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Unit - 1
Protocol architecture

Overview

- Compluter Network - two or more comp. connected togeth -er to a communication media form a comp. network
- Computers are connected in a network, to exchange info. & data, it can also use resources of other computers.

1) Server
Powerful comp. that provide services to other comp. for the network.

2) Client
Comp. that uses the services that a server provides. The client is less powerful than a server.

3) Media - A physical connection bet" the devices on a network.

4) Network adapter / NIC is a circuit board with the components necessary for sending & receiving data it is plugged into 1 of the available slot on PC & Transmission cable is attached to the connector on NIC.

Resources
Anything available to a client on a network is consider as resource. Printer, data, facts, device & other net. devices & info. are resources.

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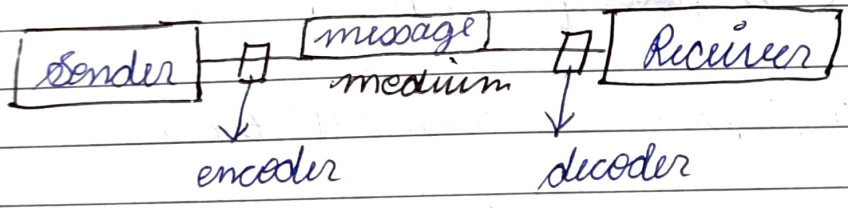
6) User
Any person that uses a client to access resources on the network.

7) Protocols
These are written rules used for communications. they are the languages that comp. use to talk to each other on a network.

Advantages of Comp. Network.
- easy accessibility.
-
-

Communication Model.
simple communication model



sender
encoder
medium
message
decoder
receiver

Protocols & Protocol Architecture
- Set of rules.

Protocol Ar. –
1. Communication Networking – LAN, WAN, MAN
2. wireless networks – sys. interconnection, wireless LAN's
   wireless WAN's

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IEEE – Institute of Electronic & Electrical Engineering

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Sys. interconnection is all about interconnecting the components of a comp. using short range radio. Almost every comp. has a monitor, keyboard, mouse & printer connected to the main unit by cables. Some companies got together to design a short range wireless network called bluetooth to connect these components without wires.
BT. also allows digital cameras, head sets, scanners & other devices to connect to a comp. within the range.

Wireless LAN's - are becoming ↑singly common in small offices & homes, there is a standard for wireless ~~lan~~ LAN called IEEE 802.11.

~~In text~~

Wireless WAN's - also uses the wireless technology ~~It~~ It focuses the high speed wireless internet access

Home Networks.
Home Networking is on the horizon. The fundamental idea is that in the future most homes will be setup for networking. Every device in the home will be capable for
& all of them will be accessible over the internet.

1) Computer - (desktop PC & Notebook PC)
2) Entertainment (TV, DVD, stereosystem)
3) Telecommunication (Telephone.)
4) Home Appliances (Oven, Washingmachine, Fan etc.)

diagram is important see from internet

Direct / Indirect

Communication bet" 2 entities may be direct or indirect. If 2 station share a point to point link the entities in these sys. may comm. directly i.e. data & control info. pass directly bet" entities with no intervening active agent.

A more extreme case is a situation in which 2 entities do not even share the same the switched network but are indirectly connected to two or more network.

Mono Monolythic / Structural

In monolythic protocols if we want to send a mail on to the machine, mail should only be send when the distination sys. & entity.

In this there is only 1 protocol

- An alternative is to use structure design & implementation technique. Instead of a single protocol

Symmetric / Asymmitric

A protocol may be either symmetric or asymm. Most of the protocol that we study are symm. i.e. they involve communication bet" peer entities

- Asymmetric may be dictated by the logic of an exchange (eg: client & a server prog.) or by the desire to keep one of entities or sys ~~at~~ as simple as possible.

