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FACULTY OF NATURAL AND APPLIED SCIENCES

DEPARTMENT OF COMPUTER SCIENCE

E-NOTE

FOR

COURSE CODE:
CMP420

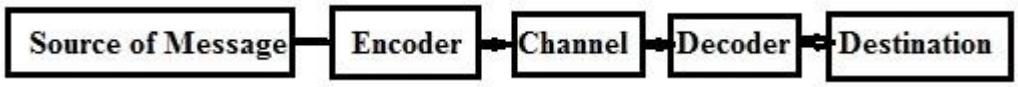
COURSE TITLE:
COMPUTER NETWORKS AND COMMUNICATIONS

2019/2020 SESSION

INTRODUCTION

This course is based on information transfer over short/long distances like problems and solutions of transporting data over distance. Information transfer generally has 3 components such as i. Sender ii. receiver and iii. Suitable medium, based on this, the basic components of a simple data transmission system are (a). Central Computer, (b). terminal devices and (c). telecommunications but there are other important items required for better data transfer.

On the other hand, under Information Theory, we have Shannon and Weiner model to learn more on communication situation like on input signal, channel, noises in the channel etc. The Information Theory, is the analysis of an entity called a communication system see the figure below.



Source of message - encoder associates with each message an "Object" suitable for transmission over the channel.

The "Object" - is sequence of binary digits, as in computer applications or a continuous wave form as in radio.

Communication - Channel is talking of medium over which the coded message is transmitted while decoder operates on the output of the channel and attempts to extract the original message for delivery to the destination.

Computer needs to interact with one another during computing. Communicating with micro-computers, and other computers seems to be the flavour of the day these days. Now the task is of connecting micro-computers to printers, "dumping" files from one micro-computer to another, connecting many computers together in a "network" and even connection of computers throughout the world through internet..

What is required to effect a successful transfer of your file from the old to the new is some systems of reading the file to be transferred character by character and transmitting these by

some process in the receiving computer, where up on this latter computer will understand what it is receiving, and hence save your transmitted characters, one by one, in some place of safety.

The more exciting is the possibility of "downloading" file of data, graphics and codes perhaps across the telephone line or space using a modern link, into an unknown and possibly unseen computer system to be accessed immediately or later by colleagues. And all in a matter of seconds.

The need to specify a standard

Two computers or devices will have to communicate or "talk" to each other. How is this to be achieved?. This means that a common standard for a system of talking will obviously have to be agreed on - they will have to talk the same language if they are to understand one another. e.g.

- How are these characters to be specified and translated?
- How are these translated characters to be transmitted?
- How will the receiving computer know to expect a character?
- How will the receiving computer know when a character starts, and when it stops?
- How will it know when the whole file has been transmitted?
- How, too can computers tell each other when to slow down or stop, and when to start transmitting again?

Solution to these questions can never be unique. There are many different solutions, each of which cater for different problems and criteria. However, out of the numerous possibilities, at least some common and widespread standards have arisen.

Character Sets

Internal working of computer and how characters are to be internally represented need to be explained.

Almost all computers nowadays work on the principle of using group of binary digits, or "bits",

to represent data. Each bit may be 1 or 0 due to the nature of the electronics used in microprocessor. Only two states are possible on & off, high & low, or logic true or false. Most microprocessors group these bit together into a string of eight called a "byte" e.g.

Binary representation.

(a) 10110011, (b) 11111111, (c) 00000000, (d) 00110001, (e)01000010

each 8 bits under number system using any base (such as 10, 8, or 16), a number is expressed in ascending powers of 2. Computer in general deal with base 2, 8, 10, or 16. i.e binary, octal, decimal and hexadecimal.

Conversion of Binary to Octal:

This is done by partitioning of the bits into group of three digits. e.g.

Note: no need of converting it to base 10 first.

Example:

10110011_2 to base 8

10 / 110 / 011

$= (2^1 \times 1) + (2^0 \times 0) / (2^2 \times 1) + (2^1 \times 1) + (2^0 \times 0) / (2^2 \times 0) + (2^1 \times 1) + (2^0 \times 1)$

$= 2 + 0 / 4 + 2 + 0 / 0 + 2 + 1$

$= 263_8$

A more convenient way to represent such numbers and bytes, especially when dealing with computers using hexadecimal representation. This means using a number system to the base 16.

Now a byte can be split into two half-bytes, or `NIBBLES' by grouping the eight bits into two sets of four bits each, called the high nibble and low nibble. A nibble is half a byte.

Base 16 - 0 1 2 3 4 5 6 7 8 9 A B C D E F

H is used to identify hexadecimal numbers. This is surely a much more elegant and compact way of representing bytes!

Conversion of Binary to Hexadecimal:

This is done like octal but in group of four digits.

Example:

10110011_2 to base 16

1011 / 0011

$= (2^3 \times 1) + (2^2 \times 0) + (2^1 \times 1) + (2^0 \times 1) / (2^3 \times 0) + (2^2 \times 0) + (2^1 \times 1) + (2^0 \times 1)$

$= 8 + 0 + 2 + 1 / 0 + 0 + 2 + 1 = 11 / 3$ note that 11 in base 16 is B

$= B3_{16}$

= B3H

Assignment:

Read conversion from base 10 to base 2, base 8 to base 10, base 16 to base 10 and vice-versa in any text book.

Computer now represents these data with standard code which must be comply with in all computers. The examples are ASCII and EBCDIC character sets.

The ASCII Character set

(American Standard Code for Information Interchange)

(a) 00H to 1FH i.e. numbers 0 to 32 in decimal codes are called control codes e.g chr(13) - return key

chr(10) - Line feed

chr(7) - Bell etc.

(b) 30H to 39H i.e. numbers 48 to 57 in decimal codes are meant for numeric characters 0 to 9.

(c) alphabet characters has their own unique code e.g.

- for upper case we have 41H to 5AH i.e. 65 to 90 in decimal.
- for lower case we have 61H to 7AH i.e. 97 to 122 in decimal

(d) Other characters and symbols continue up to 255 in decimal code, 11111111 in binary or FF in hexadecimal.

(e) There exist also, the extended ASCII character set.

Assignment: read ASCII code for representation of xters.

IBM and EBCDIC Character Set

(Extended Binary Coded Decimal Interchange Code)

EBCDIC is also a very important code being used by IBM. IBM alone amongst the major computer manufacturer uses the full 8 bits of each byte which means it has more characters. We need to note that EBCDIC code is generally peculiar only to IBM mainframe computers. Their microcomputers such as PC, XT and AT, uses the ASCII code system which allow compatibility between the vast range of microcomputers, printers and other devices.

TRANSFER OF DATA BETWEEN DEVICES

This now deals with transmission of bytes of data using ASCII coding system. Each character is a string of eight bits, then the actual transmission of 8-bits is done for each character that needs transmitting.

Do we transmit the 8-bits simultaneously or in some sort of sequence? The transmission of data simultaneously is called parallel transmission while the sequence transmission is called serial transmission.

Advantages and disadvantages of both

- Advantages of parallel transmission is that it is faster, but it is very expensive because it will need more wires e.g. 8 wires for each character.
- Serial is cheaper but its disadvantage is that it is very slow since it is going to use only one wire.

SERIAL TRANSMISSION OF DATA

Description of Basic Serial Transfer: To transmit the constituent bits one by one encoding system is set up in binary system of ones and zeros which is easily transmitted into, plus(+)

and minus(-) voltage signals on a wire. There is logic circuit that changes one to positive(+) while zero become minus(-) and interpret it as 1,0. This is the electronic part of computer.
When transmitting a byte, only one line or wire is needed and the bit move one by one, then the first bit of our data is called the "right most" or "least significant bit" (LSB)

Parallel Transmission of DATA

We need 7 or 8 separate wires, the system place each bit on the line simultaneously, then the receiving system look at them simultaneously.
Then we need to synchronise so that transmission and receiving computers know when to expect to start and stop.

