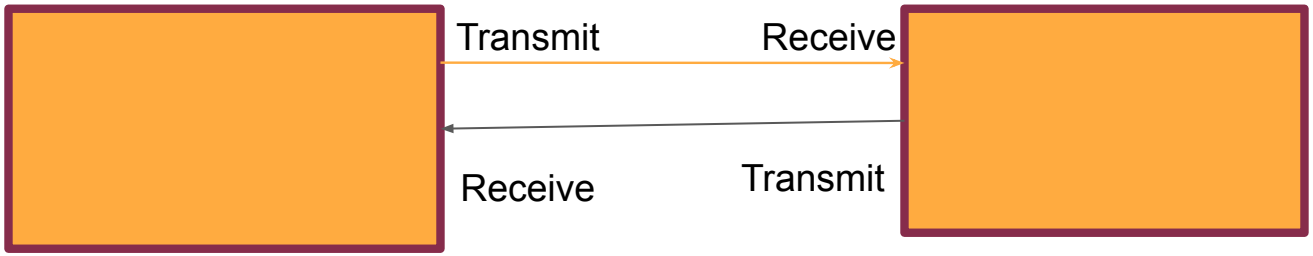
NETWORK TOPOLOGIES

Topology - is the pattern of interconnection of nodes in a network.

Factors to consider :

- Cost
- Flexibility
- Reliability

POINT TO POINT LINK



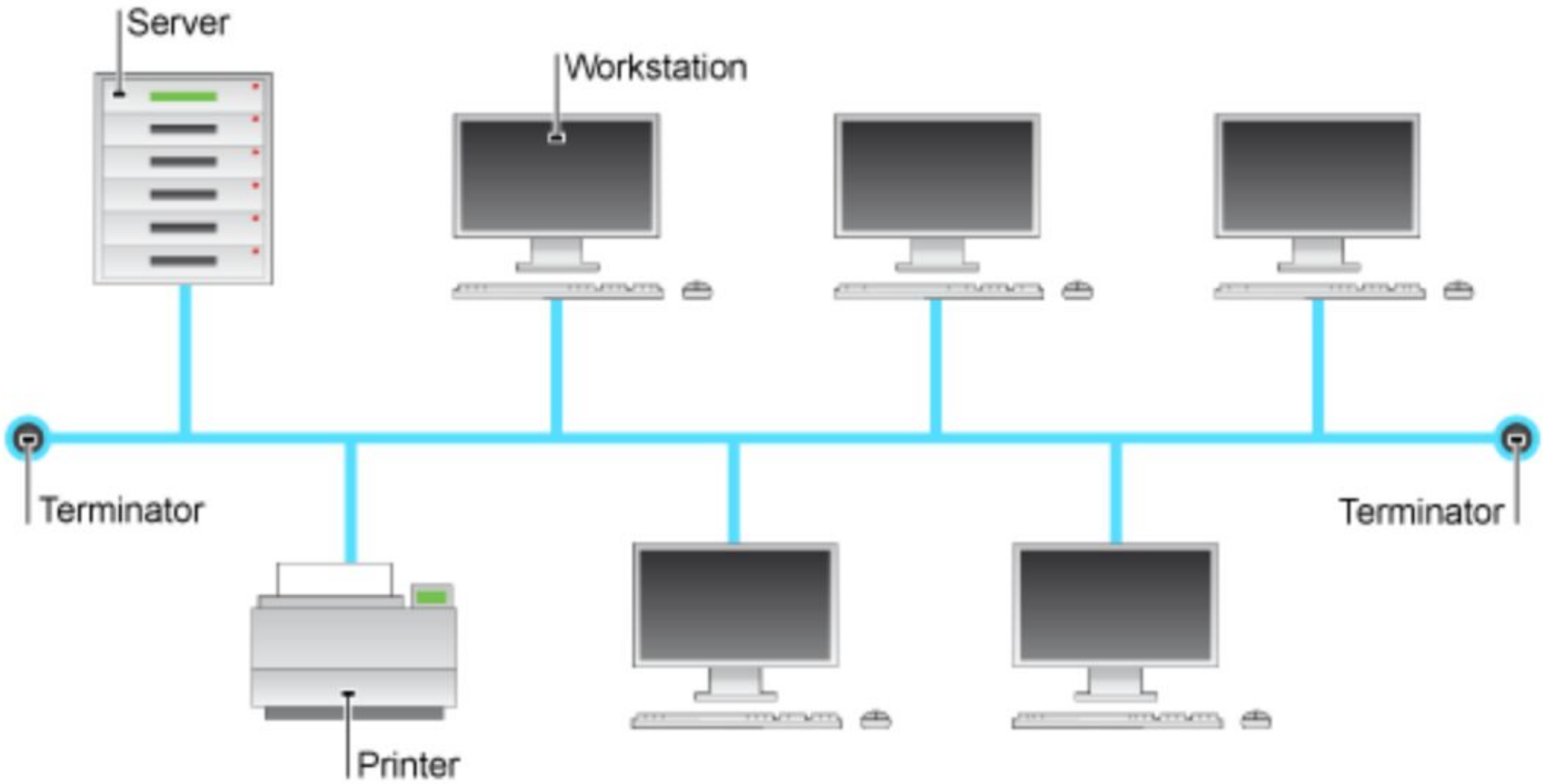
The main characteristic of P-P network is that each station receives exactly from one transmitter, and each transmitter transmits to exactly one receiver.

One method is simply install a P-P link between each pair of computers in the network. This is called a Mesh.

Major topology are:

Star Topology
Bus / Linear Topology
Ring / Circular Topology
Tree Topology
Mesh Topology

BUS TOPOLOGY



BUS TOPOLOGY

- Bus topology is also known as Linear Topology.
- In this type of topology, each node attaches directly to a common cable which acts as the backbone and therefore functions as a shared communication medium onto which various nodes are attached.
- Every workstation communicates with the other device through this Bus.
- A signal from the source is broadcasted and it travels to all workstations connected to bus cable.
- Although the message is broadcasted but only the intended recipient, whose MAC address or IP address matches, accepts it.
- If the MAC /IP address of machine doesn’t match with the intended address, machine discards the signal.

Advantages of Bus Topology

i) Since there is a single common data path connecting all the nodes, the bus topology uses a very short cable length which considerably reduces the installation cost.

ii) The linear architecture is very simple and reliable.

iii) Additional nodes can be easily connected to the existing bus network at any point along the length of the transmission medium.

