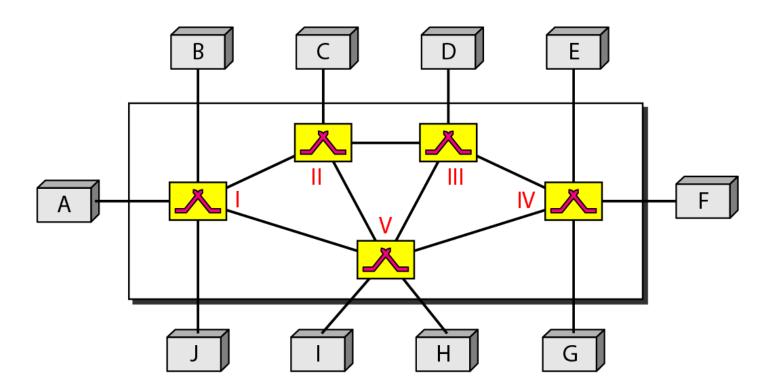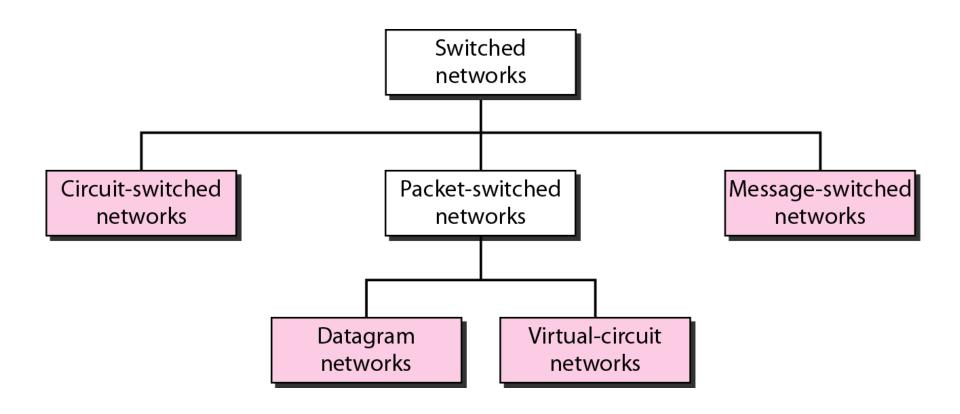# DATA COMMUNICATION AND NETWORKING

Switching

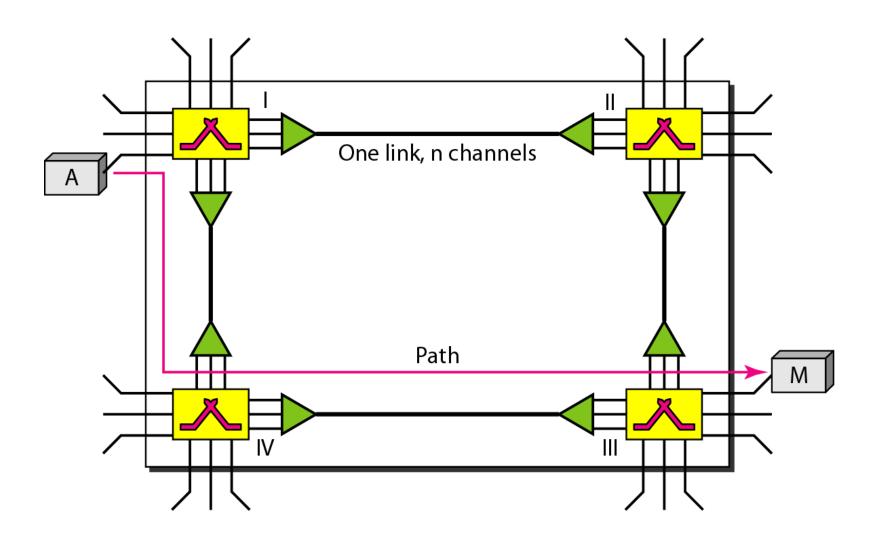# Figure 1 *Switched network*

Figure 2 *Taxonomy of switched networks*

CIRCUIT-SWITCHED NETWORKS

A circuit-switched network consists of a set of switches connected by physical links. A connection between two stations is a dedicated path made of one or more links. However, each connection uses only one dedicated channel on each link. Each link is normally divided into n channels by using FDM or TDM.

