



UNIT 2

TELECOMMUNICATION BASICS AND CABLING

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Outcomes

- Define telecommunication and data communication basics
 - Describe Classification of telecommunication networks
 - Illustrate Data transmissions mode and network topologies
 - Apply and analyse data transmission mediums
- 



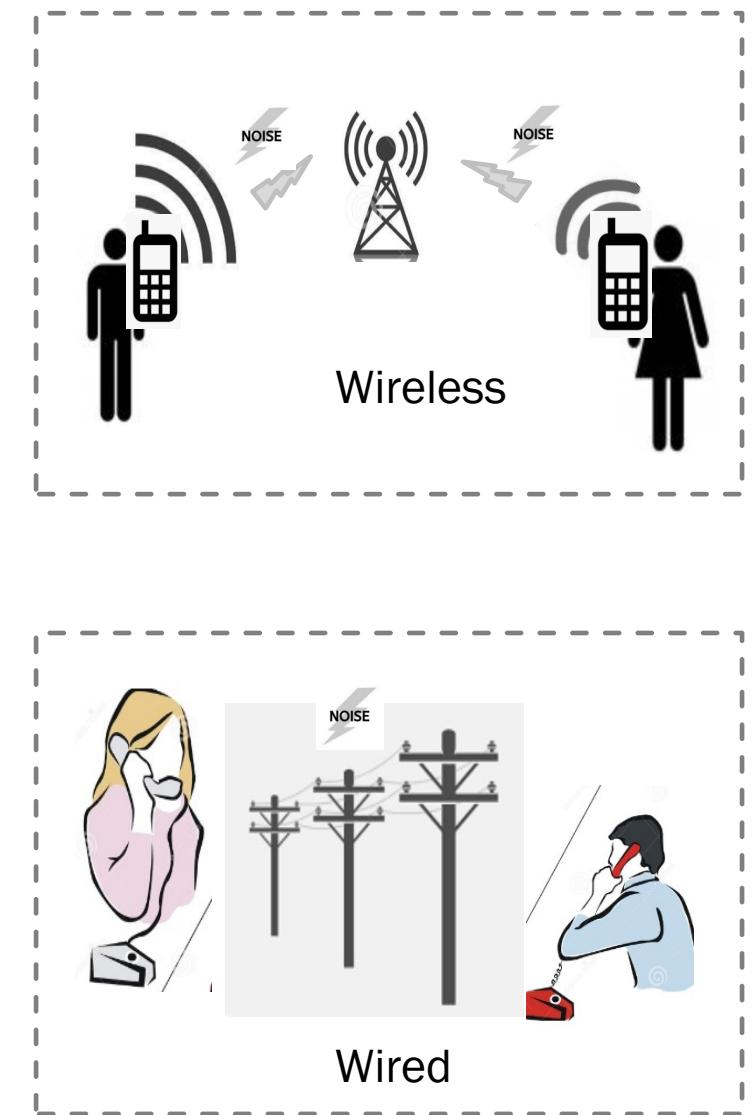
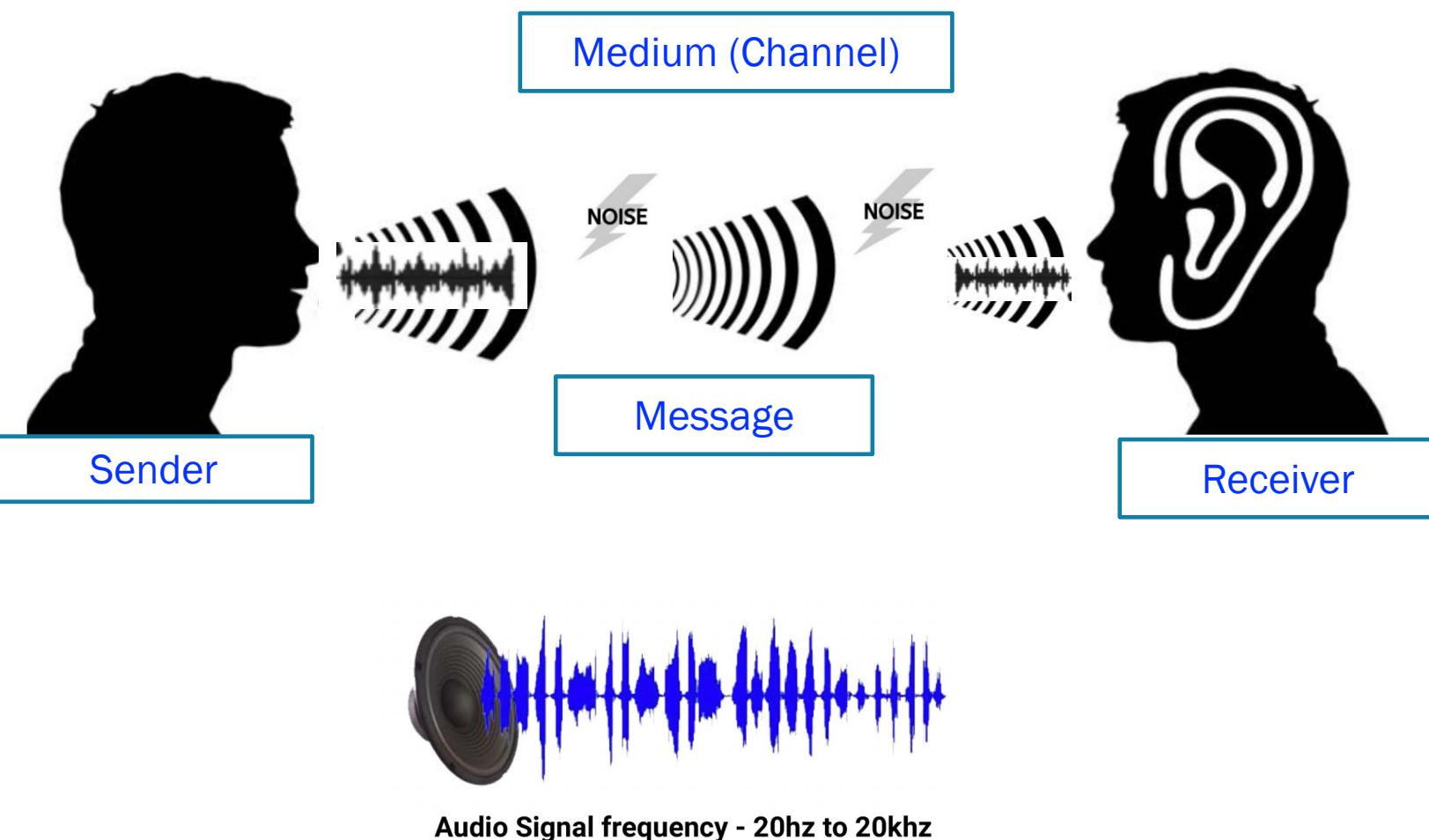
Content

- Basic Elements of telecommunication
 - Data transmission modes
 - data communication techniques
 - Types of data transmission media
 - Computer networks and topologies
 - Twisted pair cabling and applications
 - Coaxial cabling and applications
 - Fiber optical communication
- 

Telecommunication?

- What is **communication**?
 - Communication is imparting, conveying or exchanging of thoughts, messages, ideas, knowledge or information by sign and sounds like speech, signals, writing or behaviour
- What is **tele**communication?
 - Communication over long distance (tele → Far off)
 - Telecommunication refers to the data communication (transfer of data) from a transmitter to a receiver across distance

Ways of communication ?



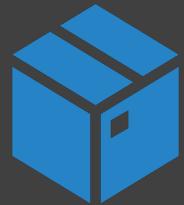
Data Communication

Data communication, the flow of electronic signal among two nodes (computer or devices)

To manage communication, data must be part of the system

Data communication software used to transfer the data

Data Communication is governed by three principles



Delivery:

System must carry data the correct destination and received by the recipient



Accuracy:

