Computer Networks (Part-1)
Based on CBSE Syllabus
Class XII

By-

Neha Tyagi

PGT CS

KV No. 5 Jaipur II Shift

Website: www.pythontrends.wordpress.com

Email: python.kvs@gmail.com

What is a Network?

- In a network, two or more computers are connected in a way so that they can share their resources like printer, CD, hard disk etc.

- A Computer network is a network of computers which share information and resources from each other.

- Such networks can be connected via cable, telephone line, radio waves, satellite, infrared etc.
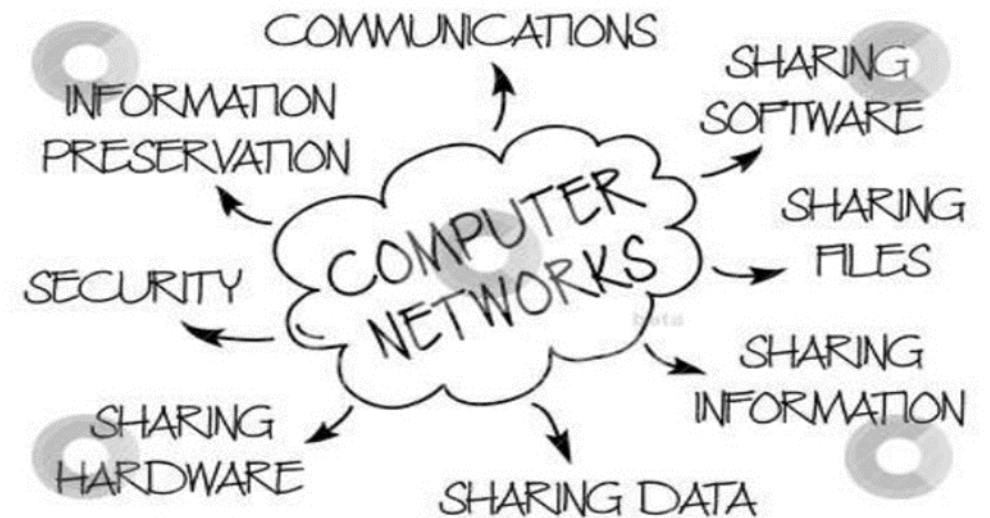
Benefits of Network

➢ RESOURCE SHARING : Now a days, computer networks are used in schools and offices to share various resources like printer, scanner etc. in order to minimize expenses of an organization.

➢ Effective communication- Communication has became very effective and fast with the help of network :

➢ Less expenses- because of sharing of resources, communication expenses has decreased on a faster rate.

➢ Reliability- With the use of computer, calculations and communications became much reliable.

➢ Central storage of data: Organizations are storing their data centrally so that it can be available to all concerned people keeping integrity of data. Banking is good example of this.

Terminology

- **Nodes(Workstations) :** The term nodes refers to computers that are attached to a network and are seeking to share resources.

- **Server :** A computer that facilities the sharing of data, software and hardware resources on the network.

- **Network Interface Unit (NIU) :** A Network interface unit is an interpreter that helps in establishing communication between the server and the client.

- **IP Address :** Every machine on a TCP/IP Network has a unique identifying number called an IP Address.

- **Domain Name :** It is a way to identify and locate the computers connected to the internet. It must be unique.

- **URL(Uniform Resource Locator)** it stands for "Uniform Resource Locator." A URL is the address of a specific webpage or file on the Internet. For example, the URL of the TechTerms website is "http://techterms.com." for ex - "http://techterms.com/definition/url" . It has following information-

    - **http://** – the URL prefix, which specifies the protocol used to access the location

    - **techterms.com** – the server name or IP address of the server

   - **/definition/url** – the path to the directory or file

Structure of a Network

Sender : A device or computer that send information/data.

Receiver : A device or computer who receives data/information.

Message : An information needs to broadcast.

Transmission Medium : It is a physical path with the help of which information goes from sender to receiver.

**Protocol:** It is a collection of rules which regulates transfer of information.
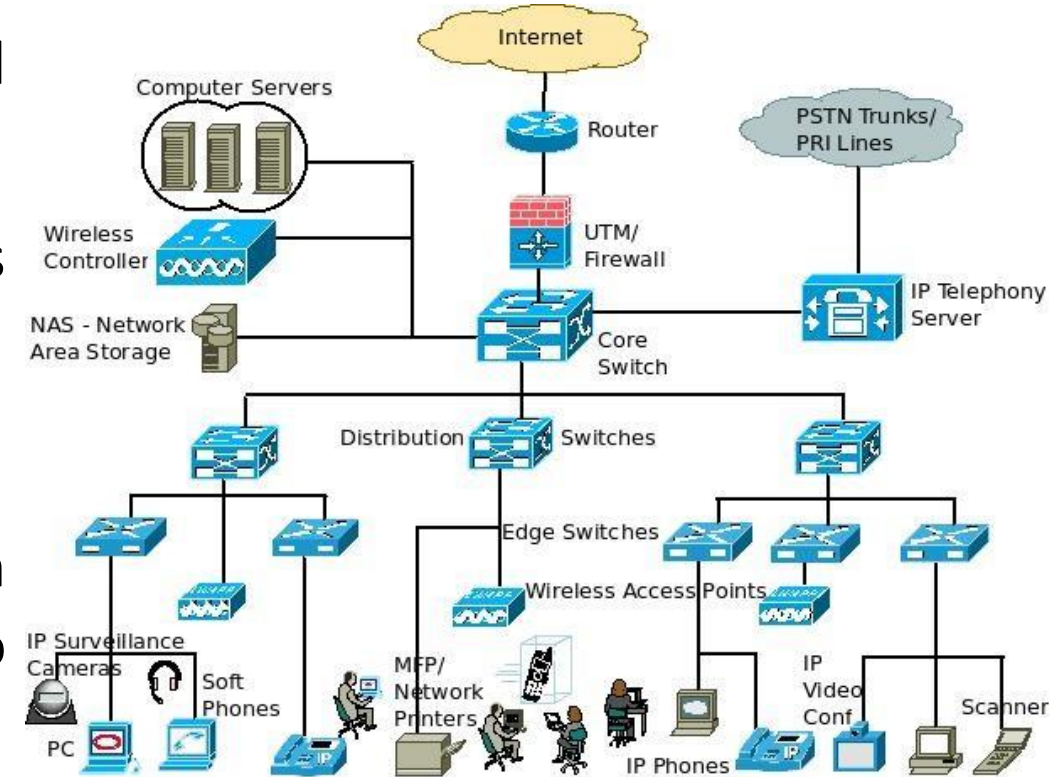
Types of Network

- **<u>PAN – PERSONAL AREA NETWORK</u>** : PANs are small networks which can be established to set communication between computer and hand handed devices. Its maximum distance capability is 10 meter. For ex- connection of two devices by Bluetooth, connection of computer and mobile via USB. PANs are used to transfer files, e-mails etc in computers, mobiles and tablets etc.

- **<u>LAN – LOCAL AREA NETWORK :</u>** It's a small network of computers to share resources. It is in a limited area like residence, school, laboratory, university campus and office building etc.

- **<u>MAN – METROPOLITIAN NETWORK :</u>** It is a computer network which spreads over a city like area. MAN is basically collection of small LANs.

