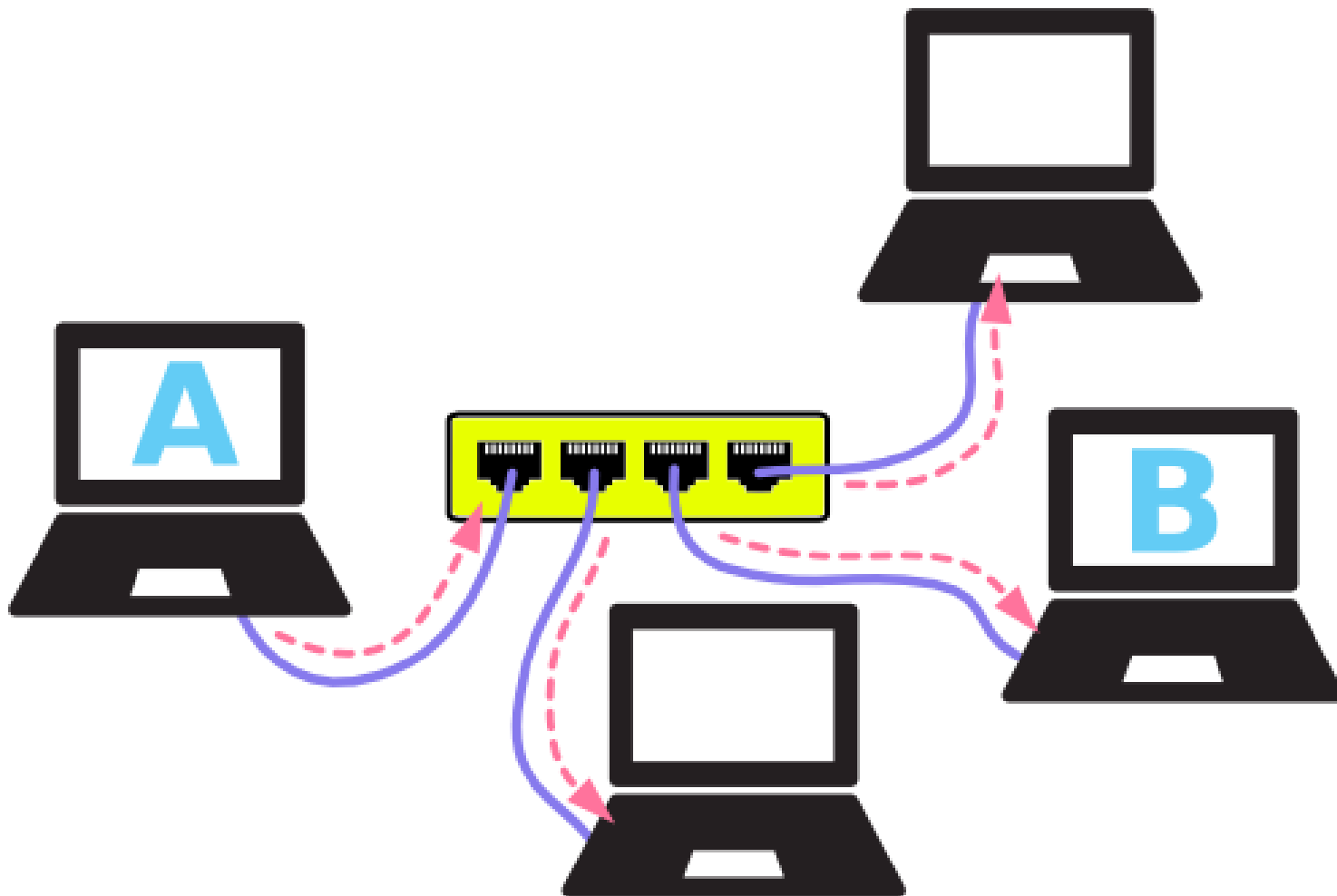


# Network Concepts



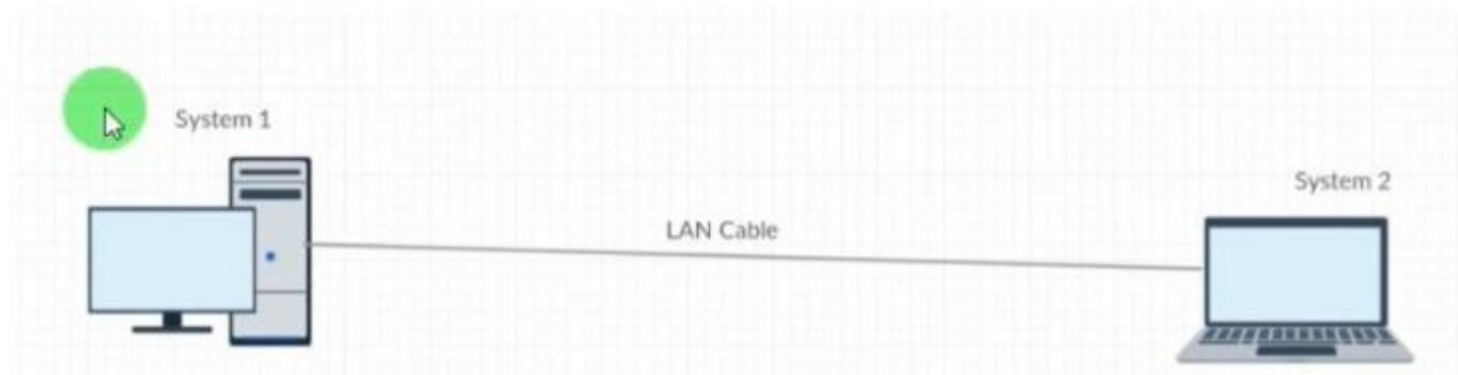
# Computer Network

Share a nearly limitless range of information and services, including:

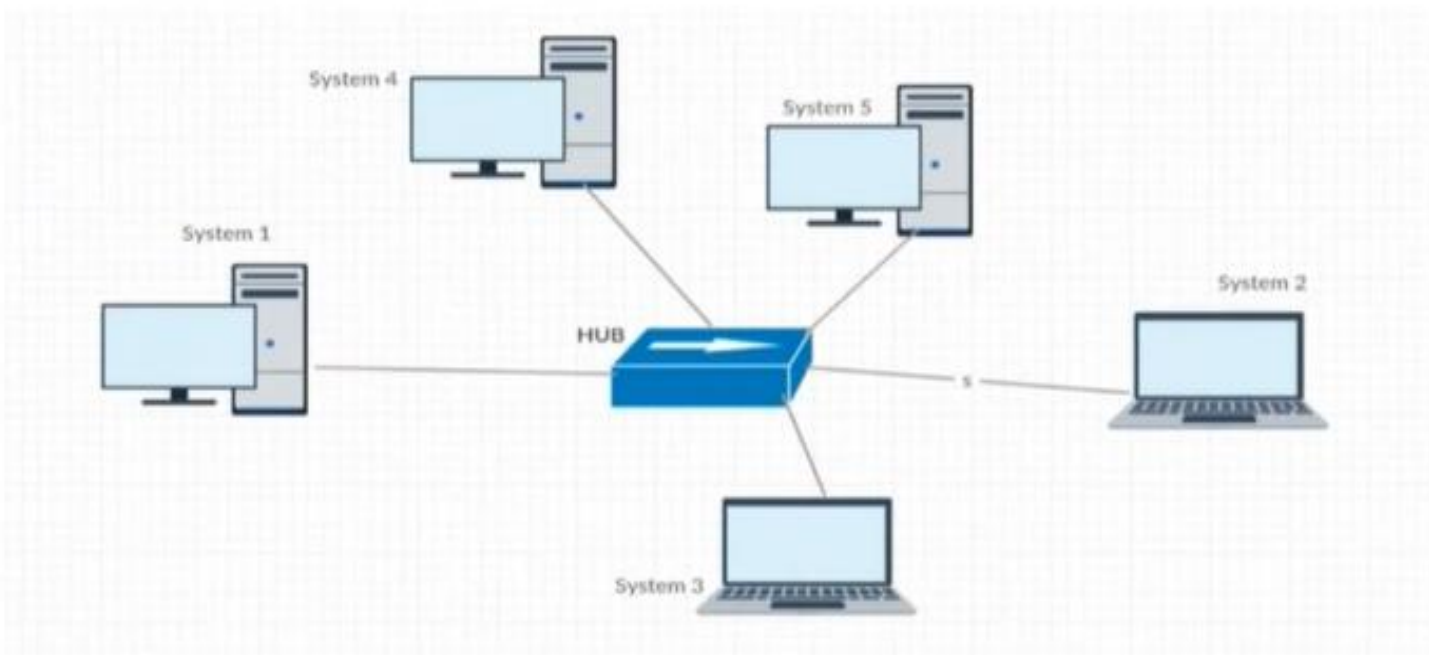
- Documents
- Email and messaging
- Websites
- Databases
- Music
- Printers and faxes
- Telephony and videoconferencing

# What is Networking

- Two Computer **can** be connected with each other with a LAN Cable.



- ▶ But if we have more than 2 system to connect with each other, We have to use some other medium . Which we called Hub as shown below



# Device Picture



LAN Cable



HUB Device

# Ipconfig/all - Command

```
C:\Users\Shaik Iftekhar Ahmed>ipconfig/all

Windows IP Configuration

Host Name . . . . . : DESKTOP-79N14PK
Primary Dns Suffix . . . . . :
Node Type . . . . . : Hybrid
IP Routing Enabled. . . . . : No
WINS Proxy Enabled. . . . . : No
DNS Suffix Search List. . . . . : domain.name

Ethernet adapter Ethernet:

Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . : domain.name
Description . . . . . : Broadcom NetXtreme 57xx Gigabit Controller
Physical Address. . . . . : F0-1F-AF-55-D4-D4
DHCP Enabled. . . . . : Yes
Autoconfiguration Enabled . . . . : Yes

Ethernet adapter VirtualBox Host-Only Network:

Connection-specific DNS Suffix . :
Description . . . . . : VirtualBox Host-Only Ethernet Adapter
Physical Address. . . . . : 0A-00-27-00-00-13
DHCP Enabled. . . . . : No
Autoconfiguration Enabled . . . . : Yes
Link-local IPv6 Address . . . . . : fe80::cd82:2bfe:dc2a:37ce%19(Preferred)
IPv4 Address. . . . . : 192.168.56.1(Preferred)
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . :
DHCPv6 IAID . . . . . : 738852903
DHCPv6 Client DUID. . . . . : 00-01-00-01-28-5C-6B-77-F0-1F-AF-55-D4-D4
DNS Servers . . . . . : fec0:0:0:ffff::1%1
                       fec0:0:0:ffff::2%1
                       fec0:0:0:ffff::3%1
NetBIOS over Tcpi. . . . . : Enabled
```

# Computer Address

A Computer has two types of Address

- ▶ Physical Address (Permanent Address)
  - MAC address is the physical address.
  - MAC address is of 48 Bit.
  - MAC address can't be changed and It exist on the NIC Card.
- ▶ 2) Logical Address (Temporary Address)
  - IP address is the logical address.
  - IP address is of 32 Bit.
  - IP address can be change and it is provided by System & ISP.

