# SWITCH

Switches are key building blocks for any network. They connect multiple devices, such as computers, wireless access points, printers, and servers; on the same network within a building or campus. A switch enables connected devices to share information and talk to each other
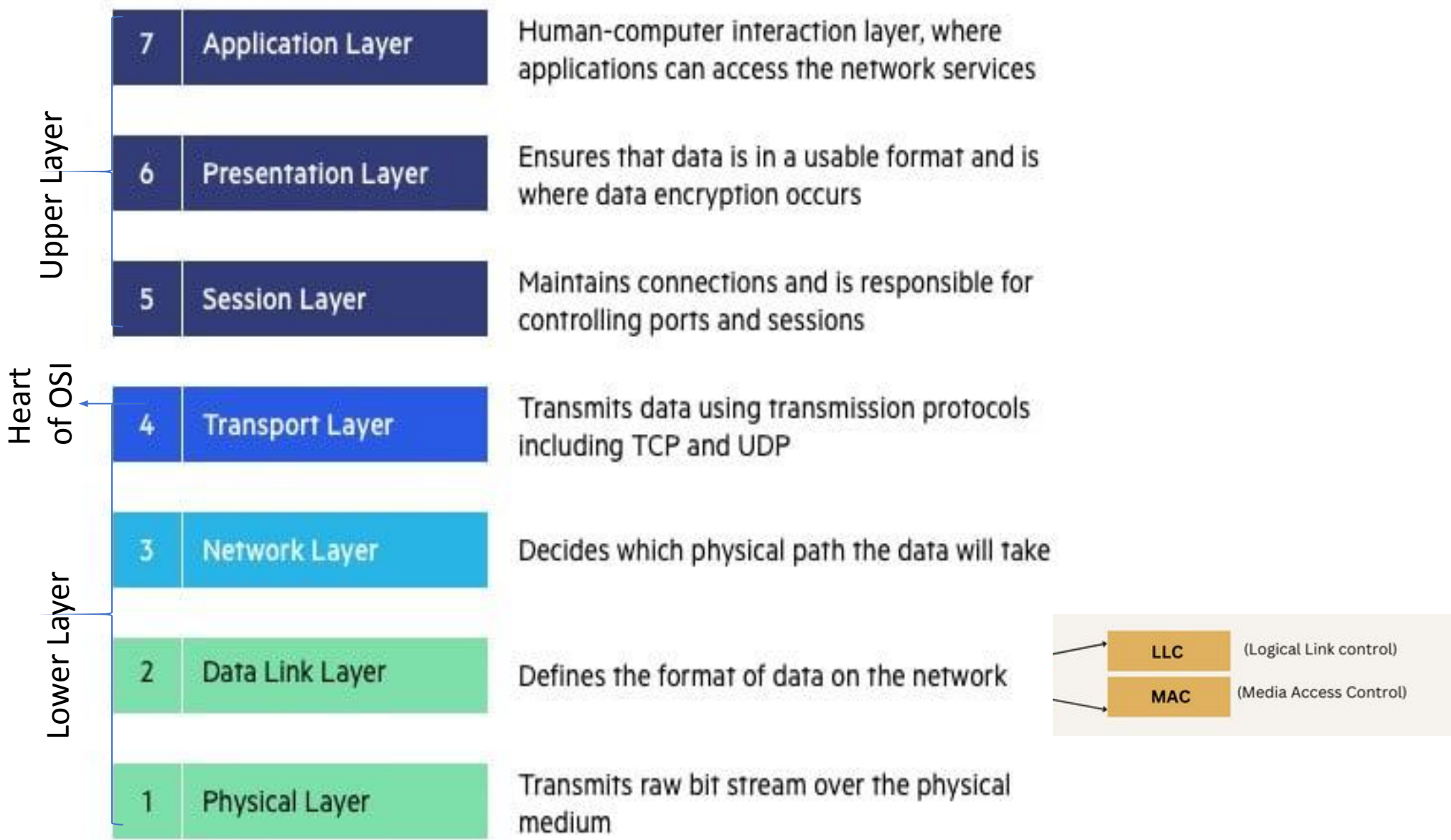
# Repeater