A circuit-switched network is made of a set of switches connected by physical links, in which each link is divided into n channels.

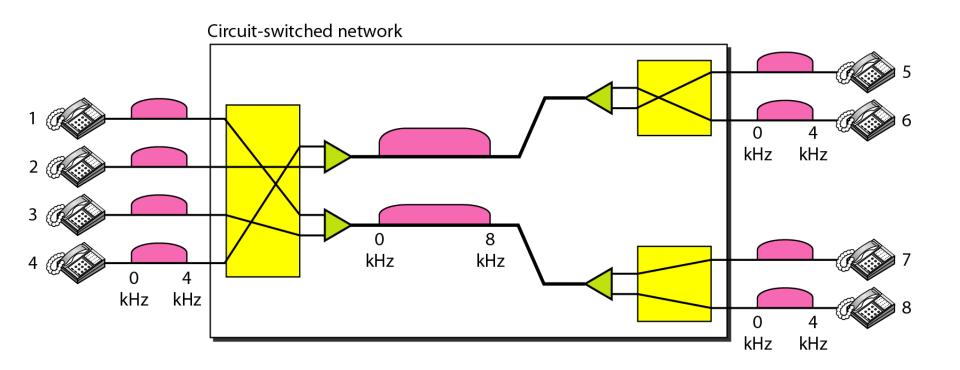# Figure 3 *A trivial circuit-switched network*

In circuit switching, the resources need to be reserved during the setup phase; the resources remain dedicated for the entire duration of data transfer until the teardown phase.

Example 1

As a trivial example, let us use a circuit-switched network to connect eight telephones in a small area. Communication is through 4-kHz voice channels. We assume that each link uses FDM to connect a maximum of two voice channels. The bandwidth of each link is then 8 kHz. Figure 4 shows the situation. Telephone 1 is connected to telephone 7; 2 to 5; 3 to 8; and 4 to 6. Of course the situation may change when new connections are made. The switch controls the connections.

Figure 4 *Circuit-switched network used in Example 1*

Example 2

As another example, consider a circuit-switched network that connects computers in two remote offices of a private company. The offices are connected using a T-1 line leased from a communication service provider. There are two 4 × 8 (4 inputs and 8 outputs) switches in this network. For each switch, four output ports are folded into the input ports to allow communication between computers in the same office. Four other output ports allow communication between the two offices. Figure 8.5 shows the situation.
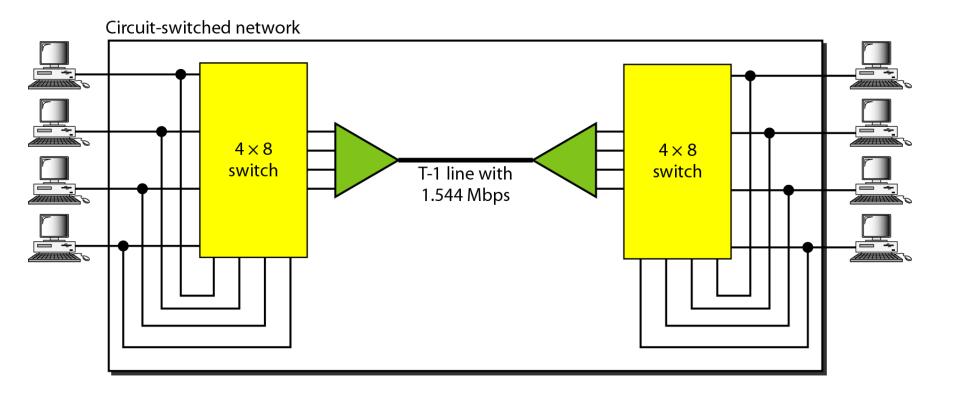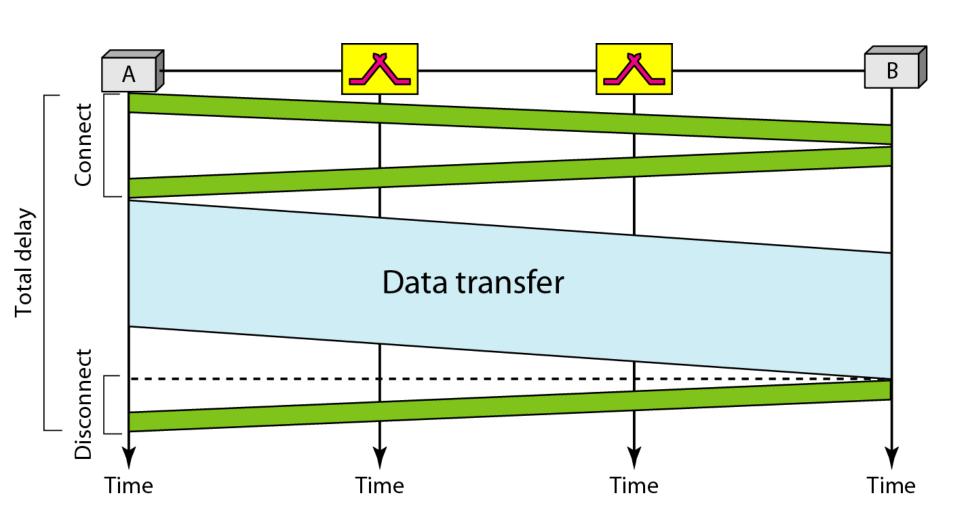
Figure 5 *Circuit-switched network used in Example 2*