- **<u>WAN – WIDE AREA NETWORK :</u>** It is wide telecommunication network which spreads over a very huge geographical area . It can be through out a country or world.
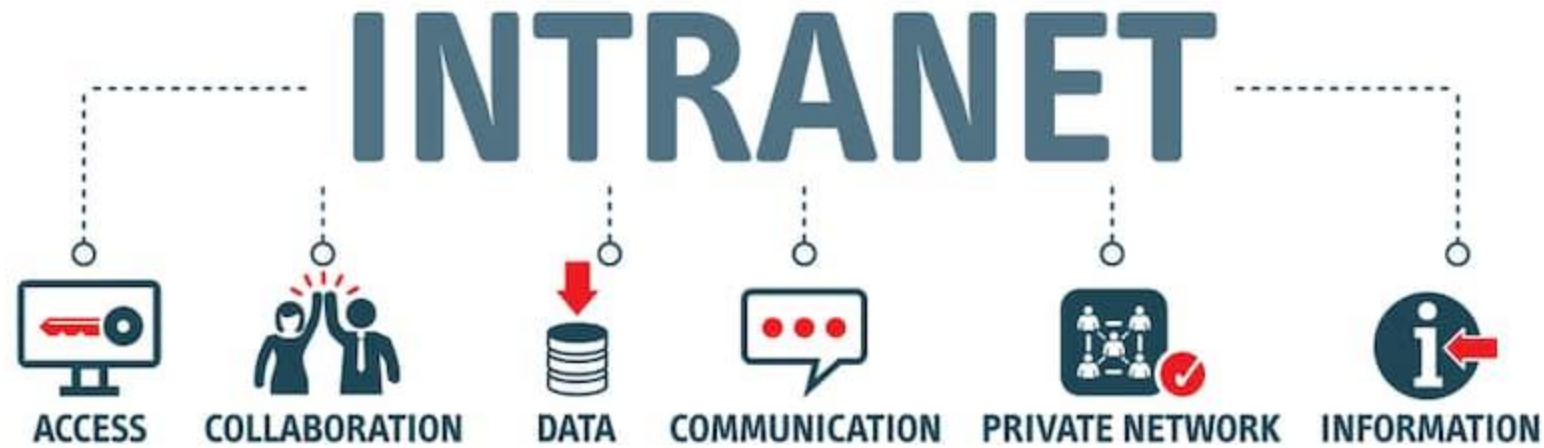
Types of Computer Networks

Wide Area Network(WAN)

Metropolitan Area Network(MAN)

Personal Area Network(PAN)

Local Area Network(LAN)
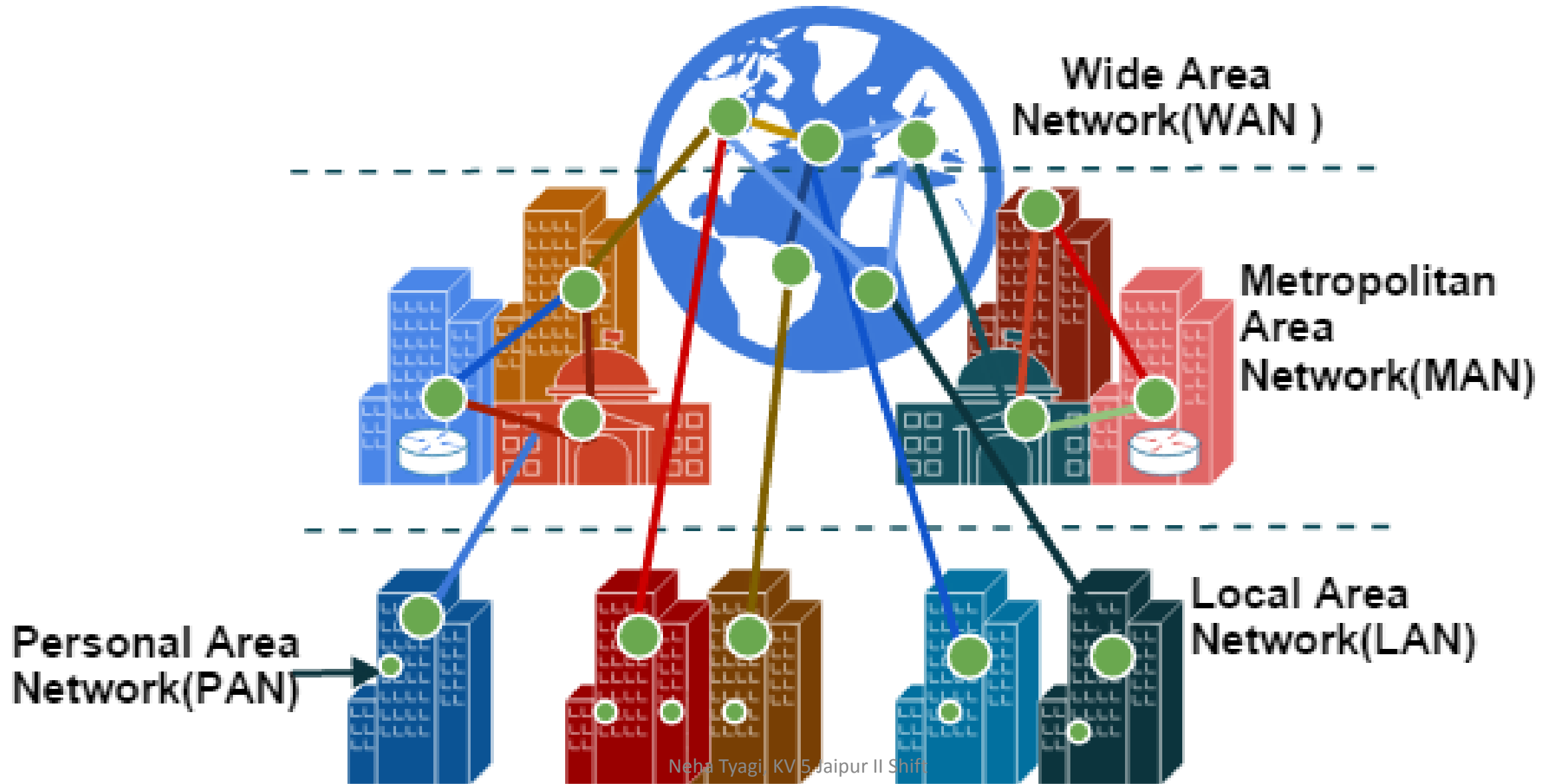
INTERNET

- Internet is the latest technique of information broadcasting. It is basically a collection of computer networks through out the world. Thousands of computers are connected to each other in this network. Generally, computers are connected via telephone lines. Other option are also there for connection by which a computer can get connected to internet.

- Internet is not subject to any company or government but it has several servers which are related to various organizations or private companies. We can say that internet is a medium for world wide communication. It is an easy and feasible medium to analysis any product at an international level. It is an effective medium to publish various information like report, article etc.
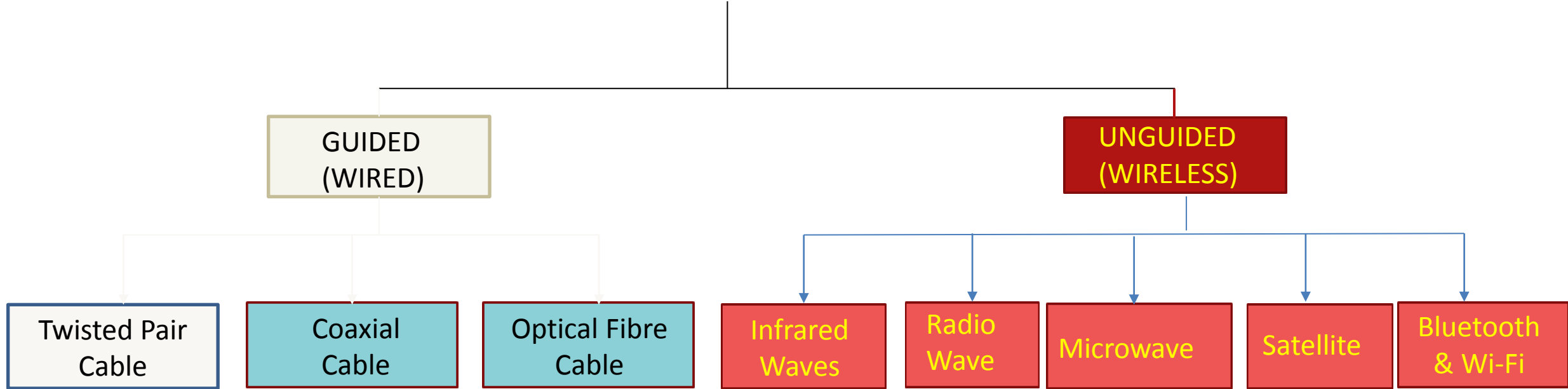
- It is world's biggest WAN.

