DESIGN AND IMPLEMENTATION OF A LOCAL AREA NETWORK USING A PEER – TO –PEER NETWORK ARCHITECTURE WITHIN THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING, F. U. T MINNA.

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A PROJECT SUBMITTED TO THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR'S DEGREE IN ELECTRICAL AND COMPUTER ENGINEERING.

CERTIFICATION

This is to certify that this project was carried out by Uduehi Cyril Ohinorenuan of the Electrical and Computer Engineering Department of the Federal University of Technology, Minna under the Supervision of Mr.. M. S. Jedna

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Supervisor
Mr. M. S. Jedna

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Head of Department
Dr. Y. A. Adediran

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Date

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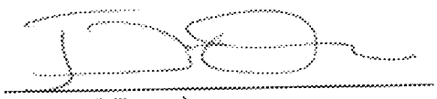
Date



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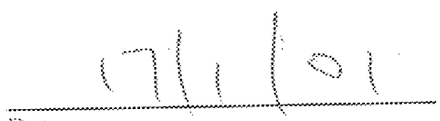

Date

DECLARATION

I hereby declare that this project is an original work of mine and has never been presented in any form for the award of diploma or degree certificate. All information derived from both published and unpublished work has been acknowledged.

UDUEHI CYRIL OHINORENUAN
95/4639EE

DATE

DEDICATION

"In a world of many superlatives only God is the greatest" this project is dedicated to the Glory of the Almighty for his banner over me is love. It is also wholeheartly dedicated to my late loving father who left this world at a very early stage of my education. And my mother who has stood by my side till this very moment.

ACKNOWLEDGEMENT

A task of this magnitude cannot be accomplished without the help and cooperation of others. It is on this note I direct my profound gratitude to all persons who have contributed to the success of this pursuit.

First I thank God Almighty who is always willing and abundantly able, for making this come true. My Lecturer past and present, Engr. Ahmed Shehu, Engr Nwohu, Engr Danujuma, Attah, Jedna, Pinne, Abraham, Engr Dr. Adediran, for their patience and understanding. Special thanks goes to Mr Badmus and Mr Segun Oyero of Maths/Computer department and Agric Science department whose advices and contributions are immense and ever remembered. Unreserved thanks and appreciation to the Head of Electrical/Computer Engineering Department Engr. Dr Y. A. Adediran and Engr. Danjuma for their effort in ensuring the successful completion o this work. May God reward you both bountifully.

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My unreserved profound gratitude goes to Engr. And Mrs. P. J. Uduehi of EHI construction Ltd, Engr. Chief Igwe and family of Dumez Nigerian Limited, Mr & Mrs Santus Aroh of Guaranty Trust Bank Lagos, for their immense contributions that brought to the success of this write-up both technically and financially or otherwise.

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To my friends Buddy, Chukuwdi (Gates), Thompos, Iyke (Michichi), Kayode Ayo Uche (Elder),Kingsley, Dumeibi, Lewis and to all BAN members, I say thanks. Words

contained in my hearts for you Abiodun Alonge. Thanks for the companionship, the love, the care ……, Thanks for everything, may God be with you always.

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And finally to all those, who confined space I have not mention, I say thanks and God`s blessing`s be upon you all.

ABSTRACT

Local area network is the foundation for information Technology (IT), since I.T. is changing fundamentally, standards have been developed in the design of materials and practices to meet the requirement of current and expected network.

The major aims of this project is to provide facilities for sharing of resources, data security and an avenue for the students of the department to learn how the computer networks work.

The report started with a general introduction which features the historical background and a study of previous works in this field.

This followed by an insight into computer networks and the general concepts involved in the computer networks.

The implementation of local area network on Electrical & Computer Engineering department was done on a low scale, due to limitations, using a peer – to - peer network architecture on windows 98 operating system on a 10 Base T Ethernet Star Topology.

Using the limited testing facilities available, some tests were carried out on the networks and the results obtained were properly presented and discussed.

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CHAPTER ONE

INTRODUCTION AND LITERATURE REVIEW

1.1 INTRODUCTION

The method of communication between different locations is a vital part of modern life. As we perform our daily operations in life, it is very impossible to avoid coming into contact with an application that is not fully dependent upon communication

In communication via networking information is captured in electronic form and needs to be communicated to computers of various type and models, using probably different operating systems. One of the major problems of personal computer is the primary use of such device as isolated workstations.

The interconnection of systems which facilitates this communication is called networking. An example of a network from the smallest and the simplest to the largest and the most complex are two computers connected together by a cable and the internet.

Before network came into existence, people who wanted to share information were using verbal communication, memos, and copying the information into floppy diskettes and taking it to another computer and then copying the data onto that computer which is time consuming. Therefore Local Area Networks (LAN_S) implementation was aimed at increasing office efficiency through Local Area Communication. In a general survey made by a research group in November 7, 1995 reported that in the wall street journal nearly a quarter of about 170 large and

medium scale organizations have set up intranets (i.e. collection of LAN_S), while another 20% have already done so (14)

1.2 LITERATURE REVIEW

No matter how complex, computer network are, all evolved from the basic need to communicate.

The very first step in modern communication was made in 1839 by Samuel F. B. who sent a message "What hath God Wrought" over a 37 mile telegraph line laid in the United States of America (from Baltimone to Washington (1).

In 1845, Charles wheatstone and William Cooke worked on the telegraph and it became the medium of traffic information exchange between trains stations by the British railroad. (1).

In 1876, a new technology which was based on the transmission of several telephone signals over one telegraph line and it was named telephone. This was done by Alexander Graham Bell (1).

The telephone and the telegraph hence came into use in the USA and the UK and the potentials of both technologies to bridge large distances was achieved (2).

The demand for computer communications came into existence in the mid-1950s and these early systems made use of the already existing wide communication medium, and the existing telephone network (3).

Digital signals used in computers were converted into analog signals for suitability by a device called the modem (demodulator & modulator) (2).

In 1960s on-line communications began to replace order forms of input as cost of computing began to drop (2).

1.2.1 EVOLUTION OF NETWORKS

From 1960s computer networks have been undergoing development. In the mid 1960s an experiment was conducted by Marill & Roberts in which a TX–2 computer was connected at Lincoln laboratories with the Q–32 computer at the systems development corporation in such a way that a user of one of the systems could access the other (4).

Due to these early experiments ARPANET (Advance Research Projects Agency Network) was awarded a contract for the U.S department of defence to a system house in Cambridge which was operational by the end of that year (4).

ARPANET grew from a small net in 1969 to a network providing computing to about 100 computers by 1975 (5). Routing and messaging were established by the new techniques. At the particular time, packet switching was introduced.

The problem of interconnectivity of the technologies was developed because of the development of computers in commercial environment and in specific countries which was only solved by a concerted effort that developed standards on an international basis. These particular standards led by the international Standard Organization (ISO) a seven layer reference model for open systems interconnection (OSI) (2).

The ARPANET was the prototype of Networks which span a wide geographical area (i.e. Wide Area Networks). Those networks that span limited geographical areas are called Local Area Networks (4).

1.3 PROJECT DEFINITION AND OBJECTIVES

1.3.1 DEFINITIONS

The design and implementation of a Local Area Network using a peer-to-peer architecture within the department of Electrical/Computer Engineering of the Federal University of Technology Minna.