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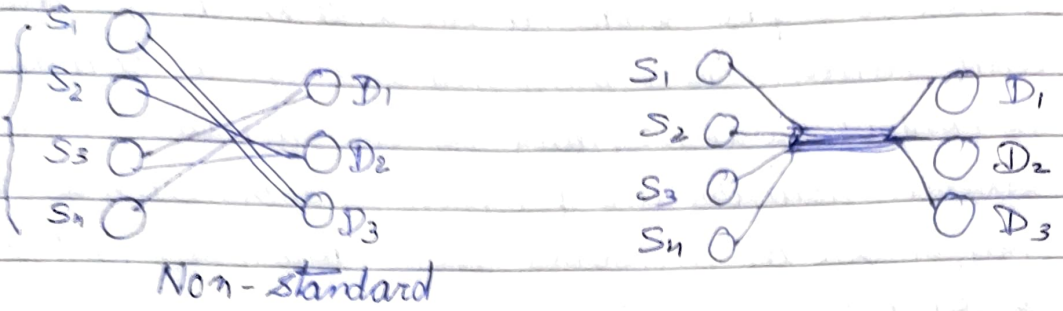
Standard or non-standard



Non-standard

→ Design Issues for several ~~layers~~ ~~hosts~~ in Computer network layers in comp. n/w

- The various key design issues are present in several The imp. design issues are:

1) Addressing: Mechanism for identifying senders & recievers on the network need some form of addressing. There are multiple processes running on one machine. Some means is needed for a process on one machine to specify with whom it wants to communicate.

2) Error Control: There may be erroneous transmission due to several problems during communication. These are due to problem in communication circuit, phy. due to thermal noise & interference.

- Many error detecting & error correcting codes ~~or~~ & Known but both ends on the connection must ~~of~~ agree ~~on~~ on which one being used. In addition the receiver must have some mechanism of some receiver telling the server which msgs have been received correctly & which has not.

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3) Flow Control

If there is a fast sender at one end sending data to a slow receiver then there must be flow control mech. to control the loss of data by slow receivers. There are several recievers use for flow control, such as ↑ing buffer size at receivers, slow down the fast sender & so on. Some process will not be in pos. to accept arbitarily long msgs. ~~Then~~

4) Multiplexing & Demultiplexing

If the data has to transmitted on transmission ~~data has to be~~ media siparately it is inconvinient ~~it is inconvinient~~ or expensive to setup siparate connection for each pair of communicating process. so multiplexing is needed in the physical layer ~~at~~ & at sender end & demultiplexing is needed at the reciver end.

5) Routing

When data has to be transmitted from source to destination there may be multiple path bet" them. An optimized (shortest) root must be choosen. This decission ~~is~~ is made on the the basis of several routing algorithm, which chooses optimized ~~which chooses optimized~~ root to the destination.

Services

Connection Oriented & Connection less services

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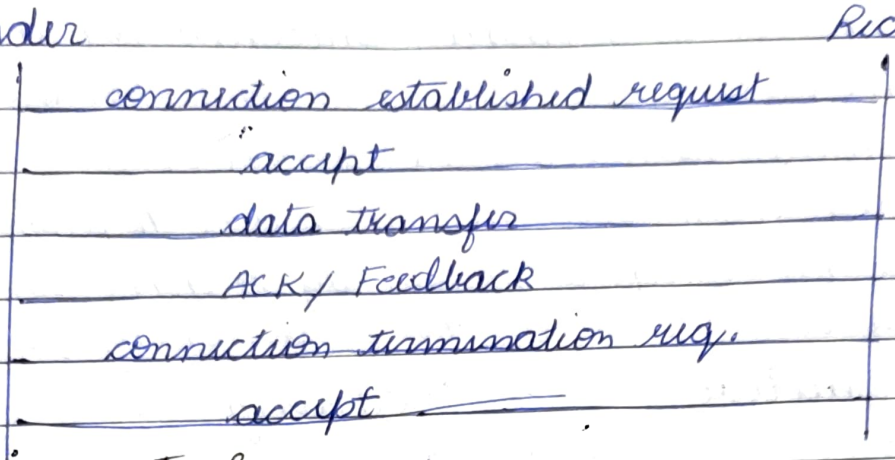
Connection Oriented Services



ACK → acknowledge

Connection control :

The service user first establishes a connection, uses the connection & than releases the connection Once the conn. is established bet" source & user the path is fixed. The data transmission takes place through this path established. The order of the msgs send will be saved at the services end. Services are reliable & there is no loss of data most of the time reliable service provides acknowledgement.