- Intranet is a private network of computers which works on internet protocols for working. Any organization can use intranet for secure transmission of information amongst its employees. Internet is a network between various organizations whereas intranet is a network of one organization only.

REVIEW

- **Network:** A collection of independent computers that communicate with one another over a shared network medium.
- **Node**: A computer attached to a network.
- **Server:** A computer that facilitates sharing of data, software and hardware resources on the network.
- **Network Interface Unit (NIU):** A device that helps to establish communication between the server and workstations.
- **Circuit switching:** A technique in which a dedicated and complete physical connection is established between two nodes for communication.
- **Packet switching:** A switching technique in which packets are routed between nodes over data links shared with other traffic.
- **Personal Area Network (PAN):** A computer network organized around an individual person.

- **Local Area Network (LAN):** A network in which the devices are connected over a relatively short distance.
- **Metropolitan Area Network (MAN):** A network which spans a physical area (in the range of 5 and 50 km diameter) that is larger than a LAN but smaller than a WAN.
- **Wide Area Network (WAN):** A network which spans a large geographical area, often a country or a continent.
- It is a network of networks spread across the globe
- **Internet:** all of which are connected to each other.
- **Interspace:** A client/server software program that allows multiple users to communicate online with real time audio, video and text chat in dynamic 3D environments.
- **Channel:** A medium that is used in the transmission of a message from one point to another. Bandwidth: The range of frequencies available for transmission of data.

COMMUNICATION/TRANSMISSION MEDIA

```
COMMUNICATION/TRANSMISSION MEDIA
    ├── GUIDED (WIRED)
    │       ├── Twisted Pair Cable
    │       ├── Coaxial Cable
    │       └── Optical Fibre Cable
    └── UNGUIDED (WIRELESS)
            ├── Infrared Waves
            ├── Radio Wave
            ├── Microwave
            ├── Satellite
            └── Bluetooth & Wi-Fi
```

TWISTED PAIR(Ethernet) CABLE

- 2 or 4 insulated wires are in twisted form in this cable. Twisting resists the effect of surrounding noise and electromagnetic interference. RJ-45 (registered jack)connector is used to connect computers.

- Cat-5 and Cat-6 specifications are generally used in LAN whereas other lower categories are used in telephone connections.

- It is further divided in to categories-unshielded and shielded twisted pair cable. Shielded twisted pair cable remains covered with insulation to reduce signal interference .

Advantages :

- Cheap, light weight and flexible cable.
- It is easy to install and maintain.

Shielded Twisted Pair

Disadvantages :

- It is effective up to 100 meters only after this, repeaters are required.
- It supports low bandwidth with the speed up to 100Mbps.

Unshielded Twisted Pair

COAXIAL CABLE(coax)

- In a coax, there are two solid insulated conductors which shares one common axis. Inner conductor is a straight wire surrounded by a wired mesh. Internal core carries signals and mesh works as a noise reflector. It is generally used in cable TV transmission.

- ADVANTAGES :
  - It provides high bandwidth. It carries data up to the distance of 185-500 meters.
  - It is suitable for broadband transmission(cable TV) and can also be useful in shared cable network.
  - It is less sensitive towards electromagnetic fields.

- DISADVANTAGES :
  - As compared to twisted pair cable, it is less flexible and is expensive.
  - Installation is not easy due to thickness of 1 cm diametere and poor flexibility.

COPPER WIRE
INSULATION
COPPER MESH
OUTSIDE INSULATION
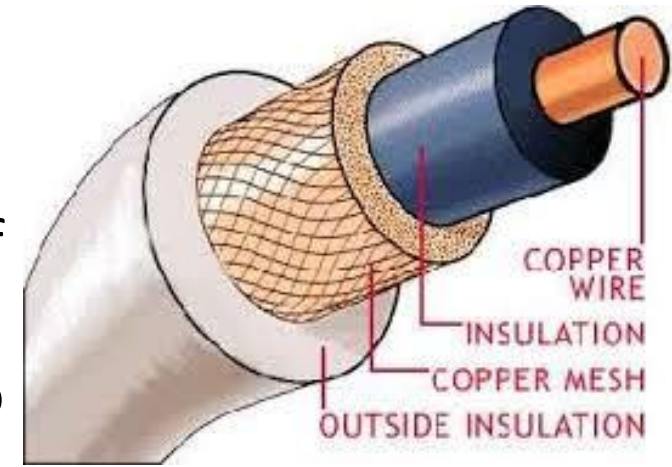
OPTICAL FIBRE CABLE

- Its design is based on the concept of total internal reflection.

- It has glass tubes to carry signals in the form of light rays (photons). Signals are to be emitted by Light Emitting Diode (LED) or laser beam from source.

- It has following parts-

- **CORE(Glass/Plas**tic) : it is a thin glass rode, light rays travels from one end to other.

- **CLADDING** : it is an optical material covering core that transforms the light and sends it back to the core.

  - **BUFFER COATING** : it is a plastic coating which prevents the cable from damage and moisture.

- ADVANTAGES :

  - It is free from Electromagnetic Interference(EMI).

  - It is secure and suitable for high speed transmission.

- DISADVANTAGES :

  - It is fragile and very expensive.

  - Its installation is very tough and expensive.

Neha Tyagi, KV 5 Jaipur II Shift
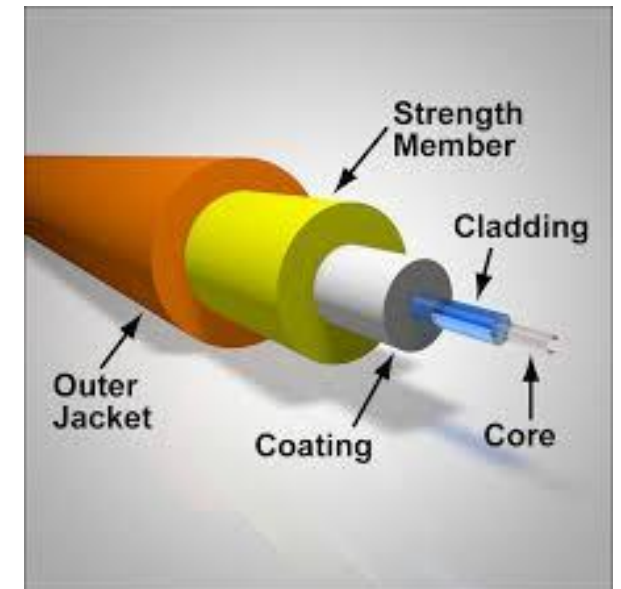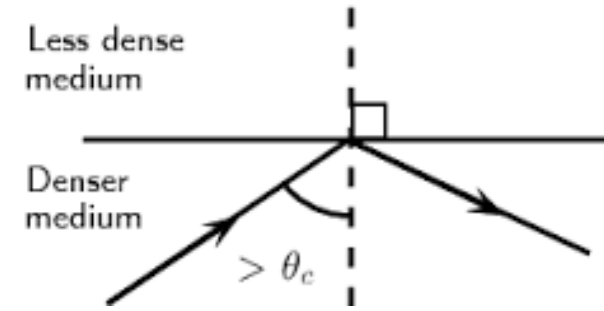
FACTORS	TWISTED PAIR CABLE	COAXIAL CABLE	OPTICAL FIBRE CABLE
DATA TRANSFER RATE	10 Mbps – 10 Gbps	100 Mbps	>100 Gbps
DISTANCE(range)	100 m	185-500 m	>10 KM
EMI susceptibility	More	Less	Nil
COST	Least cost	More than Twisted Pair	Very expensive

WIRELESS MEDIA

- **RADIO WAVES**

- Radio waves uses radio frequencies in the limit 3 GHz to 3 Ghz. Signals are modified on high speed radio wave carrier frequency using amplitude modulation (AM) and frequency modulation (FM). These waves uses ionosphere as shown in the diagram for signal transmission. It can be transmitted on long distance and supports mobility.

