Communication and Network Concepts

- Tanebaum [1] defines a network as *'an interconnected collection of autonomous computers'.*

- AUTONOMOUS: Central to this definition is that all computers are autonomous i.e. no computer on a network can start, stop or control another.

- INTERCONNECTED : Two or more computers are interconnected if they can exchange information.

Network Goals

- Resource Sharing: The aim is to make all resource available to anyone or everyone connected.

- Reliability: The idea is –if one crashes other can carry on.e.g. if one file is deleted from a system it's safely stored on an another on the network.

- Cost Factor: PCs've better performance ratio than micro computers. So better to have 1 pc/user with data stored on 1 shared *file server* machine.

- Communication Medium: the changes at one end can suddenly be sent to the other & vice-versa. It brings faster and better co-operation.

SHARING 1.PERIPHERALS 2.INFORMATION 3.SHARING PROCESSING

ACCESS TO REMOTE DATABASE

COMMUNICATION FACILITIES

networking started way back in 1969 and has evolved since .

The important stages are listed below:-

ARPANET

THE INTERNET

THE INTERSPACE

- Advanced Research Projects Agency NETwork.
- Way back in 1969 it began sponsored by US Dept. of defense with the goal of linking computers at universities and US defense. Soon the systems began exchanging data & info.
- It had handful of components but expanded a lot. Another event was creation of another highly (better than ARPANET)capable network by National science Foundation namely-Nsfnet.
- But nsfnet allowed didn't allow any private business so private companies built their own networks later joined with arpanet & nsfnet to form internet.

- The internet is a worlwide network of computer networks.

- It's a super network. The common use is that users can communicate with any other user on a different network.

- To accomplish these exchanges certain rules (*called protocols)* must be followed. The internet uses a set of protocols called as TCP/IP *(transmission control protocol/internet protocol) .*

- All the computers are not directly connected to internet. Rather they connect to a small network which connect to the internet BACKBONE through GATEWAYS.
- *Gateway:-Device connecting dissimilar networks.*
- *Backbone:-Central interconnecting structures in which other networks are plugged.* **(imagine the trunk of any tree from which branches emerge or a human backbone).**

- At the source computer, the message/file is divided into very small parts called packets.
- Packet has a serial number.
- All packets are sent to the destination computer.
- The destination computer receives these packets (not surely serially). If a packet is garbled or lost\,it is demanded again.
- The message is arranged serially to get back the message/file.

You know how it functions but what makes it possible?

- The reason that internet works at all is that every linked computer uses the **same set of rules for communication. DON,T YOU KNOW THAT A SET OF RULES IS CALLED PROTOCOL.**
- **TCP/IP** is responsible for division and reassembling of packets.
- Ip is responsible for guiding the packets to the proper destination.
- The future of the internet is *interspace*.

- Interspace is a client/server software program that allows multiple users to communicate online with real-time audio, video and text-chat in a dynamic 3D environments.
- As the internet is a protocol eenvironment for interconnectinf=g networks to transmit data similarly interspace is an application envirom-nment for interconnecting spaces to manipulate information.

- switching techniques are used to transmit data across networks.
- There are various techniques :-

Circuit switching

Message switching

Packet switching

- The complete physical connection is established before any data can be exchanged.
- Since circuits are switched it gets it's name.
- Telephone is a good example of this technique.
- Earlier switching was done manually. There was an operator who would reside in switching office and plug a jumper connecting input & output sockets. Now switching is done automatically.

- The method is same as message switching.
- The difference lies in the way of storing and transmitting data.
- Block size of data has an upper limit (that requires transfer of chunks of data under the limit called as packets).
- The storage is in the main memory instead of on the hard disk.

- No physical copper path is established in advance between the sender and the receiver as in circuit switching.
- Instead, the sent data is first stored in the first switching office and then forwarded later, one hop at a time.
- Each block is received entirely, inspected for errors, and then retransmitted. This procedure continues until message reaches its destination. Owing to its working principle, it is also known as store and forward.

