



**Data Communications  
and Networking**

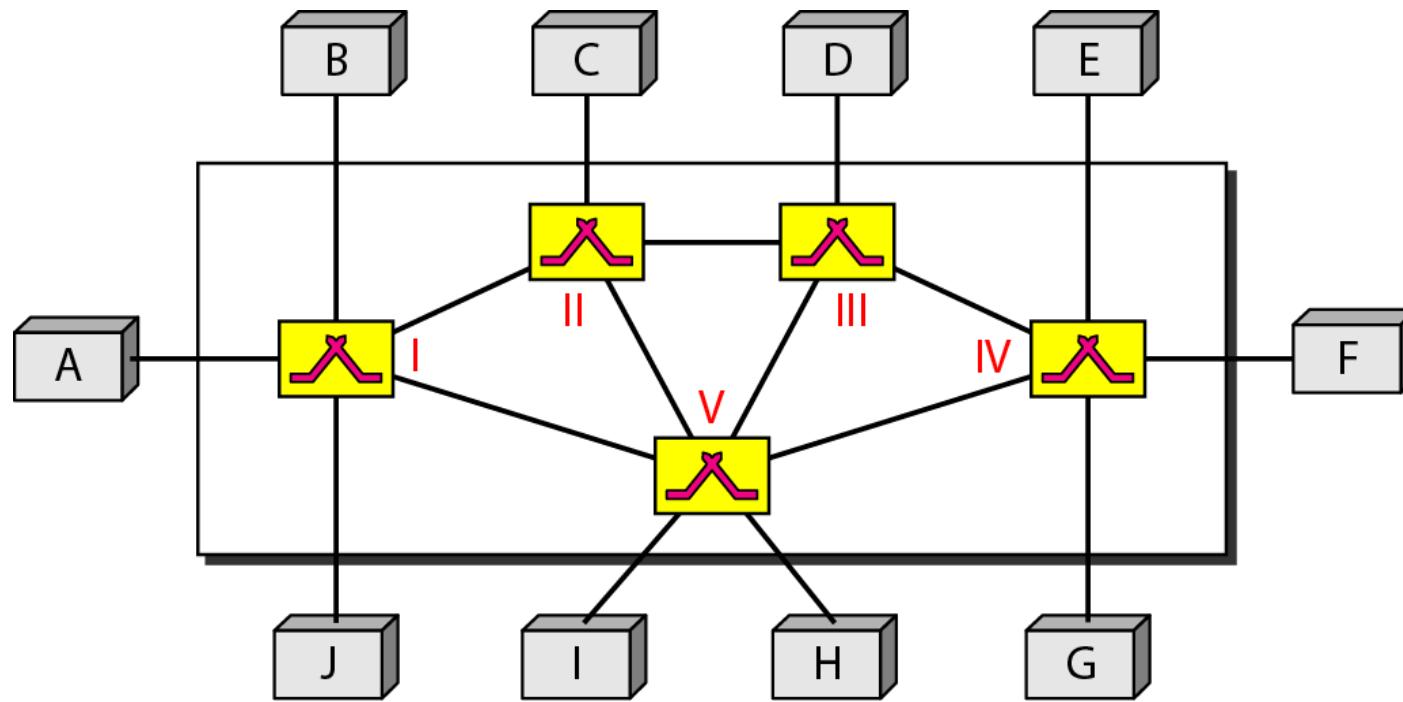
**Fourth Edition**

**Forouzan**

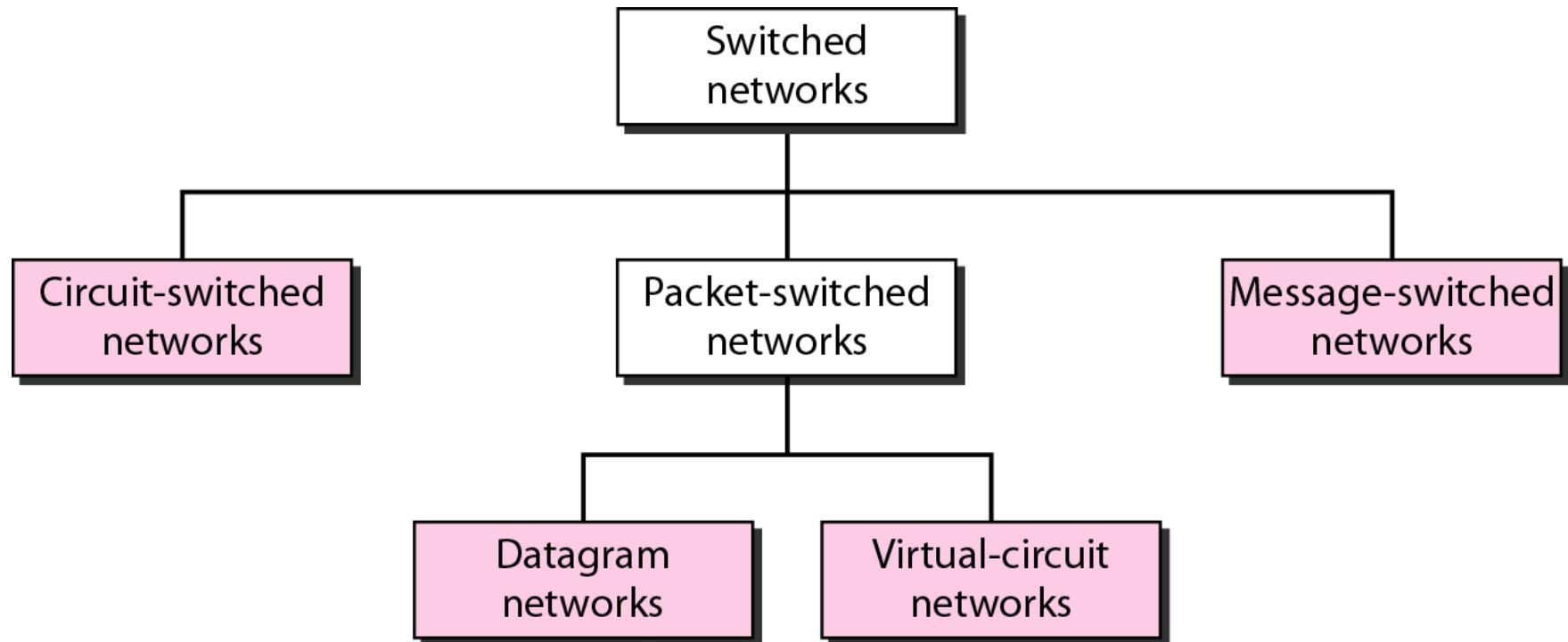
# **Chapter 8**

# **Switching**

**Figure 8.1** *Switched network*



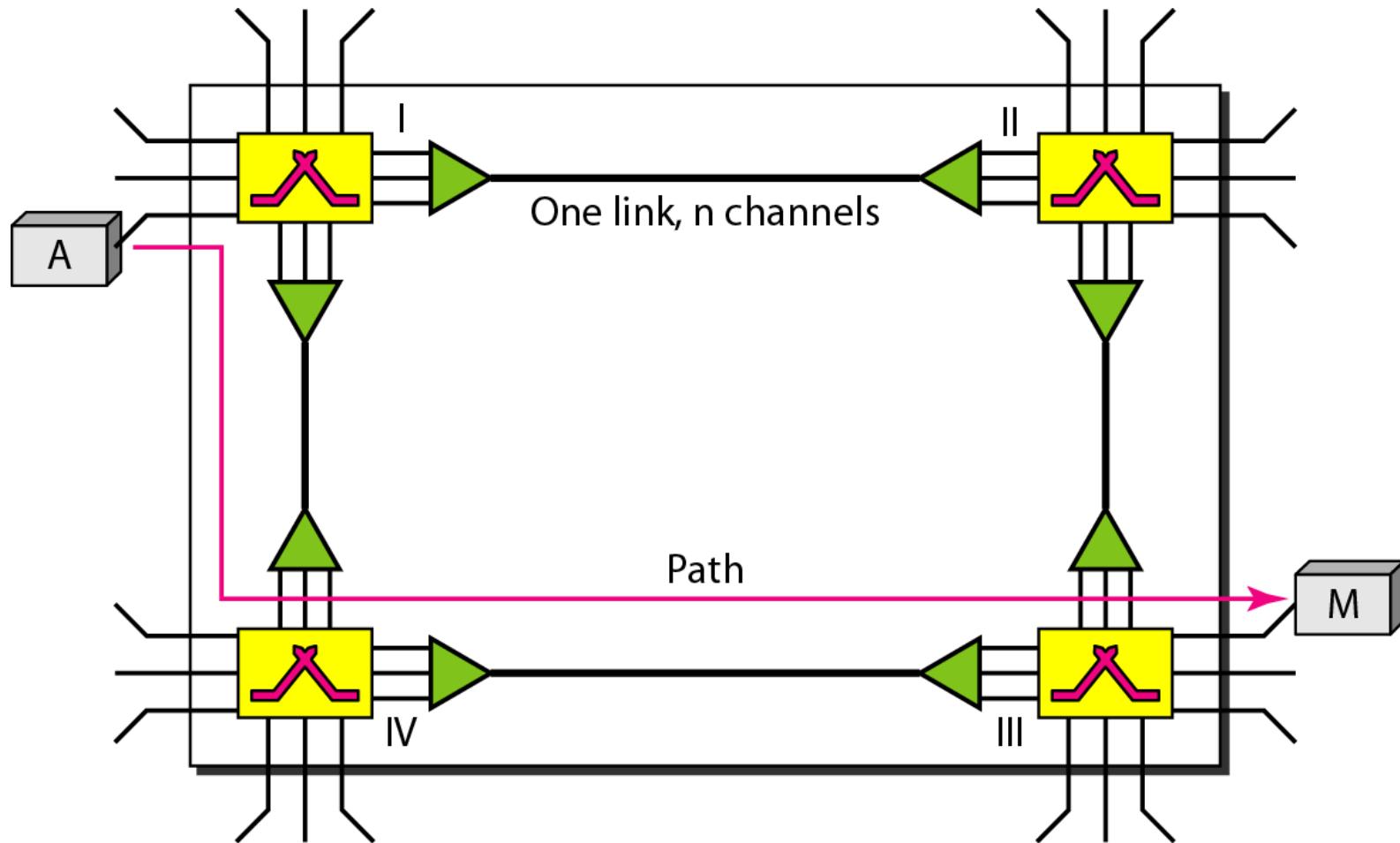
**Figure 8.2** *Taxonomy of switched networks*

