Ch.8 Switching

Chapter 89 of ***Data Communications and Networking, 5th Edition, Behrouz A. Forouzan (ISBN: 0-07-251584-8)***

Jin Seek Choi
jinseek@hanyang.ac.kr

Review of Physical Layer

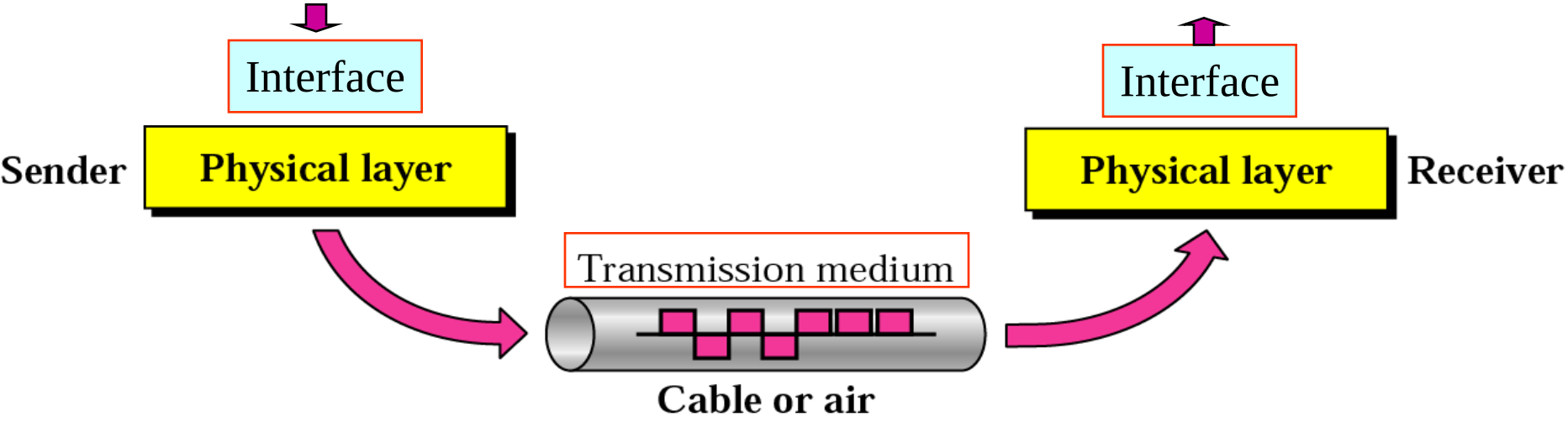
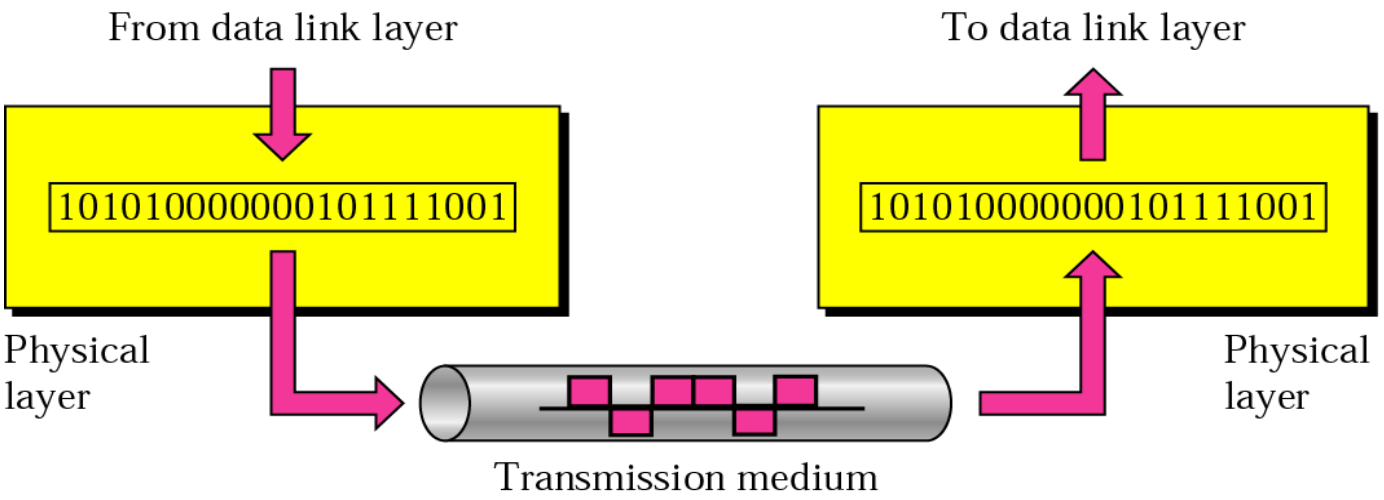


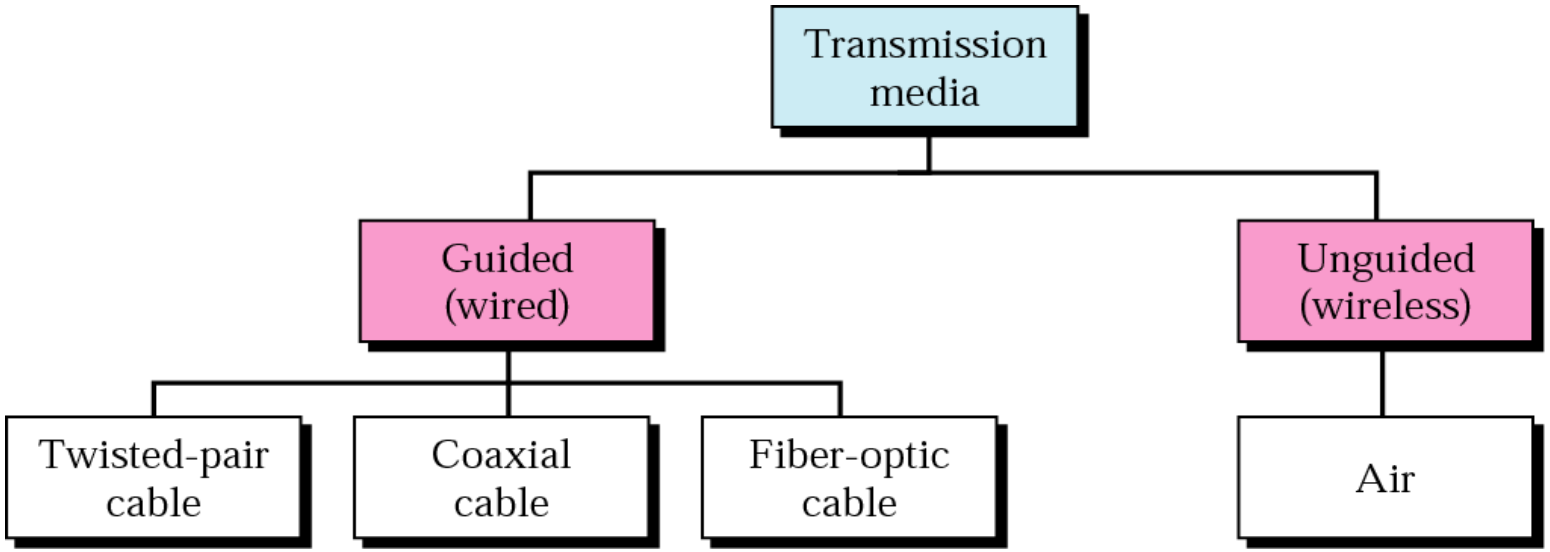
Figure 7.1 **Transmission medium and physical Interface**

Review of Signals



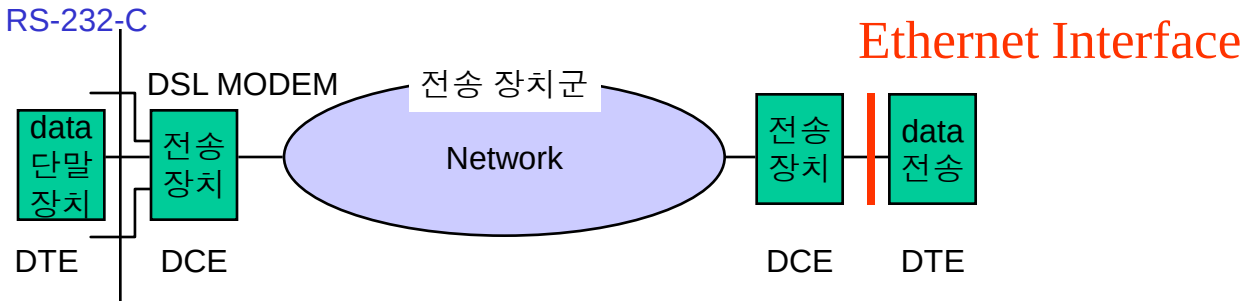
	Analog signal	Digital signal
Analog Data	**AM, FM**	**PCM & Video using codecs**
Digital Data	**ASK, FSK, PSK, QAM**	**LAN Cable Standards (bi-phase, Manchester)**

Review of Transmission Media

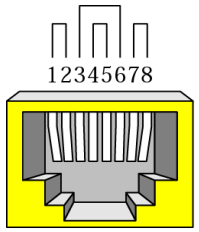


- Medium**: the physical matter that carries the transmission.**
  - **With** Guided media **the transmission flows along a physical guide. The three main types of guided media: twisted pair wiring, coaxial cable and optical fiber cable.**
  - **With** Wireless media **there is no wave guide and the transmission just flows through the air (or space). The main forms of wireless communications are radio, infrared, microwave, and satellite communications.**

