LOCAL AREA NETWORK:

A CASE STUDY OF

FEDERAL UNIVERSITY OF TECHNOLOGY

LIBRARY, MINNA

BY

JOEL J, KOLO

(PGD – COMPUTER 99/2000/890)

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

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A PROJECT SUBMITTED TO

DEPARTMENT OF MATHEMATICS/COMPUTER SCIENCE

SCHOOL OF SCIENCE AND SCIENCE EDUCATION

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MINNA – NIGER STATE

IN PARTIAL FUFILMENT OF THE REQUIREMENTS FOR THE AWARD OF

POST GRADUATE DIPLOMA OF TECHNOLOGY (COMPUTER SCIENCE)

APRIL, 2002

CERTIFICATION

This project by Mr Joel. J. Kolo entitled "Local Area Network: A case study of Federal of Technology, Minna Library" meets the requirements for the award of Post-Graduate Diploma (Computer Science) of the Federal University of Technology, Minna and it has been approved for my contribution to Scientific knowledge and literate presentation both locally and international.

DR BABATUNDE L. ADELEKE	MR LAWRENCE N. EZEAKO
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CO-ORDINATOR – PGD COMPUTER SCIENCE

DECLARATION

I do solemnly declare that this project entitled "Local Area Network": "A case study of Federal University of Technology, Minna library" is an original Work done by me. The project work has not been presented in any form elsewhere for the award of Diploma, Higher National Diploma, Degree or Doctor of Philosophy (PhD) degree in any institution of higher learning.

All quotations, abstract and references from professional in the field of Information Technology (especially Networking are duly acknowledged and credited).

JOEL J. KOLO

DEDICATION

This research work is specially dedicated to almighty God, the creator of the whole Universe. Also, to my wife and children. May the good Lord bless you all (Amen).

ACKNOWLEDGEMENT

I will give all thanks to the lord for his mercies and divine favour over me for sparing my life, given me the strength and wisdom to successfully complete this programme.

I wish to express my deep and concern gratitude to my supervisor in person of Dr. Babatunde L. Adeleke and Mallam Audu Isah for their tremendous efforts in equipping me with the necessary and current basic information needed to successfully carryout this study. Despite your tight schedules, you still create time to scrutinize this work of mine. I thank you.

Further appreciation goes to all lecturers in the department of Maths/Computer Science for their patience and guidance.

I am indebted to Mr Moses Dogonyaro (Systems Analyst/Programmer) for the professional advice he rendered during the course of this project.

Finally, I appreciate the contribution of my immediate family financially, morally or otherwise. And to any other person that in one way or the other contributed to the successful completion of this project. I love you all and may God reward you bountifully.

ABSTRACT

The project focuses on Local Area Network (LAN) a case study of Federal University of Technology Library, Minna.

The project starts with the implementation of Information Technology (I.T) in the Nigerian Universities and its benefits in Managing Information Systems (M.I.S.). Also, it treats in detail different types of Network topologies, advantages and the disadvantages of each.

The project, suggests better way of networking the University Library (i.e star topology format) instead of the `Bus' topology that exists as at now.

Finally, the project left no stone unturned thereby unfolding how the overall system can be implemented.

A cost analysis was carried out on the old system and the newly designed system while suggestions and recommendations were made.

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CHAPTER ONE

INTRODUCTION

History shows that, the development of computerization of libraries began in the United States of America (USA), and later in United Kingdom (UK) in early 1960s. Much of this early experimental works using computers were done in special libraries.

In the 1970s, it was the growth in co-operative services and Resource sharing among Universities that encouraged the use of Computers. Ohio College Library Centre (OCLC) came with this experimental works using the computer, which was later re-named online computer library center (OCLC). This was established in 1967 to develop and operate a computer services to support college libraries in the state of Ohio, U.S.A. Its products to services were used by libraries in surrounding countries.

Further development in 1980s centred amount online Public Access catalogues (OPAC). With this development, library clients sit at different workstations to access the books in the library. Other development processes resulted in 1980s growth in information available on devices such as CD-ROM. These are databases that provide a huge amount of information to many users in many different locations.

The 1990s saw the introduction o flow Cost and high performance computer hardware and the massive increase in software development. Added to this were standardization of communication systems and the establishment of commercial Database Management centers (DMC).

Further to this development in the area, computerized libraries should be able to provide:

- Necessary institutional (set up) structure to support the development and exploitation of information and communication Technology (ICT).
- Development of the human resources for effective exploitation of ICT since the technology provide a means for enabling lifelong learning (education) for more widespread education which leads to improve quality of life;
- Training of end-users; and
- The eventual integration with the emerging information infrastructure to facilitate prompt and time access to transborder (international) information networks computer over the past decade have come to play a dominant role in the processing of information that it is unfathomable to imagine any enterprise to function efficiently and effectively without them. The computer is a useful tool for data information input, storage, processing and output.

Computers, as enthused by Awe (1997) are needed when:

a) There is the need for a more accurate and cost-effective knowledge to assist decision-making

b) It is cumbersome to get results through manual operations due to either time constraints or sheer magnitude of work.

c) There is need to improve on customer services

d) There is need to reduce mental and physical efforts in tackling certain tasks.

e) There is need for cost efficiency through elimination and reduction of inefficient practices.

Libraries, the repositories of human heritage and knowledge have proven to be different in terms of improved productivity through the use of information technology, including computers for information storage, input and processing. Productive I. T. based activity is referred to as the application of automation. There is no doubt that the future of library information services in our society is bound closely with the development of information Technology I.Ts)

Olalokun and Salisu (1993) grouped the application of computers in the library into three categories:

a) House keeping functions, which embodies four sub-systems, viz:

   i) Acquisitions, cataloguing, Circulation and Serials. The acquisition of intellectual materials by direct legal deposit. Records could be kept with the aid of computers for the performance of book dealers being patronized by the library. Automation can also help in fund control and the generation of accessions list.

   ii) Cataloguing involves the preparation of catalogue entries and other processes connected with the maintenance of the catalogue. The establishment and maintenance of catalogue

database, Online Public Access Catalogue (OPAC) and inventory Control and statistical analysis.

iii) In the area of circulation of acquired intellectual materials, the computer can lend weight to:

- The process of lending and locating available collections.
- The establishment and generation of users record and give instant status information about loan items.
- Output generation, customized reports and notices for overdue, reservations, usage statistics, preparation of printed circulation list and fines records.

iv) For serials holdings, automation can facilitate the following:

- Subscription control, procurement procedures, order preparation, fund analysis and counting;
- Cataloguing of new serials, preparation of serial record entries, transaction control, additions, changes and relations;
- Output generation and dissemination, including the preparation of serial holdings, accessions lists as well as union lists.
- Information storage and retrieval including selective Dissemination of Information (SDI)
- Management functions, encompassing user habits or management of work performance.

b) **CD-ROM SEARCHING**

Information seekers in many developing countries have virtually no access to the large computerized information sources, resulting in the emergence of an information gap. This therefore afforded database producers in Europe and U.S.A. the opportunity to offer their products on-line as the Compaq Disk – Read only Memory (CD-ROM)

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c) **NETWORK**

Nigerian University Libraries are currently aware that the traditional manual methods of processing, storing and disseminating information have to give way to the most efficient and effective method that provides speed in the availability of required information, ascertain accuracy of and guarantees the efficiency of the information provided. This lead to many Nigerian University libraries to network their libraries.