MORE SERIAL TRANSMISSION

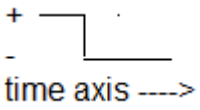
There are two fundamentally different ways in transmitting data-

1. Asynchronous
2. Synchronous

The different between both of them centres around the ideal of whether or not it is wished to control the transfer exactly in time, with both transmitting and receiving devices being synchronized (get the data at the same time or as faster as possible) i.e. bit transfer taking place at a preselected time and rate or whether the exact timing or rather sequence of these events is to be somewhat arbitrary and even random.

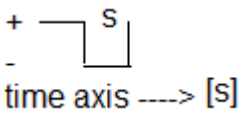
Asynchronous Transmission (Under Serial Transmission)

Remember that serial transmission uses only one line or wire to carry the transmitted data. The line will be at rest called logic high or positive.



This is the input to the receiving device and independent of time and it will not mind how long

it stay in the high level. The transmission only commence when the line is "pull" to low, i.e. minus(-) or logic zero.



This is the start bit [S] which computer recognize in order to start. After woken up by this first bit or called start bit, it will be expecting another 8 bits of data.(a byte).

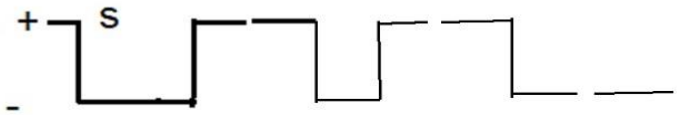
NOTE: that Asynchronous transfer is partially synchronous since there may be gap between characters, but the system pull itself together by the time transmission started and synchronizes.

Examples

1.

time axis –>[s] [a] [b] [c] =>110

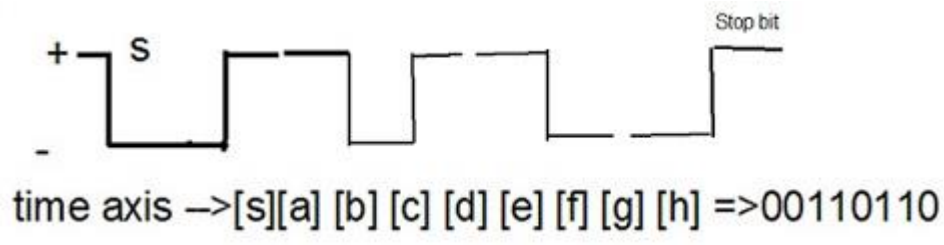
2.



time axis –>[s][a] [b] [c] [d] [e] [f] [g] [h] =>00110110

Now that we have been able to let the receiving device know that data is coming using start bit (logic zero or minus), how will it know when to stop. The addition of end signal is very important.

The **stop-bit** is logically opposite of a start bit which must be a logic one, or positive or the line is high. This is the rest state for the line. e.g.



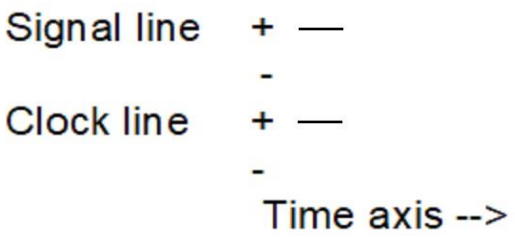
The line is back until when there is another start bit.

Asynchronous bit serial transfer is more advantageous since it uses only one line throughout, then a lot of copper is being saved so far.

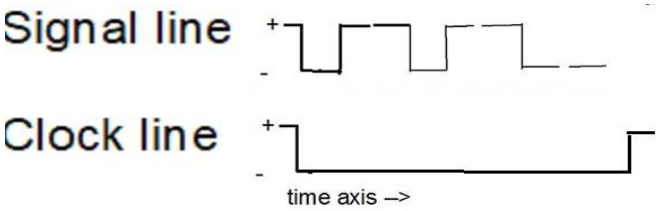
Synchronous Transmission -bit Serial

This one only need additional second line called the clock line for synchronization. This is to provide a regular series of pulses.

This time the receiving computer is keeping time with the clock signals, it can keep time with the bits that it is receiving. e.g.

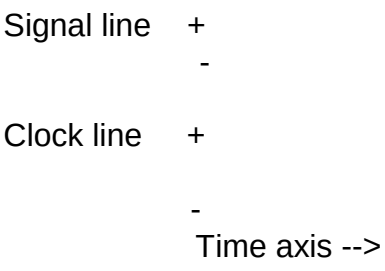


The receiving device now watches the clock line but at rest, both lines are held high in their rest state.



No start bit is required but it knows by noticing change in clock line from high to low. Thus the receiving device knows, that there is something going on - there will be some data on the signal line. The signal line may now be either high or low.

The receiving machine only sample the signal line straight away and record the value.



From the above diagram, only 3 bits 0, 1 and 0 have so far been transmitted due to resting after each bit. But there is improvement in which there is no need of resting after each bit. So we have 011101 for the above figure. This effectively double the rate of transfer of bit.

The clock pulse can now have high frequencies then we have microprocessor with 7mhz, 33mhz or 100mhz even in 3Ghz now.

COMPARISON OF SYNCHRONOUS AND ASYNCHRONOUS COMMUNICATION

Why is it that asynchronous communication more popular?

The evidence for this is the wide spread use of the RS-232 interface. The RS-232 Interface Lead has even been satirised in popular television.

The disadvantage of using clock line is that an extra line has to be used. This may become troublesome over a long distances which may lead to loss of data. But it may be managed satisfactorily over short distances like a few feet from one device to another e.g. in printer/computer with few feet apart.

Another reason is to do with the electrical characteristics of data transmission over wires - the long the space the more the problems.

We can now summarize that any universally useful or acceptable system will have to be rugged, cheap on materials and must be capable of working over reasonable distances.

SYNCHRONOUS BIT-PARALLEL SYSTEM

7/8 wires with a clock line making 8/9 lines are going to be used which keep the whole

transfer affair in order. All the bits will be transfer in one go.

signal lines
bit 0 +
-
bit 1 +
-
bit 2 +
-
bit 3 +
-
bit 4 +
-
bit 5 +
-
bit 6 +
-
bit 7 +
-
clock line +
-

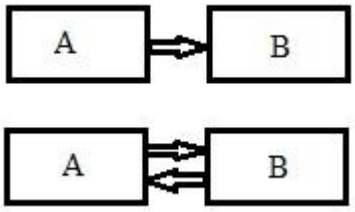
RS-232 Serial Interface

This is the most important interface standard to consider and most widely used standard for communication in the computer industry. RS means Recommended Standard while it can be called EIA RS-232 in which EIA stands for Electronic Industries Association, an American governing body based in Washington. We also have other versions such as RS-232C, RS-423, RS-422, RS-499, etc.

In computer communication, we have two types of equipments:

1. Data Terminal Equipment (DTE) e.g. computer
2. Data Communication Equipment (DCE) e.g. Peripherals.

The communication between them can either be one way or two ways.



The equipment that is transmitting data is called DTE while the one receiving it at the other end is called DCE. But if both equipment can be sending and receiving, the one sending is called DTE while any one receiving will be referred to as DCE.

Signal Lines

Then to connect DTE and DCE together we normally use the standard RS-232 serial interface which has about 25 lines or pins. Each has its own number and function. The pin number and its corresponding function are as follows:

Pin Number	Description
1	Protective ground
2	Transmit Data (TXD)
3	Receive Data (RXD)
4	Request to send (RTS)
5	Clear to Send (CTS)
6	Data Set Read (DSR)
7	Signal Ground (Common Return)
8	Data Carrier Detect (DCD or CD)
9	(Reserved for data set testing)
10	(Reserved for data set testing)
11	(Unassigned)
12	Secondary DCD
13	Secondary CTS
14	Secondary TXD
15	Transmitter Signal Timing Element (DCE source) etc.

PLUGS AND SOCKETS

Confusion abounds, unfortunately over plugs and sockets. Though it is compulsory but manufacturer make it like that. A plug (male), fits into a socket (female) with one to 25 pins or lines in them. Thus our plug has 25 pins stick out while socket has an outer protective cover which encloses all the pins internally.

In Asynchronous Data Transmission there is need for the following to complete transmission of a complete data.