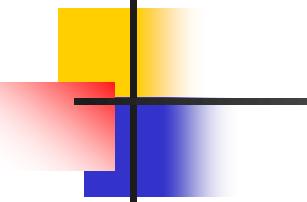


## 8-1 CIRCUIT-SWITCHED NETWORKS

*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.*

**Figure 8.3** A trivial circuit-switched network



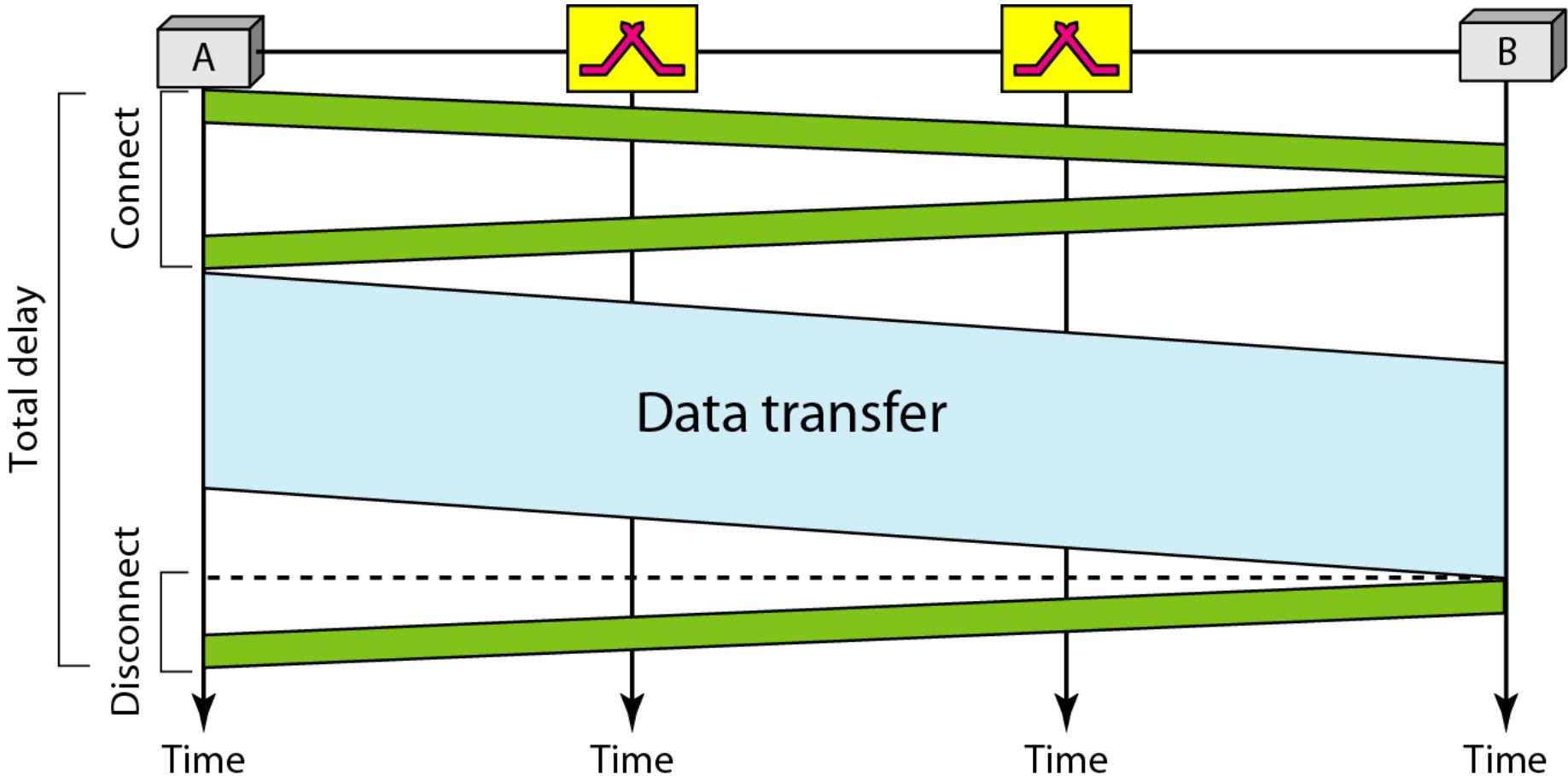


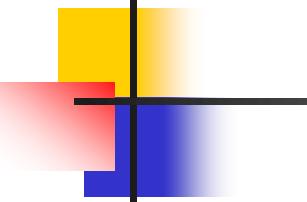
## **Note**

---

**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.**

**Figure 8.6** Delay in a circuit-switched network





## **Note**

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

## 8-2 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.*

# Two Basic Forms of Packet Switching

- Packets handled in two ways
  - Datagram (covered in this section)
  - Virtual circuit (covered in the next section)

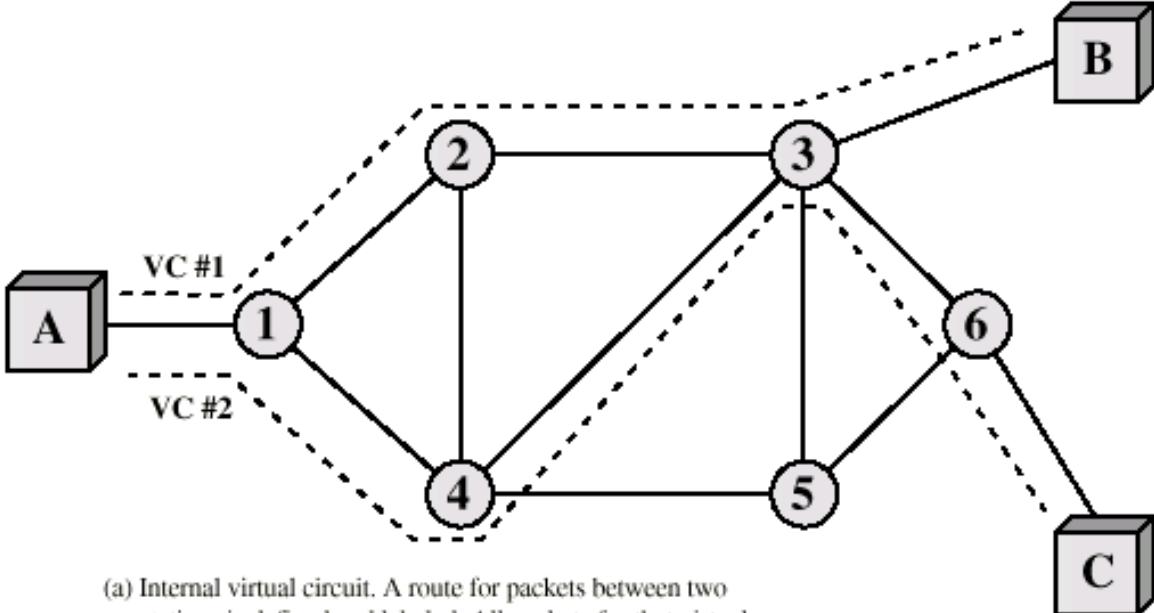
# Datagram

- Each packet treated independently
- Packets can take any practical route
- Packets may arrive out of order
- Packets may get lost or delayed
- Up to receiver to re-order packets and recover from missing packets

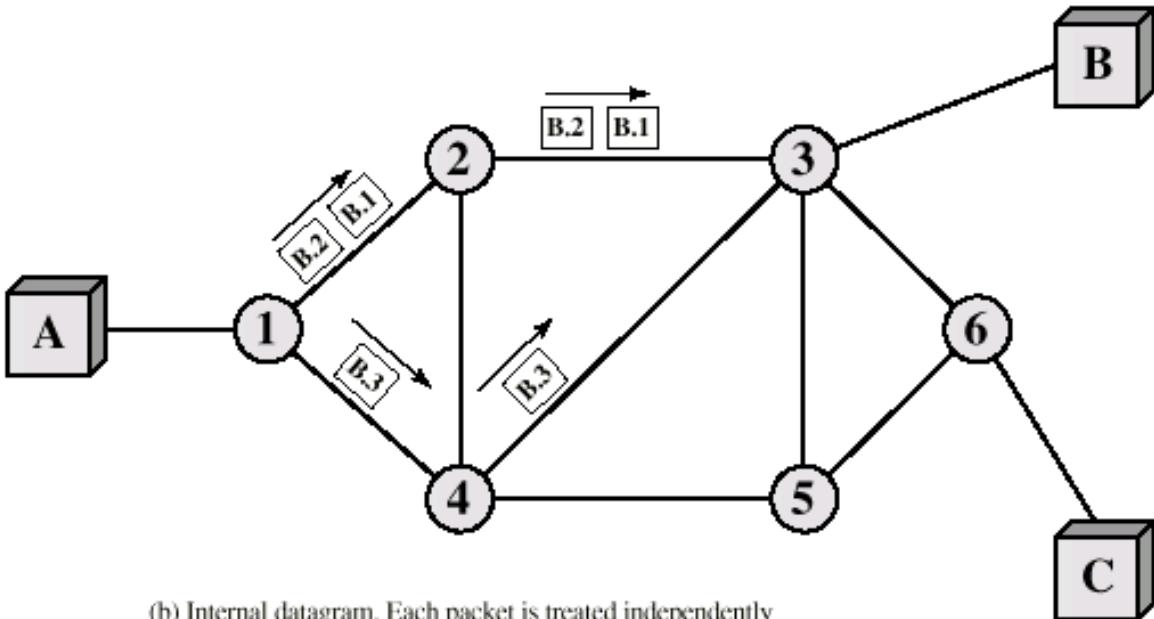
# Virtual Circuit

- Preplanned route established before any packets sent
- Call request and call accept packets establish connection (handshake)
- Each packet contains a virtual circuit identifier instead of destination address
- No routing decisions required for each packet
- Clear request to drop circuit
- Not a dedicated

