application software are installed in the file server a certain degree a degradation may occur. However, OPTI-NET does not allow the 'dumb' terminals to be used on its network.

South Bank Polytechnic Library and Kimberlain Library, at De Montfort University are among those known to employ this network.

#### 4.2.4 Costs

The costs of OPTI-NET may decrease as more and more systems are sold. Akeroyd et. al(6) give the installation costs of OPTI-NET as below:

Number of users/nodes	Costs
	£
1 - 8	795
1 - 100	1495

Other equipment	Costs
	£
Ethernet cards	200/workstation
Cables	20
2 Mb RAM	250

Table 1. Cost of OPTI-NET

## 4.3 MultiPlatter

### 4.3.1 Operational aspects

MultiPlatter from SilverPlatter will run on various network operating system such as the Novell's Advanced Netware, MS-NET and Microsoft's LAN Manager and any NETBIOS compatible system(7). MultiPlatter can read not only SilverPlatter's products but any CD-ROM products conform to the ISO 9660 standard which use MSCDEX.

MultiPlatter system is based on CBIS product, CD-Connection which has been largely customised. It has a tower which can store 7 to 21 CD-ROM discs. It can run on at least 286 processor and 2Mb RAM(8).

Librarians can develop their own menu and maintain usage statistic for their library housekeeping. The Usage Statistics Software Module(9), even provides on-screen graph of statistics of the usage. The software maintains logs, by giving detail information such as which discs is heavily used, which disc is not used or under utilised, time users spend on a particular disc, and even the number of simultaneous users use a particular disc. The statistic can be stored on a weekly basis, monthly basis or yearly basis.

The MultiPlatter CD Server is a combination of file server and CD-ROM server. The main advantage is its single supply power, single controller, and its compact storage. MutiPlatter can be configured either on Ethernet, Token Ring0 or Arcnet. The average access time is 350ms.

The availability of caching, eliminates time wastage as every search will be stored in the cache RAM. This will avoid repetition of searching the same information in the disc which definitely increase the access time. Searching will be executed quickly since the search is done first in the cache RAM. The capability of sequential searching will further increase the performance reduce the access time. Sequential searching is the technique where searching is done in anticipation of the users need. If the anticipation is true the result will be displayed quickly.

In MultiPlatter(10), the retrieval softwares are not installed on the file server but on each local workstation. Each local workstation requires 640Kb RAM and 20Mb hard disk. So far there is no literature mentioning about the diskless workstations in the MultiPlatter network. Once in operation, the network can support 20 users simultaneously and eight users may

access the same database at the same time. However the access time will be reduced by 30 seconds.

Although MultiPlatter can support WAN, remote access, and narrowband networks but the system still inefficient and having many difficulties especially when involving transferring large amount of data. But in a LAN it has proven to be very successful. Another problem with the network is its co-processors. 4 co-processors are limited to a board and 4 boards to a server. On a WAN only 16 users can access the network simultaneously. Searching on a WAN or remote access will reduce the access time since searching is done on the file server instead of the local workstations.

#### 4.3.2 Costs(11)

The costs of a complete system of a MultiPlatter is £18,000. These will include a CD-Server with seven CD-ROM drives, the network server with 2Mb RAM, 4 Ethernet network cards and the relevant softwares. The costs also include the installation of the system, and after-sale service called 'Controlled Release Programme'.

## 4.4 LANTastic

### 4.4.1 Operational aspects

LANTastic is a peer-to-peer network. It is unique because apart from operating as a CD-ROM network software, it is also a NOS(Network Operating System). The other NOS such as Novell products or 3COM do not have the ability for CD-ROM network(12).

LANTastic can run on a twisted-pair cable or on a standard Ethernet hardware. LANTastic uses NETBIOS for all network communications and it can also run on network adaptor that use NETBIOS standard including both the Ethernet and the Token Ring(13).

LANTastic network can work in two environments. Each workstation is linked to a CD-ROM or only a few workstations linked to a CD-ROM drives without a dedicated server. Provided the workstations have sufficient RAM, they can share among themselves the CD-ROM drives. LANTastic consume only 12K RAM in the workstations(14).

In the second environment, CD-ROM server is linked with multiple drives. The MSCDEX needs to be installed only



on the server instead of on every workstations. The server software only use about 50K RAM.

LANTastic has the ability to perform statistical functions such as providing monitoring usage, printer sharing, log-ins, logs-out and electronic mail.

LANTastic is basically meant for small network with several workstations. Its main weakness is that most of the CD-ROM products executing directly to MSCDEX or the CD-ROM device driver will not run.

The libraries that are known to install LANTastic network in their libraries are John Cotton Dana Library at Rutgers University and the Southern Maryland Regional Library Association in the United States.

#### 4.4.2 Costs

The cost of networking software to install LANTastic is the cheapest available in the market at the moment, The price of the software is US\$300-500(15).

But Pesch(16) quoted the price of connecting two workstations with CD-ROM drives using LANTastic starter kit is US\$525.

## 4.5 CD-NET

### 4.5.1 Operational aspects

CD-NET from Meridian Data is basically hardware-based products. It has an integrated hardware and software system. CD-NET can be configured for Ethernet, Token Ring, or ArcNet and run on top of Novell products, 3COM, Ungerman Bass, LANtastic or PC LAN network software.

Recently Meridian Data has marketed 3 new CD-ROM servers. The Model 100NC which is 16 inches in height replaces the old Model 214 (26 inches). Model 100NC is a 12Mhz 286-based processor CD-ROM server accommodating up to eight drives and includes 1Mb RAM for caching which is expandable to 4Mb. The second is Model 314-33 the equivalent of Model 314-20 which accommodate fourteen drives, has a 33Mhz 386-based processor, 2Mb RAM and is expandable to 16Mb. The third, Model 428, with a 33Mhz 486-based processor, 4Mb RAM, expandable to 16Mb. The maximum drives held in two cabinets can accommodate twenty-eight discs (17).

Other CD-NET features are Windows 3.0, a front panel with a lock and fast drives from Toshiba with average access time 350ms. CD-NET the cache RAM facilities and

thus increasing performance and the access time. Several copies of discs with the same title can also be accommodated to avoid problems with the access time. The number of CD-ROM discs can be increased as long as the CD-NET tower is added.

Meridian data has also made available MSCDEX for network. The price of MSCDEX network for one to five user is US\$99 instead of US\$50 on a single workstation.

Meridian Data is learned to carry out a new development to allow IBM Mainframe and DEC users to access CD-ROM based information through dumb terminals over a variety of networks including TCP/IP.

