Computer Network Architecture & Components

CST 05202: BASICS OF DATA COMMUNICATION NETWORKS

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Computer Network Architecture

Computer Network Architecture is defined as the physical and logical design of the software, hardware, protocols, and media of the transmission of data.

- Simply we can say that how computers are organized and how tasks are allocated to the computer.

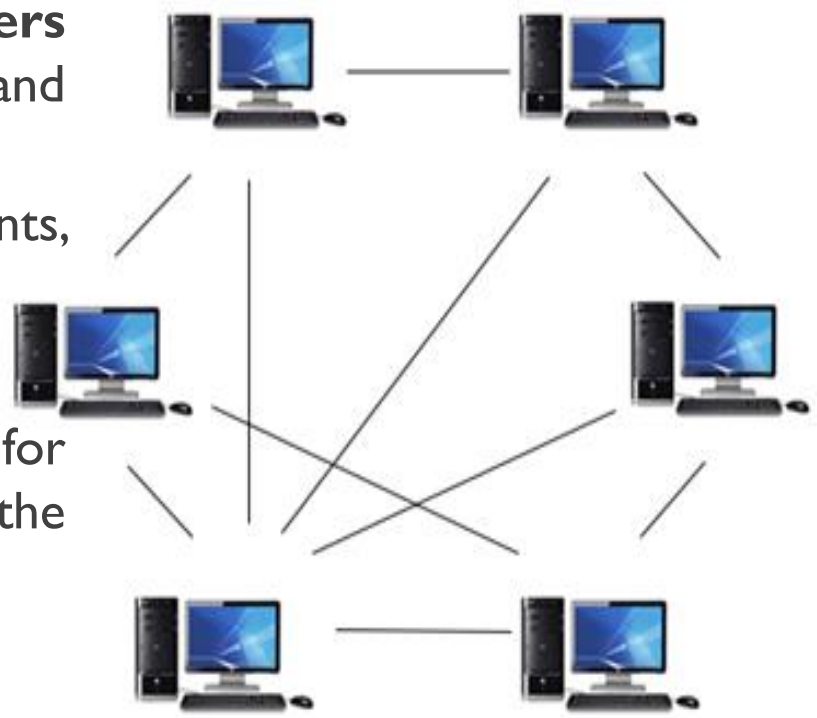
Types of computer architecture:

1. Peer-To-Peer network
2. Client/Server network

Peer-To-Peer network

Peer-To-Peer network is a network in which all the **computers** are **linked together** with **equal privilege** and **responsibilities** for processing the data.

- Peer-To-Peer network is useful for small environments, usually up to 10 computers.
- Peer-To-Peer network has **no dedicated server**.
- Special permissions are assigned to each computer for sharing the resources, but this can lead to a problem if the computer with the resource is down.



Peer-To-Peer network

Advantages Of Peer-To-Peer Network:

- It is less costly as it does not contain any dedicated server.
- If one computer stops working but, other computers will not stop working.
- It is easy to set up and maintain as each computer manages itself.

Disadvantages Of Peer-To-Peer Network:

- In the case of Peer-To-Peer network, it does not contain the centralized system . Therefore, it cannot back up the data as the data is different in different locations.
- It has a security issue as the device is managed itself.

Client/Server network

Client/Server network is a network model designed for the end users called clients, to access the resources such as text, video, etc. from a central computer known as Server.

- The central controller is known as a server while all other computers in the network are called clients.
- A server performs all the major operations such as security and network management.
- A server is responsible for managing all the resources such as files, directories, printer, etc.
- All the clients communicate with each other through a server.

For example

If client1 wants to send some data to client 2, then it first sends the request to the server for the permission. The server sends the response to the client 1 to initiate its communication with the client 2.