Connection less Services

In this type of services no connection is established bet" source & destination. Here is no fixed path. Therefore, the msgs. must carry full distination address & each one of these messages are ~~msgs are~~ send independent of each other. Msgs send will not be delivered at the distination in the same order ~~groups~~ Thus grouping & ordering is required at the receiver end & the services are not reliable There is no acknowledgement confirmation from the receiver.

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Service Primitives

A service is formally specified by a set of primitives (operations) available to a user process to access the service.
These primitives tells a service to perform some action or report taken by a peer entity.

→ 5 service primitives for implementing a simple connection oriented protocol

Primitive	Meaning
1) LISTEN	Block waiting for an incoming connection
2) CONNECT	Establish a connection with a waiting peer.
3) RECEIVE	Block waiting for an incoming msg.
4) SEND	Send a msg to the peer.
5) DISCONNECT	Terminate a connection.

Relationship of services to protocols

- Services & protocols are distinct concept although they are frequently confused. This distinction is so imp. however that we imphasise it again here.
- A service is a set of primitives (operations) that a layer provide to a layer above it. The service defines what operations the layer is prepared to perform on behalf of its users but it says nothing at all about how the operations are implemented. A service relates to an interface b/t two layers with the lower layer being the service provider & the upper layer being the service user.

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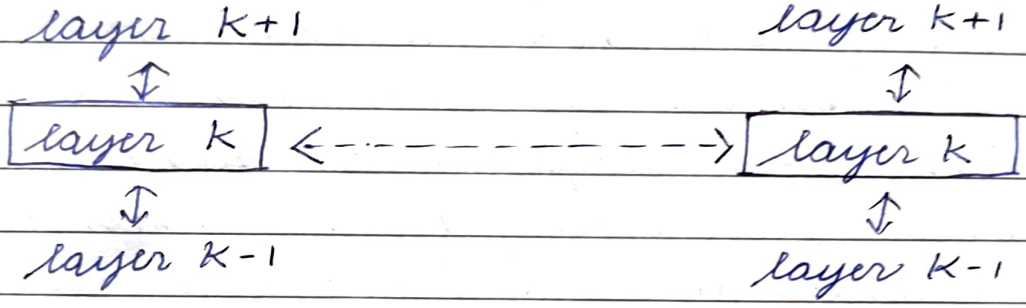
Protocol

Protocol in contrast is a set of rules governing the format & meaning of the packets, or msgs that are exchanged by the peer entities within a layer. Entities use protocols to implement their service definitions. They are free to chang their protocols at will, provided they do not change the service visible to their user. In this way the service & the protocols are completely decoupled.

