NETWORK LAYER

Functions of Net Work layer

1. Routing 2. Congestion Control

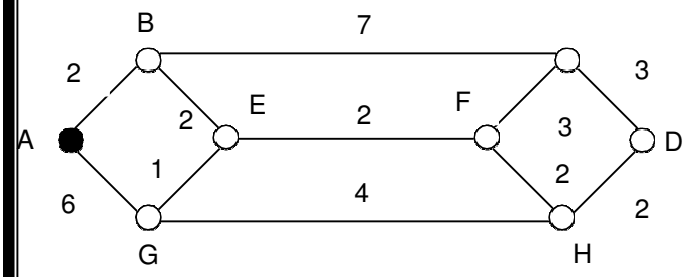
Routing algorithms

The main function of the network layer is routing packets from the source machine to the destination machine. Routing algorithm can be grouped into two major classes. Nonadaptive and Adaptive algorithms.

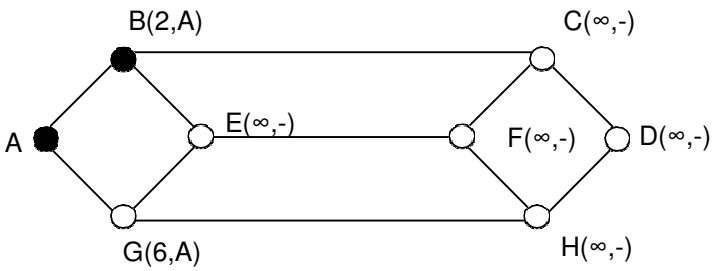
	Non adaptive	Adaptive
1)	Routing decisions are not based on measurements or estimates of the current traffic and topology.	Routing decisions are based on measurements of the current traffic and topology.
2)	The route is computed well in advance.	The route is computed depends on situation.
3)	When the network is booted the routers are downloaded.	The routers are not downloaded.
4)	This is a static routing.	This is a dynamic routing.

Shortest Path Routing:

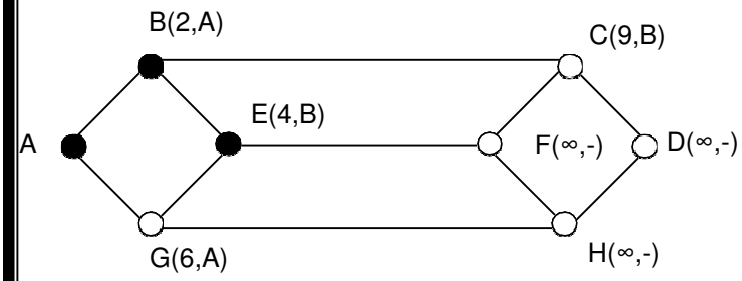
This is a static routing algorithm. The idea is to build a graph of the subnet, with each node of the graph representing a router and each arc of the graph representing a communication line. To choose a route between a given pair of routers, the algorithm just finds the shortest path between them on the graph.


B
7
2
3
A
2
E
2
F
3
D
1
2
6
4
2
G
H

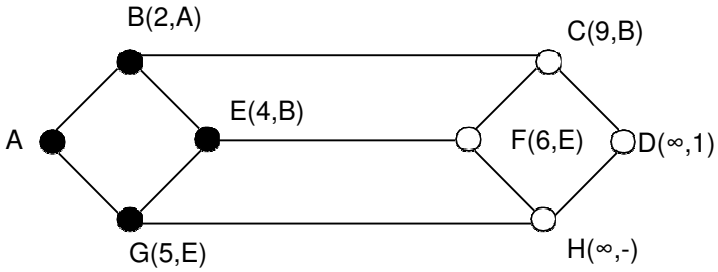
(a)


B(2,A)
C(∞,-)
A
E(∞,-)
F(∞,-)
D(∞,-)
G(6,A)
H(∞,-)

