

NETWORK LAYER

The network layer is responsible for packet forwarding including routing through intermediate routers.

① Need of Network layer (functions) -

- (1) Host addressing
- (2) Message Forwarding
- (3) Keeps track of MAC address.
- (4) Connectionless communication is possible.

② Service provided by network layer are -

Connectionless service and connection oriented service.

③ Design Issues of Network layer -

- (1) Store and Forward packet switching
- (2) Service provided to transport layer
 - service should be independent of network topology.
 - Transport layer should be shielded from the number, type and topology of the routers present
 - Network addresses should be made available to the transport with a uniform numbering plan.
- (3) Implementation of connectionless service
- (4) Implementation of connection oriented service
- (5) Comparison of virtual circuit and datagram networks

ROUTING ALGORITHMS -

④ Least Cost Routing algorithm (shortest path algorithm) -

(1) Dijkstra's algorithm -

STEP-1 - Source node is initialized and can be indicated as a filled circle.

STEP-2 - Initial path cost to neighbouring nodes (adjacent nodes) or link cost is computed and these nodes are relabelled considering source node.

STEP-3 - Examine the all adjacent nodes and find the smallest label, make it permanent.

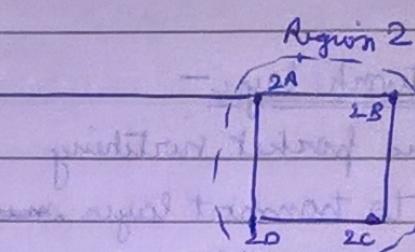
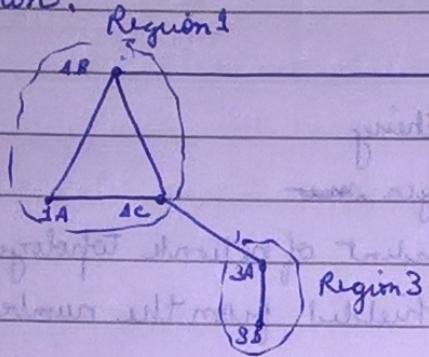
Step 4 - The smallest label node is now working node, then step 2 and step 3 are repeated till the destination node reaches.

(2) Bellman Ford Algorithm -

It is used to find all shortest path in a graph from one source to all other nodes.

(5) Hierarchical Routing -

The routers are divided into regions. It contains all the details about how to route packets to destination within its own region.



Dest	hops	Hops
1A	-	-
1B	1B	1
1C	1C	1
2T	1B	2
3	1C	2

(6) Broadcast Routing -

Transmitting data to the multidestination simultaneously called broadcasting. Various methods are -

(1) Flooding - Transmitted to all nodes and is an inefficient method.

(2) Multidestination Routing -

Router generates new copy of packets for each links with selected destination addresses.

(3) Reverse Path Forwarding -

The router checks the packet whether it is from preferred path and router sends it on the best router path. A tree like structure is formed.

⑦ Multicast Routing - (Using spanning tree)

To send messages to well defined groups that are numerically large in size but small compared to the network as a whole.

(con)

CONGESTION CONTROL ALGORITHMS -

- Congestion control is a process of maintaining the number of packets in a network below a certain level at which performance falls off. It makes sure that subnet is able to carry the offered traffic.

⑧ General principles of congestion control -

Divided into two categories -

- (1) Open loop solutions - by good design, prevention of congestion.
- (2) Closed loop solutions - Removing the congestion.

⑨ Congestion prevention policies -

(1) Data link layer policies -

- (a) Flow control
- (b) Acknowledgement
- (c) Retransmission
- (d) Out of order caching

(2) Network layer policies -

- (a) Routing algorithms
- (b) Packet queuing and service
- (c) Packet lifetime management
- (d) Packet discard
- (e) Virtual circuit versus datagram inside the subnet.

(3) Transport layer policies -

- (a) Flow Control
- (b) Acknowledgement
- (c) Retransmission
- (d) Out of order caching
- (e) Timeout determination

⑩ Congestion control in virtual circuits networks - Difficult

Remove all the path leaded to congestion and redraw or remake a new path from source to destination.

⑪ Congestion control in datagram networks - Uses & Waiting bit and

Routes use a bit in the packets header to signal the waiting state. The receiver copies the waiting bit from the packet header to the ACK message. The source, on receiving ACK with waiting bit will adjust transmission rate accordingly.

⑫ IP protocol -

It is a connectionless datagram protocol with no guarantee of reliability. It does not provide any error control or flow control. It can detect error and discard the packet if it is corrupted.

⑬ IP Addresses -

They are 32 bit long and they are used in the source address and destination address fields of the IP header. Two parts Network IP and Host IP.

⑭ Comparative Study of IPv4 and IPv6 -

IPv4	IPv6
(1) 2^{32} possible addresses	(1) 2^{128} possible addresses
(2) It is written by dotted decimal notation e.g. 121.2.8.12	(2) It is hexadecimal and consists of 8 groups e.g. AC77:7834:2222:FACB
(3) Basic header length is 20 bytes	(3) Basic header length is 40 bytes.
(4) Source and destination addresses are 32 bits in length.	(4) Source and destination addresses are 128 bits in length.
(5) IPsec support is optional	(5) IPsec support is required
(6) Address resolution protocol is used	(6) Neighbour solicitation messages are used
(7) Must be configured either manually or through DHCP	(7) Does not require manual configuration or DHCP.

⑯ Mobile IP -

It is the underlying technology for support of various mobile data applications and the networking applications.

It is designed to allow mobile device users to move from one network to another while maintaining a permanent IP address.