The relationship bet" servic & a protocol



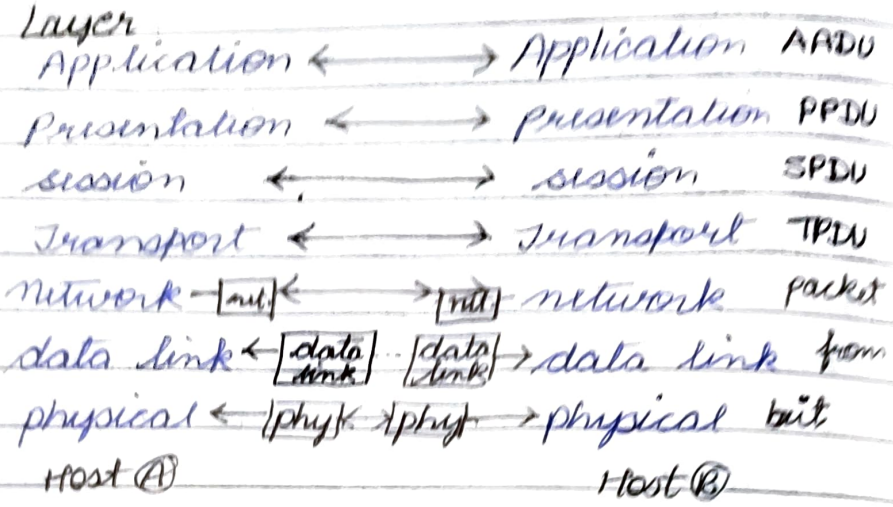
Reference Models

A comp. network can be defined as a set of computers that interact among among the indi- -vidual computer, sharing resources or info. Designing, implemnting & manufacturing comp. network & related devices are very complex activities. Therfore in order for this technology to be successful & massively used the manufact- -urer community saw the need to follow a series of standards & common models. Reference models have been establish the fun" of certain layers in the network for proper perf- -ormance.

① OSI (Open System Interconnection)
② TCP/IP (Transmission Control Protocol/ Internet Protocol)

Subject :

① Physical Layer



[1] Physical layer - is mainly concerned with electrical mechanical, procedural & functional aspects of trans-smission media for info. transmission & receiving over the network. It specifies the details of connecting cables, processing of digital signals, interface to diff. media etc. The phy. layer is also concern with the following:

① Physical characteristics of interfaces & medium
The physical layer defines the characteristics of the interface bet" the devices & the transmission medium. It also defines the types of transmission medium

② Representation of bits
The phy. layer's data consist of stream of bits with no interpretation, to be transmitted bits must be encoded into signals electrical or optical. The phy. layer defines the type of encoding.

③ Synchronization of bits
The sendrs & recivers not only use the same bit rate but are must be synchronise at the bit level.

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(1) Line configuration : phy. layer is concerned with the connection of devices to the media. In a point to point configuration two devices are connected through a dedicated link. In a multipoint config. a link is shared among several devices.

Topology

The physical topology defines how devices are connected to make a network.

Transmission mode : The physical layer also defines the direction of transition bet" two devices (simplex, half duplex, full duplex)

[2] Data ~~integrity~~ link layer

The data link layer is responsible for maintaining the integrity of data info bet" 2 sides. It offers a reliable channel for data transmitted

The protocols of the data provide error recovery.

- Responsibilites are :

1) Framing - the data link layer divides screen of list received from the network layer into managable data units called frames.
2) ~~Physical~~ Address - the Transport layer header must include a type of address called a service point. The network layer gets each packet to the ~~correct~~ i.e. the transport layer to gets the time entire
3) ~~Segmentation~~ & ~~Reassembly~~ - Already written
4) Connection control - Already written
5) Flow control - Already written
6) Error control - Already written
7) Access Control - When 2 or more devices are connected ~~are~~ to the same link, data link layer protocols are necessary to determine which device has control over the link at any time.

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Subject

[3] Network layer

The network layer provides communication bet" the multiple networks whereas the data link layer provides the comm. bet" 2 sys. on the same network of 2 sys. are connected to the same link there is usually more need for a network however if the sys. are attached to the diff. networks with connecting devices, there is often a need for a network layer to accomplish source to network layer. It defines addressing & routing bet" source & network.

RESPONSIBILITIES ARE:

1) Logical addressing

The physical addressing implemented by the data link layer handles the addressing layer properly. If the packet passes
we need another addressing sys. to help disting source & network. A header to the packet coming from the upperlayer that among other things includes the logical address of the sender & receiver.