# Internal Virtual Circuit and Datagram Operation

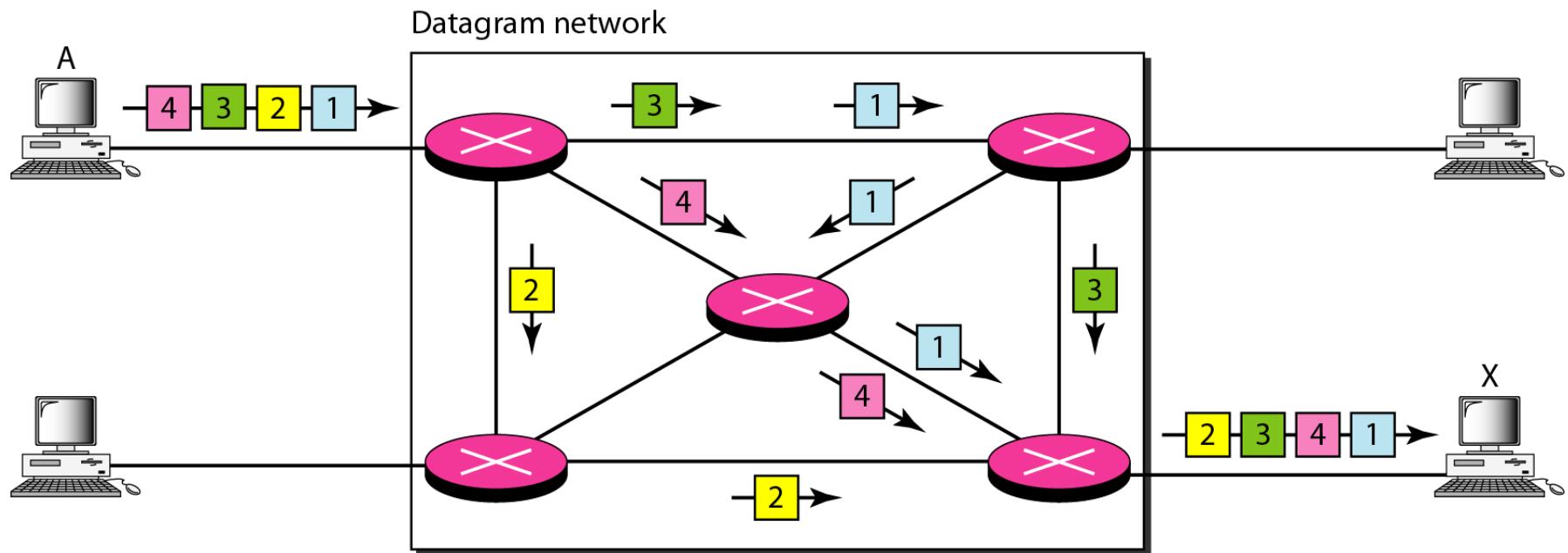


(a) Internal virtual circuit. A route for packets between two stations is defined and labeled. All packets for that virtual circuit follow the same route and arrive in the same sequence.

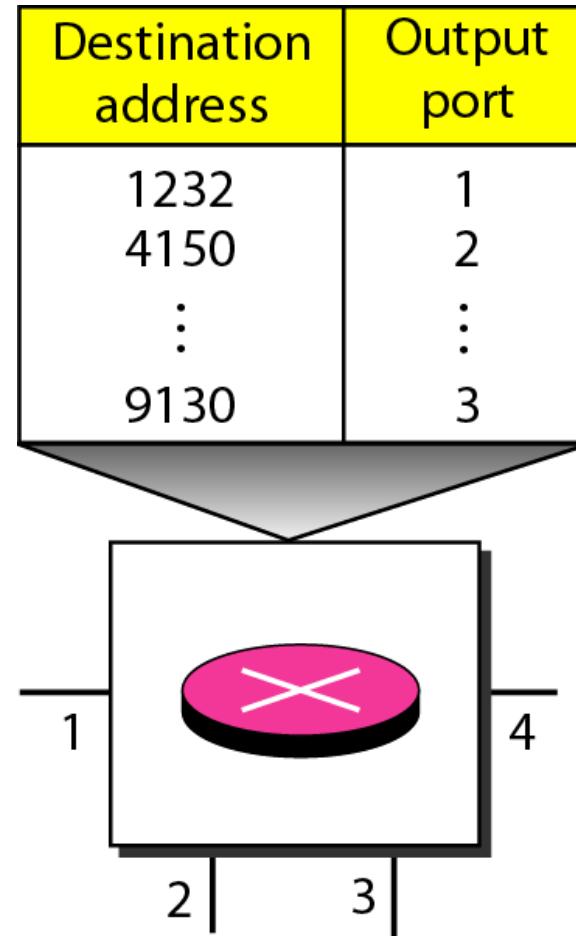


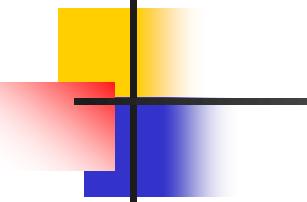
(b) Internal datagram. Each packet is treated independently by the network. Packets are labeled with a destination address and may arrive at the destination node out of sequence.