This is the backbone of this project.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 COMPUTER COMMUNICATION NETWORK

Computers are powerful tools that enable users to store and process large amount of data at a faster speed. Computers are applicable in areas like, banking, space technology, science/engineering, inventory keeping, library automation etc. As business grow, company or institutions often need several people to input and process data simultaneously. For this to be beneficial, those people engaged in the input of data must be able to store and process the data of individual operator. Networking of computers becomes a very important tool in such a situation.

Networking is simply a group of computers connected together by means of cable s or other media so that each of the computer can share information. Networks therefore make storing of data much easier and faster.

2.1.1 DATA COMMUNICATION

Information Technology (IT) and its various applications are everywhere. The challenges of the new millennium are to make information more accessible to a greater number of people. To achieve this noble task, business and computer communities especially Universities of Technology are seeking ways to connect a wide range of hardware, software and databases.

Connectivity, as it is called is necessary to facilitate the electronic communications between companies, end-users as well as the free flow of information within and between organizations.

Data communication is simply the collection and distribution of the electronic representation of information to and from remote facilities. The information could be a variety of formats e.g. Data, text, voice, pictures, graphics and video. The raw information generated by individuals have to be digitized; i.e data and text need to be translated into their corresponding ASC II codes in form of binary codes i.e 1's and 0's.

Information is transmitted from computer to terminals and other computers through one or a combination of co-axial cables, optical fibre, microwave and statellite channels. Other areas to which data communication is applied are in telecommunication. Telecommunication encompasses not only data communication but any type of remote communication, such as transmitting a television signals.

2.1.2. **CONNECTIVITY**

The term connectivity refers to the degree to which hardware devices can be linked functionally to one another. Connectivity can be expanded to include software and databases.

Connectivity is implemented in stages. In all stages, communication protocols most be obeyed. The ideal implementation of intra-institutions connectivity would be to make all corporate computer and information resources accessible from each workstation.

2.1.3 TRANSMISSION MEDIA

There are new options to which data can be transmitted. This media include microwave and satellite media. The type of cables determines the capacity of the network. Three types of cables are currently in use for data communication. These are: Twisted pair cable, co-axial cable, category 5 (cat5) cables and optical fibre cable.

2.2 TYPES OF COMMUNICATION NETWORK

Networks are classified into three (3) main categories depending on their geographical size. This include: Local, wide and metropolitan Area Networks (LANs, WANs and MANs) respectively.

2.2.1 LOCAL AREA NETWORKS (LANs)

A Local Area Network (LAN) is a system of computer hardware, software and communication channels that connects devices in close proximity, such as in a building or house. LANs have data rates up to 100 megabytes per second (greater data rates are achieved with optical fibre technology). LAN involves client server and a peer – to – peer network.

A client server network is one where some nodes (the servers) provided services (e.g print services) to another devices on the network, and the other work station (the clients) use the services provided.

A peer – to – peer network is where nodes may alternatively provide or receive non-dedicated services. Special connectivity devices used in most LANs include repeaters, routers, bridges, gateways etc.

LAN can be wired using cables as a medium for the purpose of communication, while it can be wireless without the use of cables. Wireless network are ideal for a number of applications, particularly in areas when cabling is difficult or hazardous.

2.2.2. WIDE AREA NETWORK (WANs)

WANs are concern with the interconnection of computer network devices over a wide geographical area. The public switched telephone network is a good example of WAN in everyday use. WANs typically extend up to a 1000-kilometer of distance.

Many existing WANs have data rates approaching 100 kilobits per second.

2.2.2 METROPOLITAN AREA NETWORKS (MANS)

MANs is a group of LANs located in a city. An example is the network that exists between three or four campuses in a university. They could be connected together so that each campus will have access to information of another.

LOCAL AREA NETWORK: The smallest network size is a LANs are normally contained in a building or small group of buildings. Some of the characteristics of LANs are high speed, small error counts and inexpensive.

Since LANs are contained in small areas, high-speed cable can be used. Also, since they are installed in a small area, errors that do occur during transmission of data is minimize. The equipments used in LANs are cheaper compare to WANs and MANs.

WIDE AREA NETWORK: The largest network size is a WAN. WAN can interconnect any number of LANs and WANs. They can connect networks

across cities, states, countries or even the whole world. WANs normally use connections that travel all over the country or world. For this reason, they are usually slower than MANs and LANs and are prone to more errors. They require a specialized equipment to operate. This implies that their prices are high and maintenance very expensive.

Metropolitan Area Network (MNs) are slower than LANs but usually have few errors on the network. Since special equipment are needed to connect different LANs together, this implies that their prices are high.

2.3. INTERNET

Internet as the name implies means Internet works. The Internet is a system of linked networks that are worldwide in scope and facilitate data communication services such as remote log in, fibre transfer, electronic mail, the world wide web (W.W.W.), Newsgroups.

With the meteoric rise in demand for connectivity, the Internet has become a communications high way for millions of users. The Internet was initially restricted to military and academic institutions, but now it is a full-fledged conduct for any and all forms of information and commerce. Internet websites now provide personal, educational, political and economic resources to every corner of the planet.

With the advancements made in browser-based software for the Internet, many private organizations are implementing Intranets. An intranet is a private network utilizing internet-type tools, but available only within that organization.

For large organizations, an intranet provides an easy access mode to corporate information for employees.

2.3.1 ELECTRONIC MAIL (E-MAIL)

The electronic mail popularly called e-mail is a system whereby text messages may be passed from one computer user to another. It is a kind of computer mediated text exchange of the electronic versions of the mailbox. It is focused between communication and between persons a synchronously. That is the two involve must not be online at the same time.

E-mail system is enhanced to forward mail to another person, with or without an attachment, and the ability to transmit a message to more than one mailbox. In e-mail, each participants has his own box and an outbox.

In Nigeria, the electronic mail services are a new technology in posting offered by indigenous Internet Service provides (I.S.P), NIPOST etc.