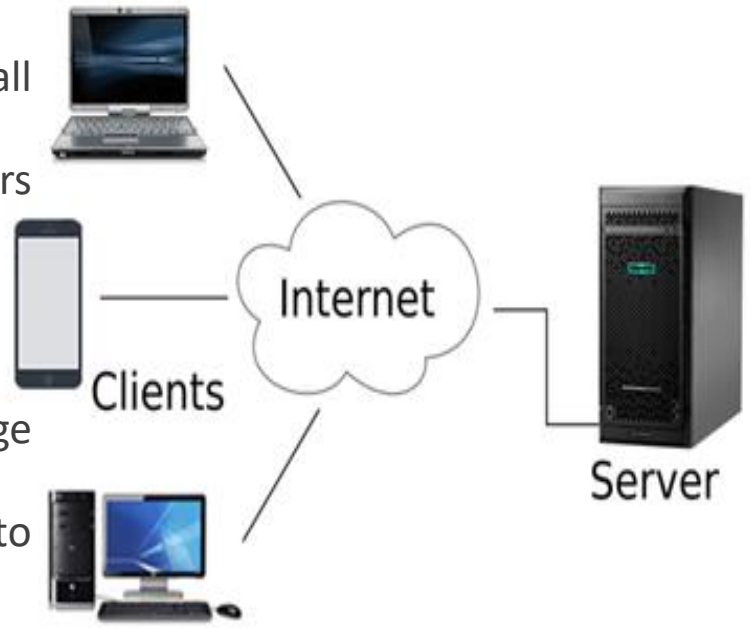
Client/Server network (Malt point)

Advantages Of Client/Server network:

- A Client/Server network contains the centralized system. Therefore we can back up the data easily.
- A Client/Server network has a dedicated server that improves the overall performance of the whole system.
- Security is better in Client/Server network as a single server administers the shared resources.
- It also increases the speed of the sharing resources.

Disadvantages Of Client/Server network:

- Client/Server network is expensive as it requires the server with large memory.
- A server has a Network Operating System(NOS) to provide the resources to the clients, but the cost of NOS is very high.
- It requires a dedicated network administrator to manage all the resources.



Computer Network Components

Network components

Some important network components are **NIC**, **switch**, **cable**, **hub**, **router**, and **modem, repeater and bridge**.

Depending on the type of network that we need to install, some network components can also be removed. For example, the wireless network does not require a cable.

Repeater - They allow a cabling system to extend beyond its maximum allowed length by amplifying the network voltages so they travel farther.

Bridge - They join similar topologies and are used to divide network segments.

NIC

NIC: Stands for Network Interface Card.

- NIC is a hardware component used to connect a computer with another computer onto a network
- It can support a transfer rate of 10,100 to 1000 Mb/s.

Types of NIC

Wired NIC: The Wired NIC is present inside the motherboard. Cables and connectors are used with wired NIC to transfer data.

Wireless NIC: The wireless NIC contains the antenna to obtain the connection over the wireless network. For example, laptop computer contains the wireless NIC.

Hub

A Hub is a hardware device that divides the network connection among multiple devices.

- When computer requests for some information from a network, it first sends the request to the Hub through cable.
- Hub will broadcast this request to the entire network. All the devices will check whether the request belongs to them or not. If not, the request will be dropped.

The process used by the Hub consumes more bandwidth and limits the amount of communication.

Nowadays, the use of hub is obsolete, and it is replaced by more advanced computer network components such as Switches, Routers.

Switch

A **switch** is a hardware device that connects multiple devices on a computer network.

- A Switch contains more advanced features than Hub.
- The Switch contains the updated table that decides where the data is transmitted or not.
- Switch delivers the message to the correct destination based on the physical address present in the incoming message.
- A Switch does not broadcast the message to the entire network like the Hub. It determines the device to whom the message is to be transmitted.

Therefore, we can say that switch provides a direct connection between the source and destination. It increases the speed of the network.

Router

A router is a hardware device which is used to connect a LAN with an internet connection. It is used to receive, analyze and 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 information available in the routing table.
- It determines the best path from the available paths for the transmission of the packet.

Modem

A modem is a hardware device that allows the computer to connect to the internet over the existing telephone line.

A modem is not integrated with the motherboard rather than it is installed on the PCI slot found on the motherboard.

It stands for Modulator/Demodulator. It converts the digital data into an analog signal over the telephone lines.

