Routing & Multicast Routing

1) Link State Routing: i) A node would broadcast information about its own connections to its neighbours, ii) periodically, it may run an algorithm such as Dijkstra's Shortest Path to establish a routing table that includes routes to all nodes that it received information about in broadcasts.

   Distance Vector Routing: A node would periodically exchange routing tables or updated information of routing tables with neighbouring nodes. When a node receives an update from a neighbouring node, it will analyse this information for updates to its own routing table.

2) Link State Routing

   Consider the network shown in Figure 1. The nodes are routers in a network, the edges are links between the routers and the numbers on the edges indicate initial latency measurements (in msec) on that link (the measurements performed by two routers connected to the same link are identical.) The network uses measured latency as its metric.

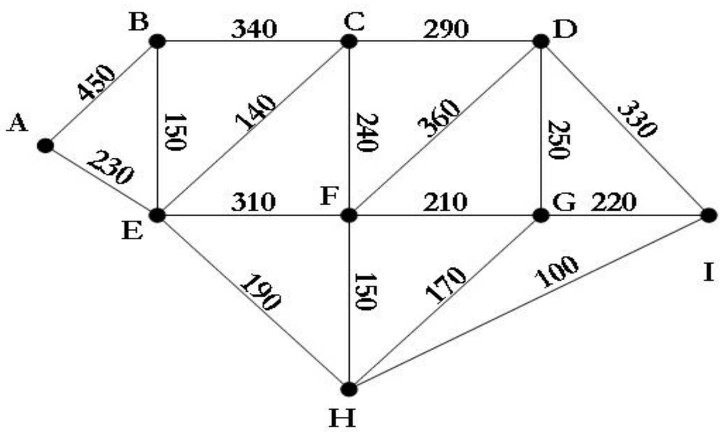


Figure 1

   a) Use Dijkstra's algorithm for finding the shortest path between A and I. A correct answer must include the complete list of routers in the shortest path between A and I, the length of that path and a list that shows the chronological order in which routers were marked permanent by Dijkstra's algorithm.

      Path: A, E, H, I
      Length: 520
      Chronological order: A, E, C, B, H, I, F, G, D

   b) Show the routing tables of the following three routers A, F, and I. Each entry in these tables has the form [destination, distance, link].

Routing table for A:

A	0	0
B	380	E
C	370	E
D	660	C
E	230	A
F	540	E
G	590	H
H	420	E
I	520	H

Routing table for I:

A	520	E
B	440	E
C	430	E
D	320	I
E	290	H
F	160	H
G	130	I
H	100	I
I	0	0

Routing table for F:

A	540	E
B	460	E
C	240	F
D	360	F
E	310	F
F	0	0
G	210	F
H	150	F
I	250	H

3) Distance Vector Routing

Router	Latency
E	390
F	260
G	270
I	380

a) Router H in the network of exercise 1) updates its neighbours using distance vectors with the information shown in the table above. Show the progression of the routing information in the network for the times t= 0, 1, 2, … and the influence on the distance of the path from router A to router I.

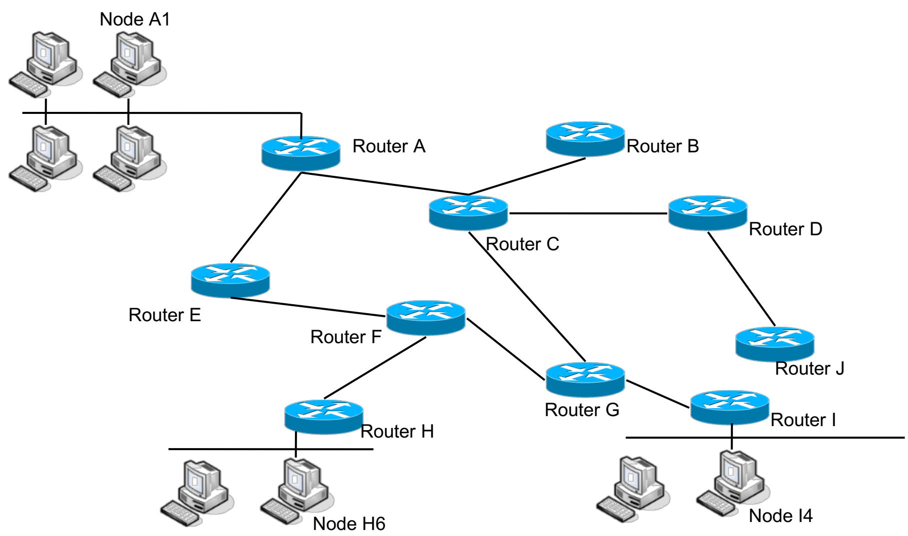
Time Update
t0 H
t1 E, F, G, I
t2 A, B, C, D

Route from A to I over E-H: 1000
Route from A to I: A-E-F-G-I
Length: 970

b) Explain the exchange of routing information in Distance Vector Routing in your own words and contrast it with the approach taken in Link State Routing.

An answer to this question should explain the exchange of complete routing tables or updates to routing tables between neighbouring nodes in Distance Vector Routing and that information in routing tables progresses through the network based on these exchanges until all nodes converge on a common view of the network. Given the volatile nature of nodes and connections, changes in the connectivity may trigger updates being propagated and the view of the network of individual routers may constantly change.
In contrast to this, Link State Routing is based on periodical or irregular broadcasts of connectivity information by individual routers. These broadcasts are gathered by individual routers and used for a shortest-path analysis, for example based on Djikstra's Shortest Path algorithm. The broadcasts of connectivity information may be triggered at regular intervals or whenever a change occurs. In contrast to Distance Vector Routing, these broadcasts should be delivered to all routers in the topology, eliminating the progression to convergence exhibited by Distance Vector approaches; at the expense of causing broadcasts throughout a topology i.e. introducing increased network traffic in exchange for reduced latency in distributing routing information.

4) Assume that the network below uses multicast routing in dense mode. Node A1, H6 and I4 subscribe to the address 224.0.0.1 and Node A1 sends a datagram to the address. Describe the initial communication between the nodes and the routers at their local network and the transfer of the subscription information and data messages between the routers.



The nodes would use IGMP to inform the routers in their local network that they are interested in address 240.0.2.1 (join). The nodes should let the routers know, once they are not interested in receiving messages to this group e.g. when a program that was listening for these messages ends.

The routers in the example use PIM-DM. Router A would broadcast the first transmission by A1 to all routers. In the next step, all routers that are not on forwarding paths – which is determined through a mechanism similar to the Spanning Tree algorithm – remove themselves from the tree for further broadcasts e.g. if router F would be selected as forwarder for routers H and G, all routers following and including router C could be removed from the forwarding path; router J would inform router D that it has no subscribers and would not be interested in further transmissions, router D would inform router C, router B would inform router C, and finally router C would inform router A. Any further transmissions by A1 would be forwarded by router A only to router E.