2.3.2 WORLD WIDE WEB (WWW)

The World Wide Web is the graphical multi-media portion of the Internet. To view a file on the web, you need a web browsing software. You use this software to view different locations on the web, which are known as web pages. A group of web pages form a web site while the first page on the web site is often called "HOME PAGE"

Table 2.3 SERVICES PROVIDED BY INTERNET

Below is a table that shows some of the services provided by the Internet;

FEATRUES	SOFTWARE NEEDED	USES
E-mail	Outlook Express	Sending messages/letters
E-commence	MS. Exchange	Business transaction
Newsgroups	News Reader, Internet News, outlook express	Read messages on various topics
Web	Web Browsing soft-ware	Read documents, listen to music, watch videos, do business, down loan files etc.

CHAPTER THREE

3.0 LAN TECHNOLOGY AND TOPOLOGY

3.1 CHARACTERISTICS OF LOCAL AREA NETWORKS

The main characteristics of an ideal local areas network can be summarized as follows:

i) High speed

ii) High Reliability/Integrity

iii) Flexibility in terms of Installation

iv) Expandability

v) Interface Standardization

vi) Application adaptability

vii) Accessibility

HIGH SPEED

High speed has been designed in Local area network to provide suitable communication path for all types of information. Base band transmission on Ethernet Systems for example operates a standard speed 10 megabits per second. While broadband system can have band width or more than 300 MH2, allowing multiple video channels as well as data and voice communication.

HIGH RELIABILITY/INTEGRITY

LAN connectivity and integrity as system designers and suppliers always provide systems with higher degree of fault tolerance.

FLEXIBILITY

Some organizations have the foresight or good fortune to be able to make provision for expansion of their personnel hardware of software resources for their LAN. LAN administrators most provide facilities for configuration of their systems. Upgrading and expansion of the entire user groups and applications in terms of communication bandwidth requirements must be a priority in designing the LAN.

APPLICATION ADAPTABILITY

In LAN, there are standard interfaces that are provided across the range of required equipment to connect to it. Since devices used in interconnecting various terminals and computers may be of different types and manufacturers. There are general-purpose network capable of satisfying many application requirements and handling different information types and volumes.

ACCESSIBILITY

LAN may be installed in view of the environmental condition requirement for the officer users in particular, ease of access is always guaranteed so that they can have physical access easily to the system.

The office accommodation and practice must be taken into consideration in designing and implementing LANs project. If terminals, for example, are to be move about, connected and disconnected and new users added, the LAN access points must be so sited so as to minimize any disruption to the office environment.

3.2. LANs STANDARD

International Standards Organization (ISO) has provided the mechanism used to formulate and agreed on standards for LAN users and manufacturers of computer equipment.

Since users have a variety of computing equipment including personal computers, word processors, mini-computers and mainframe data processing systems, therefore compatibility is not fully guaranteed.

Hence, ISO in collaboration with other national and International Standards agency came out with specification that rationalized the progress in LAN technologies by formulating and agreeing on a particular standard for computer devices that will support LANs technology.

Consequently, ISO came up with the Open Systems Interconnection (OSI) reference model as the common basis for describing communications systems, not only in Local Area Networks but also in wide area Networks.

3.2 OPEN SYSTEM INTERCONNECTION (OSI) REFERENCE MODEL

The open systems interconnection model (OSI) uses a seven-layer approach. It is the international standard organization open system Interconnection reference model, often called the ISO model.

The OSI reference model was created for two purposes:

i) Firstly, it was intended to help co-ordinate the development of new communication standard by dividing them by function into seven sub-group or layers. Thus, a set of protocol specification must be observed.

ii) Secondly, it was designed to help put existing communication standards into perspective by defining where they fit in a complete communication system.

The OSI model makes provision for each layer to use services provided by layer below it and provides services to the layer above it.

Also, each layer communicates with the same layer at the other end of the conversations. The OSI layer communication architecture is as shown below:

7:	Application	Network Services
6:	Presentation	
5:	Session	
4:	Transport	Communications
3:	Network	
2:	Data link	Physical connection
1:	Physical	

3.3.1 FUNCTIONS OF OSI LAYERS

Layer 7:- Application:- It manages programs that users interact with. Examples are terminals emulation, file transfer, electronic mail, network

operating systems. LAN utilities, identification and security passwords. Also, it defines network services.

Layer 6:- Presentation:- Converts data from a format that can be read by application – level software on another system. Example is the host operating system.

Layer 5 – Session:- The purpose of this layer is to provide a means of establishing a communications session between two applications processes with facilities to police the session and to terminate it in an orderly fashion. It also ensures integrity of the whole message.

Layer 4 – Transport: Provide for an end – to – end data delivery by connecting processes at different locations. The transport software determines the route which data will take from one point on the network to another calculating speed and cost of available connections.

Layer 3 – NETWORK:- This layer has the responsibility of ensuring that information is transferred correctly across a network by keeping track of possible connection a network can make and pass this information to the transport layer.

Layer 2 – DATALINK: This layer is responsible for maintaining the integrity of information sent between two points. Also, it is responsible for bit level operations (i.e grouping), tracking of unit of information and performing error checking.

Layer 1 – Physical: - This layer is concerned with the electrical and mechanical means of transmitting and receiving information using particular communication

medium. It specifies the details of connecting cables and processing digital signals.

Figure 3.3.1 shows a classical representation of the communication between two systems at A and B connected by a relay.

Relays are required in wide area networks, which use a store and forward system, where the route between systems (A and B in this case) passes through intermediate switching nodes, each switching node corresponds to a relay. In Local area networks, relays are not required within a single network. However, they are required between networks and are called gateways or bridges in this case.

7	APPLICATION		APPLICATION
6	PRESENTATION		PRESENTATION
5	SESSION		SESSION
4	TRANSPORT		TRANSPORT
3	NETWORK	NETWORK	NETWORK
2	DATALINK	DATALINK	DATALINK
1	PHYSICAL	PHYSICAL	PHYSICAL
	COMMUNICATION	MEDIUM	

Fig 3.3.1 O.S.I. model Architecture

3.3.2 THE LAN REFERENCE MODEL (LAN/RM)

Corresponding to the OSI reference model (OSI/RM) is the LAN reference model.

Basically the LSN/RM has only three layers of the OSI/RM (Data link, Network Physical)

Figure 3.3.2 shows the relationship between the three-reference models.

Application		
Presentation		Not defined
Session		
Transport		
Network		LLC
Datalink		MAC
Physical		Physical

Figure 3.3.2 Correspondence between OSI/RM and LAN/RM. The three LAN/RAM layers comprises of:-

a) The physical layers (defines the operation to aml from to aml transfer of information).

b) The medium Access Control (AMAC) which provides a medium independent protocol for data connectionless aml connection oriented communication among multiple peers.