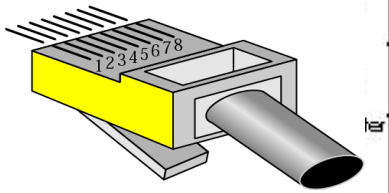
Review of - 통신 인터페이스



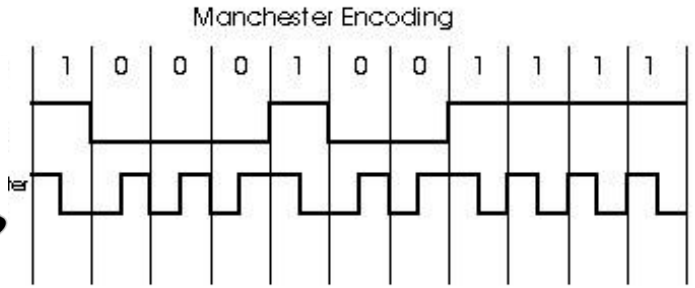
- 인터페이스 특성
  - 기계적: **connector** 모양, 치수, 핀의 수
  - 전기적: 전압/전류 레벨, 전압 변동의 **timing (eye diagram)**
  - 기능적: 각 핀의 기능(데이터, 타이밍, 접지)
  - 절차적: 송수신 제어를 위한 절차
- **Ethernet-series**
  - **10M**
  - **100M**
  - **1G**
  - **10G**



RJ-45 Female



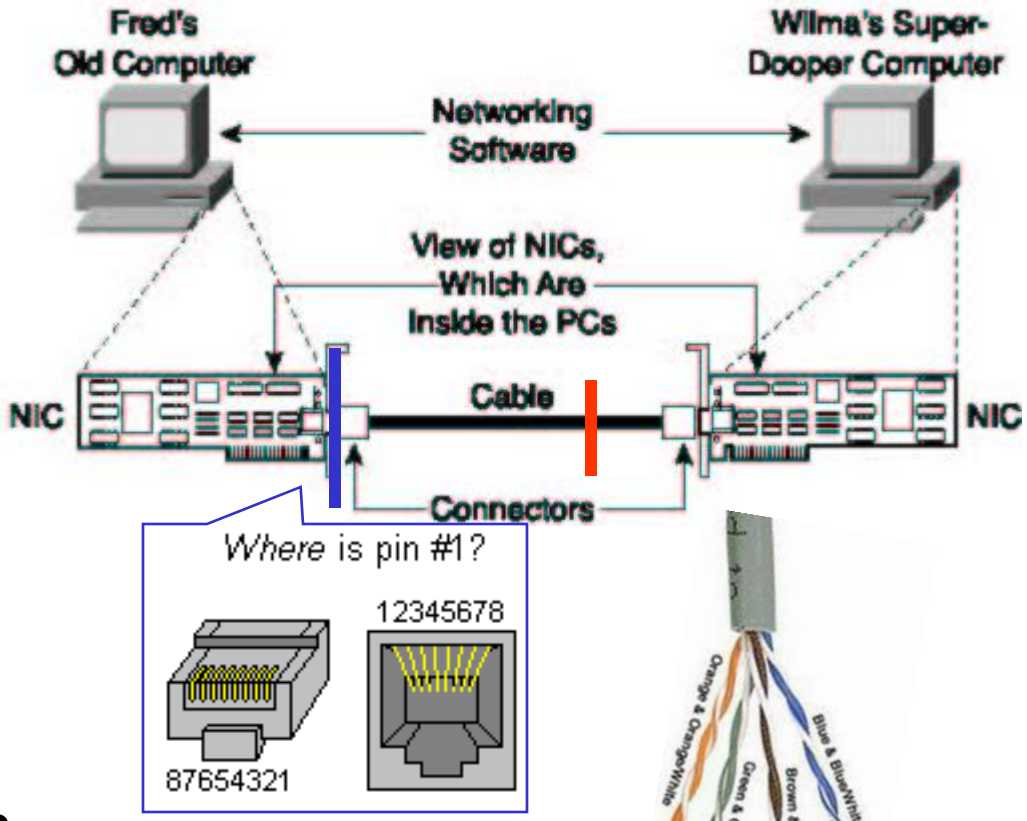
RJ-45 Male



Review of INTERFACE

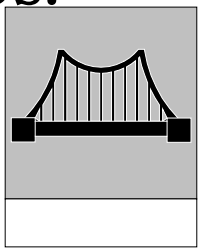
- **What is an interface?**
  - **The point at which one device connects to another**
  - 기계적:전기적:기능적:절차적: 송수신 제어를 위한 절차
- **What is an interface standard?**
  - **A description which exactly defines the electronic signals required for communication between two devices**
- **In data communication, we look at a standard from two perspectives:**
  - **DTE - Data Terminal Equipment**
  - **DCE - Data Circuit-terminating Equipment**
    - a.k.a., Data Communications Equipment
- **In Ethernet interface, we look at a network interface w.r.t. peer-to-peer connection**

Review of Ethernet LAN interface

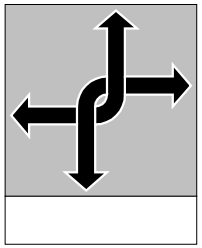


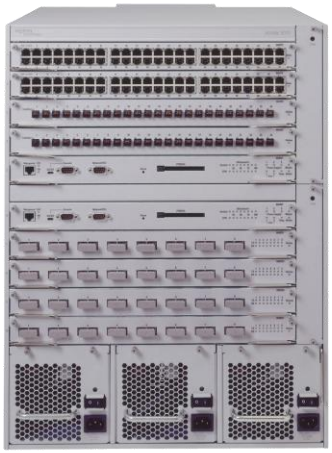
- **Cable: UTP**
- **Connector: RJ-45**
- **NIC (Network interface card)**

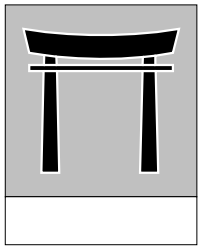
Review of "A network is a set of connected devices."



- **Repeaters – Within Segments**
- **Bridges - Within Networks**
- **Switches - Within Networks**
- **Routers - Between Networks**
- **Gateways - Between Types Of Networks**







Networks that have these devices may not support Printing across them.

Chapter 8: Outline

Figure 8.2: Taxonomy of switched networks

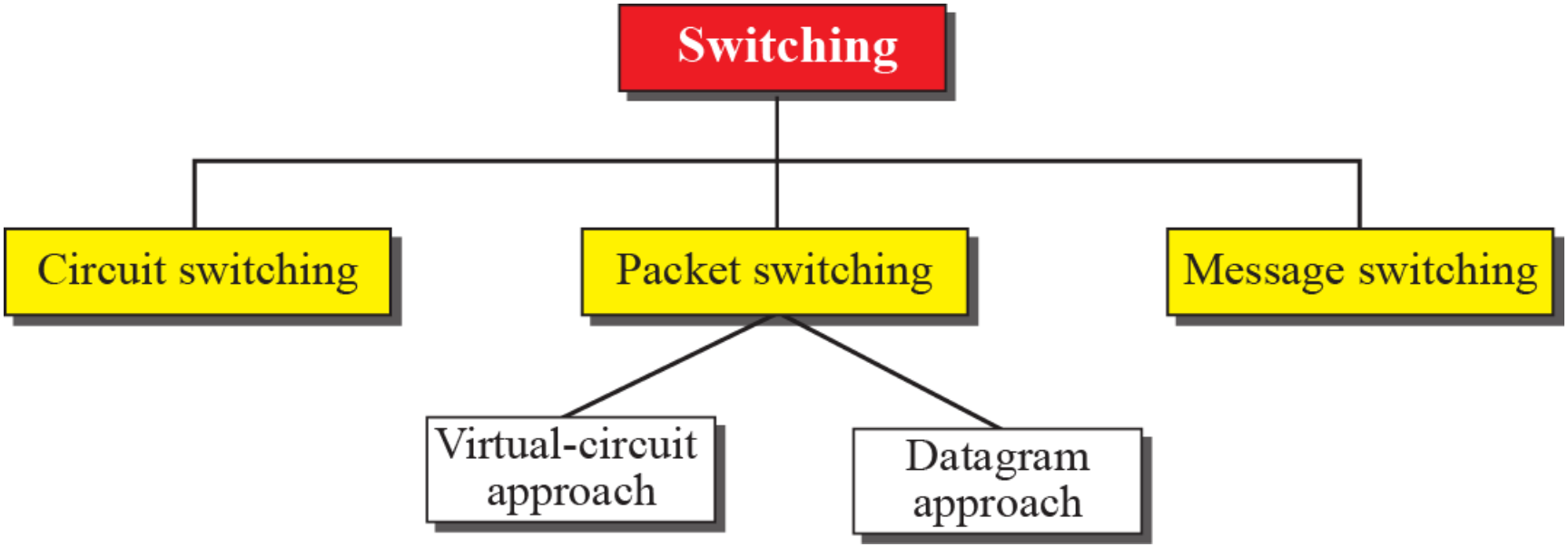
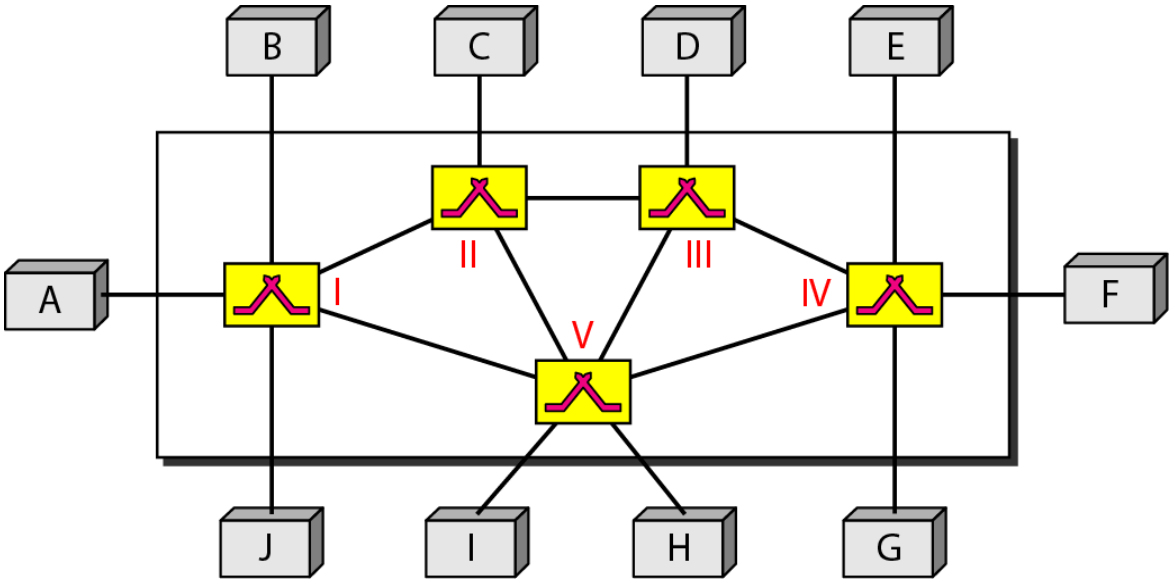