CONCEPT OF CHANNEL

BAUD,BANDWIDTH,DATA TRANSFER RATE

- Data channel : a medium used to carry information or data from one point to another.
- Baud : unit of measurement for the inforamtion carryingh capacity of a communication channel. (syn: bps-bits per second)
- Other units are : Bps, kbps, Kbps, mbps (in capitals b means byte and otherwise bit)
- Bandwidth : technically, it is the difference between the highest & the lowest frequencies of a transmission channel or the width of allocated band of frequencies to a channel.
- People generally use it to mean the amount of information/data travelling through a single channel at a time. High bandwidth channels are called broadband and low bandwidth channels narrowband channels.

- In digital systems it is expressed in terms of bps like if a modem works @ 57,600 bps and another @28,800 bps ,then the first modem has twice as bandwidth as the second one.
- In analog systems it's expressed in terms of the highest & the lowest signal component. Frequency is measured in terms of cycles/second i.e. *hertz.* 1 kHZ = thousand cycles/second, 1mHZ=10^3 1 gHZ =10^3mHZ 1 tHZ = 10^3 gHZ.
- Data transfer rates: amount of data transferred by a communication channel per second or a computing or storage device.
- Measured in bps, Bps, or baud.

TWISTED PAIR &COAXIAL CABLE,OPTICAL FIBRE

INFRARED, RADIO LINK, MICROWAVE & SATELLITE LINK

Transmission media or communication channels of network is nothing but the cable/media which provides the link.

There are numerous media which can be divided into :-

Guided media (includes wires/cables)

Unguided media (includes any form of wave media)

- It is the most common form of wiring in data communication applications.
- General Form : two identical wires wrapped together in a double helix.
- The bleeding of a signal from one wire to another and which can corrupt signal and cause network errors. This form of signal interference is called **crosstalk. To reduce crosstalk wires are twisted in pair in twisted pair cables.**

- Advantages: simple, flexible physically, easy to install and maintain, easily connected, very inexpensive.

- Disadvantages: incapable in long range transmission without repeaters due to high attenuation (reduction, decrease), low bandwidth, supports merely data rates of 1Mbps &10 Mbps (with conditioning).

Types of twisted pair cable:

Unshielded twisted pair: UTP cabling is used for variety of electronic communications. Available in 5 categories

Type   description

CAT1VGcommunication only; no data transmission

CAT2DGT up to 4Mbps

CAT3DGT up to 10 Mbps

CAT4DGT up to   16MbpsThe UTP cables can have maximum segment length of 100 meters.

CAT5DGT up to   1000Mbps

SHIELDED TWISTED PAIR(STP):

THIS TYPE OF CABLE COMES WITH SHIELDIING OF THE INDIVIDUAL PAIRS OF WIRES, WHICH FURTHER PROTECTS IT FROM EXTERNAL INTERFERRENCE. ONLY ADVANTAHGE OVER THE UTP IS GREATER PROTECTION FROM CROSSTALK & INTERFERRENCE. HOWEVER, IT'S HEAVIER & COSTLIER & REQUIRES PROPER GROUNDING AT BOTH ENDS. THE MAX SEGMENT LENGTH IS SAME AS UTP.

- It consists of a solid wire core surrounded by one or more foil or wire shields, each separated by some kind of plastic insulator. The inner core carries the signal, and the shield provides the ground, has high electrical properties & is suitable for high speed communication used for TV signals.
- Its data transmission characteristics are considerably higher & so it's used as the basis for a shared cable network, with part of the bandwidth being used for data traffic.
- Advantages: greater speed, can be used as a basis for a shared cable network.
- Can be used for broadband transmission.
- Bandwidth up to 400 MBPS.
- Disadvantages: expensive, not compatible with twisted pair cables
- Types of coaxial cables:
- Thicknet: This is thicker than thinnet. Its segments can be up to 500 meters.
- Thinnet: this form of coaxial cable is thinner and it can have max. length of 185 meters.

