**TCP/IP Model**

* TCP/IP is a network model designed to support network communication even if the computers are from different manufacturers.
* TCP/IP seems to be a set of two protocols only - TCP and IP. However, it consists of numerous protocols bundled at different layers.
* There is also one more network model i.e OSI model, it is primarily used for research purposes. On the other hand, TCP/IP is a practical model developed to meet the needs of the original internet design.
* TCP stands for transmission control protocol and IP stands for Internet Protocol.
* In TCP/IP model the TCP breaks the messages into smaller data units called segments and hands them off to IP which deals with routing segments through the networks to their final destination then the TCP module at the receiver combines the segments to form the original message.
* Alternate to TCP is UDP (User Datagram Protocol), the main difference is that TCP is highly reliable but slow and UDP is less reliable but fast. Both TCP and UDP are a part of the protocol suite. However, due to heavy dependence on the TCP, and for historical reasons, the entire set of protocols is referred to as TCP/IP.

**Layers of TCP/IP model:**

**Network Access Layer (Physical Layer + Data Link Layer)**

**The Physical Layer:**

* The physical layer is the layer where the actual communication takes place.
* A sequence of 0s and 1s represent the message/data, the physical layer converts this binary sequence into signals and transmits them over the local media.
* The signal generated by the physical media depends on the type of local media used to connect the two devices. For example: if the local media is copper cable/LAN cable the signal will be electrical signal, if the local media is optical fiber then the signal will be light signal, and if it is air or vacuum then the signal will be radio signal.
* The most common protocol used at the physical layer is Ethernet.
* The protocol also specifies the type of cables that can be used for data transmission. For example: if the protocol used is ethernet then twisted pair cable, coaxial cable, fiber optic cable can be used for data transmission and if the protocol used is Fast Ethernet or Gigabit ethernet then twisted pair cable or fiber optic cable can be used as local media.

**Data Link Layer:**

* The data unit in the data link layer is called an Ethernet frame.
* The data link layer is divided into two sublayers:

1)Medium Access Control or MAC sublayer

2)Logical link control or LLC sublayer.

* The MAC sublayer is responsible for Data Encapsulation and Accessing the media.
* In Data Encapsulation the MAC sublayer adds a Header and Trailer to the IP packet received from the network layer.
* The header contains the MAC addresses of the sender and the receiver and the trailer contains 4 bytes of error checking data used to detect errors in the received ethernet frame.
* For accessing the media, the access method ethernet uses is called Carrier Sense Multiple Access/Collision Detection or CSMA/CD.
* In this method, each computer listens to the cable before sending data through the network. If the network is clear, the computer will transmit. If a computer is already transmitting on the cable, then the other computer will wait and try again when the line is clear. Sometimes two computers attempt to transmit at the same instant. When this happen a collision occurs. Each computer then stops transmission and waits for a random amount of time before attempting to retransmit. However, the delay caused by collisions and retransmission is very small and does not affect the speed of transmission on the network.
* LLC sublayer: It offers flow control and error control.
* Flow control: is a technique that restricts the amount of data that a sender can send without overwhelming the receiver. In data link layer, flow control restricts the number of frames the sender can send without overwhelming the receiver.
* Error Control: in data link layer refers to error detection and retransmission. Error Detection is done by using the error checking bytes added in the trailer of the frame. The frame retransmission is done by Automatic Repeat Request or ARQ. The receiver sends an ACK when a frame is received, when the ACK is not received. The sender sends the frame again. This is called Automatic Repeat Request or ARQ.
* LLC sublayer also resize the IP packets received from network layer to fit them in the data link frames.

**Internet Layer (Network Layer):**

* The transport layer passes the TCP segments or UDP datagrams to the network layer. The network layer adds logical addresses or IP addresses to the TCP segments or UDP datagrams to form an IP packet and then uses routers to send the IP packets to other networks it also determines the best path for data delivery.
* Functions of network layers are:
* 1)Logical Addressing: IP is the single standard protocol for this layer. Each computer in a network has a unique IP address. The network layer assigns sender and receiver’s IP addresses to each segment or datagram to form an IP packet so that each IP packet can reach the correct destination present in different networks.

2)Routing: is a method of moving an IP packet from source to destination present in different networks. Routing is not needed if the source and destination are present in the same network.

3)Path determination: Choosing the best possible path for data delivery from source to destination is called Path Determination. Layer 3 devices use protocols such as OSPF (Open Shortest Path First), BGP (Border Gateway Protocol), IS-IS (Intermediate system to intermediate system) to determine the best possible path for data delivery.

**TRANSPORT LAYER:**

* The transport layer receives message from the application layer. When the message reaches the transport layer one of the transport layer protocols that is TCP or UDP is selected.
* TCP supports segmentation, so if the message is large, TCP divides it into smaller pieces and adds a header to form a TCP segment.
* On the other hand, UDP does not support segmentation, so the applications using UDP should send messages short enough to fit into one UDP datagram.
* UDP datagrams are considered unreliable because there is not guarantee that all datagrams sent will be received in the destination and in the correct order. So, if reliability is needed UDP should not be used. UDP lacks error checking and correction, it makes UDP fast and efficient for DNS, DHCP, SNMP and RIP protocols.
* TCP on the other hand is reliable and guarantees in order delivery of data from the sender to the receiver.
* The data transmission via TCP has 3 phases: Connection Establishment, Data transfer and Connection Termination.
* TCP is connection-oriented protocol.
* During data transfer, TCP offers some key features:

1)Error free data transfer.

2)Ordered data transfer.

3)Retransmission of lost data.

4)Discarding duplicate packets.

5)Congestion throttling.

**APPLICATION LAYER:**

* It is used by network applications. Network applications are computer applications that use internet. Example: Google chrome, Firefox, outlook, skype etc.
* Application layer provides services for network applications with the help of protocols to perform user activities.
* Its protocols enable application layer to work with whatever data the client is using.
* Application Layer Protocols: HTTP, HTTPs, FTP, NFS, FMTP, TELNET, SNMP, IRC, NNTP. All these protocols collectively form the application layer.
* File transfer is done by FTP protocol, web surfing is done by HTTP or HTTPs protocols, emails is done by SMTP protocol and for virtual terminals TELNET is used.
* Web server like chrome and Firefox use application layer protocols like HTTP and HTTPs for web surfing.
* These protocols form the basis for various network services like file transfer, web surfing, emails, virtual terminals etc.
* The application layer sends data to, and receives data from, the presentation layer.