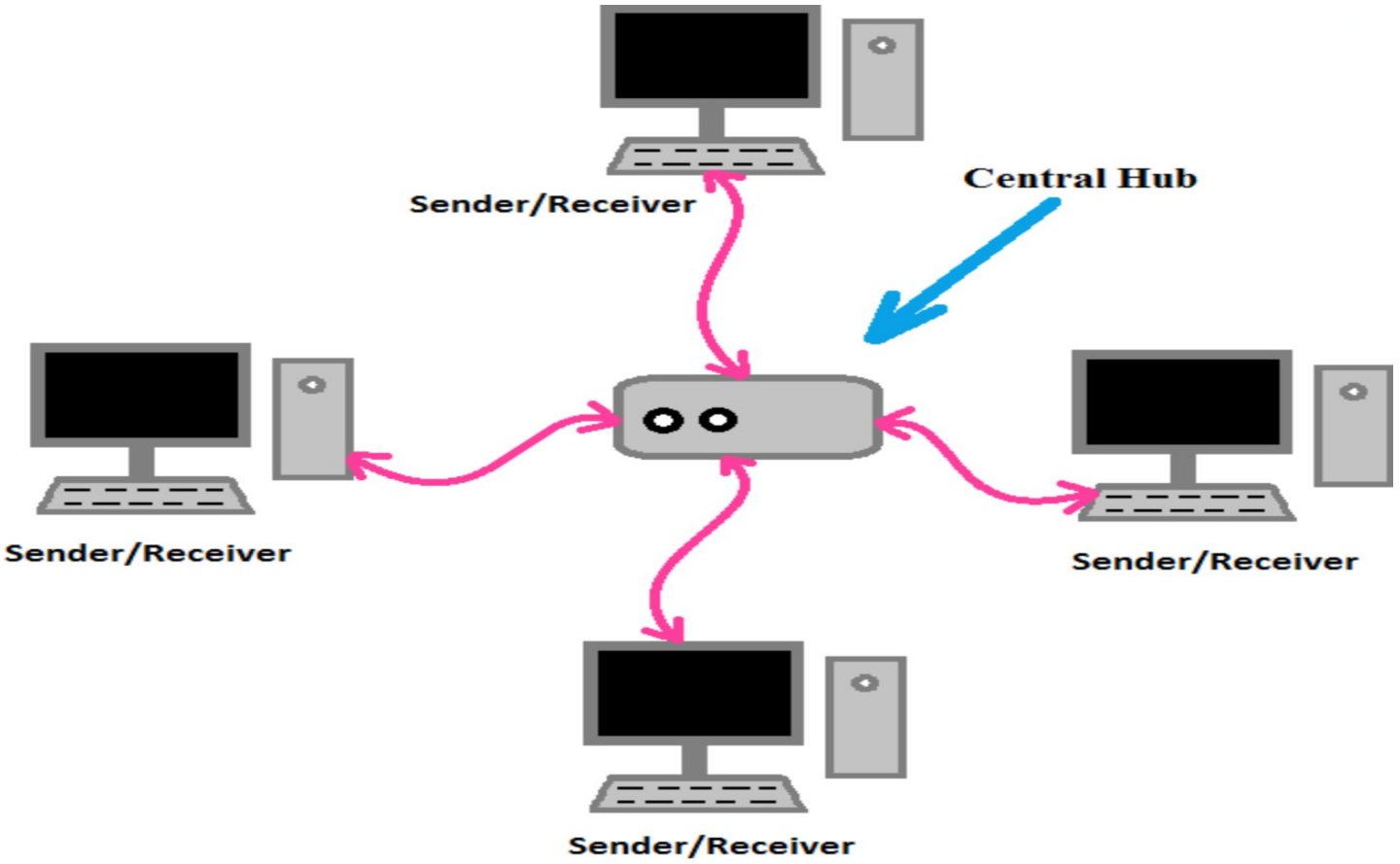
Disadvantages of Bus topology

i) Fault detection and isolation is difficult. This is because control of the network is not centralized in any particular node. If a node is faulty on the bus, detection of fault may have to be performed at many points on the network. The faulty node has then to be rectified at that connection point.

ii) If the central bus length becomes too long, then repeaters might have to be used to amplify the signal. The use of repeaters makes reconfiguration necessary.

iii) Since each node is directly connected to the central bus, so there has to be some way of deciding who can use the network at any given time.

STAR TOPOLOGY



STAR TOPOLOGY

- A star network features a central connection point called a "hub node" to which all other nodes are connected by a single path.
- Each node has a dedicated set of wires connecting it to a central network hub.
- Since all traffic passes through the hub, the hub becomes a central point for isolating network problems and gathering network statistics.
- This type of topology is used in most existing information networks involving data communications or voice communications.

Compared to the bus topology, a star network generally requires more cable, but a failure in any star network cable will only take down one computer's network access and not the entire LAN.

On the other hand if the hub fails, the entire network also fails.

Advantages of Star Topology

(i) Failure of a single connection does not affect the entire network. It just involves disconnecting one node from an otherwise fully functional network. This also helps in easy reconfiguration of the network.

ii) Fault detection is easier.

iii) Access protocols being used in a Star network are very simple since the central node has the control of the transmission medium for data transmission

Disadvantages of Star Topology

(i) Since every node is directly connected to the centre, so large amount of cable is needed which increases the installation cost of the network.

ii) The entire network is dependent on the central node. If the central node fails the entire network goes down.

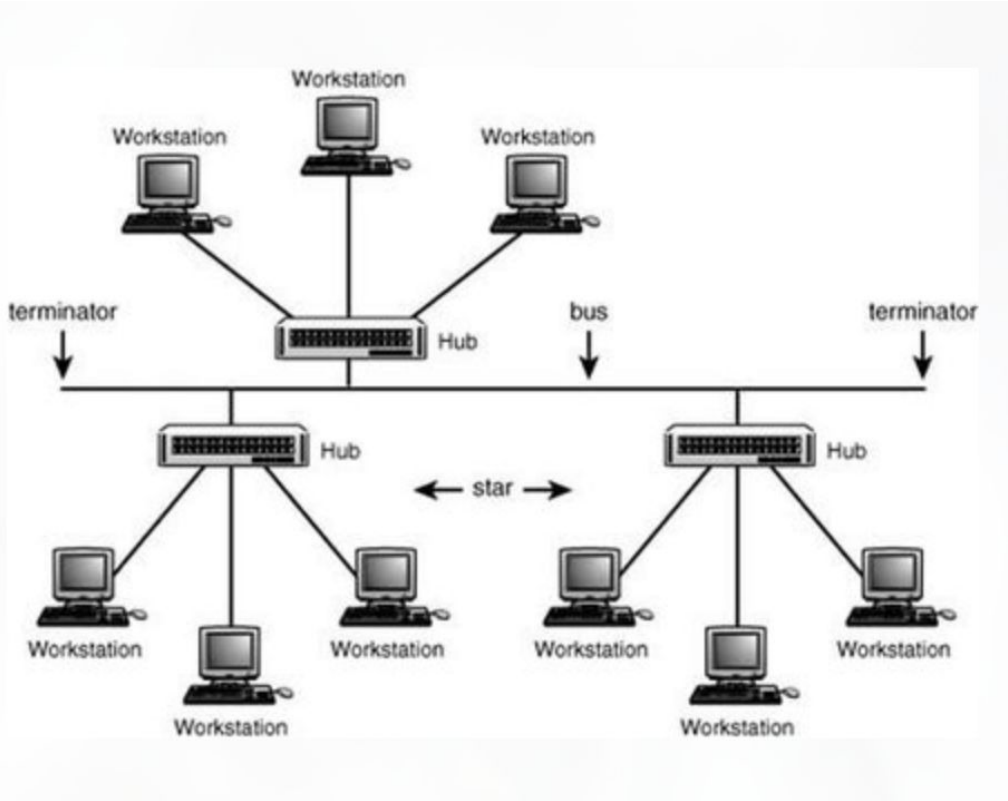
TREE TOPOLOGY

Tree topology is a combination of bus and star topology.

The network looks like an inverted tree with the central root branching and sub-branching down to the nodes.

It integrates multiple star topologies together onto a bus.

In its simplest form, only hub devices connect directly to the tree bus.



- Data transmission takes place in the same way as in bus topology. When the signal reaches the end of the transmission medium, it is absorbed by the terminators.
- Tree topology is best suited for applications which have a hierarchical flow of data and control.

ADVANTAGES:

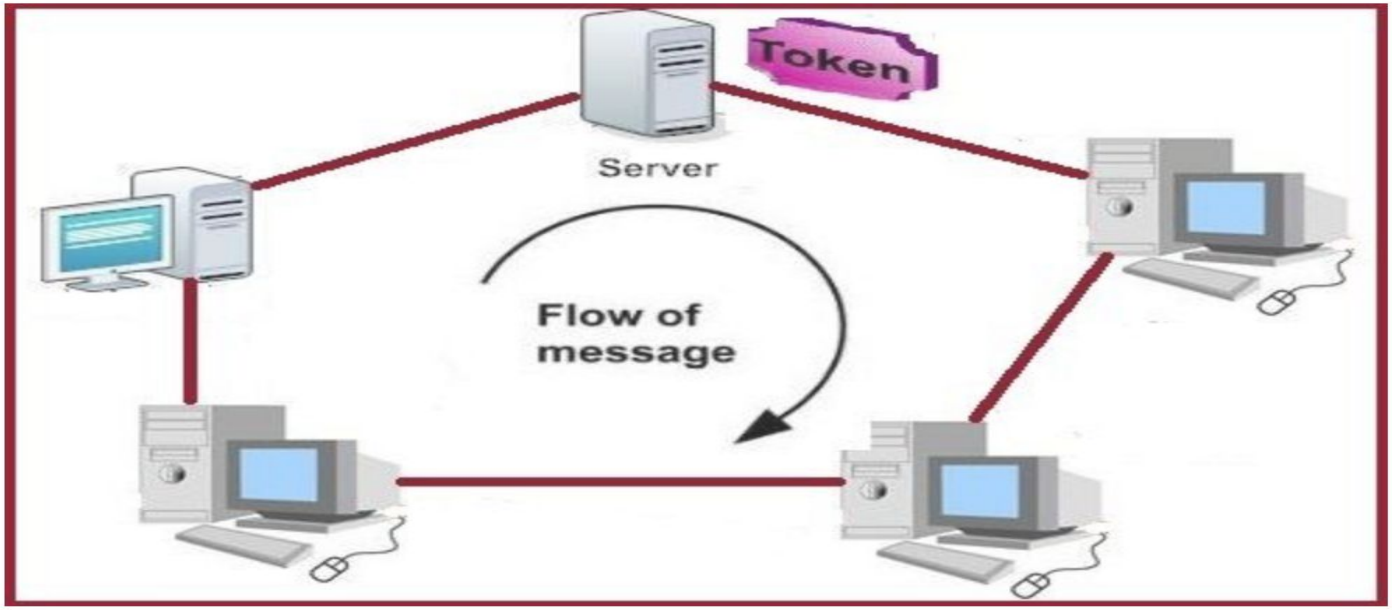
- The tree topology is useful in cases where a star or bus cannot be implemented individually. It is most-suited in networking multiple departments of a university or corporation, where each unit (star segment) functions separately, and is also connected with the main node.
- Each star segment gets a dedicated link from the central bus. Thus, failing of one segment does not affect the rest of the network.
- Fault identification is easy.

