

Networks LayerNetworks Layer:-

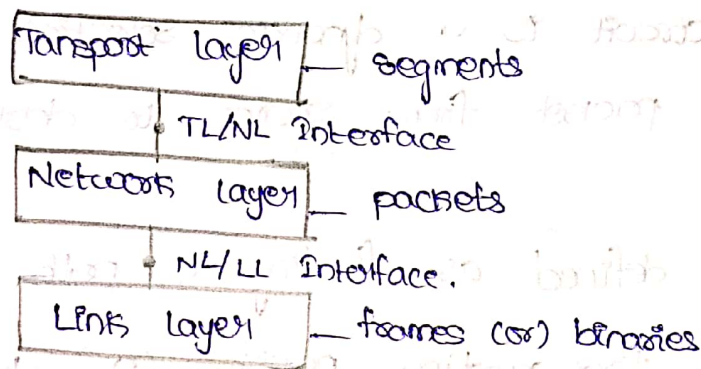
Network layer is a mandatory layer in N/T architecture which implements an important service of routing.

Networks Layer Design Issues (or) Functionality (or) Services:-

* N/T layer provides accessibility to the above and below layers.

N/T layer is accessing the services from transport layer and provides the services to the link layer at the side of source system where as N/T layer is accessing the services from link layer and provides services to the transport layer at the side of destination system.

* N/T layer data format is packets.

Design Issue (2):-Implementation of connection oriented Service:-

* N/T layer uses two types of services. One is connection oriented service (COS). N/T layer uses COS for efficient packet transmission. In this type of service (TOS) N/T layer implements and setup a connection, establishes a routing path before packet transportation.

* Generally a packet is preferred as datagram so that the datagram transportation in a N/T through a subnet is known as datagram circuit.

* N/T layer while transporting a packet through COS

is implemented reliability.

③ Implementation of connection less services:- (CLS)

- * N/t layer uses two types of services; where as the second type of service defined by N/t layer is connection less service.
- * In this type of service, N/t layer does not advancedly setup a circuit for packet transportation. When a packet transported from the source system the N/t layer connection less service implement a dynamic path for packet transportation to the destination.

* CLS implements a virtual circuit path by the N/t layer for transporting a packet from source to destination.

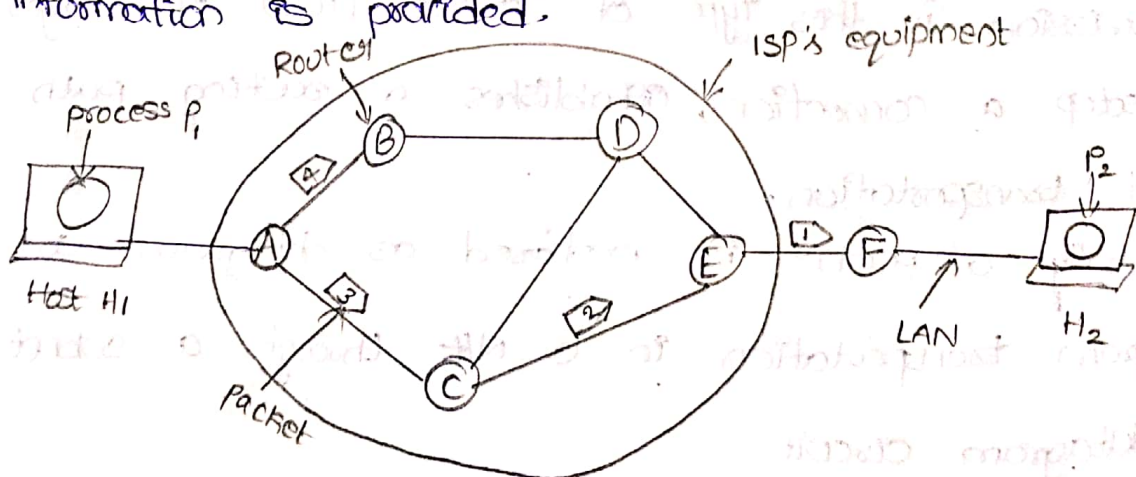
* A virtual circuit is a dynamic selection of routing path to transport a packet from source to destination.

④ Routing:-

* Routing is defined as finding a path from source to destination for transporting packets (or) datagram.