Circuit-switched network

4 × 8 switch

T-1 line with 1.544 Mbps

4 × 8 switch

Figure 6 *Delay in a circuit-switched network*

Note

Switching at the physical layer in the traditional telephone network uses the circuit-switching approach.

DATAGRAM NETWORKS

In data communications, we need to send messages from one end system to another. If the message is going to pass through a packet-switched network, it needs to be divided into packets of fixed or variable size. The size of the packet is determined by the network and the governing protocol.

In a packet-switched network, there is no resource reservation; resources are allocated on demand.

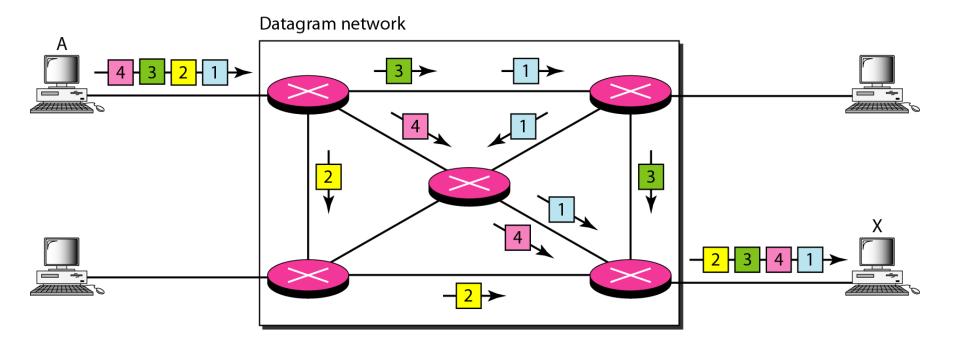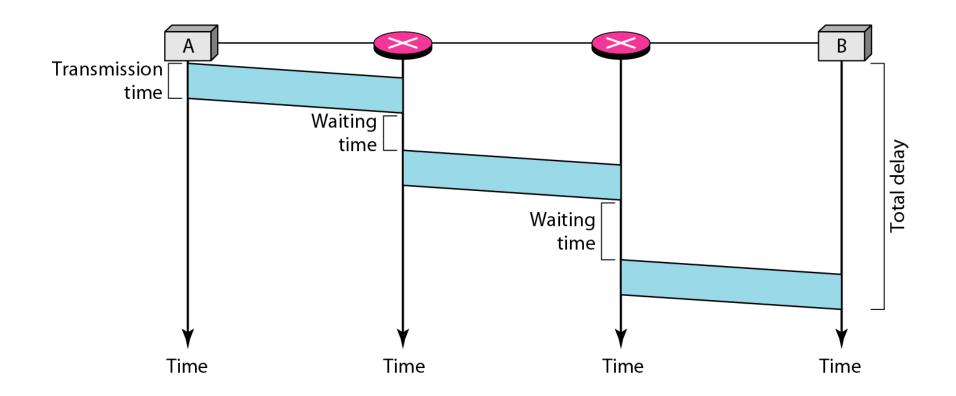# Figure 7 *A datagram network with five switches (routers)*

Figure 8 *Routing table in a datagram network*

Destination address	Output port
1232	1
4150	2
⋮	⋮
9130	3

A switch in a datagram network uses a routing table that is based on the destination address.