Based on the differences in speed and transmission rate, a modem can be classified in the following categories:

i. Standard PC modem or Dial-up modem
ii. Cellular Modem
iii. Cable modem

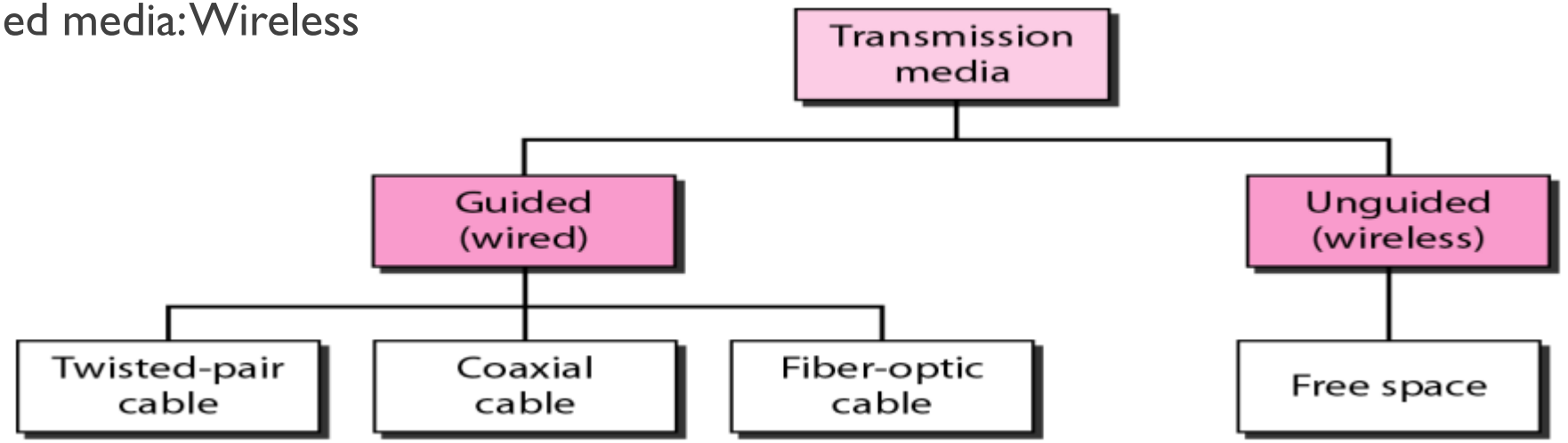
Transmission medium

A transmission medium can be broadly defined as anything that can carry information from a source to a destination.

Cable is a transmission media used for transmitting a signal.

Classes of transmission media:

i. Guided media: Twisted pair cable, Coaxial cable, Fiber-optic cable
ii. Un-guided media: Wireless