- Radio waves are used for communication from small walkie-talkie distances to sufficient distances within a city (AM/FM radio broadcasting).

Ground wave

Earth's surface

(a)

Ionosphere

Earth's surface

(b)
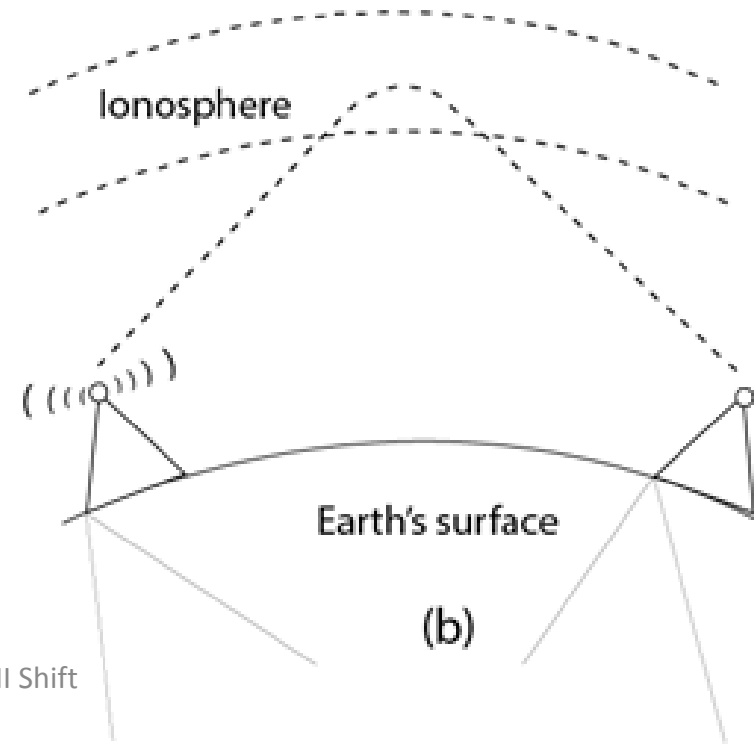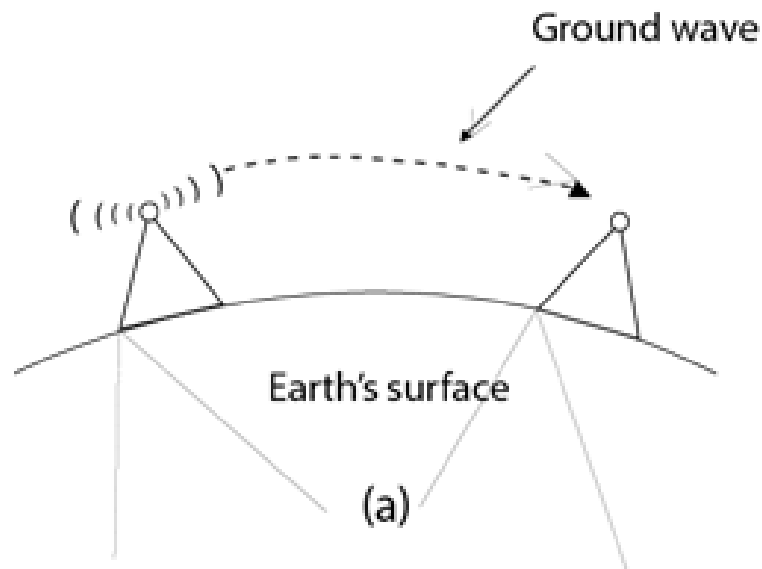
- ADVANTAGES :
  - Radio communication covers a big area and supports mobility.
  - Radio waves can disperse in all directions and can cross the solid walls as well.
  - These waves facilitates the communication in inaccessible areas.
  - It is not needed to physically aligned transmitter and receiver antenna.
  - DISADVANTAGES :
  - It is expensive and unsecured communication medium.
  - It is very sensitive towards weather..
  - Permission from concerned departments is required for radio waves transmission.

MICROWAVES

- In microwave transmission, two direct parabolic antennas are needed to install on towers/ buildings/mountains for sending and receiving signals. They are needed to aligned to each other.

- ADVANTAGES :

  – This facilitates transmission in tough areas.

  – It supports data transmission at the speed of 16 Giga bits per second.

DISADVANTAGES :

  – It is an unsecured communication.

  – Signals are distributed and transmitted in all directions.

  – It gets affected by weather conditions.

  – Cost of placing tower and antenna is high.

INFRARED WAVES

- Infrared waves allows transmission in devices up to small distances of 300 GHz to 400 THz (about 5 meters) using wireless signals. Infrared transmission technique used in computer is similar to the technique used in remote operated electronic equipment like TV, cordless phone toys etc.

- **Advantages:**

  – It is a kind of line of sight transmission.

  – It does not require government Licence.

  – It is basically for less distance transmission.

  - **Disadvantage:**

  – It is a kind of line of sight transmission, therefore, at a time, only two devices can communicate with each other.

  – It can not travels through solid materials.

  – It gets affected by long distances.

SATELLITE LINK

- Satellite communication uses microwave (1.5GHz-20GHz) as a medium. Satellites like Geostationary or Polar satellites are used to set transmission on various center on earth.

- Services like DTH, VSAT, GPS Satellite phones, etc. have became possible by satellite transmission. A satellite works as a Trans-Receiver Antenna in space which receive, regenerate and redirect signals.

- ADVANTAGE:
    - It covers a large geographical area.
    - It provides secure, uninterrupted and high quality transmission.
    - Geographical conditions like mountains, tall building, towers does not raise interruption.
    - Signals sent or received by earth stations may be fixed or mobile.

- DISADVANTAGE:
    - These are slow than microwave transmission.
    - legal permissions are needed for these.
    - Installation is very complex.
    - Signals can be interrupted by external interference.

Client-Server Architecture

- In this model data is stored in powerful computers, these computers are known as servers.

- These are generally maintained by system administrator. Other employees works on other machines, known as clients.

- This system is termed as client-server model.