DISADVANTAGES:

- Owing to its size and complexity, maintenance is not easy and costs are high.
- Though it is scalable, the number of nodes that can be added depends on the capacity of the central bus and on the cable type.

RING TOPOLOGY

In this **Computer Network** topology, all terminals are linked each other with ring form, and all data is traveled from one by one terminal until they chase their destination point. In this topology, all packets of data is transferred in two types like as unidirectional and bidirectional.



RING TOPOLOGY

ADVANTAGES:

Short Cable Length: The amount of cabling involved in ring is comparable to that of a bus and small relative to that of star. So, less connections will be needed,which will in turn increase network reliability.

Suitable for optical fibers: Traffic on a ring travels in one direction, it is easy to use optical fiber as a medium of transmission.

DISADVANTAGES:

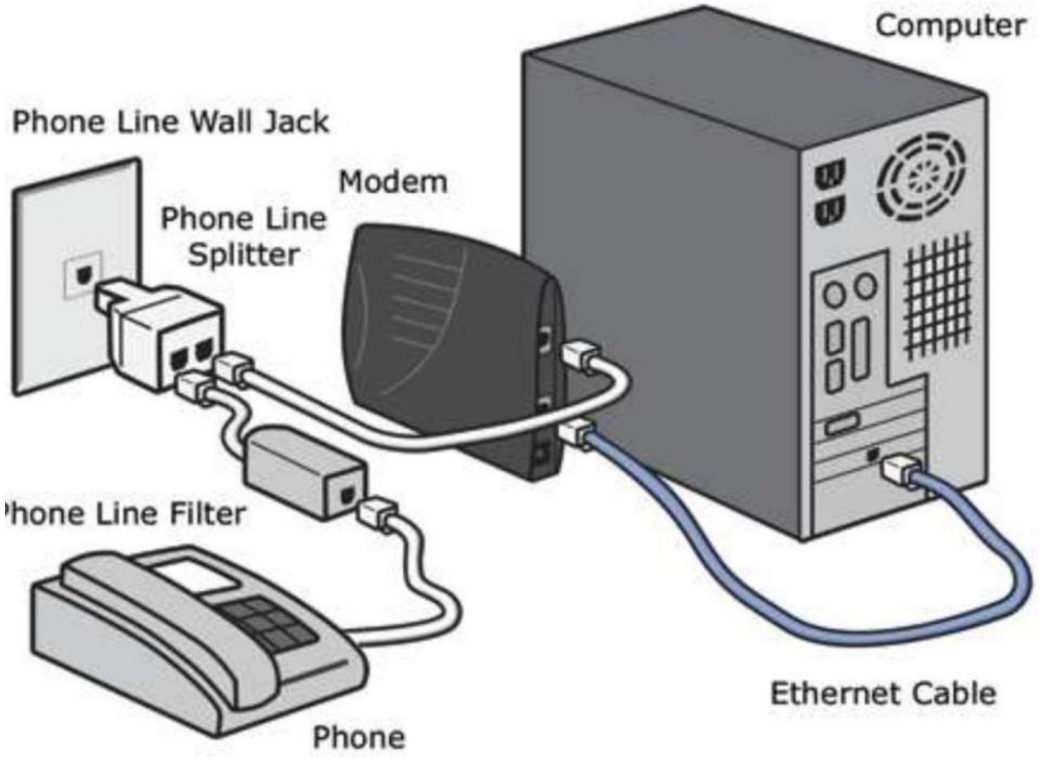
Node failure causes network failure

Difficult to diagnose faults

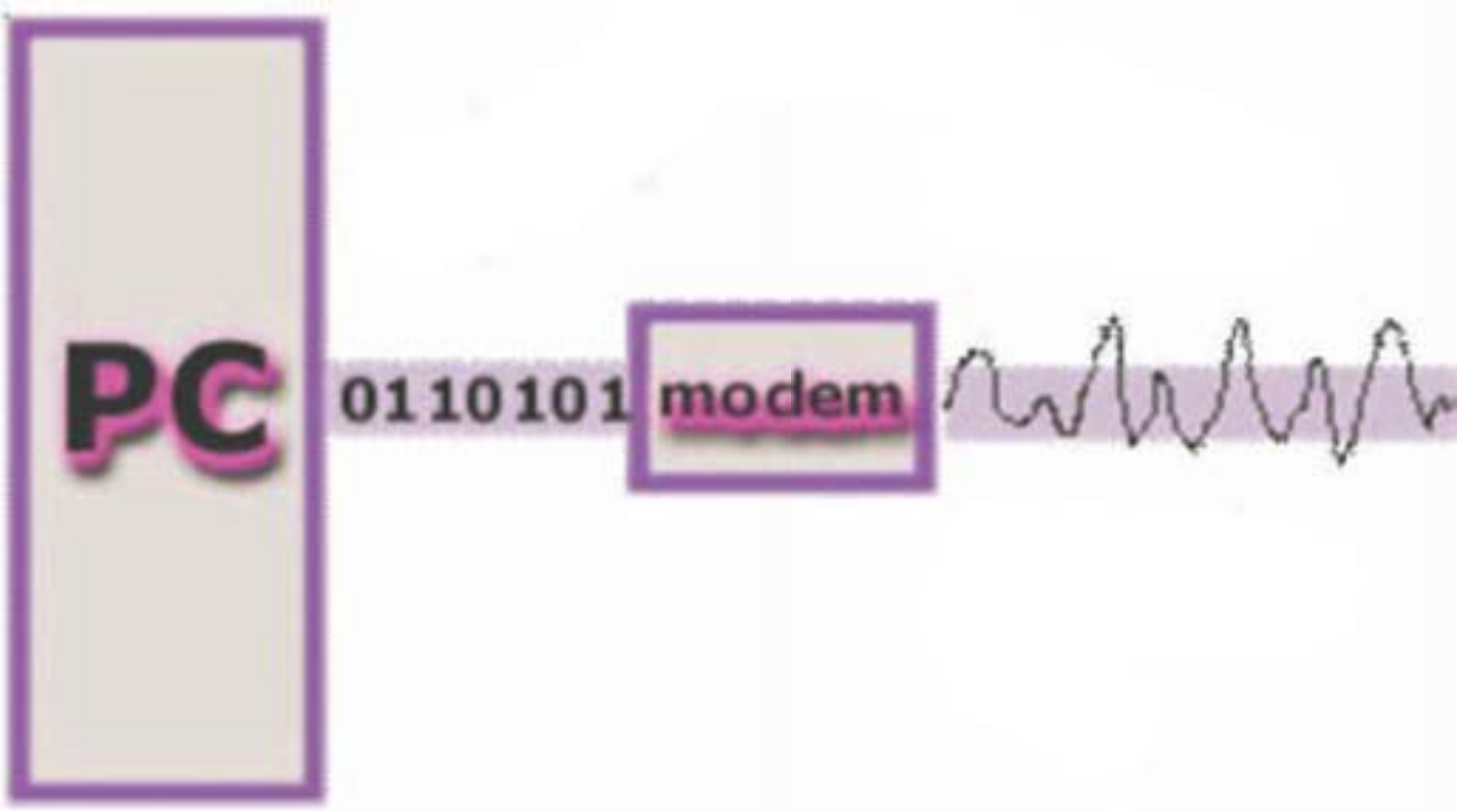
NETWORK DEVICES

Modem

A modem (Modulator - Demodulator) is a peripheral device that enables a computer to transmit data over, telephone or cable lines. The computers operate digitally using binary language (a series of zeros and ones), but transmission mediums are analogue.



WORKING OF A MODEM



External MODEM

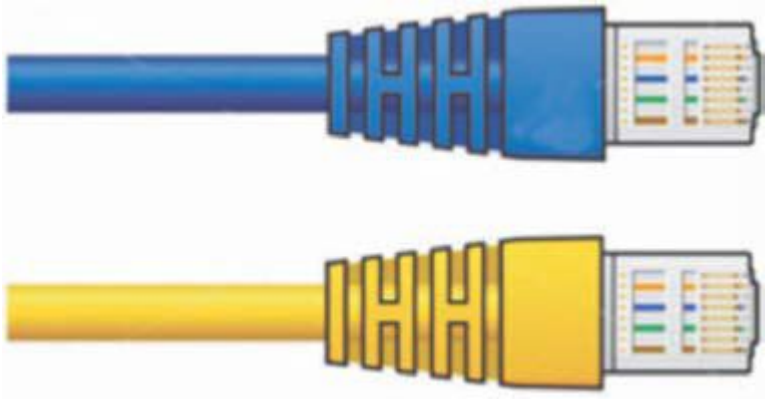
Internal MODEM

RJ-45

RJ-45 , short form of Registered Jack - 45 , is an eight wired connector that is used to connect computers on a local area network(LAN), especially Ethernet.