System must deliver accurate data as per sending format

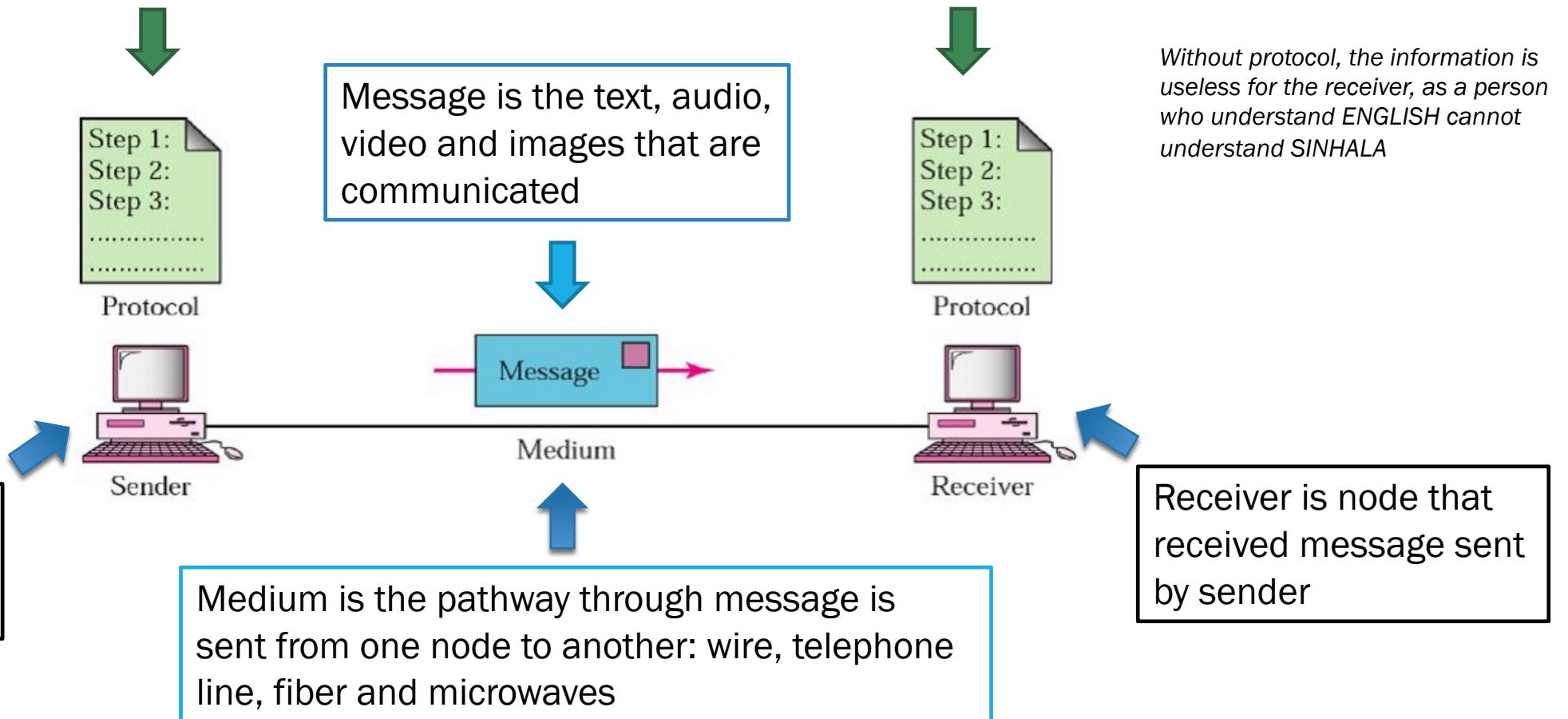


Timeline:

System must deliver data in time and late data may not effective

Basic Elements of Data Communication Systems

Protocols are sets of rules which governs the data transmission between sender and receiver



Data Representation Forms

Different kinds of information can be sent over communication channels



Text and numbers:

Text and numbers are sequence of bits (0 or 1)
They are represented by the sets of bit patterns
type using keyboard



Images:

Images are special bit patterns,
comprise matrix of pixels,
size of an image is larger than the
text/numbers

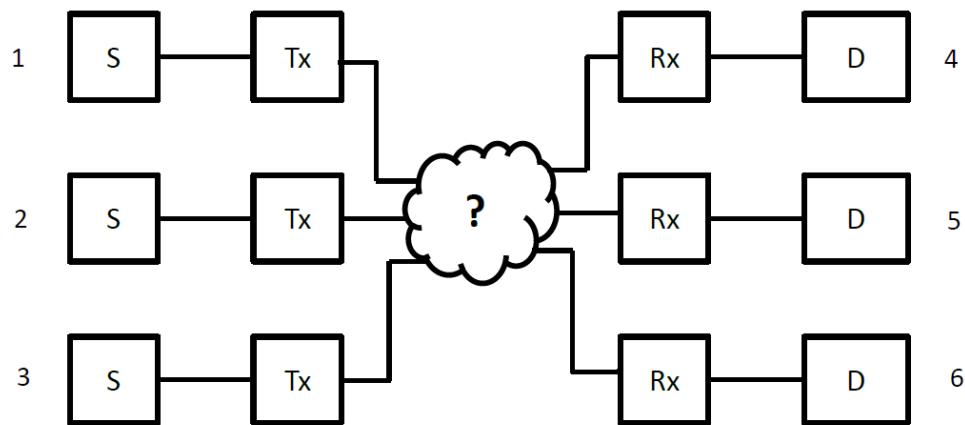


Audio and video:

Audio and video refers to recording or
broadcasting of music, sound or video

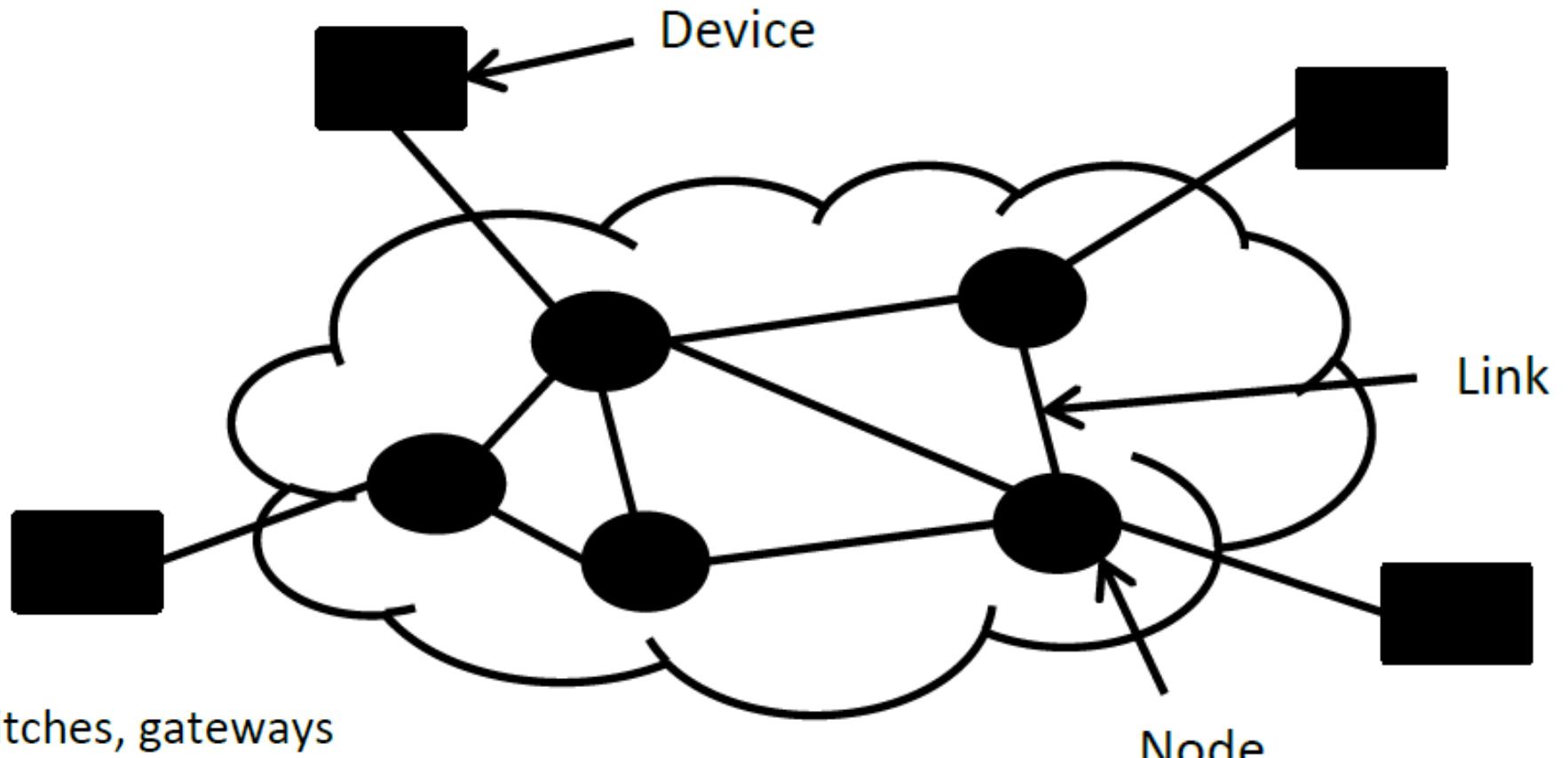
Types of Networks

TYPES OF NETWORKS



- Network connects two or more computers
- Use to exchange data and information each other
- Classified into three main categories:
 - Local Area Network (LAN),
 - Metropolitan Area Network (MAN) and
 - Wide Area Network (WAN)

Components of the Network



Nodes: routers, switches, gateways

Links: twisted pairs, fibers, wireless, etc.

Devices: end system, terminal, host, station

Classification of Networks

Scale: LAN, MAN, WAN, (Internet network)

Transmission media: wired, wireless and optical

Topologies: Bus, Star, Ring, and Mesh

Connection modes: connection oriented and connectionless

Switching techniques: circuit switched and packet switched

Communication protocols: Ethernet, IP, ATM, etc..

Users: Public or private

Transported data: voice, audio, video, text, data, etc..

Architecture: client-server, peer-to-peer, etc..

Connection types: point to point, point to multi-point, broadcast etc..