Client-Server Model

Clients

Internet

Server

shutterstock.com • 483125932

client

response

query

server

search
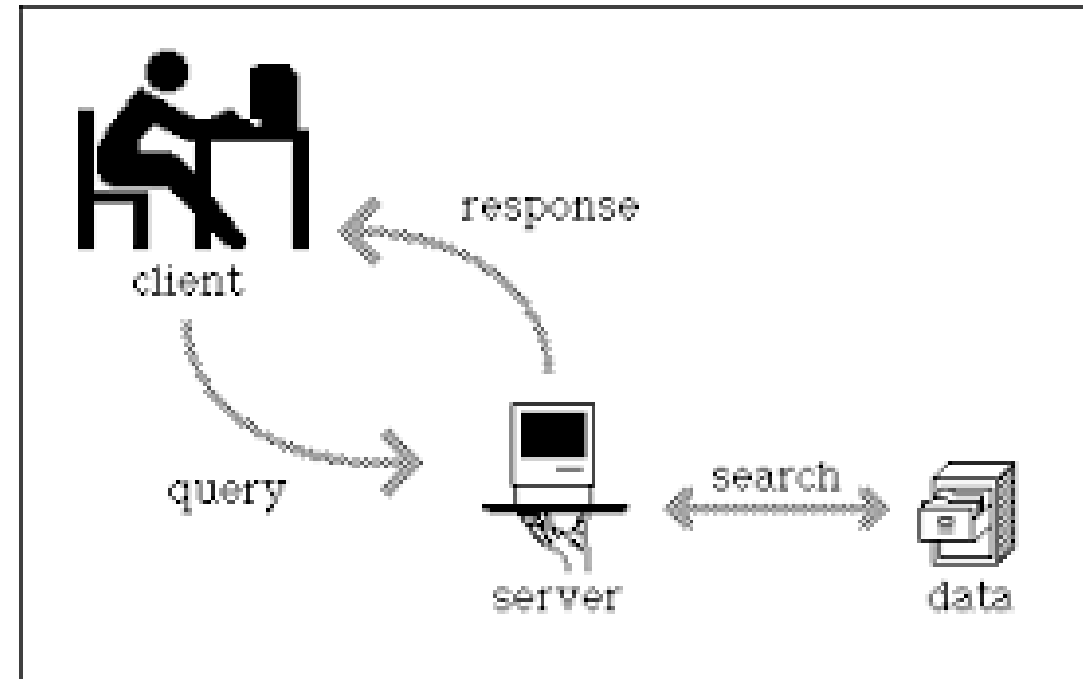
data

Cloud Computing

- Cloud computing is a kind of distributed data processing technique.

- Cloud computing is a style of computing in which dynamically scalable and often virtual resources are made available as a service over the Internet.

- **Advantages-**

➢ **Less investment**- any work can be initiated on less or zero balance. Maintenance is also less expensive.

➢ **High Speed** - cloud computing can provide required resources in less time.

➢ **Reliability**- it is provided by reliable companies/organizations, hence it is very reliable.

➢ **Scalability**- its capacity can be purchased as per your fluctuating requirements.

➢ **Environment support - cloud saves energy as well as minimize carbon excretion.**

- **Disadvantages-**

➢ Online Privacy and security is not safe.

➢ You can not access your data without internet.

➢ It is of two types-

Public Cloud – (Google Drive, Amazon Cloud Drive etc.)

Private Cloud – (Owned by one organization)
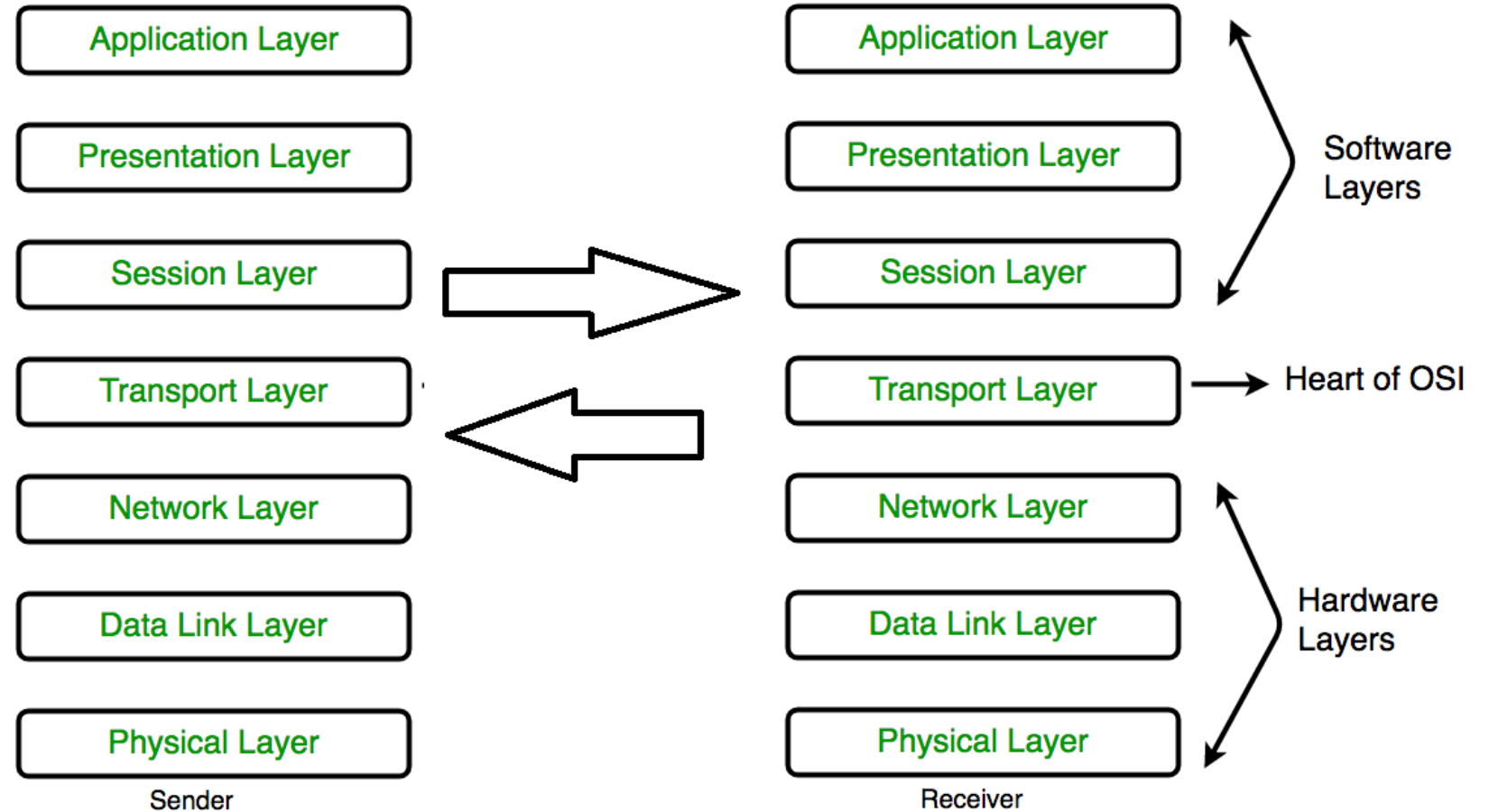
Internet of Things (IoT)

- It is a network of physical objects.

- IoT, enables the interconnection via the internet of computing devices embedded in everyday objects, enabling them to send and receive data.

- In easy language, all the things that are connected to internet are called Internet of Things .