- Advantages: immune to electrical & magnetic interference.
- Highly suitable for harsh industrial environment.
- Secure transmission & high transmission capacity.
- Can be Used for broadband transmission.
- Disadvantage: inst6allation problem. Are fragile & may need special care to provide the robustness required for office environment.
- Connecting two fibers together or a light source

Fiber Optic cables can be either

- **Single Node** that supports segment length of upto 2 Kms and bandwidth of upto 100 Mbps
- **Multinode** with segment length of upto 100Kms and bandwidth of 2Gbps.

Type	Type Sub type	Maximum Segment Length	Bandwidth Supported	Installation	Cost	Interference
Twisted Pair Cable	UTP STP	100 Mtrs 100 Mtrs	200 Mbps 500 Mbps	Easy Moderate	Cheapest Moderate	High Moderate
Coaxial Cable	Thinnet Thicknet	185 Mtrs 500 Mtrs	10 Mbps 10 Mbps	Easy Hard	Cheap Moderate	Moderate Low
Fiber Optic Cable	Multinode Singlenode	2 Kms 100 Kms	100 Mbps 2 Gbps	Very Hard	Expensive	None None

- Micro wave signals are used to transmit a data without cables. The microwave signals are similar to radio and television signals and are used for long distance communications.
- It consist of,
1. Transmitter
2. Receiver
3. Atmosphere

Advantages of Microwave

i) It is cheaper than digging trenches for laying cables and maintaining repeaters and cables. If cables get broken by variety of causes.

ii) It offers from land acquisition

- HYPER TEXT MARKUP LANGUAGE
- HTML: WHAT IT IS?

  Document-layout & hyperlink-specification language i.e., a language used to design the layout of a document & specify the hyperlinks.

  Html tells the browser how to display the contents of a hypertext document i.e., a document including text, images & other supported media. It also tells how to make the page interactive by using special hyperlinks.

- HTML: WHAT IT IS NOT?

  First of all it is not a programming language but just a descriptive language.

  It's neither a word processing tool nor a desktop publishing solution. It's just a *page-layout & hyperlink specification-language.*

- extensible Markup Language.
- XML is a markup language for documents containing structured information.
- Structured information contains both content (words, images *etc.*) & indication of what role does that content play content in a footer is different from that of header or content in a caption is different from a title).

  (HTML==XML) ??
- NO. In HTML tags and semantics meaning/role of tags) is fixed unlike in XML.
- XML permits to define tags and structural relationships between them. Since there's no predefined tag set there can't be any pre-established semantics. All the semantics of an XML is either defined by the applications that process them or by the used stylesheets.

- Dynamic HTML refers to web content that changes each time it is viewed. e.g. same page could result in a different page depending upon :
  - Geographic location of the reader
  - Time of day
  - Previous pages viewed by the reader
  - Profile of the reader
- DHTML refers to new HTML extensions that will enable a web page to react to user input without sending requests to the web server.
- It can be thought of as "animated HTML". Ex:- a piece of text can change from one color to another upon clicking or after some time.

- A modem is a computer peripheral that allows you to connect & communicate with other computers via telephone lines.
- **MO**DULATOR**DEM**ODULATOR: modulation is the process of sending data on a wave (i.e. to convert digital signal into analog signal) & demodulation is reverse of modulation (i.e. to convert analog signals into digital signal).
- These inter-conversion allows two computers to "speak".
- These come in 2 varieties:-

Internal modems (fixed within computer)

External modems connected externally as a peripheral)

- Modem converts digital signals to A/F (audio frequency) tones the telephones line can carry & can also do the reverse.
- INSERT A DIAGRAM
- Power turned on DTE & DCE run self check

- In order to connect to the network each computer must have a special network card, called **Ethernet Card**.
- It contains 48 bits unique address, called MAC address.
- Now a days it comes preinstalled in computers.
- It is used in star & bus topology. It transfer data @10 &100 mbps.

- A common connection point for devices on a network.
- Hubs are active (electrically amplifies the signal) & passive (just lets the signal pass through).
- Hub usually can support 8,12, or 24 RJ-45 ports. These are often used a star or star-wired ring topology network topology that connects network devices in a complete circle).
- Specialized software is required for port management.