CLASSIFICATION BY SCALE

Distance		Wired	Wireless
0.1 m	Circuit Board	Data flow machine	
1 m	System	Multiprocessor	
	Person	Body Area Networks: BAN (typical wireless)	
	Around a person	Personal Area Networks: PAN (typical wireless)	WPAN (Bluetooth/802.15.1, ZigBee/802.15.4)
10m	Room	Local Area Networks (802.3, 802.1)	WLAN (802.11)
100m	Building	-"-	-"-
1 km	Campus	-"-	-"-
10 km	City	Metropolitan Area Networks: MAN (DSL, cable networks)	WMAN 802.16 (WiMAX)
>10km	Country, Continent, World	Wide Area Networks (WAN)	WWAN (802.20)

Local Area Network (LAN)

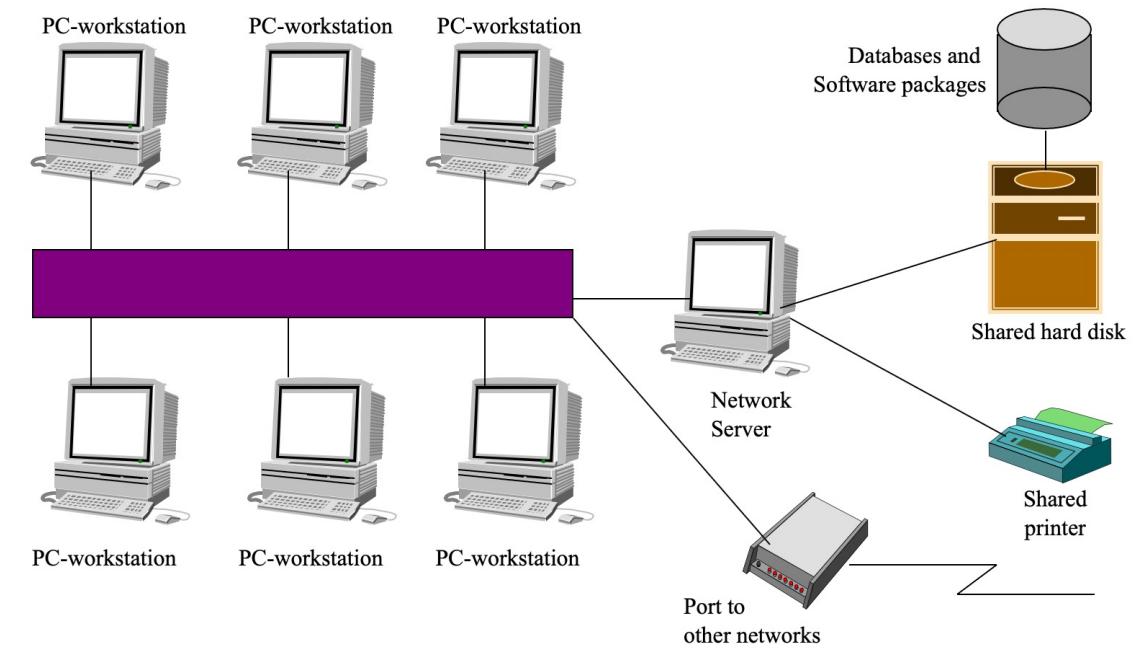
Connection of systems in limited area

Each system has its own CPU and Storage

Each node access resources of other nodes available in LAN

Allow users to share hardware and software resources

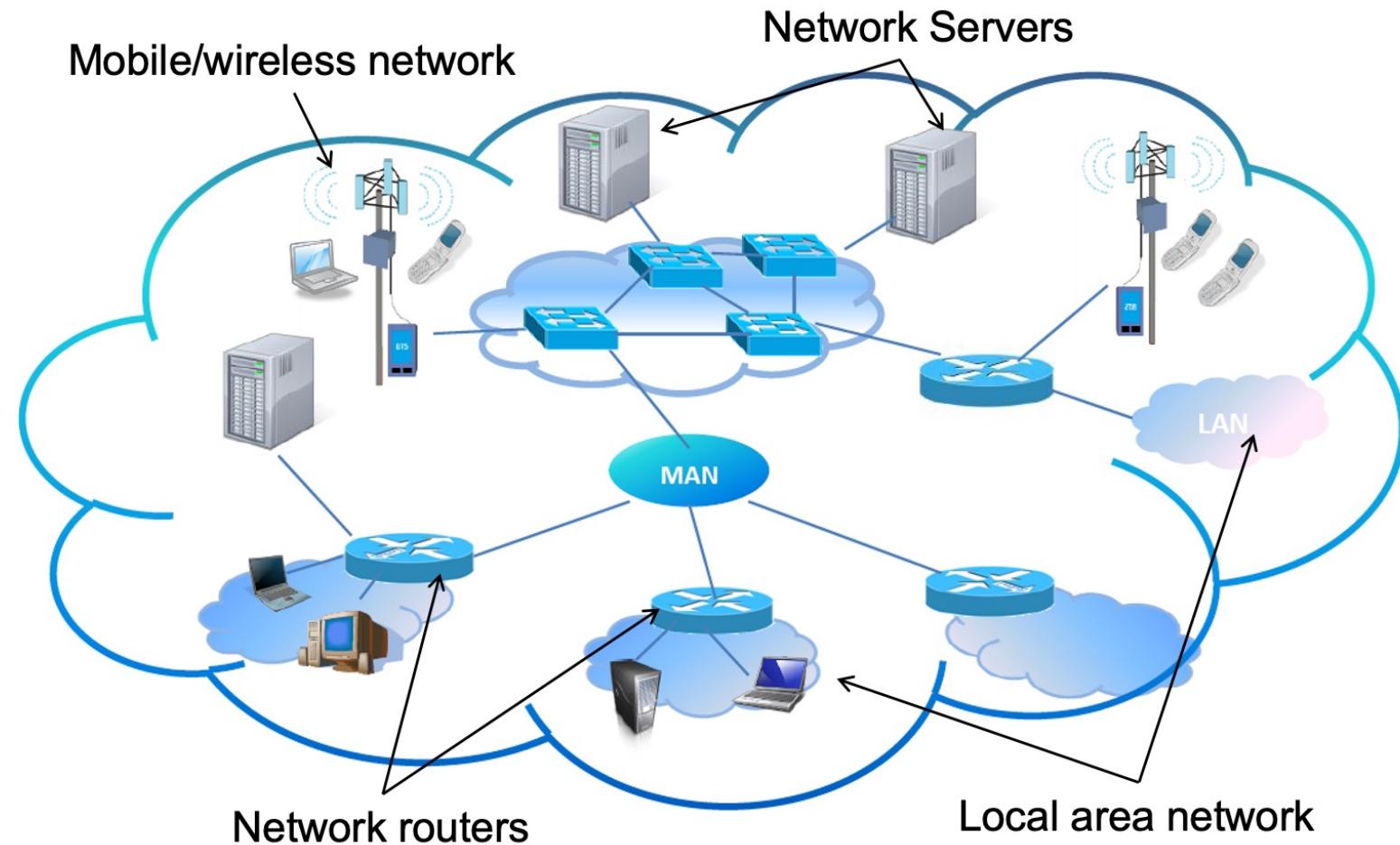
They can communicate with each other using messages and emails



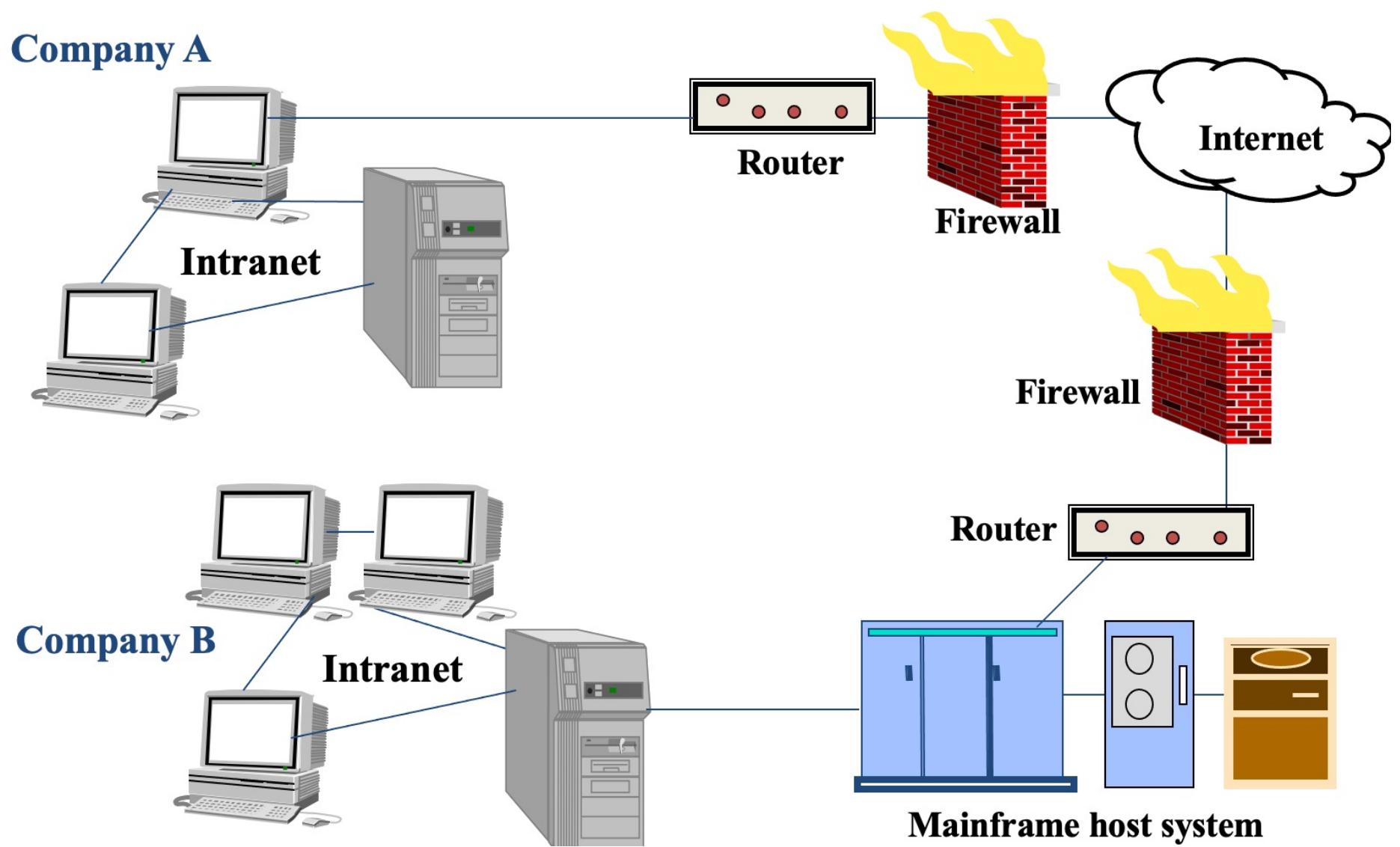
- Transfer the data with high speed
- Exist in small geographical area and Less expensive