RJ-45 connectors look similar to the RJ-11 connector used for connecting telephone equipment, but they are somewhat wider.

RJ-45



ETHERNET CARD

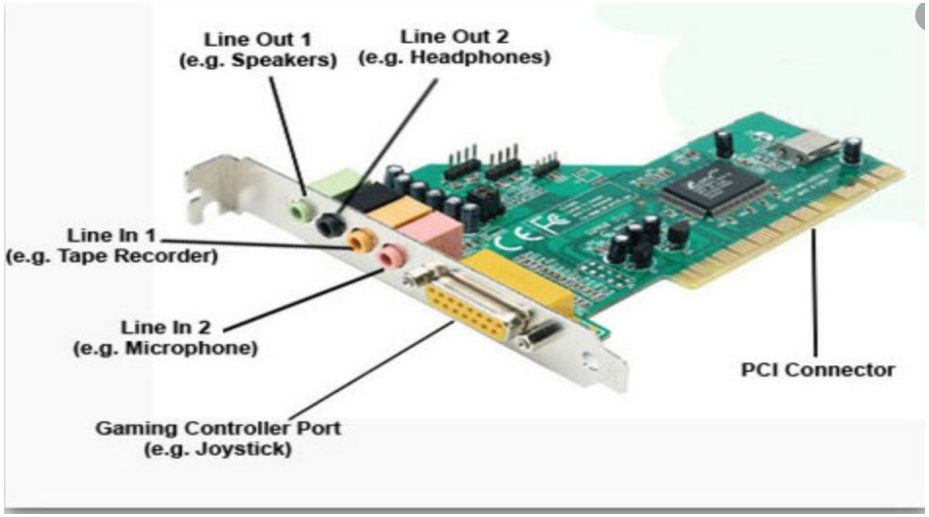
An Ethernet card is a kind of network adapter and is also known as Network Interface Card (NIC).

These adapters support the Ethernet standard for high-speed network connections via cables.

An Ethernet Card contains connections for either coaxial or twisted pair cables or even for fibre optic cable.

These insert conveniently into slots on the side or front of the device.

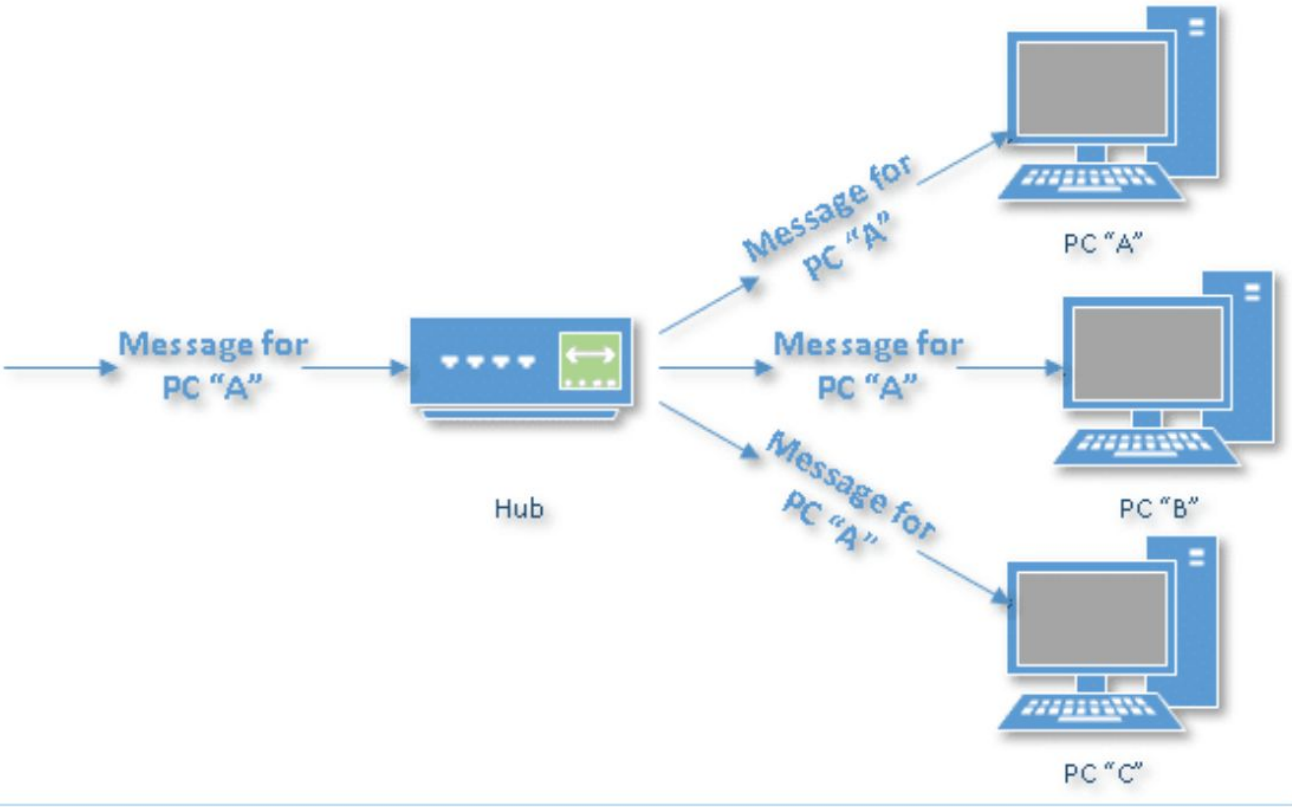
- Ethernet cards may operate at different network speeds depending on the protocol standard they support.
- Modern Ethernet adapters can support the speed of upto 100 Mbps. Fast Ethernet standards are also available now that offer speeds up to 1 Gbps (Gigabit Ethernet).



HUB

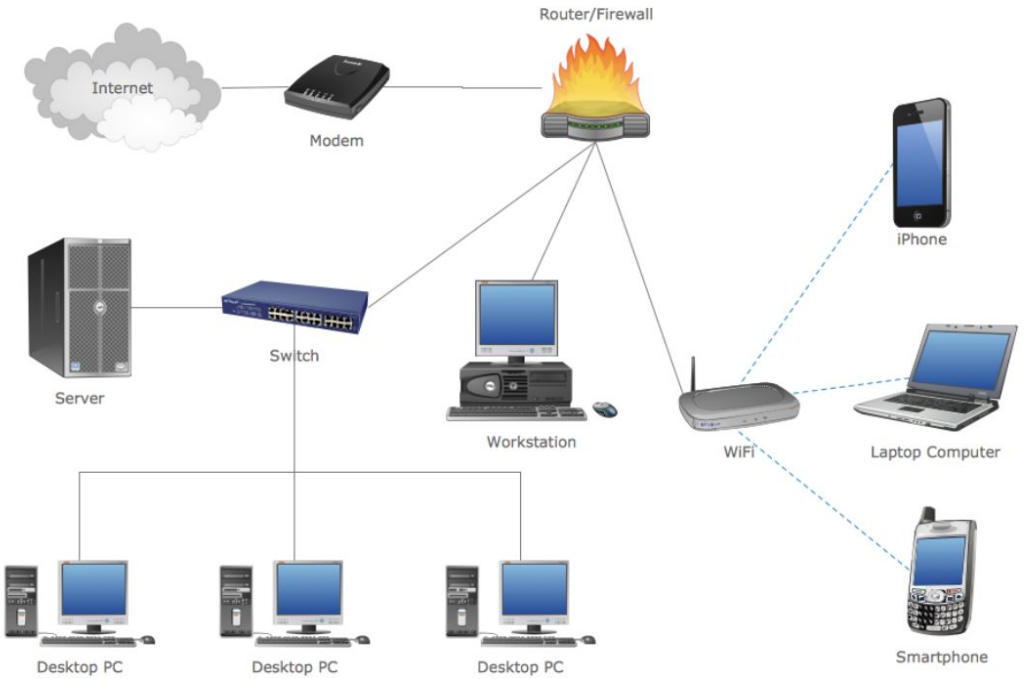
A Hub is a multiport repeater, which broadcasts all information to other ports.

It causes unnecessary network traffic. Hence, it is called non-intelligent or dumb device.



