

# COMPUTER NETWORKS



**BY SALEET**

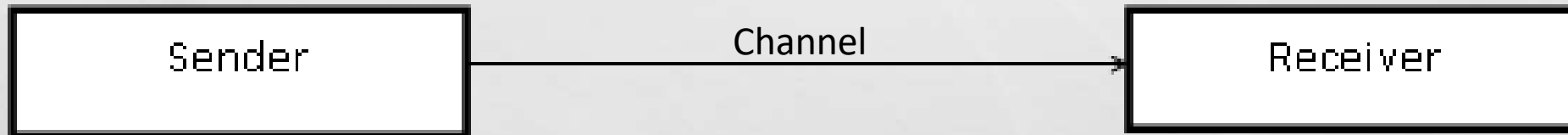
# COMMUNICATION

➤ **Exchange of ideas, messages, or information between two communicating parties.**

- SIMPLEX**
- HALF DUPLEX**
- FULL DUPLEX**

# SIMPLEX

- In simplex transmission, communication can take place in only one direction.
- Devices connected to such a circuit are either a send-only or a receive only device.
- E.g. Keyboard, Monitor etc.



# HALF DUPLEX

- A Half-duplex system can transmit data in both directions, but only in one direction at a time.
- Hence, a duplex line can alternately send and receive data.
- This is the most common type of transmission for voice communication because only one person is supposed to speak at a time.



# FULL DUPLEX

- A Full-Duplex system allows information to flow in both directions simultaneously on a transmission path.
- Use of Full-Duplex line improves efficiency, because the line turnaround time in a half-duplex path is eliminated.



# COMMUNICATION CONCEPTS

## Channel:

- By communication channel we mean a medium through which signals can be transmitted.

## Bandwidth:

- The bandwidth of the channel specifies the range of frequencies that the channels can faithfully transmit.
- Higher the bandwidth of a channel, larger is its capacity to carry information.
- Bandwidth of the channel is measured in Hz, KHz, MHz or GHz.
- 1 Hz (Hertz) equals one cycle per second.
  - 1 KHz (Kilohertz) equal thousand cycles per second.
  - 1 MHz (Megahertz) equals one million cycles per second.
  - 1 GHz(Gigahertz) equals one billion cycles per.

## Data Transfer Rate:

The data transfer rate (DTR) is the amount of digital data that is moved from one place to another in a given time. Measured in bits per second (bps).

One bit equals 0 or 1.

one kilobit per second (Kbps) equals 1000 bits per second (bps).

one megabit per second (Mbps) equals 1000 Kbps.

one gigabit per second (Gbps) equals 1000 Mbps.

one terabit per second (Tbps) equals 1000 Gbps.

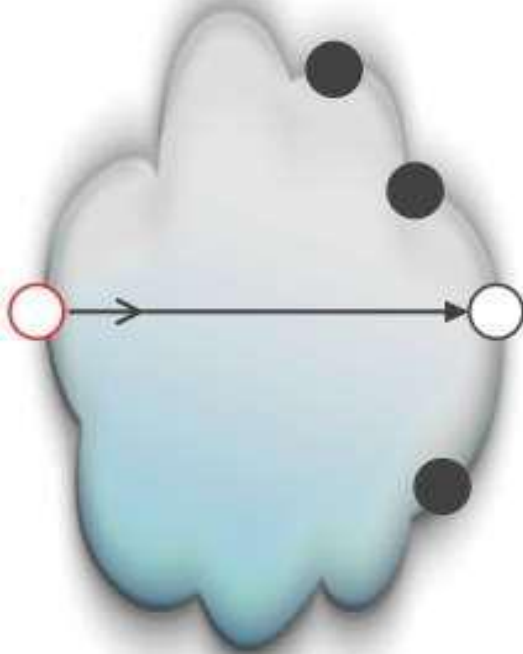
# COMMUNICATION MODES

- **UNICAST** - When message is delivered from one system to another (One to One / Single source and Single destination) connected to a network.
- **MULTICAST** – When message is delivered from one system to a specified group of systems connected to a network..
- **BROADCAST** – When message is delivered from one system to all the systems connected to a network.