- Its components are–
  – Sensors
  – Connectivity
  – People and Processes
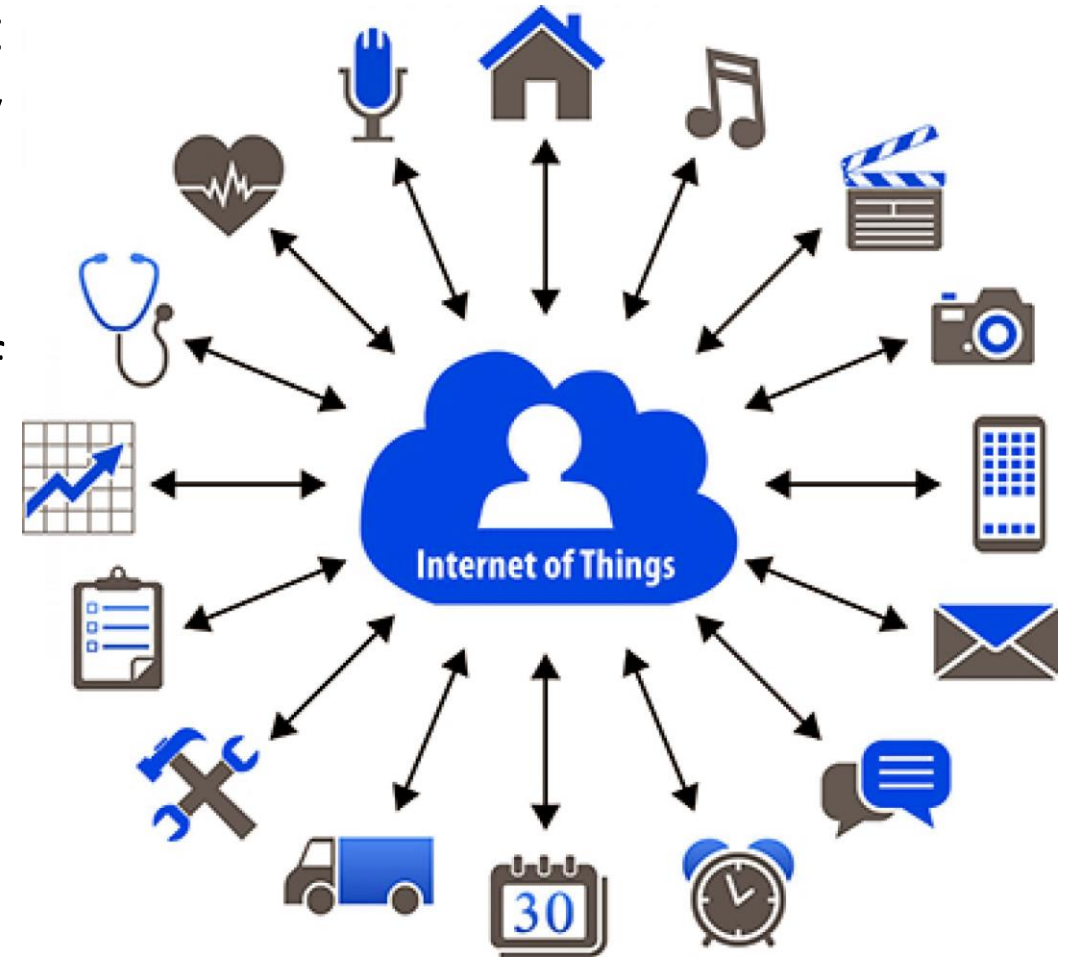
NETWORK DEVICES

- Network devices are also known as communication devices which are used to set network. These are as follows -

- NIC (Network Interface Card)
- Hub
- Switch
- Repeater
- Gateway
- Router
- WAP (Wireless Access Point)

Sender		Receiver	
Application Layer	→	Application Layer	Software Layers
Presentation Layer		Presentation Layer	
Session Layer		Session Layer	
Transport Layer	←	Transport Layer	Heart of OSI
Network Layer		Network Layer	Hardware Layers
Data Link Layer		Data Link Layer	
Physical Layer		Physical Layer	

HUB

- Hub is a broadcast device which connects several computers together.

- It can not handle network traffic.

- Message is delivered from one computer to rest of all computers i.e. broadcasting.

- In a Hub, ports are there which are used to connect NIC of computers.

SWITCH

- Switch is a type of Hub. It contains a filter which filters the data before sending and it is then directed to the intended node only.

- It is an intelligent Hub.

-

Repeater

- It is a device which accepts the weak signals and amplifies the signals for further broadcasting.
- With the use of it, signal length increases.
- It is also known as amplifier.
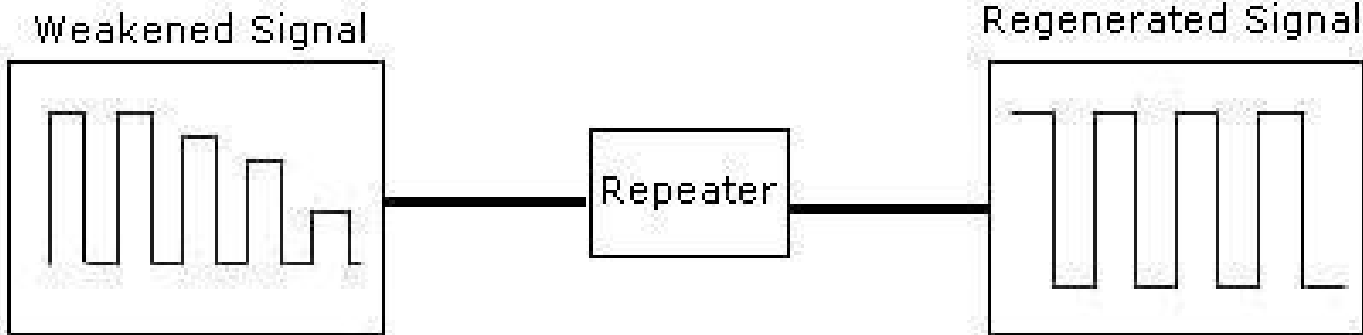
Gateway

- On internet, when two or more networks uses different hardware and software then gateway is used to set coordination between them.

- It converts one network language into another network language so that they can communicate.
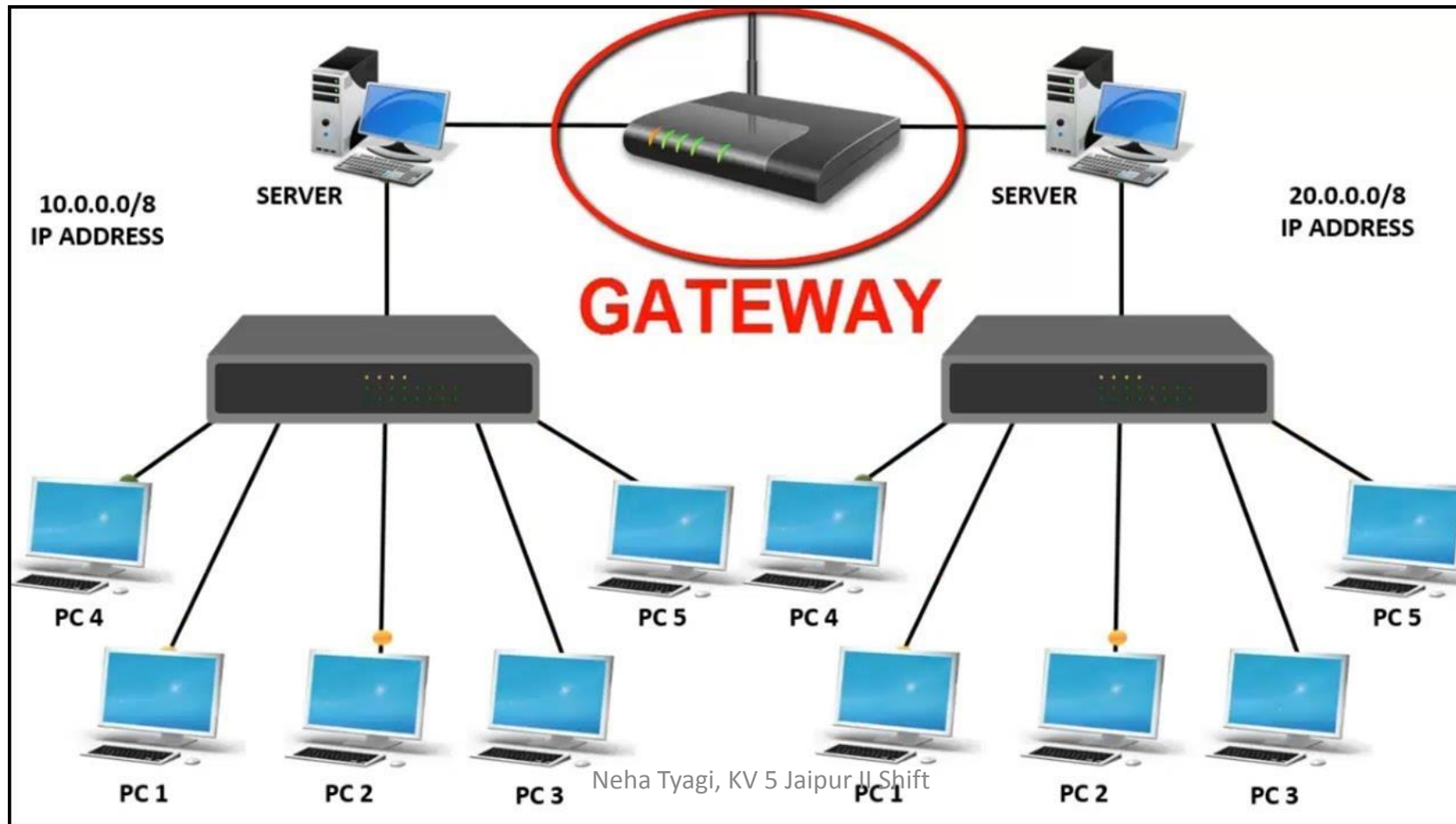
Router

- Router is also a networking device which sent data packets from source machine to destination machine.