# Physical Address

1. MAC address made by 48 Bit or 6 Bytes .
2. First 24 Bits to identify the Vendor. Which same for all adapters from same vendor.
3. Last 24 Bits are for universally administered address.

```
C:\Users\ram>ipconfig /all

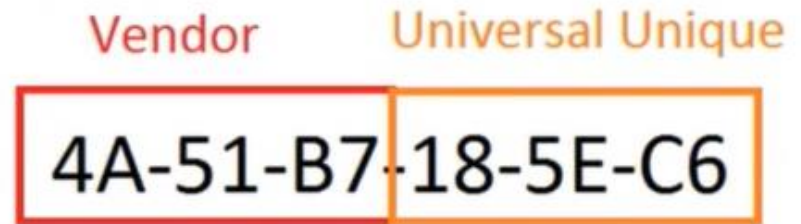
Windows IP Configuration

Host Name . . . . . : hanuman
Primary Dns Suffix . . . . . :
Node Type . . . . . : Mixed
IP Routing Enabled. . . . . : No
WINS Proxy Enabled. . . . . : No
DNS Suffix Search List. . . . . : dlinkrouter

Wireless LAN adapter Local Area Connection* 16:

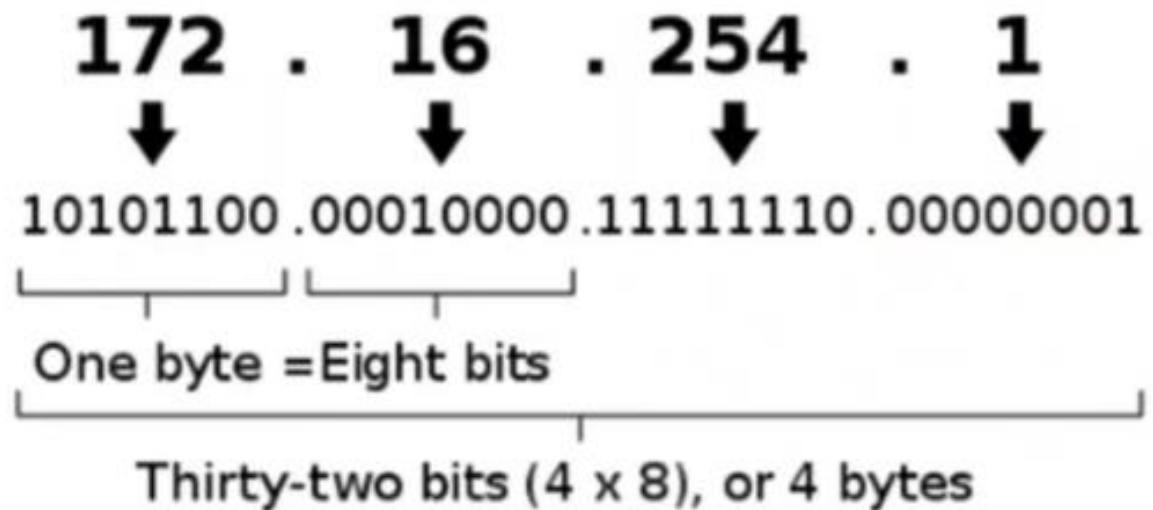
Media State . . . . . : Media disconnected
Connection-specific DNS Suffix . . :
Description . . . . . : Microsoft Wi-Fi Direct Virtual Adapter #3

Physical Address. . . . . : 4A-51-B7-18-5E-C6
DHCP Enabled. . . . . : No
Autoconfiguration Enabled . . . . : Yes
```

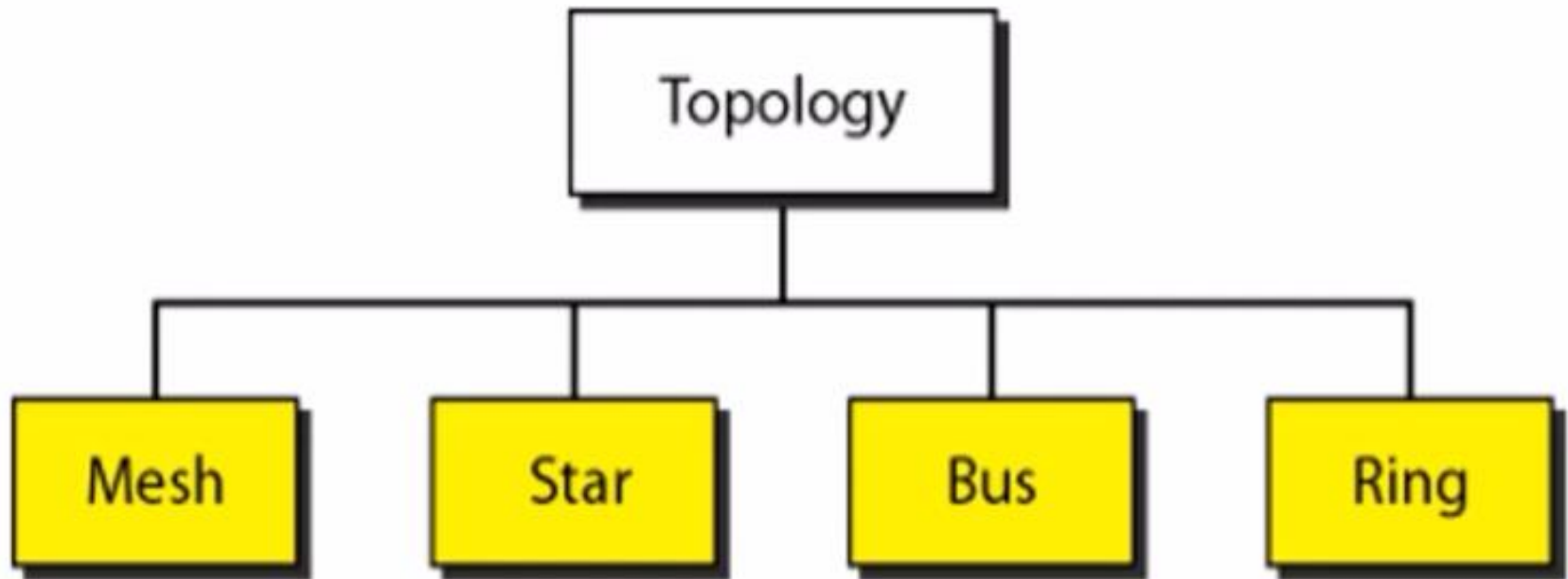


# Logical Address

- ▶ IP address is known as Logical address of the computer system.
- ▶ It is combination of 4 octets separated by “.”.

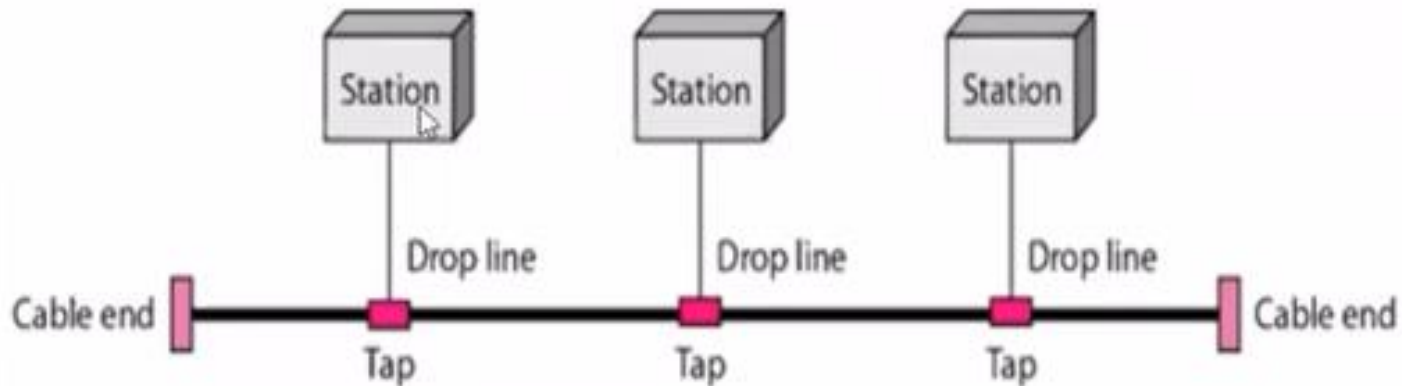


# Categories of Topology



# Bus topology

- ▶ Bus topology ,all devices share single communication line or cable
- ▶ One long cable acts as a backbone to link all the devices in a network.
- ▶ Nodes are connected to the bus cable by drop lines and taps.



## Advantages

- ▶ Ease of installation
- ▶ Bus uses less cabling

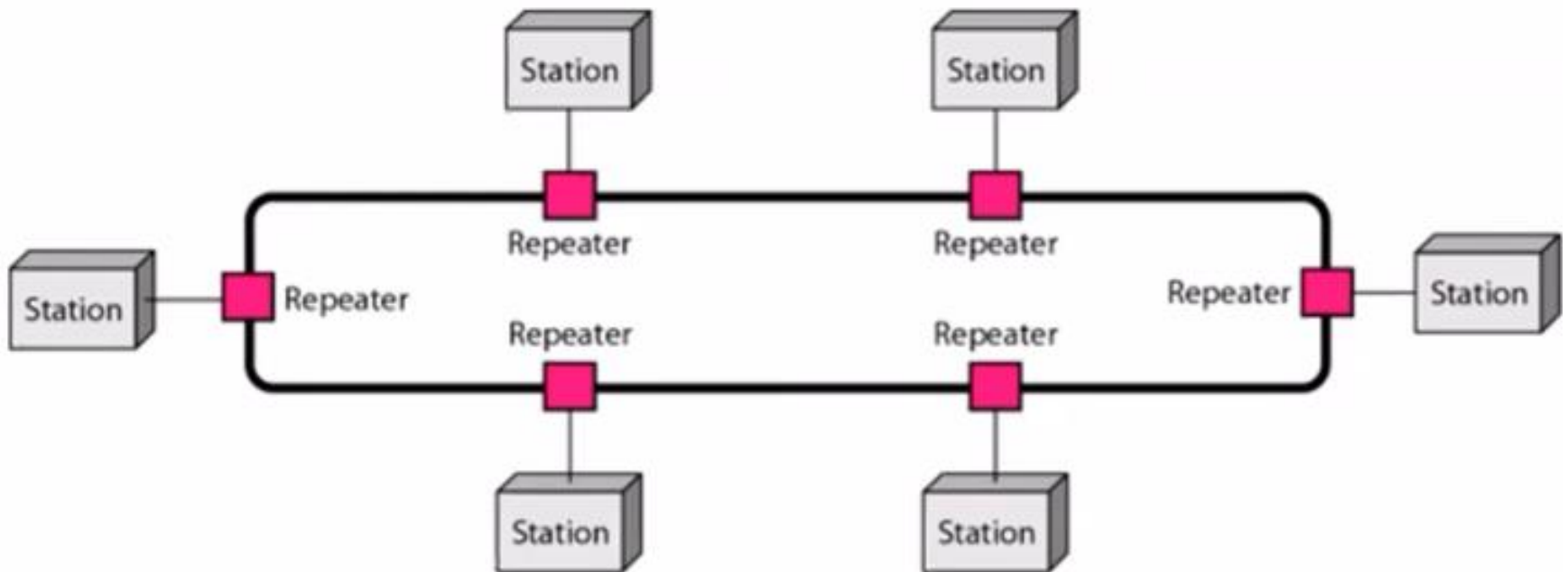
## Disadvantages

- ▶ Difficult reconnection and fault isolation
- ▶ Difficult to add new devices

❖ Bus topology was the one of the first topologies used in the design of early local-area networks.