**Figure 8.7** A datagram network with four switches (routers)



**Figure 8.8** *Routing table in a datagram network*



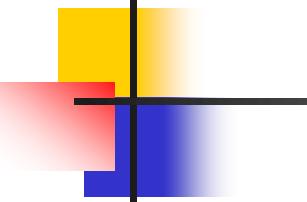


## *Note*

---

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

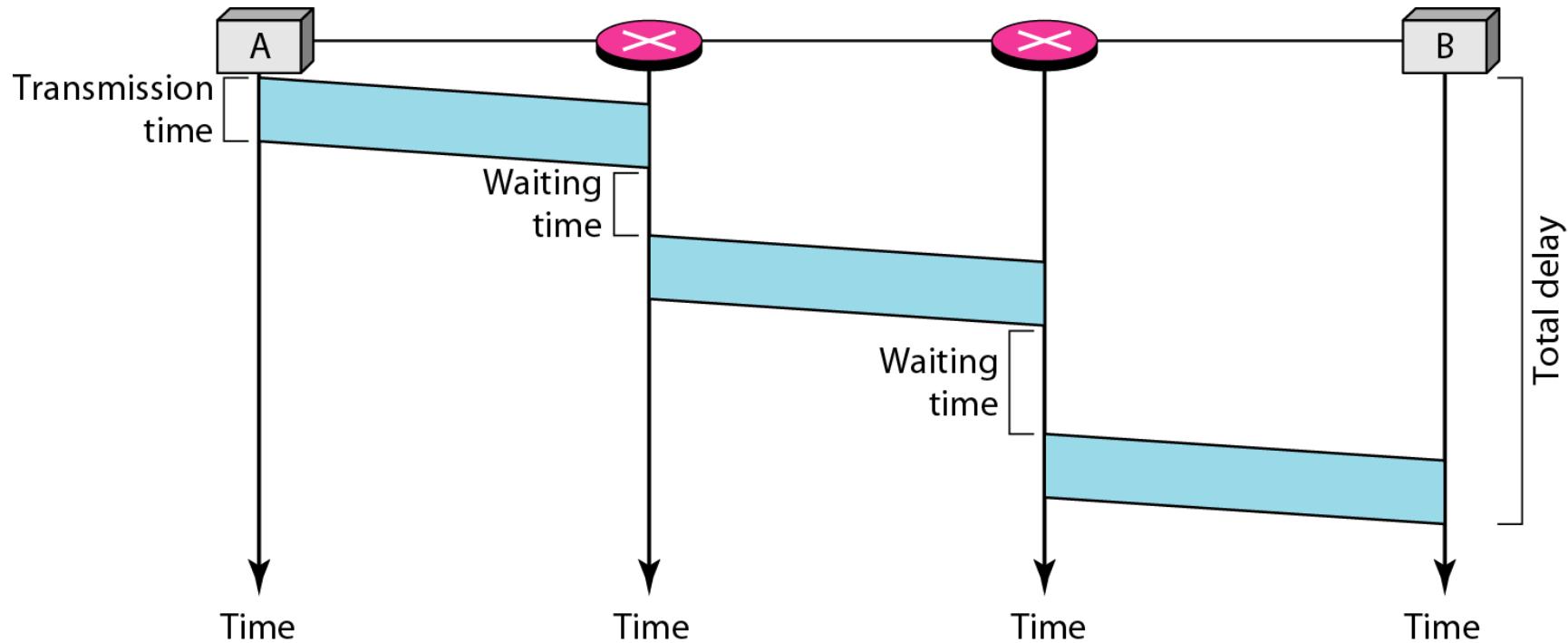
---