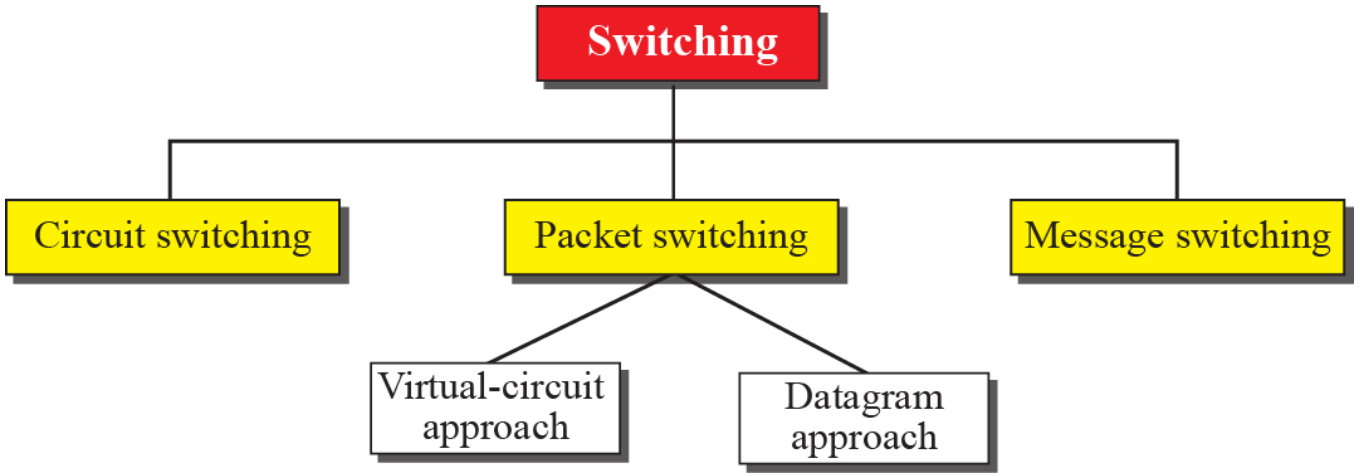
Figure 8.1 *Switched network*

- A network is a set of connected devices. Whenever we have multiple devices, we have the problem of how to connect them to make one-to-one communication possible. The solution is switching. A switched network consists of a series of interlinked nodes, called switches.



8.8.1 Three Methods of Switching

- **Traditionally, three methods of switching have been discussed: circuit switching, packet switching, and message switching. The first two are commonly used today. The third has been phased out in general communications but still has applications. Packet switching can further be divided into two subcategories, virtual-circuit approach and datagram approach, as shown in Figure 8.2.**



8-2 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, as discussed in Chapter 6.

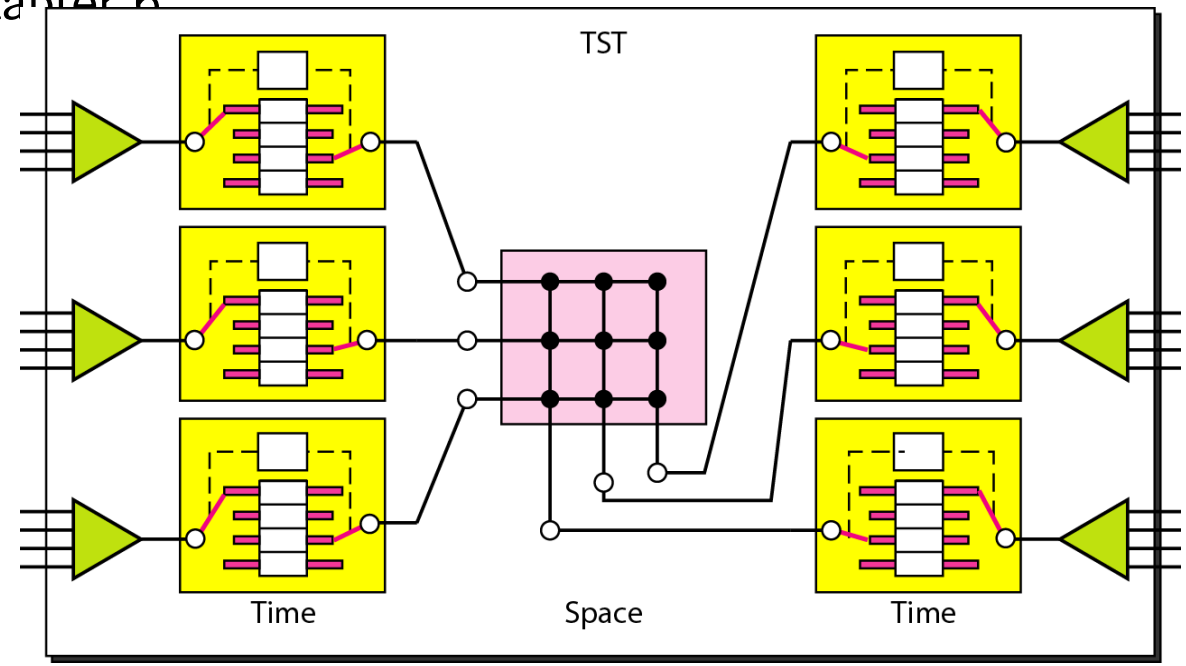
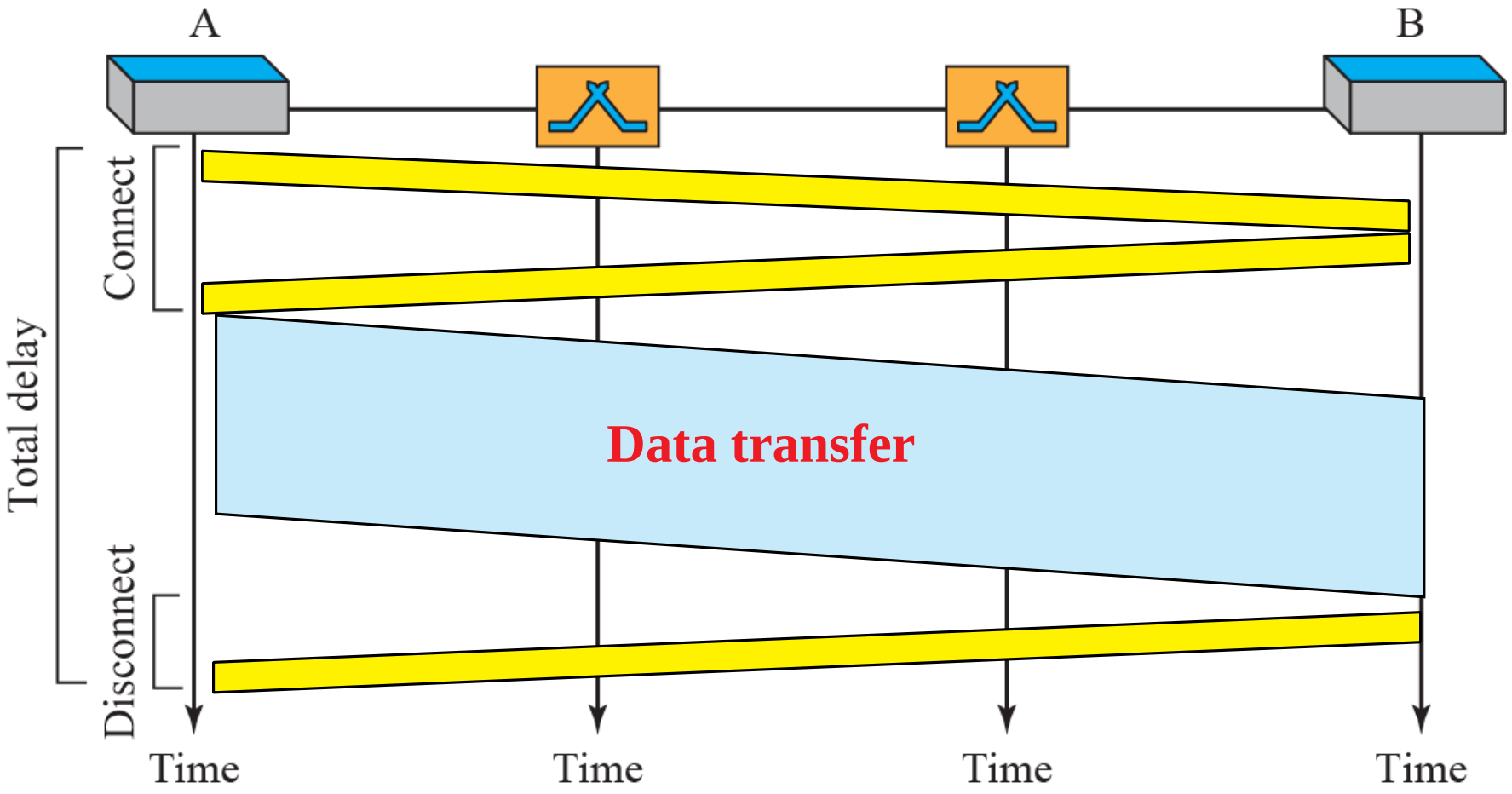