3.4 TYPES OF LAN

We have different types of LAN based on standard, topology, access, protocol and data rate.

TABLE 3.4.2 A LAN CLASSIFICATION MATARIX.

Standard	Topology	Feature Access protocol	Data Rate
Ethernet	Bus(tree)	CSMA/CD	100Mb/Sec
Token Bus	Bus	Token Passing	1.5 or 10mb/sec.
Token Ring	Ring	Token Passing	1 or 4 Mb/sec.
NON-STANDARD LAN			
PABX	Stard	Not applicable	Various
Micronet	Bus or Ring	Various	Typical Limb/sec

3.4.1 STANDARD LAN

Based on ISO standard specification, standard LANs comprises of Ethernet, Token Bus, Token ring Cambridge ring while the non-Standard LAN comprises of PABx – based LAN and Micronet:-

i) Ethernet:- is the most popular physical layer LAN Technology is used today. Ethernet is popular because it strikes a good balance between speed, cost and ease of installation. These benefits, combined with wide acceptance in the computer market place and the ability to support virtually all technology for most computer users today. The Institute for Electrical and Electronic Engineer (IEEE) defines Ethernet standard as IEEE standard 802.3.

This standard defines rules for configuring an Ethernet network as well as specifying how elements in an Ethernet network Interacts with one another. By

adhering to the IEEE standard, network equipment and network protocols can communicate efficiently.

ii) **TOKEN RING**

It is another form of network configuration, which differs from Ethernet in that all messages are transferred in an undirectional manner along the ring at all times. Data is transmitted in tokens, which are passed along the ring and viewed by each device. When a device sees a message addressed to it, that device copies the message makes it s way along the ring, it eventually get back to the sender who now notes that the message was received by the intended device. The sender can then remove the message and free that token for use by others.

iii) **CAMBRIDGE RING**

It is also called slotted ring because it use the principles of slotted ring. The bandwidth is sub-divided into slots which circulated continuously round the ring either carrying data or ready to accept data.

iv) **PABX**

It is a non – standard LAN. It is normally a star topology that is used in implementing localized telephone systems for many years. PABX based LAN has he capability to route and switch data.

v) **MICRONET**

It is also a non-standard LAN based on BUS or Ring topology. It helps in the provision of shared disk storage for a number of microcomputers of the same type.

5 LAN TOPOLOGIES

Topology refers to the layout of the route data travels along the network. There are two basic forms.

a) Logical topology

b) Physical topology

i) LOGICAL TOPOLOGY

The mode of a LAN handle message from node to node in a sequential logical topology (Token passing) or they send the messages out to all stations simultaneously in a broad cast.

ii) PHYSICAL TOPOLOGY

A physical topology is a description of the route at which the network cables as the linked nodes. Theoretically, there are several ways of physical running cables connecting a group of computers. But in the real world you can buy products conforming to one of the two different physical topologies:-

1. Star Topology
2. Bus topology
3. Ring topology
4. Loop Network topology

3.5.1 STAR TOPOLOGY

The star topology is also called the Hub topology. In this arrangement, the network wire runs between the network node and the central wiring Hub. Each device is connected to a central point. These central points are often called hubs, concentrators, multiport repeaters. There are three (3) types of hubs –

assive, active and intelligent hubs. Each type represents the efficiency and speed of transmission of data to and from the hub to the nodes.

The strategic advantage of a star topology is that mostly, network services troubleshooting and wiring changes takes place at the hub.

Another advantage is that you have to run a separate cable to every node that want to access the network. If the hub goes bad, the entire network will be affected. Star topology networks allow easier expansion of the network. Hence, the number of ports on the hub is directly to the number of nodes of the entire network. Ports on a hub ranges from 8, 16, 32, 64 etc.

10 BASE – T Ethernet and Fast Ethernet uses a star topology in which access is controlled by a central computer called a "SERVER".

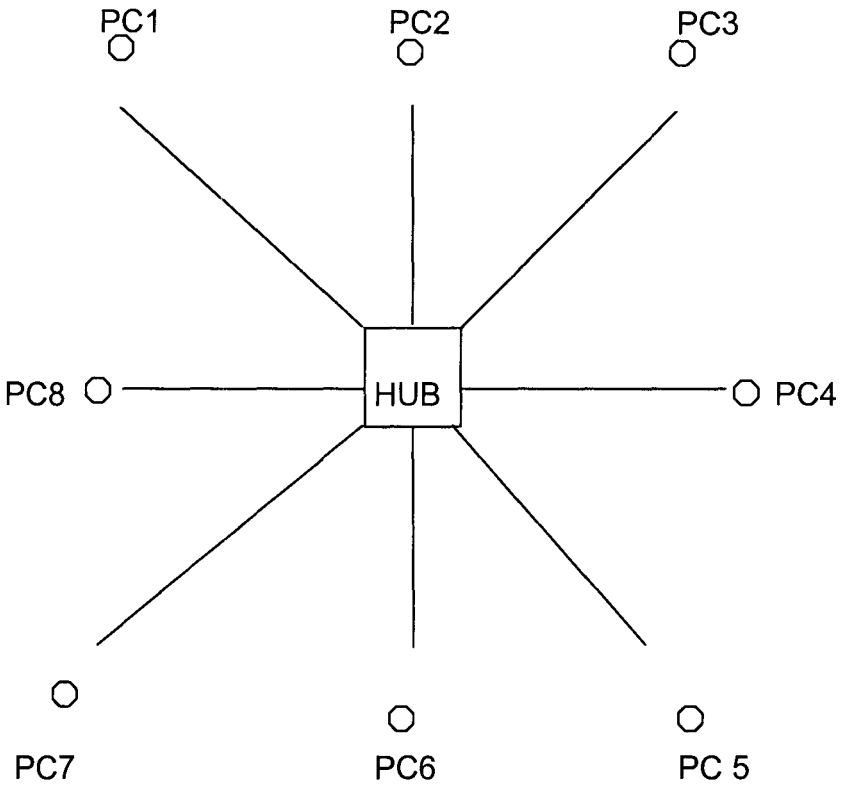
Generally a computer is located at one end of the segment, and the other end is terminated in central location with a hub.

The cable use in most star topology networks ranges from UTP and category 5 cables for best performance and high speed.

Other advantages of star topology include:

i) Reliability:- If one of the node that is point – to – point segments has a break, it will only affect the two nodes on that link. Other users of the computer on the network continue to operate as if that segments were non-existing.

A simple star topology network is shown below in figure 3.5.1.