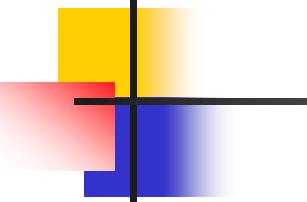


## **Note**

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

**Figure 8.9** Delay in a datagram network





## **Note**

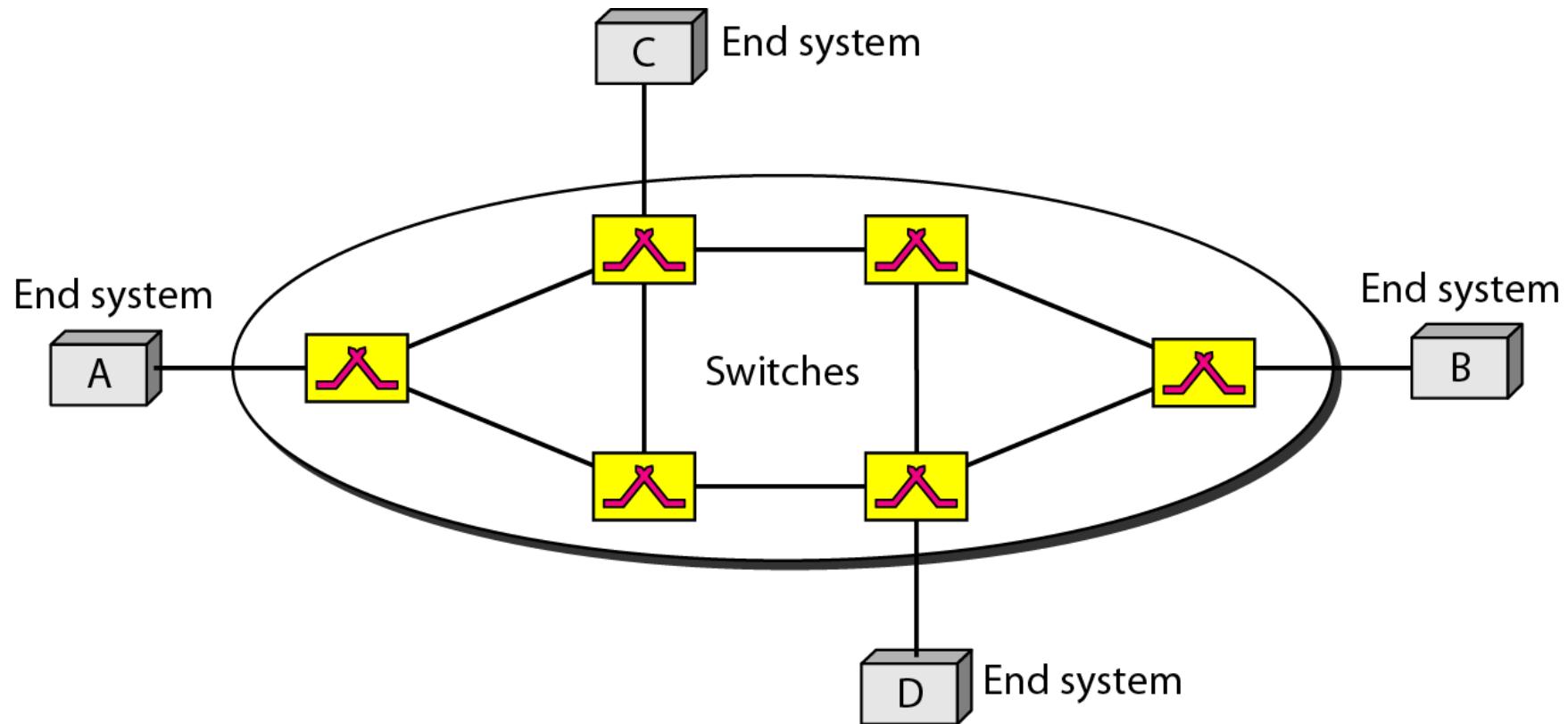
---

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