Functioning at Physical Layer. A repeater is an electronic device that receives a signal and retransmits it at a higher level and/or higher power, or onto the other side of an obstruction, so that the signal can cover longer distances.
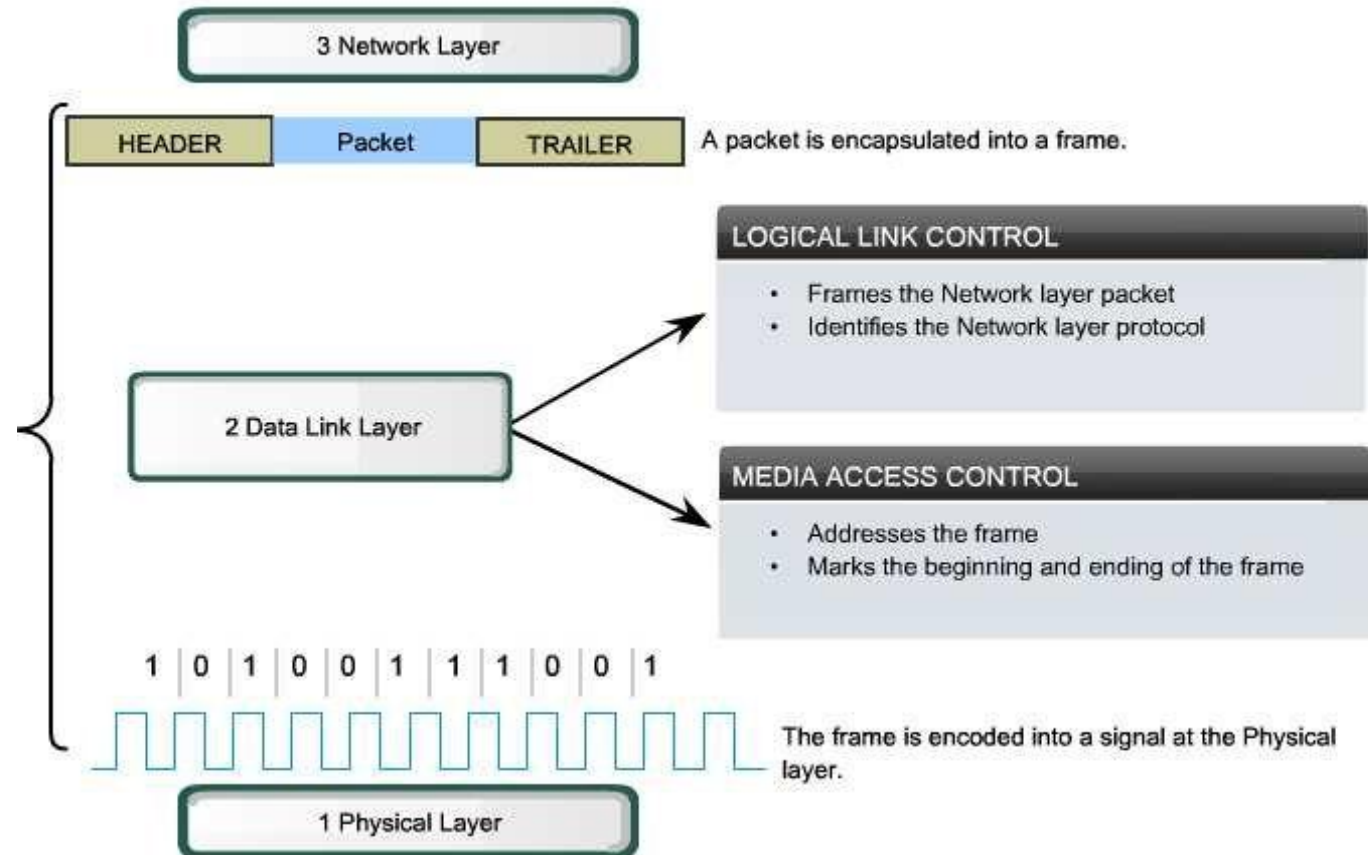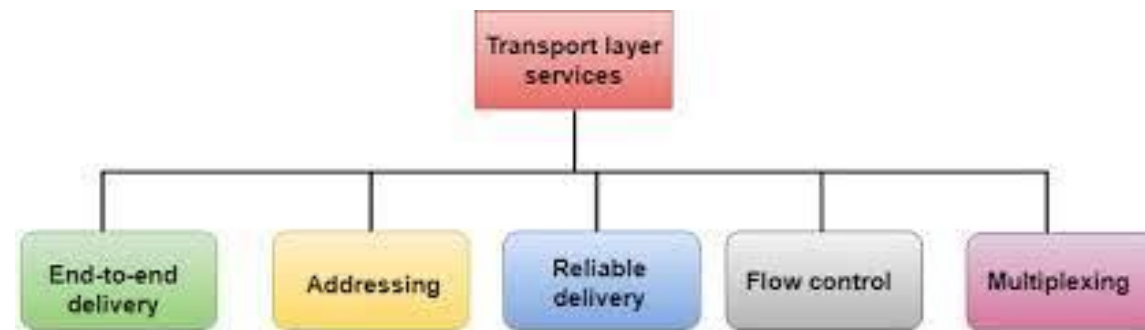Repeater have two ports, so cannot be used to connect for more than two devices

# Router

Router: A router is an electronic device that interconnects two or more computer networks and selectively interchanges packets of data between them. Each data packet contains address information that a router can use to determine if the source and destination are on the same network, or if the data packet must be transferred from one network to another. Where multiple routers are used in a large collection of interconnected networks, the routers exchange information about target system addresses, so that each router can build up a table showing the preferred paths between any two systems on the interconnected networks.