Figure 8.6: Delay in a circuit-switched network



Performance

- **8.2.1 Three Phases:**
  - **The actual communication in a circuit-switched network requires three phases: connection setup, data transfer, and connection teardown.**
- **8.2.2 Efficiency**
  - **It can be argued that circuit-switched networks are not as efficient as the other two types of networks because resources are allocated during the entire duration of the connection. These resources are unavailable to other connections. In a telephone network, people normally terminate the communication when they have finished their conversation.**
- **8.2.3 Delay**
  - **Although a circuit-switched network normally has low efficiency, the delay in this type of network is minimal. During data transfer the data are not delayed at each switch; the resources are allocated for the duration of the connection. Figure 8.6 shows the idea of delay in a circuit-switched network when only two switches are involved.**

8-3 Packet-SWITCHED 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.
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Figure 8.7 *A datagram network with four switches (routers)*

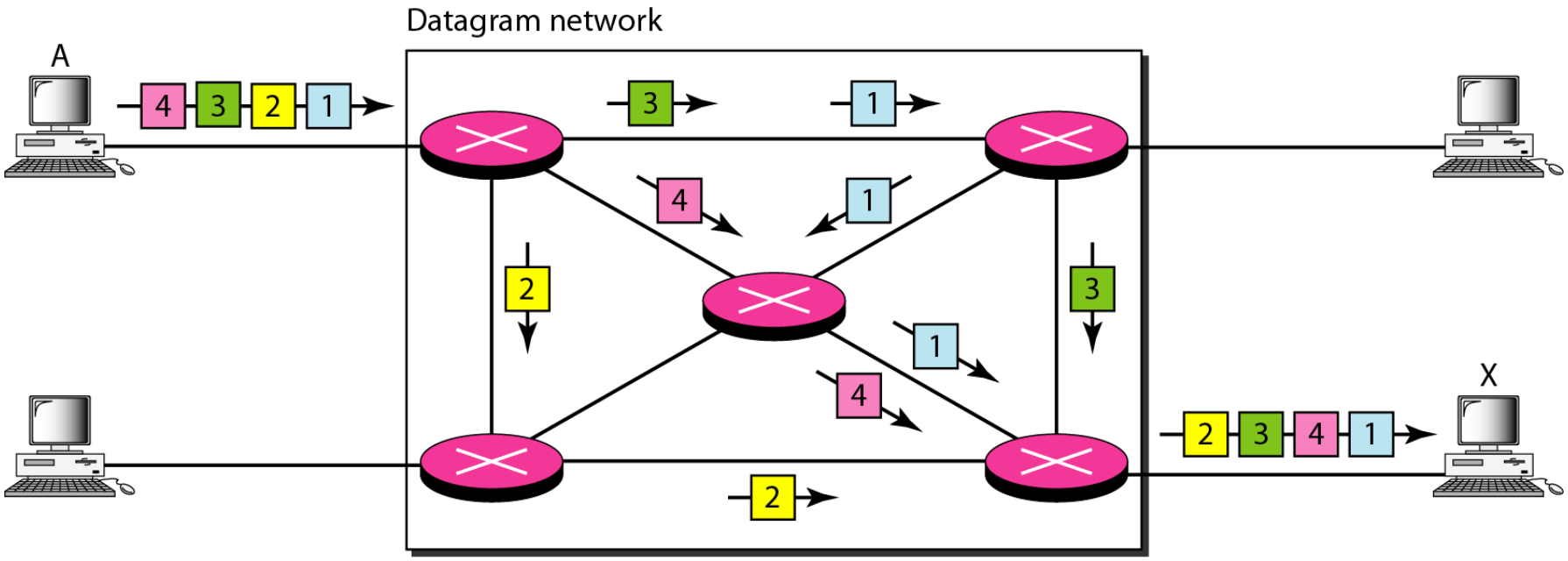


Figure 8.8: Routing table in a datagram network

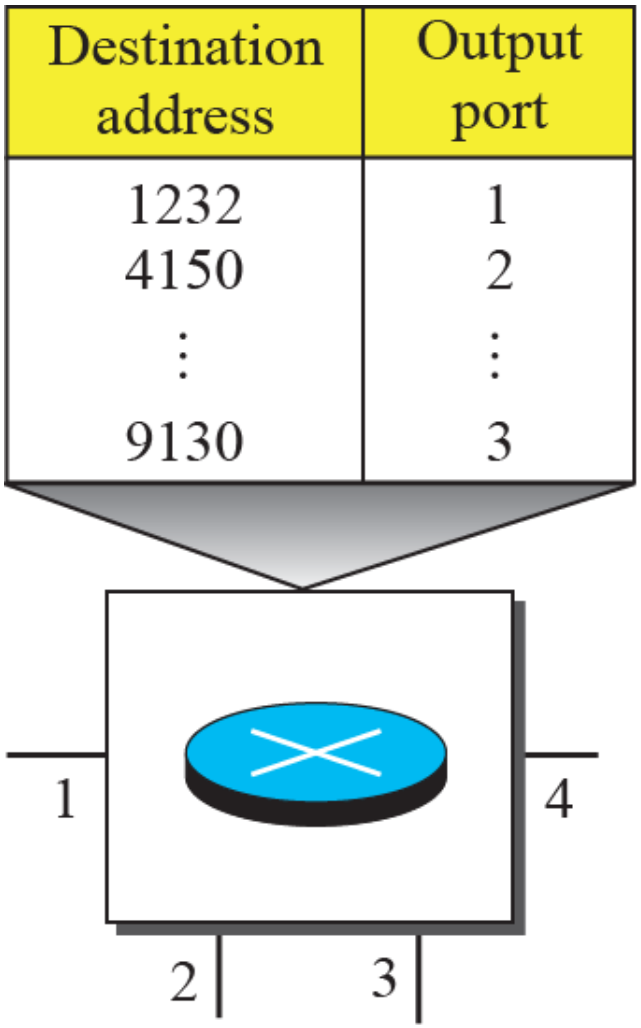
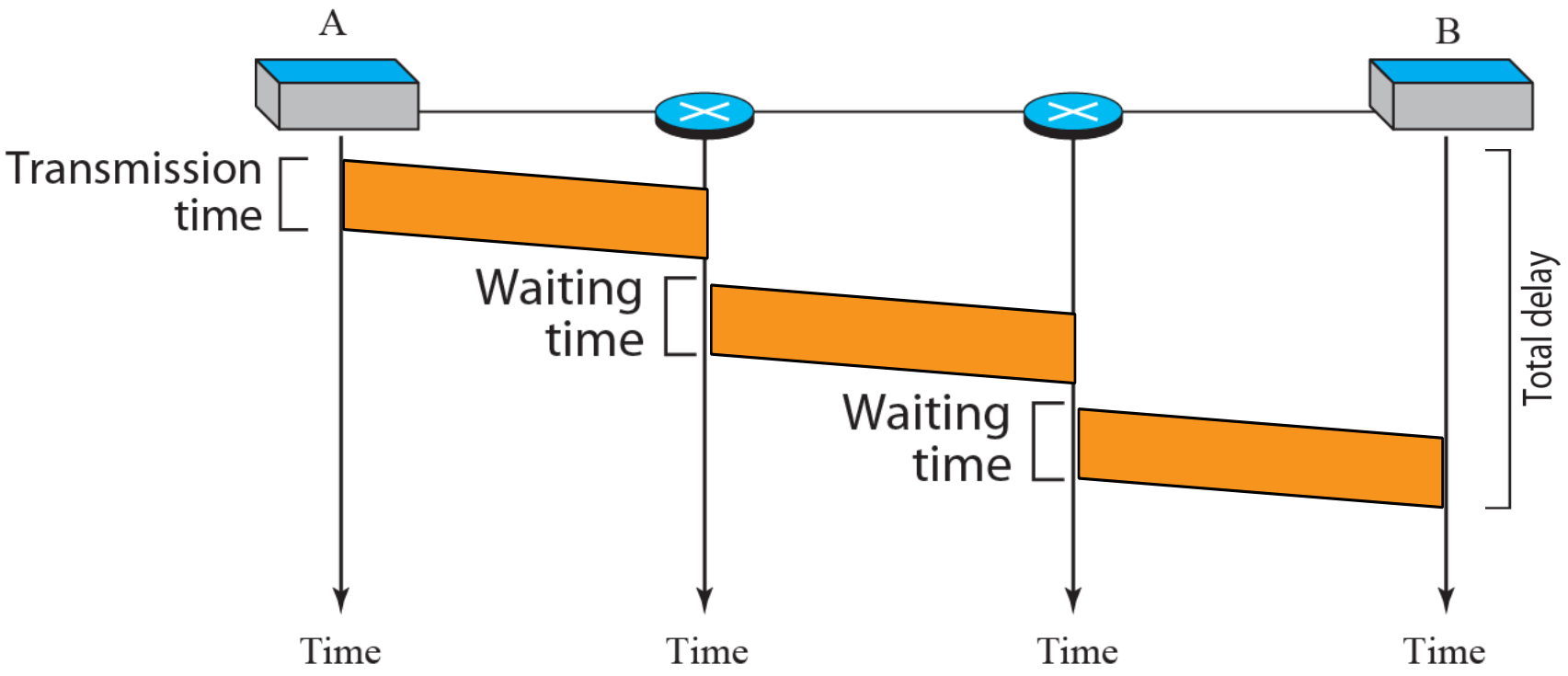


Figure 8.9: Delays in a datagram network



8.3.2 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.**

Topics discussed in this section:

Addressing
Three Phases
Efficiency
Delay
Circuit-Switched Technology in WANs

8.3.2 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.