Another unique feature of CD-NET is its audio diagnostic capability. A pair of audio headphones will be connected to CD-NET. The audio compact disc is used to conduct the test on CD-NET. The results of the test will be echoed through the headphones. (18)

Bielefeld University Library, West Germany, the Institute for Management Development, Lausanne, Switzerland and Kerr Library at Oregon State University are a few libraries known to installed this system.

## 4.6 CD-CONNECTION

### 4.6.1 Operational aspects

CD-Connection is a system from CBIS. MultiPlatter's is basically CBIS product. CD-Connection will run on either Ethernet, Token Ring or Arcnet. CD-Connection can run on any NETBIOS compatible system. CD-Server can accommodate fourteen drives per server. They are two versions of CD-Connection. One for CBIS Network OS LAN and the other is for Novell Netware(19). CD-Connection can also run on Netware's IPX.

CD-Connection does require MSCDEX to be installed on each workstation. This may save each workstation 13K of RAM. The CD-Connection products that is employed by MultiPlatter consist of keyboard power, video adapter and MSCDEX. The system allows 254 users to access the network simultaneously and use 23 CD-ROM discs at a time(20). CD-Connection can also support remote access and bridging facilities.

### 4.6.2 Costs

The price of the whole system is US\$5,300 high consist of a 286-based machine, a Toshiba drive and the

software(21).

## 4.7 SCSI Express(22 & 23)

### 4.7.1 Introduction

SCSI Express is a product from Micro Design International. SCSI Express offer flexibility allowing any addition or combination of CD-ROM, fixed disk, jukebox, multifunction, tape and WORM supported devices. It would accomodate any system using its device driver modules.

SCSI Express eliminates the cumbersome process of connecting multiple SCSI products. It eliminates the need of multiple software versions regardless of multiple devices. Since SCSI Express is completely integrated, various peripheral devices can be put together without software or hardware conflicts.

### 4.7.2 Operational aspects

SCSI Express will run on most of the operating systems such as MS-DOS, UNIX/XENIX versions, Novell Net Ware 286 and 386 and OS/2.

SCSI Epress consists of five types of modules: the kernel; host adapter driver; device class; device driver and device utility. The kernel acts as coordinator and central meeting place for all parts of the system. It also acts as Dynamic Link Library for other modules of the system. The host adapter driver provides generic interface for different devices. The HA driver, routes input and output requests to the proper device and route messages from devices back to the system. Device class allows device drivers to access devices in a generic fashion. It recognise the specifics of devices such as error reporting. The device driver deals with specific input and output request from the Net Ware operating system. It uses the device classes to communicate with devices in generic fashion. Changes or additions to drives do not affect the device driver modules. Device utilities present in the device drivers enhance device operations. It enables the monitoring of devices, control error reporting or tuning jukebox system for optimal performance.

Generally SCSI Express run better on Novell Net Ware 386. It requires a file server with 386 or 486 processor. The CD-server is integrated in a tower consisting of seven drives per tower. A controller card supports seven drives in a tower. Therefore any

additional tower of seven drive may require and additional card. However, unlike OPTI-NET, SCSI Express would not accept any standalone drives to be daisy chained together.

It can run on either Ethernet, Arcnet or Token and NETBIOS compatible system.

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## CHAPTER 5

### CD-ROM NETWORKING APPLICATION IN LIBRARIES

#### 5.1 Introduction

This chapter present an overview and case studies of the present state of the applications of CD-ROM networking with the emphasis on the United States and the United Kingdom.

#### 5.2 OPTI-NET

##### 5.2.1 Kimberlain Library, De Montfort Uiversity, Leister, the United Kingdom (1)

Kimberlain Library started the CD-ROM networking in May 1991. The library selected OPTI-NET for their fnetwork.

##### 5.2.1.1 Hardware and software

OPTI-NET was bought from Attica Cybernetic. It run on Novell Netware 286. 386 processor machine with 2 Mb RAM is used for CD-ROM server. The CD-ROM multidrives was SONY consisting of eight drives per tower. An

additional of eight drives per tower was added making the total drives sixteen altogether. The file server is 386 machine with 4 Mb RAM and 100 Mb hard disk. Six workstations used for the network are Genies 1s with 1 Mb RAM, VGA colour monitor and 3.5inch disk drive. All the workstations are diskless to avoid users hacking through the hard disk. A dot matrix printer is attached to the network.

#### 5.2.1.2 Databases

The databases available on the networks are Art Index; Bookbank; Books In Print; BNB; Computer Select; ERIC; Justis; LISA; Oxford English Dictionary; UK Official Publications and Worldwide Standard.

Kimberlain Library planned to mount magnetic databases i.e. PC Globe and Inside Information on the file server.

#### 5.2.1.3 Problems encountered

The initial setting up of the network met with some problems especially due to the absence of the hard disk. Without the hard disk, all necessary softwares were installed on the file server instead of the individual workstations.

Novell's product was used as front-end menu. But the main weakness of the menu is its lack of security and built-in tracking. Users can easily go and access DOS, thus defeating the real purpose of a menu, preventing users to hack through the system. The menu requires only 12K of RAM. To solve this problem, the library removed the Netware menu utilities so that it is inaccessible to users. The retrieval software directory and file attributes were hidden from users.

There were initial problems installing various databases retrieval softwares such as Justis, Bookbank, and BNB. The Bookbank retrieval software had to be installed three times in different subdirectories due to the absence of hard disk. Different version of the databases has different configuration and batch files. To prevent overwriting of parameter tables during update process requires tweaking.

The problem with BNB databases are its requirement for higher RAM. Exiting from BNB will always drop users to DOS. The lack of parameter argument to the start-up command is another problem faced by BNB. The database menu within BNB is not reliable. Users may select a wrong disc each time they try to change disc using the BNB menu.

It was suspected that the lack of RAM caused problem to Justis. The vendor had to supply a smaller version of the database to make it operational. However, the lack of RAM still giving the database intermittent problem.

#### 5.2.1.4 Statistical facilities

There is no statistical facilities provided by OPTI-NET.

#### 5.2.1.5 Licencing and copyright problems

Kimberlain Library as any other libraries are having problems with licencing policies of database producers. The absence of standard price mechanism make the price of licence vary from one database to another. H.W. Wilson is the most flexible by not charging any licence fees.

#### 5.2.1.6 Future development

The library will increase the workstations from the existing six to ten. The workstations remain diskless but the RAM will be upgraded from 1 Mb to 3 Mb. The

latest version of OPTI-NET will be used. The new software, DOS 5.0 will be employed for RAM saving enhancement.

However bridging was already done to enable library administrative staff that had moved to the building nearby to access the network.