# What is Open Systems Interconnection Model?

| | | | |
|---|---|---|---|
| **Upper Layer** | 7 | Application Layer | Human-computer interaction layer, where applications can access the network services |
| | 6 | Presentation Layer | Ensures that data is in a usable format and is where data encryption occurs |
| | 5 | Session Layer | Maintains connections and is responsible for controlling ports and sessions |
| **Heart of OSI** | 4 | Transport Layer | Transmits data using transmission protocols including TCP and UDP |
| **Lower Layer** | 3 | Network Layer | Decides which physical path the data will take |
| | 2 | Data Link Layer | Defines the format of data on the network |
| | 1 | Physical Layer | Transmits raw bit stream over the physical medium |

LLC (Logical Link control)

MAC (Media Access Control)

# Data Link Sublayers

**3 Network Layer**

| HEADER | Packet | TRAILER |

A packet is encapsulated into a frame.

**LOGICAL LINK CONTROL**

- Frames the Network layer packet
- Identifies the Network layer protocol

**2 Data Link Layer**

**MEDIA ACCESS CONTROL**

- Addresses the frame
- Marks the beginning and ending of the frame

1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1

The frame is encoded into a signal at the Physical layer.

**1 Physical Layer**

## Network layer

| Internetworking | | Routing |
|---|---|---|
| Packetizing | Addressing | Fragmenting |

## Transport layer services

- End-to-end delivery
- Addressing
- Reliable delivery
- Flow control
- Multiplexing

# OSI (Open Source Interconnection) 7 Layer Model

| Layer | Application/Example | | Central Device/ Protocols | | | DOD4 Model |
|---|---|---|---|---|---|---|
| **Application (7)** Serves as the window for users and application processes to access the network services. | **End User layer** Program that opens what was sent or creates what is to be sent | | **User Applications** SMTP | G A T E W A Y Can be used on all layers | | Process |
| | Resource sharing • Remote file access • Remote printer access • Directory services • Network management | | | | | |
| **Presentation (6)** Formats the data to be presented to the Application layer. It can be viewed as the "Translator" for the network. | **Syntax layer** encrypt & decrypt (if needed) | | JPEG/ASCII EBDIC/TIFF/GIF PICT | | | |
| | Character code translation • Data conversion • Data compression • Data encryption • **Character Set Translation** | | | | | |
| **Session (5)** Allows session establishment between processes running on different stations. | **Synch & send to ports** (logical ports) | | **Logical Ports** RPC/SQL/NFS NetBIOS names | | | |
| | Session establishment, maintenance and termination • Session support - perform security, name recognition, logging, etc. | | | | | |
| **Transport (4)** Ensures that messages are delivered error-free, in sequence, and with no losses or duplications. | **TCP** Host to Host, Flow Control | P A C K E T | TCP/SPX/UDP | | | Host to Host |
| | Message segmentation • Message acknowledgement • Message traffic control • Session multiplexing | F I L T E R I N G | | | | |
| **Network (3)** Controls the operations of the subnet, deciding which physical path the data takes. | **Packets** ("letter", contains IP address) | | **Routers** | | | Internet |
| | Routing • Subnet traffic control • Frame fragmentation • Logical-physical address mapping • Subnet usage accounting | | IP/IPX/ICMP | | | |
| **Data Link (2)** Provides error-free transfer of data frames from one node to another over the Physical layer. | **Frames** ("envelopes", contains MAC address) [NIC card —— Switch—— NIC card]        (end to end) | | **Switch Bridge WAP** PPP/SLIP | | Land Based Layers | Network |
| | Establishes & terminates the logical link between nodes • Frame traffic control • Frame sequencing • Frame acknowledgment • Frame delimiting • Frame error checking • Media access control | | | | | |
| **Physical (1)** Concerned with the transmission and reception of the unstructured raw bit stream over the physical medium. | **Physical structure** Cables, hubs, etc. | | **Hub** | | | |
| | Data Encoding • Physical medium attachment • Transmission technique - Baseband or Broadband • Physical medium transmission Bits & Volts | | | | | |