# COMMUNICATION MODES

## A: Unicast

L2/L3 network



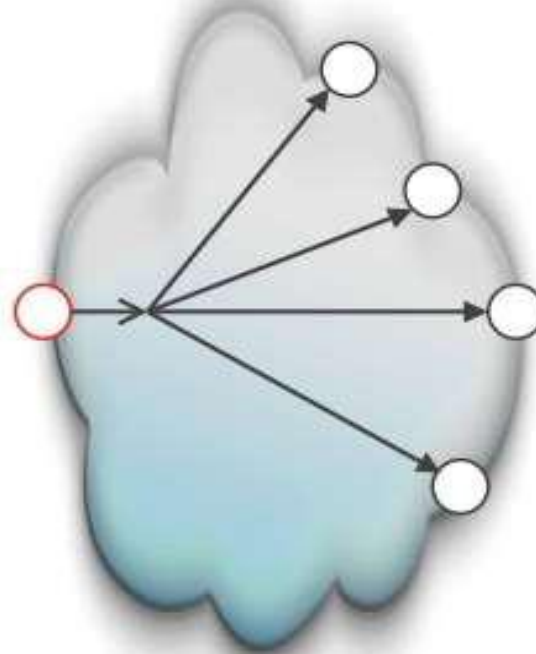
Destination MAC and IP Address

MAC – 00:50:56:01:02:03

IP – 10.20.10.10

## B: Broadcast

L2/L3 network



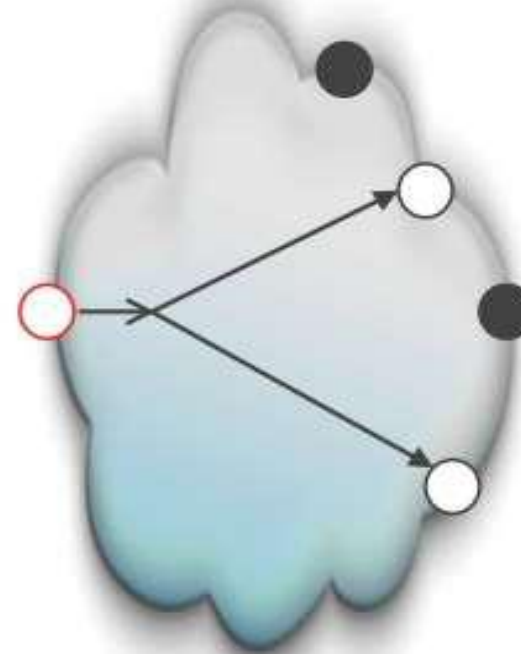
Destination MAC and IP Address

MAC – FF:FF:FF:FF:FF:FF

IP – 10.20.10.255

## C: Multicast

L2/L3 network



Destination MAC and IP Address

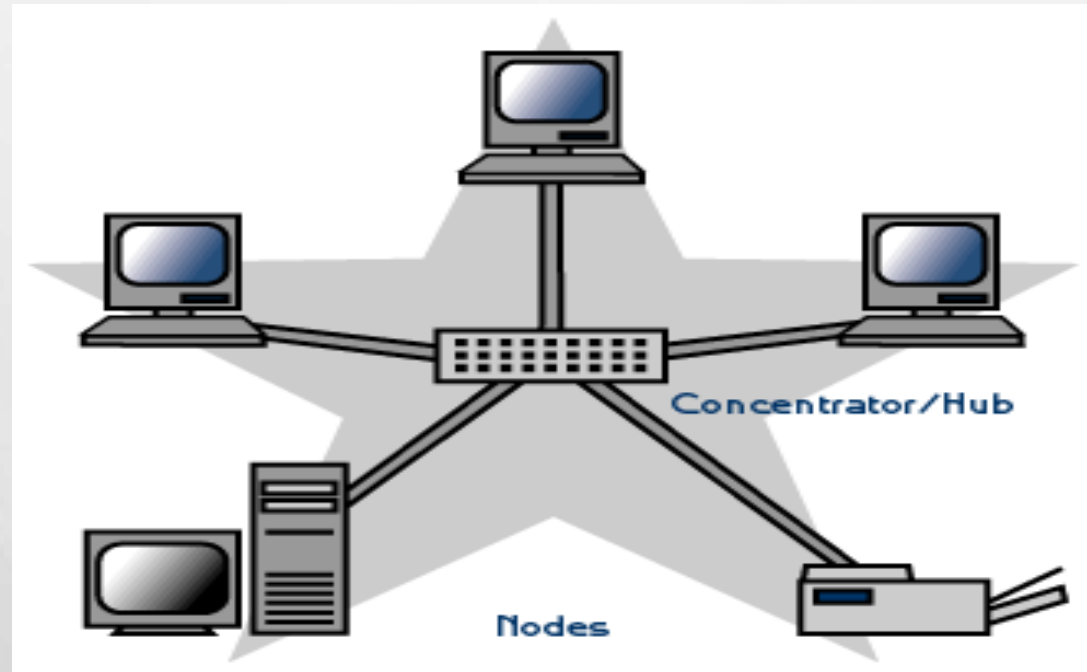
MAC – 01:00:5E:01:02:03

IP – 239.1.1.100



# COMPUTER NETWORK

- **A *COMPUTER NETWORK* IS A NETWORK OF GEOGRAPHICALLY DISTRIBUTED MULTIPLE COMPUTERS CONNECTED IN A MANNER TO ENABLE MEANINGFUL TRANSMISSION AND EXCHANGE OF INFORMATION AMONG THEM.**