PC1-8 represent different workstations connected by a central hub and one of the workstation configured as a "SERVER"

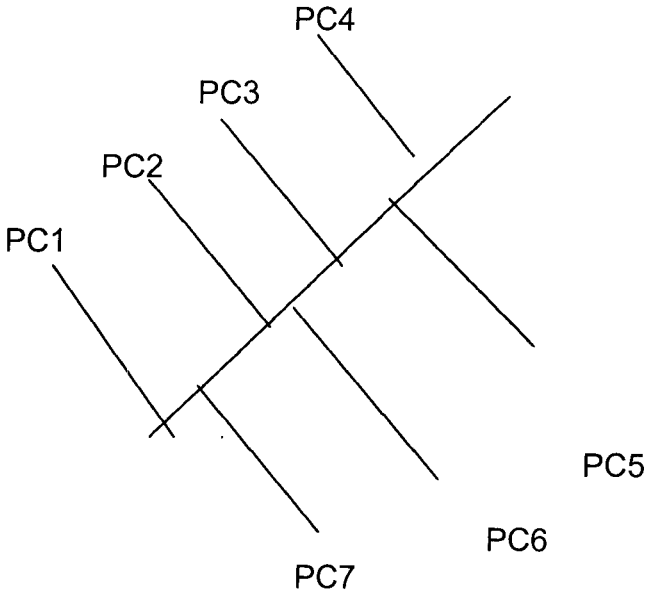
3.5.2 **BUS TOPOLOGY**

A bus topology consists of nodes linked together in a series with each node connected to a long cable or bus. Many nodes can tap into the bus and begin communication with all other nodes on that cable segment with a terminator at both nodes (BNC terminator).

One of the disadvantages of this type of Network is that a break anywhere in the cable will cause the entire segment and network breakdown. Also, the rate

at which data is transmitted along. The cable is slow. Examples of bus topology include 10BASE 2 and 10BASE5 networks.

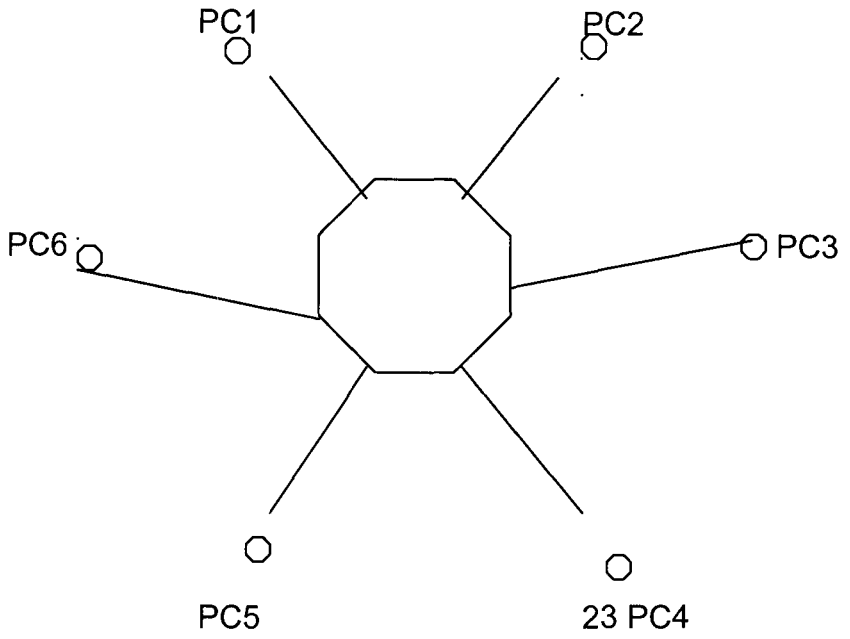
Figure 3.5.2 shows a simple bus topology network.



3.5.3 **RING TOPOLOGY**

Ring Network topology has intelligent nodes for (or terminals) spread evenly over the networks hence central control is no longer necessary. Must ring networks have one monitoring station (normally a node in the network itself) that takes care of any error in the transmission of data?

Transmission of data around this type of network is normally one way. Although some ring network system can be figured for data transmission in either direction. Ring topology network is simply shown in the table below:



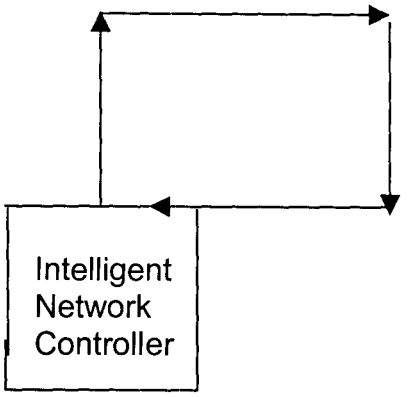
3.5.4 LOOP TOPOLOGY

The loop network topology is similar to that of the ring network, except that all message which is transmitted by device polling each other on the network.

Polling is the task of constantly asking a device (at regular intervals) whether or not it needs attention (e.g to send a message over the network etc).

A major disadvantage is the reliance on the intelligent controller node. If this breaks down, the whole system will fail, and communication across the network would be impossible.

Another disadvantage lies in the throughput rate of the system. This type of systems tends to have low data transmission speed and hence the data throughput is somewhat restricted. A loop network topology is shown below:



3.5.5. **PROTOCOLS**

Network protocols are standard that allow computers to communicate. A protocol defines how computers identify one another, the form that data should take in transit, and how this information is processed once it reaches its final destination. Protocols also defines procedures for handling lost or damaged transmissions or "packet". TCPHP (for UNIX, windows NT, windows 95 and other platforms), IPX (for Novel netware), Decnet (for networking digital equipment corporation computers) etc.

Although each network protocol is different, they all share the same physical cabling. This common method of accessing the physical network allows the builder of a network to use common hardware for a variety of protocols. The concept is known as "protocol independence" which means that devices that are compatible at the physical and data link layers allows the user to run many different protocols over the same medium.

3.5.6 **MEDIA**

An important part of designing and installing an Ethernet is by selecting the appropriate Ethernet medium. There are four (4) major types of media in use today:

1. Thickwire for 10BASE5 Networks
2. Thin Co-axil for 10BASE2 networks
3. Unshidded Twisted Pair cable (UTP) for 10BASE-T networks
4. Fibre optic for 10BASE-FL networks

All these media differ in terms of speed of transmission of data and the cost of each cable.

CHAPTER FOUR

4.0 FEASIBILITY STUDY OF FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA LIBRARY

The University Library started on 1st March, 1984 with three (3) Professional librarians and one Para-Professional. One classroom of a block of three classrooms was first used as the library. Little expansions were made not until the World Bank Projects for Books and Journals came in 1993. With the coming of the World Bank Project, it became evident that the library building would not accommodate a huge number of books. Consequently, the number of library users i.e. staff and students are of the increase. The University administration then saw it necessary to expand the building to what we have today.