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 8.10: Virtual-circuit network

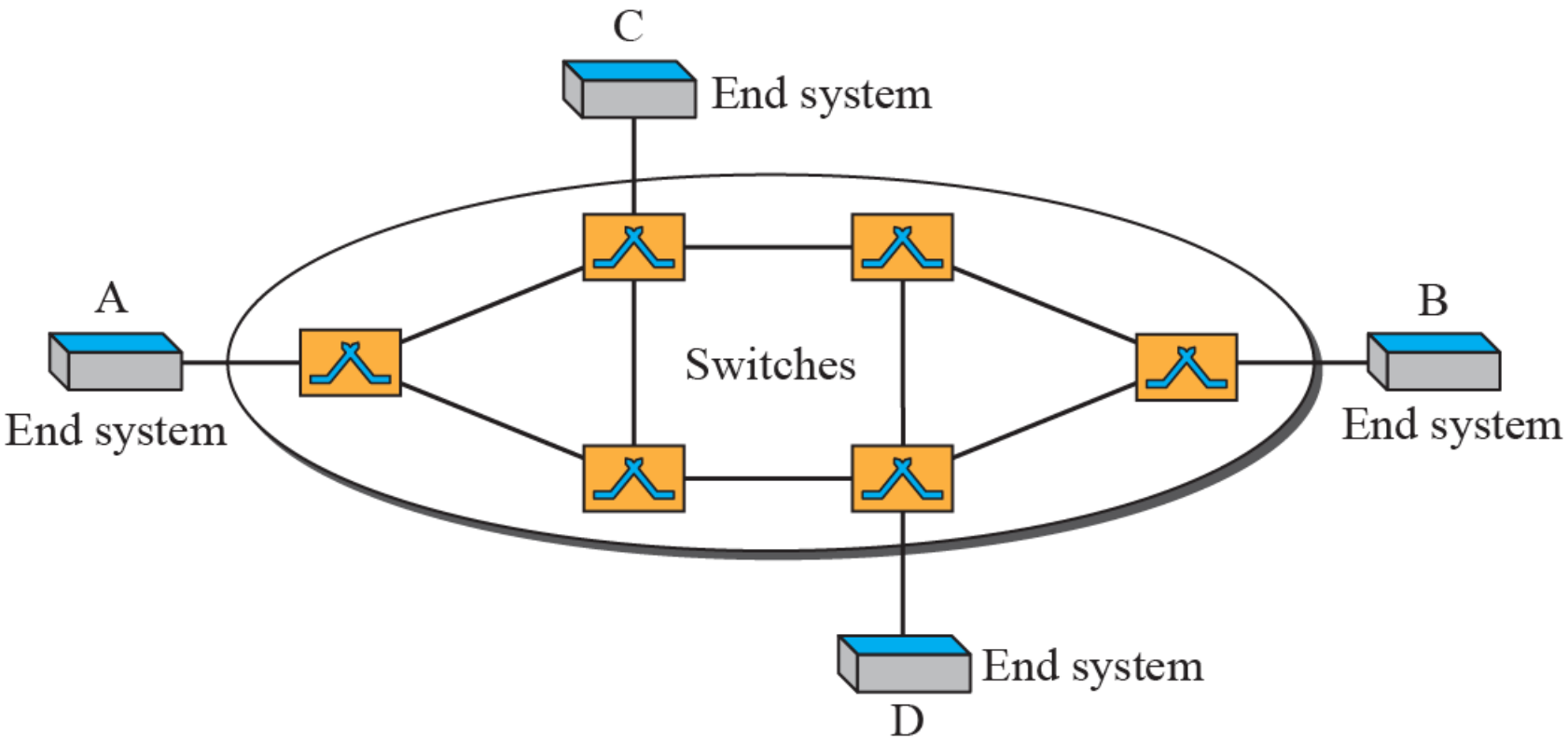


Figure 8.11: Virtual-circuit identifier

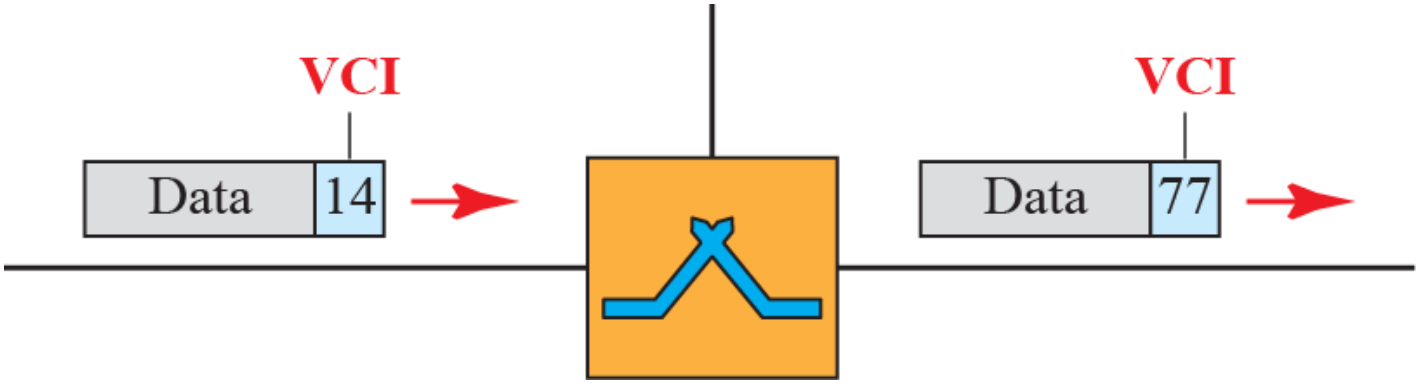


Figure 8.12: Switch and table for a virtual-circuit network

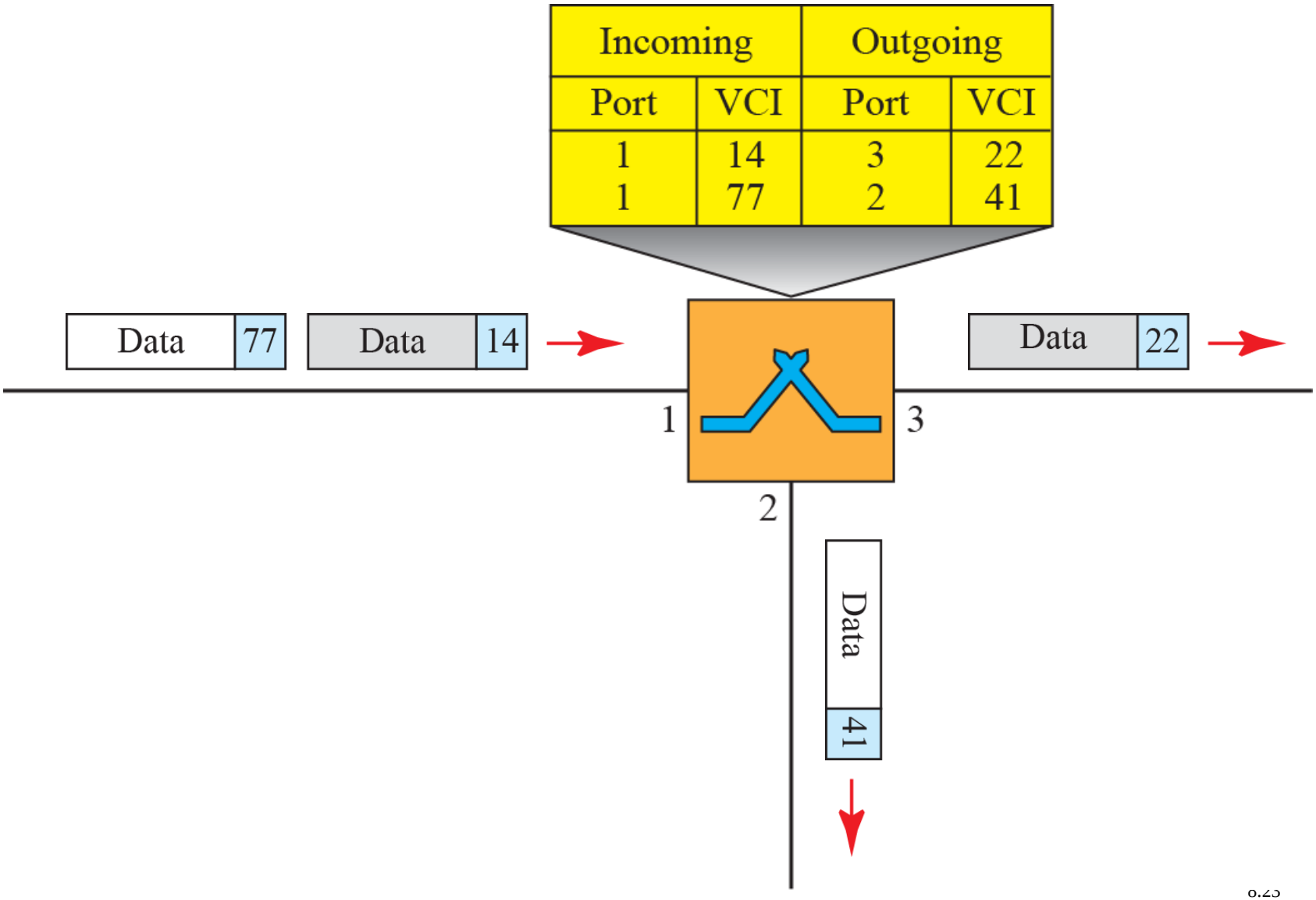


Figure 8.13: Source-to-destination data transfer in a circuit-switch network

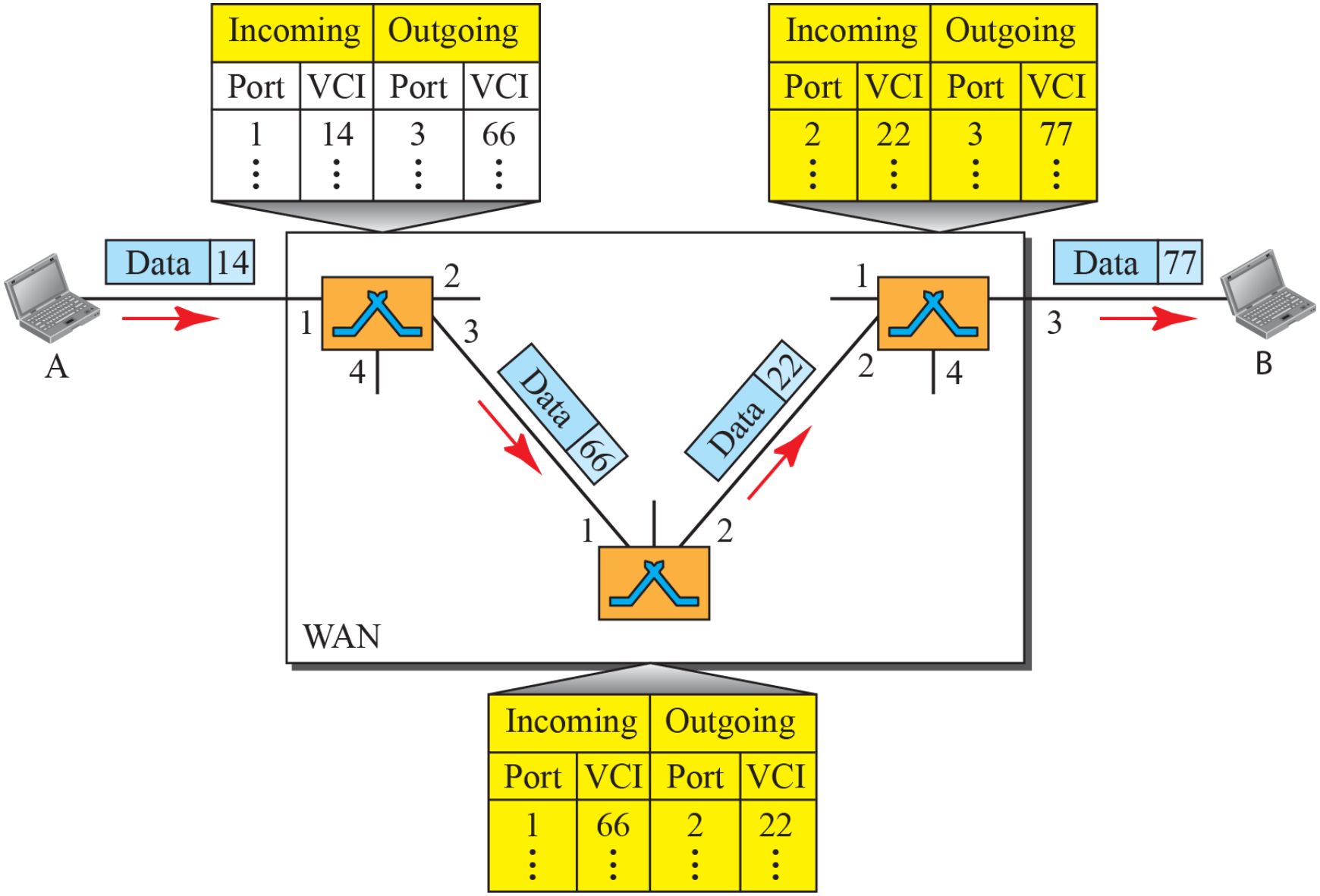


Figure 8.14: Setup request in a virtual-circuit network

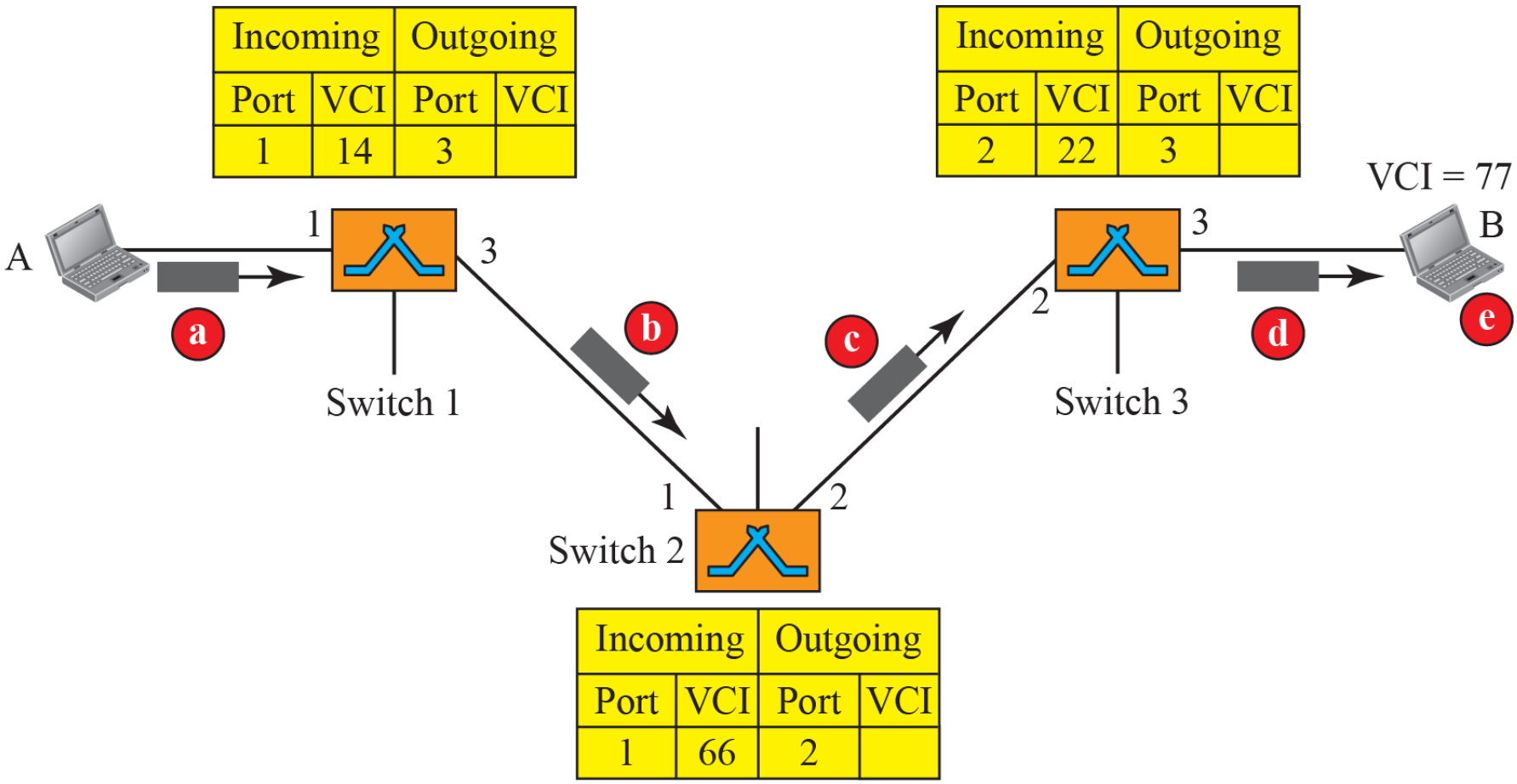