The library bought CD Sentry menu/accounting software from Attica but will only install it when the RAM is upgraded.

The campus NOS will be upgraded from the present Netware 286 to Netware 386. Thus the RAM on the file server will be upgraded to 8 Mb and the hard disk expanded.

Various departments and schools in the campus has requested to link to the networks. Project to link Business School was started and others will follow suit. This will certainly requires the library to purchase more CD-ROM servers and drives to meet the future needs.

#### 5.2.2 South Bank Polytechnic Library, the United Kingdom(2)

#### 5.2.2.1 Introduction

The CD-ROM network in South Bank Polytechnic was fully operational in summer 1990. The main library on the London Road was first to be networked. Before the network was introduced, the CD-ROM service was available on stand-alone CD-ROM drives providing a wide variety of databases. But with the introduction of new networking technology and couple with various problems on a stand-alone drives service, networking become a necessity and inevitable.

Networking manage to solve problems such as students inserting CD-ROM disc in the floppy drives, discs being mislaid or even subject to theft, eliminate staff involved in handling of discs since some users are completely a novice. The staff time spent on loading and starting off the system proved to be to costly and time-wasting.

The network enable the creation of menus, where users simply choose any database of their choice without handling them. Networking allow users to share the databases simultaneously at a time. One database can even be shared among several users simultaneously. The network has managed to solve the queuing problem.



#### 5.2.2.2 Software used and selection

The OPTI-NET was chosen because of its suitability especially it is not hardware-based. Unlike most of the network products, OPTI-NET will run on the existing equipment. The system is definitely cost-saving since the system does not require an entirely new hardware. OPTI-NET was supplied by Attica Cybernetic an Online Computer System dealer in the United Kingdom.

The project was started by the installation of cabling system. This will enable all the workstations to be connected. Once LAN was set up, the installation of OPTI-NET followed. However, the library bought a new file server and the Novell package. Attica installed the Novell package, the OPTI-NET software and the CD-ROM server together with the six existing workstations.

#### 5.2.2.3 Hardware

The CD-ROM network requires a file server, CD-ROM server and also multidrives. The file server runs on a Compaq 386, 20Mhz with 110Mb hard disk and 4Mb RAM and a 16-bit network card. The configuration is on the Ethernet using Novell Advanced 286 version 2.15. The retrieval and Novell network software are installed on

the file server. The CD-ROM server is also runs on Compaq 386, 20Mhz which runs the OPTI-NET with 20Mb hard disk, 1 Mb RAM and a 16-bit network card. 100 users can use OPTI-NET at a time.

Two stacks of of four Hitachi 3600 drives per stack are daisy-chained together. Eight workstations are on the LAN. The network can also support other library applications such as desktop publishing and spreadsheet which is also linked to the LAN. The workstations used on the network are 286 PUS V with 30Mb hard disk, 1 Mb RAM and 8-bit network cards.

South Bank Polytechnic Library, intends to purchase Dell System 210, with 286 processor, 20 Mb hard disks, 1 Mb RAM and 16-bit network cards.

All the workstations in the network is served by a dot matrix printer.

#### 5.2.2.4 Response time

Contrary to what people believe, that a network will greatly reduce the response time, especially when multi-users use the system at the same time, the OPTI-NET in South Bank Polytechnic experienced no

degradation of performance. The response time is good and at time faster than the stand-alone system. The availability of caching increase the response time greatly.

Since only one printer available, to be shared among users, many have to queue waiting for their turn. Apart from printing users may also download their result on the floppy disks, either purchase from the library staff or get their disks verified to check against viruses.

#### 5.2.2.5 System management

Initially, the retrieval softwares were installed on the local workstations. But installing softwares on the local workstations creates updating problems. Therefore the library solves the problems by installing those softwares on the file server. But some products for example the Whitaker's Bookbank still requires the retrieval software to be installed on the local workstations.

Basically, the OPTI-NET is free from hardware and software problems. The CD-ROM server only crashed three times on the first year of its operation. The

maintenance down time of the network is approximately three hours on the first year of its operation.

#### 5.2.2.6 Usage statistics

Unlike the MultiPlatter, which has a very well designed Usage Statistic Software Module, the OPTI-NET does not provide such a facility. Therefore monitoring of users usage statistics is not accurate since it is based largely on observation. To solve this problem, South Bank Polytechnic has asked Attica Cybernetics to write them the statistical collection package. The requests for inter library loan is increasing.

#### 5.2.2.7 Licences and copyright

The South Bank Polytechnic is facing some difficulties to get all their database on the network due to licencing problems. Since each database producer has their own licence pricing system, therefore the library need to treat the matter differently. Bowker charge their products on the network for 100 users, three times higher than the printed version. In addition to this a new licence is required for an additional CD-ROM server. The OPTI-NET can support 64 workstations for every one CD-ROM server.

#### 5.2.2.8 Problems encountered

Some of the network licences costs was too hefty. This prohibited some databases to go on the network. In order to enable these databases to go on the network the number of simultaneous users must be restricted. South Bank Library had to ask Attica to supply them with a front-end to OPTI-NET which would restrict the number of concurrent user in accordance to the network licences.

When the network was first started, each CD-ROM retrieval software was installed on a local workstation's hard disk. The real problems cropped up each time the library received new up-dated CD-ROM databases which came together with the up-dated retrieval software. Therefore, each workstation's hard disk must be up-dated. To solve the problem, the retrieval softwares were installed on the file server instead on the local workstations hard disk. But some databases, for example the Whitaker's Bookbank still requires monthly updating on local workstation.

Unscheduled or unexpected problems end up the library calling Attica. The library must pay these extra costs since they were not covered in the maintenance agreement.

Another problem remained unsolved is the opening menu. As many users do not exit after using a particular database, the new users especially inexperienced users had to find the opening menu themselves. This caused a waste of time, frustrations or users end up asking help from library staff. No practical solution is found to solve the problem although building time-outs into the front-end software may help. But the big number of databases is not workable. To help solving this problem, the library staff will occasionally return the opening menu.

### 5.3 MULTIPLATTER

#### 5.3.1 G. Holmes Braddock Senior High School in Miami, Florida, United States(3)

##### 5.3.1.1 Introduction

MultiPlatter system was chosen for library media centre Braddock Senior High School to cater 3,800 students. MultiPlatter. The system was installed to ensure both students and staff to be an effective users of ideas and information.

### 5.3.1.2 Hardware

The hardware configuration used are a CBIS network server with 386 processor and 2Mb RAM; fourteen CD-ROM drives; one auxiliary microprocessor file server per workstation; two dial-in ports; two modems and twelve Tandy workstations with 1Mb RAM and 40Mb hard disk.