# Ring Topology

- Each host machine connects to exactly two other machines, creating a circular Network Structure
- A signal is passed along the ring in one direction, from device to device, until it reaches its destination.



## Advantages

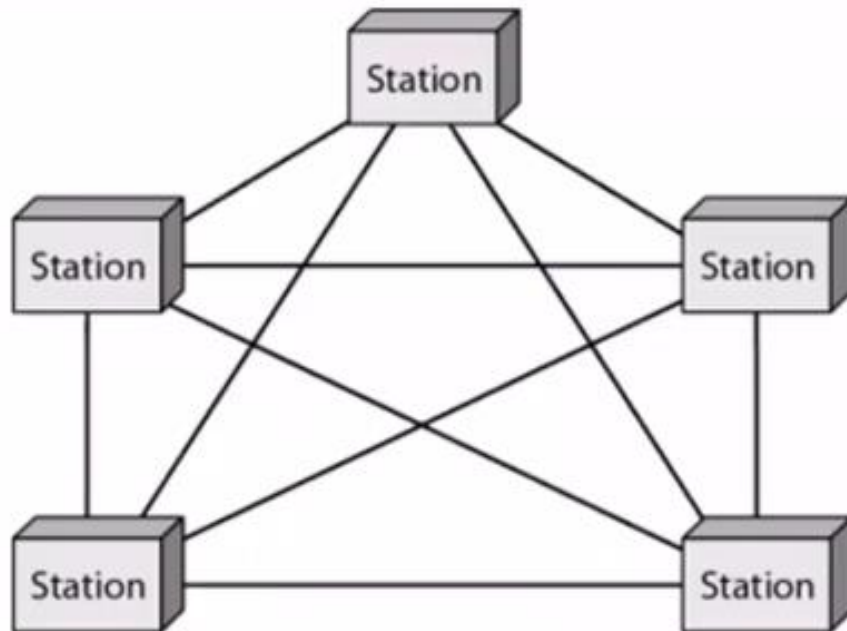
- A ring is relatively easy to install and reconfigure
- A ring is better at handling load
- A central server is not required for the management of this topology

## Disadvantages

- Data sent from one node to another has to pass through all the intermediate nodes.
- The transmission speed drops with an increase in the number of nodes
- The failure of a single node in the network can cause the entire network to fail

# Mesh Topology

- In a mesh topology, every device has a dedicated point-to-point link to every other device.
- The term dedicated means that the link carries traffic only between the two devices it connects.



## Advantages

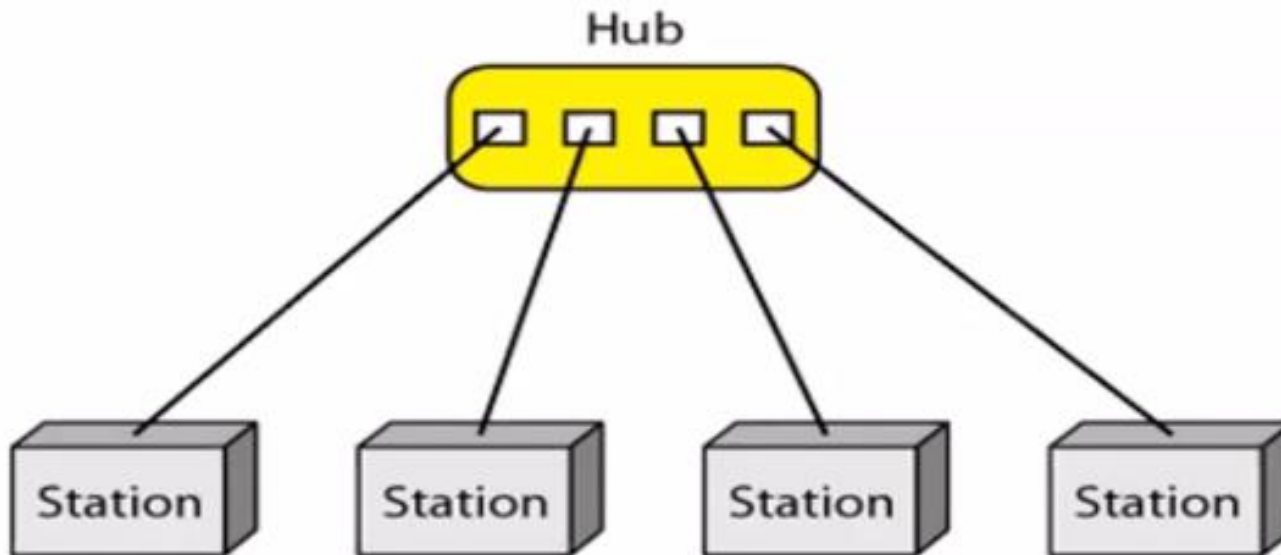
- It can handle heavy traffic, as there are dedicated paths between any two network nodes.
- The failure of a single node does not cause the entire network to fail as there are alternate paths for data transmission

## Disadvantages

- A lot of cabling is required
- Costs incurred in setup and maintenance are high.
- Administration of a mesh network is difficult.

# Star Topology

- In a star topology, each device has a dedicated point-to-point link only to a central controller. Usually called a HUB
- The devices are not directly linked to one another.
- A star topology does not allow



## Advantages

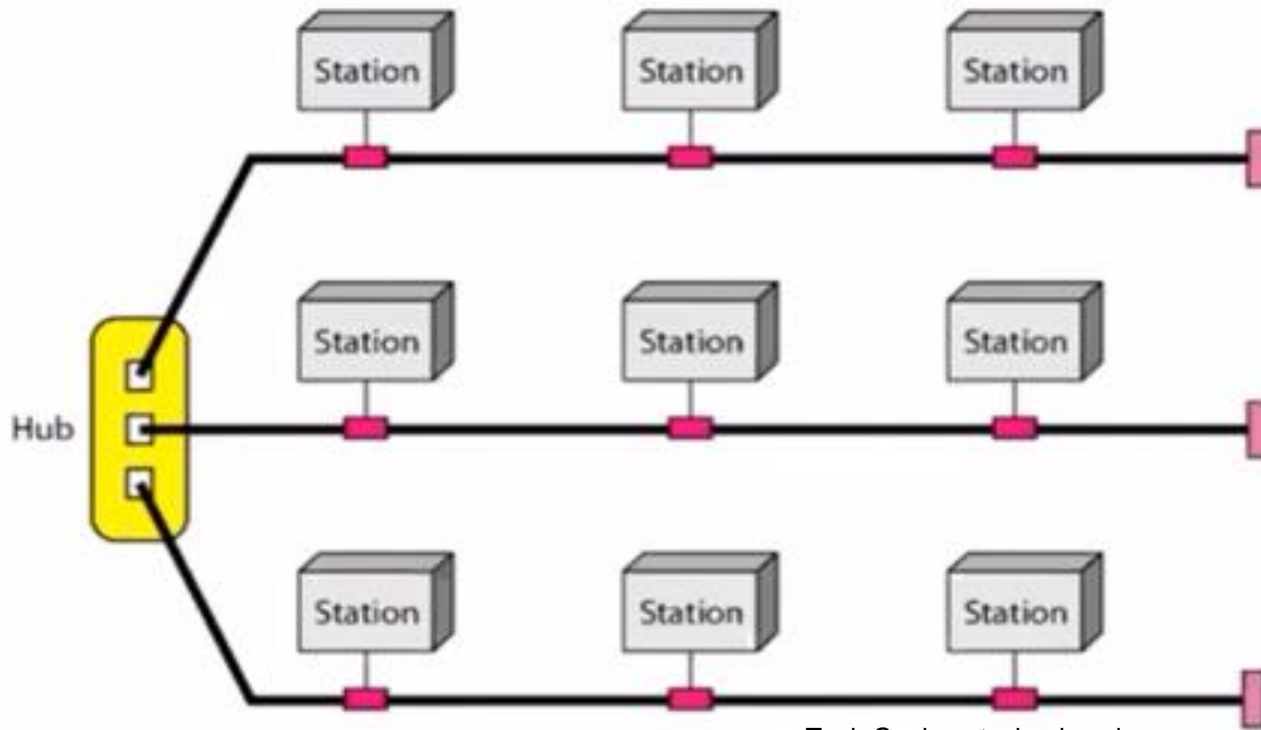
- A star topology is less expensive
- It easy to install and reconfigure
- Robustness

## Disadvantages

One big disadvantage of a star topology, is the dependency of the whole topology on one single point in the hub

# Hybrid Topology

- It is two different types of topologies which is a mixture of two or more topologies.
- For example if in an office in one department ring topology is used and in another star topology is used, connecting these topologies will result in Hybrid Topology