With the expansion, the library now has three (3) large reading rooms and fifteen officers. The two large reading rooms on the ground floor are used as Readers Services with one large reading room upstairs being used as Reference and Serial units. Thus, the new library can now seat 364 readers and also able to accommodate more reading materials.

LIBRARY COMPUTERIZATION AT FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

According to Asamoah Hassan and Barnnerman (2001) "University libraries in sub-sahara Africa are not truly virtual, or electronic. Even in developed countries, very few libraries have reached that stage of development when their libraries can be called `electronic' because according to the network configuration of the electronic library system, it enables uers obtain open digitized data from anywhere in the world through on-line access. It access networked resources of other libraries. Most African libraries are however far from reaching this stage"

The thought of computerizing the library of Federal University of Technology, Minna came into being in the year 1991, when the first University Librarian, Dr. Nassir Bello assumed duty. The library as at that time had no professional in the area of computer studies. Hence, the University computer center assists the library in this field. The Centre appointed a computer professional to write an in-house program using Dbase III to be used as our only software.

At the completion of this software, the software was documented and put into use. This was done by removing the catalogue card drawers beginning from letter A – Z.

The Library had not gone so far with her existing data entries, when the National Universities Commission (N.U.C) Abuja gave the University library an ICI 386X model computer. With this development, the library stopped entering

her data at the University is computer center. With a short time, one new ROYAL 386 model computer was supplied to the library making a total of two.

In the year 1996, NUC. Distributed a Disk operating system (D.O.S) based software called TINLIB V280 to the University library. The idea was to introduce a uniform software usage into the library system of Nigerian Universities.

TINLIB (The information Navigator Library) is Library software Product of Information Management of Engineering Limited London. They are ably represented here in Nigerian by BUSICON Nigeria Limited, Lagos. The software came in modules such as cataloguing, Circulation, serials and Acquisitions. It is an application of the TINMAN, the Information management program. It is a modular; software particularly aimed at special libraries but has been remodeled to be used in academic and public libraries as well.

TINLIB is useful for single or multi-users and networking environments as well as operating systems. With it, the user can easily browse and navigate search facilities. TINLIB helps to manage database by carrying out such activities as entering new records into the database, altering and deletion records, managing the thesaurus and searching the data The above is particularly useful in the catalogue module because it is the circulation and cataloguing modules that are currently being used in this library.

By 1992, the idea of networking the library services was muted following the increase in the number of our computer systems. BUSICON Nigeria Limited was invited to do a Local Area Network for the Library. This was done using the

Bus topology format. Its disadvantage is that, when the central cable is damage, all the workstations will stop communicating.

With the introduction of a Local Area Network, data entry became faster and effective. However, after some time of using TINLIB software, the University administration upgrade TINLIB software, the University administration upgrade TINLIB software which is a DOS base software to GLAS (Graphical Library Systems) Software. It is a window-based software and thus allows users to open multiple windows/modules to perform multiple task all at the same time and the same workstation.

Another merit of GLAS over TINLIB is that it is a graphical user Interface (GUI), which is easy to use and efficient. The GLAS Cataloguing Module for example is used to set-up bibliographic records. It has also the ability of entering new records to the existing database, and sending new records received from the Acquisitions to Circulation modules.

4.1 SYSTEM DESIGN AND ANALYSIS

4.1.1 THE PROPOSED DESIGN

The already existing system LAN topology in the Library is the Bus network topology. From the experiences we have had with the Bus topology, we intend to suggest the star topology for a number of reasons mentioned in page (3.5.1).

In the network design and implementation actual physical layout of the structure proposed must be studied and simulated first before the actual implementation is done.

This Local Area Network is designed to link the whole University together and provide access to the Library Information Systems (LIS) of the Library Information Network LIBNET.

In our design, we group the University Community into three (3) domains each with its own domain name and a named work group with workstations.

Domain one were the host "SERVER" and the central intelligent hub will be located will be in the library complex of the University. The Senate building and Deans office, School of Science and Science Education will be in another domain. The third domain comprises of School of Environmental Technology, School of Engineering, School of Agricultural Technology, and post-graduate school.

Apart from the main domain that host the server and the Central Hub (connectivity device) each domain i.e domain two and three would have a booster hub linking one hub to another and also linking one domain to another. The hub provides signal amplification and also take incoming signal from one domain and repeats it out to all other ports on the network.

4.2 SETTING UP THE NETWORK

4.2.1 SYSTEMS SPECIFICATION

The system comprises of the Hardware and the software. The hardware specification includes the `Server' and other workstations.

For the `Server' the minimum hardware specification include:

- 17" .26mmdp, 75Hzmin at maximum ATX casing monitor from compaz, Samsung or equal.

- Mother board + original Intel chipset + PIII dual Bids ATX.
- 133MHz FSB + PS/2, USB, Fas UART Serial, parallel and G. Ports
- 56X self sensing CD-ROM drive
- 128MB SGRAM VGA
- 512MB SDRAM
- PC133 PIII 1.0 GHz and above Intel MMX Intel processor
- V.90 50K US Robotics Data/Fax/Voice Modem
- FDD.
- 20GB SCSI HDD
- PS/2 KB/Mouse/Pad
- 3D Sound Blaster Card Creative
- 10/100 Ethernet NIC
- 200 Watts Stereo speakers/Norton's 2002

WORK STATIONS

Other workstations within the University Community that want access to this network should have at least this hardware specification:

- ATX casing 15" – 26mmdp
- 75Hz Digital monitor
- 32MB SDRAM
- 256MB 133MHz SD-RAM
- Gigabyte motherboard with Intel 440BX AGP Chipsets + USB, PS/2 Fast UART Serial/Parallel Ports
- PIII 800MHZ intel MMX Processor

- FDD
- 20GB HDD
- Keyboard/mouse pad
- 56KPs US Robotics internal Fax modem
- 10/100 Ethernet NIC
- 3D Sound blaster card (optional)
- 120 Watts stereo speakers
- Norton 2002 anti-virus

Note:- Specification less than this can also access the network but at a slow speed.

4.2.3 **SOFTWARE**

The operating system that is recommended for the effective running of this network is windows 2000 Server for the system designed to be the `Server' and windows 2000 professionals for all the workstations.

Reasons for choosing these operating systems is for compatibility with the hardware and also for easy network monitoring and configuration.

In addition, Microsoft Window 2000 Professional Provides a desktop operating System for business users and administrators that is reliable and easy to install, use and maintain, regardless of the type of network in which it is deployed. Using windows 2000 Professional with Microsoft windows 2000 Server greatly extends the level of support that you can provide to your users. It allows you to centrally deploy and manage the operating system. It provides a stronger security and networking infrastructure; and it extends interoperability

with other environments such as Novel Netware and UNIX. Window 2000 professional and windows 2000 Server will support up to 11,000 hardware devices. This will support further expansion of the proposed network in future.