SWITCH

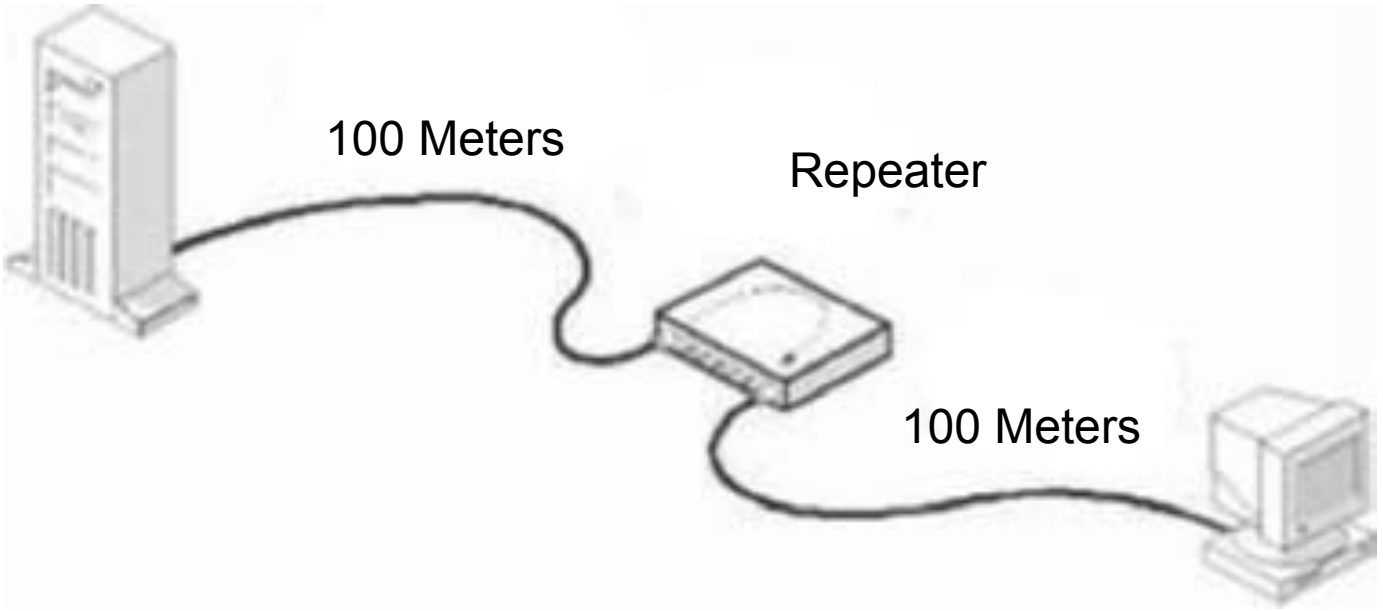
- A switch is a device that is used to break a network into different sub-networks called subnet or LAN segments.
- This prevents traffic overloading on the network.
- Switches are another fundamental part of many networks because they speed things up.
- They allow different nodes of a network to communicate directly with one another in a smooth and efficient manner.
- In simple terms, a network switch is a small hardware device that joins multiple computers together within one local area network (LAN).



SWITCHES

HUB	SWITCH
Repeats the incoming traffic to all connections	Sends traffic only to appropriate connections
Offers single lane connection, hence either send or receive at a time	Establishes two-lane communication, facilitating send and receives at the same time
Shares bandwidth among its connections	Does not share bandwidth, each connection gets full bandwidth
Inexpensive choice	Expensive than hubs

A REPEATER



REPEATER

- A repeater is an electronic device that receives a signal , amplifies it and then retransmits it on the network so that the signal can cover longer distances.

- Network repeaters regenerate incoming electrical, wireless or optical signals.

- An electrical signal in a cable gets weaker with the distance it travels, due to energy dissipated in conductor resistance and dielectric losses.
- Similarly a light signal travelling through an optical fibre suffers attenuation due to scattering and absorption.

- With physical media like Ethernet or WiFi, data transmissions can only span a limited distance before the quality of the signal degrades.

- Repeaters attempt to preserve signal integrity by periodically regenerating the signal and extend the distance over which data can safely travel.

Bridge

A bridge is a device that helps to link two networks together.

Bridges are smart enough to know which computers are on which side of the bridge, so they only allow those messages that need to get to the other side to cross the bridge.

Bridges can handle networks that follow same protocols.

ROUTERS

- A Router is a network device that works like a bridge to establish connection between two networks but it can handle networks with different protocols.
- The data is sent to the router which determines the destination address (using logical address) and then transmits the data accordingly
- Hence routers are smarter than hubs and switches.
- Using a routing table that stores calculated paths, routers make sure that the data packets are travelling through the best possible paths to reach their destinations.
- If a link between two routers fails, the sending router can determine an alternate route to keep traffic moving.
- Routers provide connectivity inside enterprises, between enterprises and the Internet, and within an Internet Service Provider (ISP).
- Routers can be wireless or wired.

GATEWAY

A gateway is a network device that establishes an intelligent connection between a local network and external networks with completely different structures i.e. it connects two dissimilar networks.

In simple terms, it is a node on a network that serves as an entrance to another network.

WI-FI (Wireless Fidelity) CARD

Wi-Fi cards are small and portable cards that allow your desktop or laptop computer to connect to the internet through a wireless network. Wi-Fi transmission is through the use of radio waves.

The antenna transmits the radio signals and these signals are picked up by Wi-Fi receivers such as computers and cell phones equipped with Wi-Fi cards.

These devices have to be within the range of a Wi-Fi network to receive the signals.

The Wi-Fi card then reads the signals and produces a wireless internet connection.

Where to place server in a network?

80:20 Rule :

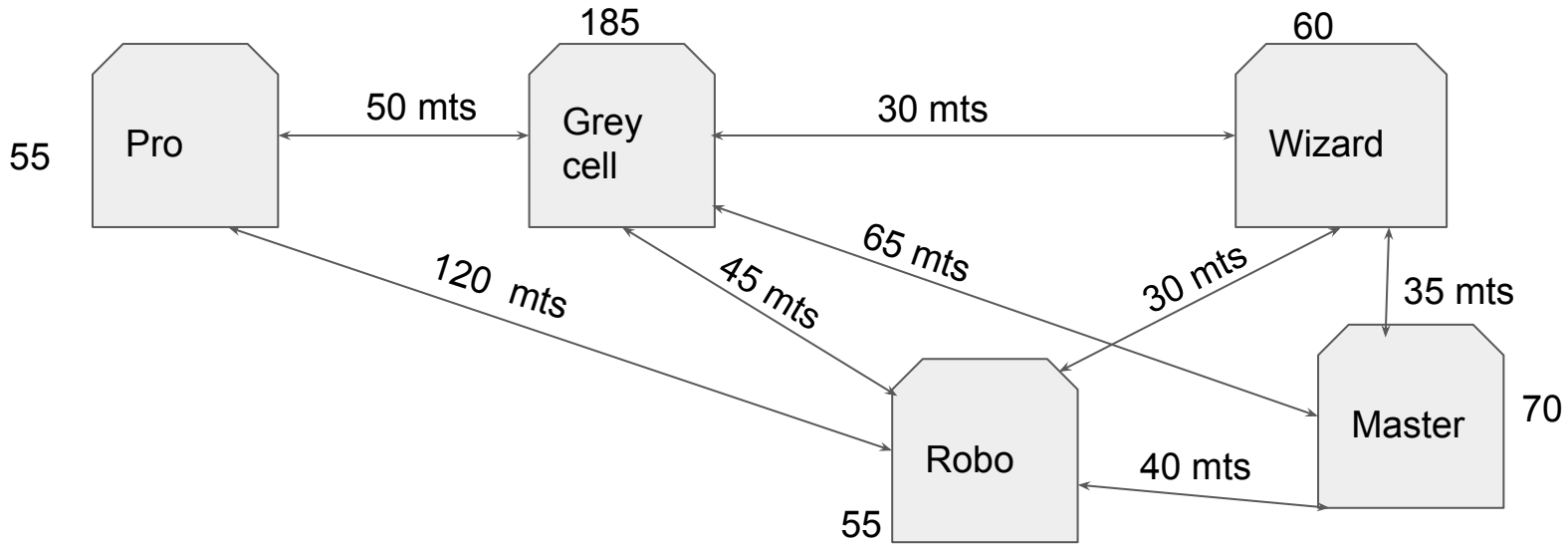
80 percent of the traffic on a given network segment is local (destined for a target in the same workgroup), and not more than 20 percent of the network traffic should need to move across a backbone(the spine that connects various segments or subnetworks)

Which cable to be chosen and when?