The modem and the dial-in ports is to allow access from other areas in the building and also for the maintenance and various other relevant functions b.y the SilverPlatter.

### 5.3.1.3 Operational aspects

The system can be access simultaneously by several users on a rotational basis. Since access is so fast it is transparent to the users(users think that searching is done simultaneously).

The menu will enable users to choose the database of their choice. The MultiPlatter software will control the network traffic. When choosing menu, the front-end software on the workstation will serach from the hard disk. When the search is done, the front-end software

will search from the CD-ROM disc and the result will be sent back to the workstations.

Among the CD-ROM products chosen for the network are the Reader's Guide to Periodical Literature, ERIC, Facts-on-File, Sports Discus, the Oxford English Dictionary, World Atlas etc. All the databases can run on the MultiPlatter. The MultiPlatter is capable to run any type of databases as long as they adhere to the High Sierra format or the ISO 9660.

#### 5.3.1.4 Usage Statistics

The statistical facilities provided by MultiPlatter is called Usage Statistics Software Module. Each database can be evaluated their frequency of use, the number of users using them, the time users spent on a particular database, the number of users use a database simultaneously etc.

#### 5.3.1.5 Problems encountered

The users could access the MS-DOS easily. To prevent users from dropping into DOS and using floppy drives, the media staff had to secure covering in front of the drives.



The media library had to check all the LAN products to make sure that none the products allowed users to drop into DOS. They also had to disabled control/break option.

## 5.4 LANTastic

### 5.4.1 The Southern Maryland Regional Library Association(SMRLA), the United States(4)

#### 5.4.1.1 Introduction

SMRLA consists of eleven public libraries. Therefore the sharing information and resources was necessary and cost-saving while giving users better information services. The objective of SMRLA was to provide remote access to remote users in its county and also allowing the internal staff to have a simultaneous access to its CD ROM databases using the 800 existing telephone numbers. Apart from remote access, remote printing was thus necessary too. SMRLA started the project with the acquired grant of US\$20,000.

#### 5.4.1.2 Hardware and software selection

They bought 386SX with 4Mb of RAM, 95 Mb hard drive as a communications server, a 286 machine for CD-ROM server, four CD-ROM drives, a 60 Mb high speed tape drive and two 2400-baud modems. The system is supported by Artisoft LANTastic Ethernet.

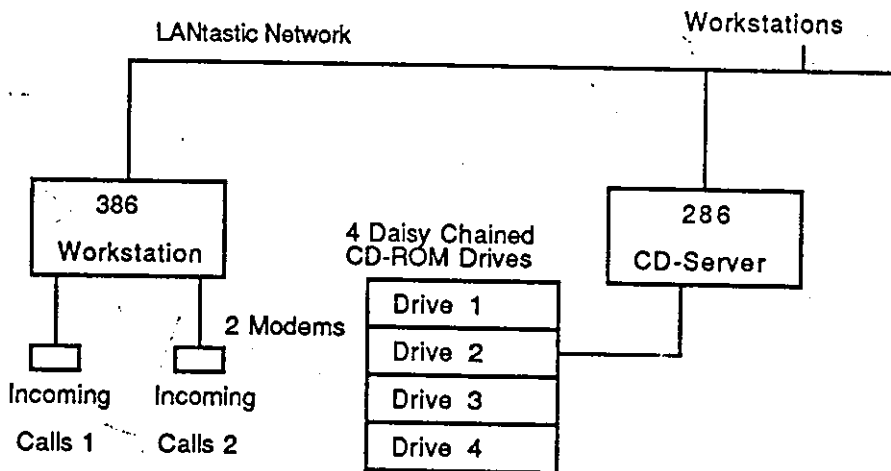
The softwares chosen were pcANYWHERE, a communications package; QEMM 5.1, a memory management package, DESQview 2.3 for multitasking capabilities, Direct Access fort controlling the user session. The 800 telephone numbers will allow two simultaneous users to access via two ports, allowed by LANTastic.

#### 5.4.1.3 Configuration

A 286 machine serves as a CD-ROM server linked to four Hitachi CD-ROM drives, daisy-chained together. The CD-ROM server was configured by defining each of the four CD-ROM drives as a network resource. The CD-ROM server instead support the in-house and remote access in the network. The network resource, however operates with each workstation in the network access the CD-ROM drives as ordinary hard disk drive.

For a remote access, a 386SX machine will behave as a communications server. Both the 2400-baud modems were linked to the 16Mhz 386SX communications server. The modems will entertain the incoming calls. However in LANtastic, a communications server can also act as a workstation by providing access to CD-ROM applications. Figure 9 below shows the above configuration.

Figure 9. SMRLA's CD-ROM Network Configuration(9)



#### 5.4.1.4 Supporting software

##### a) pc ANYWHERE and Direct Access

In LANTastic pcANYWHERE controls the incoming calls through the modems linked to the communications server. pcANYWHERE allows remote workstations to access the network and the remote search to be executed on the communications server. The result of the search will then be displayed on both the communications server and the remote workstation. Other features of pcANYWHERE are the passwords protection and statistical facilities to monitor the usage of the network.

SMRLA employed Direct Access by DETA Technologies which has the capabilities to terminate the telephone call automatically immediately after the caller exit from the network. Direct Access used less than 1K of memory. It also has the ability to restrict access to the system prompt by employing the passwords protection. The disadvantage of Direct Access is its inability to allow more than one remote user to access at a time.

To expand the system to allow more than one remote user to access the network, the 386SX communications server can be used to control more than one modems. They are

four software installed on the communications server to control the network. They are QEMM 5.1, DESQview 2.3, pcANYWHERE and Direct Access.

b) QEMM 5.1 and DESQView 2.3

Instead of MSCDEX SMRLA employed QEMM 5.1 for its memory management. QEMM 5.1 will support the multitasking and also load the network device drivers above 640K.

DESQview 2.3 however support multitasking in the network by allowing the tasks to executed on a rotational basis starting from the foreground and then the background. But once in operation, it is transparent to users. Another front-end software employed for pcANYWHERE for the remote access is ATERM.

c) Access

The LANTastic network in SMRLA provides a menu for selection. The system will automatically disconnect once a user exit from the network and the next caller can then move in. To prevent a user from wasting time, the system will be disconnected or logged off if no activity is done within five minutes.

#### d) System management

The two common process involved in LANtastic network in SMRLA is creating and deleting temporary files. But without proper precaution this may cause the hard disk in the communications server to crash or slowing down the system. To avoid the problems, the disk optimization package is used twice a week to ensure disk read and write with maximum efficiency. In addition to the usage of disk optimization package, the CD-ROM drives and discs are cleaned regularly.