1.3.2 OBJECTIVES

Some of the objectives that this project is meant to achieve are:

1. Data storage and retrieval reliability through backup and redundancy will be improved.
2. Provision of insight into the benefits of similar projects been carried out by other students of the department.
3. Provision of a means of compatibility between dissimilar equipment and software.
4. Provision of a mechanism for the sharing of resources such as information or peripheral (e.g. Printers, CD-Rom devices etc).
5. Provision of a medium of learning for students of the department.
6. To elaborate the need to keep up with continuous advancement in technology

CHAPTER TWO

INSIGHT TO NETWORKS

2.1 THE COMPUTER NETWORK

A network can be defined as the linkage of systems together such that they can communicate with each other. However, the method in which a number of computers can be linked together such that they can effectively share data, information and any resources that is available is called computer network.

When computers are not linked together or networked, they are called "stand alone" computers and cannot share peripheral devices efficiently. For instance, a small office with six stand alone computers and one printer allows only one user to be connected to the printer and utilizes it alone, other users will have to copy their data onto a floppy diskette and will have to transfer it to another system in question, it will be cheaper in the long run for the company to link the computers together in a network to enable them all share the use of the printer, from various locations rather than trying to buy a printer for each system.

No matter the distance computers are from each other, they can always be linked together in a network, which vary in connection modes based on their distances apart.

2.1.1 TYPES OF COMPUTER NETWORKS

Computer networks are classified basically by their speed, transmission media, distance covered and mode of information dispersion (6). There are however three fundamental types of computer network, They are:

1. Wide Area Networks (100km – 1000km)
2. Metropolitan Area Networks (10 km – 100 km)
3. Local Area Networks (10 m – 1 km)

2.1.2 WIDE AREA NETWORK (WAN_S)

A wide area network (WAN), spans a large geographical area, often a country or continent. It contains a connection of machines which are widely dispersed from one another. WAN_S usually have irregular topologies.

In most WAN_S, the network contains numerous cables or telephone lines, each one connecting a pair of routers (i.e. specialized computers used to connect two or more transmission lines). The connections can be point-to-point (packet switched) or by any other system (9).

2.1.3 METROPOLITAN AREA NETWORKS (MAN_S)

This is basically a bigger type of LAN or larger version of LAN and normally uses similar technology. It might cover a group of offices or a city and might be either private or public.

A MAN can support both data and voice. It has just one or two cables and does not contain switching elements. A key aspect of MAN is that there is a broadcast medium to which all the computers are attached. The media consist of two unidirectional cables to which the computers are connected.

Traffic destined for a computer to the right of the sender, uses the upper bus while traffic to the left uses the lower one (9).

2.1.4 LOCAL AREA NETWORKS (LAN_S)

Local area network (LAN) are networks which span a limited geographical area. For example, a campus. They are widely used to connect personal computers and workstations in offices to share resources (e.g. printers) and exchange information. LAN_S are restricted in size, often use a transmission technology consisting of a single cable to which all the machines are attached. Traditional LAN_S run at a speed of 10 to 100 mbps.

The scope of this project is based on this LAN_S, hence LAN_S are treated in detail.

Traditionally, line speeds are measured in megabits per second (mbps), not megabytes per second (mB/sec). A megabyte is 1000000 bits not 1,048,576 bits.

2.2 LOCAL AREA NETWORKS

LAN_S can be classified in a number of ways, none of which are completely convenient for all circumstances. By

1. Transmission mode
2. Network topology
3. Resource – sharing mechanism
4. Physical transmission medium

It can be observed that there is a considerable overlap between classes:

Some modes of operation are only applicable to particular topologies or physical transmission media.

Each way of classifying local area network tends to be suitable for some ways of looking at the problem and equally unsuitable for others (9).

2.2.1 TRANSMISSION MEDIA

A LAN consists of a physical medium (typically an electrical cable) linking a set of user stations in its simplest form which themselves contain sufficient logic and electronic circuits to enable them to use the network (13).

In many LAN_S (local area networks) the medium can be of several options, or even combinations of medial.

The major types of cables in use are:

1. Coaxial cable
2. Twisted Pair cable
3. Fiber optic cable

2.2.1a. COAXIAL CABLE

Coaxial cable consists of a single central conductor surrounded by a concentric layer of dielectric material, which is surrounded by a metal screen which can be either solid or a mesh of wire.

The whole assembly is protected from the outside environment by another layer which is usually an insulating material. Coaxial cable can be used in both Baseband and broadband transmission. Coaxial cable is ideally suited to a broadcast network system with each user attaching to the network wherever required (11)

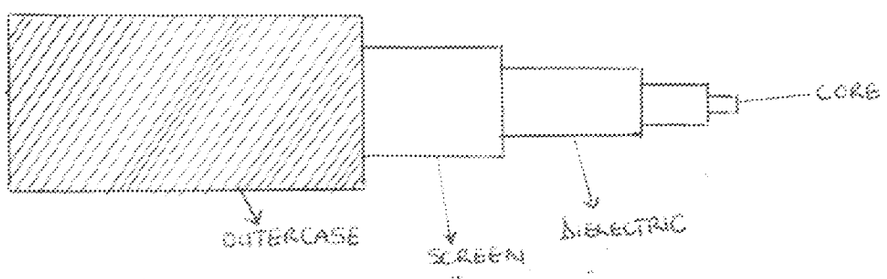

Fig 1 Coaxial cable

2.2.1b TWISTED PAIR

This is a standard telephone or telex terminal cable in which one or more pairs of wires are contained within a single outer case. It is in common use in office building.

It is best suited for transmission of information over relatively short distances. With careful choice and installation of cable, information transmission rates of several million bits per second over short distances (a few hundred metres) can be reliably achieved.

By its very nature, twisted pair is best suited for point-to-point links between devices on the network.

The kind of twisted pair normally available is not shielded (unshielded), and consequently it radiates to its surroundings when it is carrying information. Shielding can be provided at extra cost to reduce but not eliminate the radiation (11).

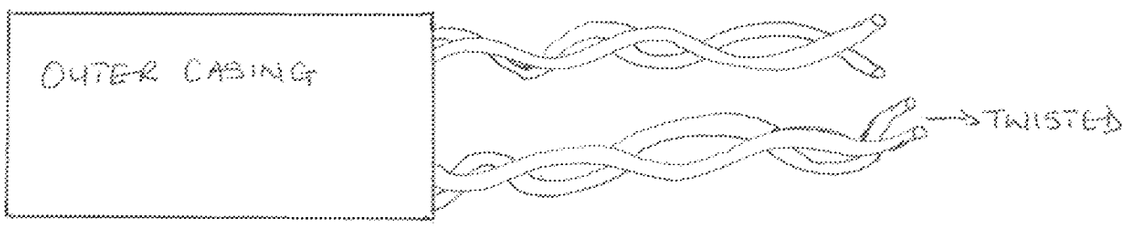

Fig 2 Twisted Pair cable

2.2.1c FIBRE OPTICS

This is different from the other types of cables in that it transmits light rather than electrical signals. One very important advantage of fiber optic over traditional electrical conductors is their immunity to electrical interference.

Fibre optics requires a special device to convert electrical signals to corresponding light pulses for each electrical connection. The reverse system is required at each point where the cable is been tapped from (11).

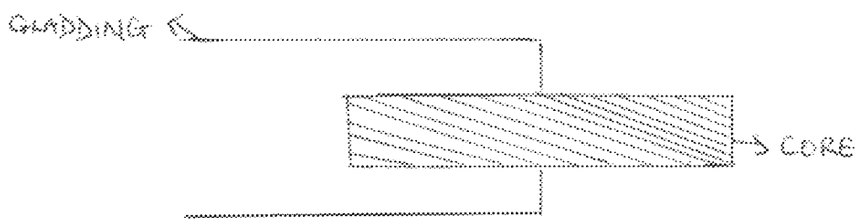

Fig. 3 Fibre Optic cable

UNSHIELDED TWISTED PAIR (UTP)

In this type of cable, the word "unshielded" does not mean unprotected rather each individual wire in the cable is enclosed in a protective sheath. The word "Unshielded" refers to lack of additional protective layer in the cable to filter out interference from electromagnetic and radio frequency signals. Each of the wires in a pair is important. One pair is usually assigned for transmission and another for reception. This is so because the use of wire from one pair for transmission and another for reception from the same pair would make the electromagnetic "noise" from one wire in the pair to bleed into the other wire causing interference and garbling of the data (cross talk) (12).