METROPOLITAN AREA NETWORKS (MAN)

- Larger network than LAN
- Comprise in large city
- Connects several LANs and individual systems at high speed

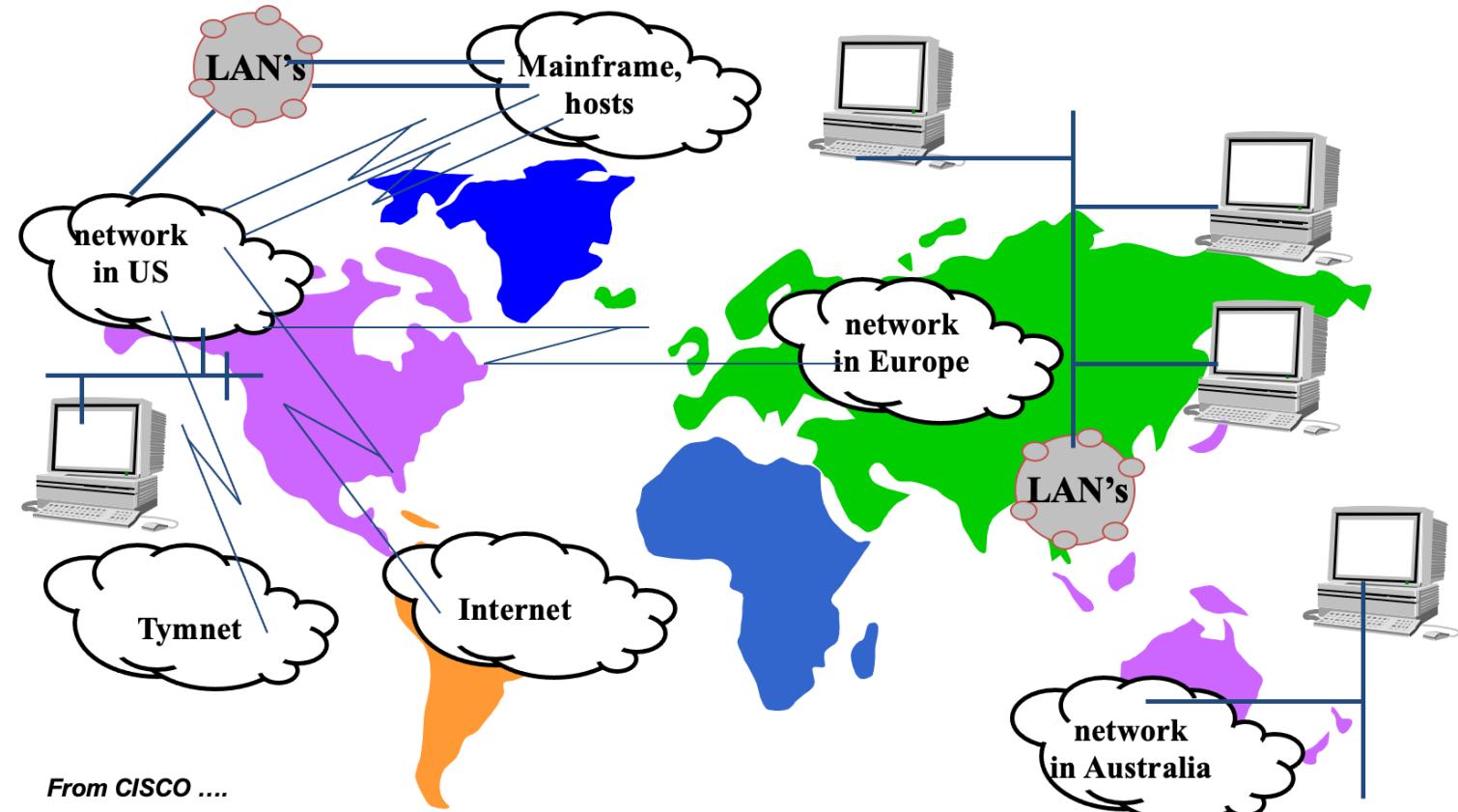


Client – Server Architecture



WIDE AREA NETWORK (WAN)

- Interconnects LAN's, MAN's and individual systems located in country or whole world
- MAN can span in an unrestricted area
- More complicated and complex than LAN and MAN
- Expensive Technology



Network Topologies

Network topologies

Topology is a connection arrangement of nodes in a computer networks

It is structure of the network that defines configurations of cables, computers, and devices

Types of Topologies

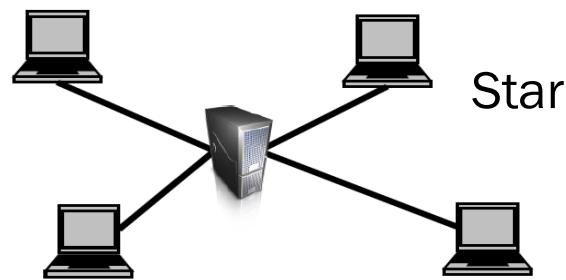
Star Topology

Ring Topology

Bus Topology

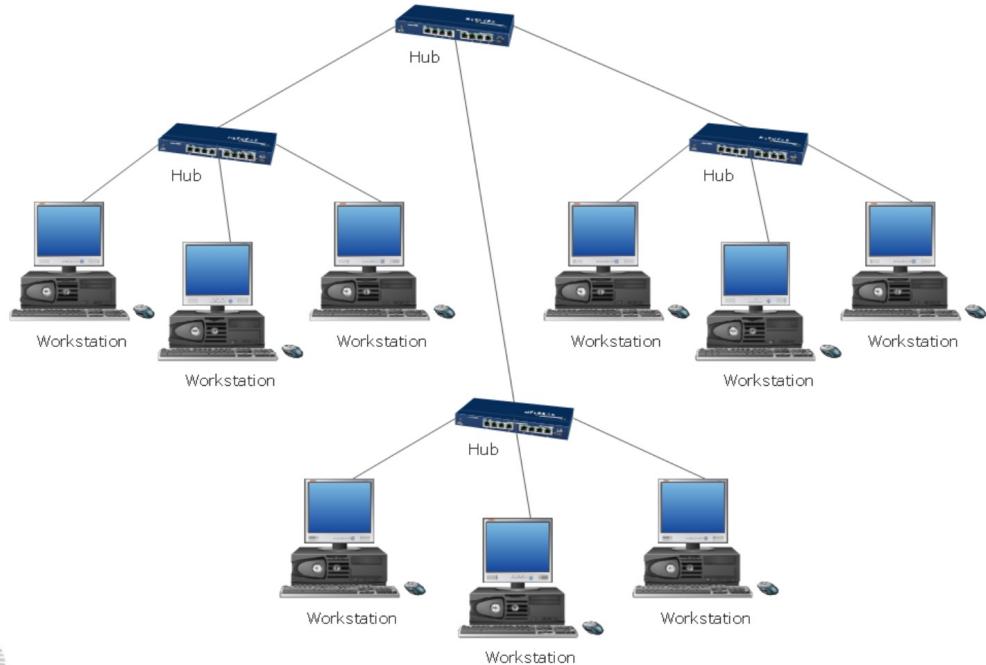
Mesh Topology

STAR TOPOLOGY



- The Most general type of arrangement
- Used in Offices and Homes
- All computers are connected to central hub or switch
- Communication takes place via Switch/Hub
- Data Initiated by Nodes passes through the Switch
- The Switch forward data to the destination node
- The Switch manages the network

Star Topology cont.



Advantages

- Easy to install and wiring arrangement is also easy
- The transmission delays do not increase if a new node is added
- If any node fails, it does not affect to the network (Not the central Switch)
- It is easy to detect faults
- Addition or removal of nodes are easy

Disadvantages

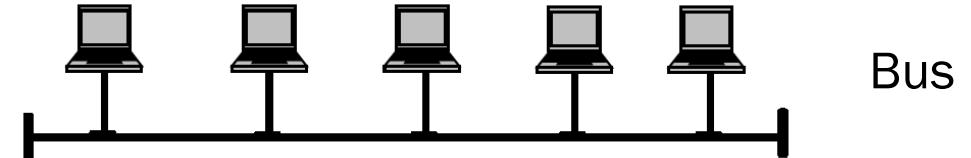
- Star topology requires large cable lengths
- If Switch fails, all nodes are affected

Bus Topology

- One of the most simple network topology
- All nodes are connected a single cable
- This cable is the backbone of the network
- Every node sends and receives data through Bus

Advantages

- It is easy to add a new node
- Bus topology requires small cable lengths compared to star topology
- It is cheaper compared to Star topology
- Only suitable for small networks

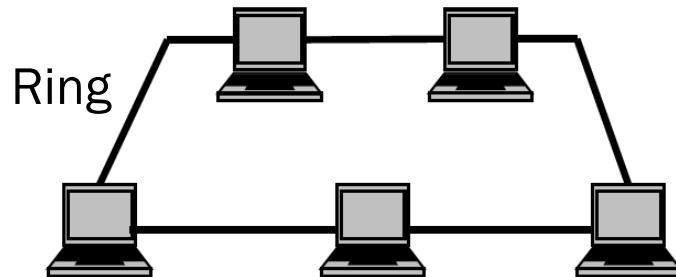


Disadvantages

- If main cable breaks whole network fails
- The main cables require terminators at ends
- If number of devices increases, the efficiency of the network goes down
- Not suitable for heavy traffic networks
- Security of the data is low since all nodes receives the data