* A packet is routed by using routing table information provided by routing algorithms in dynamic routing, routing tables are updated dynamically where as in static routing information is provided.

eg. fig



A's table (initially)

A	
B	B
C	C
D	B
E	C
F	C

Dest Line

A's table (later)

A	
B	B
C	C
D	B
E	D
F	D

C's table

A	A
B	A
C	
D	E
E	E
F	E

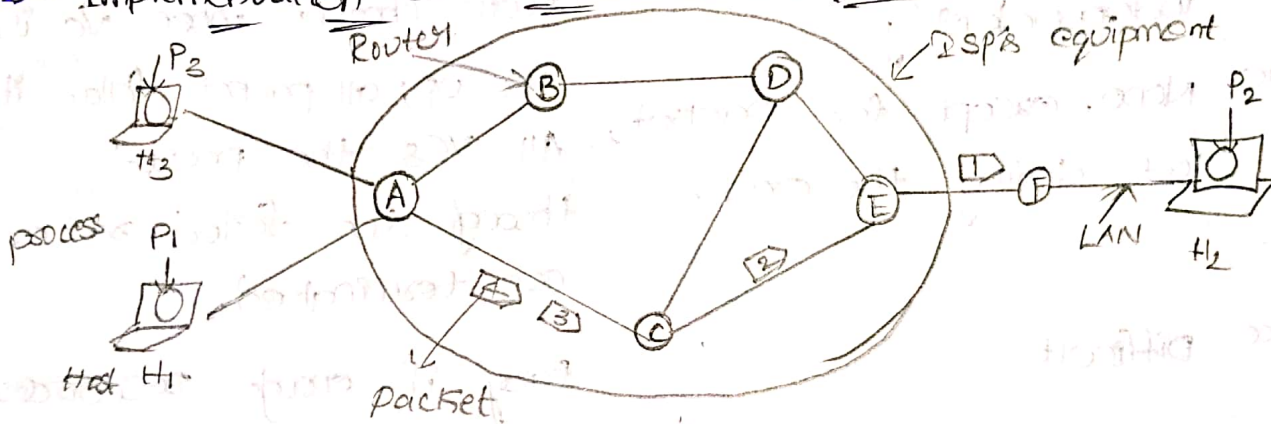
E's Table

A	C
B	D
C	C
D	D
E	
F	F

Routing within a datagram n/t.

11/2/19

Implementation of connection-oriented service:-



A's Table

H1	1
H3	1

In

C	1
C	2

Out

C's Table

A	1
A	2

E	1
E	2

E's table

C	1
C	2

F	1
F	2

Routing within a virtual-circuit n/t.

composition of

** Comparison of virtual-circuit and Datagram N/t.

Issue	Datagram N/t	virtual-circuit N/t.
Circuit Setup	Not Needed	Required
Addressing	Each packet contains the full source and destination address	Each packet contains a short Vc number.
State Information	Routers do not hold state information about connections	Each Vc requires router table space per connection.
Routing	Each packet is routed independently	Route chosen when Vc is set up; all packets follow it
Effect of router failures	None, except for packets lost during the crash.	All VCs that passed through the failed router are terminated.
Quality of service	Difficult	Easy if enough resources can be allocated in advance for each Vc.
Congestion ^{traffic} Control	Difficult	Easy if enough resources can be allocated in advance for each Vc.

comparison of datagram and virtual-circuit networks.

20/12/19 Routing Algorithms:-

- * N/t layer implements routing service using routing algorithms. These algorithms are useful to find out a path b/w source & destination where the packets are cross many hops (routers).
- * The calculation of Routing path is done according to the rules and regulations of routing algorithm.
- * The various routing algorithms are applied based on wire, wireless n/t with respect to node ability.

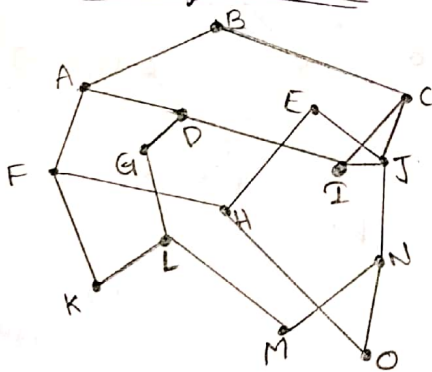
* Some of the routing algorithms are capable to update route information dynamically in routing table where as some algorithms can specify static routing information in routing tables of the n/w routers. Some of the routing algorithms are listed below.

- Optimality principle
- Shortest path algorithm (Non-adaptive)
- Flooding
- Distance vector Routing
- Link state routing
- Routing in ad hoc networks,

* The Routing algorithm finds a path for packet transportation from source to destination by considering the following parameters.