Recommended UTP pin assignments do not produce cross-talk. UTP is available in five categories. The factor use for differentiating is the type of insulation material used. The functions and the various categories are listed as shown below.

Category 1 & 2 - for voice and low speed operations (unsuitable for LANs

Category 3 - for voice traffic and data operations at speeds Up to 16Mbps (conforms to IEEE 10 base T standard)

Category 4 - for voice traffic and data operations at speeds up to 20Mbps

Category 5 - It is presently the best and it is suited for LANs and it offers the best possible speed (12).

Types of topologies

The various types of existing topologies are listed below and their modes of operation

1. The star topology
2. The Ring topology
3. The Bus topology
4. The mesh topology

2.2.3a THE STAR TOPOLOGY

A Star topology is the simplest type of topology and it is used in a network with nodes that are linked to a central switching node (i.e. a hub). The hub is used to transfer the traffic in the network.

The central Hub is acting as a primary communications controller, facilitating communication among the nodes on the outside of the star. Getting data between end nodes requires the data to pass through a central node. Its Major advantage is its structural simplicity. It is easier to add or remove nodes by simply upgrading the central node (10)

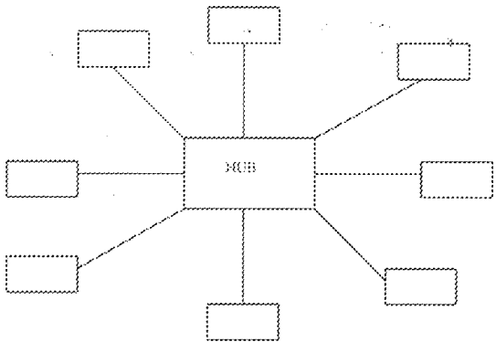

Fig 4 Star Topology

Topologies can either be logical in their operations or physical in their operations. Logical topologies refer to the route of the message on these cables, while the physical topologies refer to the path of the cables or how the cables are laid down.

2.2.3b THE RING TOPOLOGIES

The ring topology is characterized by a path between network nodes that forms a complete circle, with each of the node connected to two adjacent neighbour nodes. The data flow may be unidirectional or bi-directional. Two methods of sharing the ring are given below.

1. Taking the turns through the use of a token
2. Allowing each potential sender contend for use of the medium (10).

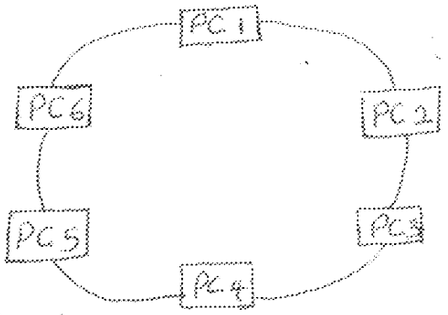

Fig 5 Ring Topology

2.2.3c. THE BUS TOPOLOGY.

The bus topology is often used when a network is small, or simple, or temporary. On a typical bus network, the cable is just one or more wires, with no active electronics to amplify the signal or pass it on, making this topology a passive one (2).

Here, only one computer at a time can send a message, then the number of computers attached to a bus network can significantly affect the speed of the network. When one system sends a signal, all other systems on the network receives the information, but only the one with the address that matches the encoded message accepts the information.

Termination in bus network is a very important concept, since it is passive, the electrical signal from a transmitting computer is free to travel the length of the cable, without termination, the signal bounces back and forth on the bus, this is called "RINGING" The terminators absorb the electrical energy and stop the reflectors (7)

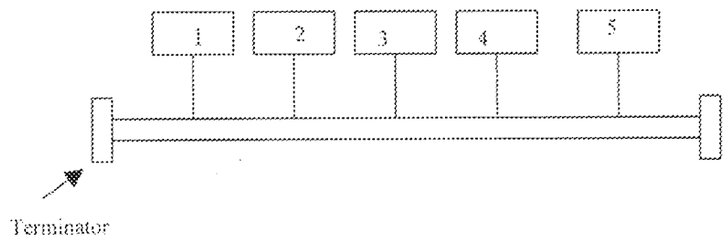

Fig 6. Bus Topology

2.2.3d. MESH TOPOLOGY

Here each computer is connected to all the others at once, this becomes quite difficult to install as the number of computers increases. To connect 7 computers together, it will require 21 links (1 + 2 + 3 + 4 + 5 + 6) and so on. However, they are easy to troubleshoot, and are fault tolerant, it is difficult to install and re-configure

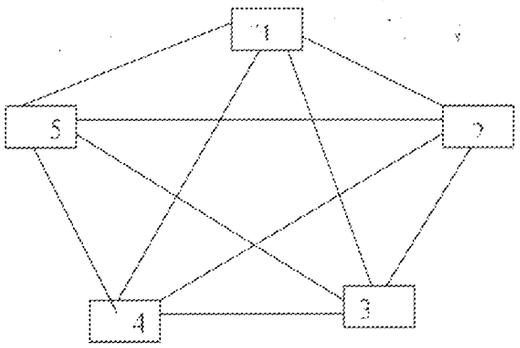

Fig 7. Mesh Topology.

2.2.4 SIGNALLING TECHNIQUES

For successful transmission of information from one location to another over a cable or other transmission medium requires the information to be coded in a manner, which is suitable for the medium and information type involved.

For local area networks (LAN_S), two classes are used for signalling techniques. These classes are Broadband and Baseband (11)

2.2.4a BROADBAND

In this type of technique it uses a method of frequency multiplexing i.e. many users into a single cable so that in effect several channels are

created. It has its origin on the cable television (CATV–community antenna television) market. Broadband can either use a single-cable or a double cable system. In the double cable system, one is dedicated to transmitting and the other to receiving. While in a single cable system, the cable bandwidth is split into two bands. One of the bands does the transmission and the other band does the reception.

2.2.4b. BASEBAND

The digital signal on the Baseband systems are transmitted as discrete charges on the signals, which corresponds to the digital info of the incoming data. The Baseband accepted standard method is known as Manchester encoding.

This Manchester encoding has a feature which make it very valuable for data communication systems, it consist of an inbuilt clock scheme which enables every system on the network to remain in synchronization.

The time interval is divided into equal cells, each of which is used to represent the single bits (11).

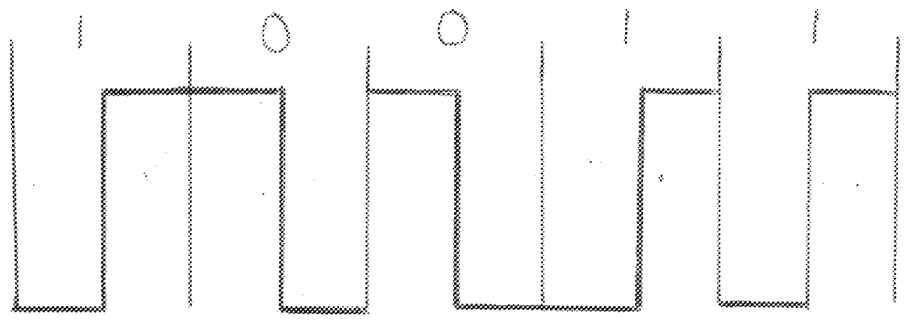

Fig 8 Manchester Encoding

2.2.5 NETWORK SHARING TECHNIQUES

Methods of using the network must be devised to make it suitable for carrying data. To make a network operate, more than just a few lengths of wire are required. Networks with the same topology can be used in several different ways and can use different media to effect interconnection. Thus neither the topology nor the mediums are wholly suitable as a method of classifying LANs. It is much better to approach the problem through the way the network operates and access the control procedures which have to be followed to make it operate as desired, although even here the same method may be applicable to several different topologies and applications (11).