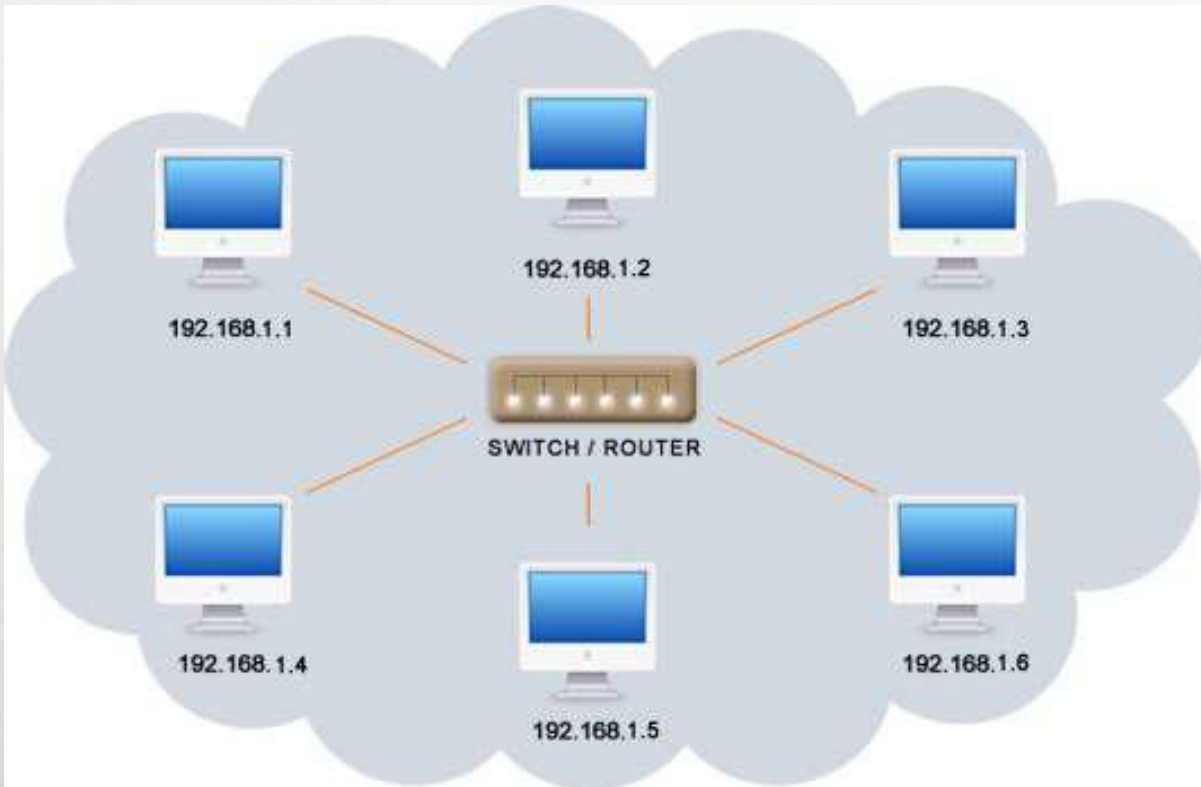
# NEED FOR COMPUTER NETWORKING

- ***RESOURCE SHARING***- THROUGH A NETWORK, DATA, SOFTWARE AND HARDWARE RESOURCES CAN BE SHARED IRRESPECTIVE OF THE PHYSICAL LOCATION OF THE RESOURCES AND THE USER.
- ***RELIABILITY***– A FILE CAN HAVE ITS COPIES ON TWO OR MORE COMPUTERS OF THE NETWORK.
- ***REDUCED COST***– SHARING RESOURCES REDUCES THE COST.
- ***FAST COMMUNICATION***– INFORMATION CAN BE EXCHANGED AT A VERY FAST SPEED.

# TYPES OF NETWORKS

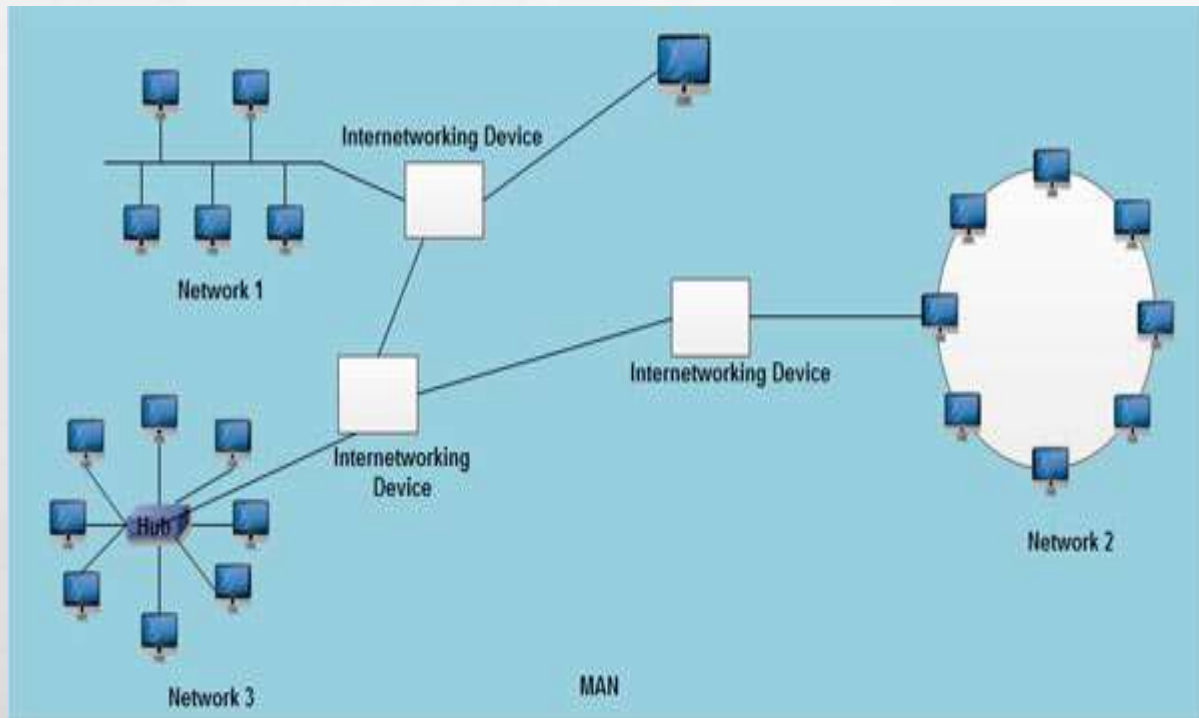
- **LAN – LOCAL AREA NETWORK**
- **MAN – METROPOLITAN AREA NETWORK**
- **WAN – WIDE AREA NETWORK**
- **PAN – PERSONAL AREA NETWORK.**

# LAN – LOCAL AREA NETWORK



- *Privately Owned Network.*
- *Covering a **small geographical area**, like a home, office, or groups of buildings e.g. a school Network.*
- *Resource Sharing.  
(printer/data/software)*
- *Devices in LAN are connected to central devices called Hub or Switch using a cable.*

# MAN – METROPOLITAN AREA NETWORK



- *MAN is larger than a local area network and as its name implies, covers the area of a single city.*
- *It can be single network such as a cable TV network, or it is a means of connecting a number of LANs into a larger network so that resources can be shared LAN to LAN as well as device to device.*