The destination address in the header of a packet in a datagram network remains the same during the entire journey of the packet.

Figure 9 *Delay in a datagram network*

Switching in the Internet is done by using the datagram approach to packet switching at the network layer.

VIRTUAL-CIRCUIT NETWORKS

A virtual-circuit network is a cross between a circuit-switched network and a datagram network. It has some characteristics of both.
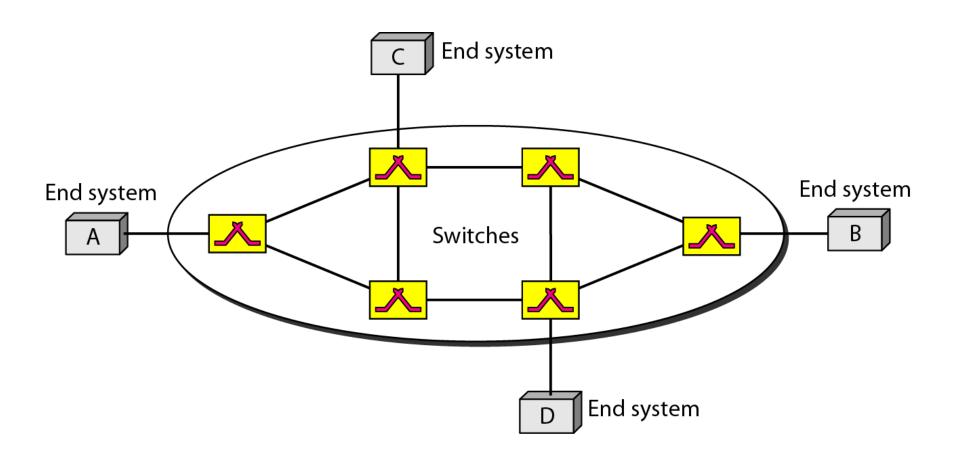
Figure 10 *Virtual-circuit network*
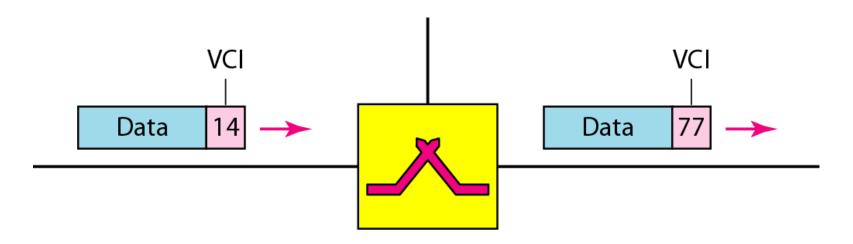
Figure 11 *Virtual-circuit identifier*