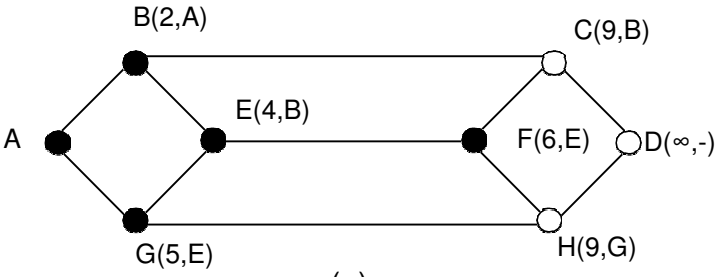
(b)


B(2,A)
C(9,B)
A
E(4,B)
F(∞,-)
D(∞,-)
G(6,A)
H(∞,-)

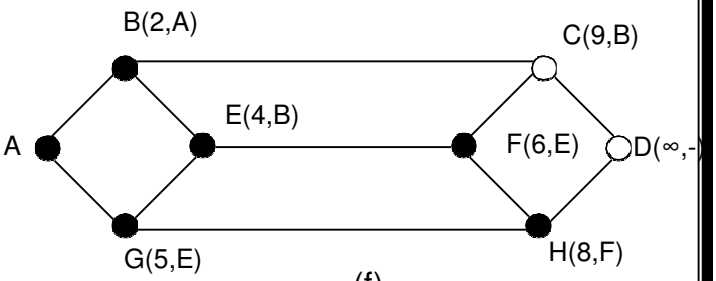
(c)


B(2,A)
C(9,B)
A
E(4,B)
F(6,E)
D(∞,1)
G(5,E)
H(∞,-)

(d)


B(2,A)
C(9,B)
A
E(4,B)
F(6,E)
D(∞,-)
G(5,E)
H(9,G)

(e)


B(2,A)
C(9,B)
A
E(4,B)
F(6,E)
D(∞,-)
G(5,E)
H(8,F)

(f)

One-way of measuring path length is the number of hops. Using this metric, the paths ABC and ABE are equally long. (Two hops).

Another metric is the Geographic distance in Kilometers. ABC is clearly longer than ABE.

Many other metrics are also possible besides hops and physical distance. Each are could be labeled with the mean queuing and transmission delay for some standard test packets as determined by hourly test runs. With this graph labeling, the shortest path is the fastest path, rather than the path with the fewest arc or kilometers.

In most general case, the labels on the arcs could be computed as a function of the distance, bandwidth, average traffic, communication cost, mean queue length, measured delay and other factors.

The shortest path can be calculated using Dijkstra method. Each node is labeled with its distance from the source along the best known path. Initially, no paths are known, so all nodes are labeled with infinity. As the algorithm proceeds and paths are found, the labels may change, reflecting better paths. Initially all labels are tentative. When it is discovered that a label represents the shortest path from the source to that node, it is made permanent and never changed thereafter.

In the above diagram, let the weights represents the distance. To find out the shortest path from A to D. We start by marking A as permanent. The examine each one with the distance to A, relabeling each one with the distance to A. Whenever a node is relabeling also label it with the node from which the probe was made. After examing each of the nodes adjacent to A, examine all the tentatively labeled nodes in the whole graph and make the one with the smallest label permanent. This one becomes the new working node.

The same procedure is adopted to all the nodes and the shortest path is found.

Flooding:

This is a static algorithm. In this, every incoming packet is sent out on every outgoing line except the one it arrived on. Flooding will generate

vast numbers of duplicate packets, some measures have to take to dump the duplicate packets. One such measure is to have a hop counter contained in the header of each packet, which is decremented at each hop, with the packet being discarded when the counter reaches zero. The hop counter should be initialized to the length of the path from source to destination. If the sender does not know how long the path is it can initialize the counter to full diameter of the subnet.

A variation of flooding is 'Selective Flooding'. In this the routers do not send every incoming packet on every line, instead only on those lines that are going approximately in the right direction which leads to the destination.