- Hubs forward the received packet from one port to all other ports.
- All users connected to a hub is in the same segment, sharing the hub's bandwidth. When packets containing data reaches to all it is their job to accept if needed or to just discard.

- A network device that filters and forwards packets between LAN segments.
- LANs that are segmented through switches are known are called *switched LANs.* In the case of ethernets they are known as *switched ethernets.*

- To insulate the transmission from the other ports, the switch establishes a temporary connection between the source and the destination, and then terminates the connection once the conversation is done.
- Think of telephone conversation for a good analogy.

- A network device to amplify & restore signals for long range transmission .
- It works on physical layer of **OSI** reference model.
- Used in long range transmission.
- Repeaters are of two kinds :-

    amplifier it amplifies all signals and noises as well)

    Signal repeater it collects and re-transmits the packet as if received from source)

- A **_BRIDGE_** is a network device that establishes an intelligent connection between two local networks with the same standard but with different types of topologies.

- Bridges know computers on both the sides, so they only allow needed messages to go to the other side. This improves performance on both sides.

- As a packet arrives at the bridge, the bridge examines the physical destination address of the packet. Then it decides whether or not to let it pass.

- It works on data link layer of **OSI** reference model.

- It works on network layer of **OSI** reference model.
- A router is a network device that is used to separate different segments in a network to improve performance and reliability. A router works like a bridge but can handle different protocols. Ex:- it can link ethernet to a mainframe.
- It uses logical addresses unlike bridges which uses physical address.
- If the destination is unknown to a router it sends the traffic to another router which knows the address.

- Router uses a more complete packet address to determine which router or workstation should receive the packet next.
- Routers can help ensure the most efficient path to destination based on a network road map called *routing table.*
- In case a link between two routers fails the sending router can determine an alternate route to keep the traffic moving.

- A gateway is a network device that connects two dissimilar networks. It establishes an intelligent connection between a local network and external networks with completely different structures.
- It works on application layer of **OSI** reference model.
- A gateway is actually a node on a network that serves as an entrance to another network. In enterprises a computer acts as a gateway & in homes it is the ISP which acts as a gateway.
- The gateway nodes often act as a proxy server (not actually a server but appearing so) & a firewall a system designed to prevent unauthorized access to or from a private network).
- The gateway is associated to both a router determines where a packet is sent) and a switch(provides actual path).

Registered Jack-45. it is an eight-wire connector, which is commonly used to connect computers on LAN specially Ethernets.(ethernet is a lan architecture developed by xerox corp along with dec and intel. It uses bus or star tropology and supports data transfer rates of upto 10 mbps).

MODEM

RJ45 CONNECTOR

ETHERNET CARD

HUB

SWITCH

GATEWAY

BUS, STAR, TREE

CONCEPTS OF LAN, WAN,MAN

TCP/IP, FTP, PPP,

LEVEL-REMOTE LOGINI(TELNET),INTERNET,
WIRELESS/MOBILE COMMUNICATION

GSM, CDMA, WLL, 3G, SMS,VOICE MAIL,

APPLICATION,E-MAIL,CHAT, VIDEO
CONFERENCING

- Transmission control protocol/internet protocol is a layered set of protocols.
- Tcp is responsible for making sure that the commands get through to the other end. It keeps track of all that is sent and sends again something if it didn't get through.
- You can think of tcp as library of routines which applications can use when they feel the need of reliable communication with another system. Similarly tcp calls on the services of ip. Ip ,again, can be considered as a library of certain routines called by tcp or by any other application that may not be using tcp.
- Layering is this strategy of building several layers of protocols. E-mail, tcp, ip can be thought of as separate layers each calling on the services of one below.