1. **Start Bit**:- this bit is send after a full byte to indicate to receiving device that data is on its way through RS-232.
2. **Baud Rates**:- This is the speed at which data is sent down the line, this depends on the length of time that bit stay in line. It can be set during installation of communication packages and it is set in bit per second (bps). e.g. 50, 75, 1200, 9600 and 1150. But this depend on how far are you sending your data.
3. **Parity**:- This is used to know when the data becomes corrupted along the way. So this is used for error checking. This means after our 8 bits, an extra bit can be transmitted after each byte called parity bit. e.g. 1 00111011 -> one start bit, 5 1's and 3 0's with one parity bit will now give us this:

1 00111011 0 -> this means we have odd parity since we have odd number of "1"'s. Conversely extra 1 may be send such as:

1 00111011 1 -> which means we have parity even.

So if the parity bit is set to be even, it will always make the 1's be even and if it is set to be odd all the time, the transmitting machine will be making it odd.

If 100101011 is transmitted then the receiving machine will know that there is problem on the way. There may be a message of "parity error" !!! on the VDU or something similar.

Types of parity are NONE, ODD, EVEN, MARK, and SPACE parity.

4. **Stop Bit(s)**:- Finally for a datum or character to be completely send and computer to rest or send another character, there must be a stop bit. This is equivalent to returning the transmit signal line to its normal state. Stop bit can even be more than one, it can be one or

two just to wait before sending another character since some machine needs a little more time than usual to process the incoming data and hence requires two stop bits. But note that 2 stop bits is used only when using very slow baud rates like 300/50 or lower.

Conclusively, we can see that to transmit a complete character called **A DATA STREAM**, there is need for Start bit, data bits, parity bit and stop bit.

HANDSHAKING

In sending data or receiving data between two devices, it is possible for one to be slower than the other e.g. Printer is quite slower in printing by the time computer sends data. This is where the concept of handshaking comes in. We require a system that allows the printer to tell the microcomputer "hang on a minute - I'm getting full", and then later say "it's OK now - you can send me some more records".

There are 2 possible ways!

1. Software handshaking - XON/XOFF (DC1 11H and DC3 13H)
2. Hardware handshaking - RTS/CTS (pin 4 and pin 5)

Software Handshaking: If the microcomputer receives a byte of data which is 13H, it means printer is telling it to wait for a time. When it receives 11H, it will start sending data again.

The fundamental requirement for software handshaking is that the receiving machine must be capable of transmitting characters as well. But not all, then we must use hardware handshaking.

Hardware Handshaking: This need extra signal lines, we require one line with which the DTE tells the DCE what to do and vise-versa. The most common lines to use are 4 and 5 - RTS & CTS signal lines.

Advantages and Disadvantages:- Software handshaking requires both transmits and receive capability which may not be so. Hardware handshaking on the other hand, requires 2 extra control lines but it will have problem over a long distance especially over a telephone lines by using a modem or acoustic coupler. So software handshaking is the best. Generally,

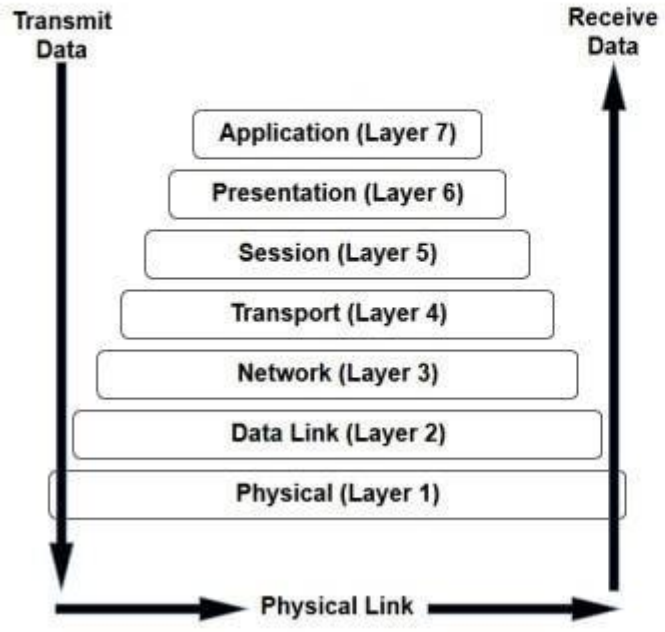
most devices nowadays are capable of both types of handshaking.

Communication Packages:- this is the software that helps connecting two devices over a short or a long distances like connecting two microcomputers, or through modem and telephone line and then the mini or mainframe computers in electronic mail system such as Telecom Gold, or Easylink. Then there is need for something to take over control of machine and link them together. Examples are Lap-link, Kermit, IBM LAN Manager, 3COM, Novel Netware, Windows'95,etc.

NETWORK LAYERS

Open standard layers for all networks specify by Open System Interconnect (OSI) are seven (7) which is established by International Standard Organization (ISO). These layers are as follows:

OSI Network layers necessary for transfer of data from one system to another



1. **Application Layer:** This layer is responsible for providing interface to the application user. This layer encompasses protocols which directly interact with the user.
2. **Presentation Layer:** This layer defines how data in the native format of remote host should be presented in the native format of host.
3. **Session Layer:** This layer maintains sessions between remote hosts. For example, once user/password authentication is done, the remote host maintains this session for a while and does not ask for authentication again in that time span.
4. **Transport Layer:** This layer is responsible for end-to-end delivery between hosts.
5. **Network Layer:** This layer is responsible for address assignment and uniquely addressing hosts in a network.
6. **Data Link Layer:** This layer is responsible for reading and writing data from and onto the line. Link errors are detected at this layer.
7. **Physical Layer:** This layer defines the hardware, cabling, wiring, power output, pulse rate etc.

NETWORK PROTOCOLS

Network protocols are formal standards and policies comprised of rules, procedures and formats that define communication between two or more devices over a network. They govern the end-to-end processes of timely, secure and managed data or network communication. Generally speaking, we have three types namely; communication, such as Ethernet; management, such as the Simple Mail Transfer Protocol (SMTP); and security, such as Secure Shell (SSH).

Each category has several types of them.

- Network communication protocols: Basic data communication protocols, such as TCP/IP and HTTP.
- Network management protocols: Provide network governance and maintenance and include SNMP and ICMP.
- Network security protocols: Implement security over network communications and include HTTPS, SSL and SFTP.

NETWORKING

With all our knowledge of how communications work in principle, and in practice, we can now advance on to the most exciting part of communications - making computers talk over telephone networks.

Users would prefer to have access to the computer from their place of work or even their homes without having to go to the computer centre. Such access can be provided by connecting the users' terminals by communication lines to the computer.

This is not new any more, using large scale communications to enable mini or mainframe computers to talk to each other or to the terminals connected to a computer many miles or kilometres away. e.g. British Aerospace, usually they are all using RS-232-C interface. There also tend to be a number of voices sharing in using telephone line at any one time- This is known as multiplexing. The method used in multiplexing is time sharing.

The range of technology in networking has been divided into 3 areas.

1. Local Area Network (LAN) or private networks.
2. Wide area Network (WAN)
3. Radio and satellite broadcast networks.(It can be under WAN)
4. Metropolitan Area Network (MAN)
5. Hybrid Network

LOCAL AREA NETWORK (LAN):

A local or private network is a communication system connecting computers in a small geographical area, say less than a few kilometres. The network is wholly owned and run by one administration. It includes computer-to-computer communication within an office, building

or small complex with distances of 1km. LAN can then be connected depending on the topology or technology chosen by the organisation. e.g. Star, Ring, Bus or Cable and use different communication media such as twisted pair of wire, coaxial cable or optic fibre.
This is useful to share files, to transfer the load from one of the machines to the other when a machine breaks down and to exchange massages between departments. Such a connection of computers is called a Local Area Network (LAN) for short.
Micro, mini, midi or mainframe computers can be use for LAN.

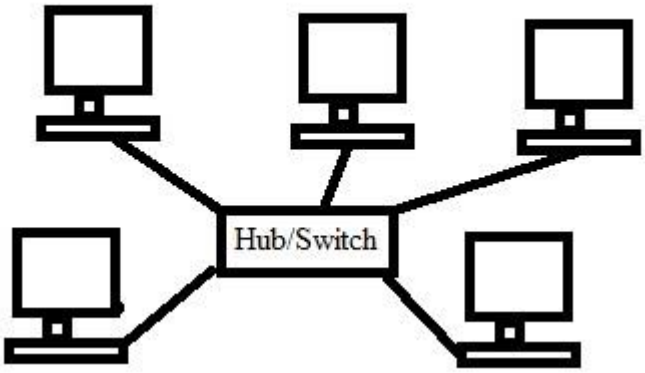
LAN CONNECTION

To connect two computers, you may not need any other hardware other than a cross link cable, but with three or more systems, you need additional hardware called hub or switch.