# WAN – WIDE AREA NETWORK

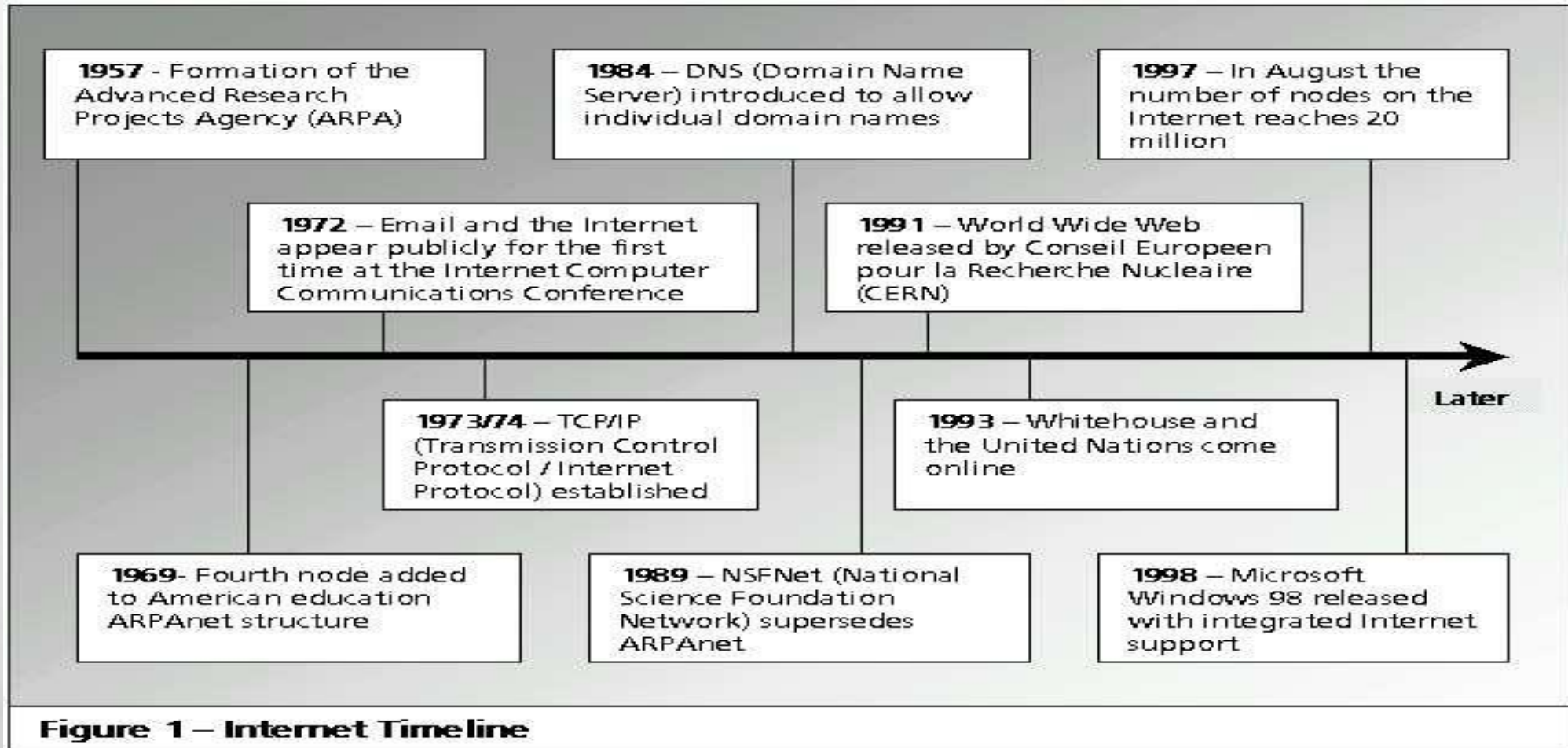


- *WAN is larger than a metropolitan area network and as its name implies, covers the large geographic area.*
- *Its is simply a packet switching telecommunication network.*
- *Organizations supporting WANs using the Internet Protocol are known as Network Service Providers (NSPs).*

# INTERNET

- **NETWORK OF NETWORKS OF COMPUTERS.**
- **GLOBAL NETWORK.**
- **GLOBAL RESOURCE HUB.**

# EVOLUTION OF THE INTERNET



**Figure 1 – Internet Timeline**



# FEATURES OF THE INTERNET

➤ ***E-Mail***

➤ ***Video Conferencing***

➤ ***Social Networking***

➤ ***Web Advertisements***

➤ ***IRC – Internet Relay Chats.***

# NETWORKING DEVICES

HUB	SWITCH	ROUTER
<p>1. HUB is a networking device mostly used to connect computers in a LAN.</p>	<p>1. Switch is a networking device mostly used to connect computers in a LAN and MAN.</p>	<p>1. ROUTER is a networking device mostly used to connect computers in a LAN, MAN and WAN</p>
<p>2. The function of the HUB is to accept data from one computer and broadcasts it to every other computer on a network. The intended computer accepts this data while rest of the computers discards it.</p>	<p>2. The function of the SWITCH is to accept data from one computer and then checks destination MAC address in the MAC address table which is maintained on it. If it matches then forwards the data to the intended computer only.</p>	<p>2. The function of the ROUTER is to accept the message from one computer or network and splits it into the fixed size packets and then forwards these packets towards the destination by choosing the best of the available paths. At the destination another ROUTER receives these packets coming from different paths and assembles them into a message.</p>
<p>3. HUB uses IP Address to transmit the data.</p>	<p>3. SWITCH uses MAC Address to transmit the data.</p>	<p>3. ROUTER uses IP Address to transmit the data.</p>

## REPEATER

1. Repeater is a networking device mostly used to **REGENERATE** the weak incoming signal into original signal.

## GATEWAY

1. Gateways are very intelligent devices or else can be a computer running the appropriate software to connect and translate data between networks with different protocols or architecture, so their work is much more complex than a normal router.

## BRIDGE

1. Bridge is a networking device mostly used to connect LANs of different architectures.

## MODEM

*Modems are most frequently used to enable computers to communicate with each other across telephone lines. Stands for Modulation – demodulation. Converts digital signal to analog signal and vice versa.*

## RJ 45 Connector

*Register Jack 45 is an 8 wire connector which is commonly used to connect computers on LAN. Looks like RJ-11 telephone connector. RJ45 is a standard type of connector for network cables. RJ45 connectors are most commonly seen with Ethernet cables and networks.*

## ETHERNET

*An Ethernet card is one kind of network adapter. These adapters support the Ethernet standard for high-speed network connections via cables. Ethernet cards are sometimes known as network interface cards (NICs).*

# NETWORK TOPOLOGIES

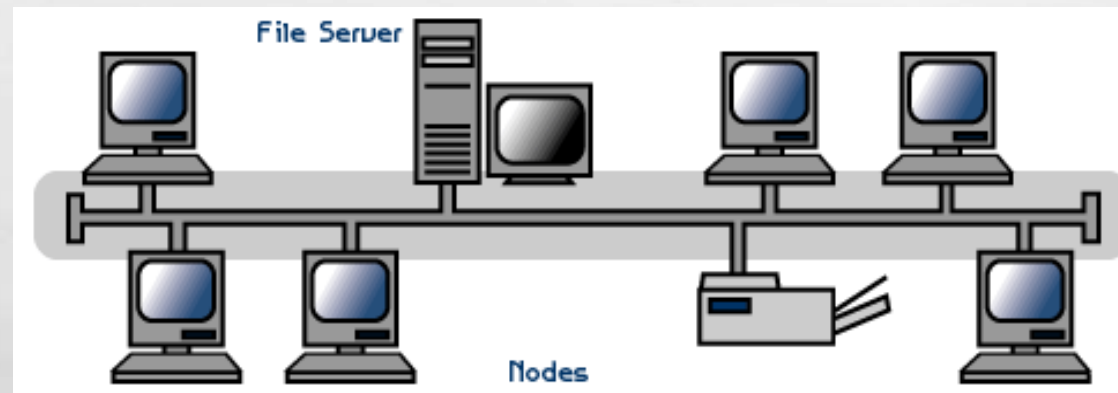
The physical topology of a network refers to the configuration of cables, computers, and other peripherals.