THREATS AND PREVENTION FROM VIRUSES,WORMS,TROJAN HORSE, SPAMS

USE OF COOKIES, PROTECTION USING FIREWALL

INDIA IT ACT, CYBER LAWS, CYBER CRIMES,

IPR ISSUES, HACKING

- Computer Virus is a malicious program that requires a host & is designed to make a system sick, just like a real virus.
- Three basic types:-
    - File infectors (attach themselves to a program file)
    - Boot sector viruses (installs themselves on)
    - Macro viruses (infect data files)
- Characteristics of a virus are replicatibility, requirement of host, external activation, replication ability is limited to (virtual)system.
- DAMAGES:-
    - Can destroy FAT
    - Can create bad sectors on disk or duplicate itself
    - Can format entire disk or a specific tracks
    - Can destroy specific executable files and alter data files, causing loss of integrity
    - Can hang the system

- A trojan horse is a code hidden in a program such as a game or a spreadsheet that looks safe to run but has hidden side effects.
- Trojan horses spread through e-mail, exchange of disks & information exchange. Worms also spread trojans.
- It causes damages what a virus can but only difference is its masking effect which hides its operation.

- A worm is a program designed to replicate.
- Characteristics of a worm:
    - Can replicate
    - No host or is self contained
    - Activated by creating a process (need for a multi-tasking system)
    - If a network worm, will replicate across communication links
- How they **Spread**?
- Worms are generally found in multitasking & network systems. Worms, they spread autonomously, without needing any other program, user's action or intervention etc.
- **Damage ?**
- Disrupt or create system management problems.
- Some scan for passwords and other loopholes then send it to the attacker.
- Some times they install trojans or viruses that damage our system.

- **Spam refers to electronic junk mail or junk newsgroup postings.** Some people define spam more generally as any unsolicited e-mail.
- Merriam-webster dictionary defines spam as unsolicited usually commercial e-mail sent to a large number of addresses.
- **AVOIDING SPAM**
- Creating a filter that finds and does something to e-mail that you suspect is spam.
- Another escape is not to register yourself with a true id to sign up for things on the net. These places often share that e-mail id with other companies that fills you with spam in exchange of benefits.

- It is not an easy task. Needs extra carefulness & adherence to these guidelines:-
- Never use a foreign disk without scanning for viruses.
- Scan files downloaded from internet. Always.
- Never boot computer from a floppy which may contain virus.
- Write protect your disks.
- Use licensed software.
- Password protect your pc to prevent unattended modifications.
- Make regular backups.
- Install & use antivirus software.
- Keep antivirus software up to date.

- HTML , DHTML
- XML
- HTTP
- URL & DOMAIN NAMES
- PROTOCOL ADDRESSES
- WEBSITE
- WEB BROWSER
- WEB SERVERS
- WEB HOSTING
- WEB SCRIPTING CLIENT SIDE & SERVER SIDE

- **Hyper Text Transfer Protocol is an application-level** but light & fast protocol.
- It's a generic, stateless, object oriented protocol.
- Another feature is typing of data representation, allowing systems to be built independently of the data being transferred. It has been in use by WWW since 1990.
- HTTP allows an open-ended set of methods to be used to indicate the purpose of a request.
- It builds on the discipline of *URI (Uniform Resource Identifier),* as a location or name, for locating resource on which method is to be applied.
- Messages are passed to the HTTP in a format same as internet email or MIME (multipurpose internet mail extensions). HTTP is also used as a generic protocol for communication between gateways/proxies etc. to other protocols.
- It consists of two fairly distinct items: 1. set of requests from browsers to servers 2. set of responses going the other way.
- Though HTTP was designed to work with web but it's been made more general to accommodate future possibilities of OO applications.
- HTTP has different built-in methods to allow users to open a web page, to disconnect an existing connection, to read the header of a webpage, to append to an existing resource or to store a webpage etc.

- HTTP uses internet address in a special format called a **Uniform Resource Locator** or **URL.**
- Typically URLs look like this:
- **type://address/path**
- Type:- type of server address (also the protocol they use):- address of the server path:- location of file on the server.
- In the address last group of characters (.com, .gov etc.) is domain indicator.
- The naming scheme by which servers are identified is known as domain name system.
- Another method of addressing (identifying server) is by assigning distinct numbers known as **IP addressing method.** Such addresses are called as IP addresses.
- **Lastly,** *a url specifies a distinct address for each resource on the net. A character based internet address is a domain name.*

- A web browser is a WWW client that navigates through the World Wide Web and displays web-pages.
- A web server is a WWW server that responds to the requests made by the web browsers.