- It takes the shortest path for this.

- Router, works on third layer (NETWORK LAYER) of OSI reference model.
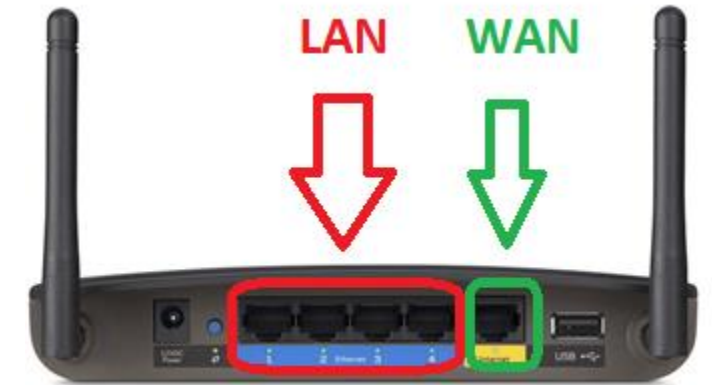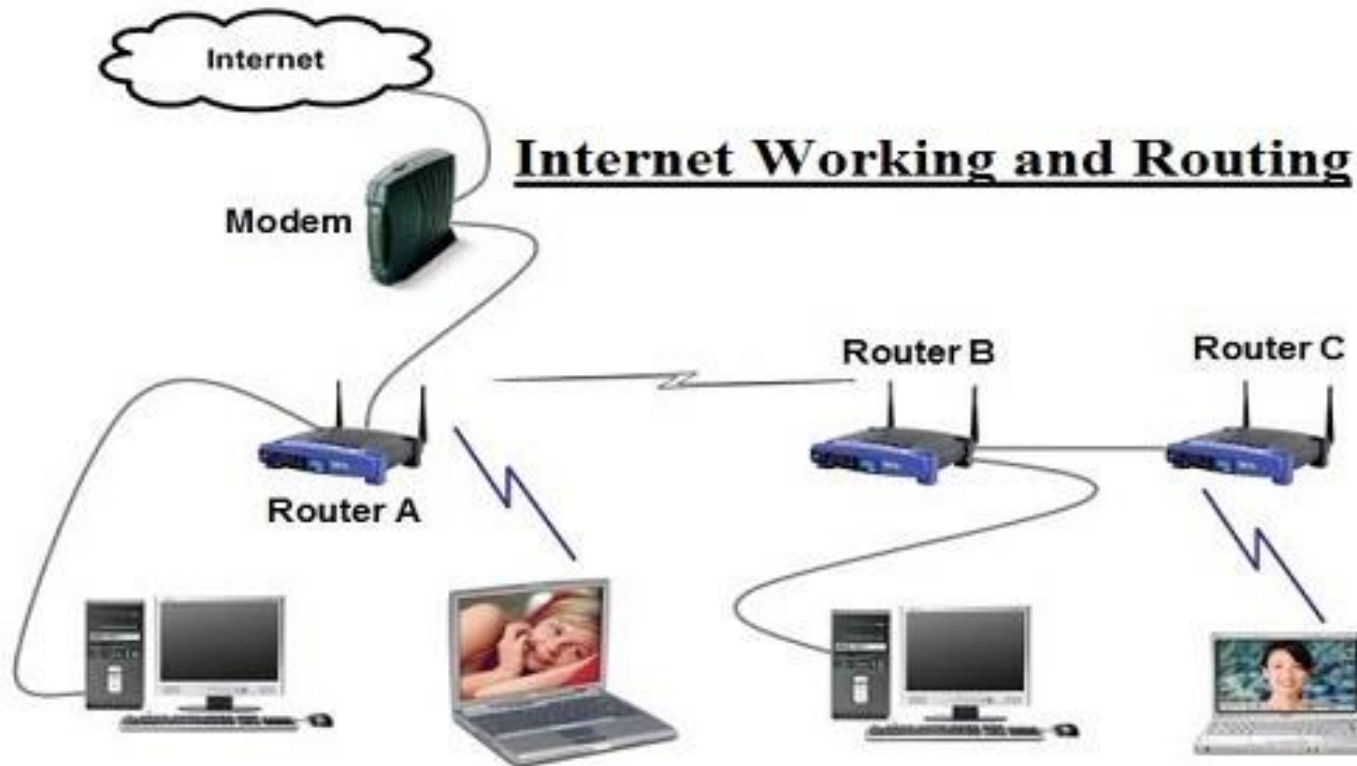
Wireless Access Point (WAP)

- It is also a type of device which provides wireless connection facility to a wired network as per Wi-Fi rules.

- Its transmission medium is air.

- A WAP, can be standalone.

- A WAP, can be connected to a router.

- It can be a part of router (wireless router).