Twisted Pair	Coaxial	Fiber optic
Low cost Easy installation No high speed data requirement - 1 to 100 MHz	Local area networks are to be formed Long distance telephone transmission to take place	Lower attenuation & secured Data rates of 100s of Gbps

Problem 1:

Intellect Corp. caters to many high profile clients and has 6 buildings where it runs its operations

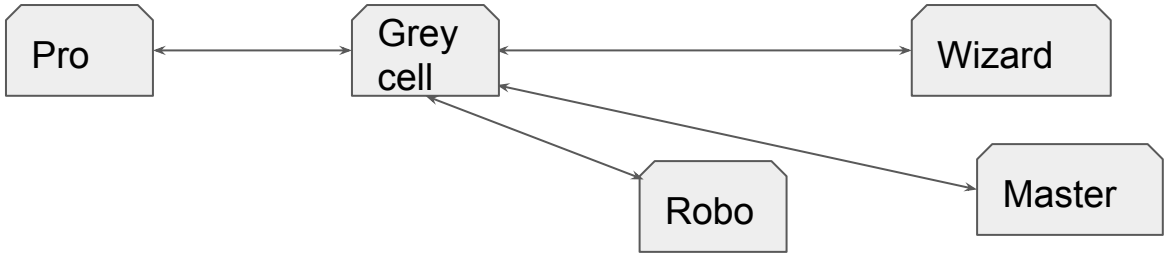


Answer the following questions on the basis of above given information:

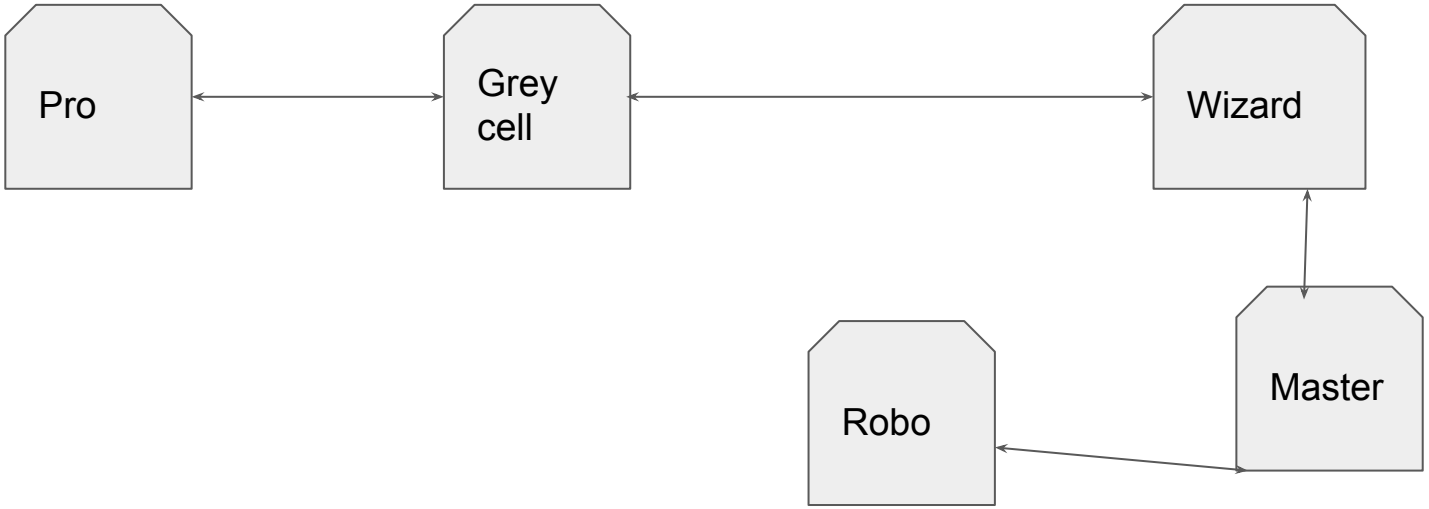
1) Suggest the possible cable layout for the buildings?
2) Where would you suggest the placement of server?
3) Suggest the cable type that should be used?
4) The management wants the network traffic should be minimized. For this which network device would you suggest out of the following devices and why?
   a) hub b) repeater c) bridge

1) Possible Layouts:

Total Cable Length = 190 mts



Total Cable Length = 155 mts



2) As per 80-20 rule, the server should be placed in the building with maximum number of computers. Grey cell building is suggested

3) Thicknet coax cable as these can support networks of upto 500 mts.

4) To minimize traffic, we should try to stop data broadcast and for this bridge is ideally suited. This is because a bridge does not broadcast data rather it identifies the destination segment depending upon the receiver's MAC address.

NETWORK PROTOCOLS

- A Protocol is a format description of message formats and the rules that two or more machines must follow to exchange those messages.
- A protocol means the rules that are applicable for a network.
- Protocol defines standardized formats for data packets, techniques for detecting and correcting errors.
- Most protocols support multitasking.
- One operation can involve several Protocols - eg -NFS (Network File System) Protocol -

    - uses one protocol to write to a file
    - another to perform a function call on a remote host
    - another to deliver a datagram to port on a remote host
    - another to deliver a datagram on a Ethernet.

Network Protocols

- http - hypertext transfer protocol is the set of rules for transferring hypertext(text, graphic, image, sound, video etc.) on WWW(World Wide Web)
- http - has been in use by the WWW global information initiative since 1990.
- http - builds the communication with URI (Uniform Resource Identifier), Location (URL - Uniform Resource Location) or name (URN - Uniform Resource Name) for indicating the resource on which a method is to be applied.
- Messages are passed to http in a format similar to that used by Internal Mail and MIME (Multipurpose Internet Mail Extensions)
- http - is also used as a general protocol for communication between user and gateways to other internet protocols like SMTP, FTP, NNTP, WAIS allowing access to resources using different applications by the users.

File Transfer Protocol

- FTP is a standard for the exchange of files across Internet.
- FTP is used for downloading the files.
- FTP establish two connections, one is for control command (authentication) and another is for data transfer.
- Provides high security.
- Two ways :
  - Connect to ftp server by typing ftp from the browser address bar
  - Use ftp client - a popular free ftp client is Filezilla.
- Ftp servers will require an account with a username and password.

TCP/IP - Transmission Control Protocol/Internet Protocol

TCP/IP is the base communication protocol of the internet.

TCP provides reliable delivery of messages between networked computers.

IP uses numeric IP addresses to join network segments.

TCP is responsible for dividing the content into packets, IP is responsible for routing the packets through the network and the destination again TCP is responsible for rearranging the packets and delivering the data.

TCP is responsible for making sure that the commands get through to the other end. It keeps track of what is sent, and retransmits anything that the not get through.

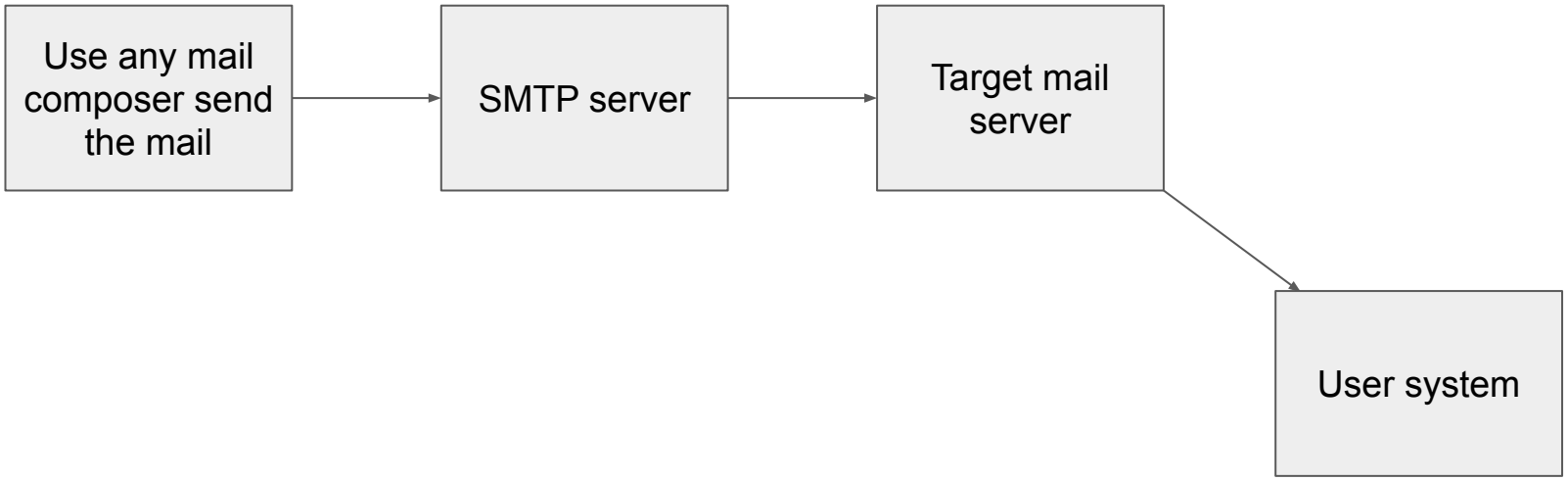
Protocols used in e-mail

SMTP - Simple Mail Transfer Protocol

Send mail to people on internet.

