used to exchange these messages are often referred to as **signaling protocols**. VC setup is shown pictorially in Figure 4.4. We'll not cover VC signaling protocols in this book; see [Black 1997] for a general discussion of signaling in connection-oriented networks and [ITU-T Q.2931 1995] for the specification of ATM's Q.2931 signaling protocol.

4.2.2 Datagram Networks

In a **datagram network**, each time an end system wants to send a packet, it stamps the packet with the address of the destination end system and then pops the packet into the network. As shown in Figure 4.5, there is no VC setup and routers do not maintain any VC state information (because there are no VCs!).

As a packet is transmitted from source to destination, it passes through a series of routers. Each of these routers uses the packet's destination address to forward the packet. Specifically, each router has a forwarding table that maps destination addresses to link interfaces; when a packet arrives at the router, the router uses the packet's destination address to look up the appropriate output link interface in the forwarding table. The router then intentionally forwards the packet to that output link interface.

To get some further insight into the lookup operation, let's look at a specific example. Suppose that all destination addresses are 32 bits (which just happens to be the length of the destination address in an IP datagram). A brute-force implementation of the forwarding table would have one entry for every possible destination address. Since there are more than 4 billion possible addresses, this option is totally out of the question.

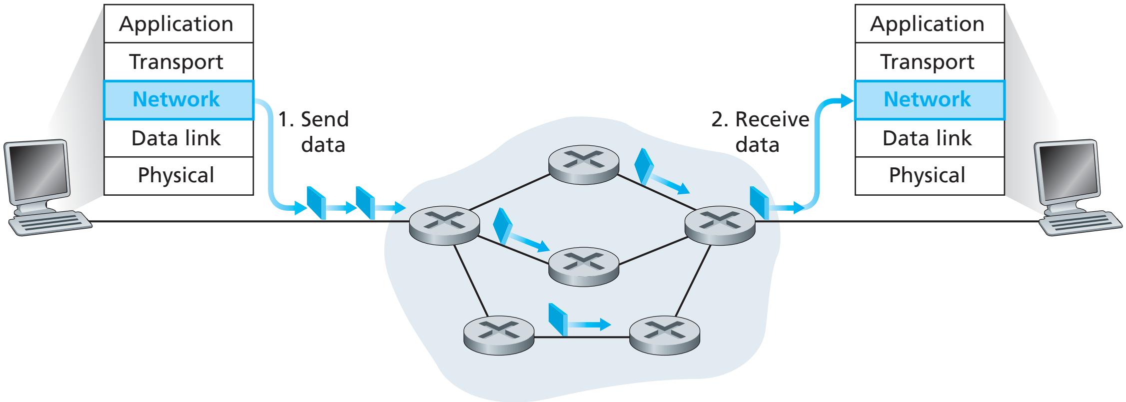

Figure 4.5 ♦ Datagram network

Now let's further suppose that our router has four links, numbered 0 through 3, and that packets are to be forwarded to the link interfaces as follows:

Destination Address Range	Link Interface
11001000 00010111 00010000 00000000 through 11001000 00010111 00010111 11111111	0
11001000 00010111 00011000 00000000 through 11001000 00010111 00011000 11111111	1
11001000 00010111 00011001 00000000 through 11001000 00010111 00011111 11111111	2
otherwise	3

Clearly, for this example, it is not necessary to have 4 billion entries in the router's forwarding table. We could, for example, have the following forwarding table with just four entries:

Prefix Match	Link Interface
11001000 00010111 00010	0
11001000 00010111 00011000	1
11001000 00010111 00011	2
otherwise	3

With this style of forwarding table, the router matches a **prefix** of the packet's destination address with the entries in the table; if there's a match, the router forwards the packet to a link associated with the match. For example, suppose the packet's destination address is 11001000 00010111 00010110 10100001; because the 21-bit prefix of this address matches the first entry in the table, the router forwards the packet to link interface 0. If a prefix doesn't match any of the first three entries, then the router forwards the packet to interface 3. Although this sounds simple enough, there's an important subtlety here. You may have noticed that it is possible for a destination address to match more than one entry. For example, the first 24 bits of the address 11001000 00010111 00011000 10101010 match the second entry in the table, and the first 21 bits of the address match the third entry in the table. When there are multiple matches, the router uses the **longest prefix matching rule**; that is, it finds the longest matching entry in the table and forwards the packet to the link