USB 2.0 USB Card Reader

USB 2.0 USB Storage

WAP-0008

Router

ADSL/Cable Modem

Internet

MP3 Player

Game Console

Computer

Neha Tyagi, KV 5 Jaipur II Shift

Setting up a computer network

- The 80-20 Thumb Rule:
  - According to this rule, in a properly designed and organized network, 80% of the traffic of whole network should be dedicated to local network.
  - 20% of whole traffic should not exceed backbone. If it happens, there may be a condition of network congestion arises.
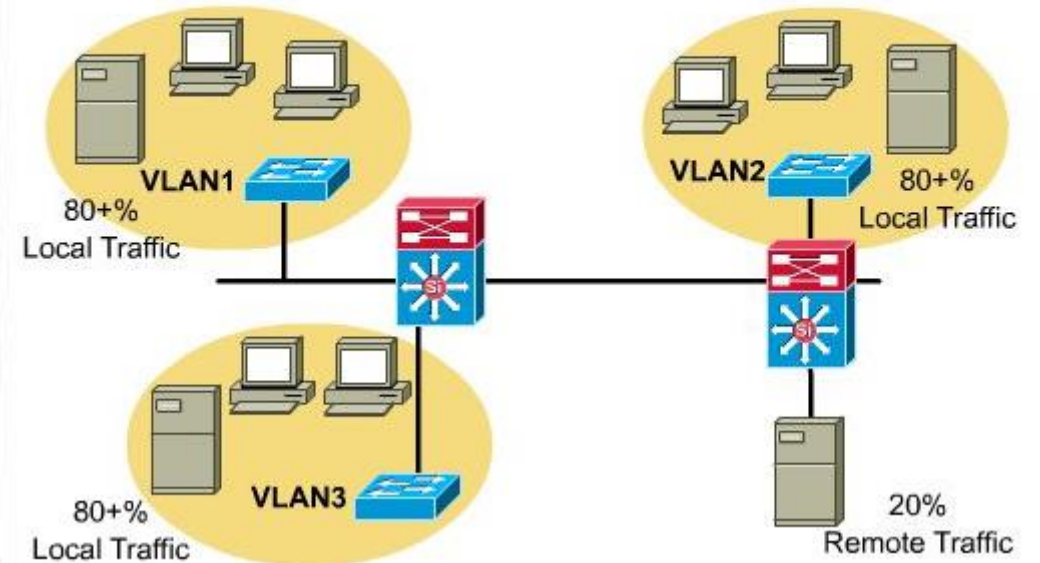 - We need to follow above rules while designing a network.
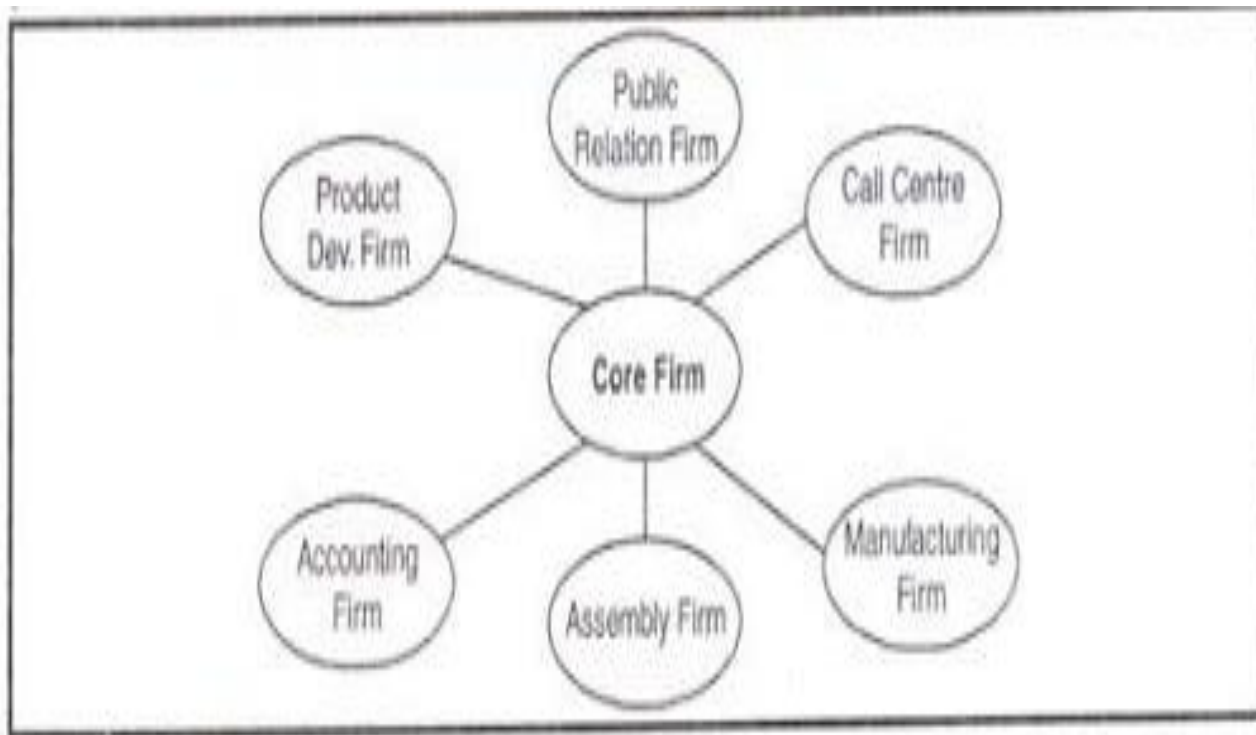
Fig. 10.4

Easy way to solve questions

1. **Where to set Server ? :** At the place with maximum number of computers.

2. **At what place following devices are to be used? :**

    1. **Server :** The building with maximum number of computers.

    2. **HUB/SWITCH:** In each building.

    3. **Modem:** The building with server.

    4. **Repeater:** buildings having distance more than 70 meters so that channel can be amplifies.

    5. **Router:** when a LAN is to get connected with other LAN.

    6. **Best Cable: T**wisted Pair, Ethernet Cable (when the distance is in meters and needs to be feasible.)**, coaxial cable (**when high speed is required)

    7. **Best Cable:** Fiber Optical Cable (when distance is in kilometers and high speed is required.

    8. **Best Connecting Technique:** In Hilly areas satellite signals , for city to city radio waves and state to state satelite signal.

An example

CASE STUDY BASED QUESTION :

Ayurveda Training Educational Institute is setting up its centre in Hyderabad with four specialised departments for Orthopedics, Neurology and Pediatrics along with an administrative office in separate buildings. The physical distances between these department buildings and the number of computers to be installed in these departments and administrative office are given as follows. You, as a network expert, have to answer the queries as raised by them in (i) to (iv).

Shortest distances between various locations in metres :

Administrative Office to Orthopedics Unit	55
Neurology Unit to Administrative Office	30
Orthopedics Unit to Neurology Unit	70
Pediatrics Unit to Neurology Unit	50
Pediatrics Unit to Administrative Office	40
Pediatrics Unit to Orthopedics Unit	110

Number of Computers installed at various locations are as follows :

Pediatrics Unit	40
Administrative Office	140
Neurology	50
Orthopedics Unit	80
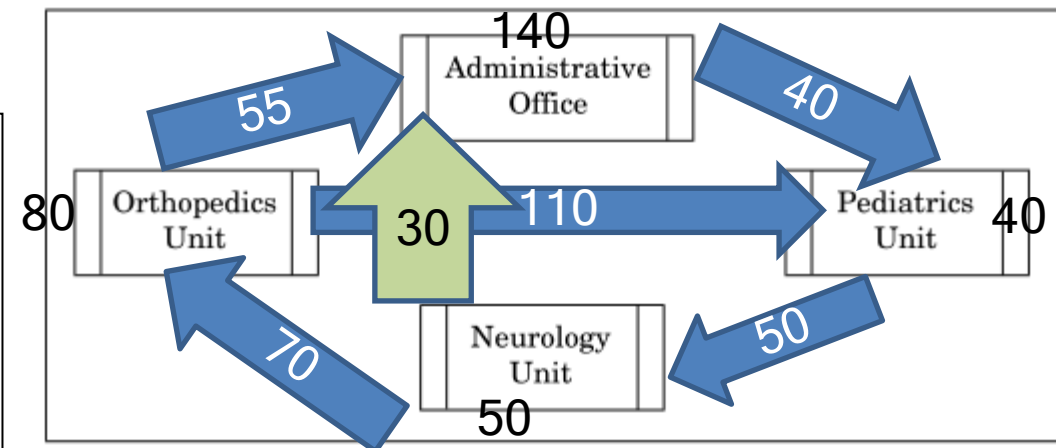
(i) Suggest the most suitable location to install the main server of this institution to get efficient connectivity. **1**

(ii) Suggest the best cable layout for effective network connectivity of the building having server with all the other buildings. **1**

(iii) Suggest the devices to be installed in each of these buildings for connecting computers installed within the building out of the following : **1**
- Gateway
- Modem
- Switch

(iv) Suggest the topology of the network and network cable for efficiently connecting each computer installed in each of the buildings out of the following : **1**

Topologies : Bus Topology, Star Topology

Network Cable : Single Pair Telephone Cable, Coaxial Cable, Ethernet Cable

Part - 2

1. Part -2 we will cover following in part-2

   1. Topology
   2. Protocols
   3. Network stack
   4. Modulation
   5. Collision
   6. Error Checking And correcting codes
   7. MAC
   8. Routing
   9. Domain name Systems
   10. URL Structure
   11. Basic Networking tools
   12. Application Layer

   12. HTTP
   13. TCP/IP
   14. E-mail
   15. Secure Communication
   16. Network applications
   17. FTP
   18. Telnet
   19. CDMA/CSMA
   20. SMTP
   21. VoIP
   22. POP/IMAP
   23. SCP
   24. SSHNFC

Thank you

Follow us at

www.pythontrends.wordpress.com