Along with this operating system, Library software (specialized software) like TINLIB or GLAS will be installed on each workstation that will access the library Information Network (LIBNET).

4.4 INSTALLATION OF NETWORK DEVICES

The following network devices needs to be install on the `Server' and other workstations for best performance

i) Network Interface card

ii) AGP VGA card (Server)

iii) Sound cards

iv) V.90 56K US Robotics Fax/Voice/data modem etc.

V.90 56K US ROBOTICS MODEM

The MODEM (Modolator/Demodulator) devices are devices that allow a computer to transmit data from one computer to another over telephone lines. This is very necessary when the systems will be linked with or housed into the Internet. The MODEM translates between digital signals that the computer uses, to analog signals suitable for transmission over the telephone lines. When transmitting, the MODEM modulates the digital data onto a carrier signal on the telephone line. When receiving, the MODEM performs the reverse process and demodulates the data from the carrier signal. The speed of data and voice of the modem 90 and 56kilobyte.

NETWORK INTERFACE CARD

It is a device that is plug into the motherboard bus. These Buses can be ISA or PCI slots. The Network Interface card (NIC) provides a physical connection between the networking cable and the computers in the network so that communication between the systems is possible. NIC are categories by the number of bits on them, i.e 8bits; 16-bits; 32bits. The higher the number of bits, the greater and faster data can be transfer on the card.

Many NIC adapters comply with `plug-n-play' specification on some systems. With this feature, when they are installed, they automatically configured into the system and adapt by any changes that may occur. But for some systems, the NIC needs to be configured manually.

NIC are available to support almost all networking standards, including the lastest fast Ethernet environment. Fast Ethernet NICs are often 10/100 capable, and will automatically set to the appropriate speed.

CREATIVE SOUND CARD

Sound is needed for a system that does not have sound on board. The sound capability is required for audio PC communication to end-users.

4.5. NETWORK CABLING

To determine which cabling is the best for a particular network, we need to answer these few questions:

i) How heavy will the traffic be?

ii) What are the security needs of the network?

iii) What are the distances the cable most cover?

iv) What are the cable options?

v) Lastly, what is the budget for cabling?

The more cable protects against internal and external electrical noise, the farther and faster the cable will carry a clear signal. However, the better the speed, clarity and security, the higher the cabling cost. In this project, we shall choose the unshidded Twistal pair Cable (UTP) which is commonly use in most networks. Utp cables comes in different categories. We shall consider Cat5 which is the highest offering support for transmission rates of up to 100Mbs. Level4 and 3 are less expensive, but cannot support the same rate of data throughput speeds.

For specialized applications, fibre-optic, or 10BASE-FL Ethernet segments are popular. Fibre-optic cable is more expensive, but it is invaluable for situations where electronic emissions and environmental hazards are a concern. Fibre optic cable is often used in Inter building applications to insulate Networking equipment from electrical damage caused by lightening. Because it does not conduct electricity, fibre-optic cable can also be useful in areas where large amounts of electromagnetic interface are present, such as on a factory.

The Ethermet standard allows for fibre-optic cable segments up to 2 kilometers long, making fibre-optic Ethernet perfect for connecting nodes and buildings that are otherwise not reachable with copper media.

In this network, the Cat5 cable will be connected from the `Main Server' which will be located in the University Library complex and from there to the main `HUB'. Cables will be passed through underground and well protected by plastic

trunk materials. There will be stopovers between one domain and the next. This will be done to increase the speed of transmission of data and to enable to active hub analysed packets at a faster rate between one workstation and the next. It will be noticed that the distance between one workstation and the next using UTP cable is about 500 meters distance apart. Below are cable comparison based on characteristics and network topology. (see table 4.5.1) Appendix I)

4.6 INCREASING THE SPEED OF THE NETWORK DESIGNED

When we talk of speed in a network environment, we mean the rate at which data is transmitted between terminals through the connecting devices (media). The need to increase the speed of the network becomes very important and necessary because, which more users are added to a shared network or as applications requiring more data are added, performance deteriorates. This is because all users on a shared network are competitors for the Ethernet bus. On a moderately loaded 10Mbps Ethernet network being shared by 30-50 users, that network will only sustain throughput in the neighbourhood of 2.5. Mbps after counting for packet overhead, inter-packet gaps and collisions.

Increasing the number of users (and therefore packet transmissions) creates a higher collision potentials. Collisions occur when two or more nodes attempt to send information at the same time. When they realized that a collision has occurred, each node shuts off for a random time before attempting another transmission. With shared Ethernet, the likelihood increases as more nodes are added to the shared collision domain of the shared Ethernet. One of the steps taken to alleviate this problem is to segment traffic with a "bridge" or a `Switch'.

A switch can replace a hub and improve network performance. For example, an eight-port switch can support eight Ethernets, each running at a full 10Mbs. Another very important option is to dedicate one or more of these switched ports to a high traffic device such as a file server.

Apart from deciding when to forward or when to filter the packet, Ethernet switches also completely regenerates the Ethernet packet. This generation and re-timing allows each port on a switch to be treated as a complete Ethernet segment, capable of supporting the full length with all of the repeater restriction.

Additionally, bad packets are identified by Ethernet switches and immediately dropped from any future transmission. This `cleansing' activity keeps problems isolated to a single segment and keeps them from disrupting other network activity. This aspect of switching is extremely important in a network environment where hardware failures are to be anticipated.

A case study of Federal University of Technology, Bosso Campus Minna shows that, presently we have 3-4 networks that is NUNET and GIS network of the Geography Department. It has therefore become imperative that a `switch' devices to replace the `Hub' we are using now in future. Why? Because LAN switches can link four, six or ten or more networks together, and have the two basic architecture: cut-through and store-and-forward. In some years back, cut-through switches were faster because they examine the packet destination address only before forwarding it on its destination segment. A store-and-forward switch, on the other hand, accepts and analyzes the entire packet before forwarding it to its destination (see Appendix I)

4.7 COST BENEFITS/ANALYSIS OR STAR AND BUS TOPOLOGY NETWORKS

Now that limitations, cost, efficiency of different cabling schemes are know, considerations should be given to the following questions as particular network needs for the LIBNET are defined:

- How large (Land mass) is F.U.T. that the cable is going to cover.
- How many strunk or UTP segments will best suit the physical layout of Bosso Campus?
- How many Hubs, trunk materials, and NIC will be required in the Network?
- How many "stop-over" will be required and at what locations in each domain?
- How many network stations (file servers, Print Servers or work stations) will be connected to the cabling system?
- What potential growth i.e future expansion do we expect in the network? etc.