Figure 8.15: Setup acknowledgment in a virtual-circuit network

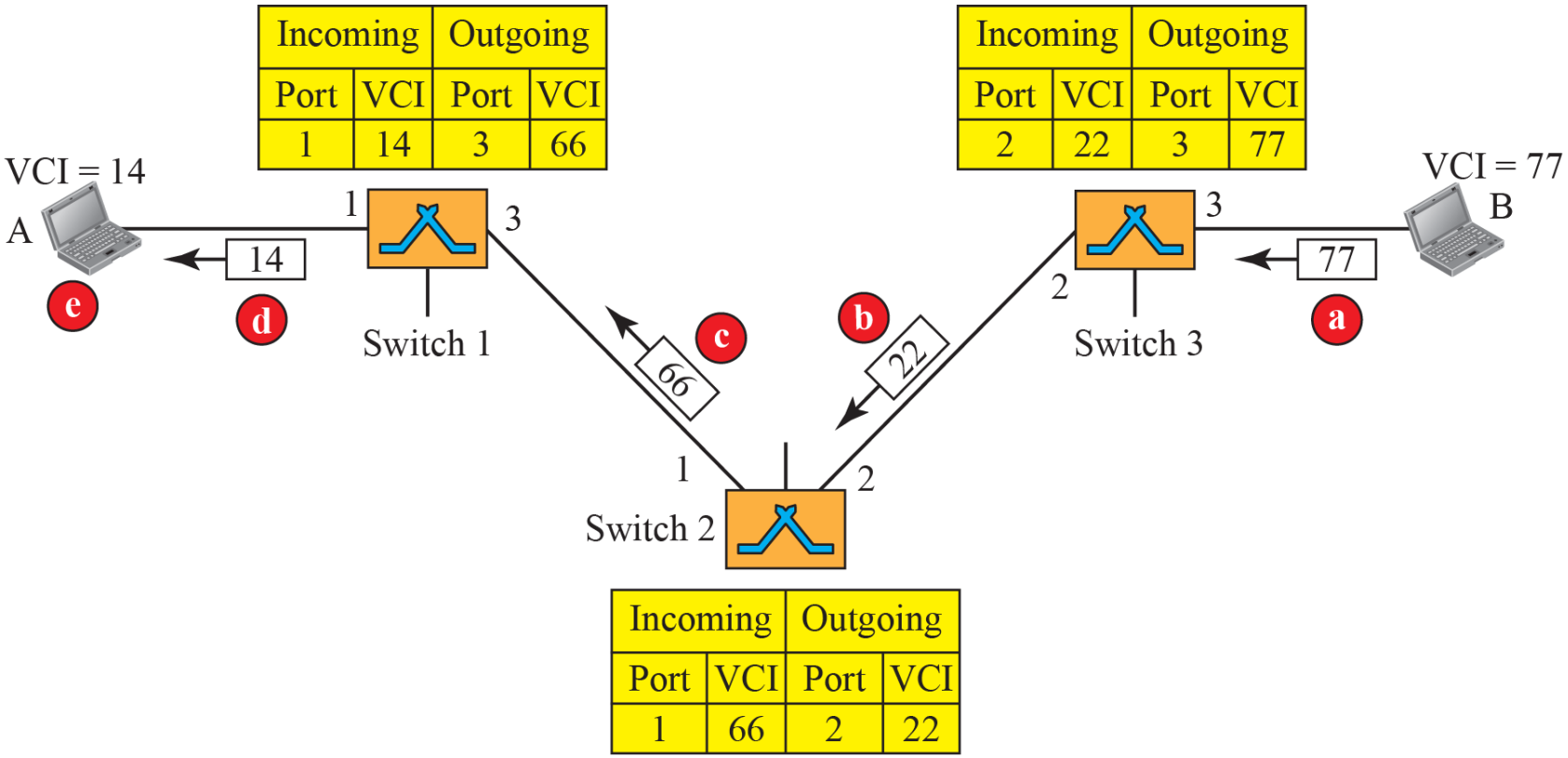
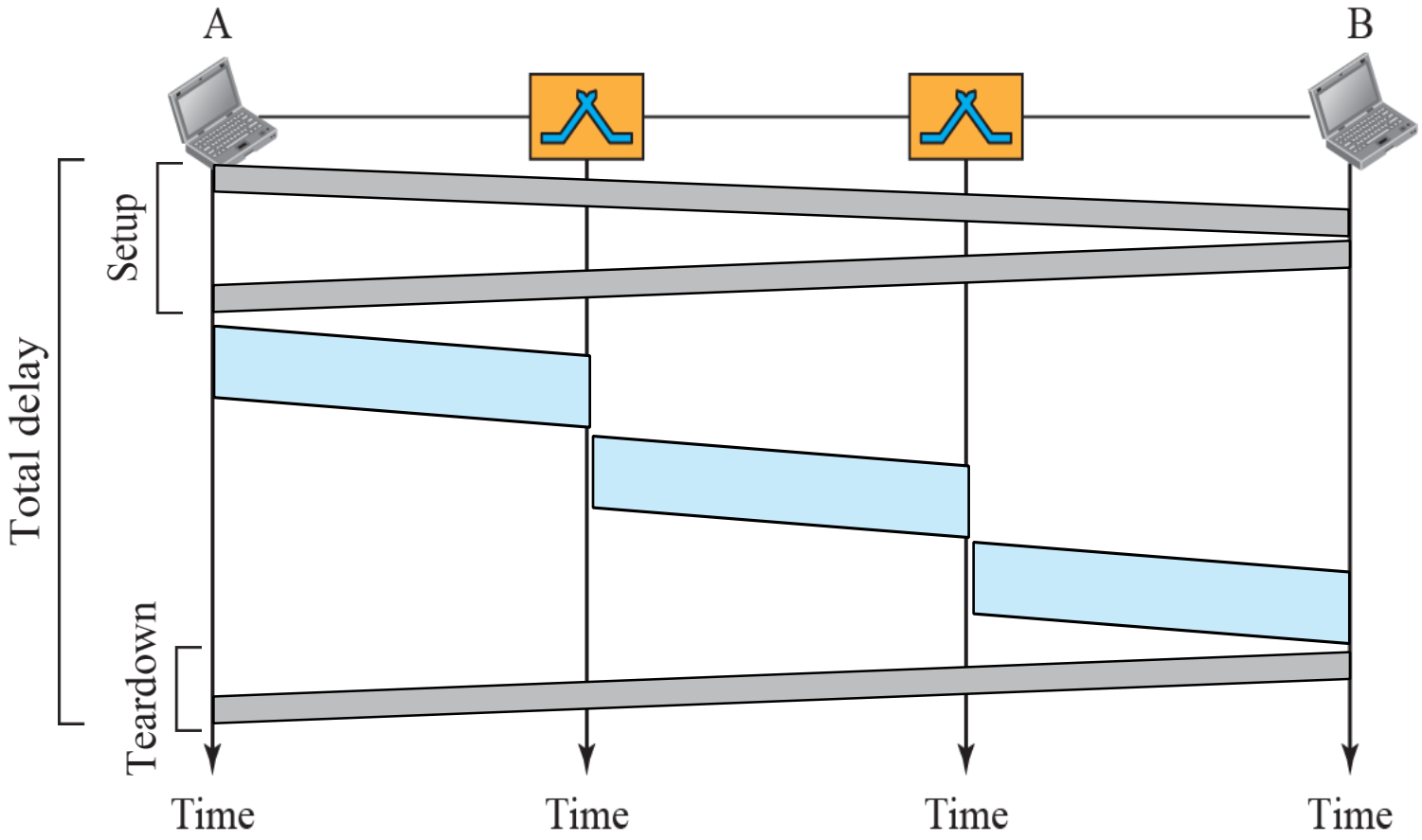


Figure 8.16: Delay in a virtual-circuit network



8.4.2 Structure of Packet Switches

A switch used in a packet-switched network has a different structure from a switch used in a circuit-switched network. We can say that a packet switch has four components: input ports, output ports, the routing processor, and the switching fabric, as shown in Figure 8.28.