- A location on a net server is called web sites.
- The unique address of each (URL) is called address.
- A web page is document or simply a page in a web site.

- Web hosting is a means of hosting web-server application on a computer system through which electronic content on the internet is readily available to any web browser client.
- Web Hosting Can Be Grouped Under:

   1.free hosting:- site hosting for free. You too can put up own websites for raw fun.

   2. virtual or shared hosting : virtual hosting is where one's site is hosted on the web server of the hosting company along with other web-sites giving 24-hour access& can be updated through a password log-in.

   3.dedicated hosting: a dedicated server is rented usually for big websites by companies. Dedicated for large, high traffic, or for those with special needs e.g. e-commerce, security.

- A script is a list of commands embedded in a web-page. Scripts are interpreted and executed by a certain program or script-engine.
- Most common scripting languages are VBScript, ASP(Active Server Pages), JavaScript, PHP(Hypertext Preprocessor), PERL, JSP etc.
- Types of scripts:

   Client-side script : It enables interaction within the web-page, is downloaded and executed by the browser (is browser-dependent i.e. browser must be enabled to run the script).Applications : To get data from user's screen or browser, online games, customized web-pages.

   Server-side script: It supports execution at server end. Results are sent to the client, is browser independent of browsers. APPLICATIONS : password protection, dynamic addition of content to web-pages.

4. co-location hosting: the company actually owns the server & is responsible for all server administration and the web hosting company provides physical requirements of rack, high speed connection, a regular power supply, and a limited amount of technical support such as data back up or hardware upgrades.

OPEN SOURCE SOFTWARE

FREEWARE

SHAREWARE

PROPRIETARY SOFTWARE

FLOSS

GNU

FSF

OSI

- Open Source Software commonly means software whose licenses do not impose much conditions. Users are free to use, modify & distribute software hassle-free but not certainly free of charge.
- It has been officially defined by the **open source definition** at http://www.opensource.org/docs/definition_plain.html. It states that :-
- *Open source doesn't just mean access to source code. The distribution terms of open-source software must comply with the following criteria :-*

Free Redistribution

Source Code

Derived Works

Integrity of The Author's Source Code

No Discrimination Against Persons Or Groups

No Discrimination Against Fields Of Endeavor

Distribution Of License

License Must Not Be Specific To A Product

The License Must Not Restrict Other Software

License Must Be Technology Neutral

- The term freeware has no clear definition, but generally refers to free of cost & redistributable software, but no modification & no source code.
- It is distributed in binary form.
- Freeware is often used in marketing situations in order to sell products and gain market advantages.
- One example is *Microsoft Internet Explorer.*

- Shareware is a software, which is made available with the right to redistribute copies, but it is stipulated that if one intends to use the software, often after a certain period of time, then a license fee must be paid.
- Source code & modifiability absent.
- The objective is to increase no. of prospective users.
- Generally a built-in timed mechanism limits the functionality after a certain period of time.

- Neither open nor free, its use is regulated and further distribution and modification is either forbidden or requires special permission by the supplier or vendor.
- Normally the source code is not given to the user.

- FLOSS refers to *Free Livre And Open Source Software* or to *Free Libre And Open Source Software.*

- The term is used for software that is both *free software* and *open software.*

- Here the words libre(a Spanish word) or livre(a Portuguese word) mean freedom.

- GNU is a recursive acronym for GNU's NOT UNIX.
- This project was initiated by richard m. stallman with an objective to create a system compatible with UNIX but not same as UNIX.
- It has not only made an OS but the project has grown since its inception and now it creates software of almost all kinds.
- The same person founded the *Free Software Foundation*.

- FSF is *Free Software Foundation.* It is a non profit organization created to support free software movement in 1985 by *Richard M Stallman*.

- FSF has funded many software developers to write free software.

- Now a days, it also works on legal and structural issues for the free software community.

- OSI is *Open Source Initiative founded by*Bruce perens & erics raymond (in feb 1998) .
- *Itr specififes the criteria for open source software & properly defines terms and specifications for open source software.*