2) Routing : Already written

[4] Transport layer

The transport layer offers network independent service to higher layers & hides all details regarding network being used for transmition. The upper layers have no idea about the
which is transmiting or receiving
This layer breaks the msg into smaller packets &

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it also offers end to end error control & recovery

RESPONSIBILITIES

1)

The transport layer header must :. include a type of address called a service point. The network layer to the correct comp. i.e. the transport layer gets the time

2) Segmentation & Reassembly – ~~se~~ already written

3) Connection Control – already written

4) Flow control – already written

5) Error Control – already written

5 Session Layer

This layer provides a data communication bet^{n} 2 application processes. It also supports the synchroni-sation bet^{n} sites & defines check points from which diagnostic & test can be performed in the event of failure. It establishes the length of session during which user log in & log out.

RESPONSIBLITIES.

1) Dialogue Control

The session layer allows two sys. to enter into a dialo-gue. It allows the communication bet^{n} 2 processes to take place in either half duplex or full duplex.

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2) Synchronisation

The sission layer allows a process to add check points or synchronisation points to a stream of data.

6 Presentation layer

It represents the data info. in appropriate form to be acceptable to the lower layer of the network. The presentation layer provide diff. formating styles & it also converts the info to video, audio & other formats. All the application entities of the app. layer are mapped into suitable entities by this layer

1) Translation

The processes in ② sys. are usually exchanging info in the form of char strings, nos. & so on. The info. must be changed to bit streams before being transmitted. The presentation layer at the sender changes the info layer at the receiving machine changes the common format into its receiver depended format.

2) Encryption

Encryption means that the sender transforms the original info. to another form & sends the the resulting msg. out over the network.

Decryption info, data compression becomes particularly imp. in the transmission of multimedia such as ~~text~~ text, audio & video.

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7 Application layer

The app. layer provides an interface bet" application entities & the users computer. This layer offer services to a variety of aspects of data commu-nication bet" the users comp. & application entities including terminal handling, text interchange job transfer & manipulation. The application layer offers a variety of applications such as e-mails, data transfer, file transfer, digital audio, audio, data, remote login & other internet services.

RESPONSIBILITIES ARE

- Network Virtual Terminal

It is software version of physical terminal & it allows a user to log on to a remote host.

- File transfer & access management

application allows a user to access files in a remote host to retrieve files from a remote comp. for use in the local comp. & to manage all control files in a remote comp. globally.

- Mail Services

This application provides the basis of e-mail forwarding & storage.

- Dictionary Services

application provides distributed database sources & access for global info. about various object services.

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TCP / IP

This is the other refrence model which was used earlier by ARPANET (Advance Research Projects Agency Network) and then it is ~~beam~~ been used in the Internet TCP/IP is a short form of transmission Control Protocol & Internet Protocol.

a) application layer

TCP/IP model does not have session & presentation layer because they are of little importance in most application.

- The layer on top of transport layer is called application layer. This layer enables users to access the network by providing a few services to the user. Some of the protocols & services available to the user are file tranfer protocol exchanging main messages
- The application layer interact with the OS & the file system for data conversion & encryption. The protocol related to this layer are all high level protocols such as virtual terminal (TELNET), (FTP) file Transfer electronic mail (SMTP)

b) Transport Layer

Communication bet" comp. is handled by the transport layer, which is comprised of transmission control protocol (TCP) & the User data gram protocol (UDP) This layer divides the data into logical units called Packets before transmitting theme. TCP offers a reliable transport of data whereas UDP does not, TCP is a connection oriented protocol that insures that data is transmitted properly to the

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destination. If there is an error in data transmission TCP takes the responsibility of transmitting data again to the destination. However UDP being connectionless it does not insure data packets have reached the distination properly.

c) The Internet layer

It is responsible for routing the data packets to the appropriate destination. Internet Protocol is responsible for data integrity is not a fun' of IP. IP interacts with the address resolution (ARP) protocol & reverse (RARP) address resolution protocol for addressing protocol. ARP & RARP operate from the layer called the link layer This layer is implemented as a combination of software & act as an interface bet^n the internet layer & the network interface layer.

d) Network Access Layer.

