NETWORK LAYER

It is the third layer of OSI model. It responds to service requests from the transport layer and issues service requests to the data link layer. Network layer addresses messages and translates logical addresses and names into physical addresses. it also determines the route from the source to the destination computer and manages traffic problems, such as switching. routing, and controlling the congestion of data packets.

It describes how a series of exchanges over various data links can deliver data between any two nodes in a network. This layer defines the addressing and routing structure of the Internet. Network layer is concerned with controlling the operation of the subnet.

Functions of Network Layer

1: Logical Addressing: The physical addressing implemented by the data link layer handles the addressing problem locally. If a packet passes the network boundary, we need another addressing system to help distinguish the source and destination systems. The network layer adds a header to the packet coming from the upper layer that. among other things. includes the logical addresses of the sender and receiver.

2: Routing: When independent networks or links are connected together to create an internetwork (a network of networks) or a large network, the connecting devices (called routers or gateways) route the packets to their final destination. One of the functions of the network layer is to provide this mechanism.

3: internetworking: This is the main duty of network layer. It provides the logical connection between different types of networks.

4: Packetizing: The network layer encapsulates the packets received from upper layer protocol and makes new packets. This is called as packetizing. It is done by a network layer protocol called IP (Internetworking Protocol).

5: Fragmenting: The datagram can travel through different networks. each router decapsulates the IP datagram from the received frame. then the datagram is processed and encapsulated in another frame

ROUTING

Routing is the process of selecting paths in a network along which to send network traffic. Routing is usually performed by a dedicated device called a router

A router is a networking device that forwards packets between networks using information in protocol headers and forwarding tables to determine the best next router for each packets. Routers work at the network layer(Layer 3) of the OSI model and the Internet Layer of TCP/IP

for routing of packets, routing algorithms are used. the routing algorithm is that part of the network layer software responsible for deciding which output line an incoming packet should be transmitted on

Routing table

is an electronic document that stores routes to various nodes in a computer network. The nodes may be any kind of electronic device connected to the network. The routing table is usually stored in a router or networked computer in the form of a database or file.

Network id	Cost	Next hop
....	....	....
....	....	....

When data needs to be sent from one node to another on the network, the routing table is referred to in order to find the best possible route for the transfer of infom1ation.

The routing table consists of at least three information fields:

1: Network ID: i.e., the destination network id.

2: Cost: i.e, the cost or metric of the path through which the packet is to be sent.

3: Next Hop: The next hop, or gateway. is the address of the next station to which the packet is to be sent on the way to its final destination.

Shortest Path Routing

is suited for static routing. A path selected can be called shortest in many contexts. If one selects cost as criteria then the shortest path is the route which is least expensive. If distance is the criteria for determining shortest path then minimum length path is taken in to consideration.

Dijkstra Algorithm
known= {s}
for i = 1 to n, dist[i] =infinity
for each edge (s,v), dist[v]=d(s, v)
last=s
while (last=/ 1)
select V Such that dist(V) = MINunknown dist(i)
for each (v,x), dist[x] = min(dist[x],dist[v]+ w(v,x))
last= v
known = known U {v}

Bellman-Ford Algorithm

This algorithm is suitable for a directed graph. In this case too the least cost distance from every node in a network to a special node is found out. If for a given graph it is required to find the minimum path from all nodes to A then we proceed in such a way that we consider all those nodes which can reach that particular node in a single hop. Each node is marked in the format

Distance Vector Routing Algorithm

DVR is also known as the Bellman-Ford or Ford-Fulkerson routing algorithm

It is the original dynamic routing algorithm used in the erstwhile ARPANET.

This scheme may be expressed as:

1: Each router knows/discovers its di stance from its neighbours

2: Each router locally maintains a routing table indexed by an entry for every other router in subnet and identification of a preferred neighbour/link leading to that router,

3: Metric of estimation may vary. For example, it may be any one of physical distance, hops, delay, etc.

4: Periodically each router ends a vector to it neighbouring router. As this vector contain estimated distances, it is called a distance vector.

5: On receipt of such vectors from it neighbours. ever router revises its estimates and updates its low routing table.

Flood-based Routing Algorithm/Flooding

Flooding adapts the technique in which every incoming packet is sent on every outgoing line except the one on which it arrived. One problem with this method is that packets may go in a loop.

As a result of this a node may receive several copies of a particular packet which is undesirable. Some techniques adapted to overcome these problems are as follows:

1: Sequence Numbers: Every packet is given a sequence number. When a node receives the packet it sees its source address and sequence number. If the node finds that it has sent the same packet earlier then it will not transmit the packet and will just discard it.