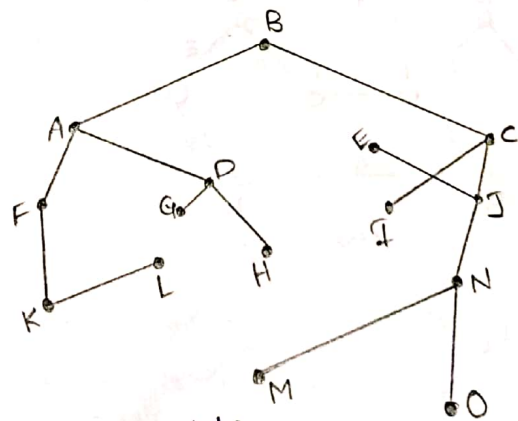
1. The type of n/w
2. Numbered hops
3. Minimizing cost
4. Network providers interest.
5. Timing constraints
6. Delay

* Optimality principle:-



(a)

a Network



(b)

A Spanning tree for router B

In optimality principle is

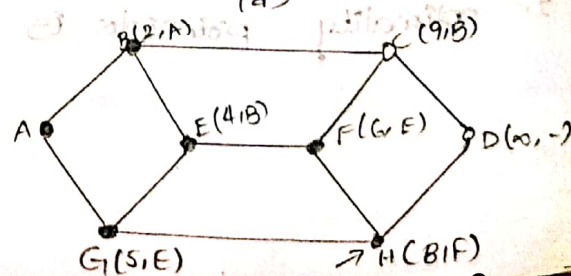
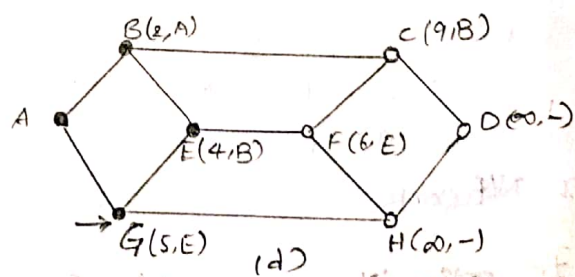
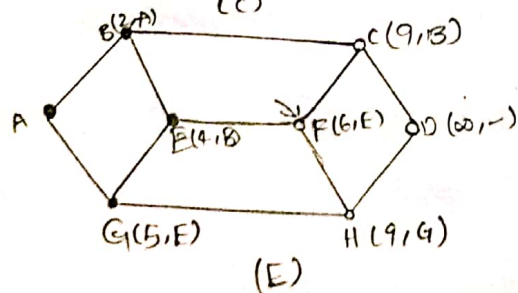
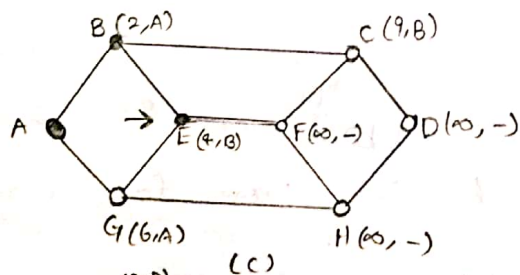
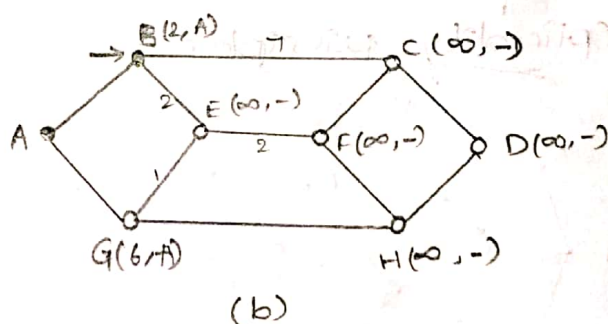
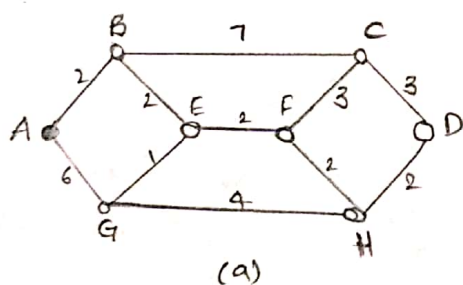
* An optimality principle is applied on networks to select an optimal route between set of source known to a selected destination.

* An optimality principle is used by networks to construct a sink tree to transport the packets efficiently between source to destination.