2.2.5a. TOKEN PASSING

This is a method of media reservation in which a control token is used. This is a special packet which itself conveys not information but enable the holders of it to have exclusive use of the medium without fear of interruption from any one. The most important technique required is to ensure that each user of the network is given the token in turn. For this reason token passing is especially useful for ring topologies where it is easier to ensure that the token is passed from one node to the next because, data always passes around the network sequentially.

2.2.5b.CONTENTION

Contention is a way of sharing the use of the medium on a LAN by employing a scheme for obtaining exclusive use of the medium in contention with the other users of the network as at when required (11).

2.2.5bi CSMA (Carrier Sense Multiple Access.)

This means that before accessing the transmission medium to send a message, each o the devices first will listen to it so as to establish if there is a carrier signal present indicating that someone else is already using the network.

Multiple access is used to indicate that a number of users share the same transmission resources. Therefore with a CSMA network all the users share the same circuits and each one listens to it all the time so that it does not try to transmit when someone else is using the network at that particular time (1).

In the basic CSMA, the nodes which are transmitting, the messages will continue to do so until all the packet has been put on the network even though it will have to be retransmitted later when a positive acknowledgement from the recipient is not received. The nodes will try to send the packets at some point later on.

2.2.5bii CSMA/CD

The development of the CSMA technique, which is now, the most commonly used in most current LANs, is the one known as CSMA/CD. This simply means that the nodes listen to the network at the same time as they are transmitting, so that if collusion occurs in the process of

transmission, it can be detected as soon at it occurs. In this particular type of technique there is no need to have a specified packets, since the transmitter can actually hear if a collision is happening.

The main advantage is that, time is not wasted in transmitting information which will have to be retransmitted because it will not reach its destination "Unharmed" (11).

2.2.5biii CSMA/CA

This technique is not widely known as the CSMA/CD is known. It is essentially a combination of time division multiplexing (TDM) and CSMA/CA. The time is divided into slots which are located to each of the nodes on the entire network.

The node which have the first time slot transmits a packet of information if it has one available. Then the next node transmits and so on. If all the nodes are not ready to transmit when their appointed time slot is reached, then the network reverts to the normal CSMA/CD mode of operation. When the channel has once been used to transmit a packet, the system switches to the time slots (11).

2.3 LAN CONFIGURATION

In local area networks (LAN_S) computers have some roles. This roles include:

1. Servers (This provides network resources)
2. Clients (This uses but do not provide network resources)
3. Peer (This provide & use network resources)

Due to the roles of the computers connected to them, network are divided into three types namely:

1. Client-server (contains clients & servers)
2. Peer-to-peer (contains no server instead it uses the network to share resources).
3. Hybrid networks (contain client-server networks that also have peers sharing resources.)

1. CLIENT-SERVER

All the various network operations have communication with server. For the reason, the server should have enough capacity (memory and hard disk space) to store files and perform the task for many users. The servers can thus be said to be the brain or the focal point of client-server networks (7).

2. PEER-TO-PEER

This is a network that is defined by lack of central control over the entire network. These networks are also called workgroups. Each group member determines the data to be shared on the network.

3. HYBRID NETWROK

This is a type of network, that is it is a client server that also have peers sharing resources.

2.4 NETWORK SOFTWARE

Network operating system is the main network software. It arbitrates the links between network components (hardware). Network operating system (NOS) determines if a network is a "client-server" or a "peer-to-peer".

The major difference between a client computer and a server is the software each one of them runs. Clients runs client network, while servers runs network operating system (NOS), For a network to be complete it requires two types of network software.

1. Client network access software, which runs on the client and provides access to the resources shared by the server.
2. The Network operating system (NOS), which runs on the server and allows the sharing of the server resources.

Types of Network operating systems (NOS's)

1. Power LAN
2. Windows NT
3. Windows Workgroup
4. UNIX
5. Banyan vines

NETWORK OPERATING SYSTEM STRUCTURE

It is believed that some of the programs run in client PCs act as workstations. The Networking software in servers provides and control simultaneous access to resources. The networking software running in client stations intercepts and redirects request for services that the

application programs generate and sends each of them to the server for actions.

Clients Software

Client stations operating system module include the redirector and the software elements that carry the redirectors output through the network.

This redirector modifies the operating systems in the client stations to enable requests made by applications on through the network adapter and not through local facilities.

Server software

Server software makes it possible for resources to be shared in a timely and organized way.

2.5 NETWORK HARDWARE

THE HUB

This is the center of activity in a UTP star topology. It is a device in which all cables from the nodes on the network are connected and through which all signals flowing though the network are routed.

There are two types of HUBS

1. Active operation HUBS
2. Passive operation HUBS

    1. Active HUBS were brought by advancement in technologies. This are Hubs that do not use power supply units and it is used to connect various cable types i.e. This are the third generation

HUB: This active HUBS are powered and also generate signals & do impedance matching on the network.

2. Passive Hubs are not powered; it does no signal generation and does no impedance matching, matching on the network (7).

NETWORK INTERFACE CARDS (NICs).

Network interface cards (NICs) are sometimes called Network adapters. These are peripheral cards that are plugged into the motherboard of the network cable.

The computer communicates on the network through the network interface card (NIC) it converts the parallel signals into a stream of digital pulses to be transmitted over the cable connecting the nodes to the network.

This NICs is integrated with the computer by a manufacturers software called the cards drivers. While adapters transmit.

They listen to the wire to compare the data on the line with the data being transmitted. If another adapter interrupts the data being "heard" by the transmitting, NIC will not match the data being transmitted. This particular type of occurrence is called a collision.

The various choice of adapter depends on the type of network, media and bus on the computer to be connected to the network.

PC BUS types

These are connection slots on computers which are provided for the connections of peripherals, they could be:

- Micro-channel

- Proprietary local bus etc
- EISA (Extended Industry Standard Architecture)
- VESA local bus
- ISA (Industry Standard Architecture)

2.6 NETWORK COMMUNICATION

Sending data from one computer to another could be termed as network activity. The process can be divided onto discrete tasks.

- Add timing and error checking info
- Add info to each chunk of data to the receiver or determine the location of the data.
- Divide the data into manageable chunks
- Recognize the data
- Putting the data on the network and sending it on its way.

The network operating system follows a set of procedures in performing each task. And each procedure is called protocols. This protocols guide each of the activity to successful compietion.

2.6.1 NETWORK PROTOCOLS

This is the computer language. Protocols are ways that computers exchange information. Networks are full of protocols. A computer needs to know exactly how messages will arrive from the network so it can make sure the message gets to the right place (7).

2.6.2 HARDWARE AND SOFTWARE INTERFACE

When a computer needs to access a hardware program, such as when a message has arrived from the network and is now waiting in the adapter cards memory is ready to be received, the computer program uses a predefined hardware software protocol. This basically means that the computer program can expect the data to always be in the same place; that certain registers on the cord will indicate what is to be done with it; and that when other registers are accessed in the proper order, the card will do something logical, such as received another message or send a message out (7).

2.6.3 SOFTWARE PROTOCOLS

Software protocols helps programs to communicate to each other. Network server and Network client computer both have protocol packages that must be loaded to allow them to talk to other computers. These packages contain the protocols the computer needs to access a certain network device or services.

In order to communicate properly all computers on a network must have at least one set of protocols in common in order to communicate (7).