2: Hop count: Every packet has a hop count associated with it. this is decremented (or incremented) by one by each node which sees it. When the hop count becomes zero (or a maximum possible value) the packet is dropped.

3: Spanning Tree: The packet is sent only on those links that lead to the destination by constructing a panning tree routed at the source. This avoids loops in transmission but is possible only when all the intermediate nodes have knowledge of the network topology.

Flooding is not practical for general kinds of applications. But in cases where high degree of robustness is desired such as in military applications, flooding is of great help. Flood-based routing, as the name suggests, uses redundant replication of incoming packets/NLDUs on available outgoing links.

Routing Protocols

A routing protocol specifies how routers communicate with each other. Disseminating information that enables them to select routes between any two nodes on a computer network. Routing algorithms determine the specific choice of route. Each router has a priori knowledge only of networks attached to it directly. A routing protocol shares this information first among immediate neighbours, and then throughout the network. This way routers gain knowledge of the topology of the network.

Types of Routing Protocol

1: Interior Gateway Protocols (IGPs): The router within an autonomous system uses an interior Gateway Protocol (IGP) to exchange routing information. There are several IGPs available each autonomous system is free to choose its own IGP. Usually, an IGP is easy to install anti operate, but an IGP may limit the size or routing complexity of an autonomous system

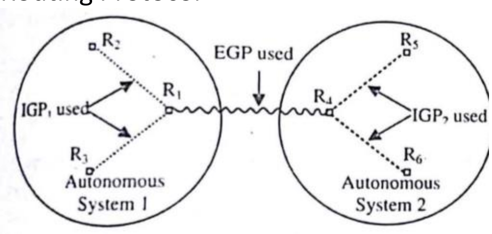
There are two types Interior Gateway Protocols:

1: Interior gateway protocols type 1, link-state routing protocols, such as Open Shortest paths First (OSPF) and IS-IS.
2: Interior gateway protocols type 2, Distance-vector routing protocols such as routing information protocol. RIPv2, IGRP. enhanced Interior Gateway Protocol(EIGRP) is an advanced Distance-vector routing protocol that is used on a computer network for automating routing decisions and configuration

2: Exterior Gateway Protocols (EGPs)

A router is one autonomous system uses an exterior gateway Protocol (EGP) to exchange routing information with a router in another autonomous system. EGPs are usually more complex to install and operate than IGPs, but EGPs offer more flexibility and lower overhead. To save traffic, an EGP summarises routing information from the autonomous system before passing it to another autonomous system. More important an EGP implements policy constrain that allows a system manager to determine exactly what information is released outside the organization

Exterior gateway protocols are routing protocols used on the internet for exchanging routing information between autonomous Systems such as border Gateway protocol (BGP) Path Vector Routing Protocol



Autonomous System 1 (AS1) has chosen IGP1 to use internally, and Autonomous System 2 (AS2) has chosen IGP2. All routers in AS1 communicate using IGP1, and all routers in AS2 communicate using IGP2, Router R1 and R4 use an EGP to communicate between the two autonomous systems. That is, R1 must summarise information from its autonomous system and send the summary to R4. In addition, R1 accepts a summary from R4 and uses IGP1 to propagate the information to routers in AS1R4 performs the same service for AS2

ROUTING INFORMATION PROTOCOL(RIP)

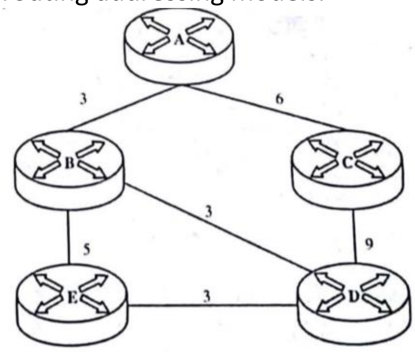
It is one of the oldest distance-vector routing protocol which employ the hop count as a routing metric. RIP prevents routing loops by implementing limit on the number of hops allowed in a path from source to destination. The maximum number of hops allowed for RIP is 15, which limits the size of networks that RIP can support. A hop count of 16 is considered an infinite distance and the route is considered unreachable. RIP implements the split horizon, route poisoning und hold down mechanisms to prevent incorrect routing information from being propagated.

In most networking environments. RIP is not the preferred choice for routing as its time to converge and scalability are poor compared to EIGRP, OSPF or IS-IS. However, it is easy to configure, because RIP docs not require any parameters unlike other protocols.

RIP uses the User Datagram Protocol (UDP) as its transport protocol, and is assigned the reserved port number 520.