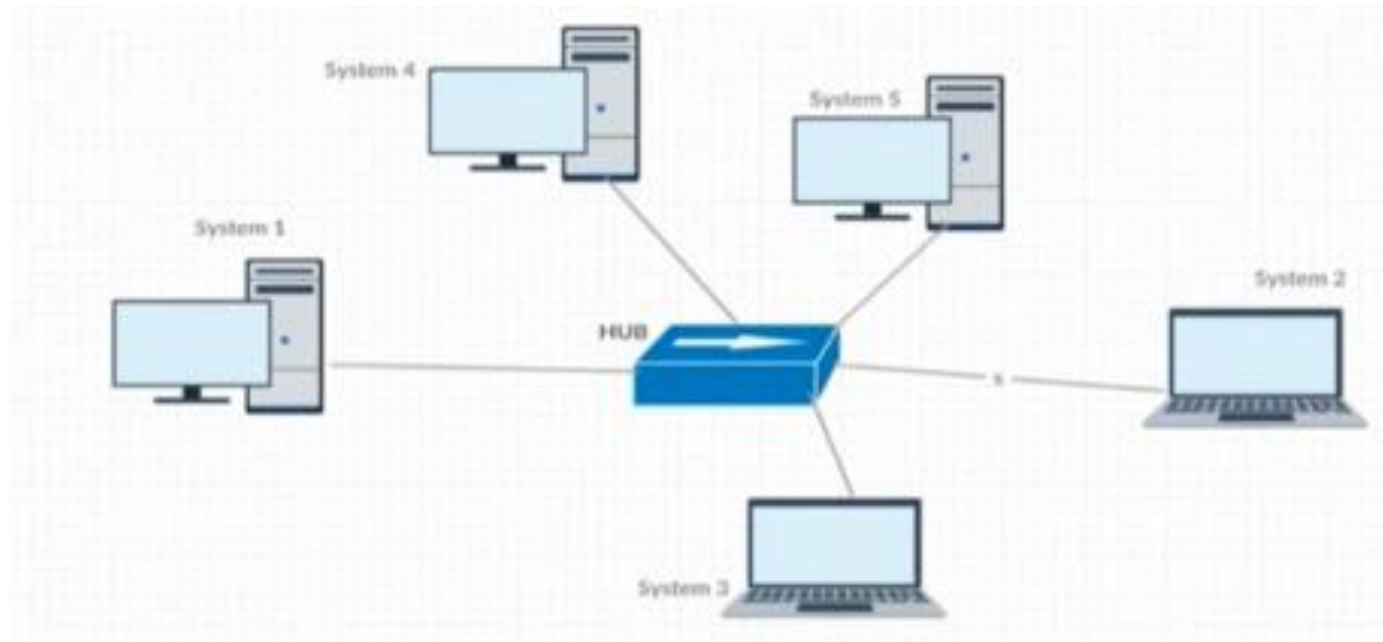
# Network Devices

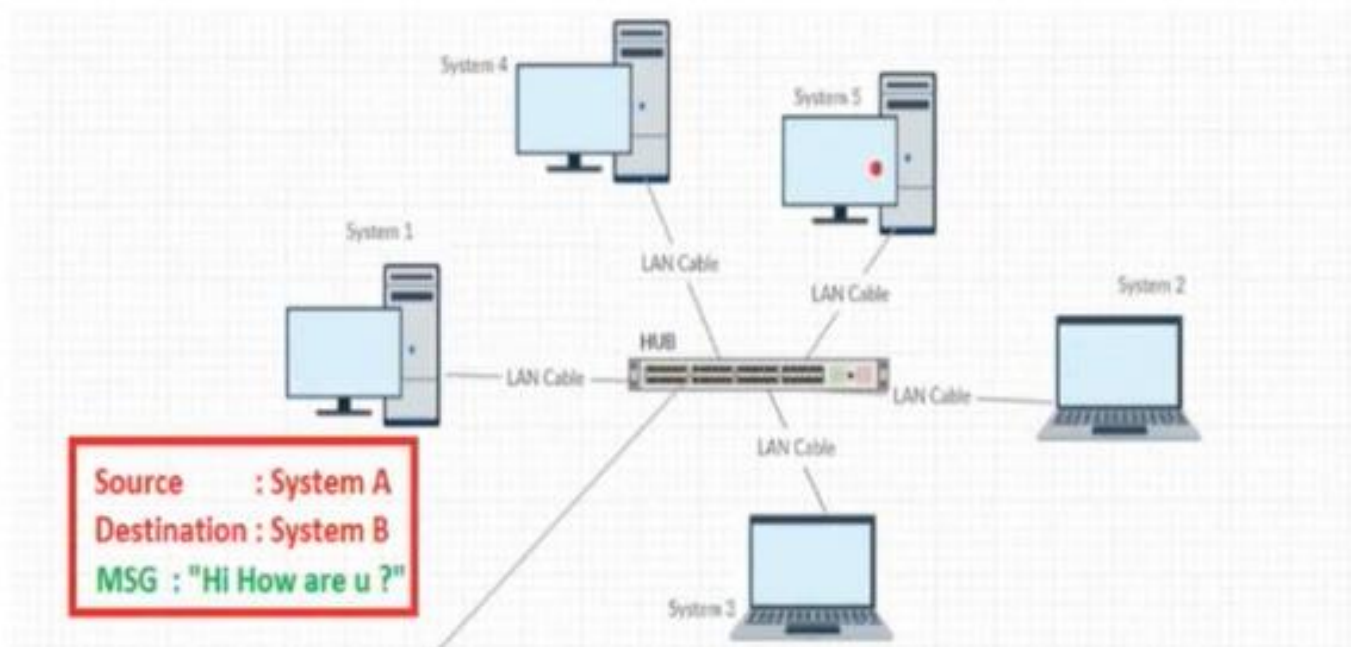
1.Hub

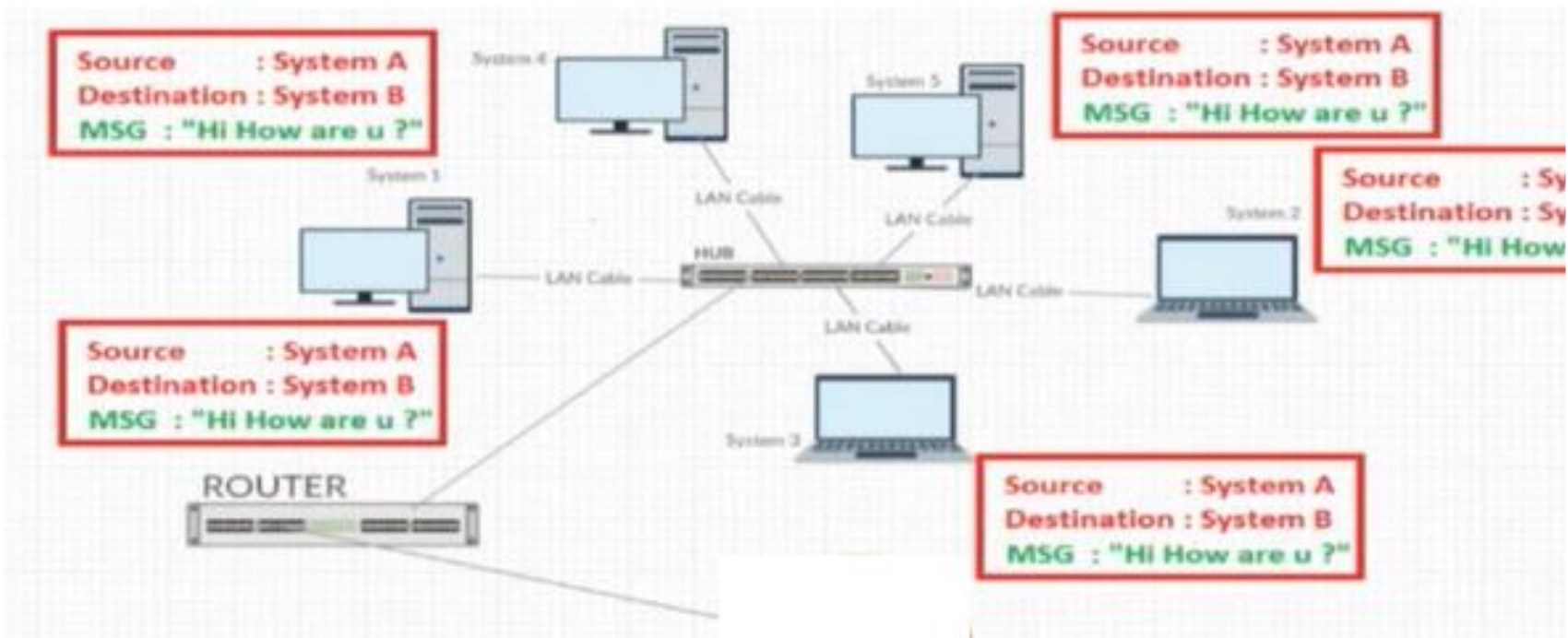
2.Switch

3.Router

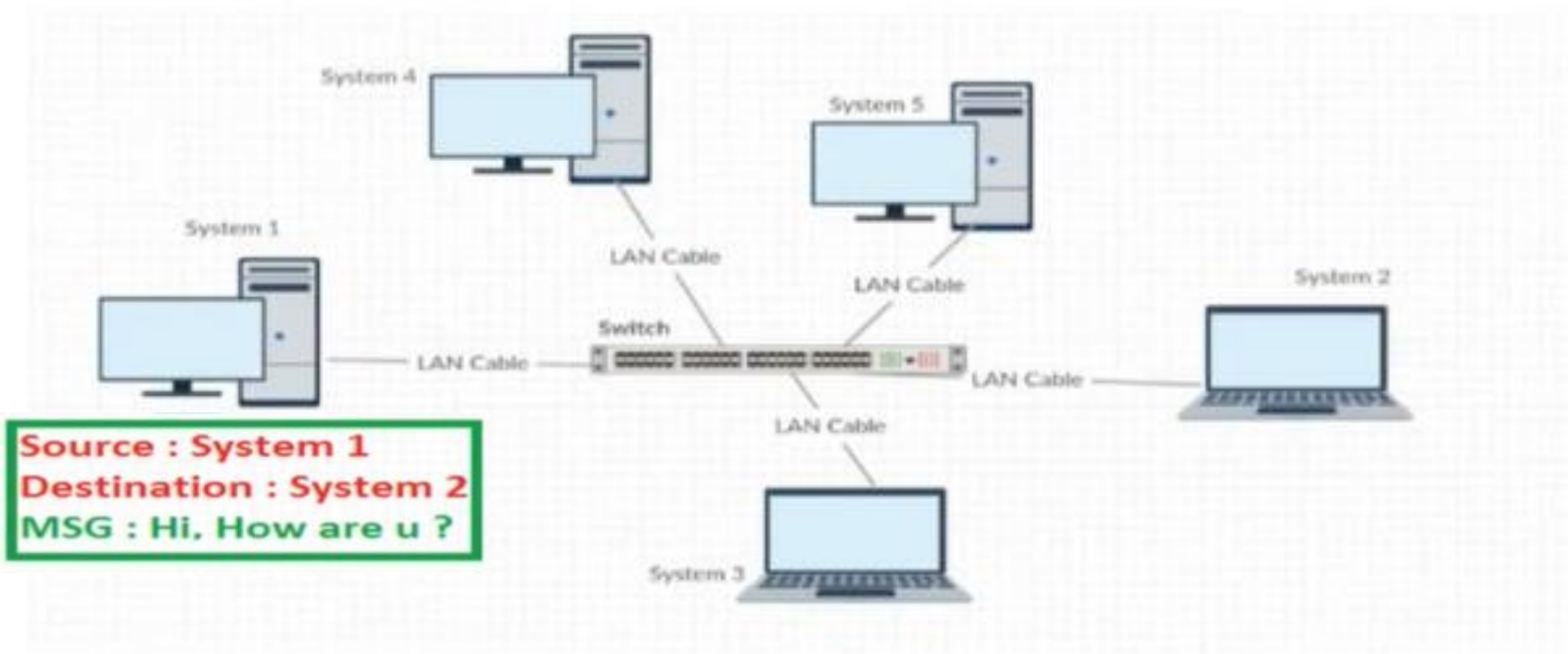
# HUB



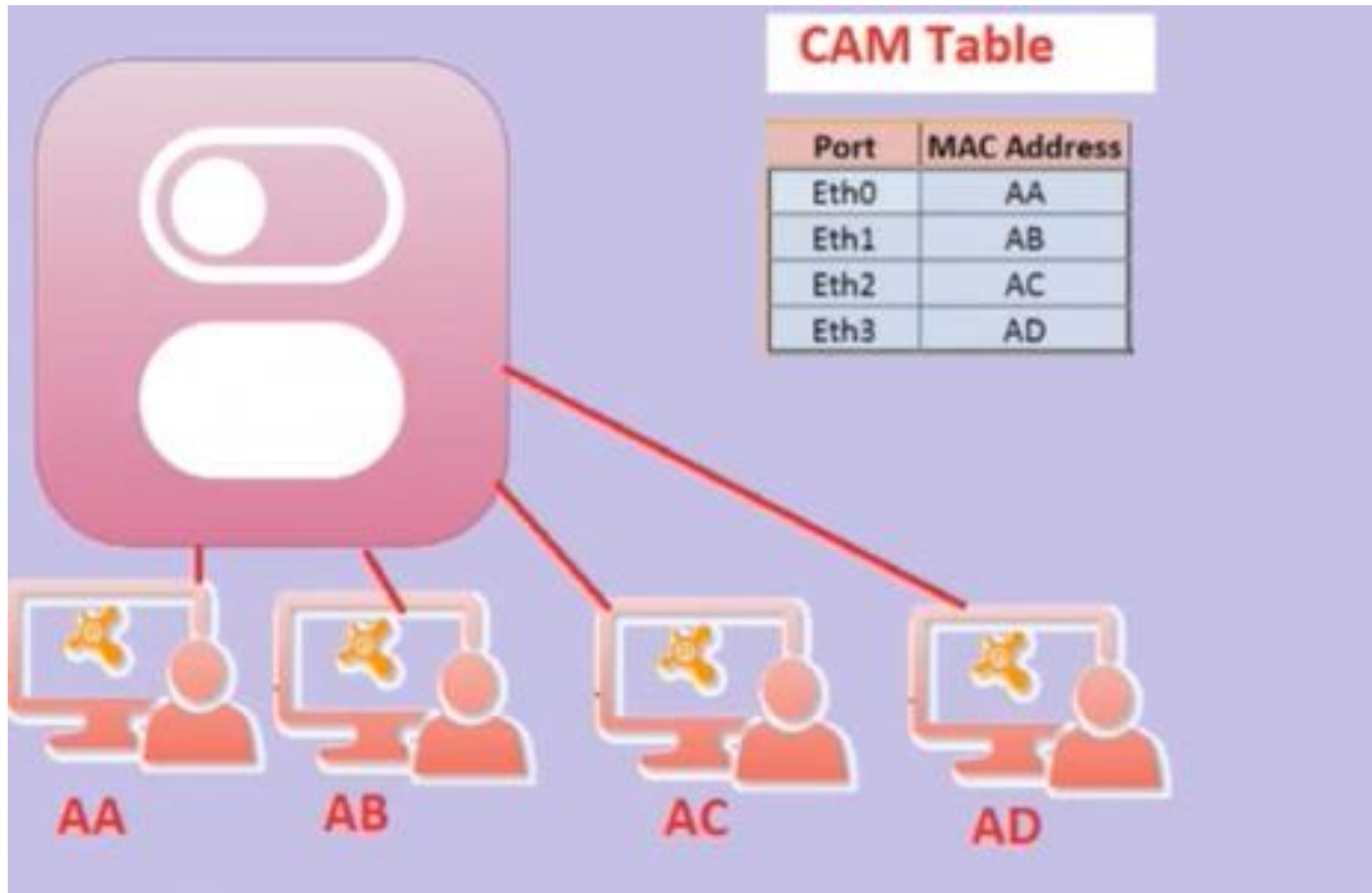




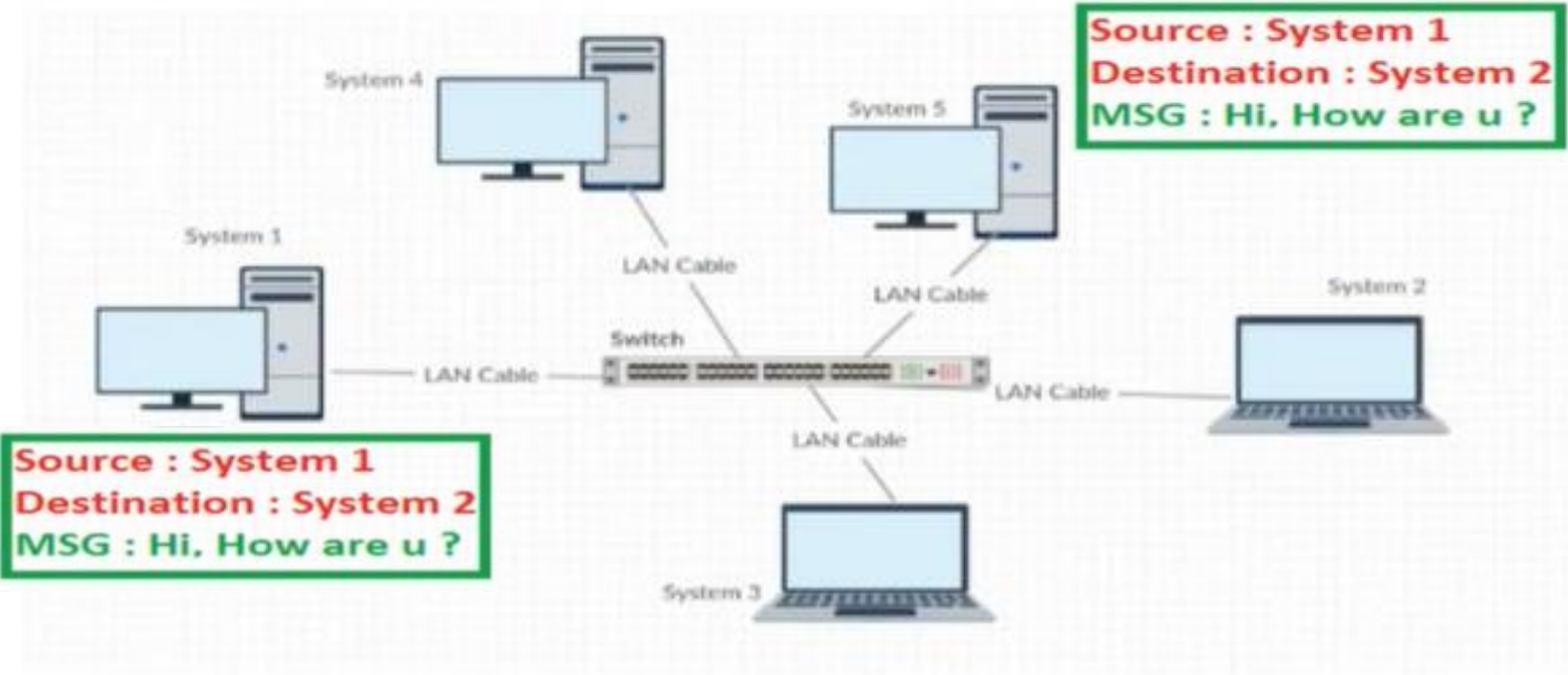
# Hub Replaced by Switch



# Switch-CAM Table

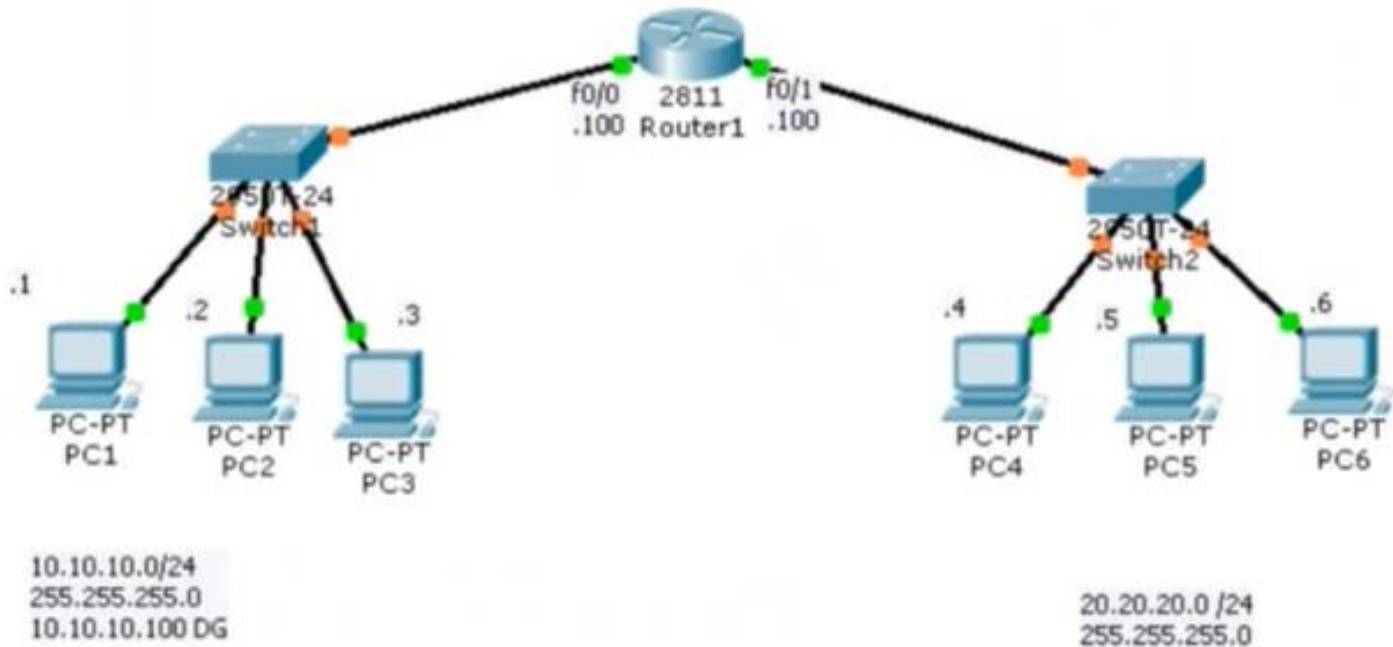


# Received by Only B



# Router?

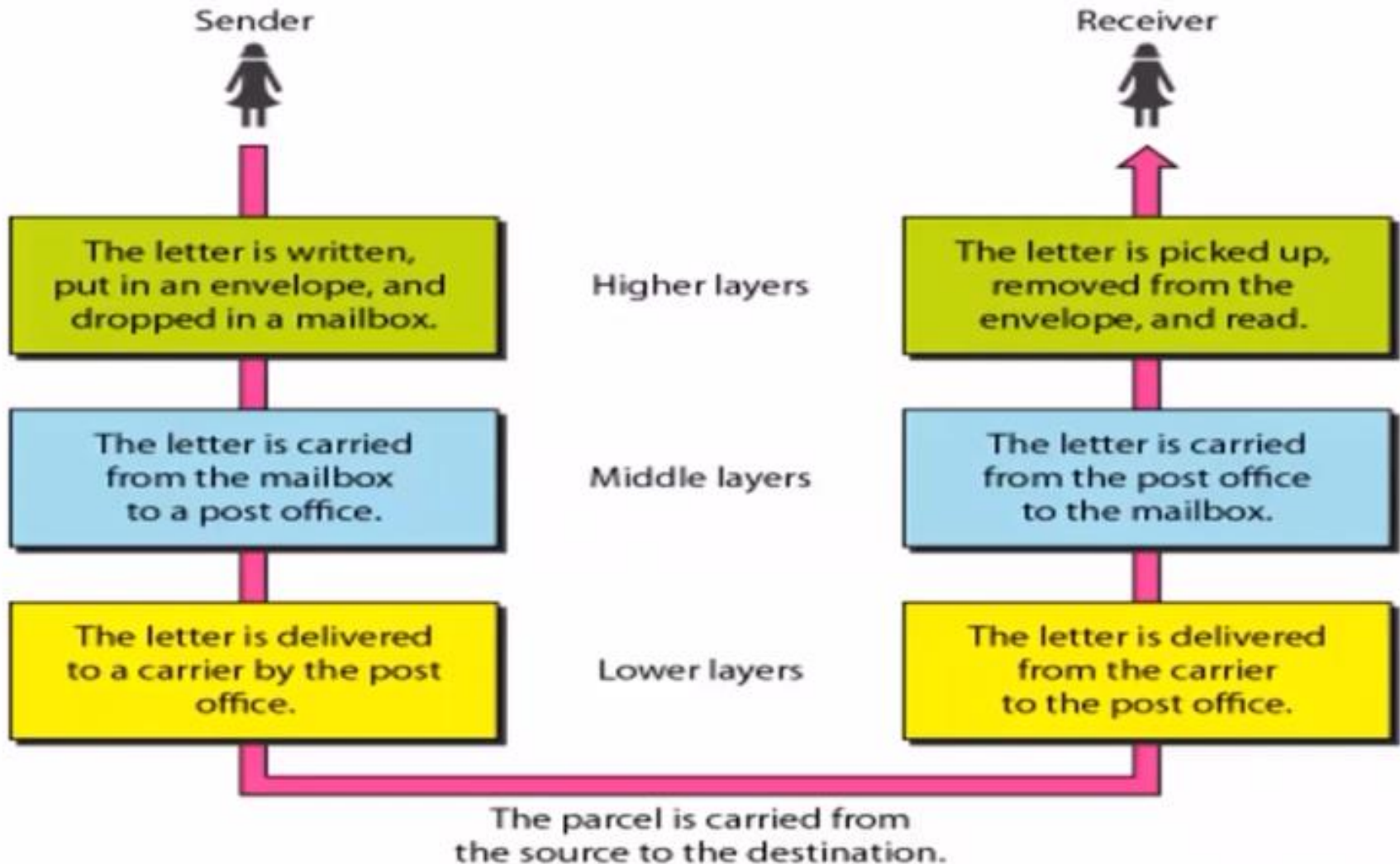
## ► Connect different Network



# Router?



- ▶ Router is responsible for sending packets in the network.
