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GENESIS – Networking Learning Report

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# NETWORKING CONCEPTS

## NETWORK TOPOLOGIES

The arrangement of a network which comprises of nodes and connecting lines via sender and receiver is referred as network topology.

### MESH TOPOLOGY

In mesh topology, every device is connected to another device via a particular channel.

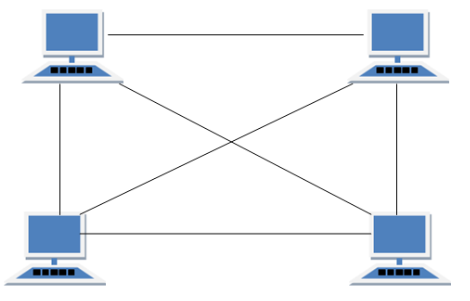


Figure MESH TOPOLOGY

|  |  |
| --- | --- |
| ADVANTAGES | DISADVANTAGES |
| * It is robust. * Fault is diagnosed easily. Data is reliable because data is transferred among the devices through dedicated channels or links. * Provides security and privacy. | * Installation and configuration is difficult. * Cost of cables are high as bulk wiring is required, hence suitable for less number of devices. * Cost of maintenance is high. |

### STAR TOPOLOGY

In star topology, all the devices are connected to a single hub through a cable. This hub is the central node and all other nodes are connected to the central node.

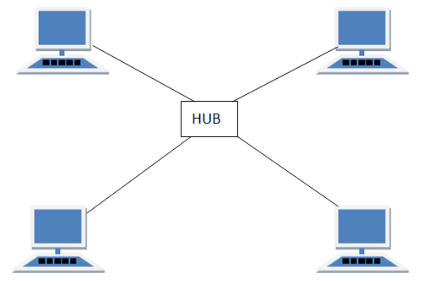


Figure STAR TOPOLOGY

|  |  |
| --- | --- |
| ADVANTAGES | DISADVANTAGES |
| * If N devices are connected to each other in star topology, then the number of cables required to connect them is N. So, it is easy to set up. * Each device require only 1 port i.e. to connect to the hub. | * If the concentrator (hub) on which the whole topology relies fails, the whole system will crash down. * Cost of installation is high. * Performance is based on the single concentrator i.e. hub. |

### BUS TOPOLOGY

Bus topology is a network type in which every computer and network device is connected to single cable. No bi-directional feature is in bus topology.

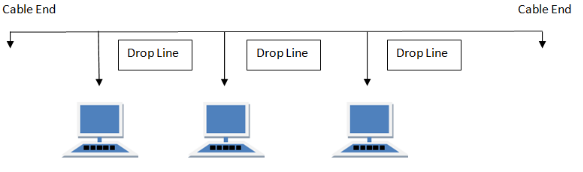


Figure BUS TOPOLOGY

|  |  |
| --- | --- |
| ADVANTAGES | DISADVANTAGES |
| * If N devices are connected to each other in bus topology, then the number of cables required to connect them is 1 which is known as backbone cable and N drop lines are required. * Cost of the cable is less as compared to other topology, but it is used to built small networks. | * If the common cable fails, then the whole system will crash down. * If the network traffic is heavy, it increases collisions in the network. To avoid this, various protocols are used in MAC layer known as Pure Aloha, Slotted Aloha, CSMA/CD etc. |

### RING TOPOLOGY

In this topology, it forms a ring connecting devices with its exactly two neighboring devices. The transmission is unidirectional, but it can be made bidirectional by having 2 connections between each Network Node, it is called Dual Ring Topology.

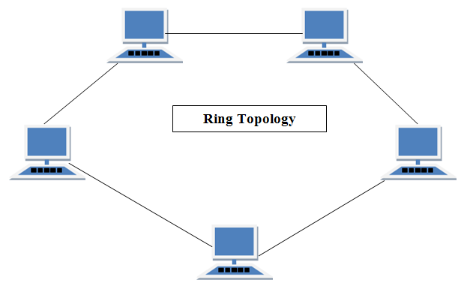


Figure RING TOPOLOGY

|  |  |
| --- | --- |
| ADVANTAGES | DISADVANTAGES |
| * The possibility of collision is minimum in this type of topology. * Cheap to install and expand. | * Troubleshooting is difficult in this topology. * Addition of stations in between or removal of stations can disturb the whole topology. |

### TREE TOPOLOGY

This topology is the variation of Star topology. This topology has hierarchical flow of data.