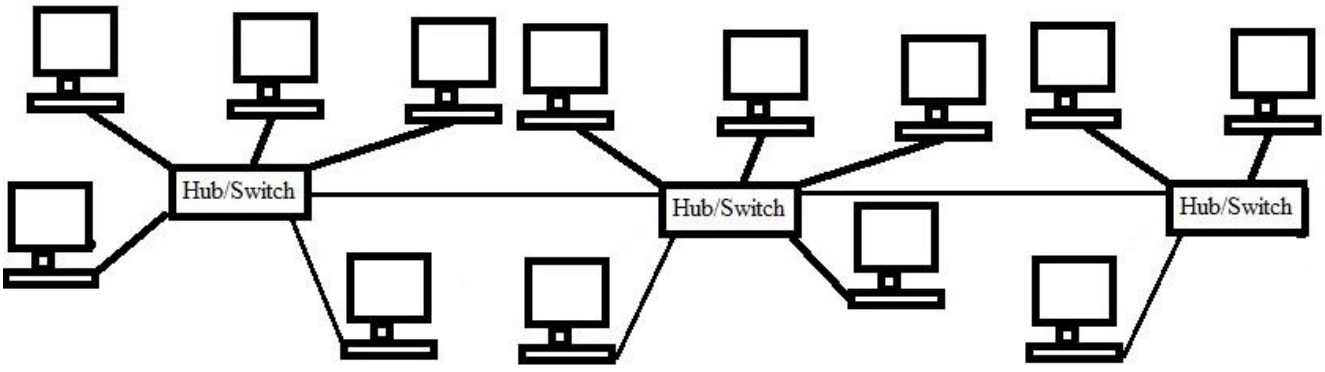
Cross link cable arrangement:

	T468B	T468A
1.	W/Orange	W/Green
2.	Orange	Green
3.	W/Green	W/Orange
4.	Blue	Blue
5.	W/Blue	W/blue
6.	Green	Orange
7.	W/Brown	W/Brown
8.	Brown	Brown

A hub/switch is a box that has several ports or network connections into which you can connect the wires from your computers. E.g.



A typical hub/switch has 4,8,16,24 or 48 ports. If we have more computers we can add more hubs and connect them together. A single LAN could have 2 or more hubs. The cable connection should be straight connections. Hubs are sometimes called multiport repeaters.



Using Uplink

If the two hubs have uplink, use straight through connection (i.e. both sides of the cable should be the same) and then allow one of the two hubs to have uplink and disable the

second to be normal.

Configuration

After connection, software configurations help the systems to have addresses to route messages between sender and receiver. Every computer is given a node address which is typically a number between 1 and 254. Each computer must have a unique node address. When one computer sends a packet to another, it puts in the node address of the computer which supposed to receive that packet. That address is called the destination address.

When one computer transmits a packet, every single system on the LAN receives that packet, each then check the node address in the packet and ignore it since it is not its own.

The most common network configuration uses a single eight –bit-byte for the node address, and this is called a CLASS C network. We have Class A to E but Class is the commonest among them. It allows node address from 0 to 255. The address 255 is called the broadcast address. It is not good to use address 0 which leaves address through 254.for the computer node addresses. Networks types may be LAN, MAN(link several LAN in a city), CAN(Link several LAN in a campus), WAN(Internet).

Network Design

1. Peer Networking: 10 or less users – cheapest easiest form to setup. No security or administrator.
2. Single-Server Networks: 8 to 40 users- Central security, data storage and file sharing.
3. Multi-Server Networks: 40 to 200 users- Provide segmentation between networks.
4. Multi-Server MAN or CAN:200 to 1000 users: Require high speed backbone and expensive.
5. Enterprise Network or WAN: Over 1000 users - Several multi server networks with high speed backbones tied together.

Peer to Peer Networks VS Server Based Networks or Server/Client Networks

1. Peer to Peer Networks are where every computer in the network perform the same

function. Functions such as file sharing and print sharing but for small networks.

Advantages: Allow simple file and print sharing, low cost, no need for separate server client software or multi user's O.S, easy to setup and no need for network administrator.

Disadvantages: Very little security since each computer controls its own security, heavier load on computers since resource sharing causes higher processor usage and slow down the systems. No central data storage, only work for small network and network slowdown.

2. Server based networks or Server/Client networks have two distinct units. The Server Unit: Server perform several functions on the network. They are the central file storage area, as well as providing security and resource sharing functions. Servers are the central connection point for all the computers on the network.

   Client Computers are the workstations of the network. They are smaller than server because they use the resources of the server computers.

   Advantages: Very strong security with less intrusive than peer to peer security, central file storage in which everybody works from the same data and backups are much easier; ability to share equipment such as printers, modems, plotters, etc; faster data sharing and resource sharing; easy management of large number of users. Central organisation which keeps data from getting lost among computers.

   Disadvantages: Expensive dedicated hardware, expensive dedicated server and client software licenses, dedicated network administrator; server breakdown affects the whole network/organisation or client systems.
3. Hybrid networks contains both peer to peer and server/client systems.

WIDE AREA NETWORK (WAN):

The wide area network is applied to a network that covers a large physical area, say a whole country or large area under one administration. Such an area may be worldwide where a multi-national organisation owns the network. i.e. when a number of computers are at widely

dispersed locations, say various cities of a country or even in different countries. Connection of a number of mini, midi, mainframe or maxi-computers are necessary. In this case it would be necessary to use communication media maintained by post and telegraph or telephone companies. Such communication networks are known as public networks or common carrier networks. These networks usually have land telephone lines, underground coaxial cables, microwave communication and satellite communications.

Communication media used are dedicated circuits with about 50Khz bandwidth, for digital circuits bandwidth would be 64KHZ. Physical circuits are provided by PTT (Postal, Telegraph, and Telephone authority) where only the license can erect systems to any signals. Telephone bandwidth is 3KHZ of voice telephone line. How information can be transferred from one computer to any other on the network can be in two ways:

1. transferring information via a medium, such as a wire.
2. addressing and routing.

Using dedicated connection is very expensive. To increase utilisation, switching is introduced.

SWITCHING

Three types of circuits are Circuit switching, Message switching and Packet switching.

Circuit Switching used to connect telephone subscribers with computer, it need circuit to a local exchange connected to form a network. Circuit has been "switched" by the exchange.

Disadvantage: 1. Cost high, and not high enough quality for computer communication. 2. the circuit can only be used by 2 computers on the call. 3. Time wastage in setup of physical path.

Advantage: 1. Changes are made only for the time that a call is connected. Short connections & infrequent is better with switch. (2). single device use for long process line, facsimile machine is better with circuit switching.

Message Switching is permanent circuits and switch the data to a no of its neighbours but

not to all computers on the network.

2 characteristics of computer network are:

1. Addressing - The message is address to a remote destination
2. Store and Forward - received message into the node storage so processed as a whole unit and then send.

The physical equipment involved is used more efficiently than in circuit switching. The multiplexing of these messages is the most important advantage of message and packet switching computer networks.

Characteristics of message switching:-

1. Any computer (or node) can communicate with any other with direct physical connection.
2. Any computer can communicate with several others using same equipment by multiplexing messages.
3. No delay due to circuit set up, but delay messages when pass through a node en-route. Messages can be transferred between nodes, hosts using ARR protocol (Automatic Repeat Request).

Advantages over circuit switching:-

1. Sender may dispatch the message when convenient even if the receiver is not ready; as the network will store the messages. But if storage runs out, the massage may be deleted.
2. Information are exchange at different speed as network buffer the message.
3. Broadcasting of a message may be possible.
4. Equipment is used more efficiently
5. Message may be handled by priority

Disadvantage:- Long message hold up.