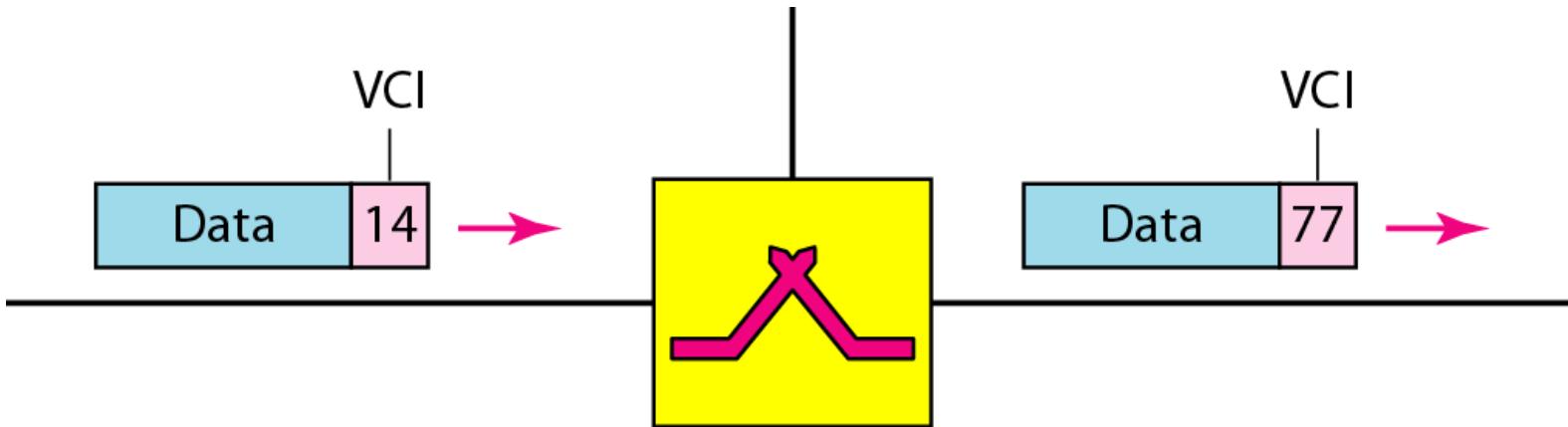
## 8-3 VIRTUAL-CIRCUIT NETWORKS

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

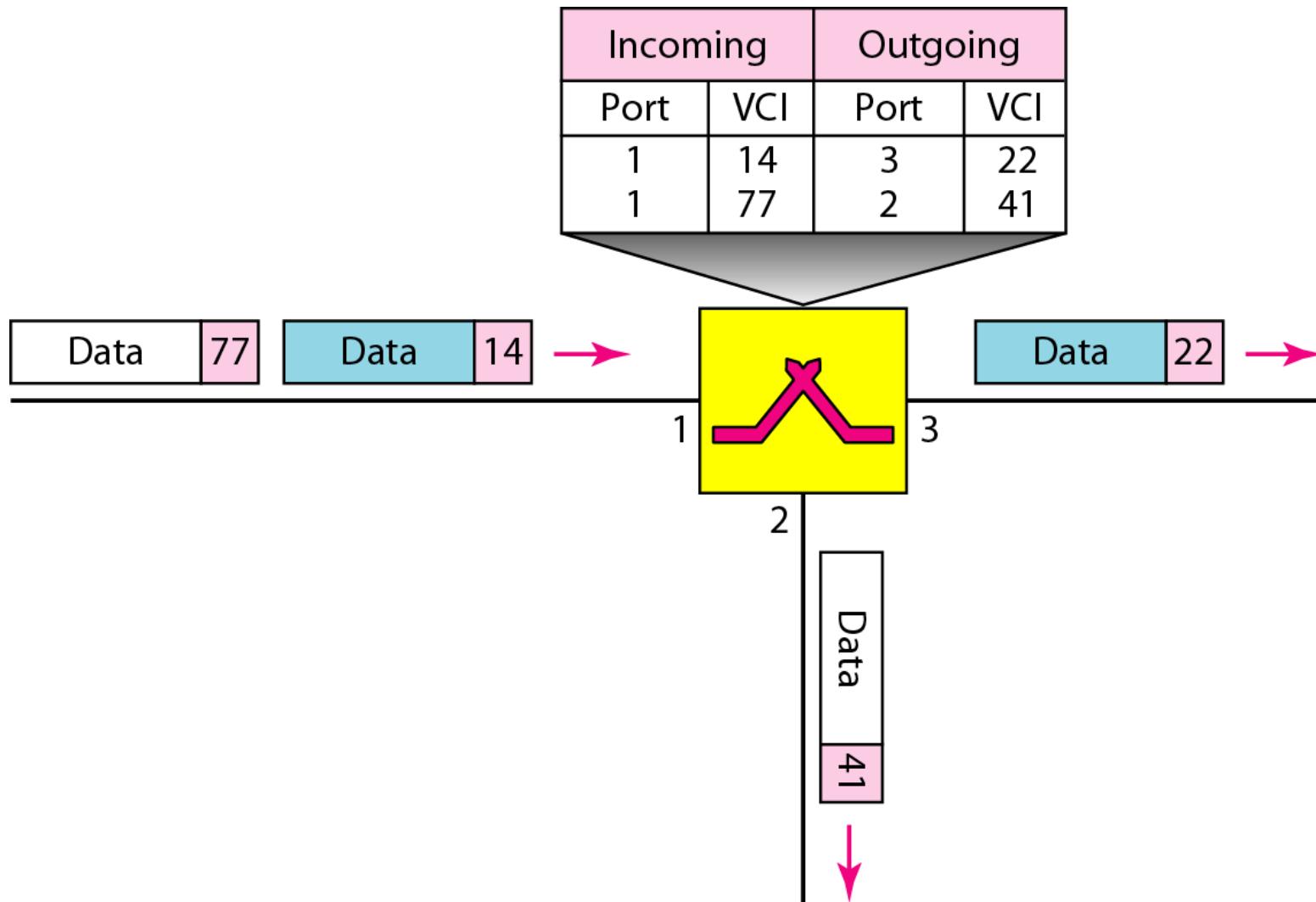
**Figure 8.10** *Virtual-circuit network*



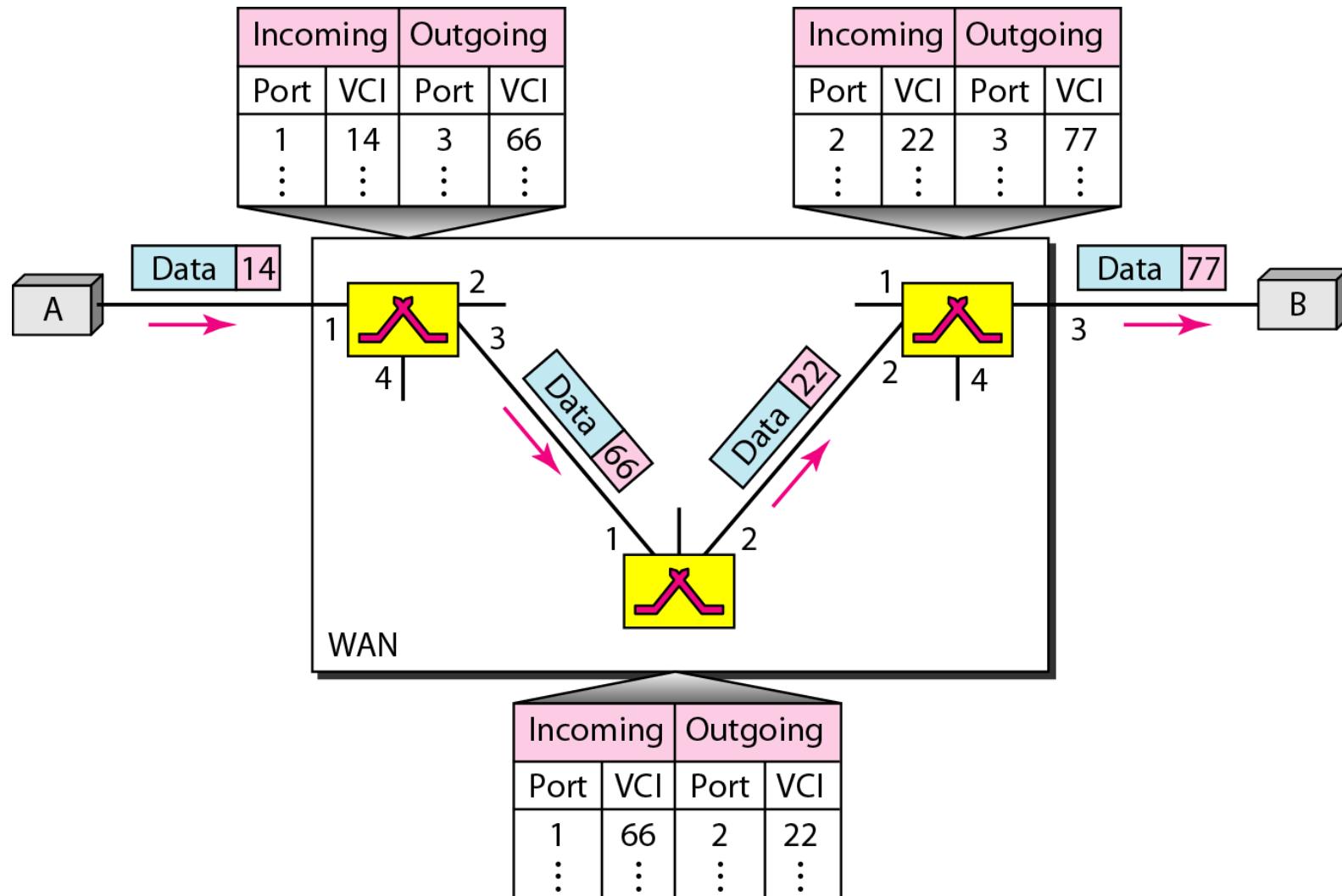
**Figure 8.11** *Virtual-circuit identifier*