SMTP can only be used to send emails, not to receive them.

SMTP is used by the Mail Transfer Agent(MTA) to deliver the sent e-mail to the recipients mail server.



Protocols used in e-mail

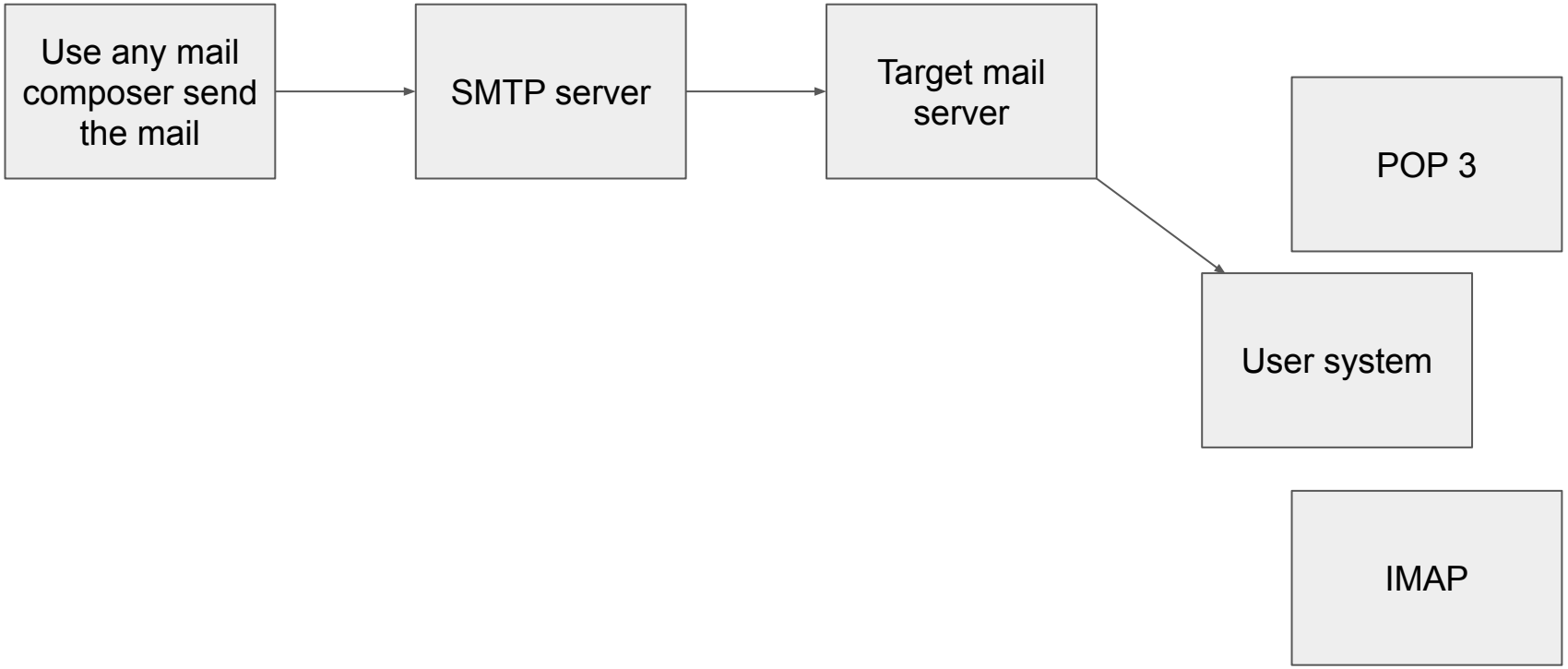
POP3 - Post Office Protocol 3

POP provides a simple, standardized way for users to access mailboxes and download messages to their computers.

All e-mail messages get downloaded from the mail server to user's local computer.

Once downloaded to user's system it is deleted is mail server unless it is preferred to be saved in the mail server.

Downloaded mail can be opened without internet connections.



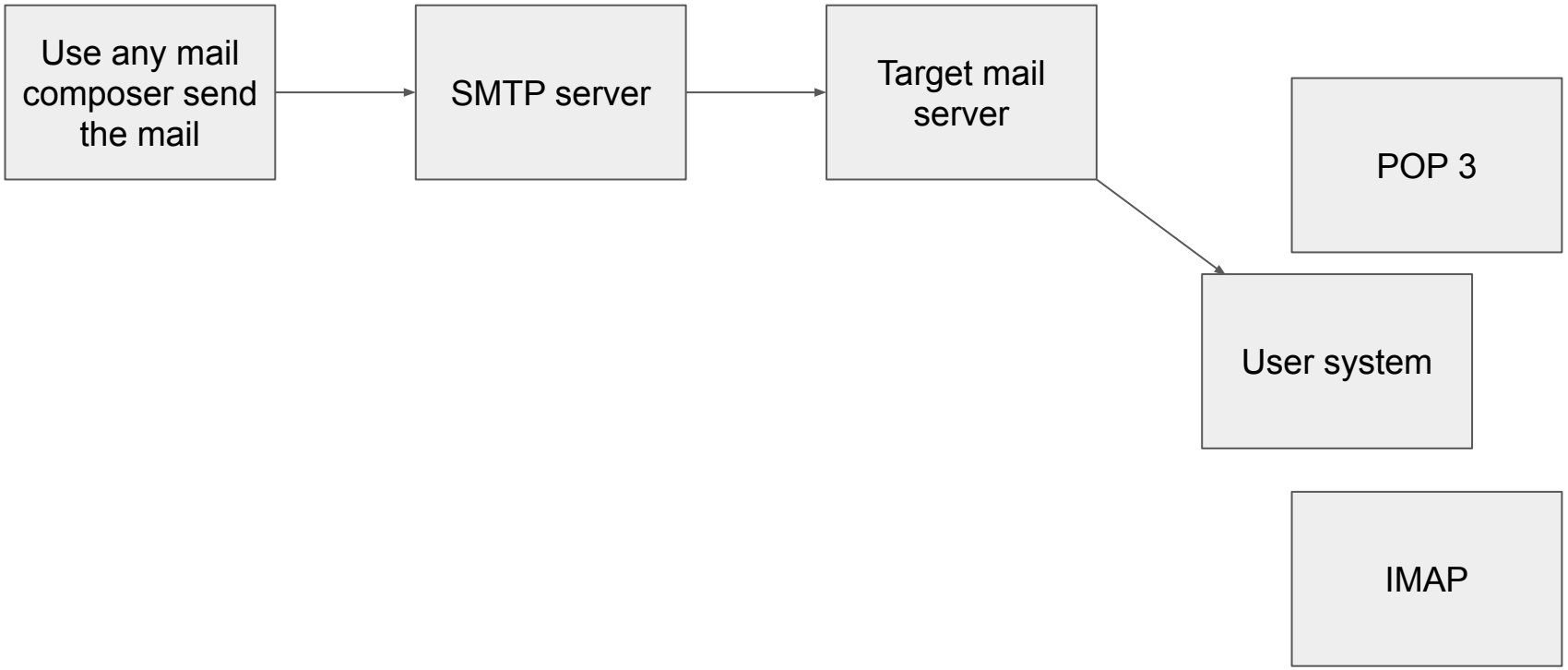
Protocols used in e-mail

IMAP - Internet Message Access Protocol

It is a standard protocol for accessing e-mail from local server.

Only if the user requests to read a specific email message, then will be downloaded from the server.

One can also create and manipulate folders or mailboxes on the server, delete messages.



Wireless Vs Mobile Computing

Wireless communication is simply data communication without the use of landlines.

Mobile computing means that the computing device is not continuously connected to the base or central network.

Not all wireless communications technologies are mobile.

Wireless - Two-way radio, satellite communications.

Mobile - PDAs, laptop, smart phones.

Wireless/Mobile Computing Technologies

GSM - Global System for Mobile - standard for digital cell phones established in Europe, now in Asia, Africa, Australia.

To connect to the specific server providers in different countries, the user needs to switch SIM (subscriber identification module)

GSM uses narrowband TDMA - Time Division Multiple Access which allows eight simultaneous calls on the same radio frequency.

AT & T, use GSM.

Advantage of GSM - ease of changing phones

SIM card is a tiny computer chip that gives a cellular device its unique phone number. It has memory, a processor and ability to interact with people.

Wireless/Mobile Computing Technologies

CDMA - Code-Division Multiple Access - Unlike GSM which uses TDMA, CDMA does not assign a specific frequency to each user. Instead it uses spread-spectrum where data is sent over number of discrete frequencies.

At the receiver end, the same unique code is used to recover the signal.

Jamming transmissions become difficult is used in military communications.