2.6.4 HARDWARE PROTOCOLS

This defines how hardware devices operates and work together .The 10 Base T Ethernet protocol is a hardware protocol specifying exactly how two 10 base T Ethernet devices will exchange information and what they do if it is improperly transmitted or interrupted it determines

the voltage level and the particular pairs of wires that will be used for transmission and reception. (7)

2.7 OPEN SYSTEM INTERCONNECT (OSI)

It is used to describe the frame work through which a collection of standards is being developed under the guidance of the international Standards Organization (ISO). The main purpose of the standard is to create an environment where complete networking between computer systems supplied by different vendors become very possible (13).

2.7.1 THE OSI MODEL

The ISO in 1984, released a revision of this model and called it open systems interconnect (OSI) reference model. This revision has basically become an international standard and serves as a guide for computer networking. It shows how network hardware and software work together in a layered fashion to make communication easy. The OSI model is not a network architecture because it does not specify the exact services and protocols to be used in each layer. Instead if tells what each layer should do, it is an architecture that divides network communication into seven layers. It's layer has a well defined network functions and the function of each layer immediately above and beneath it. The layers are separated form each other by boundaries called interface. This interfaces carries all request from one layer to the next layer.

2.7.2 RELATIONSHIPS OF OSI MODEL LAYERS

The major purpose to each layer is to provide services to the next higher layer and shield the upper layer from the details of how the services are actually implemented. The layers are set-up in such a way that each layer acts as if it is communicating with its associated layer on the other computer

Before data is passed from one layer to another, it is broken down into packets. A packet is a unit of information transmitted as a whole from one soft ware layer to another in the order of the layer. At each layer, the software adds some additional formatting or addressing to the packet which it needs to be successfully transmitted across the network.

Physical layer:

This layer defines the Physical interface between devices and the rules of which bits are passed from one device to another. It is concerned with fundamentals such as pin connection and electric voltage levels. The most common layer I standard in use today in RS-232 as a method to connect a DTE to a DCE such as a modem (7).

DATA LINK LAYER

This layer defines protocols for transferring messages between DCE and DTE. It operates to overcome the deficiencies of the physical layer, in particular the effect of noise and electrical interference, which may have been introduced in transmission across the medium. It carries out error detection and correction for errors arising during transmission in

effect it converts a simple physical, but possibly unreliable connection into a tested and error free digital connection between two end locations (7).

NETWORK LAYER

This layer supports network connection between two hosts communicating over a network. It converts the reliable digital connection provided by layer 2 into a multi node network exchange of data (routing and also it specifies the destination address (IP-address). This is the layer that is responsible for traffic congestion on the network, consequently maintains a degree of efficiency in the network traffic (7),.

TRANSPORT LAYER

This layer provides a reliable mechanism for the exchange of data between end systems. It ensures also that data units are delivered error-fee in sequence and with no losses of duplications. This layer breaks large message from the session layer into packets to be sent to the destination computers and reassemble packets into messages to be presented to the session layer. It can be viewed as a bridge between the communication oriented and application oriented layers (7).

SESSION LAYER

This layer allows application on separate computers to shared connection (called session). It provides for data sychronization and check pointing so that in the even of a network failure, only the data sent after the point of failure need to be resent. It also determines who can transmit and who can receive at any point during communication (7).

PRESENTATION LAYER

This layer resolves differences in representation of information task uses. It translates data between the formats, the network requires, and that which computer expects. It does protocol conversion, data translation and encryption. The layer makes files on the file server visible to the client computer (workstation); it also makes remote printers act as though they are attached locally to any workstation (7).

APPLICATION LAYER

This is the ultimate source and link for data exchange. It takes no part in communication system but acts to provide services that directly support user application software to communicate with software on other linked computers as though they were on same computer. Examples of protocol at this level are the FTP and E-mail (7).

Figure 9 OSI REFERENCE MODEL

Level 7	Application layer
Level 6	Presentation layer
Level 5	Session layer
Level 4	Transport layer
Level3	Network layer
Level 2	Data link layer
Level 1	Physical layer

2.8 ETHERNET

This is the most popular physical network architecture in use today. It is a bus or star bus-based technology that uses Baseband signalling and CSMA/CD to arbitrate network access.

The Ethernet medium is passive, i.e. the computers drive the signal over the networks most Ethernet networks, currently run at 10 Mbps.

10MBps ETHERNET

Ethernets is available for several types of cable or physical media. The various types of Ethernet use various signalling characteristics, and share the Ethernet framing specification, the 10Mbps speed, and use of CSMA/CD to arbitrate access. They are 4 (four) major types of Ethernet cabling system (10Mbps), they are:

1. 10 Base 2 or thinnet, which uses thin coaxial cable.
2. 10 Base 5 or thicknet, which uses thick coaxial cable.
3. 10 Base T, which uses unshielded twisted pair cable
4. 10 Base FL, which uses single-or-multimode optical fibre.

2.81 10 BASE T (TWISTED – PAIR) ETHERNET

UTP cable is now a fully used trend in Ethernet network wiring schemes. The specification for UTP was created by the 802.3 sub-committee of the ISO. It has the following specifications.

i. Maximum segments 1024

ii. Maximum segment with nodes 1024

iii. Maximum nodes per segments 100m (330ft).

iv. Maximum nodes per network 1024

v. Maximum HUBS in a chain 4

This particular 10 base T is wired as a star. And as such each device has its own set of wires connected to a HUB. Although the physical topology of 10 Base T is a star, its logical topology is a bus. Then the connection of this 10 Base T to the hub and the cards is made with an RJ – 45 connector.

2.9 NETWORK ADMINSTRATION

This is a process of maintaining, enhancing and operating the network. The main administrative task of the network include the following.

1. Allocation of disk space.
2. Network performance maintainace.
3. Workable directory structure establishment.
4. Network security establishment
5. File management
6. Troubleshooting network problems
7. Setting up user accounts and corresponding access rights

CHAPTER THREE

IMPLEMENTATION AND TESTING

3.1 INTRODUCTION

In order to successful implement LAN_S, careful planning is essential. The Primary networking rules is that "the network will always outgrow initial expectations".

Networks are modular: once a network is built on a solid base, additional network needs can be easily added.

The following procedures were carried out in the implementation of the LAN within the Electrical Department. These procedures were to ensure that the network meets the standard set by the ISO. The seven-layer reference model.

3.2 LIST OF ITEMS USED.

3.2.1 1. **10 Base T Ethernet Hub**

2. Dozen of RJ 45 connectors
3. Ethernet cards
4. RJ wall sockets
5. CAT 5 UTP cable
6. Cable holders

3.2.2 TOOL USED

1. Crimping tool
2. Screw driver set
3. Digital Multimeter
4. Hammer
5. Cutter
6. Tape Rule
7. Chisel

3.3 CHOICE OF CABLES

The very first step taken was the topology (i.e. the determination of choice of cables). This involves a careful assessment and measurement of the site. A drawing was produced which was (labeled 01) showing locations of various offices. The next was analyzing a cable scheme, and because of future expansion, which is important in any network design. A topology that could ease the problem was chosen. And as such the STAR topology was decided upon to be used, this star topology was agreed upon because of its ease of expansion and troubleshooting.

CAT 5 UTP cables were agreed on to be used.

3.4 INSTALLATION OF CABLES

After the site plan has been completed, another cabling layout was produced (labeled 02) which shows the connection of cables from the central connections to all the nodal points. The cables were ran overhead from the control from (labeled D in 01 & 02) to all the nodal points and some were laid on the office partition walls. The four pairs on the UTP were linked with RJ 45 connector at one end by a process known as crimping, an the other end was linked to the RJ 45 socket by a process called termination. The length of the patch cables are 3m. Eight drop cables were clearly labeled for proper identification and trouble shooting. Printed self-laminated wraps, around the cables were employed.