Ring Topology

- Computers are attached with each other with a close cable loop
- Each node has exactly two neighbours
- Computer connect each other and complete the network
- Data passes through all nodes until it reaches the destination node
- Any break in cable leads to entire network failure



Advantages

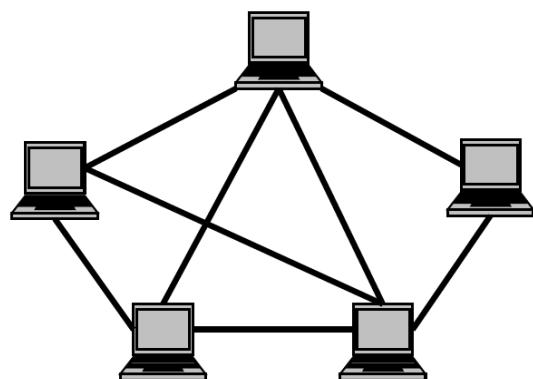
- There is no central device for controlling the network
- Ring topology is easy to install and the wiring arrangement
- It provides equal access to all devices
- It is easy to detect faults
- Adding and removing nodes are easy

Disadvantages

- Transmission signal goes in sequential order and it creates delays
- A single break in cable can disturb the flow of whole network

Mesh Topology

- In mesh network, all nodes are interconnected with each other
- Provide one-to-one connection among the nodes
- Arrangement is expensive, since a dedicated links are required among the nodes
- Network is complex



Advantages

- Mesh topology allows data to send from different nodes simultaneously
- If a node fails, it will not be affected to other nodes
- Extension and alteration can be done without disturbing other nodes

Disadvantages

- There are high chances of redundancy in many network connections
- Overall cost is high compare to other networks
- Setting up and maintenance are difficult compared others

- Reliability
- Link lengths for a given set of nodes
- Ability to support broadcasting

IMPORTANT ASPECTS FOR TOPOLOGY SECTION!!

IMPORTANT ASPECTS FOR TOPOLOGY SECTION!!

Reliability

The most obvious aspect here is to identify the bottle neck of the network. Examples are central node in star networks or any link in a unidirectional ring. However, a single point of failure doesn't necessarily mean that the system is unreliable. A reliability analysis should take into account the failure probability of every component in the system.

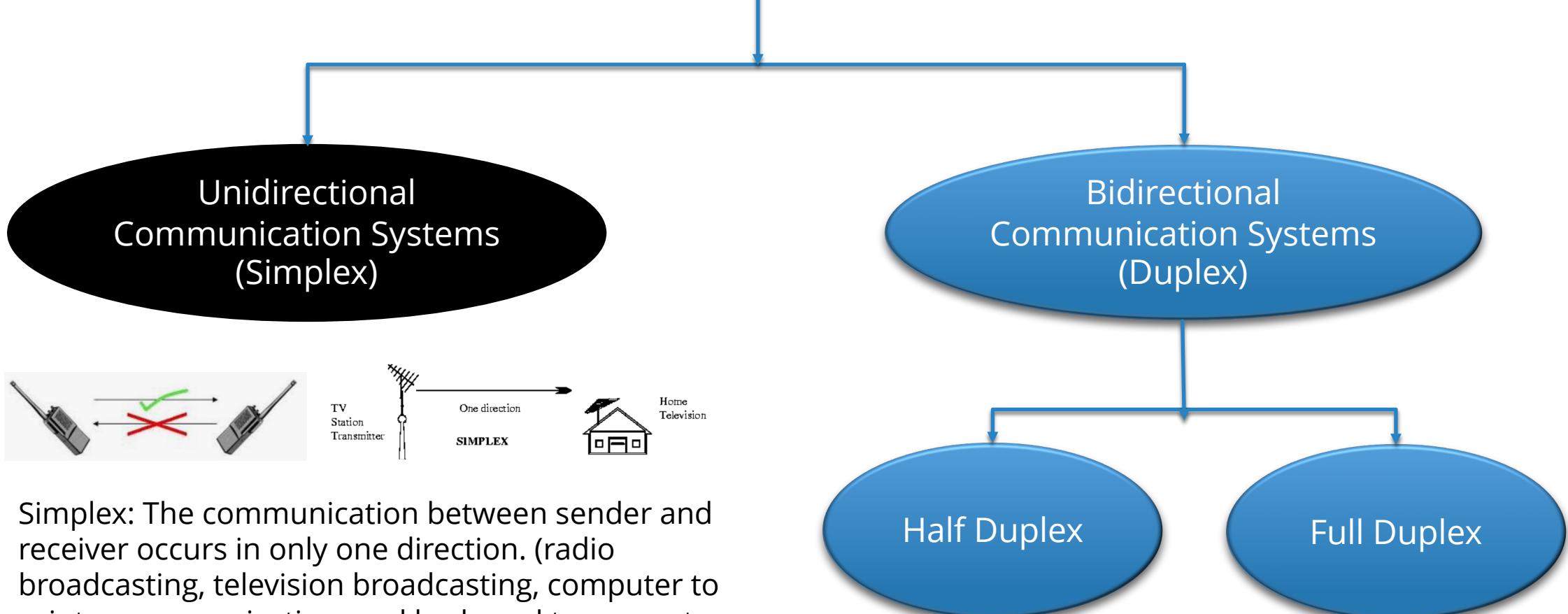
Link length

The consideration here is which topology results in the least cable length. Obviously, the results depend on the number of nodes. Another aspect is that we have to differentiate the length of ducts and those of cables. For a green field installation, the former is more important because it has a stronger impact on investment cost.

Support of broadcasting

Broadcasting is the method to transmit information to all recipients simultaneously. There are networks that do support it in a natural way. Examples are satellite and radio networks, bus, and ring network.

Data Transmission Modes



Data Transmission Modes

Simplex mode

- Data flows only in one direction, from source to destination.
Example: radio broadcasting, fire alarm, keyboard, etc..

Half-duplex mode

- Data flows in both directions, but one at a time. Example
walkie-talkie

Full-duplex mode

- Data flows in both direction at the same time. Example:
Telephone network, allow user to talk and hear same time

Half Duplex



Computer A

Computer B

Can only communicate in **one** direction at a time.

Example



Just like how walkie-talkies work.

HALF DPLEX

Full Duplex



Computer A

Computer B

Communicates in **both** directions at the same time.

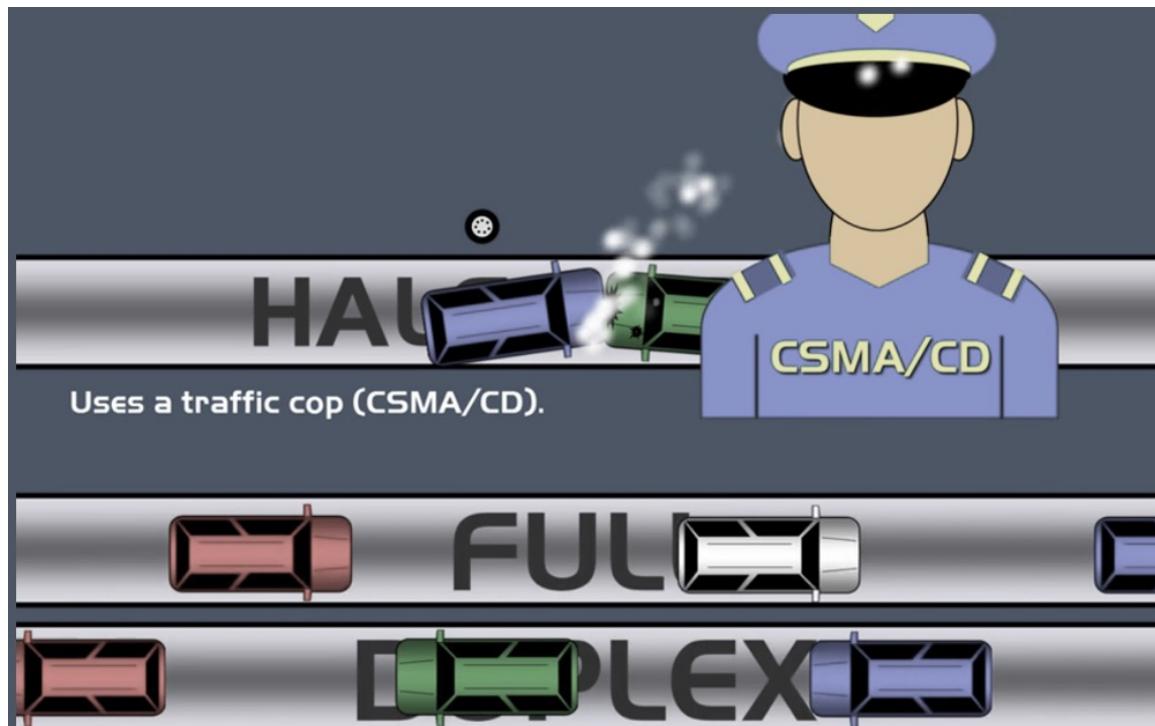
Example



An example of a full duplex would be telephone communication.

FULL DPLEX

Example for Half and Full Duplex



Today we use full-duplex networks.

A main reason for using half-duplex today, is for older (legacy) equipment.



