SHORTEST PATH ALGORITHMS - AN INTRODUCTION

Network routing is a major component at the network layer and is concerned with the problem of determining feasible paths (or routes) from each source to each destination. A router or a packet-switched node performs two main functions: routing and forwarding.

In the routing function an algorithm finds an optimal path to each destination and stores the result in a routing table. In the forwarding function a router forwards each packet from an input port to the appropriate output port based on the information stored in the routing table.

Shortest-path routing algorithms: the **Bellman-Ford algorithm and Dijkstra's algorithm.**Some other routing approaches are flooding, deflection routing, and source routing.

Most routing algorithms are based on variants of shortest-path algorithms,which try to determine the shortest path for a packet according to some cost criterion. To better understand the purpose of these algorithms, consider a communication network as a graph consisting of a set of nodes (or vertices) and a set of links (or edges, arcs, or branches), where each node represents a router or a packet switch and each link represents a communication channel between two routers. Figure 1.28 shows such an example. Associated with each link is a value that represents the cost of using that link. For simplicity, it is assumed that each link is nondirected. If a link is directed, then the cost must be assigned to each direction. If we define the path cost to be the sum of the link costs along the path, then the shortest path between a pair of nodes is the path with the least cost. For example, the shortest path from node 2 to node 6 is 2-4-3-6, and the path cost is 4.

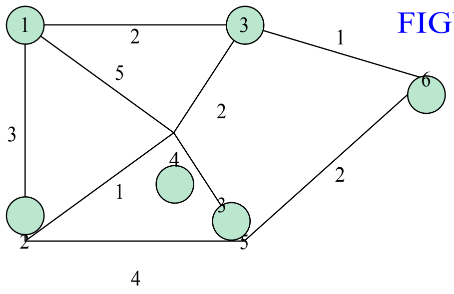

FIGURE 1.28 A sample network with associated link costs

Many metrics can be used to assign a cost to each link, depending on which function is to be optimized. Examples include

1. Cost 1/capacity. The cost is inversely proportional to the link capacity. Here one assigns higher costs to lower-capacity links. The objective is to send a packet through a path with the highest capacity. If each link has equal capacity, then the shortest path is the path with the minimum number of hops.

2. Cost packet delay. The cost is proportional to an average packet delay, which includes queueing delay in the switch buffer and propagation delay in the link. The shortest path represents the fastest path to reach the destination.

3. Cost congestion. The cost is proportional to some congestion measure, for example, traffic loading. Thus the shortest path tries to avoid congested links.

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