Figure 8.21: Packet switch components

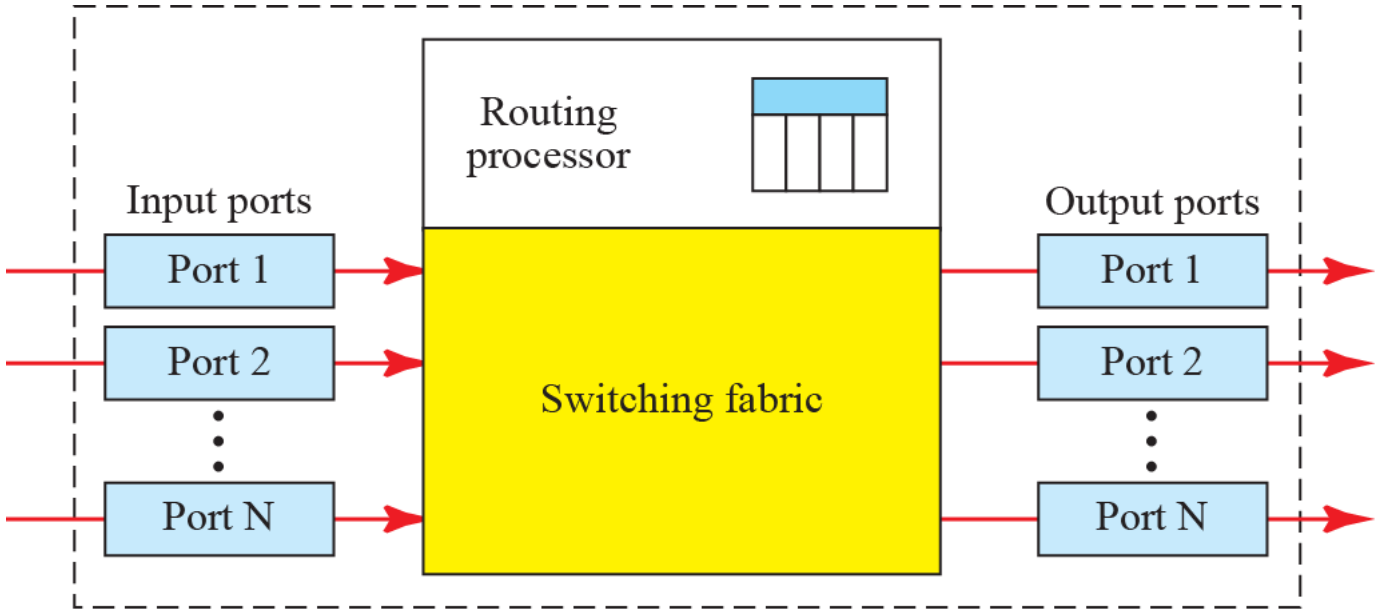


Figure 8.22: Input port

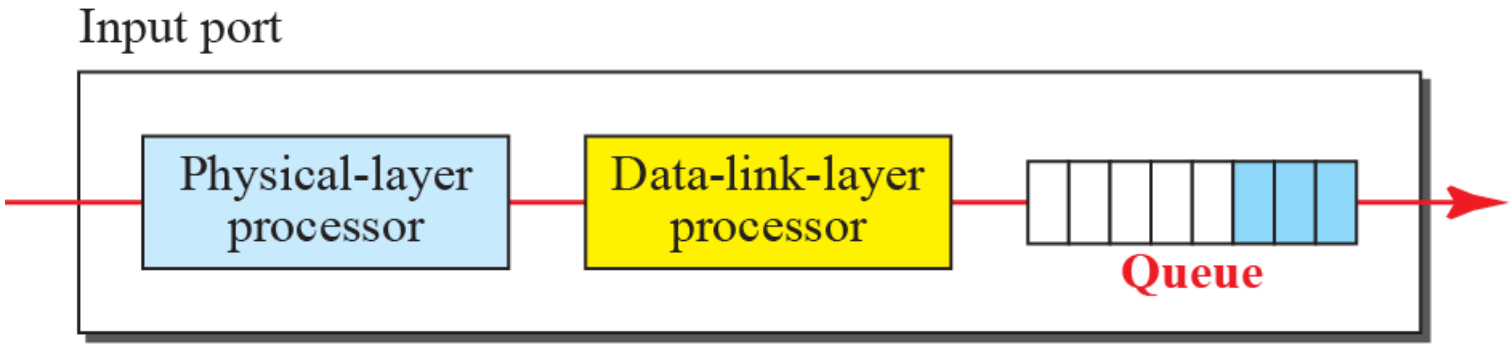


Figure 8.23: Output port

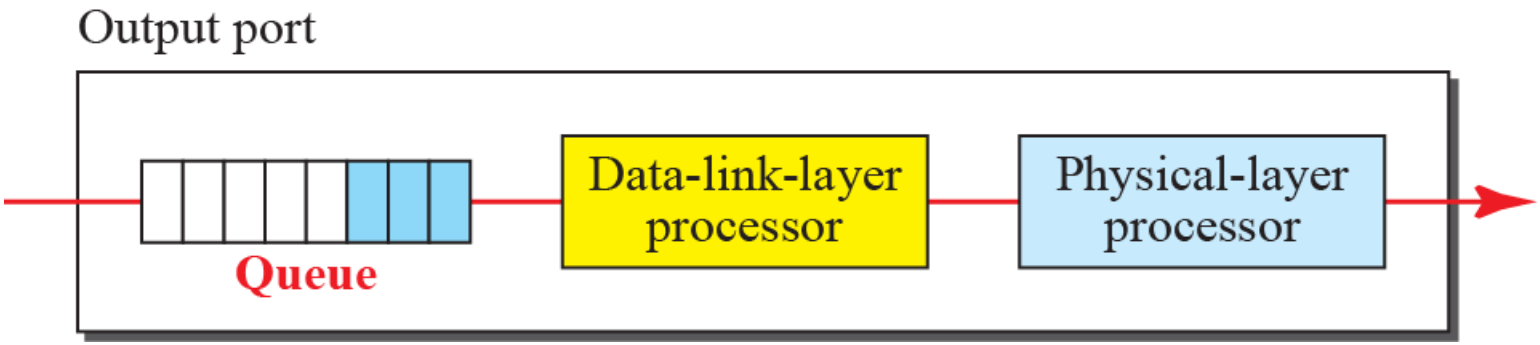