HUB

Only uses half-duplex



SWITCH

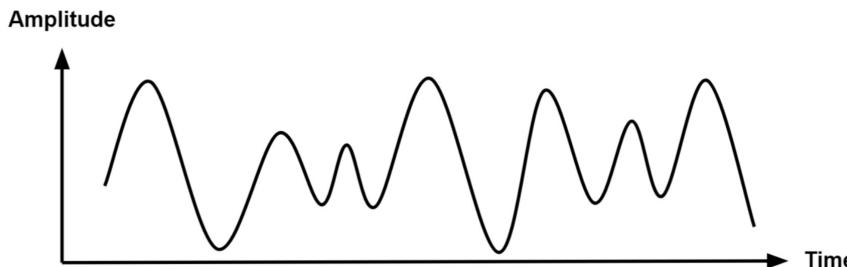
Used in full-duplex networks.

In today's networking: Hubs are replaced by the Switches that perform Isolate Communication

Data Transmission Forms

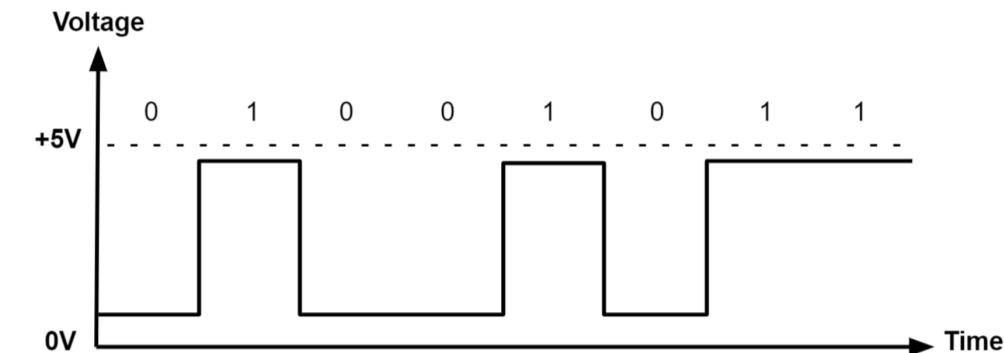
Analog Transmission

- Analog transmission of data in continuous mode
- Human voice creates analog signals
- When someone talks, analog wave is created in air medium



Digital Transmission

- Transmission of data using distinct “ON” and “OFF” electrical states
- Switched ON/OFF represented by 1/0 bits
- “0” and “1” are called bits and combination of these bits creates digital signals



Data Transmission Media

Media is the pathway used to carry signal from one to another

Data Transmission Media



Guided Media

Guided media to direct the signal along the path

Data signal are dependent upon the physical characteristics
of the medium

Three main basic types: *Twisted pair, coaxial cable and
optical fiber*



Unguided media

Does not use any physical path

Carries electromagnetic waves

Signal transmitted through Air

Two types: *Microwave and Satellite
communications*

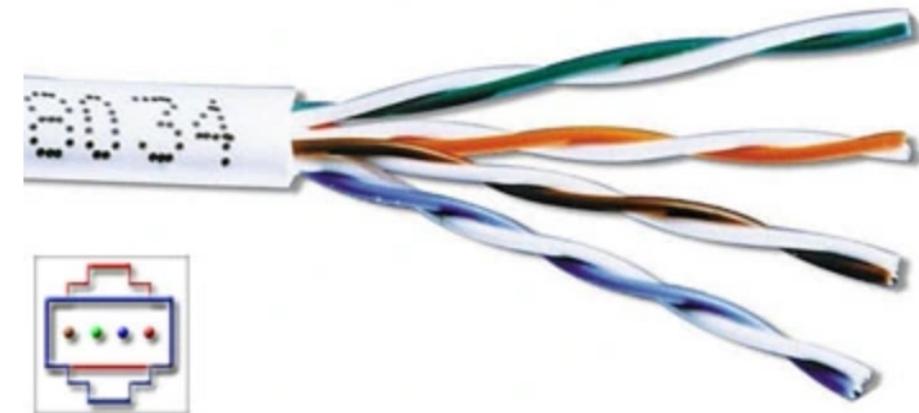
Twisted Pair Cable

- A pair of wires are twisted and forms a circuit that transmits data.
- Twisted pair cabling is used for most modern Ethernet networks, amongst other things.
- two conductors of a single circuit are twisted together for the purposes of Avoiding electromagnetic interference
- Mainly two types
 - Unshielded Twisted Pair
 - Shielded Twisted Pair

Shielded twisted pair (STP)

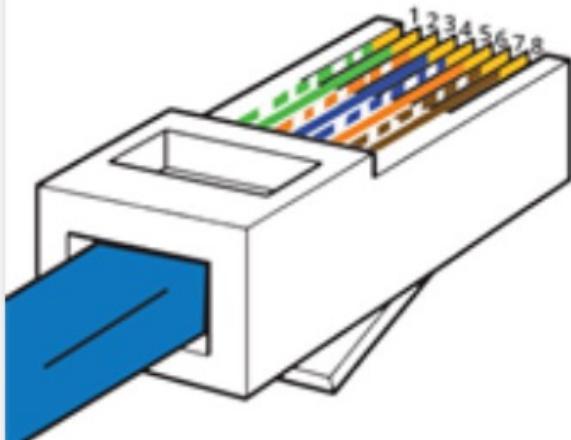


Unshielded twisted pair (UTP)



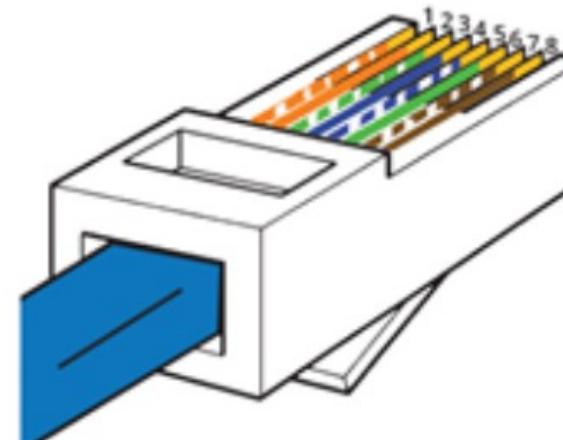
Difference of UTP and STP is that the STP use's metallic shield wrapping to protect the wire from/to interference (external).

RJ45 Pinout T-568A



- | | |
|-----------------|----------------|
| 1. White Green | 5. White Blue |
| 2. Green | 6. Orange |
| 3. White Orange | 7. White Brown |
| 4. Blue | 8. Brown |

RJ45 Pinout T-568B



- | | |
|-----------------|----------------|
| 1. White Orange | 5. White Blue |
| 2. Orange | 6. Green |
| 3. White Green | 7. White Brown |
| 4. Blue | 8. Brown |

There are two standards recognized by ANSI, TIA and EIA for wiring Ethernet cables. The first is the T568A wiring standard and the second is T568B. T568B has surpassed 568A and is seen as the default wiring scheme for twisted pair structured cabling.

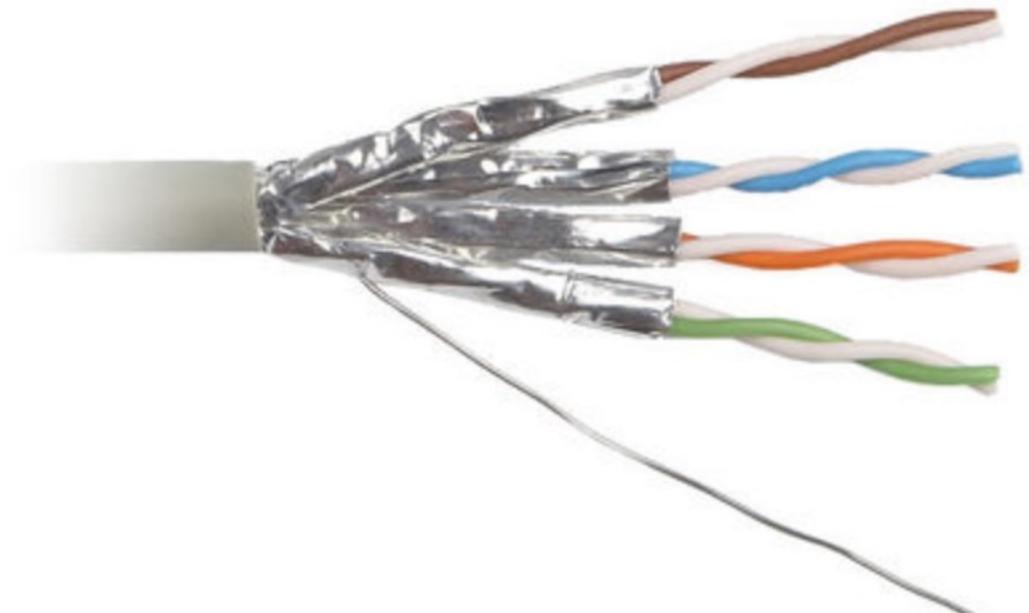
Unshielded Twisted Pair Cables

- UTP is NOT enclosed in copper shielding
- Flexible and easy to use
- Can get unnecessary interference, and data from other cables or network
- It can leak its data to nearby cables
- Used in local telephone and short distance networks



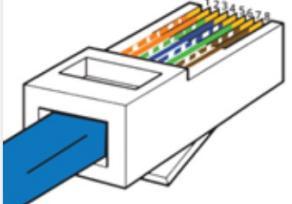
SHIELDED TWISTED PAIR CABLES

- STP composed of two pairs, twisted with each other, enclosed in foil and copper shielding
- Secure cable, reduce outside interference and noise