Main Types of Physical Topologies are:

- *Linear Bus topology.*
- *Star topology*
- *Tree (Expanded Star) topology.*

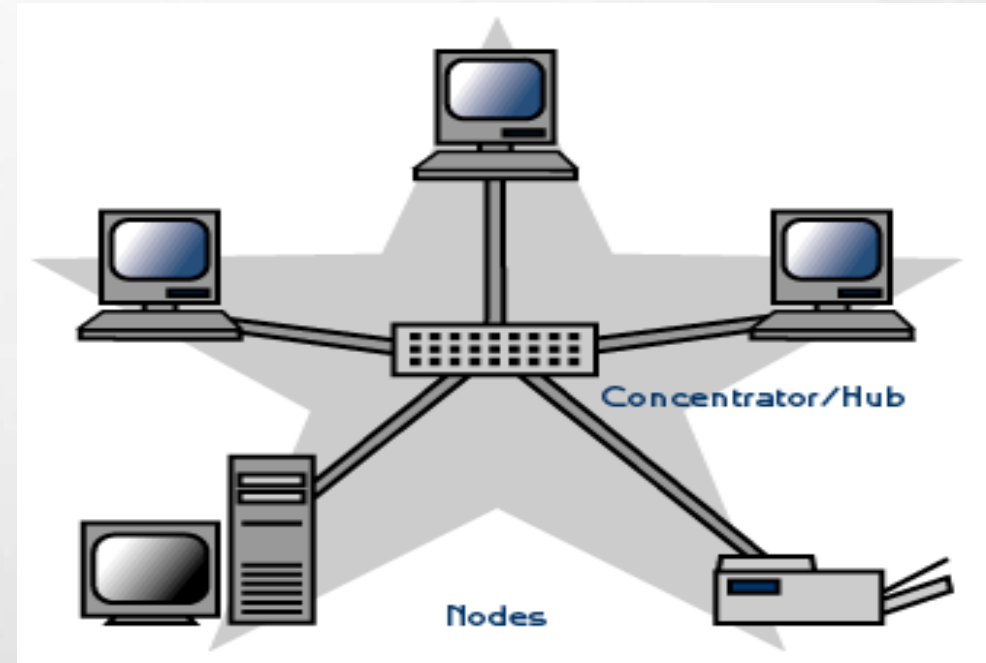
# LINEAR BUS TOPOLOGY

- A linear bus topology consists of a main run of cable with a terminator at each end as shown in fig. below.
- All nodes (file server, workstations, and peripherals) are connected to the linear cable.



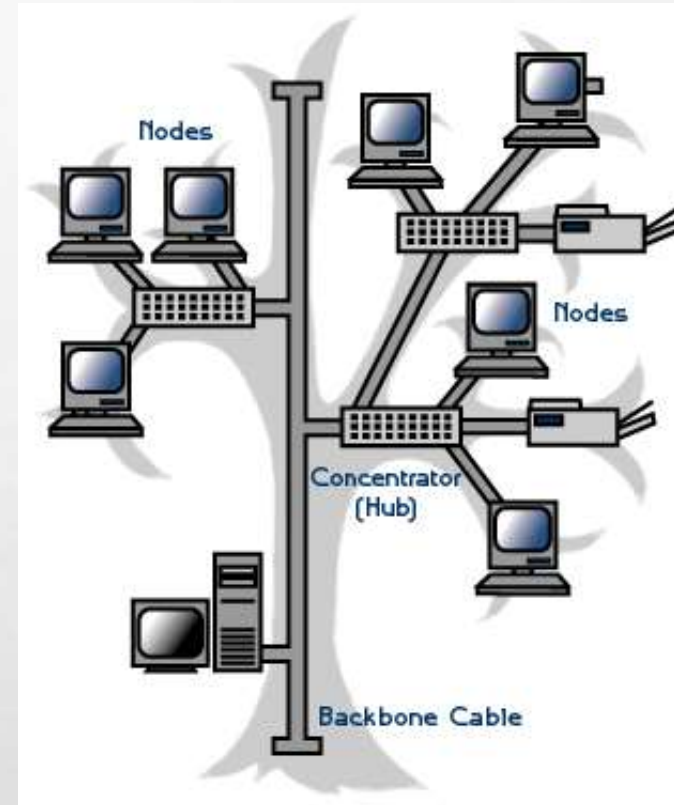
# STAR TOPOLOGY

- A star topology is designed with each node (file server, workstations, and peripherals) connected directly to a central network hub, switch, or concentrator.
- Data on a star network passes through the hub, switch, or concentrator before continuing to its destination.
- The hub, switch, or concentrator manages and controls all functions of the network



# TREE OR EXPANDED STAR TOPOLOGY

- A tree topology combines characteristics of linear bus and star topologies.
- It consists of groups of star-configured workstations connected to a linear bus backbone cable.
- Tree topologies allow for the expansion of an existing network, and enable schools to configure a network to meet their needs.





# COMMUNICATION MEDIA

Means by which a communication signal is carried from one system to another.