#### e) Databases on hard disk

The in-house database, the Southern Maryland Union List of Serials was installed on the hard disk for users to access. Another database, Community Information Directory will also be installed on the hard disk.

SMRLA planned to replace the 286 CD-ROM server with a faster 386 processor to increase the performance and speed of the network. By February 1991, the network has allowed nine libraries and school to participate and successfully access the system.

#### 5.4.1.5 Problems encountered

SMRLA had US\$20,000 grant for their CD-ROM network. This grant was considered insufficient. To help building their network, SMRLA engaged a consultant to provide them a workable solution within the financial limit. Unfortunately, the project became complicated. The consultant failed to complete the project.

SMRLA did not have the technical expertise to proceed with the project. They sought assistance from SOLON Consulting Group, a local LANTastic supplier. The whole system had to be reconfigured to enable remote access which would support in-house access; enable two or more simultaneous remote users by using all the software and hardware SMRLA had bought.

The other problem was the inability of Direct Access by DETA Technologies, to allow more than one user to remote access the system simultaneously. They had to choose between two solution either to purchase a new 386 machine and a modem acting as a second communications server or using the present communications server which would control two or more modems at one time. To save further costs, SMRLA chose the second option.

## 5.5 CD-NET

### 5.5.1 Kerr Library, Oregon State University, the United States(5)

#### 5.5.1.1 Introduction

The system chosen for the Kerr Library was CD-NET. The network serves 12 computers. Various databases are run on the network. They are UMI databases, SilverPlatter databases and Cambridge Indexes.

#### 5.5.1.2 Operational aspects

The problems with the network is basically products incompatibility. The network fails to run as long as the SilverPlatters discs and Cambridge Indexes are run together. The removal of Cambridge Indexes will solve the problem.

#### 5.5.1.3 System management

The hardware problems caused the system to freeze altogether every two weeks and sometimes several times a day. The solution is normally rebooting the system. Another problem is most of the H.W. Wilson products do



not run very well on the network because it occupies too much RAM.

#### 5.5.1.4 Licencing

Kerr Library was having problems with databases publishers over the site lincencing. A few databases such as SilverPlatter PsyLit, UMI databases and Science Citation Index were removed from the network because of the unresolved lincencing problems.

#### 5.5.2 International Institute for Management Development(IMD), Lausanne, Switzerland(6)

##### 5.5.2.1 Introduction

The International Institute for Management Development is located in Lausanne, Switzerland attracts participants from over 85 countries all over the world. English is the medium of instruction. The Institute offers MBA and management development programmes.

Therefore the selection of CD-ROM networking software must cater 300 general users and 100 simultaneous users.

#### 5.5.2.2 Software selection

CD-NET was chosen and the system was installed by Dr Holtaus and Heinisch, Gottingen, Germany which is reknown for the many CD-NET installations in Germany.

#### 5.5.2.3 Configuration

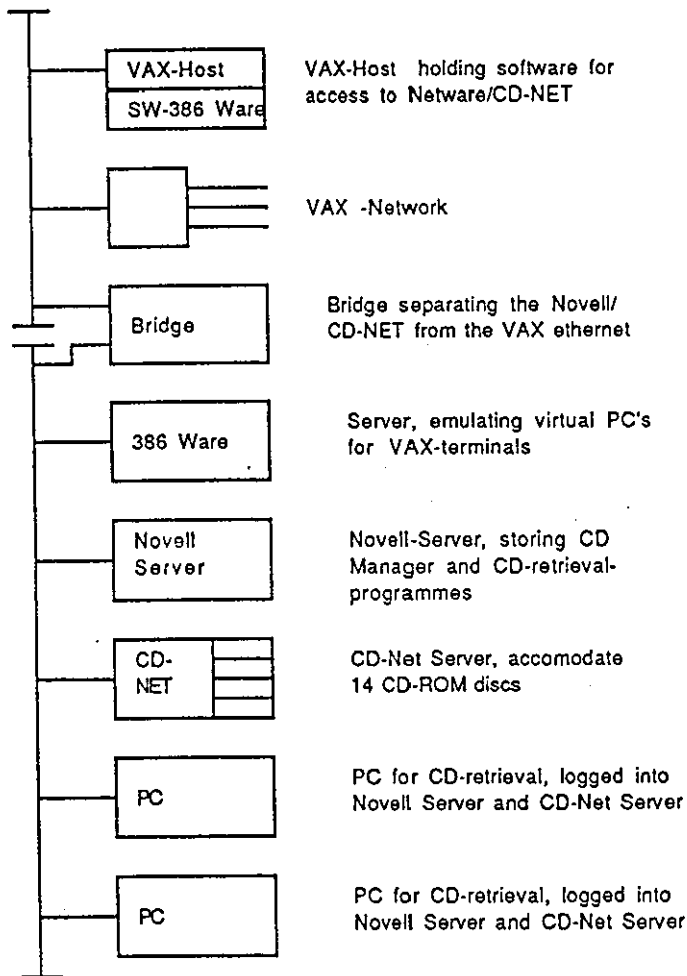
The system installed by Dr Holtaus and Heinisch consists of CD-NET, Novell, Logcraft, both hardware and software and PCSA. A VAX was designed as a host on the ethernet. CD-NET accomodates 14 CD-ROM drives and the system is run on top of Novell Netware 386. To run the PCSA, the ethernet cards were required. The Logcraft 386-ware server control the CD-ROM and VAX network. 200 microcomputers including Macintosh are linked to the system.

The 286-based machines were upgraded using Upper Memory Board. Thus the 286-based PCs will have the capabilities of the 386-based machines.

The CD-Manager used in the network was designed by Dr Holtaus and Heinisch serves as a coordinator in coordinating access in the network. CD-Manager will coordinate the whole range of software and hardware in

the network. Figure 10 below is the CD-NET configuration in IMD.

Figure 10. IMD's CD-ROM Network Configuration (10)



#### 5.5.2.4 Operational aspects

The CD-Manager has many features to make the network a

very efficient and keeps problems to the minimal. Its user friendly appearance is enhanced with the presence of the pull-down menus for databases selection. Information can either be downloaded into the floppy disk or exported to the integrated export file manager for further manipulation using the word processor.

CD-Manager is capable to allow the library to limit the simultaneous access to the system. It may also define group of users can have access to the system. The 'infoboard' is basically a screen noticeboard for the library to interact or get users informed.