- ▶ Router will check the routing table and route, it accordingly.
- ▶ Router will decide the best and fast route for the packet

# Layered communication



OSI Model	TCP/IP Protocol Suite
Physical Layer	Physical Layer
Datalink Layer	
Network Layer	Internet Layer
Transport Layer	Transport Layer
Session Layer	Application Layer
Presentation Layer	
Application Layer	

# TCP/IP Protocol Suite?

<b>Application Layer</b>	
<b>Transport Layer</b>	<b>53 (DNS)</b>
<b>Internet Layer</b>	<b>192.168.1.1</b>
<b>Data Link layer</b>	

# TCP/IP Protocol Suite?

```
C:\Users\Shaik Iftexhar Ahmed>ping 127.0.0.1
```

```
Pinging 127.0.0.1 with 32 bytes of data:
```

```
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128
```

```
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128
```

```
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128
```

```
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128
```

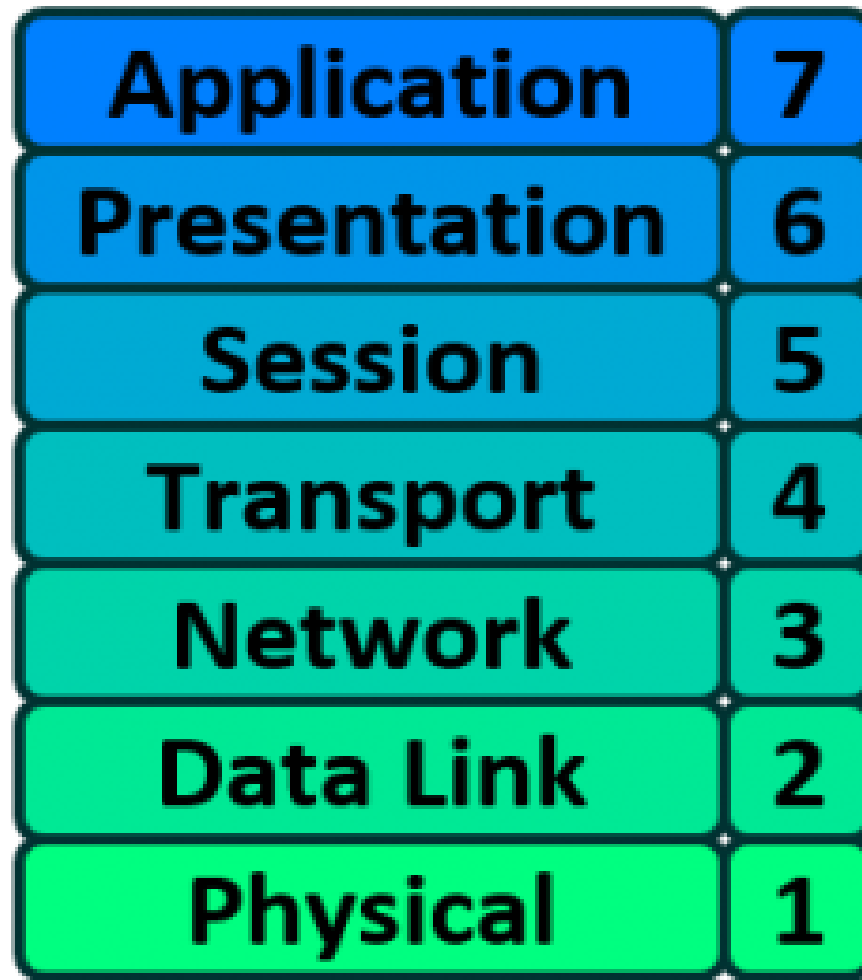
```
Ping statistics for 127.0.0.1:
```

```
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
```

```
Approximate round trip times in milli-seconds:
```