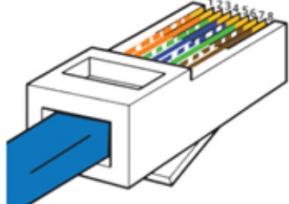
STRAIGHT-THROUGH

SIDE ONE



1. White Orange
2. Orange
3. White Green
4. Blue
5. White Blue
6. Green
7. White Brown
8. Brown

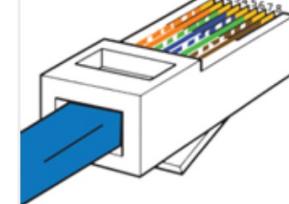
SIDE TWO



1. White Orange
2. Orange
3. White Green
4. Blue
5. White Blue
6. Green
7. White Brown
8. Brown

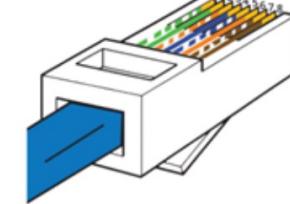
CROSSOVER

SIDE ONE

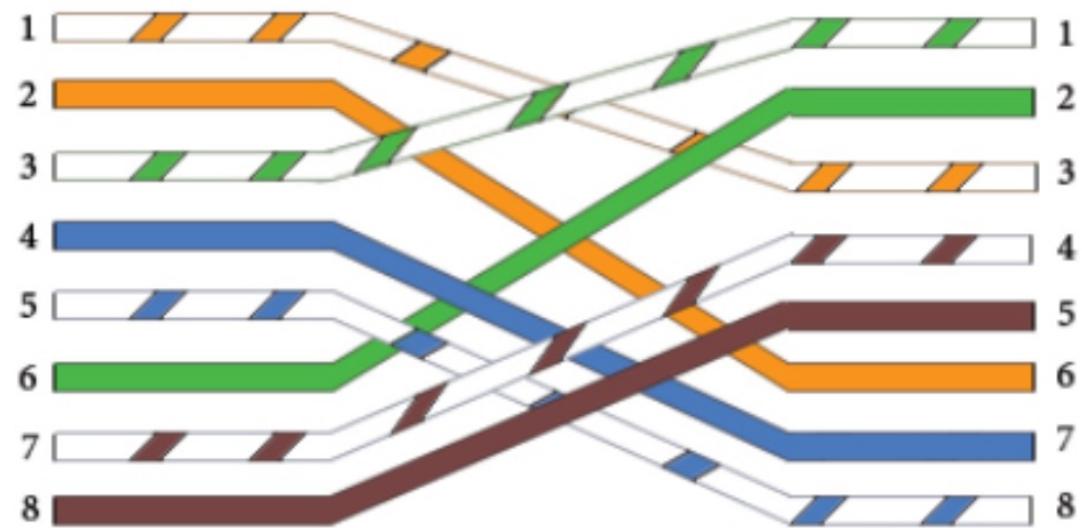
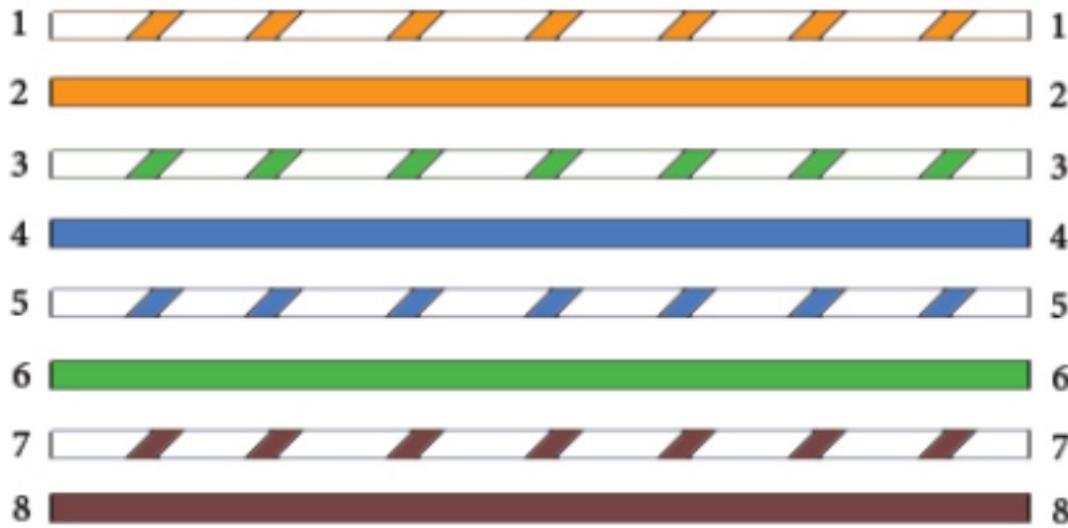


1. White Orange
2. Orange
3. White Green
4. Blue
5. White Blue
6. Green
7. White Brown
8. Brown

SIDE TWO

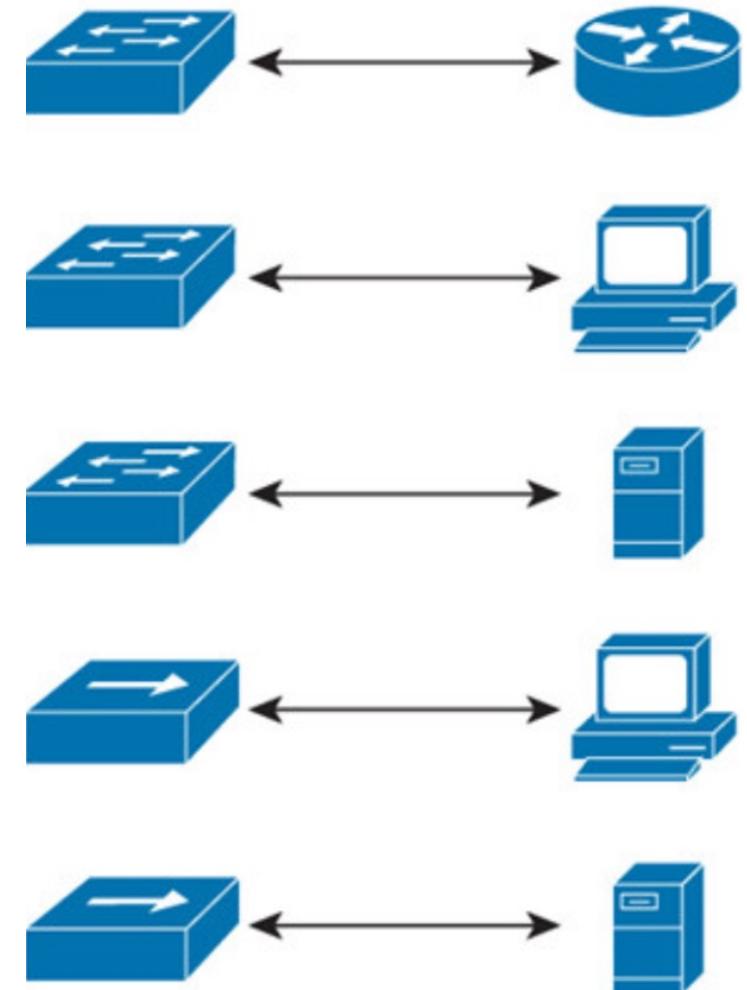
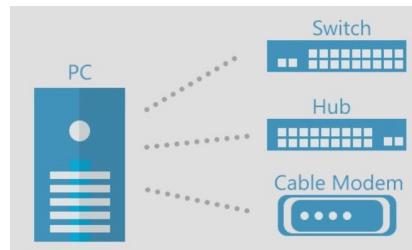


1. White Green
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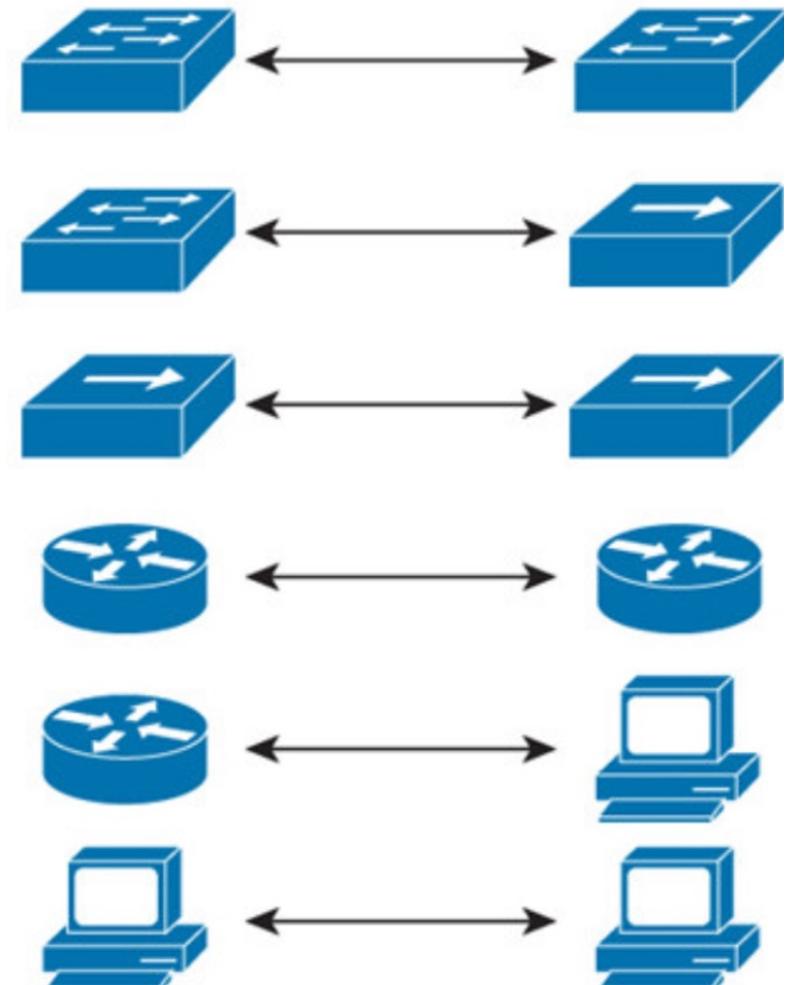
Straight Through Cabling