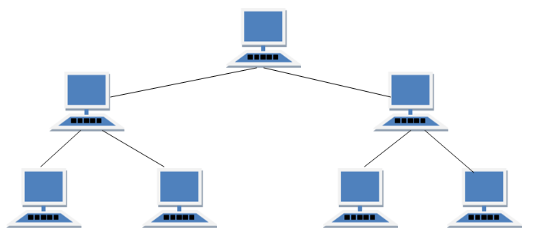


Figure TREE TOPOLOGY

|  |  |
| --- | --- |
| ADVANTAGES | DISADVANTAGES |
| * It allows more devices to be attached to a single central hub thus it increases the distance that is travel by the signal to come to the devices. * It allows the network to get isolated and to prioritize from different computers. | * If the central hub gets fails the entire system fails. * The cost is high because of cabling. |

### HYBRID TOPOLOGY

[Hybrid Topology is basically](https://www.educba.com/what-is-a-hybrid-topology/) a network topology comprising of two or more different types of topologies.

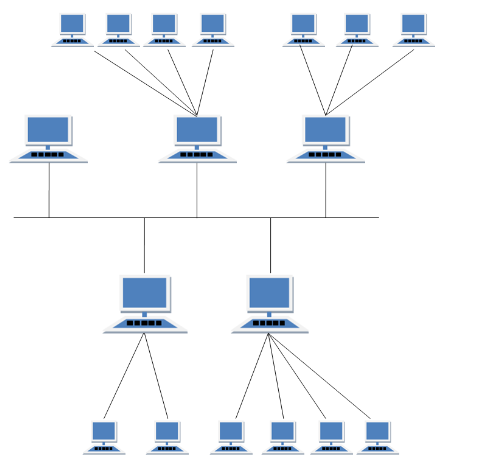


Figure HYBRID TOPOLOGY

|  |  |
| --- | --- |
| ADVANTAGES | DISADVANTAGES |
| * It is easy to troubleshoot and provides simple error detecting techniques. * It is a flexible network topology, making it quite effective. * It is scalable since the size can be made greater easily. | * If the central hub gets fails the entire system fails. * The cost is high because of cabling. |

## WIRED AND WIRELESS NETWORKS

### PAN

PAN is a computer network formed around a person. It generally consists of a computer, mobile, or personal digital assistant. PAN can be used for establishing communication among these personal devices for connecting to a digital network and the internet.

### LAN

A Local Area Network (LAN) is a group of computer and peripheral devices which are connected in a limited area such as school, laboratory, home, and office building. It is a widely useful network for sharing resources like files, printers, games, and other application.

### WAN

WAN (Wide Area Network) is another important computer network that which is spread across a large geographical area. WAN network system could be a connection of a LAN which connects with other LAN's using telephone lines and radio waves. It is mostly limited to an enterprise or an organization.

### MAN

A Metropolitan Area Network or MAN is consisting of a computer network across an entire city, college campus, or a small region. Depending upon the type of configuration, this type of network allows you to cover an area from several miles to tens of miles.

### WLAN

WLAN (Wireless Local Area Network) helps you to link single or multiple devices using wireless communication within a limited area like home, school, or office building. It gives users an ability to move around within a local coverage area which may be connected to the network. Today most modern day's WLAN systems are based on IEEE 802.11 standards.

### WI-FI

WI-FI is a family of [wireless network](https://en.wikipedia.org/wiki/Wireless_network) [protocols](https://en.wikipedia.org/wiki/Communication_protocol), based on the [IEEE 802.11](https://en.wikipedia.org/wiki/IEEE_802.11) family of standards, which are commonly used for [local area networking](https://en.wikipedia.org/wiki/Wireless_LAN) of devices and [Internet](https://en.wikipedia.org/wiki/Internet) access.