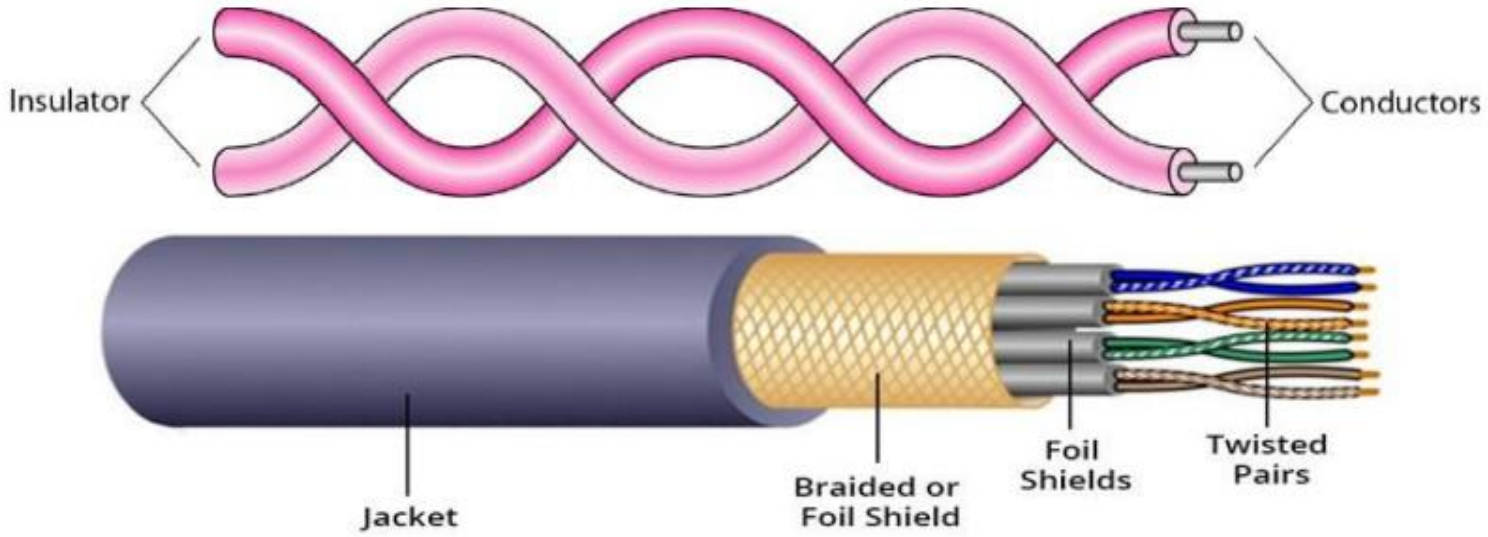


Twisted-Pair Cable

Twisted pair consists of two conductors (normally copper), each with its own plastic insulation, twisted together. One of the wires is used to carry signals to the receiver, and the other is used only as a ground reference.

Types of twisted pairs:

1. Shielded (STP)
2. Unshielded (UTP)



Twisted-Pair Cable

Unshielded Versus Shielded Twisted-Pair Cable:

STP: Uses a woven copper-braid jacket that is more protective and of a higher quality than the jacket used by UTP. STP also uses a foil wrap around each of the wire pairs. This gives STP excellent shielding to protect the transmitted data from outside interference, which in turn allows it to support higher transmission rates over longer distances than UTP.

UTP: using the 10BaseT specification, is the most popular type of twisted-pair cable and is fast becoming the most popular LAN cabling. The maximum cable length segment is 100 meters, about 328 feet.

The most **common UTP connector is RJ45 (RJ stands for registered jack)**

Lab work: attaching rj45 into twisted pair

UTP/STP Categories

Category 1 This refers to traditional UTP telephone cable that can carry voice but not data transmissions. Most telephone cable prior to 1983 was Category 1 cable.

Category 2 This category certifies UTP cable for data transmissions up to 4 megabits per second (Mbps). It consists of four twisted pairs of copper wire.

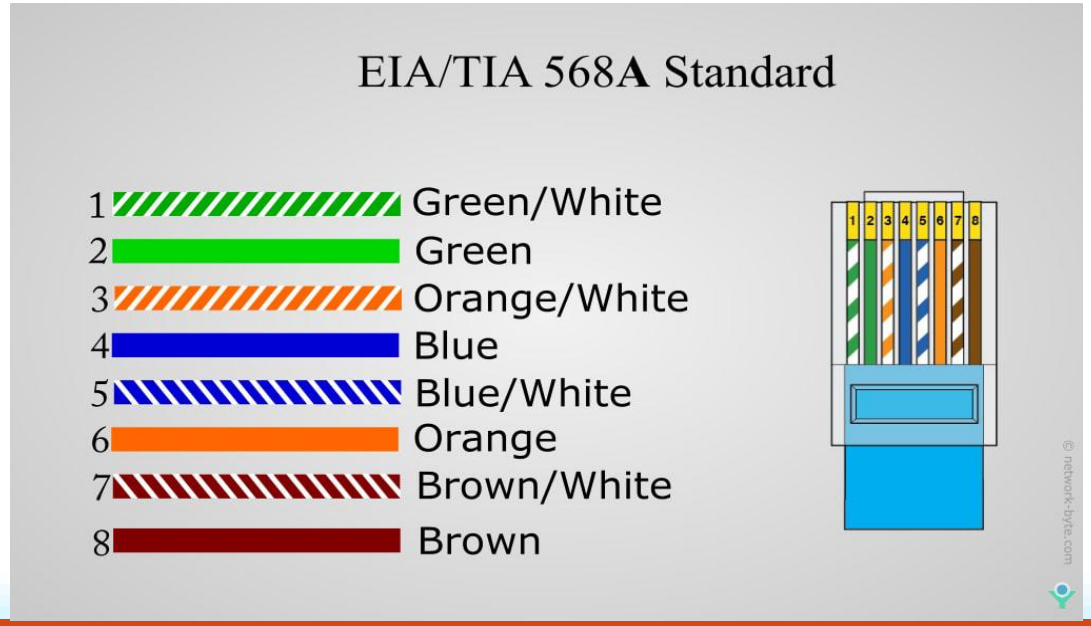
Category 3 This category certifies UTP cable for data transmissions up to 16 Mbps. It consists of four twisted pairs of copper wire with three twists per foot.