# Switch
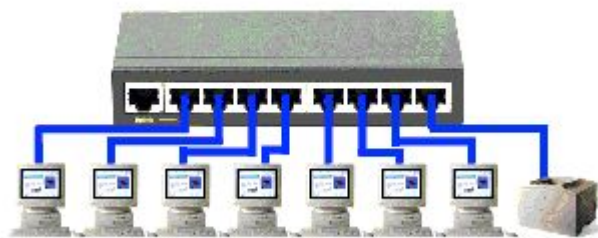
# Hub
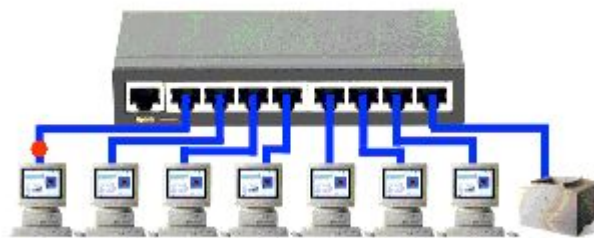
| | | | |
|---|---|---|---|
| Function | To connect a network of personal computers together, they can be joined through a central hub | Allow connections to multiple devices, manage ports, manage VLAN security settings | Direct data in a network |
| Data Transmission form | electrical signal or bits | frame & packet | packet |
| Port | 4/12 ports | multi-port, usually between 4 and 48 | 2/4/5/8 ports |
| Transmission type | Frame flooding, unicast, multicast or broadcast | First broadcast, then unicast and/or multicast depends on the need | At Initial Level Broadcast then Uni-cast and multicast |
| Device type | Non-intelligent device | Intelligent device | Intelligent device |
| Used in(LAN, MAN, WAN) | LAN | LAN | LAN, MAN, WAN |
| Transmission mode | Half duplex | Half/Full duplex | Full duplex |
| Speed | 10Mbps | 10/100Mbps, 1Gbps | 1-100Mbps(wireless); 100Mbps-1Gbps(wired) |
| Address used for data transmission | MAC address | MAC address | IP address |

# Switch vs. Router: What is the Difference?

| | ⬅️➡️ **SWITCH** | ⊕ **ROUTER** |
|---|---|---|
| | Operates at OSI Layer 2 (Data Link Layer) | Operates at OSI Layer 3 (Network Layer) |
| | Connectivity between multiple devices, manages ports & VLAN security settings | Directs data flow through a network |
| | Transmission Form: Frame (L2 switch), Frame and Packet (L3) switch | Transmission Form: Packet |
| | Transmission Form: Half & Full Duplex | Transmission Mode: Full Duplex |
| | Used in LANs | Used in LANs, MANs, WANs |
| 192.168.1.1 | Stores Media Access Control (MAC) address in a lookup table & maintains as address on its own. Can learn the MAC address. | Stores IP address & maintains as address on its own |
| | Is a multi-port bridge (24/48 ports) | Is a networking device (2/4/8 ports) |
| | Max. speed is 10/100Mbps | Max. speed for wireless is 1-10Mbps; Max. speed for wired connection is 100Mbps |
| | Connects to multiple PCs or networking devices via Cat5e/6/6A cables | Connects to numerous PCs or networking devices via Ethernet or Wi-Fi |
| | One broadcast domain (except when a VLAN is implemented) | Every port has its own broadcast domain |
| | Restricted to wired network connections | Works in both wired & wireless network connections |
| | More time when routing decisions are complicated | Takes faster routing decisions |

How VLANs work. A VLAN is identified on network switches by a VLAN ID. Each port on a switch can have one or more VLAN IDs assigned to it and will land in a default VLAN if no other one is assigned. Each VLAN provides data-link access to all hosts connected to switch ports configured with its VLAN ID.

| Layer 2 Switch | Layer 3 Switch |
| --- | --- |
| » Data Link Layer of OSI | » Network Layer of OSI |
| » Sends frames to destination based on MAC address | » Routes packets using IP address |
| » Works with MAC address only | » Performs both L2 & L3 switch functions |
| » Used to reduce LAN traffic | » Used to implement VLANs |
| » Very fast | » Slower |
| » Has a single broadcast domain | » Has a multiple broadcast domain |
| » Communicates within a network only | » Communicates within or outside of a network |

A network controller collects and analyzes network traffic to proactively detect any potential issues before they become real problems. It can perform root-cause analysis and alert IT operations who can take corrective and preventive steps to ensure network services always remain available.

In computing, a firewall is a network security system that monitors and controls incoming and outgoing network traffic based on predetermined security rules. A firewall typically establishes a barrier between a trusted network and an untrusted network, such as the Interne