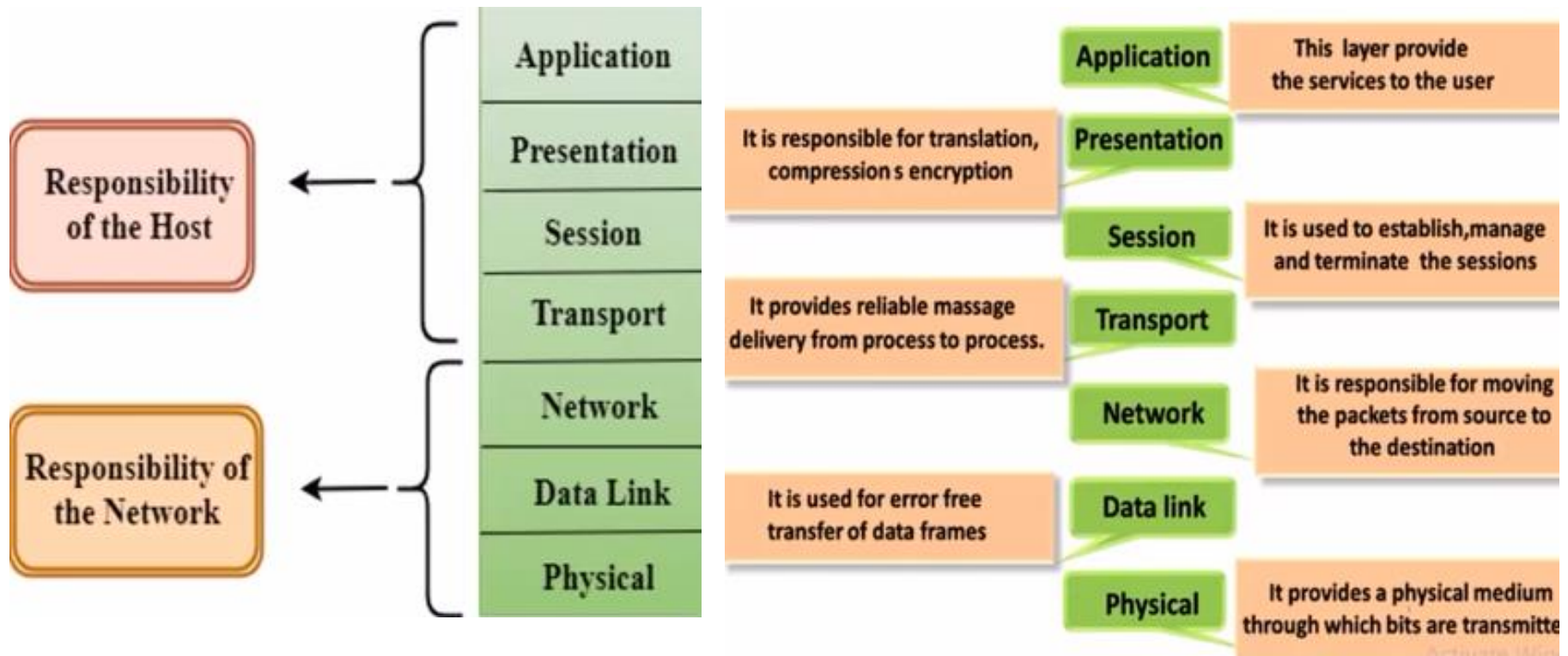
```
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

# Seven layers of the OSI model



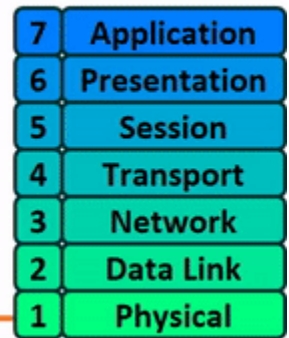
# Open Systems Interconnection (OSI) model

The OSI model is not a protocol; it is a model for understanding and designing a network architecture that is flexible, robust, and interoperable





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# Protocol Data Units (PDUs)

- OSI model, each layer adds a header containing protocol information specific to that layer.
- These headers are called Protocol Data Units (PDUs), and the process of adding these headers is called encapsulation.

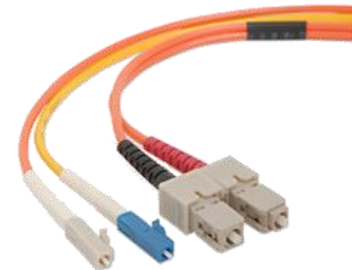
<i>Layer</i>	<i>PDU Name</i>
Application	-
Presentation	-
Session	-
Transport	<b>Segments</b>
Network	<b>Packets</b>
Data-Link	<b>Frames</b>
Physical	<b>Bits</b>

# Physical layer

The Physical layer (Layer-1) controls the signalling and transferring of raw bits onto the physical medium I.

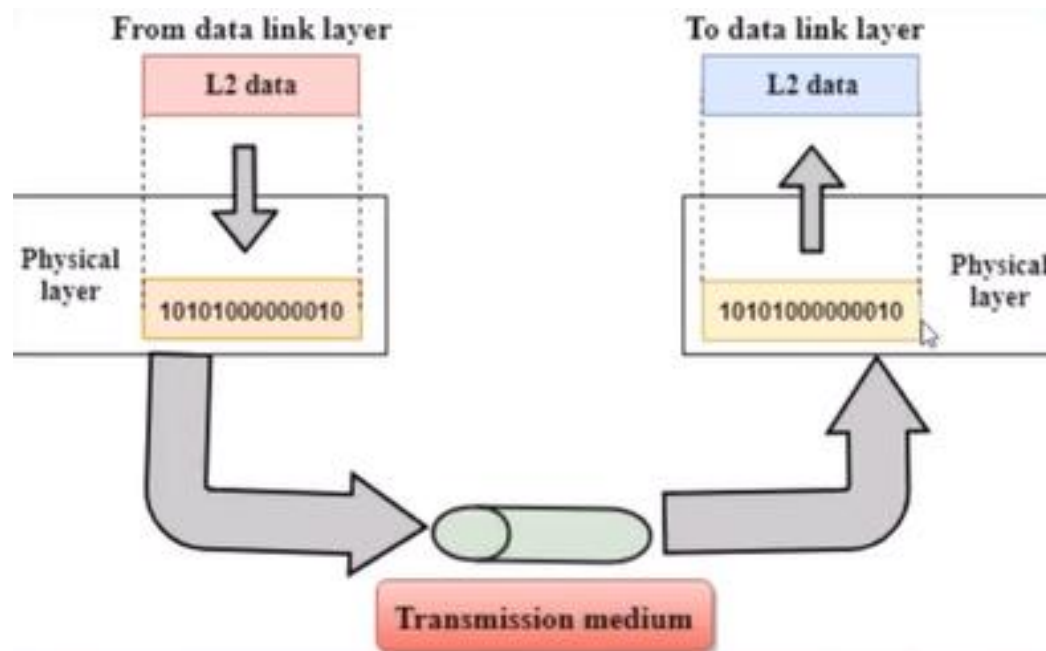
The Physical layer provides specifications for a variety of hardware:

- Cabling
- Connectors and transceivers
- Network interface cards (NICs)
- Wireless radios
- Hubs



# Protocol Data Units (PDUs) = Bits

The physical layer coordinates the functions required to carry a bit stream over a physical medium.



The physical layer is responsible for movements of individual bits from one hop (node) to the next.

# Physical characteristics

- Representation of bits (0s and 1s).
- Data rate.
- Physical topology.
- Transmission mode.

# Data Link Layer

- The Data-link layer packages the higher-layer data into **frames**,
- The data-link frame contains the source and destination **hardware (or physical) address**
- The most common hardware address is the **Ethernet MAC address**.
- Data link layer has two sub-layers:

**Logical Link Control** : It deals with protocols, flow-control, and error control

**Media Access Control**: It deals with actual control of media

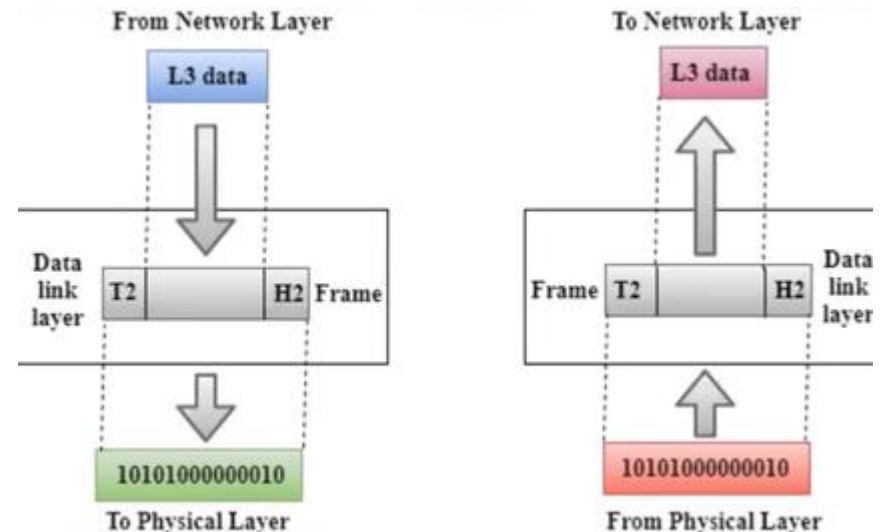
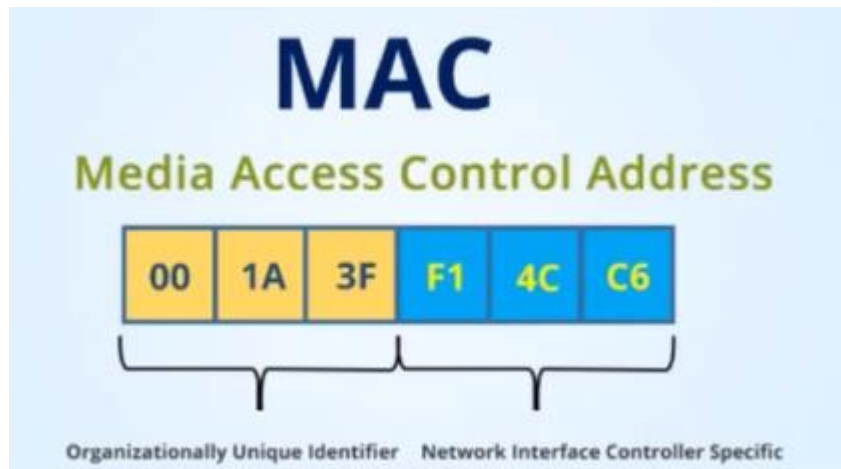


**The data link layer is responsible for moving frames from one hop (node) to the next.**

# Protocol Data Units (PDUs) = Frames

Data link layer does many tasks on behalf of upper layer

- Framing
- Addressing
- Error Control
- Flow Control



# Network Layer

The network layer is responsible for the source-to-destination delivery of a packet, possibly across multiple networks (links).

The network layer ensures that each packet gets from its point of origin to its final destination

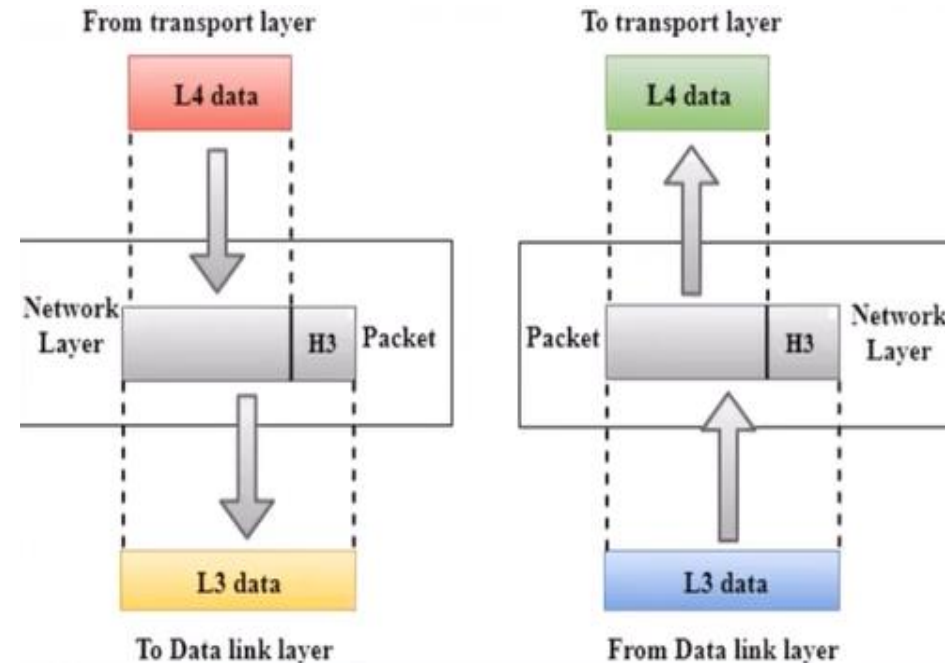
Routers are Network Devices that operate at Layer 3 of the OSI model. A Router's primary responsibility is to facilitate communication between Networks.



**The network layer is responsible for the delivery of individual packets from the source host to the destination host.**

# Protocol Data Units (PDUs) = Packets

- Responsibilities of the network layer :-
- Addressing devices and networks.
- Populating routing tables or static routes.
- Queuing incoming and outgoing data and then forwarding them according to quality of service constraints set for those packets.
- Internetworking between two different subnets.
- Delivering packets to destination with best efforts.
- Provides connection oriented and connection less mechanism.

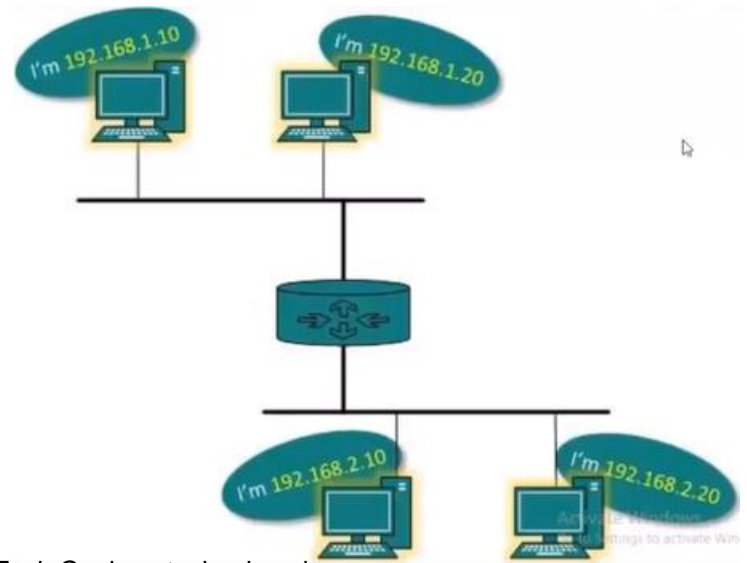


# Network Addressing

IP Address

## IP Address routing

- Unicast (destined to one host)
- Multicast (destined to group)
- Broadcast (destined to all)
- Anycast (destined to nearest one)



# The Transport Layer

Transport layer offers peer-to-peer and end-to-end connection between two processes on remote hosts.