2. Large message may not have enough memory in node to store it before forwarding it, then the message might have lost.
3. A very large message may monopolise the storage of a node.

Packet Switching

The disadvantages of message switching relate to the possible occurrence of large message, depend on the network. So to satisfy user, it must be able to handle very large and small messages. The solution to this is to break the user's message into SMALL PACKETS for transfer through the network and reassembled by the receiver.

This is the most widely used switching techniques for computer networks. Its physical organisation is the same as message switching. On ARPA network in USA, the nodes are called (IMPs) Interface Message Processors.

Advantage over Message Switching:

1. Small maximum packet size makes storage allocation and management easier in the switching nodes sufficiently for micro computers.
2. Multiplexing of packets enables several messages to be interleaved on one circuit, reducing the delay seen by the user.
3. Total transmission time (delay) through the network is reduced.

It would appear that packet switching solves all the problems of wide area network. Even it uses fixed speed lines & minicomputer for nodes. and it is more efficient and responsive than message switching. But it also has shortcomings.

Disadvantages

1. Packet switching introduces another layer of complexity and translation between the user & physical network transporting the bits.
2. Each packet will have its own over heads as well as those used for each message then reduce the efficiency of the physical circuits.

Conclusively, out of the 3 switching techniques, packet is the best for wide area computer networks. It is also used in other network techniques rather than message

switching.

Examples are PSS (Packet Switch Service) - British Telecom Network, ARPA (Advance Research Project Agency) - From U.S, TYMNET, TELENET etc.

RADIO AND SATELLITE BROADCAST NETWORK

This can be categorised as WAN but differ little bit from WAN in the way in which the channel is used for communication between users. Broadcast network use a channel to which all users are connected - Users receive transmission in the channel. The two types of channel in use are:

1. Local radio - covering up to a few hundred kilometres.
2. Satellite channels - span very large distances.

Network using radio and satellite channels have special problems because noise in channels cause errors and problem of allocating the channel for transmission.

Packet radio techniques: Every node receives all packets transmitted on the broadcast channel. Here node checks for errors and destination address. The simplest transmission technique is called PURE ALOHA where a node has a packet to transmit and does so immediately.

More explanation can be found under unbounded media.

Merit of Computer Networking

1. Remote time sharing terminals are most useful for program development. The rapid turn around provided such a use increase programmer productivity. A user who has a personal computer at home would use it for most of his work and connect the video terminal of the personal computer to a big computer for solving larger programs and to access special library programs and data resident in the big computer.
2. It is useful for in-house computer. In such a case they buy a terminal, place it in their

premises and connect it as time-sharing terminal to a larger computer. This allows them to conveniently access a larger machine without having to make frequent trips to the computer centre.

3. It stores large amounts of data. Since the memory of computers used for networking is large, it help in keeping a lot of information. e.g. patents, technical reports, journal articles. etc. in an organised fashion. A user requiring specific information, say on patents in a specified area, can connect his terminal through a telephone line to the larger computer and retrieve the information using appropriate descriptors.

4. International telex networks is also possible.

5. Remote Job Entry Stations are very useful to access bigger computer facilities by an organization which has a small computer. As RJE provides faster I/O, the bigger remote computer may be used for massive data processing and for storing large files, and all slower operations like printing and card reading may be done at the RJE station.

6. Local Area Networks are also used in factories for controlling plants and processes. Individual small computers would be usually installed to monitor and control critical processes in the plant. These computers may be interconnected and connected in turn to another computer which would perform supervisory functions, such a network provides an integrated control of the plant.

7. World Airlines also interconnect their computers which are used primarily for passenger reservations. Such a networking is essential because a passenger may change many airlines during international travel and the reservation status of each of the airlines would be required. Thus the database containing reservation status of individual airlines must be accessible via the network to all the co-operating airlines. Two international networks of this type are the SITA network and the British Airways network.

8. It is cost effective and efficient since it allows many terminals or computers to have access to shared logic and shared
resources.

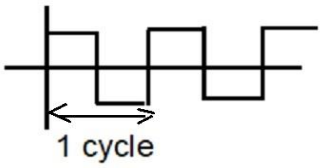
CHANNEL

Ultimately the design of a digital communication system depends on the properties of the channel. The channel is typically a part of the digital communication system that we cannot change. Some channels are simply a physical medium, such as a wire pair or optical fiber. On the other hand, the radio channel is part of the electromagnetic spectrum, which is divided by government regulatory bodies into band-limited radio channels that occupy disjoint frequency bands.

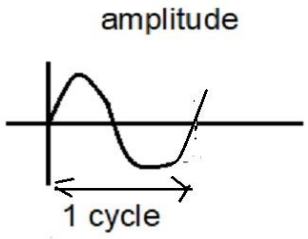
Various physical factors limit the maximum and minimum frequencies that a given medium can carry. By a communication channel we mean a medium through which electrical signals can be transmitted. It can also be define as a transmission link. Tr*ansducers* such as antennas, lasers, and photo-detectors, are also part of the channel.

Characteristic of communication channels

Signals transmitted may be classified as either analog or digital. An analog channel transmits continuously varying signals such as sine waves. A digital channel, on the other hand, transmits binary digits represented by voltage pulse. e.g. +12 volts pulse may represent 1 and -12 volts pulse for 0.



A simple digital signal



A simple analog signal

Half of a cycle in the analog signal is called amplitude and analog signal is represented by sine wave. Then a complete cycle in either digital or analog signal is called a frequency.

The amplitude of the sine wave is defined as v and its frequency is defined as f. The amplitude of electrical signals is measured in volts and its frequency in Hertz (in honour of Heinrich Hertz who first generated electromagnetic waves) and is abbreviated as HZ. Sine wave signals may be generated in the laboratory with an instrument called an **OSCILLATOR**. The amplitude and the frequency of the signals generated by an oscillator can be varied. For low frequencies the number of times the sine wave crosses the time axis will be small. In the limit when f= 0 the signal is said to be direct current (DC) signal. For high frequencies the number of times the sine wave crosses time axis will be very large.

The range of frequencies over which a transmission may take place over a channel is called the **bandwidth** of the channel.

The capacity of an analog channel is specified by its bandwidth. We may measure the bandwidth of an analog channel by connecting an oscillator at one end of the channel and send sine waves. Most telephone lines used for communication within a city would have a bandwidth of about 300HZ. The value of f1 would be about 300HZ and fh about 3300 HZ. This bandwidth is appropriate for local telephone lines as these lines are meant to transmit conversations whose frequency range is between 300HZ and 3300HZ. Thus human voice will be transmitted by such lines without loss. such lines are known as voice Grade communication channels.

The larger the bandwidth of a channel, the higher its capacity to carry information. For example, the bandwidth of coaxial cables used for inter_city trunk telephone calls (STD calls) is about 300 Mega HZ. such channels are used to transmit several conversations simultaneously using a carrier modulation scheme.

There are two basic ways in which analog signals may be transmitted over a channel. They may be sent in their original form as they arise physically, this is known as baseband signal. Another way is for them to be modulated or carried by a higher frequency called a carrier frequency and transmitted at the new frequency.

Allocation of channel

A channel is an expensive resource. In computer communication, except for short communication lines, the channel is shared by many computers. The channel is shared in such a way as to maximise the utilisation of the channel capacity. The method of dividing a channel into many channels so that a number of independent signals may be transmitted on it is known as Multiplexing. There are three basic methods of multiplexing channels. They are space Division Multiplexing, Frequency Division Multiplexing and Time Division Multiplexing.

1. **Space Division Multiplexing (SDM)**

SDM is creating a communication channel by grouping together a number of individual communication lines. For example, a number of subscribers` lines are packaged in a multi wire cable at a telephone exchange. Near the subscribers' premises they are separated into individual lines. This type of multiplexing is inefficient as a number of physical twisted wire pairs are used per telephone instrument and a bandwidth of only 3KHZ is used in each line. Each line is capable of being operated at a much wider bandwidth. The advantage of this method is that it allows individual connection to each user. When this method is used, transmission of information will be in the base band for short distances. The system is simple to implement and use.