#### 5.5.2.5 Statistical facilities

The CD-Manager can create various statistical facilities for library housekeeping, to help librarian to monitor the the efficiency of the network. The statistical facilities can analyse the length or time a particular database is used, type of users who used the network or a specific database, the database which is heavily used, or even the frequency of usage of a particular workstation. The data which have analysed can be displayed on screen by line or pie-chart but it can not be printed. However, the system allows the data to be downloaded into any spreadsheet software for further

manipulation or graphical representation.

#### 5.5.2.6 System management

The Library System Coordinator run the network with assistance from computer department. The system is known to have a very occasional problem.

#### 5.5.2.7 Licencing and copyright

IMD Library faced many problems with the uncompromising databases producers. One database producer was reported to charge IMD 200 per cent of the subscription price for a licence but still limit the number of simultaneous access. Another was reported to charge US\$100 per extra terminal. Another database producer was known to charge US\$90 for between 2-5 simultaneous users. The statistical facilities will help the library to monitor the usage of the databases, to assist them in renewing or cancelling its subscription.

#### 5.5.2.8 CD-ROM databases used

IMD subscribed 9 databases. They are ABI/Inform from

UMI; Computer Select from Ziff Communications; F & S Index plus Text from Predicasts; Wilsondisc Business Periodicals Index from H. W. Wilson; Fame from Bureau van Dijk; Dafne from Bureau van Dijk; Diane from Bureau van Dijk; Corporations Ondisc from Standard & Poor's and Gale Global Associations from SilverPlatter. Added to the network is Standard Industrial Classification Cross Reference Software from Robert Fox & Associates for industry analysis.

#### 5.5.2.9 Problems encountered

IMD Library was fortunate because their network was installed by Dr Holthaus & Heinisch which is an experienced and efficient vendor that had installed most of the CD-NET networks in West Germany. The problems they faced initially was insufficient memory in 286 machines. This problem was solved by using Upper Memory Boards in 286 machines. Thus the 286 machines will have equal capabilities of 386 machines. The insufficient memory was further solved by replacing the older machines with 386 PCs.

The library was assisted by the computer department to install the entire system. It took them almost two

weeks to install the system. For the first two months the library was assisted occasionally the computer department. However, the CD-ROM network is managed by the Library System Coordinator who received network training with the basic knowledge of DOS and training to install CD-ROM software.

However, there was no report of after lay-out problems from the literature.

## 5.6 CD-CONNECTION

### 5.6.1 Loma Linda University Library, the United States(7)

#### 5.6.1.1 Introduction

The Loma Linda University Library selected CD-Connection from CBIS for their CD-ROM networking system. The networking also allows remote access from both IBMs and Macintosh microcomputers.

#### 5.6.1.2 Cabling system

The CD-ROM network run on Ethernet using bus topology.

They employed 10BaseT version of Ethernet, a thin version of coaxial also known as thin-net or thin Ethernet. The thin-net cable run in a T-like connector rather than the usual drop-down. A computer was connected from the file server by the thin-net cable and each computer was connected to one another in line. The 10BaseT can be wired with unshielded twisted-pair normally used for telephone lines. This is a hybrid between a star and bus topology and functions like the token ring. A card was plugged into the file-server and connected to a hub.

To allow a better transmission of data and also images, the library decided to install fibre optic cable. They also bought fibre hubs and T1 connections. T1 allows digital transmission of voice data used by telephone lines. The function of fibre hub is to carry both voice and computer data or communication through the fibre optic cable. Lightwatch is a software allowing fault diagnosis. It will identify precisely the faulty cable for maintenance personnel to repair. This greatly reduce time wastage in tracing the problems. Loma Linda University Library bought all the fibre optic hardware and software from a company called fibermux.

#### 5.6.1.3 CD-ROM hardware and software



The Novell 3.11 allows network interface in the campus with the campus mainframe, sun workstations and macintosh microcomputers.

CBIS CD-Connection with a single expansion per CPU containing fourteen drives was bought instead of a normal tower of seven drives per tower, with a system memory, a floppy drive and a CPU either with 286,386 or 486 processor. This will give a better response time instead of adding expansion towers containing seven drives per tower. CD-Connection allows an additional of two seven drives tower to be added to the existing tower (seven drives tower).

For a CD-server, a 386/25 MHz machine with 8 Mb RAM was bought instead of the normal 4 Mb. The RAM is expandable to 16 Mb. The system allows 255 users to access the network simultaneously.

The 10BaseT card and the Novell card were installed in the server. Novell network treats the CD-Connection tower as workstations although it functions more as a file sever and CD-server. The batch files were installed on the server. It was necessary to direct and re-direct the CD-ROM drives for each user on the network.

The Uninterrupted Power Supply(UPS) was bought from Network Security System. In addition to UPS, a software to alert users of power outages was also bought. LANSafe will be informed by UPS of that it loses power supply. LANSafe will then inform users of this situation and then will shut the network neatly.

Other software used in the network was SABER LAN administration and cc Mail for network electronic mail. pcAnywhere and pcMacTerm were installed in the twelve PCs in the remote access network to control the twelve phone lines(refer remote access below).

#### 5.6.1.4 Remote access

The Loma Linda Library chose CUBIX products for their remote access. Twelve 286/12MHz machine with 1 Mb RAM were bought to connect the external modem. Two AT-clones were also bought as bridges or routers. Each bridge serves three machines. Three CUBIX card were installed on each bridge. Twelve 9600 baud modems were also bought.

#### 5.6.1.5 CD-ROM databases

Most of the datases make available on the networks are from SilverPlatter. This is to enable users to use the databases with the same user interface with ease.

#### 5.6.1.6 Problems encountered

The Loma Linda University Library bought various hardware and software without realising that no library had done it before the way they did it. They were informed that they were the first to do it by combining various hardware and software together and was also informed that all the vendors did not guarantee every piece of equipment would work. Fortunately enough the system was able to run. However, they had to correct several problems before the system run smoothly.

The library asked for technical support from CUBIX to enable the miniboards to communicate to the network. They purchased Move'em, a memory management software to enable it to utilize the upper 384K memory on each CUBIX CPU, where the CUBIX cards were installed. The memory management software solved the problems of memory insufficiency to load SilverPlatter software, DOS, NOS, remote access system, the CD-ROM drivers and various CD-ROM softwares.

### 5.6.1.7 Costs

The costs provided below are various breakdown cost incurred to install CD-ROM network in Loma Linda University Library.