Wireless/Mobile Computing Technologies

WLL - Wireless in Local Loop - to serve subscribers at home or offices.

It is a 2-way communication server to use a user station near a small service area.

This uses radio signal & wireless network technology to local loop instead of copper cable technology to access Public Switched Telephone Network(PSTN).

Wireless/Mobile Computing Technologies

GPRS - General Packet Radio Service - to access the internet, send emails and large data, to watch News, download games and watch movies.

GPRS - breaks data into packets and send it across.

GPRS - provides a high-speed data transfer between 56Kbits per second to 110Kbits per second.

An advantage GPRS over GSM is that GPRS has a much higher data transmission speed.

Comparison of Wireless Communication Technologies

Technology	1G	2G/2.5G	3G	4G	5G
Development	1970/1984	1980/1999	1990/2002	2000/2010	2014/2015
Bandwidth	2 kbps	14-16 kbps	2 mbps	200 mbps	> 1 gbps
Technology	Analog cellular	Digital cellular	Broadband/ CDMA/IP technology	unified IP & seamless combo of LAN/WAN/ WLAN/PAN	4G + WWW
Services	Mobile technology (Voice only)	Digital voice/ Short messaging (SMS), Media	Integrated high quality audio, video & data	Data + Voice converged over IP	Better quality voice with super high speed data transmission
Switching	Circuit	Circuit/Circuit for access network & air interface	Packet network	Internet	Internet

Short Message Service - is the transmission of short text messages to and from a mobile phone.

Chatting - online textual talk, in real time.

Video Conferencing - A two-way video phone conversation among multiple participants.

SIP - Session Initiation Protocol - Video-conferencing protocol

Wi-Fi - Wireless Fidelity - lets you connect to the Internet without a direct line from the PC to the ISP.

Wi-Fi Hotspots - A hotspot is a venue that offers Wi-fi access, these are public locations with free or fee-based wireless Internet access.

WiMax - wireless digital communication system. Can provide broadband wireless access upto 30 miles(50 km) for fixed stations, 3-10 miles(5-15 km) for mobile stations, whereas WiFi LAN is limited to 100-300 feet(30-100m)

VoIP - Voice over Internet Protocol - is a technology that enables voice communications over the internet through the compression of voice into data packets that can be efficiently transmitted over data networks and then converted back into voice at the other end.

WWW - World Wide Web - set of protocol that allows you to access any document on the net through a naming system based on URL.

Telnet - Older internal utility that lets to log on to the remote computer systems.

Web browser - is a WWW client that navigates through the WWW and display the web pages.

Web Server - is a WWW server that responds to the requests made by the web browser.

Web site - A location on a net server is called web site.

Web hosting - means hosting web-server application on a computer system.

Script - is a list of commands embedded in a web-page and executing by scripting engine.

Two types of scripts

1) **client-side scripts** - supports interaction within a webpage.
   a) Egs - online games
   b) to get data from user's screen or browser Eg : PHP, JavaScript
2) **Server-side scripts -** supports execution of client request and sending the result
   a) Form processing
   b) Password protection Eg. JSP, ASP

Network Security Concepts

Firewall - The system designed to prevent unauthorized access to or from a private network.

Cookies - a message that a web server transmit to web browser to keep track of user's activity on a specific web site.

Crackers - are the malicious programmers who break into secure systems.

Hackers - are more interested in gaining knowledge about computer systems.

Cyberlaw - refers to all the legal and regulatory aspects of internet and the WWW.

Virus - is a malicious program that requires a host and is designed to make a system sick.

A Trojan Horse -is a code hidden in a program such as a game or spreadsheet that looks safe but when run causes virus attack.

Worm - is a program designed to replicate and destroy data

Spam - refers to electronic junk mail.

Ecommerce payment transactions using online banking, mobile banking and payment apps and services

An **e-commerce payment system** facilitates the acceptance of electronic payment for online transactions. Also known as a sample of Electronic Data Interchange (EDI), e-commerce payment systems have become increasingly popular due to the widespread use of the internet-based shopping and banking.

Online banking

- Online banking allows a user to execute financial transactions via the internet.
- Internet banking or Web banking

Advantages

- Convenience
- Fast and efficient
- 24x7 service

Disadvantage

- Security is increased still it is at risk
- Connectivity issues
- Complex issues need to be address face-to-face

Mobile banking

Mobile banking is a service provided by a bank or other financial institution that allows its customers to conduct financial transactions remotely using a mobile device such as a smart phone or tablet.

Unlike the related internet banking it uses software, usually called an app, provided by the financial institution for the purpose.

iMobile
Yono
M-connect

Mobile payments

Mobile payment (also referred to as **mobile money**, **mobile money transfer**, and **mobile wallet**) generally refer to payment services operated under financial regulation and performed from or via a mobile device. Instead of paying with cash, cheque, or credit cards, a consumer can use a mobile phone to pay for a wide range of services and digital or hard goods.

Most mobile payment systems can be identified in one of these categories:

Everyday Transactions: One type of mobile payment takes place anywhere you are, like at home. You can open an app on your phone and pay anyone for any reason you wish. Split a bill, send a money gift, refund someone for something they did for you, etc. Money is usually taken straight from your bank account but some services let you hold the cash in a "mobile wallet" for quicker transfers.

Mobile payments

Point of Sale Payments: These take place at the place where you're buying the service or good. Lots of stores have POS mobile payment systems in place that make is super easy to just tap your phone on the card reader or press a button on your phone to instantly pay the bill.

Closed Loop Mobile Payments: These types of mobile payments are specific to a company. For example, Starbucks lets you buy anything from their menu using your phone, and you can even skip the line in the store and go directly to a mobile-order-specific line to quickly pick up your order.

Mobile payments

Carrier Payments: Since every mobile payment-capable phone uses a cell phone carrier, some services are in place that let you pay for things from your phone but not actually have to pay until you get your cell phone bill.

Mobile Card Reader: Some companies offer a small device that plugs into your phone or tablet that can be used to accept payments from a debit or credit card. These are perfect for small businesses or even individuals who are accepting payments on the go.

List of Mobile Payment Apps in India

- Airtel Money
- Axis Bank Lime
- BHIM App (Bharat Interface for Money)
- Chillr
- Citrus Pay
- Freecharge Ftcash
- HDFC PayZapp
- ICICI Pockets
- Itzcash
- Jio Money Mobikwik
- mRupee
- Oxigen Wallet Paytm
- PhonePe
- SBI Buddy
- Trupay
- Vodafone M-Pesa

Shortform - Expansion

LAN	LOCAL AREA NETWORK
WAN	WIDE AREA NETWORK
PAN	PERSONAL AREA NETWORK
MAN	METROPOLITAN AREA NETWORK
NIC/NIU/TAP	NETWORK INTERFACE CARD NETWORK INTERFACE UNIT TERMINAL ACCESS POINT
WWW	WORLD WIDE WEB
PDA	PERSONAL DIGITAL ASSISTANT
ARPANET	ADVANCED RESEARCH PROJECTS AGENCY NETwork
NSF	NATIONAL SCIENCE FOUNDATION
TCP/IP	TRANSMISSION CONTROL PROTOCOL/INTERNET PROTOCOL
bps	bits per second
Bps	Bytes per second

Shortform - Expansion

VGM	Voice Grade Medium
DGM	Data Grade Medium
UTP	Unshielded Twisted Pair
STP	Shielded Twisted Pair
RJ	Registed Jack
MAC	Media Access Control
WiFi	Wireless Fidelity
HTTP	HyperText Transfer Protocol
URL	Uniform Resource Locator
MIME	Multipurpose Internet Mail Extensions
FTP	File Transfer Protocol
SMTP	Simple Mail Transfer Protocol
POP	Post Office Protocol
IMAP	Internet Message Access Protocol

Shortform - Expansion

SLIP	Serial Line Internet Protocol
PPP	Point to Point Protocol
ISP	Internet Service Provider
NCP	Network Control Protocol
LCP	Link Control Protocol
TDMA	Time Division Multiple Access
CDMA	Code Division Multiple Access
GSM	Global System for Mobile
GPRS	General Packet Radio Service
SIM	Subscriber Identity Module
WLL	Wireless in Local Loop
LTE	Long Term Evolution
WiMax	Worldwide Interoperability for Microwave Access

Shortform - Expansion

GPU	Graphics Processing Unit
IRC	Internet Relay Chat
SIP	Session Initiation Protocol
VoIP	Voice over Internet Protocol
HTML	Hyper Text Markup Language
XML	eXtensible Markup Language
DHML	Dynamic HTML
JSP	Java Server Page
ASP	Active Server Page
PHP	HyperText PreProcessor
BHIM	Bharat Interface for Money
UPI	Unified Payments Interface
NPCI	National Payments Corporation of India