HUB TO RJ45WALL JACK			RJ45WALL JACK TYPE
CABLE LABEL	CABLE LENGTH (M)	CABLING TYPE	
01*	11.00	Overhead	SF
02	14.80	Metallic conduit	SF
03*	5.95	Overhead	"
04	2.0	Surface	"
05	3.0	"	DF
06	3.0	"	"
07*	4.08	"	SF
08*	7.45	"	"
09*	9.30	"	"
10	11.9	Overhead	DF
11	11.9	"	"
12	5.5	"	SF
13	12.3	Metallic conduit	DF
14	12.3	"	"
15	13.3	"	"
16	13.3	"	"

* = Existing Hub to RJ 45 wall jack configuration

SF = single face RJ45 wall Jack

DF = double face RJ 45 wall jack

Number of SF= 8

Number of DF = 4

After cable preparations, they were installed from the hub to RJ 45wall jack Via different method of cabling. Theses methods are the overhead cabling, surface cabling, and metallic cabling (Conduit). Two types of data outlets were used, the single face (SF) and the double face (DF) RJ45 wall jack. The tab le below shows the colour code for the cat 5 UTPL cable.

During installation, careful consideration was given to the proximity of cabling to nearby sources of electromagnetic interference, such as fluorescent lighting, radio, frequency sources. During installation and subsequently, care was taken to prevent damage to the cabling, were possible. Surface cabling was avoided to prevent exposure. Special precautions were taking to reduce or damage in case of surface cabling. Rough edges were avoided as much as possible.

Table 3.1 Colour code for CAT 5 UTP cable

WIRE ID	COLOUR CODE	ABBREVIATION
1	White – blue	W – BL
2	Blue	BL
3	White – Orange	W – O
4	Orange	O
5	White – Green	W – G
6	Green	G
7	White – Brown	W – BR
8	Brown	BR

3.5 INSTALLATION AND LOCATION OF HUB

A 9 port 10 Base T Ethernet Hub was installed. The positioning of Hub as shown in cabling layout produced (Labeled 01) was then taken

after considering the locations and number of computer system and data outlet to enable easy visibility and accessibility.

3.6 INSTALLATION OF NIC'S AND CONFIGURATRION OF NIC'S

The installation of network interface cards. The PC's were shutdown and disconnected form the power supple unit, and the cover of the PC's were removed. A suitable free expansion slot was located in each of the PC's and the cards were fitted and secured firmly, then the covers were replaced. The network cables were plugged in for each of the cards installed and connected to the other end of the hub. The maximum length of the UTP cable must not exceeds 100m (i.e. from the computer to the hub).

3.6.1 CONFIGUARTION OF NIC'S

After installation of NIC's, the PC's were turned on, and the new hardware was detected by windows 98. This is because it is a well known brad of network card, then the best driver was automatically loaded, if not the driver diskette, that came with the card would have been loaded. After restarting the system, a network neighbourhood ICIN appeared on

The desktop and a network user name and password was demanded for buy the system. Each of the PC's was given a unique computer name that identifies it to the other users. The PC's were provided with work group name specifies which group of users it belongs to, and as such the PC's were all using the same workgroup name. Windows 98 defaults to

installing the TCP/IP network Protocol and it requires a unique address to identify each P.C. The TCP/IP address comprises of four numbers each between 0 and 255. An IP address was specified and the choice was entered.

3.7 TCP/IP CONIGURATION

IP Address

An ip address consists of 32 bits in four group of octet (or 8 – bytes). The four octets are separated by a period.

Subnet mask:

This allows the network software know what the other addresses are, on the same local network, or subnet, as the computer .

Subnet mask: 255.255.255.0 for all workstations

Workstation 01: IPAddress 192.168.01

Workstation 02: IPAddress 192.168.02

Workstation 03: IPAddress 192.168.03

Workstation 04: IPAddress 192.168.04

Workstation 05: IPAddress 192.168.05

Workstation 06: IPAddress 192.168.06

Workstation 07: IPAddress 192.168.07

Workstation 08: IPAddress 192.168.08

Default gateway = Nil (for all workstations)

3.8 TEST CARRIED OUT

3.8.1 CONTINUITY TEST

The continuity test was employed to ensure that the drop cables and patch cables are in good condition of operation.

Type of meter used: Digital Multimeter

Meter specification: Diode scale

3.8.1A.DROP CABLE TEST

An RJ45 pin-to-pin test was carried out on the drop cable using the digital Multimeter. The table 4.1 in chapter 4 shows the test and result of continuity on drop cables.

3.8.1b HUB TO RJ 45 WALL JACK TEST

A pin-to-pin test was carried out between the RJ 45 wall and RJ 45 Jack going into the hub. The table 4.2 in chapter 4 shows the test on hub to RJ 45 wall jack.

3.8.2 CONNECTIVITY TEST OF LAN

This test was carried out to ensure that there is communication between the computer systems LAN.

Ping utility was employed. This particular type of utility is used to test connectivity for target system. This is done by sending out ICMP echo packets and waits up to one second, by default listening for the reply. The table 4.4a in chapter 4 shows the test of connectivity.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

INTRODUCTION

The results of the entire test carried out in chapter three are properly presented and are also discussed in this chapter.

4.1 DROP CABLE TEST RESULTS

Pin tested	DROP CABLES								Meter Result	Comment
	1	2	3	4	5	6	7	8		
1 to 1	"	"	"	"	"	"	"	"	BEEP	PASS
2 to 2	"	"	"	"	"	"	"	"	"	"
3 to 3	"	"	"	"	"	"	"	"	"	"
4 to 4	"	"	"	"	"	"	"	"	"	"
5 to 5	"	"	"	"	"	"	"	"	"	"
6 to 6	"	"	"	"	"	"	"	"	"	"
7 to 7	"	"	"	"	"	"	"	"	"	"
8 to 8	"	"	"	"	"	"	"	"	"	"

Table 4.1 Drop cable test.

4.1.1a DISCUSSION OF RESULT SHOWN ON TABLE 4.1 ABOVE

The pin-to-pin test shows that there was a beep; hence the cable has continuity, which indicates proper functioning of the cable.

4.2 RJ 45 WALL JACK TEST RESULT

Pin tested	Hub to RJ 45 wall jack connections											Meter result	Comment
	02	04	05	06	10	11	12	13	14	15	16		
1 to 1	"	"	"	"	"	"	"	"	"	"	"	BEEP	PASS
2 to 2	"	"	"	"	"	"	"	"	"	"	"	"	"
3 to 3	"	"	"	"	"	"	"	"	"	"	"	"	"
4 to 4	"	"	"	"	"	"	"	"	"	"	"	"	"
5 to 5	"	"	"	"	"	"	"	"	"	"	"	"	"
6 to 6	"	"	"	"	"	"	"	"	"	"	"	"	"
7 to 7	"	"	"	"	"	"	"	"	"	"	"	"	"
8 to 8	"	"	"	"	"	"	"	"	"	"	"	"	"

Table 4.2

4.2.1 DISCUSSION OF RESULTS SHOWN ON TABLE 4.2

The meter beep on a particular pair of wires indicates that the wall Jack passed the continuity test, hence the wall jack has continuity which indicates proper functioning of the RJ 45 wall jack.

4.3 CONNECTIVITY TEST PROCESS

All the workstation were pinged to test connectivity.