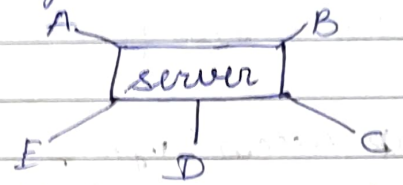
This is lowest layer in TCP/IP reference model. The host has to connect to the network using some protocols so that it can send the IP packets over it. This protocol varies from host to host & network to network The fun' of the data links & physical layer of the OSI model have been combined into a single layer called The Network Interface Model in the TCP/IP model. This layer is responsible for dividing the data send by the internet layer into logical groups called frames. Depending on the type of connection ~~oriented~~ which could connection oriented & connection less

This layer adds appropriate header to the frames. If the session is connection oriented session the headers must indicate the no. of frames in the group & the order in which the frame need to be reassembled in the distination. The network layer at the receiving end then reassembles all the control frames & sends to the other layer. This layer insure that all the frames are received properly by a method called CRC (Cyclic Redundancy Check)

Network Classification

① LAN

The LAN is a network which is design to operate over a small physical area such as an office, building, factory, etc. In a LAN one comp. can become a server serving all the remaining comps. called client.



- LAN components

① work station - server PC, client PC, general purpose PC
② file server - storing the data in a particular PC
③ gateway - It connects two networks with diff. transmission protocol together.
④ Network Interface Unit - It is a device that serves as a common interface for various other devices within a LAN.
⑤ Hub: It provides multiple connection
⑥ Communication Channels

Advantages

High reliability, fast, accuracy of data transmission adding workstation is easy, sharing of peripheral device like printer is easy.

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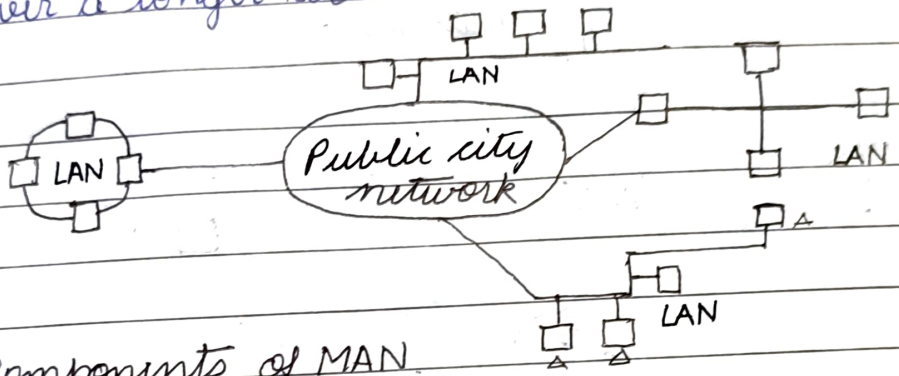
Application of LAN.

a) Education Centres, Offices

b) Factories, Houses

② MAN.

MAN is basically bigger version of LAN & normally use similar technology. It is designed to extend over a longer area such as an entire city.



Components of MAN

Advantages of MAN

High speed, internet sharing, High security (compared to LAN & WAN), less expensive, sending local emails. (MAN allows you to send local e-mails quickly for free).

- Conversion of LAN to MAN is easy.