There are two basic categories of transmission media

1. Guided
2. Unguided

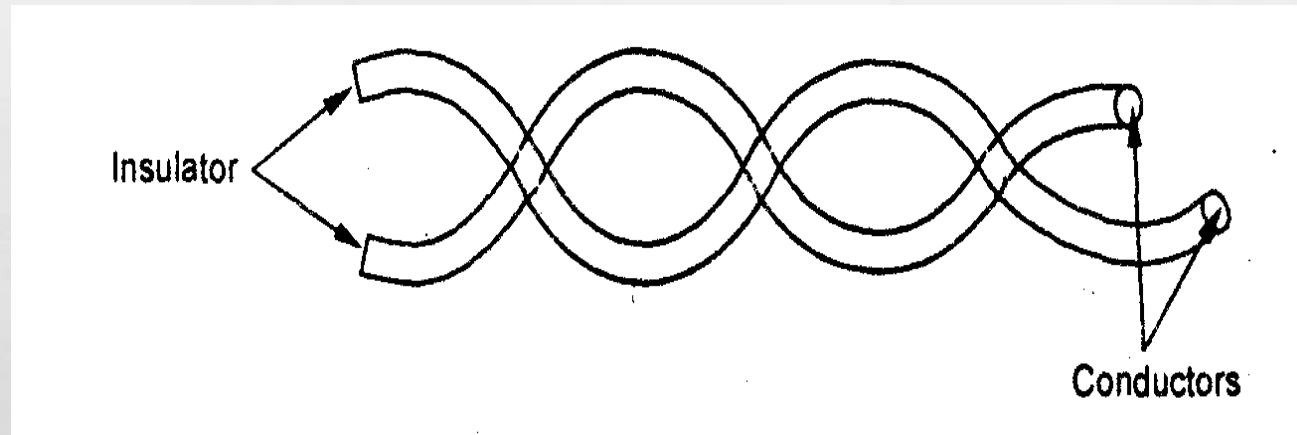
Guided Transmission media uses a 'Cabling system that guides the data signals along a specific path. Examples are twisted-pair wire, coaxial cable, fiber-optic cable.

Unguided transmission media consists of a means for the data signals to travel but nothing (cabling) to guide them along a specific path. Unguided media include radio waves, microwaves, satellites, infrared.

# TWISTED PAIR WIRE.

A twisted pair consists of two bunches of copper wires, each with its own plastic insulation, and then twisted around each other to reduce the interference from the adjacent wires.

One of the wires is used to carry signals to the receiver and the other is used only as a ground reference.



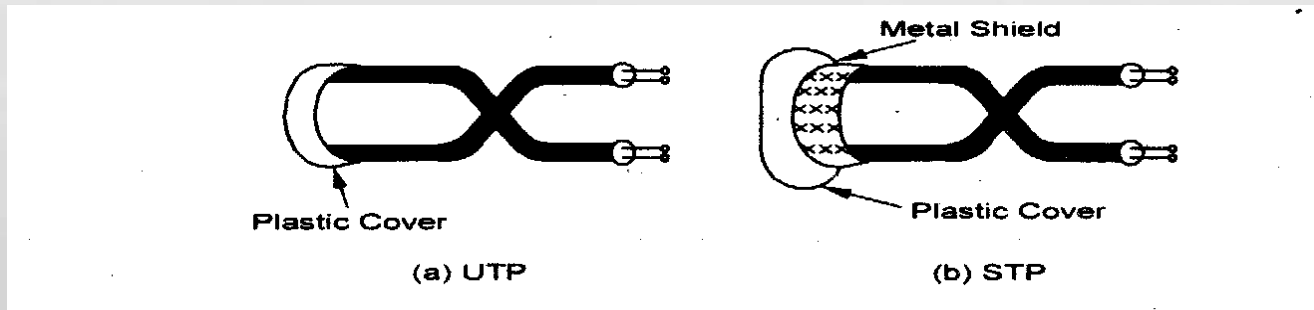
# TWISTED PAIR WIRE

The most common twisted pair cable used in communication is referred to as:

- Unshielded twisted pair (UTP) and.
- Shielded twisted pair (STP)

*UTP cables* are so named because other than the plastic coating around the two bunches two individual bunches of copper wires, nothing shields it from outside interference.

*STP Cables* are similar to UTP but has a mesh shielding that's protects it from EMI which allows for higher transmission rate.



# COAXIAL CABLE

Coaxial cable contains two conductors that are parallel to each other.

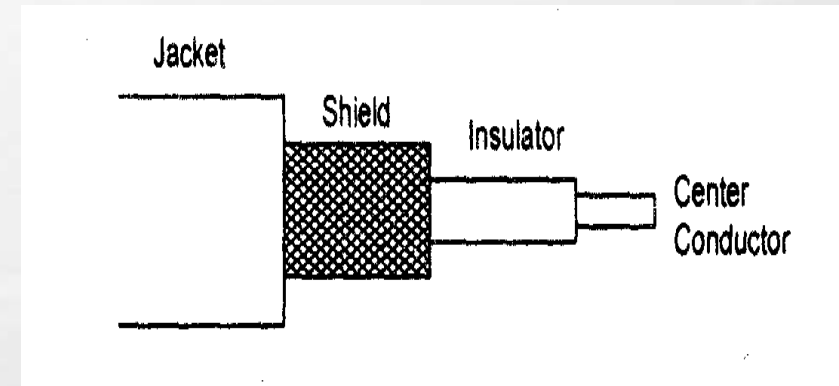
The inner conductor in the cable is usually copper.

The other Conductor is a fine copper mesh.

Outside the inner Conductor is a non-conductive plastic material used to separate the inner Conductor from the outer Conductor. It is used to help shield the cable from EMI.