OPEN SHORTEST PATH FIRST (OSPF)

OSPF stands for Open Shortest Path First which uses link state routing algorithm. Using the link state information which is available in routers. it constructs the topology in which the topology determines the routing table for routing decisions. It supports both variable-length subnet masking and classless inter-domain routing addressing models.

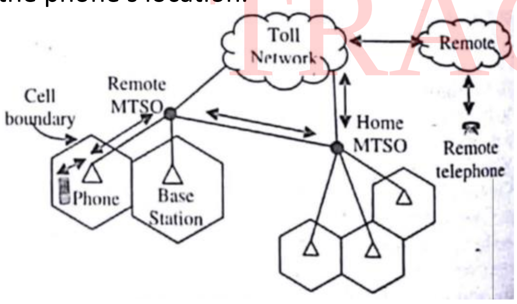


Since, it uses Dijikstra's algorithm, it computes the shortest path tree for each route. The main advantages of the OSPF is that it handles the error detection by itself and it uses multicast addressing for routing in a broadcast domain

Mobile Routing in the Telephone Network

Cellular telephones use radio frequencies to communicate with a base station, usually located on a tall tower with a triangular platform on top, which you can see along major highways or in city centres that relays their call to a Mobile Telephone Switching Office (MTSO). (To prevent unfair advantage to the local telephone company. the Federal Communications commission in the US requires that MTSO be separated from central office, though they serve nearly the same purpose. Routing calls to and from a cellular telephone that may be associated with any MTSO in the cellular-service provider's service area.

Each cellular phone is statically assigned a globally unique ID and a home MTSO that does billing and provides access to the long-distance (toll) telephone network. The phone is also assigned a telephone number from the address space assigned to the home MTSO. When a cellular phone is switched on. it use ALOHA contention on a common signalling channel to identify itself to the local MTSO. The MTSO, in turn contacts the home MTSO and informs it of the phone's location.



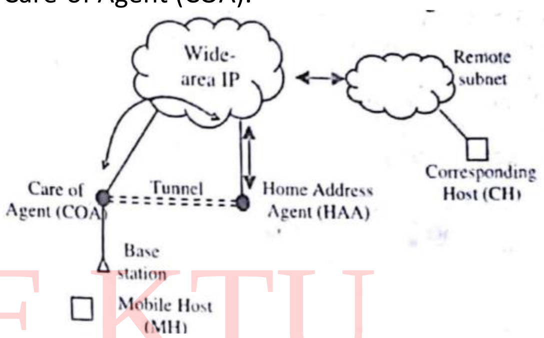
When someone makes a call to the phone, the telephone network deliver it automatically to the home MTSO. which setup a connection to the phone through the remote MTSO, using Signalling System 7(SS7) signalling. The remote MTSO contacts the nearest station, which rings the cellular phone. The identity of the nearest base station is dynamically updated using the cellular hand-off.

This architecture allows cellular phones to roam within the entire service are freely, but has the overhead that calls are always routed to the home MTSO, requiring additional bops in the network. it scales well, because new MTSOs can be added dynamically as service demands increase. moreover heavily loaded MTSOs can be split to share the load. the cellular phone solution to mobility is simple and robust and has been modified for solving the mobility problem on the internet

Mobile Routing in the Internet

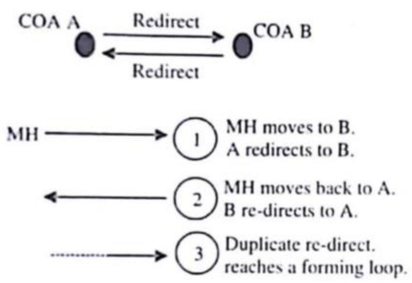
*Mobile Host:- The host that moves
*Corresponding Host:- The host that the mobile is talking to
*Home Address Agent:- The "home" base assigned to the mobile host
*Care of Agent:- The base closest to the mobile host that forwards packets to it

The basic model for mobile routing. which is similar to the cellular telephone model. Mobile Hosts (MHs) which are mobile computers with a fixed IP address (much like a cellular phone with a fixed telephone number) communicate with the nearest base station which is attached to a Care-of Agent (COA).



packets to a Mobile Host (MH) are always Routed through a Home Address Agent (HAA). which Tunnels Packets for the MH to a Care-of Agent (COA). When the MH Moves it listens to Beacons to Detect that it has a New COA. It then Updates both the HAA and the Old COA. Packets from the MH use Normal Routing

A Second open problem concerns the formation of loops when mobile host move from one care-of agent to another



It then registers itself with the care-of agent using a registration packet. The care-or agent in turn passes on the registration to the home address agent, which then knows which care-of agent to use for the mobile host.