Application of MAN

- University Campus Networks
- Government agencies
- Urban Analysis
- Libraries, hospitals & airports

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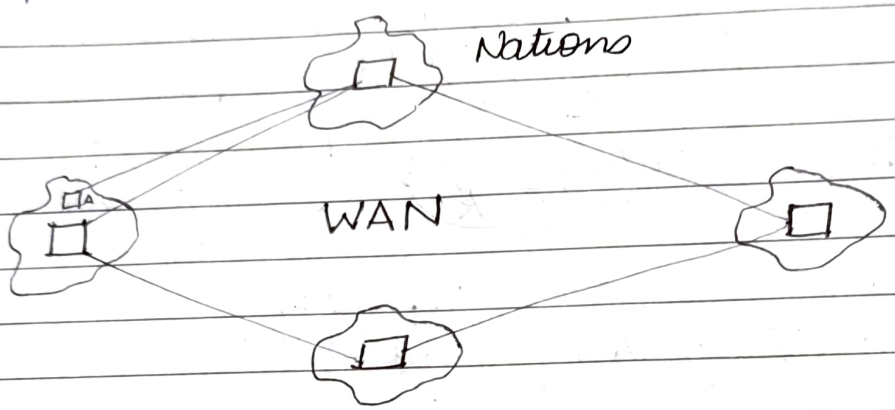
WAN (Wide Area Network)

When a network spans on a large distance or when the computers to be connected to each other are at widely separated location a LAN cannot be used for such situations a WAN must be installed. Eg: The communication channels in telephone lines & satellite links.



Components of WAN

(i) Routers, switches & Modems (edge devices)
(ii) connecting media (fibre, wireless, microwave, or satellite)
(iii) Customer Premises Equipment (CPE)

Advantages of WAN

(i) High Bandwidth
(ii) Access to online working
(iii) You can save everything on this network.
(iv) Sharing of software resources & other resources with the help of this network.

Applications of WAN

(i) WAN network are used for military services.
(ii) Airlines & Railways use WAN network for booking tickets from anywhere in the country.

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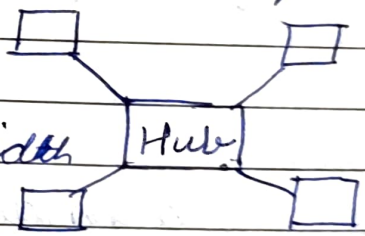
Networking Connected Devices

Two or more devices are connected to each other for the purpose of sharing data or resources form a network.

Networking connected devices

↓ Repeater ↓ Hub ↓ Bridge ↓ Router ↓ gateway ↓ Switch

① Hub : It is a hardware device that divides the network connection among multiple devices. When comp. repeats ~~fo~~rom some info. from a network it first sends the ~~repeat~~ request to the entire network All devices will check whether the ~~repeater~~ req. belongs to them or not. If not, the req. will be dropped.



The process used by the Hub ~~connection~~consumes more bandwidth & limits the amount of communication. Nowadays, the use of hub is obsolete, & it is replaced by more advance comp. network component such as switches, routers

Types of Hub
Active Hub
Passive Hub
Intelligent Hub

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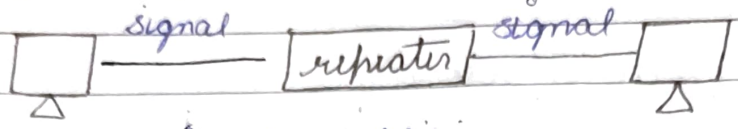
Subject :

② Repeater

Repeater is a connecting device which can operate in the data link layer. A repeater regenerates the original signal



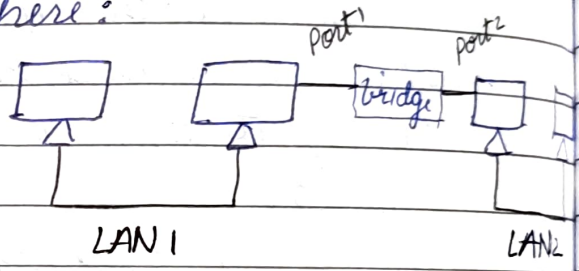
signal amplifies bet" two stations

③ Bridge

Major diff. bet" bridge & repeater is that bridge has a filtering capability.