- A straight through cable is a type of twisted pair cable that is used in local area networks to connect a computer to a network hub such as a router.
- This type of cable is also sometimes called a **patch cable**
- Straight through Ethernet cable uses for the following cablings:
 - Switch to router
 - Switch to PC or server
 - Hub to PC or server
- Higher layer device to Lower layer device (Boss to employee)



The Crossover Cabling

- A crossover Ethernet cable is a type of Ethernet cable used to connect computing devices together directly.
- The crossover cables uses for the following cablings:
 - Switch to switch
 - Switch to hub
 - Hub to hub
 - Router to router
 - Router Ethernet port to PC NIC
 - PC to PC
- Peer to Peer Communication (same executive level)



Twisted pair cables: Advantages and categories

Advantages

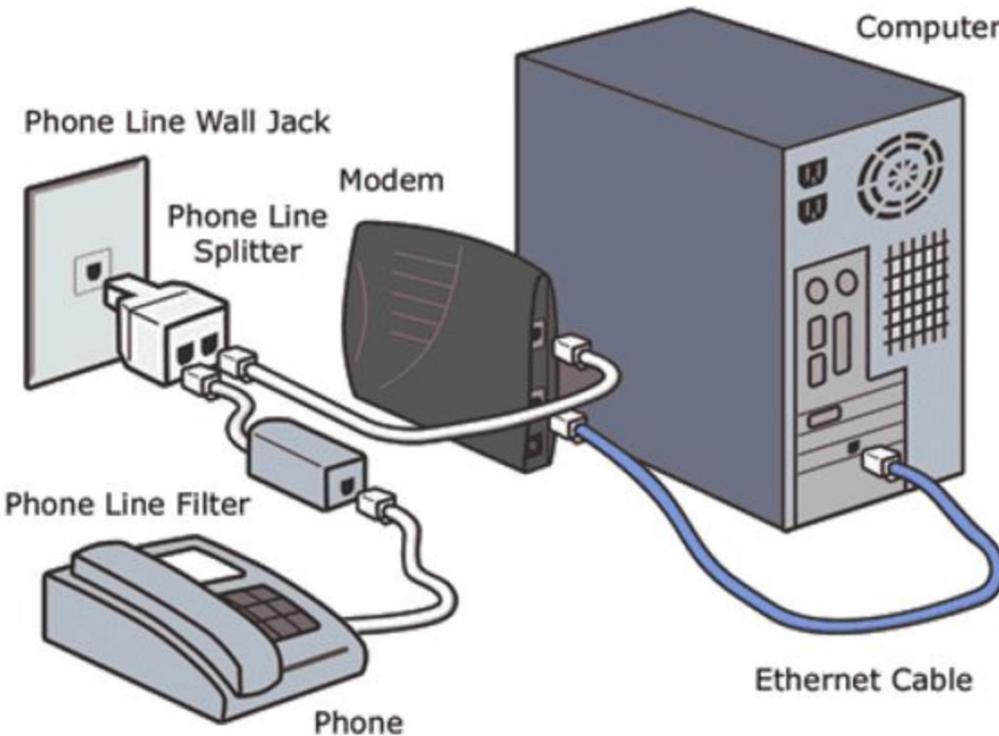
- Inexpensive and readily available
- Flexible and light weight
- Easy to setup and install
- It support analog as well as digital transmission
- Used for several technologies

Disadvantages

- Susceptible to noise and interference
- Limited range due to attenuation

Category	Speed	Frequency
CAT 1	Carry only voice	1MHz
CAT 2	4Mbps	4MHz
CAT 3	10Mbps	16Mhz
CAT 4	16Mbps	20Mhz
CAT 5	100Mbps	100Mhz
CAT 5e	1000Mbps	100Mhz
CAT 6	1000Mbps	250MHz
CAT 7	10Gbps	600MHz
CAT 7a	10Gbps	1000Gbps
CAT 8	25Gbps	2000Mhz

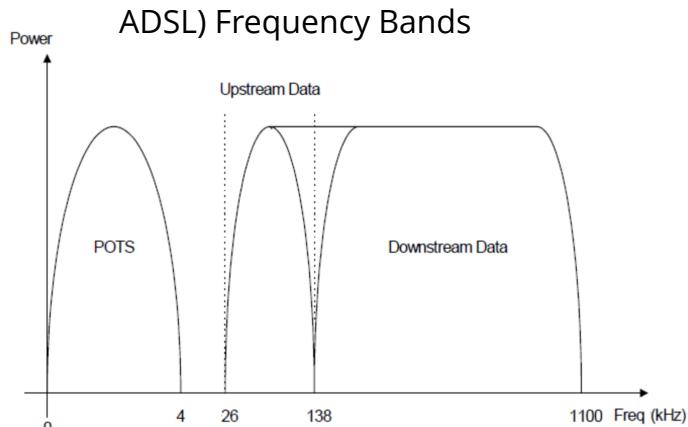
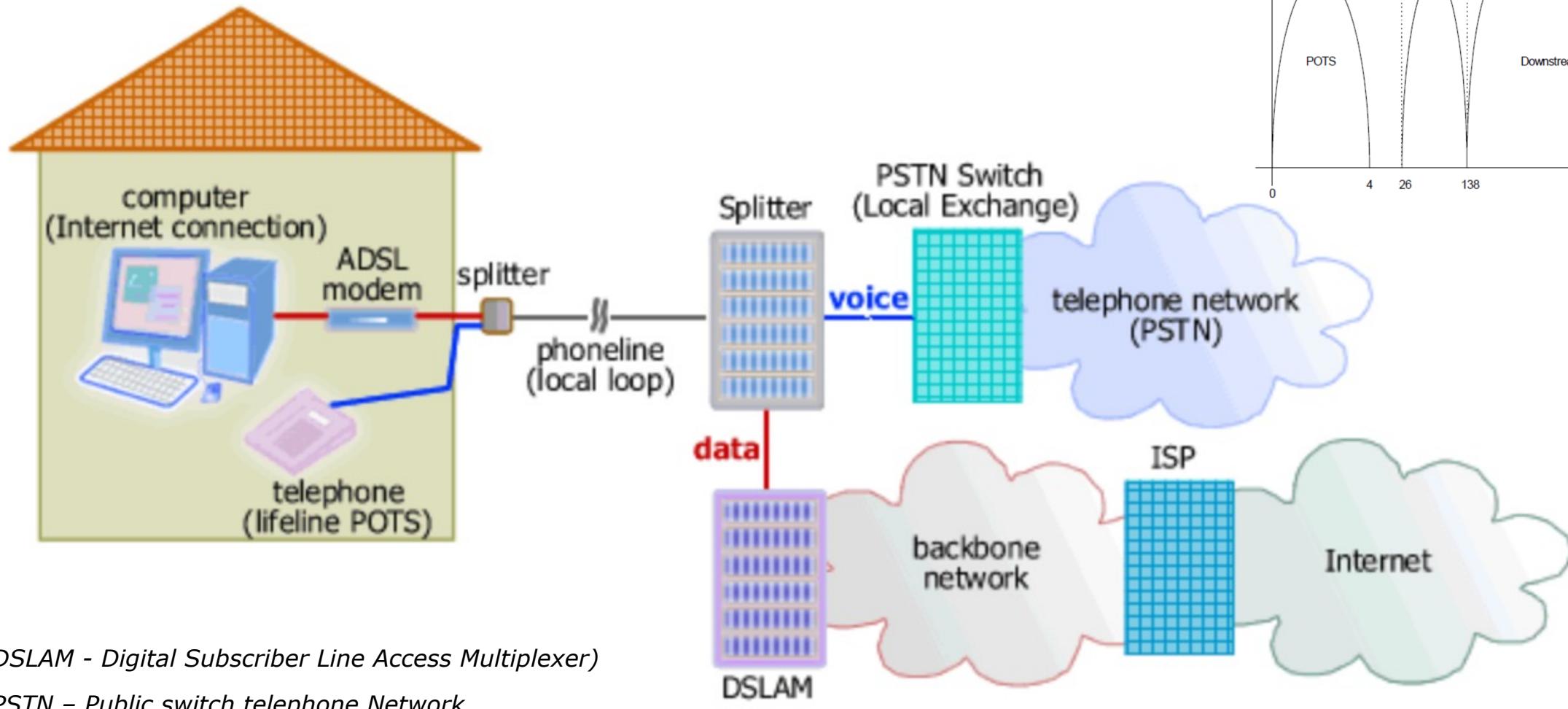
DSL cabling (twisted pair telephone line) - Internet



DSL stand for "Digital Subscriber Line"

- DSL is a technology for providing high speed Internet services to homes and small businesses over a standard traditional phone line.
- It is known as an "always-on" service because unlike the old dial up service there is no logging on with username and passwords required.
- Two types
 - Asymmetric Digital Subscriber Line (ADSL) – DL high Data rate than UL
 - Symmetric Digital Subscriber Line (SDSL)

DSL over Internet



ANY QUESTION??

THANK YOU!!