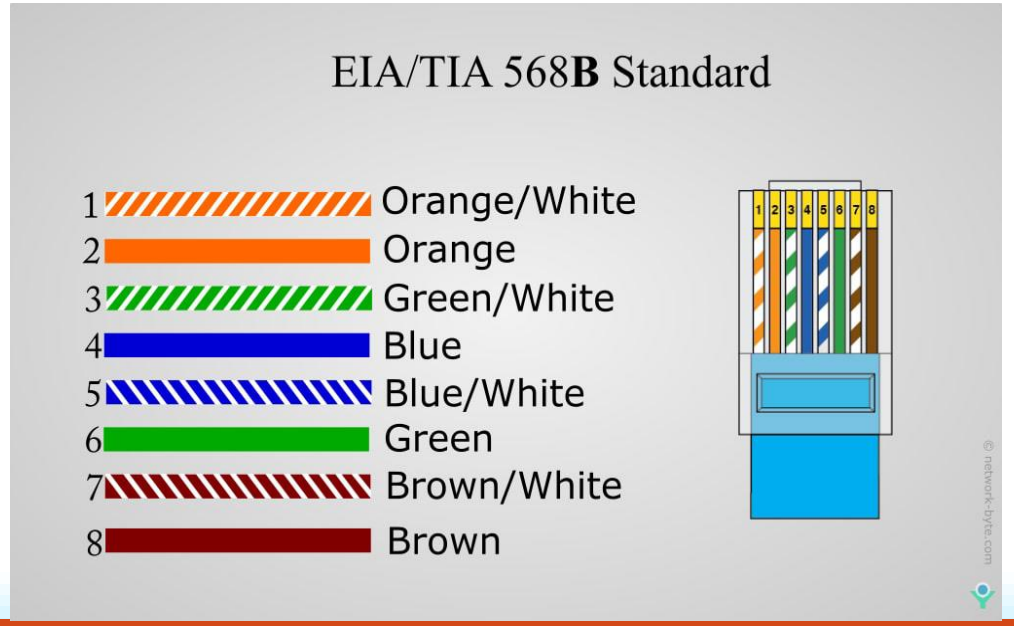
Category 4 This category certifies UTP cable for data transmissions up to 20 Mbps. It consists of four twisted pairs of copper wire.

Ethernet Cable Color Coding

In UTP cable consist of 4pair or 8 wire of different color that is used to terminate on RJ45 or 8P8C connector.

Ethernet cable color coding as standardized by EIA(Electronic Industries association) and TIA(Telecommunication Industry Association) there are two standard EIA/TIA-568-A and EIA/TIA-568-B.



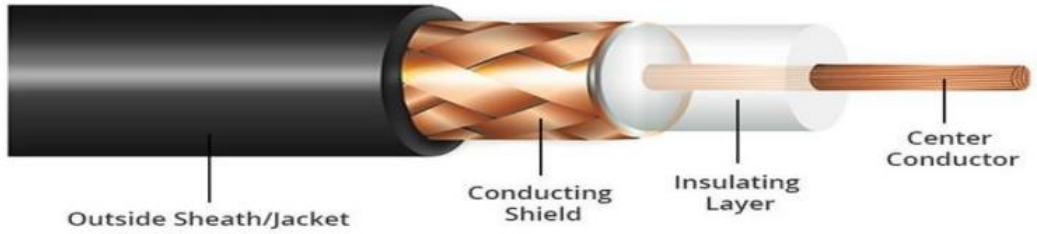


Cables

Coaxial cable was widely used in analog telephone networks, digital telephone networks

- Cable TV networks also use coaxial cables.
- Another common application of coaxial cable is in traditional Ethernet LANs

The most common type of connector used today is **the Bayone-Neill-Concelman (BNe),** connector



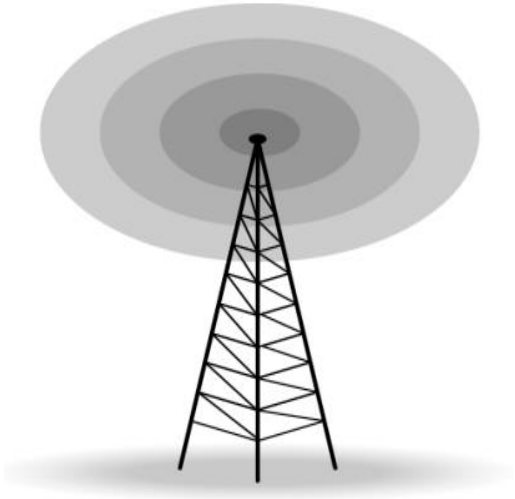
A **fiber-optic cable** is made of glass or plastic and transmits signals in the form of light. Light travels in a straight line as long as it is moving through a single uniform substance.

