

Functions of Network Layer

The main function of the network layer or layer 3 of the OSI (Open Systems Interconnection) model is delivery of data packets from the source to the destination across multiple hops or links. It also controls the operation of the subnet.

The functions are elaborated as below –

- When data is to be sent, the network layer accepts data from the transport layer above, divides and encapsulates it into packets and sends it to the data link layer. The reverse procedure is done during receiving data.
- The network layer is responsible for **routing** packets from the source host to the destination host. The routes can be based upon static tables that are rarely changed; or they can be automatically updated depending upon network conditions.
- Many networks are partitioned into sub-networks or subnets. The network layer controls the operations of the subnets. Network devices called routers operate in this layer to forward packets between the subnets or the different networks.
- The lower layers assign the physical address locally. When the data packets are routed to remote locations, a logical addressing scheme is required to differentiate the source system and the destination system. This is provided by the network layer.
- This layer also provides mechanisms for **congestion control**, in situations when too many packets overload the subnets.
- The network layer tackles issues like transmission delays, transmission time, avoidance of jitters etc.
- **Quality of service:** offer the appropriate service
- **Internetworking:** deal with network differences, if source and destination are connected to different networks

Network Services: Virtual Circuits, Datagram service

Computer networks that provide connection-oriented services are called Virtual Circuits while those providing connection-less services are called Datagram networks. For prior knowledge, the Internet which we use is actually based on a Datagram network (connection-less) at the network level as all packets from a source to a destination do not follow the same path. Let us see what are the highlighting differences between these two topics

Virtual Circuits:

1. It is connection-oriented, meaning that there is a reservation of resources like buffers, CPU, bandwidth, etc. for the time in which the newly setup VC is going to be used by a data transfer session.

2. The first sent packet reserves resources at each server along the path. Subsequent packets will follow the same path as the first sent packet for the connection time.
3. Since all the packets are going to follow the same path, a global header is required. Only the first packet of the connection requires a global header, the remaining packets generally don't require global headers.
4. Since all packets follow a specific path, packets are received in order at the destination.
5. Virtual Circuit Switching ensures that all packets successfully reach the Destination. No packet will be discarded due to the unavailability of resources.
6. From the above points, it can be concluded that Virtual Circuits are a highly reliable method of data transfer.
7. The issue with virtual circuits is that each time a new connection is set up, resources and extra information have to be reserved at every router along the path, which becomes problematic if many clients are trying to reserve a router's resources simultaneously.
8. It is used by the ATM (Asynchronous Transfer Mode) Network, specifically for Telephone calls.

Datagram Networks :

1. It is a connection-less service. There is no need for reservation of resources as there is no dedicated path for a connection session.
2. All packets are free to use any available path. As a result, intermediate routers calculate routes on the go due to dynamically changing routing tables on routers.
3. Since every packet is free to choose any path, all packets must be associated with a header with proper information about the source and the upper layer data.
4. The connection-less property makes data packets reach the destination in any order, which means that they can potentially be received out of order at the receiver's end.
5. Datagram networks are not as reliable as Virtual Circuits.
6. The major drawback of Datagram Packet switching is that a packet can only be forwarded if resources such as the buffer, CPU, and bandwidth are available. Otherwise, the packet will be discarded.
7. But it is always easy and cost-efficient to implement datagram networks as there is no extra headache of reserving resources and making a dedicated each time an application has to communicate.
8. It is generally used by the IP network, which is used for Data services like the Internet.