SYNTAX

Ping	192.168.0.1
Ping	192.168.0.2
Ping	192.168.0.3
Ping	192.168.0.4
Ping	192.168.0.5
Ping	192.168.0.6
Ping	192.168.0.7
Ping	192.168.0.8

Table 4.3

4.4 CONNECTIVITY TEST RESULTS

Reply from 192.168.02: bytes = 32, time = 150ms, TTL = 244

Reply from 192.168.03: bytes = 32, time = 150ms, TTL = 244

Reply from 192.168.04: bytes = 32, time = 150ms, TTL = 244

Reply from 192.168.05: bytes = 32, time = 150ms, TTL = 244

Reply from 192.168.06: bytes = 32, time = 150ms, TTL = 244

Reply from 192.168.07: bytes = 32, time = 150ms, TTL = 244

Reply from 192.168.08: bytes = 32, time = 150ms, TTL = 244

Table 4.4 TTL = time to live

4.4.1 DISCUSSION OF RESULTS

When all the workstations were pinged as shown in table 4.3, there was a reply as shown in table 4.4. This indicates that there was connectivity established.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSIONS

At the beginning of this project, it was taking and mind-boggling. All knowledge of computer hardware and software was tested during the course of the implementation o this network. I would like to say that the aims of this project were achieved. The major objective whish was to implement a local Area Network within the department was successfully carried out, considering the fact that the materials available were state-of-the art, the network is in it's best technically functioning state. A 9 port Hub was used, this makes expansion easier.

The conclusion is that the network, worked.

5.2 RECOMMENDATIONS

At this point, I recommend that the network be expanded to its full capacity, either within the department or even to the DEAN's and SCHOOL EXAMINATIONS OFFICES. At some point in time, a network to all the departments in the school of engineering should be implemented, within the growing confluence of computers with communication and emphasis should be laid on acquisition of computers alone, but also on maximizing its performance by having them on a network. And this will improve them on a network. And this will improve the efficiency of the services rendered within the school and the university community.

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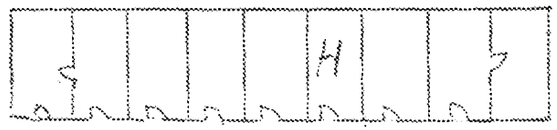
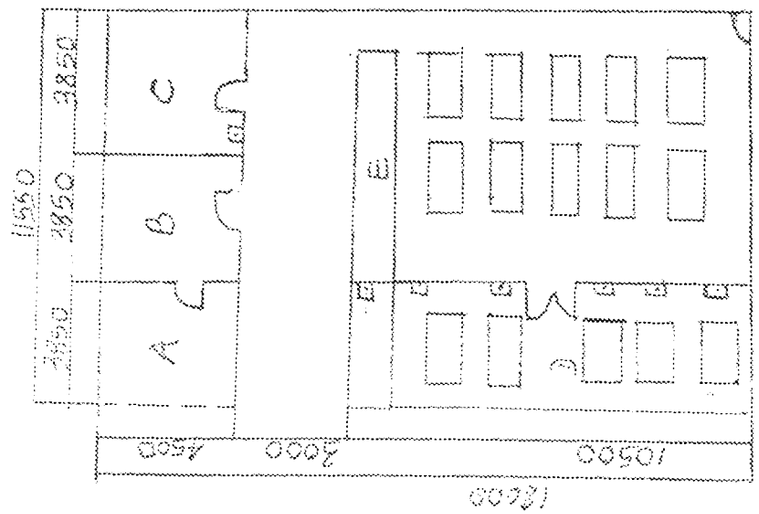
SITE LAYOUT





KEY

A	LECTURERS OFFICE
B	SECTARYS OFFICE
C	TECHNICIANS OFFICE
D	COMPUTER ROOM
E	GENERAL CLASSROOM
H	HOD's OFFICE

Project title:
DESIGN AND IMPLEMENTATION OF A LOCAL AREA NETWORK

Name:	no:
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Department:
ELECTRICAL/COMPUTER ENGINEERING