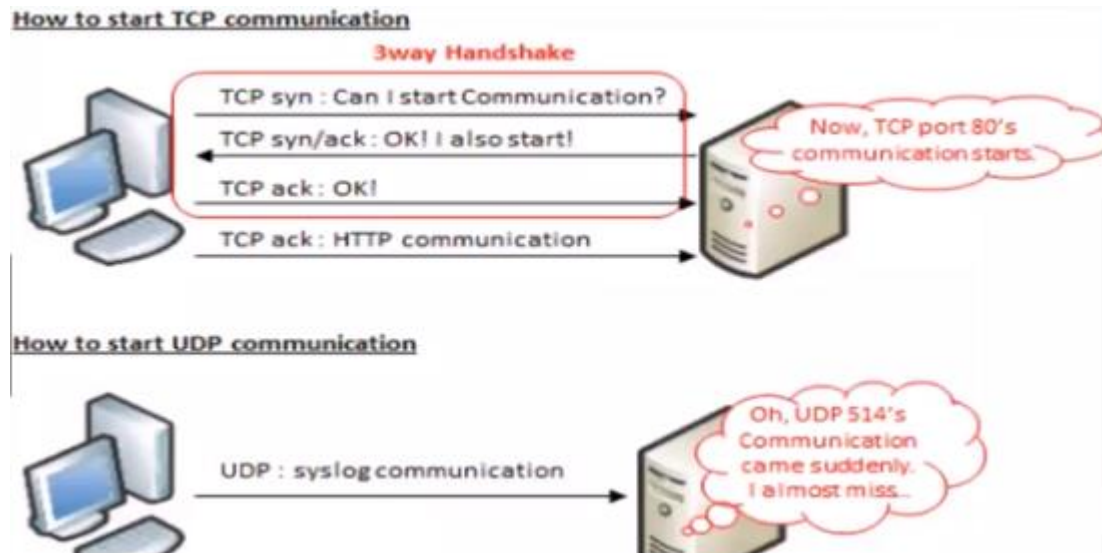
Transport layer communication falls under two categories:

- **Connection-oriented** - requires that a connection with specific agreed-upon parameters be established before data is sent.
- **Connectionless** - requires no connection before data is sent.

**The transport layer is responsible for the delivery of a message from one process to another.**

The TCP/IP protocol suite incorporates two Transport layer protocols:

- Transmission Control Protocol (TCP) - connection-oriented
- User Datagram Protocol (UDP) - connectionless



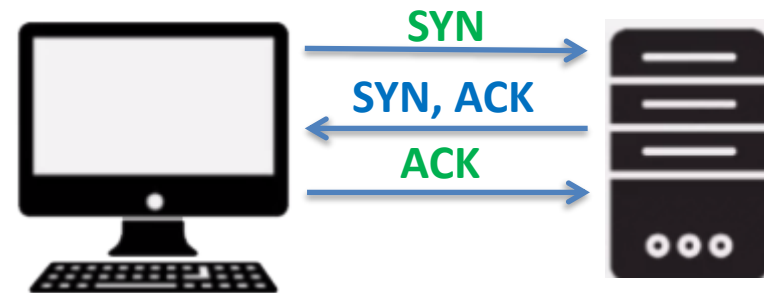
# 3 way handshake

A three-way handshake is a method used in a TCP/IP network to create a connection between two hosts.

It is a 3 step process that requires both the client and server to exchange SYN and ACK (acknowledgment) packets before actual data communication begins.

Process is as Follows:

- A client node sends a SYN data packet to a server it wants to communicate to. The objective of this packet is to ask/infer if the server is open for new connections.



- If the server is willing to communicate to the client (if the port is open) it responds with an ACK packet.
- It also expresses its intention of talking back to the client with its SYN packet.
- Together it is SYN/ACK
- The client node responds with an ACK for the server's SYN.

Upon completion of this process, the connection is created and the host and server can communicate.

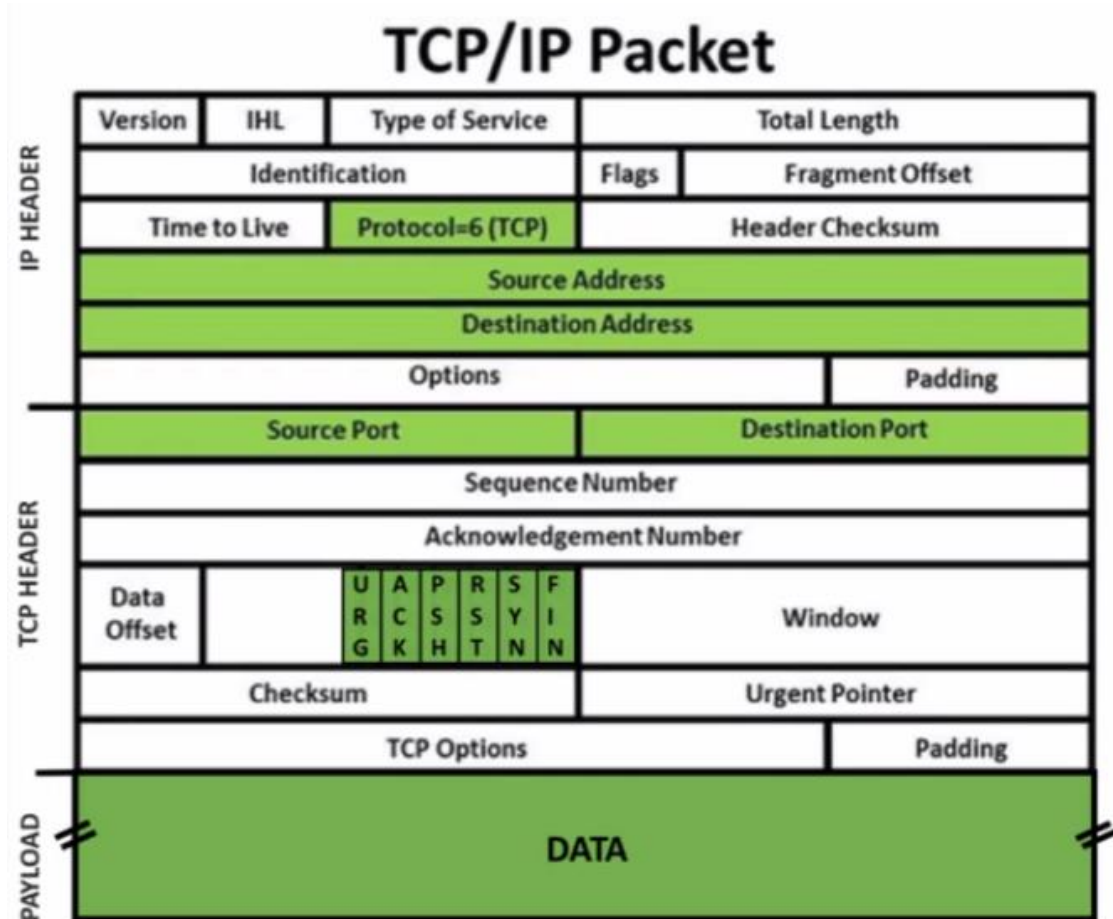
# Packet Structure

A packet has 3 main sections

- IP Header
- TCP Header
- Payload

Few of the important fields in the packets are

- Source IP
- Destination IP
- Source Port
- Destination Port
- TCP Flags
- Data

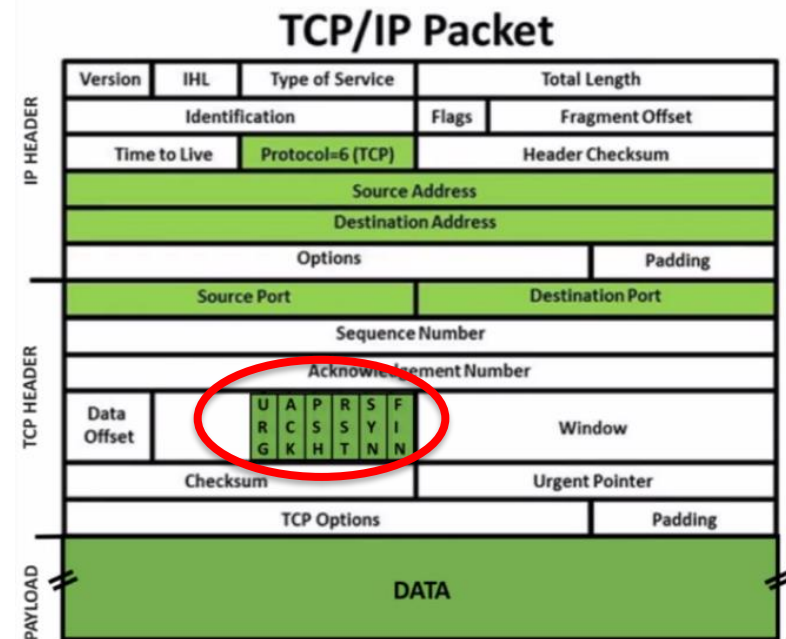


# TCP Flags

In TCP connection, flags are used to indicate a particular state of connection.

There are 6 Flags in a TCP Header

Flag	Description
<b>SYN</b> (Synchronization)	It is used in first step of connection establishment phase or 3-way handshake process between the two hosts.
<b>ACK</b> (Acknowledgement)	It is used to acknowledge packets which are successful received by the host.
<b>FIN</b> (Finish)	It is used to request for connection termination i.e. when there is no more data from the sender, it requests for connection termination.
<b>RST</b> (Reset)	It is used to terminate the connection if the RST sender feels something is wrong with the TCP connection or that the conversation should not exist
<b>PSH</b> (Push)	It tells the receiver to process these packets as they are received instead of buffering them.
<b>URG</b> (Urgent)	Data inside a segment with URG = 1 flag is forwarded to application layer immediately even if there are more data to be given to application layer.



# Commonly used port Number

Protocol	Service	Port Number
FTP	File Transfer Protocol	20, 21
Telnet	Telnet	23
SSH	Secure Shell	22
SMTP	Simple Mail Transfer Protocol	25
DNS	Domain Name System	53
DHCP	Dynamic Host Configuration Protocol	67, 68
HTTP	Hyper Text Transfer Protocol	80
POP3	Post Office Protocol	110
NTP	Network Time Protocol	123
NetBIOS	NetBIOS Name Service	135 - 139
IMAP	Internet Message Access Protocol	143

# Commonly used port Number

Protocol	Service	Port Number
SNMP	Simple Network Management Protocol	161, 162
LDAP	Lightweight Directory Access Protocol	389
HTTPS	Secure Hyper Text Transfer Protocol	443
MS SQL	Microsoft SQL	1433
MySQL	mySQL Database	3306
RDP	Remote Desktop Protocol	3389
Syslog	Used to send logs to remote server	514
TLS Syslog	Secure Syslog	6514
SFTP	Secure File Transfer Protocol	22
Secure SMTP	Secure Simple Mail Transfer Protocol	587

# Thanks