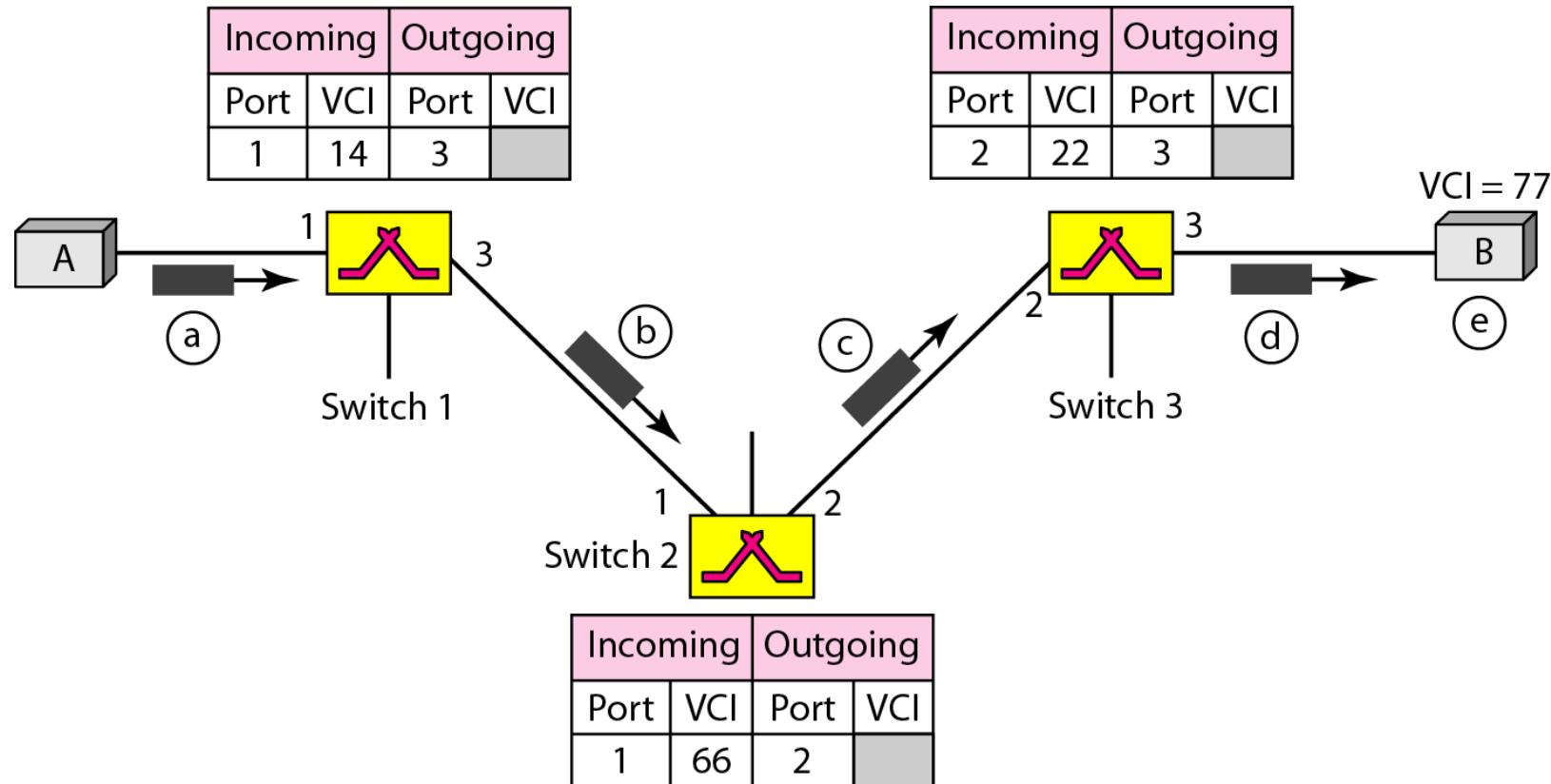
**Figure 8.12** *Switch and tables in a virtual-circuit network*