2. **Frequency Division Multiplexing (FDM)**

Frequency division multiplexing (FDM) is the technique used to divide the bandwidth available in a physical medium into a number of smaller independent logical channels with each channel having a small bandwidth. The method of using a number of carrier frequencies each of which is modulated by an independent speech signal is in fact frequency division multiplexing.

The best example of FDM is the way we receive various stations in a radio. The physical channel in this case is the "ether", an unbounded medium. Many radio stations use the

medium. Each radio station is assigned a frequency range within a band of radio frequencies.

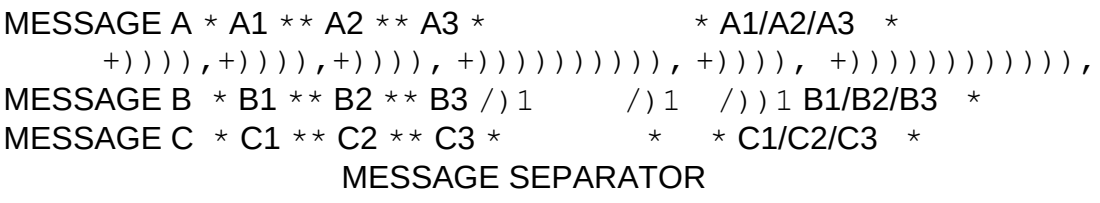
The carrier, amplitude modulated by speech, music, etc, is transmitted by the radio station. A radio receiver's antenna receives signals transmitted by all stations. The tuning dial in the radio isolates the station turned, demodulates the signal and converts it to the audio baseband signal. This is amplified by the radio and converted to sound by the loudspeaker.
In a bounded medium such as a telephone cable, the cable is connected between exchanges of main cities. In this case a cable has bandwidth of about 200KHZ. Each telephone conversation would need a bandwidth of around 4000HZ. We can transmit around 10 different conversation simultaneously on this channel by using a FDM scheme. We pick ten carrier signals of 50KHZ, 60KHZ, 70KHZ,....140KHZ and modulate the ten individual speech signals. This is transmitted over the cable and at the receiving telephone exchange they are demodulated using the respective carriers, filtered and routed to the appropriate instruments.
We will now look at the characteristics of FDM. In order to use FDM the signals to be transmitted must be analog signals. Thus digital signals, if they are to use FDM, must be converted to analog form. The second important characteristics of FDM is that all the signals in the physical channel travel simultaneously. Thirdly, the physical channel is split into a number of logical channels. Each logical channel is distinct and carries an independent signals. The available bandwidth of the physical channel is efficiently utilised.

Finally, we need a modulator at the sending end and a demodulator at the receiving end of each logical channel. If we need too many communication, that is, if both ends of the physical channel are to be used to send message as well as receiving messages then we need a modulator and a demodulator at each end. A modulator_demodulator pair is known as a MODEM.

3. **Time Division Multiplexing (TDM)**

Time division multiplexing (TDM) is another popular method of utilizing the capacity of a

physical channel effectively. Each user of the channel is allotted. a small time interval during which he may transmit a message. thus the total time available in the channel is divided and each user is allocated a time slice.



Time division multiplexing

In FDM a number of users send messages in parallel, simultaneously. The channel bandwidth is divided and allocated. In TDM, on the other hand, users send messages sequentially one after another. Each users can, however, use the full channel bandwidth during the period he has control over the channel. The channel capacity is fully utilised in TDM by interleaving a number of messages belonging to different users into one long message. This message sent through the physical channel must be separated at the receiving end. Individual chunks of message sent by each user should be re-assembles into message.

When the signal is received it must be demodulated back into its constituents signals. The devices used to perform these functions are called multiplexors and de-multiplexors.

BOUNDED MEDIA

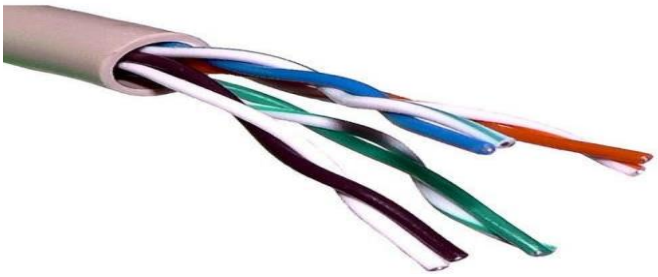
Bounded media means physical media used in connecting computers.

e.g. twisted pair wires, coaxial cables and optic fibres cables.

1. **Twisted pair of wires:**

This is the main media used in local telephone communication and short distance digital data transmission. Pairs of wires are twisted together to reduce interference by adjacent wires. Wires are usually made of copper. This medium is inexpensive and easy to install and use.

The twisted pair is used for audio telephone communication with speech signal bandwidth of 4 KHZ. It however, has a much higher bandwidth of about 50 KHZ. The typical speed of digital signal transmission using local telephone lines is 1200 bits per second (bps) (Also commonly quoted as 1200 bauds). Twisted pair used to connect terminals to a computer may be used up to 9.6 Kbps if the length is less than 100 meters. Noise pick up by twisted wires limit their use. Error rates become high when the line length goes beyond 100 meters.



2. **Coaxial cables:**

It offers much higher bandwidth and noise immunity. It is widely used in long distance telephone lines and as cables for closed circuit TV. Coaxial cables consist of central copper wire surrounded by a Teflon or PVC insulation over which a sleeve copper mesh or extruded aluminium is placed. The metal sleeve is covered by an outer shield of thick PVC material. The signal is carried by the inner copper wire. The signal is electrically shielded by the outer metal sleeve.

Coaxial cables have a very high bandwidth. A 3/8 inch television cable has a bandwidth around 300 Mega Hz. The cable can carry digital signals at very high rates of 10 Mega bit per second.

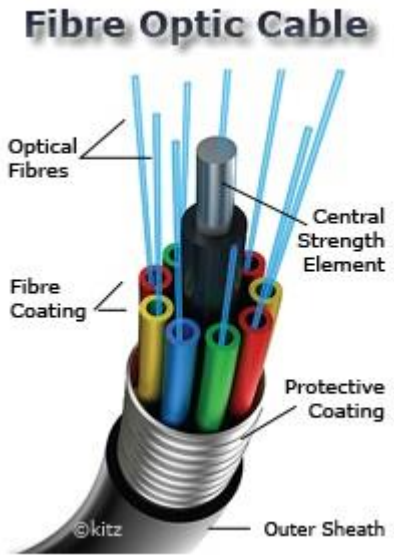
TEFLON/PVC EXTENDED ALUMINUM TEFLON/PVC COPPER

A Coaxial Cable

3.**Fibre optic cables:**

These are made of plastic or glass and provide high quality (low error rate) transmission of signals at very high speeds. Currently available fibres have a bandwidth of 3.3 billion Hz. (GHz, called gigahertz = 10 Hz) compared with the upper limit of 500 MHz of coaxial cables. Digital transmission speeds of 1 Giga bps have been used with error less than 1 10 bits. Fibre optics transmission are not affected by electromagnetic interference.

In fibre optic communications, electrical signals are transformed into light pulses by a modulator, transmitted over the fibre as light waves, detected and converted back to electrical signals by photoelectric diodes.



It has ELECTRICAL SIGNAL, LIGHT SOURCE, LIGHT DETECTOR, MODULATOR and AMPLIFIER

Fibre Optic Transmission.

The light source used is either light emitting diode (LED) or a laser diode. For transmission of light over long distances with low dispersion it is necessary to have coherent cono-chromatic light. Lasers provide this whereas LEDs do not. Lasers are however expensive compared to LED. With LED 150 Mbps transmission has been achieved whereas with lasers the speed is 2500 Mbps.

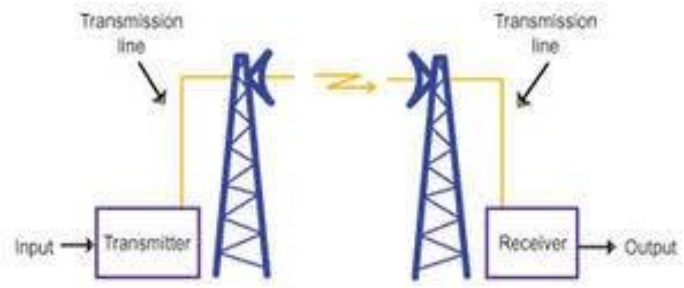
Unbounded Media

This means media used in transmitting information or data without full connection of systems. It can also be called wireless transmission. Examples are radio waves, micro waves and satellites.