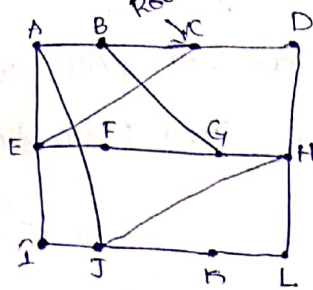
* An optimality principle is applied on networks for packet transportation with an optimal route between source to destination by loops (or) cycles in the network.

* An optimality principle can follow directly acyclic graph (DAG) so that a network can be formed sink trees without conjunctions.

Shortest path algorithm:- Non-adaptive



Distance Vector Routing:- (adaptive)



(a)

To	A	I	H	K
A	0	24	20	21
B	12	36	31	28
C	25	18	19	36
D	40	27	8	24
E	14	7	30	22
F	23	20	19	40
G	18	31	6	31
H	17	20	0	19
I	21	0	14	22
J	9	11	7	10
K	24	22	22	0
L	29	33	9	9

JA delay is 8
JI delay is 10
JH delay is 12
JK delay is 6

vectors received from J's four neighbours

(b)

New estimated delay from J	
↓	Line
8	A
20	A
28	I
20	H
17	I
30	I
18	H
12	H
10	I
0	-
6	K

New routing table for J

$$JA = JA + AA =$$

$$JI = J$$

* Routing algorithms are used to find out an optimal path b/w sender and receiver in a n/w. The routing algorithm is responsible for deciding the outgoing path for each and every incoming packet in a n/w, which should be transmitted from source to destination.

* The routing algorithms can be grouped into two major classes one is 1) adaptive routing algorithms
2) Non-adaptive routing algorithms

* Adaptive routing algorithm can allow the dynamic changes of routing decisions which reflects n/t topology where as non-adaptive routing algorithms do not depends on any measurement (or) Estimates of the current topology and topology.

* In Non-adaptive routing algorithms the routing path b/w nodes of a n/t is available fixedly. Based on this procedure only a non-adaptive routing algorithm is also known as static routing algorithm.

eg: shortest path routing algorithm.

In shortest path Routing algorithm a paths b/w nodes are available statically.

* A non adaptive routing algorithm example is distance vector routing algorithm which dynamically changes a routing paths along with decisions b/w nodes. which is generally apply on mobile nodes of a n/t.

* Distance vector Routing can find out an optimal path b/w nodes of a n/t where each and every node maintain a table (Spectrum).

* This table is consisting two entries 1) The best node distance b/w nodes

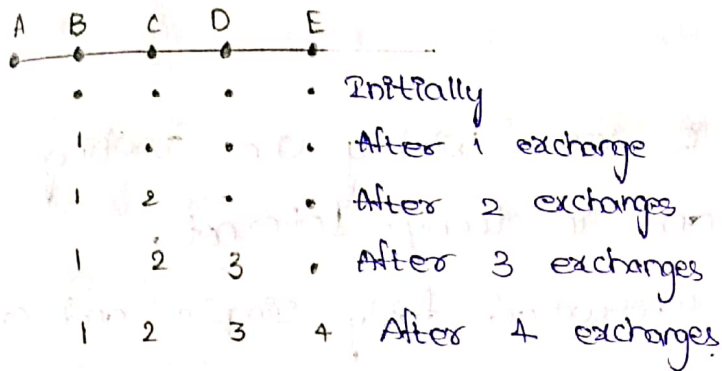
2) The line which is connecting the specify destination.

* If the distances changed b/w the nodes that will reflects an optimal path and n/t topology. For this reason the vectors (or) tables are dynamically updated depending on n/t nodes mobility (movement).

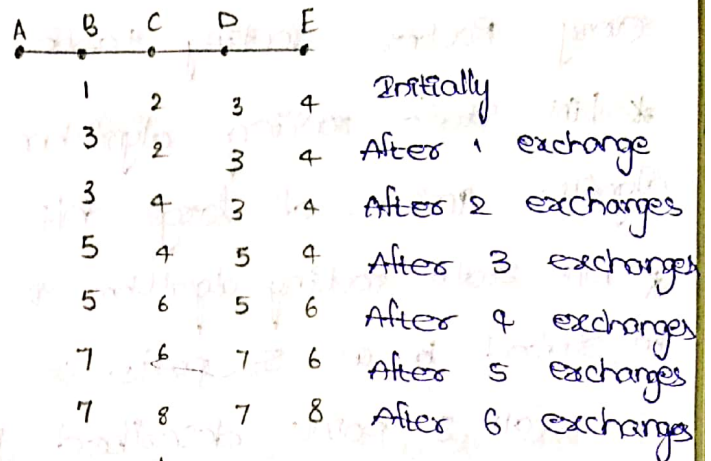
* The distance vector routing algorithm is introduced by Bellman ford in the year of 1962 with major revision.