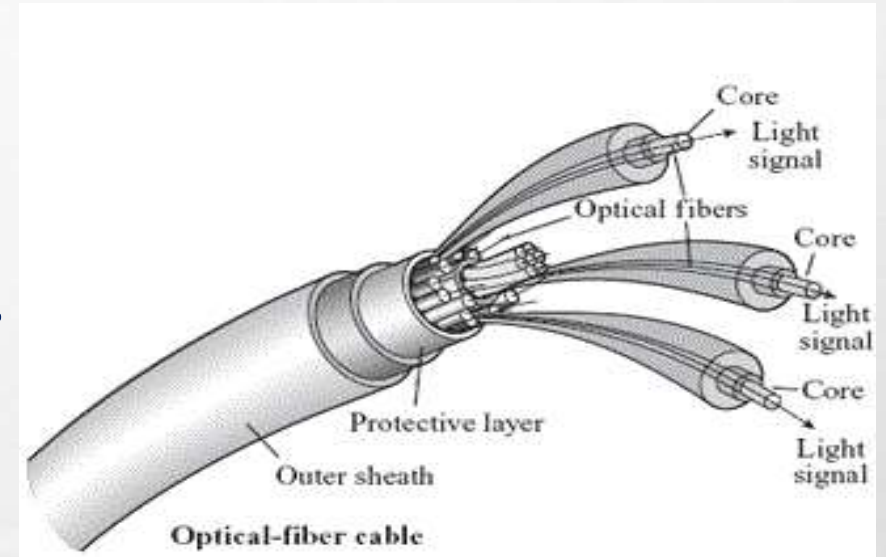
Outside the copper mesh is the final protective cover.

The actual data travels through the center conductor in the cable. EMI interference is caught by outer copper mesh.



# OPTICAL FIBER

- Optical fibers are thin threads of glass or plastic, which can serve as a data transmission medium as copper wires or co-axial cables.
- Optical fibers transmit light signals instead of electrical signals.
- Because light travels faster than the electricity, optical fibers can transmit the data at much higher speed than twisted-pair or co-axial cables and low attenuation.
- 
- In the center of fiber cable is a glass stand or core. The light from the laser moves through this glass to the other device. Around the internal core is a reflective material known as CLADDING. No light escapes the glass core because of this reflective cladding. The cladding is surrounded by outer protective coating made up of plastic.



# RADIO WAVES

Electromagnetic wave ranging in frequencies between 3 KHz and 1GHz are normally called radio waves.

Radio waves are omnidirectional when an antenna transmits radio waves they are propagated in all directions. This means that sending and receiving antenna do not have to be aligned.

A sending antenna can send waves that can be received by any receiving antenna.

Radio waves particularly those waves that propagate in sky mode, can travel long distances.

# MICROWAVES

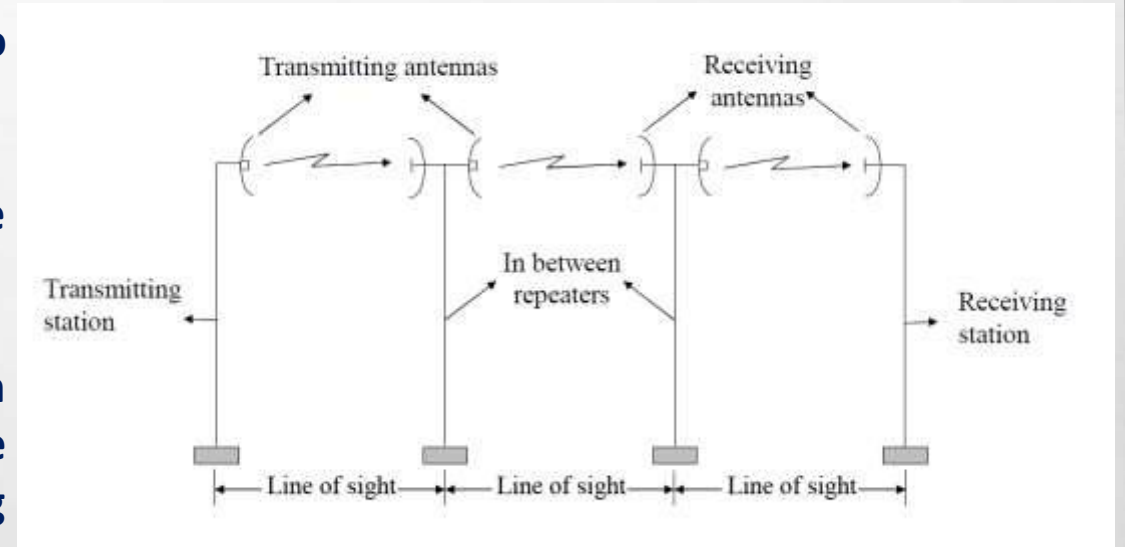
This is a popular way of transmitting data, since it does not incur the expense of laying cables.

Microwave systems use very high frequency radio signals to transmit data through space.

Microwave propagation is line-of-sight; This means that the sending and receiving antennas need to be aligned.

Since the towers with the mounted antennas need to be in direct sight of each other, towers that are far apart need to be very tall, the curvature of the earth as well as other blocking obstacles do not allow two short towers to communicate using microwaves,

Repeaters are often needed for long distance communication.



# INFRARED WAVES

**Infrared signals with frequencies ranges from 300 GHz to 400 GHz can be used for short range communication.**

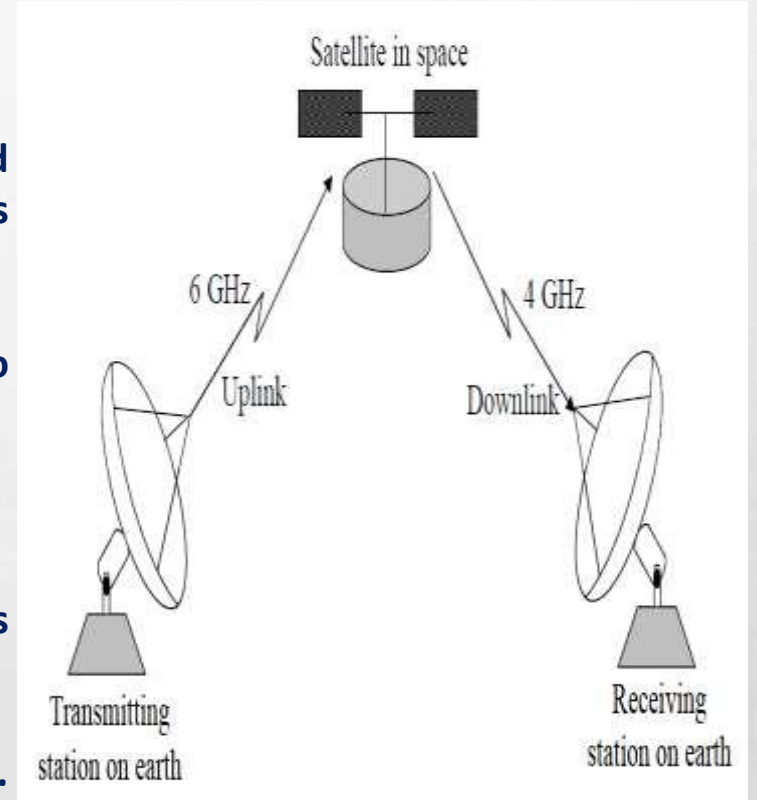
**Infrared signals, having high frequencies, cannot penetrate walls. This helps to prevent interference between one system and another.**