1 **Radio waves** in the very High Frequency band (VHF) (about 300 MHZ) which are not used for commercial broadcasting may be used for communication between terminals and computers and between computers. Allocation of radio frequencies is controlled by the

Government in most countries. One method of using radio waves is to use a packet radio. This is a combined transmitter and receiver with different transmission and receiver frequencies.

2. **Microwave** (100 GHZ) communication using wave guide and repeaters is another useful unbounded medium. At microwave frequencies the electromagnetic waves cannot "bend" or pass obstacles like hills. the transmitter and receiver should be in "a line of sight". The microwaves are also attenuated in transmission and required power amplification. Thus receivers are placed at intervals of about 48km. The receivers receive and retransmit the signal after amplification. These are called Microwave Repeaters. The great advantage of microwaves is the large bandwidth of + 0 to 110 GHZ available which will permit data transmission rates in the region of 16 Giga bps. The capital investment needed to install microwave links is very high. They are mostly used to link big metropolitan cities with heavy telephone traffic between them. The link can support about 250,000 voice channels. Some of the voice channels may be used for data communication.



Information Source Or transmitter --- Receiver or Repeater / Information destination

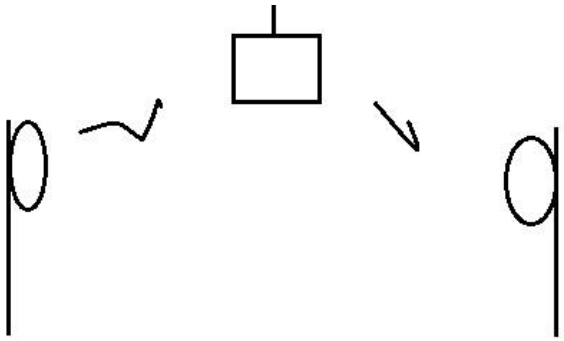
Micro wave

3. **Communication satellites** are now becoming very popular for data communication between computers. communication satellites are now launched either by rockets or by

space shuttles and parked in a geostationary orbit at 36000km above the equator. The speed of the satellite in this orbit equals the speed of the rotation of the earth and thus the satellite is stationary relative to the earth.

A communication satellite is essentially a microwave relay station in the sky. Microwave signal at 6 GHz is beamed to it from a transmitter on the earth. It is received by the satellite as a feeble signal due to 36000km travel. It is amplified and transmitted to the earth at 4 GHz by a system called a transponder mounted on the satellite. The transmission frequency is different as otherwise the powerful transmission signal interfere with the weak incoming signal. The main advantage of the satellite is that it is a single microwave relay station visible from anywhere in a country. Thus transmission and reception can be between any two randomly chosen places. The bandwidth of signals which can be handled by a transponder is about 36 MHz which would give 1200 voice channels, each supporting 4800 bps data rate or 400 digital channels of 64kbps each.

A satellite has many transponders thus providing enormous communication capacity at cost which favourably compete with microwave links on earth. Fig 1.10 illustrate a satellite communication link.



Satellite transponder, 6Ghz, 4Ghz Satellite Transmitter Satellite Receiver

Satellite Communication.

Features of a Satellite Communication Link are :

1. There is 270 msec propagation delay between the send in of data from one terminal or computer and its reception in another computer or terminal.
2. The transmission and reception costs are independent of the distance between computers.
3. Very high bandwidth is available if a user has an antenna in his own premises or radio link to an earth station. The cost of receive-transition ground stations has considerably reduced.
4. A signal sent to a satellite is broadcast to all receivers within the satellite's range. Thus special security precautions would be necessary.
5 A transmitting station can receive back its own transmission and check whether the transponder has transmitted the information correctly. If an error is detected the data would be retransmitted.

Criteria for Choosing Channels for Communication

Having discussed the various methods available for communication we will discuss in this section what we need during computer connections.

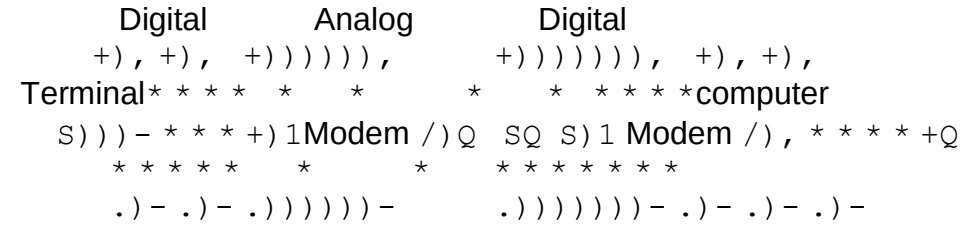
When a terminal is to be connected to a computer located at a distance of the order of 100 metres, it can be done using a twisted pair. The information originating at a terminal will be in digital form. When it is transmitted over the line it is distorted.

For low speeds of transmission of up to 300bps the distortion is not severe up to about 5 km. If the speed of transmission is increased, the distortion would increase. For 9600 bps transmission the distance should be less than 100 metres. One may go up to about 500 metres for 1200 bps speed.

When terminals are kept at a distance of the order of 1 km from computer, transmission errors due to electrical disturbances may occur if no special precautions are taken. A line driver id often used for distances up to 5 km for transmission speeds up to 1200 bps. The line driver converts a digital 1 to a +20 milliampere current and 0 into a -20 milliampere current

and transmits the current. This is known as a Current Loop and has a better immunity against electrical disturbances.

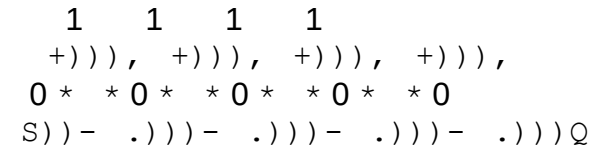
When digital signals are to be transmitted over distances greater than 5 km via public telephone lines maintained by Posts and Telegraphs Department, the signals should be converted to analog form before transmission. This is due to the fact that P & T lines are designed to transmit telephone conversation. They are voice grade lines with a bandwidth between 300 Hz and 3000 Hz and will severely distort digital signals at 1200 bps. If digital signals are to be transmitted from a terminal to a computer, they are converted to analog signals before transmission. This is done by a modulator. The analog signals received by the computer are converted back to digital form by a demodulator to permit processing by the computer. The processed digital information is modulated to analog form and returned via the telephone line to the terminal where the analog signals are demodulated to digital for display on the terminal. We thus need a modulator-demodulator pair at both ends of the telephone line. This equipment is called a MODEM.

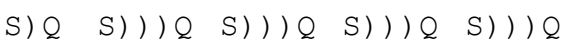


DATA TRANSMISSION & THE USE OF MODEMS

There are three ways of modulating the sine wave carrier by digital signal.

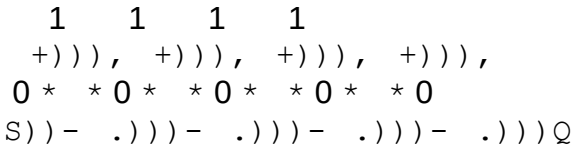
The first method is to modulate the amplitude of the carrier with digital signal as shown in fig.1.13 observe that when the digital bit is 1 the carrier is transmitted and when the bit is 0, it is not transmitted.





Amplitude Modulation of a digital Signal.

The second method is to send a sine wave of frequency f1 when the digital signal is 1 and a sine wave of different frequency f0 when it is zero. This is called Frequency Modulation Frequency modulation of digital signals is also known as Frequency Shift Key and abbreviated as FSK. Frequencies in the range 1000 Hz to 2000 Hz are appropriate.



Frequency Modulation of a Digital Signal

Amplitude modulated signals are sensitive to impulse noise picked up by the transmission line.

Frequency and phase modulated signals, on the other hand, are not sensitive to large impulse noise. In these modulation schemes an amplitude limiter is used as the binary information is carried by the frequency or the phase change and not by the amplitude. Frequency modulation modems (FSK modems) are easier to design because discrimination between two frequencies is simpler than detecting phase changes. Thus for medium speed modems (1200 to 2400 bps) the FSK scheme is preferred. For higher speed transmission of 9600 bps it is found that phase modulation is more reliable.