* This algorithm is practically applied on the n/t known as ARPANET (Advance Research project Agency for Network)

the count-to-Infinity problem:



(a)

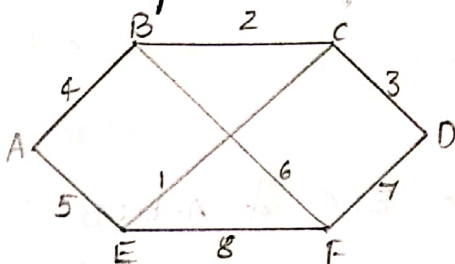


(b)

Link State Routing

1. Discover neighbours, learn networks addresses.
2. Set distance / cost metric to each neighbour.
3. Construct packet telling all learned.
4. Send packet to, receive packets, from other routers.
5. compute shortest path to every other routing.

Building Link state packets:-



(a)

Link		State		packets	
A	B	C	D	E	F
seq	seq	seq	seq	seq	seq
Age	Age	Age	Age	Age	Age
B 4	A 4	B 2	C 3	A 5	B 6
E 5	C 2	D 3	F 7	C 1	D 7
	F 6	E 1		F 8	E 8

(b)

* problem with distance vector Routing Algorithm is count-to-Infinity. Because of this reason the distance vector routing algorithm is too for implementation specifically when the n/t topology has been changed.

* In this connection the distance vector Routing Algorithm

is replaced by link state Routing Algorithm.

* Link State Routing algorithm is uses various links to the state of the node which are maintained by each and every Routers routing table.

* Link state routing algorithm is most widely use routing algorithm inside of large n/t and in today's Internet.

* Link state routing algorithm is constructed fairly simple and can be stated to as 5 parts.

(all 5 points described in the above Section).

* In link state routing algorithm once the information is needed for exchange has been collected by the immediate router in the next step so that a newly build packet is consisting all the new data items.

* Each packet is specified with identity of the sender, followed by sequence number, age and list of neighbours.

* In the above example n/t it is consisting 6 no. of nodes with labels A, B, C, D, E, F, ~~G, H, I~~

* The neighbouring nodes for A are B & E.

* For each neighbour the label cost is A-B: 4 & A-E: 5

* The corresponding link state packet for all the six routers in a given n/t are describe in figure(b).

* A link specify the neighbouring node of a sender sequentially and the age also specify based on starting and ending timing values of each and every packet in a n/t node.

* All the neighbouring nodes states (os) specify based on Senders links with neighbouring node sequence and age values

* The packets are constructed from sender to receivers computed shortest path. The computed shortest path will consist minimum values with respect to distance/cost metric.

* The link state routing algorithm defines over shortest path routing algorithm and Dijkstra algorithm. While computing the best optimal route from sender to receiver in a n/t.

Congestion control:-

Congestion:- Too many packets arriving at a node in a n/t can decrease n/t ^{performance} and increases delay and packet loss. This situation is called congestion.

* Due to reason of n/t trophy congestion will lead to bottlenecks in a n/t which also degrades the n/t throughput.

* Congestion has to be control to increase n/t data transfer rates b/w nodes.

* Congestion control is a common responsibility for n/t layer and transport layer. When congestion is control by transport layer obviously there has been less trophy in the n/t layer.

* N/t layer and transport layer should work together for controlling congestions in a n/t. Still n/t layer will implement various approaches for congestion control where as transport layer can implement different approaches for congestion control.

* The congestion when occurs in a n/t the transport layer can apply congestion control algorithms and then only sends TCP's to n/t layer. If still there is congestions the n/t layer implement its own congestion control algorithms to avoid congestions in a n/t.

* Basically n/t layer will provide the two existing soln to

address congestion issues.

- 1) N/t layer provides enough no. of n/t resources.
- 2) transport layer TCP's (N/t load) has to be decreased.

* these solutions are usually combine and applying on different schemes with respect to timing values.

* the most Basic way to avoid congestions is to build a n/t which is capable to carry the no. of generated packets, in a way by reducing traffic.

* the various approach for congestion control by n/t layer with different time scales has been pictured in the following figures.

congestion control by n/t layer assigned to basic approaches not suitable in all cases in the n/t.

