

One of the primary reasons DVR protocols exhibit problems comes from *backwash* (i.e., a packet switch receives information that it sent). For example, suppose a switch tells its neighbors, “I can reach destination D_1 at cost 3”. If the connection leading to destination D_1 fails, the switch will remove the entry for D_1 from its forwarding table (or mark the entry invalid). But the switch has told neighbors that a route exists. Imagine that just after the link fails, one of the neighbors sends a DVR message that specifies “I can reach destination D_1 at cost 4”. Unfortunately, the message will be believed, and a routing loop will be created.

Most practical routing mechanisms contain constraints and heuristics to prevent problems like routing loops. For example, DVR schemes employ *split horizon*, which specifies that a switch does not send information back to its origin. Furthermore, most practical routing systems introduce hysteresis that prevents the software from making many changes in a short time. However, in a large network where many links fail and recover frequently, routing problems can occur.

18.15 Summary

A Wide Area Network (WAN) technology can be used to form networks that span an arbitrarily long distance and connect arbitrarily many computers. A traditional WAN consists of electronic devices, called packet switches, interconnected by leased data circuits. A packet switch contains a processor, memory, and I/O interfaces. An interface either connects to a local computer or to another packet switch.

Packet switching networks use a store-and-forward approach in which an arriving packet is placed in the memory of a packet switch until the processor can forward the packet to its destination. Forwarding relies on a data structure known as a forwarding table. The table contains an entry for each destination, and the entry specifies the next hop used to reach that destination. A forwarding table lists packet switches as destinations instead of individual computers.

A WAN can be represented as a graph in which each node corresponds to a packet switch and each edge corresponds to a communication line. The graph representation is useful because it eliminates details and can be used to compute forwarding tables. The two basic approaches used in routing software are Link State Routing (LSR) and Distance-Vector Routing (DVR). LSR arranges for each packet switch to broadcast the status of each directly connected link, and uses Dijkstra’s shortest path algorithm to compute shortest paths. DVR arranges for a packet switch to send its neighbors a list of destinations and the cost to reach each. A neighbor examines the list in an incoming DVR message, and replaces items in its forwarding table if a lower-cost route is available.