TRANSMISSION MODES

Signals are transmitted in the following different modes along communication channels.

Simplex, Half Duplex and Full Duplex Transmission

1. The MODEM with two wires that can only transmit or only receive is a **Simplex**

modem.

2. A modem with two wires that can both transmit and receive, but not simultaneously is called a **Half-Duplex Modem**. The terminal equipment such as modems on a line may be designed to either transmit information on the line or receive information from the line but not do both simultaneously. Such a system is called Half-Duplex communication.

3. A modem with four wires that can transmit and receive simultaneously is called a **Full-Duplex Modem**. If information can be sent and received simultaneously by the terminal equipment then the communication is Full-Duplex. If two independent pairs of wires are used, one for transmitting and the other for receiving, then the communication is full duplex. In this case information can be transmitted and received simultaneously.

One pair of wires may be used in full duplex mode by a modem provided a distinct frequencies (assuming FSK) are used. One pair of frequencies may be used to represent 1 and 0 in one direction and another pair for the reverse direction. This method, however, requires a large bandwidth if the transmission speeds both directions are to be same. If data transmission in one direction is slow, the lower bandwidth is sufficient. Typically 4 wire full duplex modems for 1200 bps are used on public telephone lines. A 2 wire half duplex modem with 1200 bps forward transmission speed and 75 bps backward transmission is also available.

Computer Network Architecture or Topologies

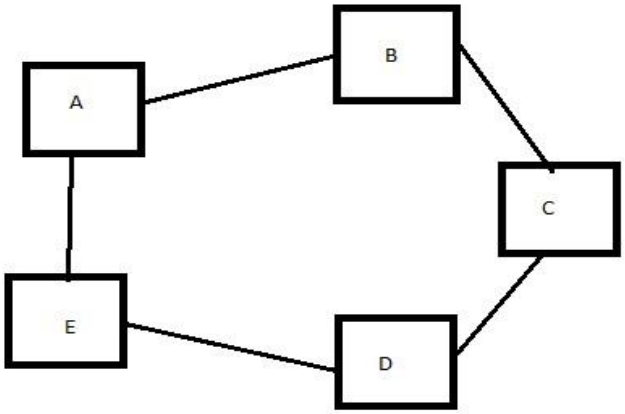
Different patterns of interconnections are known as network topologies. When computers at different locations are to be inter-connected one may do it in a number of ways.

1. Ring Network Topology:

If five computers A, B, C, D and E are to be inter-connected we may do it as shown in fig. 1.15. In this case there are physical links between A-D, A-E, D-C, and B-D. Assuming half-duplex links, A can communicate with D and E, B with E and C, C with B and D, D with A and

C, and E with A and B. Direct communication between A and B and A and C is not possible. If, however, E can route a message from A to D then there would be a logical connection between A and D. Similarly C can communicate with E via B and D with B via C. Each computer in the network will be called a node.

The pattern of interconnection below is called a ring network.

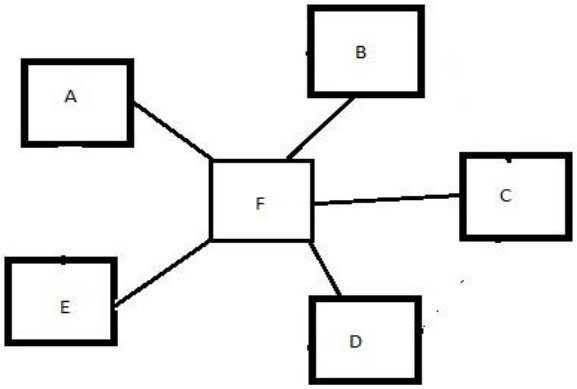


A ring or loop network.

2. **Star Networking Topology**

The star networking topology is the one that has minimum number of lines as in the figure below with only 4 lines. The routing function is performed through E which centrally controls communication between any two nodes by establishing a logical path between them. Thus if A wants to communicate with D, then E receive this request from A and set up the logical path A-E-D based on nodes availability. Delays would not increase when new nodes are added as another nodes may be connected via two links only. The system, however, crucially depend on E. If E breaks down the whole network would break down.

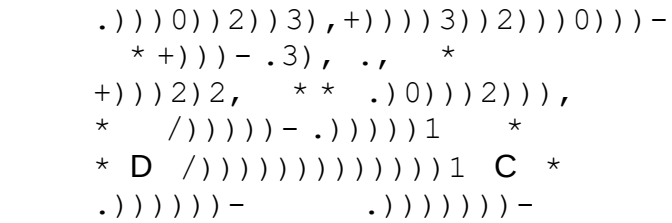
The pattern of interconnection of the figure below is called star network.



Star Network

3. **Fully Connected Topology**

This has a separate physical connection for connecting each node to any other node. Using the figure below as an example, it is the most expensive system from the point of view of lines as where there are 10 separate point lines. It is, however, very reliable as when line breakdown will affect only communication between the connected machines. Each node need not have individual routing capability.



A fully interconnected network.

The ring topology is not centrally controlled. Each node must have simple communication capability. A node will receive data from one of its two neighbours. The only decision the node has to take is whether the data is for its use or not. If the data is not addressed to it, it merely passes it on to its other neighbour. Thus if E receives data from B it examines whether it is addressed to self. If it is, then it uses the data, else it passes the data to A.

The main disadvantage of a ring is larger communication delays if the number of nodes increase. It is, however, more reliable than a star network because communication is not dependent on a single computer. If one line between any two computers breaks down, or if one of the computers breaks down, alternate routing is possible.

One may use a hybrid approach to interconnection. In other words, the interconnections may not be a pure star, loop or full interconnection. The physical links may be set up based on the criteria specified at the beginning of the section to have an optical communication capability for the specified network functions.

There are other methods like bus, multi-drop, mesh, tree etc.

The main considerations in selecting a particular topology are:

1. The availability and cost of physical communication lines between nodes and line bandwidth.
2. The capability of a node to route information to other node.
3. Delays due to routing of information.
4. Reliability of communication between nodes when there is a breakdown of a line or a node.
5. Strategy of controlling communication between nodes in the network- centralised or distributed.

INTERNET AND INTRANET

There is need to understand what Internet is first before proceeding to Intranet because they are similar other than the wideness and coverage of one that is more than the other.

Internet is a global network of computers in which every body have access to the network. There is need for domain name or IP address, Internet Service Provider (ISP), Computer with Fax Modem, telephone line. But today, we have computers configured to assess internet and E-Mail without telephone line.

Services on Internet include E-Mail, WEB (Browse, Information etc), FTP etc.

Protocol: There are two forms of protocol - Send and Receive

Send - SMTP; Receive- POP (Post Office Protocol)

WEB - 2 Protocol HTTP (Hypertext Transfer Protocol) and Language (HTML). All protocol must be in conformity with TCP/IP, that is Transfer Control Protocol/Internet Protocol

(TCP/IP).

Other important terms:

WEB page - Text file containing HTML formatting tags

WEB site - System holding the information

URL - Uniform Resource Locator which is an address used to reference.

The JAVA connection is the strongest and most important platform independent programming language for many network web application. Use with all software. Java application add dynamic content to web sites with more interesting features. Java script is the standard language for the Web.

Intranet is a replica of internet in an organisation or within a very short distance. It can be define as information transfer in an local environment. It works all the way like internet but in a LAN environment. An example is like NITEL PABS (Intercom). An organisation must have LAN.

Types of Intranet

1. Departmental Intranet - Individual department independent WEB
2. Per Departmental Intranet - Centralise Intranet for all departments
3. Corporate Intranet.

For all these there may be need for WEB Master, Department WEB Master, Primary Server and Secondary Server.

Merits

1. Improve communication
2. Make cooperation among people
3. Reduce delay in information transfer etc.

Requirements

Hardware (Pentium preferably), Software (O.S, Unix, Microsoft, IBM Lotus, Nescafe etc), IP Address such as 145.154.10.2 or called dotted code to identify a computer, WEB server, and WEB browser.

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