### WIMAX

Acronym for Worldwide Interoperability for Microwave Access. Based on Wireless MAN technology. A wireless technology optimized for the delivery of IP centric services over a wide area. A scalable wireless platform for constructing alternative and complementary broadband networks. A certification that denotes interoperability of equipment built to the IEEE 802.16 or compatible standard.

# COMPONENTS

## 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. Hub consumes more bandwidth.

## SWITCH

A switch is a hardware device that connects multiple devices on a computer network. 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 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 based on the information available in the routing table. A router works in a Layer 3 (Network layer) of the OSI Reference model. It determines the best path from the available paths for the transmission of the packet.

## BRIDGE

A bridge interconnects two networks using the same technology (such as Ethernet or Arc net). A modern bridge reads the destination address of the received packet and determines whether the address is on the same segment of the network cables of the originating station. If the destination is on the other side of the bridge, the bridge transmits the packet into the traffic on that cable segment. Local bridges are used to connect two segments of the same LAN. Remote bridges are used to link local LAN cables to thin long-distance cables to link two physically separated network. Bridges are easy to install.

## GATEWAY

Two different networks can be connected using a gateway. For example, a [mainframe](https://ecomputernotes.com/fundamental/introduction-to-computer/mainframe) can be connected and accessible to a PC network using a gateway. Unlike routers, a gateway converts the format of the data sent between two networks. A router adds only addressing [information](https://ecomputernotes.com/fundamental/information-technology/what-do-you-mean-by-data-and-information) to the data packet. Routers never change the content of the message. However, a gateway identifies the protocols used in the networks, and recognize the data format and convert the message format into a suitable format to be accepted by the other network. Wide area networks often use gateways because there is many different networks present in a WAN.

## WIRELESS ACCESS POINTS

In [computer networking](https://en.wikipedia.org/wiki/Computer_networking_device), a wireless access point (WAP), or more generally just access point (AP), is a [networking hardware](https://en.wikipedia.org/wiki/Networking_hardware) device that allows other [Wi-Fi](https://en.wikipedia.org/wiki/Wi-Fi) devices to connect to a wired network. The AP connects to a [router](https://en.wikipedia.org/wiki/Router_(computing)) (via a wired network) as a standalone device, but it can also be an integral component of the router itself. An AP is differentiated from a [hotspot](https://en.wikipedia.org/wiki/Hotspot_(Wi-Fi)) which is a physical location where Wi-Fi access is available.

# PROTOCOLS

## OSI MODEL

OSI stands for Open Systems Interconnection. It is a 7-layer architecture with each layer having specific functionality to perform. All these 7 layers work collaboratively to transmit the data from one person to another across the globe.