#### Hardware and software

- |  |          |
|--|----------|
| 1. CD-server 386/25 MHz, 4 Mb RAM<br>(the library used 8 Mb RAM) | US\$5315 |
| 2. CD Expansion Chassis for additional<br>drives                 | \$242    |
| 3. CD-ROM drives- price each                                     | \$ 695   |
| 4. Software for 255 users on Novell                              | \$1995   |

#### Communication cards

- |  |        |
|--|--------|
| 5. QL2286A Processor Boards - price each | \$1995 |
|--|--------|

#### Telecommunications products

- |  |       |
|--|-------|
| 6. Hayes Ultra 9600 modem  | \$999 |
| 7. pc ANYWHERE 111   | \$145 |
| 8. pc ANYWHERE 1V  | \$179 |
| 9. pc MacTerm 11(with portion of PC)<br>(price without portion of PC \$99) | \$195 |

UPS and smart network software

10.	IPS/A.I. 800 UPS	\$899
11.	LANSafe A.I. 286 (for Novell Netware 286 2.1x)	\$ 99
12.	LANSafe A.I. 386 (for Novell Netware 386 3.1+)	\$135

Table 2. Costs of CD-ROM networking in Loma

Linda University Library

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## CHAPTER 6

### INTERVIEW SURVEY

#### 6.1 Aims and methodology

The interview survey was conducted by interviewing two professional staff from Pilkington Library, Loughborough University of Technology. The first interviewee is a System Librarian and the second is a Senior Assistant Librarian. The aims of the survey was to get the primary information about CD-ROM networking from professional staff who were currently planned to install the CD-ROM network in their library. The interview would also raise the writer's understanding and awareness of CD-ROM networking. Besides, the survey would reduce a total dependency upon published literature in this area.

Powell(1) describes this kind of survey as an experience surveys. Experience surveys is an exploratory survey apart from enhancing writer's knowledge and familiarity, it would also clarify the concepts; gaining ideas; useful insights; getting true and accurate picture of current situation but does not emphasise of acquisition of statistics.



The interviews were conducted separately in respondents' respective office. The interviews were not structured. However a set of questions was prepared so that the interview would run smoothly and within the desired framework. The questions were not read in sequence or word for word to prevent the flow of the conversations. The interviews were tape-recorded after seeking consent from both respondents.

#### 6.2.1 Respondents experiences, involvement and knowledge of CD-ROM network

Since both respondents were involved in the project, their knowledge of the technology was profound. However, the System Librarian, who is a computer professional by training had a profound technical knowledge of the technology. The Assistant Senior Librarian(Information) concentrates more on the non-technical aspects and the information services.

Both of the respondents' keep abreast with the technology by reading information journals, attending conferences, talking to colleagues, put themselves in CD-ROM mailing lists, and also receiving products brochures from manufacturers. Both respondents' were

very enthusiastic in their project which would be implemented very soon.

In this project the System Librarian is the System Manager. His technical expertise eliminated the necessity for engaging a consultant in preparing the Request for Proposal(RFP).

However, only a few people were involved in the project. Not all staff were informed of the development of CD-ROM networking in the library because it was not in operation yet. However, the library staff will only be informed when the system is ready to be implemented.

#### 6.2.2 Reasons for networking and the system chosen

Various reasons were given as to why CD-ROM networking was necessary. It provides security purposes since users will not handle the discs any more. Thus avoiding damage or potential lost of the discs. The network will also avoid queuing by users. All databases can be access simultaneously by multi-users.

There was also demand from various departments in the campus for networking. Without networking some

departments need to buy their own stand-alone hardware and software for their own use. Thus networking can prevent wastage and duplication.

The software selected for CD-ROM network was SCSI Express. SCSI Express comes in a tower consist of fourteen drives. Every seven drives require one Network Interface Card(NIC). The 486 machine will be used as file server.

Four workstations will be installed for the users and three for the library staff. However the present stand-alone Hitachi drives are not compatible with SCSI Express. But the existing PCs can be used for the network. A few stand-alone workstations would be retained for certain databases which will not run on the network due to licencing problems or the databases do not merit to be placed on the network due to their low usage.

#### 6.2.3 CD-ROM network will run on LAN and campus WAN

The CD-ROM network will run on the existing campus ethernet. The SCSI Express will run on top of Novell Netware 386. Apart from LAN, any computer on the campus

ethernet will be able to access the CD-ROM databases.

However, there is no plan for remote access.

#### 6.2.5 Costs of the network

The estimated costs of the network is in the region of £10,000. The price of SCSI Express is about £6,000. The costs of the networking is rather low since the library does not need to install the cabling system and buying the network operating system as these are provided by the computer department.

#### 6.2.6 After-sale service and maintenance

The library had bought the hardware and the software. The installation of the hardwares will be done by the library themselves. They will not receive any after-sale service from the hardware vendor. But the library will get after-sale service from the software suppliers. But they do not have any ideas of the after-sale service from software vendor since the operation is not in operation yet.

#### 6.2.7 CD-ROM licencing problems

The library has contacted most of the database producers. There is no standardization of licencing policies among the vendors. Some database producers do not charge for network licence at all. A few are fairly reasonable and there are database producers that charge a hefty and exorbitant rate for the network licences. One of the respondent mentioned that some database producers even charge an extra 25 per cent of the subscription.

#### 6.2.8 Demand from users

Generally, users do not know the presence of CD-ROM networking. Demand only came from the faculty as explained previously.

#### 6.2.9 The technology concentrates highly in the academic libraries in the United Kingdom

The respondents were in the opinion that the academic library was in the better position to use the technology due to its nature where users do their own searching for information. Unlike the special libraries where the

researchers or users depend entirely on the librarian or the information professional to do searching for them. The most important thing to users are the acquisition of materials regardless in what media or where they come from. There are no urgent need for CD-ROM networking in the public libraries. This is especially true since most of the databases are very specialised and technical.

#### 6.2.10 The possibility of the network used for teaching

The respondents believed that in the long run there is a possibility that network will be used for bibliographic instruction and library skills. But there will not be any bibliographic instruction at present.

#### 6.2.11 Inhibitive factors preventing libraries from implementing CD-ROM network

The respondents believed that costs is one of the main factor that hinder CD-ROM networking. The lack of technical expertise is another main problem especially libraries without computer trained professional.

Engaging consultant to prepare the RFP will increase the networking cost.

Licencing problems is another main problem. The unrealistic and hefty price of licencing will erode a big sum of libraries budget. In addition to this, some database producers are not keen of network at all out of fear of losing business.

The decision to implement CD-ROM network, may also cause libraries time and money. The network will be an extra burden to the library because it may deprive the library of their budget and more staff time are needed for the system.