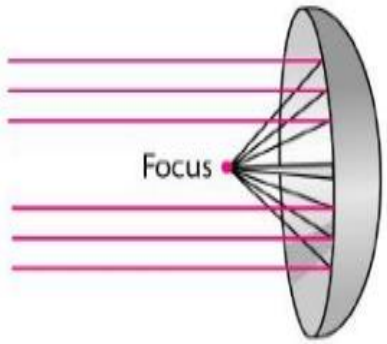


Un-guided media: Wireless

Unguided media transport **electromagnetic waves without using a physical conductor**.

- This type of communication is often referred to as wireless communication. E.g.
  - Radio Waves
  - Microwaves
  - Infrared



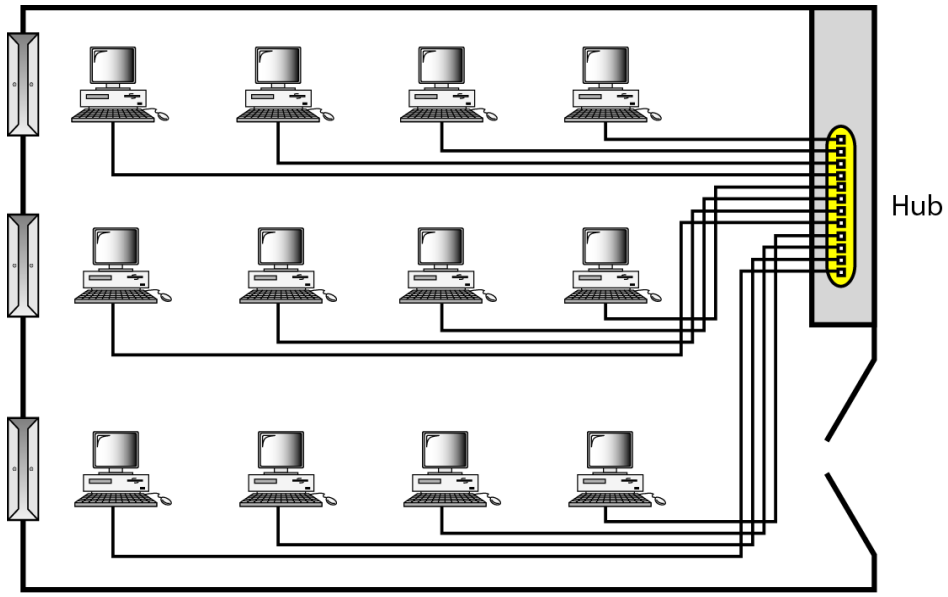


Categories of Network

Categories of Networks

Category of networks based on geographical area coverage:

1. Local Area Network (LAN)
2. Metropolitan Area Network (MAN)
3. Wide Area Network (WAN)



An isolated LAN connecting 12 computers to a hub in a closet

Categories of Networks

LAN (Local Area Network):

- Group of interconnected computers within a small area. (room, building, campus)
- Two or more pc's can from a LAN to share files, folders, printers, applications and other devices.
- Coaxial or CAT 5 UTP cables are normally used for connections.
- Due to short distances, errors and noise are minimum. Data transfer rate is 10 to 100 mbps.

MAN (Metropolitan Area Network) :

- Design to extend over a large area.
- Connecting number of LAN's to form larger network, so that resources can be shared.
- Networks can be up to 5 to 50 km.
- Owned by organization or individual.
- Data transfer rate is low compare to LAN.
- Example: Organization with different branches located in the city

Categories of Networks

WAN (Wide Area Network):

- Are country and worldwide network.
- Contains multiple LAN's and MAN's.
- Uses satellites and microwave relays.
- Data transfer rate depends upon the ISP provider and varies over the location.
- Best example is the internet.

Other types

WLAN (Wireless LAN) A LAN that uses high frequency radio waves for communication. Provides short range connectivity with high speed data transmission.

PAN (Personal Area Network) Network organized by the individual user for its personal use.

SAN (Storage Area Network) Connects servers to data storage devices via fiber-optic cables. E.g.: Used for daily backup of organization or a mirror copy

Thank you!

For listen