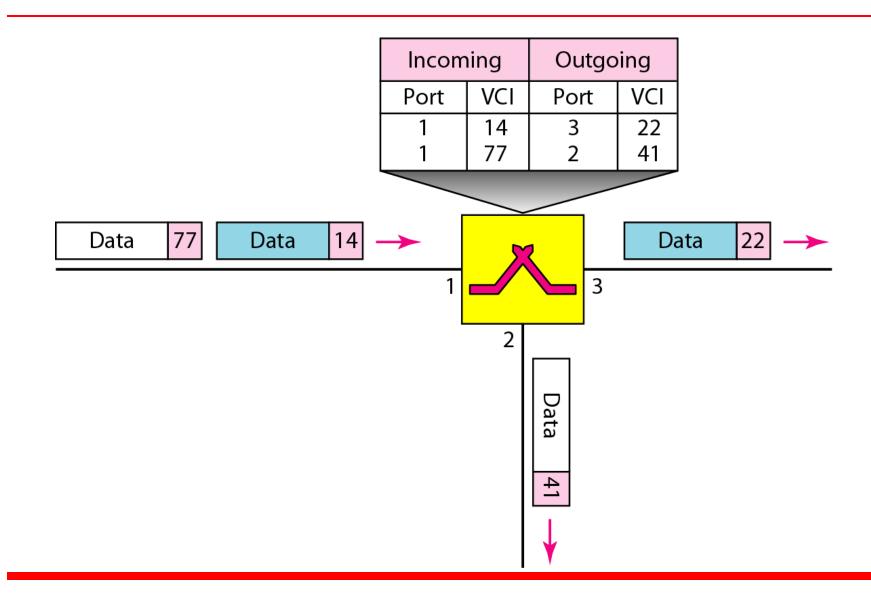# Figure 12 *Switch and tables in a virtual-circuit network*
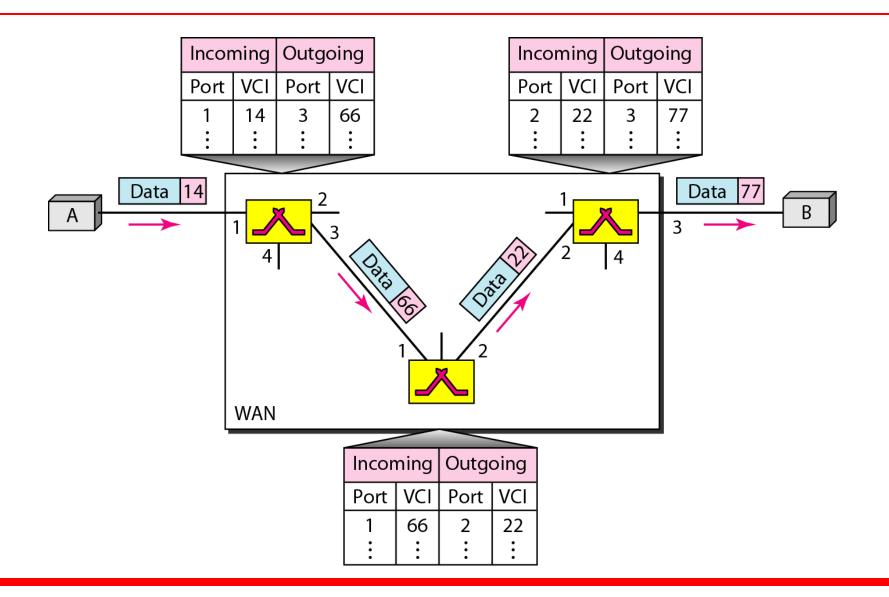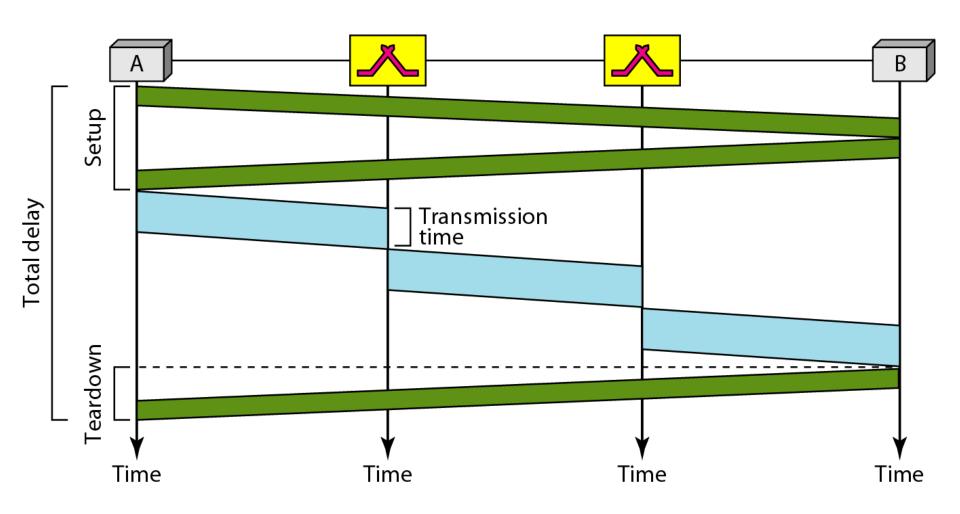
Figure 13 *Source-to-destination data transfer in a virtual-circuit network*

In virtual-circuit switching, all packets belonging to the same source and destination travel the same path; but the packets may arrive at the destination with different delays if resource allocation is on demand.

Figure 16 *Delay in a virtual-circuit network*

Switching at the data link layer in a switched WAN is normally implemented by using virtual-circuit techniques.

Packet Switching in a Data Network

Many paths may be used for a single communication as individual packets are routed to a destination.

No fixed path is established. Packets are routed according to the best path available at the time.

Prior to transmission, each communication is broken into packets which are addressed and numbered.

Internet

Source address	Destination address	Sequence number

At the destination, packets may be reassembled into order according to their sequence number.

During peak periods, communication may be delayed, but not denied.

8.30