Two types of bridges are there:

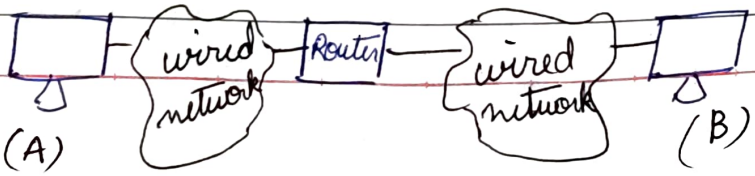
① Transparent Bridge
② Routing Bridge



④ Router

Router is a hardware device which is used to connect a LAN with an internet connection. It is used to receive, analyze & forward the incoming packets to another network.

- A router works in a layer 3 (Network Layer) of the OSI Reference model
- A router forwards the packet based on the info. available in
- It determines the best path from the available paths for the transmission of the packet.



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Advantages

- Security: the info. which is transmitted to the network will traverse the entire cable, but the only specified device which has been addressed can read the data.
- Reliability: If the server has stopped funtioning, the network goes down but no other networks are affected that are served by the router.
- Performance: Router enhances the overall performance of the network. Suppose there are 24 workstations in a network generates a same amount of traffic. This increases the traffic load on the network. Router splits the single network into 2 networks of 12 workstations each reduces the traffic load by half.
- Network Range:

⑤ Gateway

- When the networks must be connected are using completely different protocol from each other a powerful device called gateway is used.
- A gateway is a networking device that connects ② networks using diff. protocols together.
- It also acts as a "gate" bet" two networks. It may be a router, firewall, server or other devices that enables traffic to flow in & out of the network
- It is a network node used in telecommunication that connects two networks with diff. transmission protocols together. Gateways serve as an entry & exit point for a network as all data must pass

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through or communicate with the gateway prior to being routed. In most IP based networkes, the only traffic that does not goes through at least one gateway is traffic flowing among nodes on same LAN segment.

⑥ Switch

- A switch is a device which provides bridging fun with greater efficiency.
- A switch acts as a multiport bridge in a LAN.
- ② types of switch - ① Store & forward switch
  ② Cut through switch

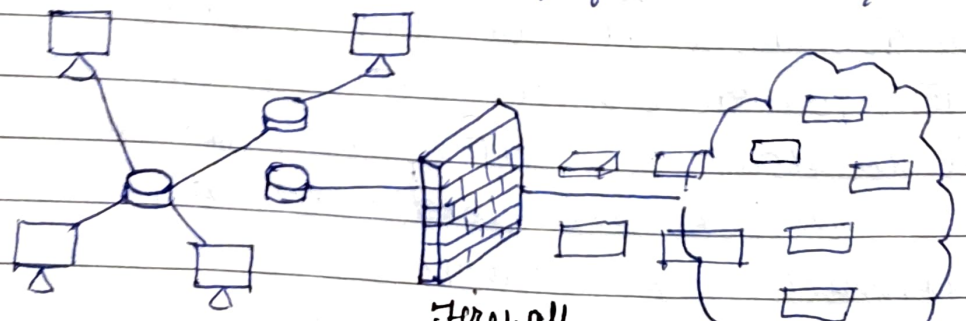
⑦ NIC. Already written

⑧ Modem.

⑨ Cables & Connectors.

⑩ Firewall

A firewall is a network security device that monitors incoming & outgoing networking traffic & decides whether to allow or block specific traffic based on a difined set of security rules. Firewalls have been a first line of difense in network security for over 25 yrs.



A firewall is a network security device that monitors incoming and outgoing network traffic & permits or blocks data packet based on a set of security rules. Its purpose is to establish a barrier b/w your internal network & incoming traffic from external sources (such as the internet) in order to block malicious traffic like viruses & hackers.

- Types of Firewall:

(i) Packet - filtering firewall
(ii) Circuit - level gateways
(iii) Stateful Inspection firewall
(iv) Application - level gateway (a.ka. proxy firewalls)
(v) Next - gen firewall
(vi) Software firewall.
(vii) Hardware firewall
(viii) Cloud firewall