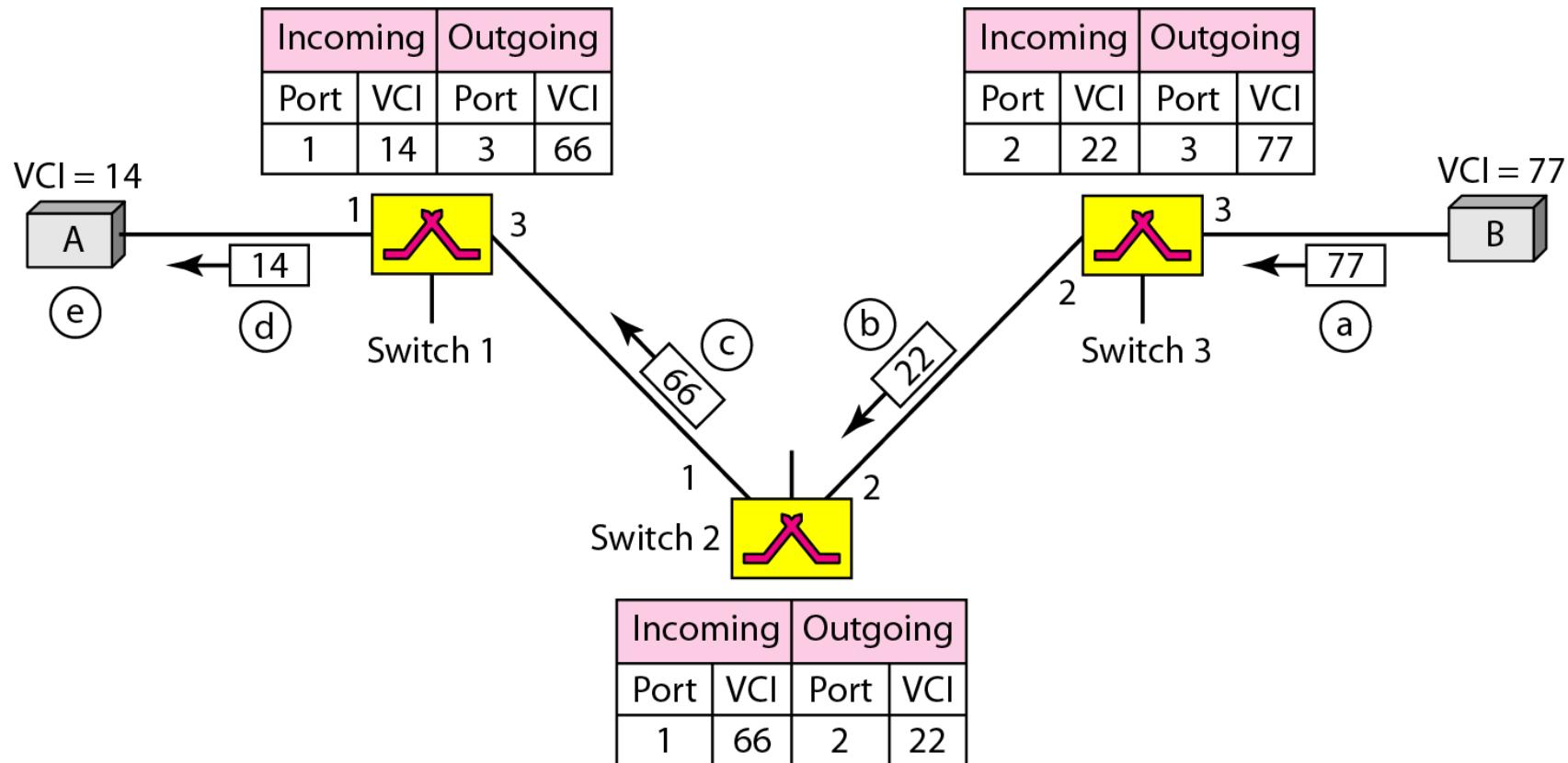
**Figure 8.13** Source-to-destination data transfer in a virtual-circuit network

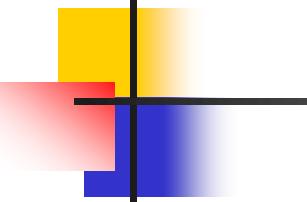


**Figure 8.14** Setup request in a virtual-circuit network



**Figure 8.15** Setup acknowledgment in a virtual-circuit network





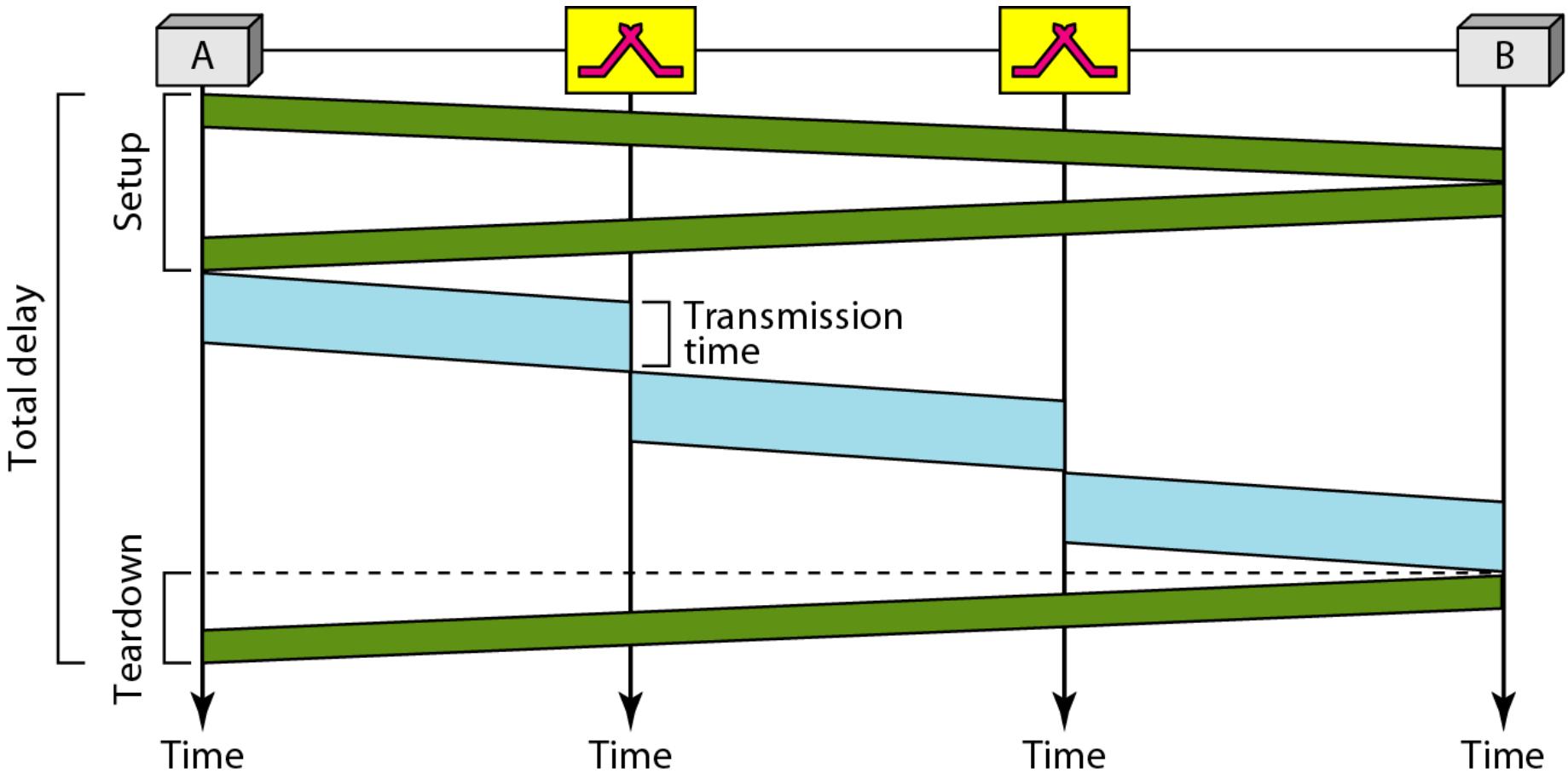
## **Note**

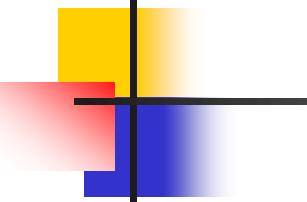
---

**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 8.16** Delay in a virtual-circuit network





## *Note*

---

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

---