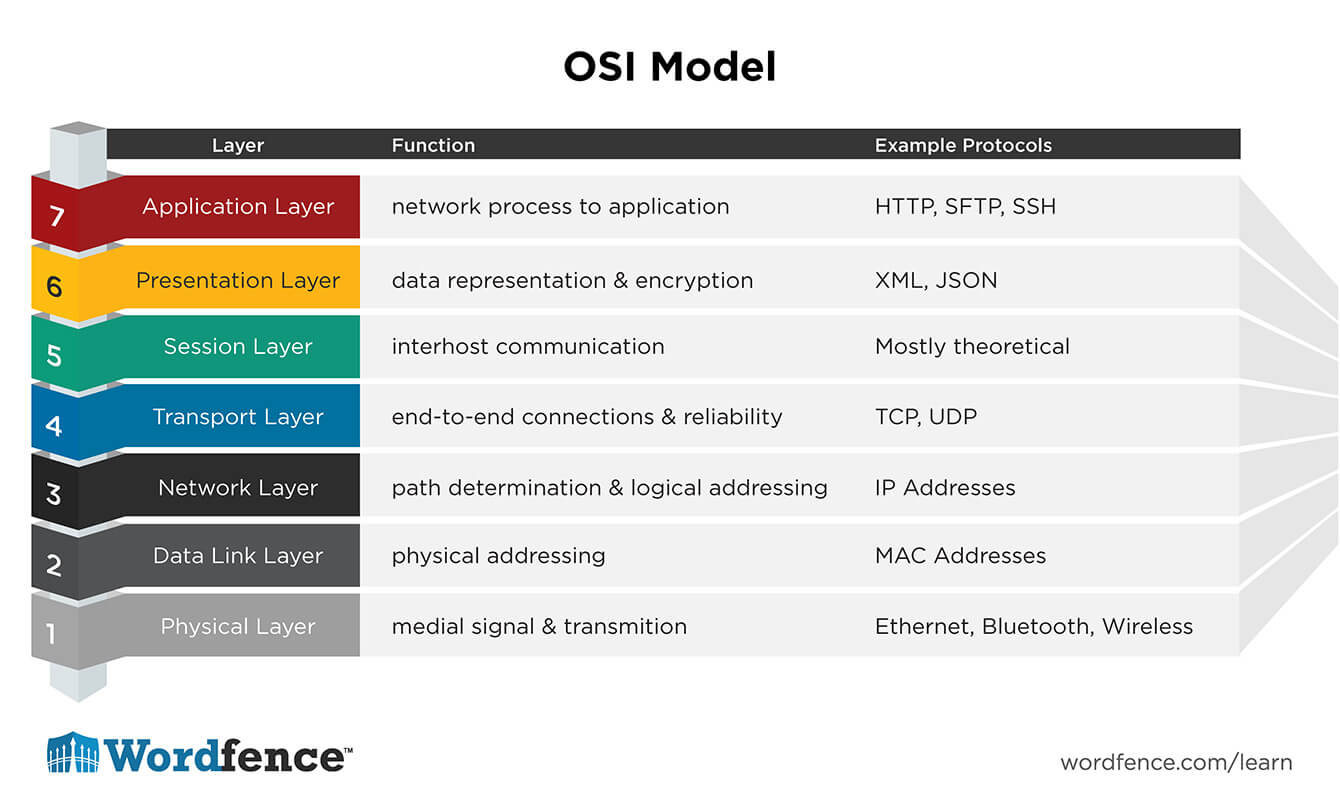


Figure OSI MODEL

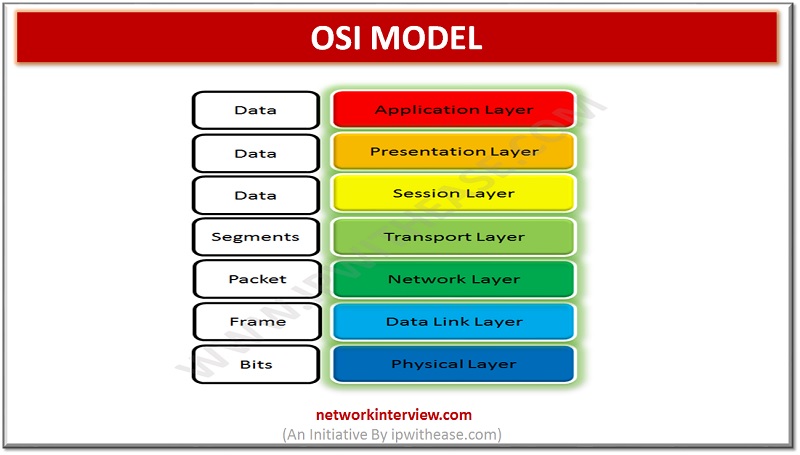


Figure OSI MODEL - DATA UNIT

## TCP/IP PROTOCOL

The Transmission Control Protocol (TCP) is one of the main [protocols](https://en.wikipedia.org/wiki/Communications_protocol) of the [Internet protocol suite](https://en.wikipedia.org/wiki/Internet_protocol_suite). TCP provides [reliable](https://en.wikipedia.org/wiki/Reliability_(computer_networking)), ordered, and [error-checked](https://en.wikipedia.org/wiki/Error_detection_and_correction) delivery of a stream of [octets](https://en.wikipedia.org/wiki/Octet_(computing)) (bytes) between applications running on hosts communicating via an IP network. Major internet applications such as the [World Wide Web](https://en.wikipedia.org/wiki/World_Wide_Web), [email](https://en.wikipedia.org/wiki/Email), [remote administration](https://en.wikipedia.org/wiki/Remote_administration), and [file transfer](https://en.wikipedia.org/wiki/File_transfer) rely on TCP, which is part of the [Transport Layer](https://en.wikipedia.org/wiki/Transport_layer) of the TCP/IP suite.

TCP is [connection-oriented](https://en.wikipedia.org/wiki/Connection-oriented_communication), and a connection between client and server is established before data can be sent. Three-way handshake (active open), [retransmission](https://en.wikipedia.org/wiki/Retransmission_(data_networks)), and error-detection