The table below shows necessary items needed for a good network using either the star or Bus topology. It also shows current prices of these network devices.

Table 4.7.1

S/NO.	ITEM	UNIT PRICE
1.	Computer System (Internet ready)	Depends on specification
2.	Hub (3 com, 24ports, 56bkbs	37,000.00
3.	LAN card	2-4 thousand (depends on the speed)
4.	UTP cable	N50.00 per meter
5.	RJ 45 plud/Jack	N40.00
6.	Trunk materials	(Optional)
7.	Sockets or Bandrex	N150.00
8	Coaxil cable	N80.00 per meter
9.	BNC connectors	N30.00
10.	LAN card with BNC port	N3-4 thousand naira (depending on the speed)
11.	BNC Terminators	N30.00

In analyzing the cost benefits, we will consider the two types of Network topology that is star and Bus topology. The main aim of this project is to propose a star topology network for the Library Information Network (LIBNET).

The cost of Installation and running of the already existing system will be analysed using 4 workstation then a comparison will be made with the same number of workstation in a star topology proposed.

4.7.2 COST OF BUS TOPOLOGY

S/NO.	DESCRIPTION	QTY	PRICE
1.	Computer system (Internet ready)	4	N87,000.00 x (348,000)
2.	Coaxil cable		N80.00per meter x175 meters =N14,800
3.	BNC Connectors		40x4=N160
4.	LAND card with BNC Connector		4,00x4 = 16,000.00
5.	Terminators (BNC)		50x4 =N200.00
	Average Total		N379,160.00

Table 4.7.3 COST OF STAR TOPOLOGY

S/NO.	DESCRIPTION	QTY	PRICE
1.	Computer System (Internet Ready)	4	87,000 x 4 = 384,000
2.	3Com Hub 8 ports	1	16,000.00
3.	LAN card	4	3,000.00 x = 12,000.00
4.	UTP cable	175 meters	50 x 175 = 8,750.00
5.	RJ 45 Plug I Jack	8	320.00
6.	Trunck materials	Optional	Optional
7.	Sockets or Bandrex	4	150 x 4 = 600.00
	Average Total		N369,770.00

From the table 4.7.2 and 4.7.3, it can be said that, the cost of setting – up a star topology using four workstations as our specimen is relatively higher than the cost of setting up a BUS topology network using the same specification.

Than the cost of setting up a star topology is high, we need to work at the future expansion, reliability and flexibility of the star topology over the BUS topology we already had on ground. Reliability in the sense that, a breakdown in one of the node will result to a malfunciton that segment. Other users on the network will continue to access the network. But in the Bus topology, reverse is the case because when one node crash down the entire network would be effected.

It is assumed that F.U.T. Minna is or will have other Networks within it for example; NUNET, GIS network of the geography department. The star topology makes it easier for these Intranets connect effectively to the LIBNET without major setback. All we need do is to reserve one port from the main hub so that

each Intranet can be hook up with the Libnet and be able to access our Library Information Systems Network. That is our vision and mission

CHAPTER FIVE

IMPLEMENTATION, CONCLUSION AND RECOMMENDATIONS

IMPLEMENTATION

The implementation of the star topology must involve social and technical
proach. The social approach involves people with their roles,
navious/attitude to networks etc while the technical dimension involves jobs,
ks and technology.

Special training of staff need to be done to ascertain that the network will
properly utilize and maintain. Also, consideration should be given to principal
aff, Readers and lectures of the entire University who are undergoing one
esearch programme or the oth to effectively participate in the operation and
se the network in their respec department or faculty.

These forms of pa ation will embrace consultative approach,
lemocratic approach and onsibility approach. During the consultation,
articipants should be abl rovide input into the system design process in the
spect of job satisfactio ls. Also, participants should have an equal say in
he decision affecting development but the main implementation of the
decision should be e hands of the authority in which the Head of library
Will be a member.

5.2 CONCLU

This pr s a comprehensive fundamental of Local Area Networks
and networ logy in general using the star topology. It discuss in
details ste escription of the key terms and materials involved in a star

topology. The study work at star topology from the top down approach, and a study of the principles, guidelines, used in selecting, installing, operating, managing, upgrading and optimization of the star topology from the Bus topology that exist in the University Library.

The subject of LAN using star topology has generated a lot of interest during the past years in some institutions of higher learning in Nigeria. This resulted from the moves by most University libraries to computerizes and network their libraries.

Articles have been published, some papers presented and standard been given, products have been released and standard been produced. Yet it cannot be said that every one even knows what a LAN is or its benefits in relation to Information Technology. We are in a jet age, we urge every University Library to be in a network using if possible the star topology compared with the enormous number of computer systems in their respective institutions.

Computer networking using star topology is providing an effective, reliable and efficient medium for rapid communication and resource sharing between one computer in a workgroup from a particular faculty to another. In general, the essence of networking is to share resources, communication, and security.

5.3 RECOMMENDATIONS

I wish to strongly recommend a networking system using the star topology scheme despite the fact that, the star topology model is a bit costly than the Bus topology. The benefits/advantages of star topology over Bus topology cannot be overemphasized.

In our design, a central Hub was used. I will further suggest and recommend that, as the network expands, i.e as many users are added to the network and applications is of the increase, a "switch" should be use instead of the Hub. A switch is faster in terms of transmission of data (packets) and it reduces a lot of traffic jambs in a more complete network.

Within some couple of days, the main campus of the University will be open. It therefore implies that, the University community needs a more higher network physical layout. This will prompt for the use of backborn network that involves the use of a sattelite dish that will linked the two campuses (Bosso and main campus) together.

It has been observed that Internet connectivity is becoming difficult in Niger State because, most computer vendors use NITEL as their only but cheaper Internet Service provider (ISP). Nitel equipment has always failed, this make Internet access difficult and not reliable. A booster station needs to be install at the mid point between Abuja and Minna so that wave signals will be increase and hence this will automatically increase packets speed.

Even though the Federal government makes effort to do this, the University on its own needs to install a VSAT (Very small Apperture Technology) equipment for it Internet access. Instead of the University to depend on Nitel or private ISP, it can render their services to computer vendors, Institutoins or cooperate enterprise in the state. This if embark upon, will improve our computer education and the teaching of computer Technology in the University. Library Information world wide using the world wide web can be access, Geography

Information Systems (GIS) Courses teached in the University will become easier. In fact, if this is implemented, the University must definitely have a web site hosted by the University. All other University will visit this site and derive information from it. Learning through the Internet for foreign students wishing to study in this University will be made possible and easier.

Lastly, this project is open for improvement and modification for those wishing or interested in Internet studies and Networking Technology in general.

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