#### 6.2.12 Impacts on respondents institution

The respondents believed that CD-ROM networking will enhance the image of the library based on a variety of previous experience. The stand-alone CD-ROM has created a profound impact on end-users. The CD-ROM databases on stand-alone system are so popular among users. The network will no longer requires users to be physically present in the library and queuing for the databases. The network will further give value for

money for library materials especially serials because abstracts, indexes on CD-ROM will allow users greater access to the materials.

One of the respondent mentioned that the inter library loan requests will definitely skyrocketing if they did not introduced fee based inter library loan. Only the post graduates students with permission from their supervisors can have free requests.



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## CHAPTER 7

### REVIEW

#### 7.1 Overview

The main aim of this thesis is to investigate CD-ROM networking technology and its applications in libraries. The study also intends to develop an informed view of this area by giving more attention and emphasis to the present state of CD-ROM networking and their capabilities; the applications of the technology in and the on-going developments in libraries and the general view of the CD-ROM technology which is considered to be important in order to comprehend the networking technology investigated.

A variety of approaches was used to achieve this goals. Firstly, a state-of-the-art literature on CD-ROM networking was studied, elaborated and examined. Various aspects of networking technology involved such as cabling system; the LAN topologies; hardware and various software required for the network were investigated.

Secondly, reports on a wide variety of literature on libraries that had implemented the network especially in the United Kingdom and the United States were covered.

Thirdly, personal interviews with two information professional in Pilkington Library, which will implement the system very soon. The interviews will provide more primary information, views, experience and insight so as not to entirely dependent on the literature.

## 7.2 Conclusions

The following conclusions can be drawn based on the preceding chapters:

- Several years after its introduction, CD-ROM networking can be considered to be feasible and reliable technology to be employed by libraries.
  
- Libraries can exploit various benefits of CD-ROM networking which provides huge storage capacity; fast random access although not as efficient as the magnetic discs; the ability of multi-user to search the database simultaneously; space-saving; remote

access; allowing end-users to use the system without being physically present in the library; increase discs security by avoiding discs handling; using the network for bibliographic instruction or teaching; saving cost by avoiding duplication where various departments in an institutions need not buy separate hardware and software; reduce queuing problems; allow resource sharing among libraries; provides speed of retrieval locally or remotely where data can be downloaded and manipulated by end-users; improved the efficiency of library housekeeping and planning using the statistical facilities provided and increase the usage of materials especially serials which give value for money of those materials.

- Standardization plays an important role which allows a wide variety of databases to run on the network. The High Sierra standard covers many area such as standard on physical discs; compatibility of drives etc. However, to date no standard on searching and retrieval softwares are available since this is considered to be a competitive aspects of marketing by database producers.
  
- The availability of wide varieties of CD-ROM

network software allow libraries to select the best system based on their financial capabilities or needs to suit the existing situation.

- As more libraries implement CD-ROM networking, database producers are bound to comply to produce databases that will run on the network. This contribute to the proliferation of network databases.
  
- The literature proved that libraries are still slow to response to the new technology. Probably, they are adopting wait and see attitude to learn from others. The lack of technical expertise among librarian posed a problem in acquiring this new technology. Generally, libraries that had implemented the networks engaged consultants to prepare RFP; or the libraries have system librarians or libarians who have profound interest in the technology and develop their knowledge through experience.
  
- Most of the CD-ROM local area network run on client-server environment instead of peer-to-peer network.

- Licencing and copyright remained unsolved problems without a standard pricing policies. These has created a lot of problems to libraries. The hefty price of licencing deprive a huge amount of libraries budget or force them to cancel the database subscription.
  
- One of the way to solve the licencing problems is restrict only one user per database instead of simultaneous users. The statistical facilities can be installed to gather information on the successful and unsuccessful users. The statistics will enable the librarian to determine the right kind of licencing and the right number of simultaneous users per database.
  
- CD-ROM networking can be run on both LAN, WAN and remote access. The ability to bridge both the CD-ROM network and minicomputers increase the function and usage of networking.
  
- The study also discovered that only a few information professional are involved in implementing the network. The rest of the staff are not really informed of the progress of the projects. Those who are involved have profound

knowledge of the technology either by attending conferences, putting themselves on CD-ROM mailing lists, reading journals, talking to colleagues etc.

- Most of the libraries that implemented the network had previous experience of stand-alone CD-ROM services.
  
- The wide variety of databases create confusion not only to the librarians but also end users especially the novice users. More time is needed for user training. One of the way to solve this problem is to purchase databases that use the user interface, meaning the databases should only be bought from a few selected database producers only. The wide variety of user interfaces will also discourage users from using CD-ROMs.
  
- In the United Kingdom, CD-ROM networking are concentrated in the academic libraries whereas in the United States, apart from the academic libraries, CD-ROM networking are also available in school libraries and other institutions.

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## CD-ROM NETWORKING INTERVIEW:

## LIST OF QUESTIONS

## Introduction

This interview is about CD-ROM networking; about your experiences with this technology; about your future plan to employ this technology in Pilkington Library and finally about your view of the present position of the libraries concerning its application.

Question 1: What is your job title and job description?

Question 2: I would like to ask about CD-ROM network. Why do you want to have a CD-ROM network in this library? What network system are you choosing and why do choose it?

Question 3: How about after the sale maintenance service? What do you expect from the supplier?

Question 4: Who is writing the RFP(Request for proposal)? Do you engage a consultant for this project?

Question 5: Do you just plan for LAN or also for WAN? Or any remote access?

Question 6 Can you explain about setting up the LAN; type of network operating system you are using and the network topology?

Question 7: How many workstations do you plan to install?

Question 8: What are you going to do with the present hardware? Will you retain the single user service or will you network totally?

Question 9: Can you give the costs or budget for the for the network? Do you face any management or technological problems in implementing this project?

Question 10: Do you think there will be problems with licences and copyright?

Question 11: How many staff are involved in this project? What is your function or role in this project?

Question 12: Do the staff of the library who are not involved in this project are informed about it? What is their reaction?

Question 13: How do you keep keep abreast and get informed about CD-ROM networking? Are you well informed with the development of CD-ROM network in other libraries?

Question 14: With the introduction of CD-ROM network, what is the impact on the users? Will it raise the image of the library?

Question 15: What are the inhibitive factors do you think would prevent libraries applying the CD-ROM networking technology? ( Will it be high costs. etc?)

Question 16: At present is there any demand from users of this library for a CD-ROM network or are they happy with the present system?

Question 17 In your opinion, why CD-ROM networking is employed by the academic libraries only in the United Kingdom? What about other libraries?

Question 18 Will you use the network for training or teaching library skills?