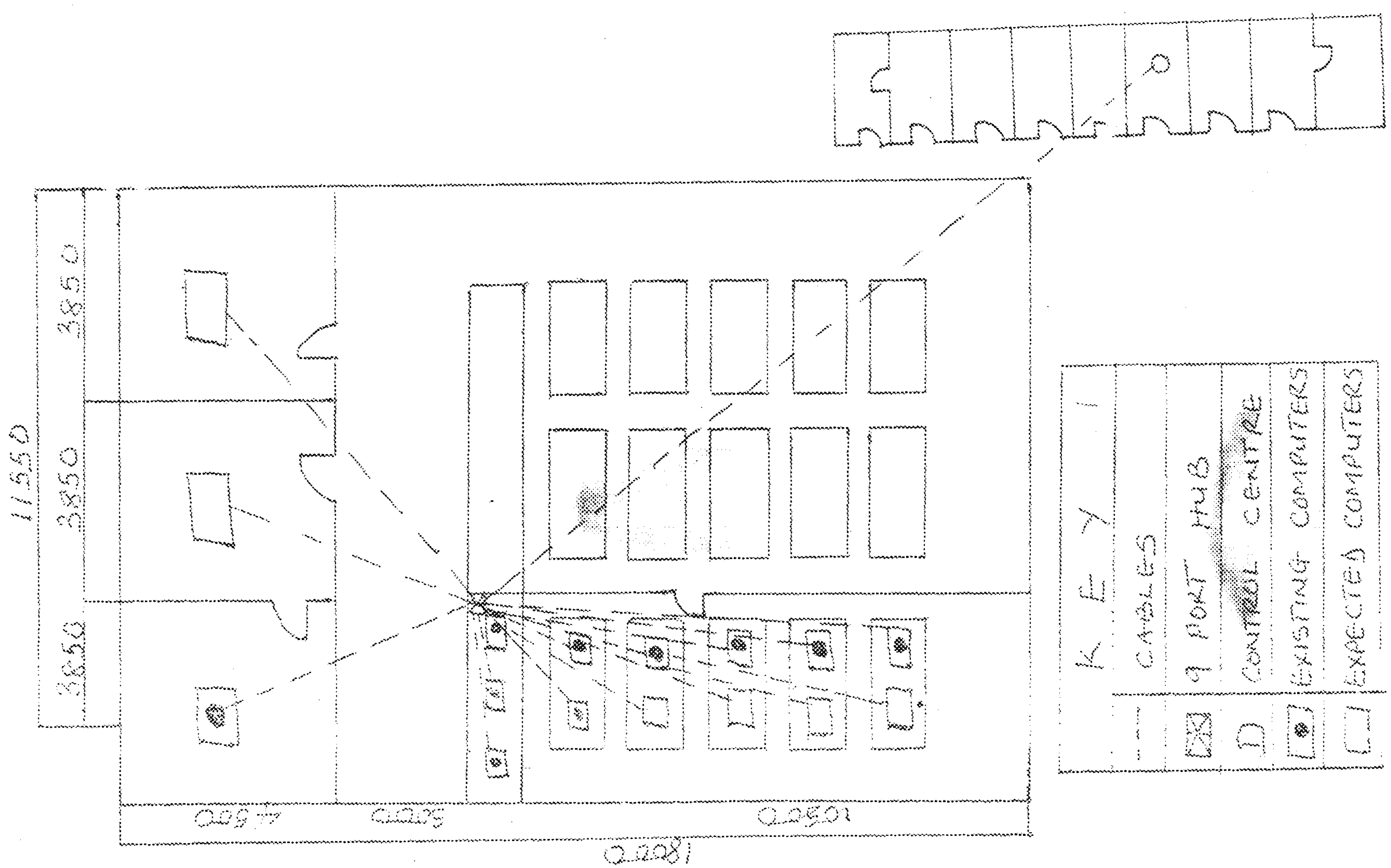
Supervisor:
JEDNA

Course code:
EEE 315/525

Date:
December 2000

Drawing no:
01

CABLING LAYOUT



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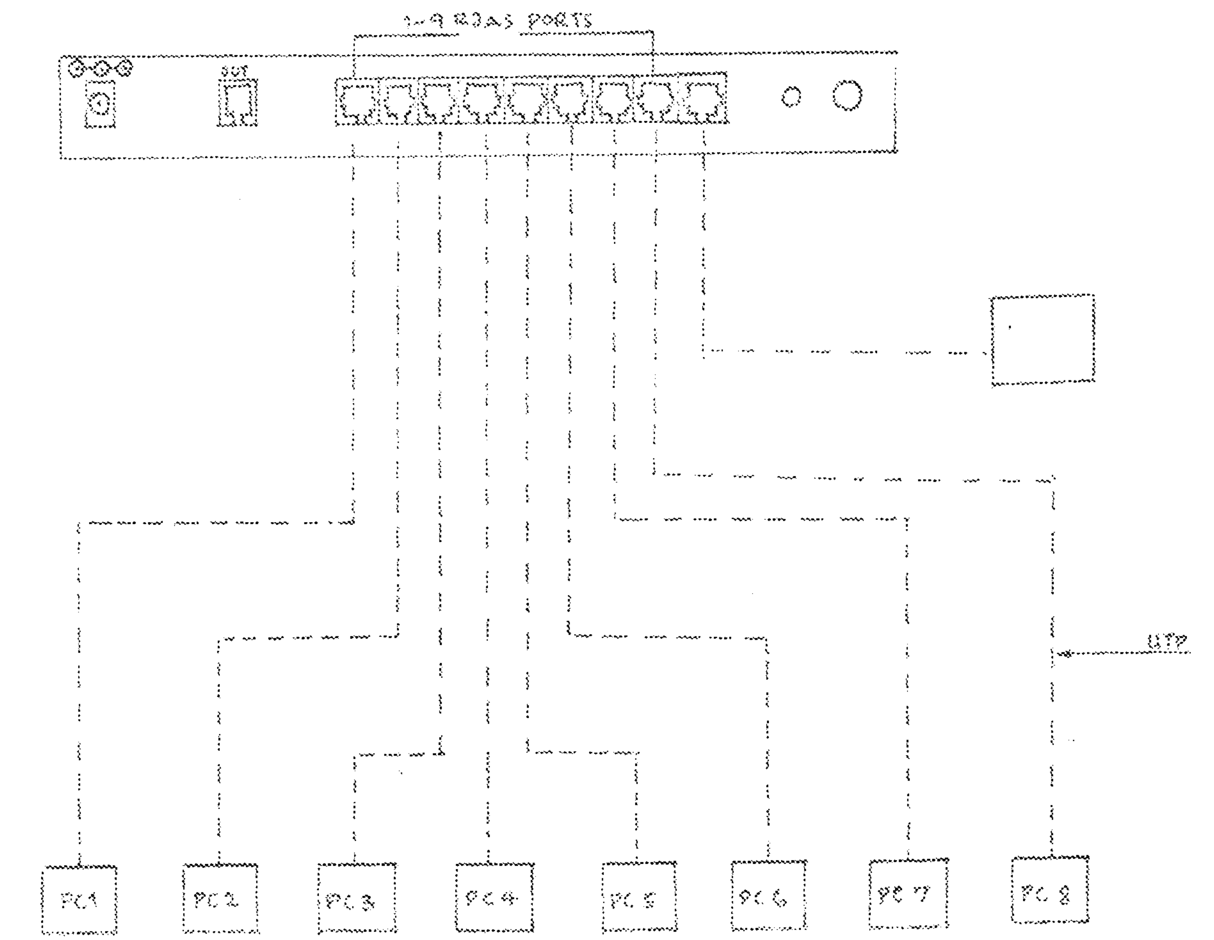
December 2000

Drawing no:
02



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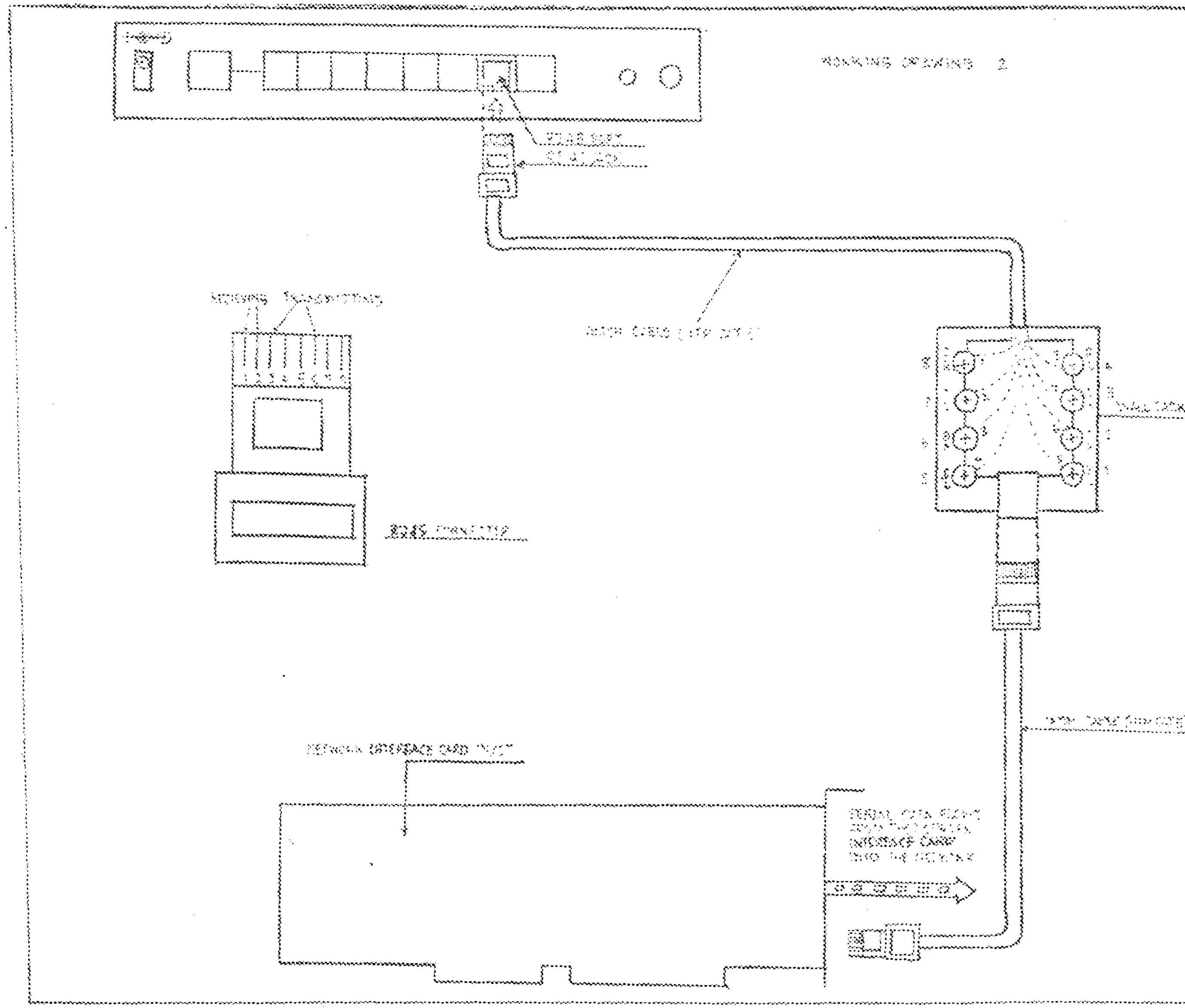

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04