**There are no. of computer devices which are used to send the data through infrared medium e.g. keyboard mice, PCs and printers.**



# SATELLITE

- Communication satellite is basically a microwave relay station placed in outer space.
- 
- These are launched either by rockets or space shuttles, and are precisely positioned 36,000 kms above the equator with an orbit speed, which exactly matches the earth's rotation speed.
- Since a satellite is positioned in a geosynchronous orbit, it is stationary relative to earth, and always stays over the same point on the ground.
- The allows a ground station to aim its antenna at a fixed point in the sky.
- As shown in figure, in satellite communication, microwave signal at 6 GHz is transmitted from transmitter on earth to the satellite positioned in space.
- By the time this signal reaches the satellite, it becomes weak due to 36,000 kms travel. A transponder, which is mounted on the satellite, amplifies the weak signal and transmits it back to the earth at a frequency of 4 GHz or 11 GHz.



# COMMUNICATION PROTOCOLS

A communication protocol is a system of digital message formats and rules for exchanging those messages in or between computing systems and in telecommunications.

## DIFFERENT PROTOCOLS

Protocol Name	Full Form	Protocol Name	Full Form
TCP	Transmission Control Protocol	DNS	Domain Name System
IP	Internet Protocol	CDMA	Code Division Multiple Access
GSM	Global System for Mobile Communication	GPRS	General Packet Radio Service
HTTP	Hypertext Transfer Protocol	WLL	Wireless Local Loop
FTP	File Transfer Protocol	iMAP	Internet Message Access Protocol
SMTP	Simple Mail Transfer Protocol	Wi-Fi	Wireless Fidelity
POP	Post office Protocol	Wi-Max	Worldwide Interoperability for Microwave Access
PPP	Point to Point Protocol	LTE	Long Term Evolution

# FUNCTIONS OF DIFFERENT PROTOCOLS

Protocol Name	Full Form	Protocol Name	Full Form
TCP	Delivering end to end byte stream over an unreliable internetwork.	DNS	Identifying servers based of their IP addresses.
IP	Delivering packets based of their IP address.	GPRS	2G internet service.
GSM	2G cellular communication. GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot.	CDMA	3G cellular communication. CDMA is a form of multiplexing , which allows numerous signals to occupy a single transmission channel , optimizing the use of available bandwidth .
HTTP	Transferring files over WWW.	LTE	4G mobile communication.
FTP	Transferring files between hosts.	Telnet	Remote login.
SMTP	sending and receiving mails.		
POP	sending and receiving mails. (mails get deleted automatically after downloading them)		

# IP ADDRESS

- **An identifier for a computer or device on a TCP/IP network. Networks using the TCP/IP protocol route messages based on the IP address of the destination.**
- **The format of an IP address is a 32-bit numeric address written as four numbers separated by periods.**
- **Each number can be 0 to 255. For example, 1.160.10.240 could be an IP address.**

# FIREWALL

- A firewall is a set of related programs, located at a network gateway server that protects the resources of a private network from users from other networks.
- Basically, a firewall, working closely with a router program, examines each network packet to determine whether to forward it toward its destination.
- A firewall works a proxy server that makes network requests on behalf of workstation users.
- A firewall is often installed in a specially designated computer separate from the rest of the network so that no incoming request can get directly at private network resources.

# HACKING

- Computer hacking is the practice of modifying computer hardware and software to accomplish a goal outside of the creator's original purpose.
- People who engage in computer hacking activities are often called hackers.

# OPEN SOURCE CONCEPTS

## Open-source software (OSS)

OSS is computer software that is available in source code form: the source code and certain other rights normally reserved for copyright holders are provided under an open-source license that permits users to study, change, improve and at times also to distribute the software. (e.g. Firefox, Chrome, Linux, python, PHP, open office etc.)

## Shareware

Shareware is software that is distributed free on a trial basis with the understanding that the user may need or want to pay for it later. Some software developers offer a shareware version of their program with a built-in expiration date (after 30 days, the user can no longer get access to the program).

# OPEN SOURCE CONCEPTS

## Proprietary Software

Proprietary software is software that is owned by an individual or a company (usually the one that developed it). There are almost always major restrictions on its use, and its source code is almost always kept secret.

## FLOSS

Free, Libre, Open Source Software is software that can be used, studied, and modified without restriction, and which can be copied and redistributed in modified or unmodified form either without restriction, or with restrictions that only ensure that further recipients have the same rights under which it was obtained and that manufacturers of consumer products incorporating free software provide the software as source code.

# OPEN SOURCE CONCEPTS

## *GNU*

Self-referentially, short for GNU's not UNIX, a UNIX-compatible software system developed by the Free Software Foundation (FSF). The philosophy behind GNU is to produce software that is non-proprietary. Anyone can download, modify and redistribute GNU software. The only restriction is that they cannot limit further redistribution. The GNU project was started in 1983 by Richard Stallman at the Massachusetts Institute of Technology.

## *FSF*

The Free Software Foundation (FSF) is a non-profit corporation founded by Richard Stallman on 4 October 1985 to support the free software movement, a copyright - based movement which aims to promote the universal freedom to create, distribute and modify computer software.



# OPEN SOURCE INITIATIVE (OSI)

The Open Source Initiative (OSI) is an organization dedicated to promoting open-source software.

The organization was founded in February 1998 by Bruce Perens and Eric S. Raymond, part of a group inspired by the Netscape Communications Corporation publishing the source code for its flagship Netscape Communicator product. Later, in August 1998, the organization added a board of directors.

THANK  
YOU