adds to reliability but lengthens [latency](https://en.wikipedia.org/wiki/Latency_(engineering)). Applications that do not require reliable [data stream](https://en.wikipedia.org/wiki/Data_stream) service may use the [User Datagram Protocol](https://en.wikipedia.org/wiki/User_Datagram_Protocol) (UDP) which prioritizes time over reliability. TCP employs [network congestion avoidance](https://en.wikipedia.org/wiki/TCP_congestion_control).

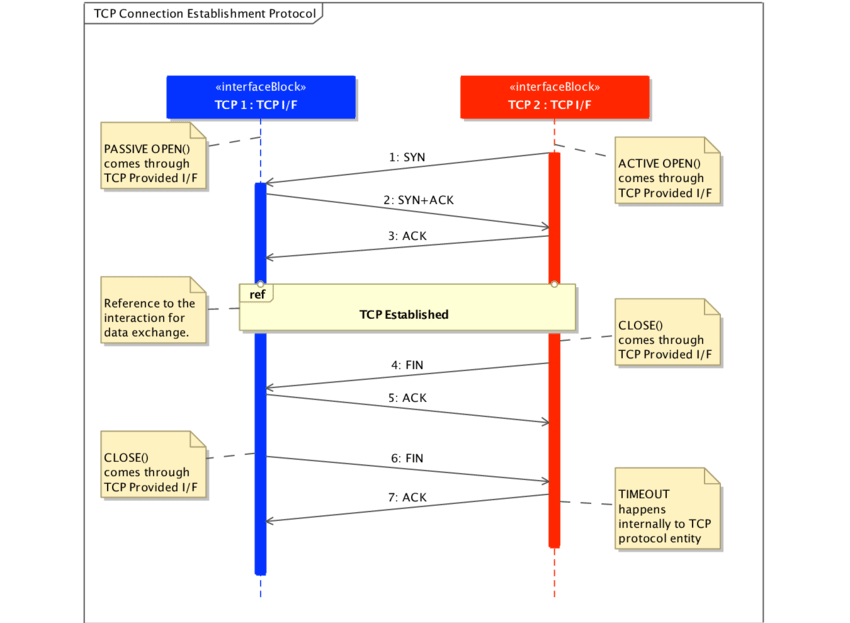


Figure TCP CONNECTION ESTABLISHMENT

## UDP/IP PROTOCOL

User Datagram Protocol (UDP) is a Transport Layer protocol. UDP is a part of Internet Protocol suite, referred as UDP/IP suite. Unlike TCP, it is unreliable and connectionless protocol. So, there is no need to establish connection prior to data transfer.

Though Transmission Control Protocol (TCP) is the dominant transport layer protocol used with most of Internet services; provides assured delivery, reliability and much more but all these services cost us with additional overhead and latency. Here, UDP comes into picture. For the realtime services like computer gaming, voice or video communication, live conferences; we need UDP. Since high performance is needed, UDP permits packets to be dropped instead of processing delayed packets. There is no error checking in UDP, so it also save bandwidth.   
User Datagram Protocol (UDP) is more efficient in terms of both latency and bandwidth.