Figure 8.24: A banyan switch

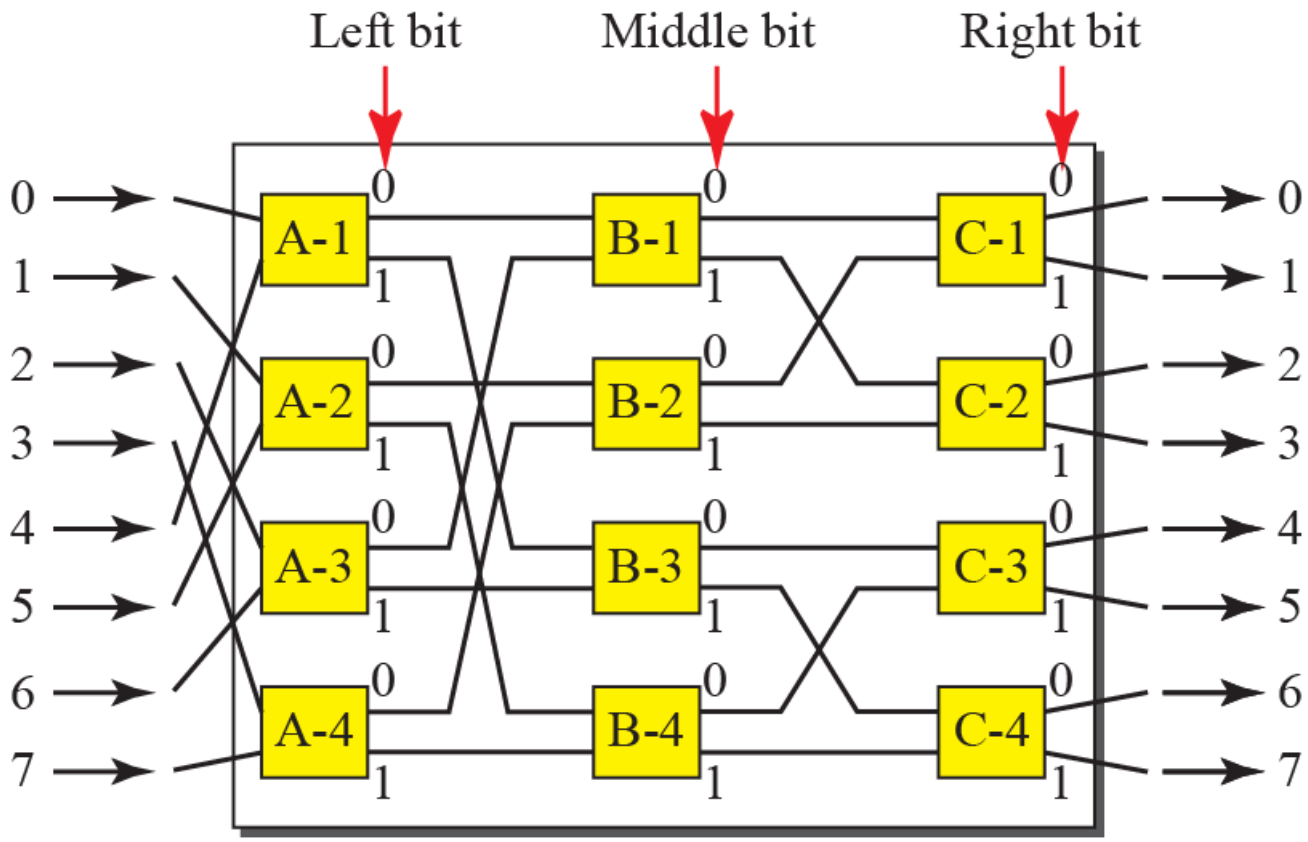
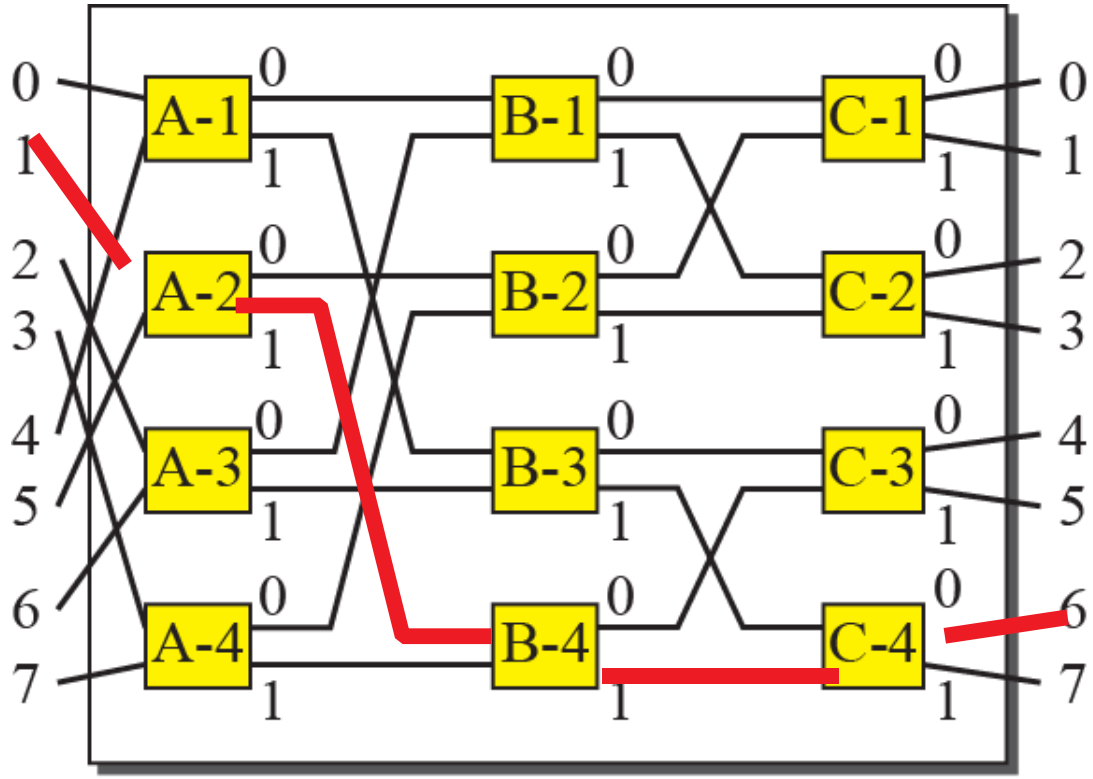
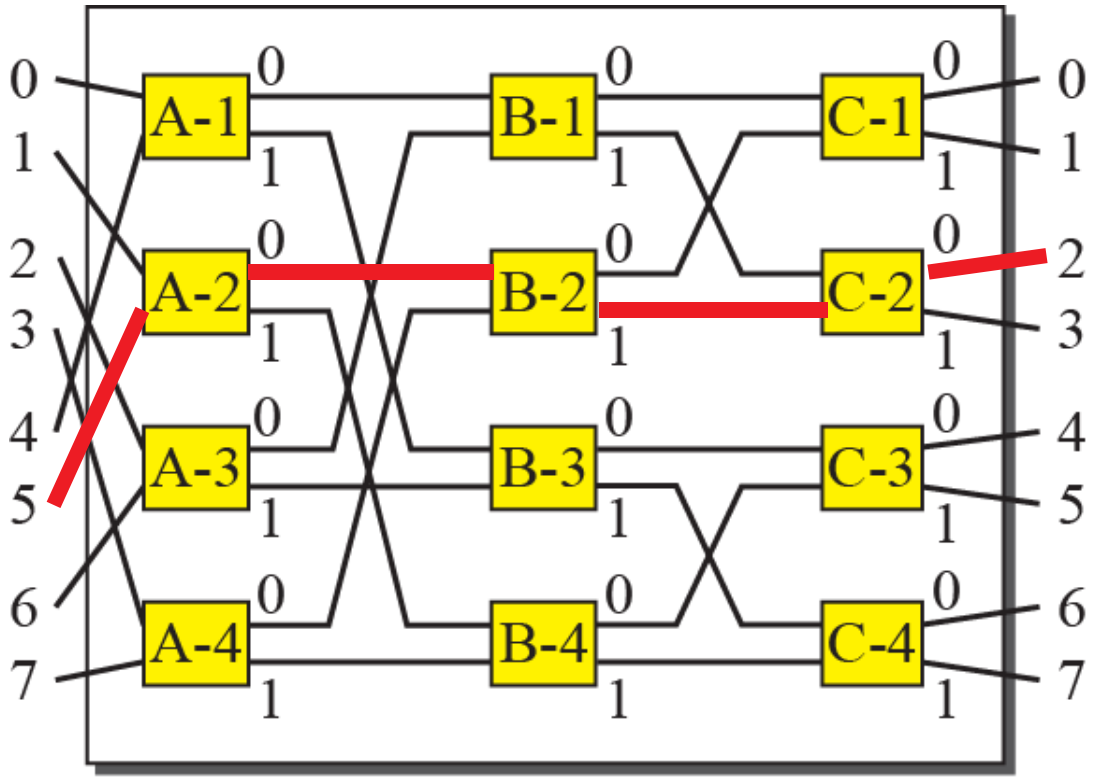


Figure 8.25: Example of routing in a banyan switch (Part a)



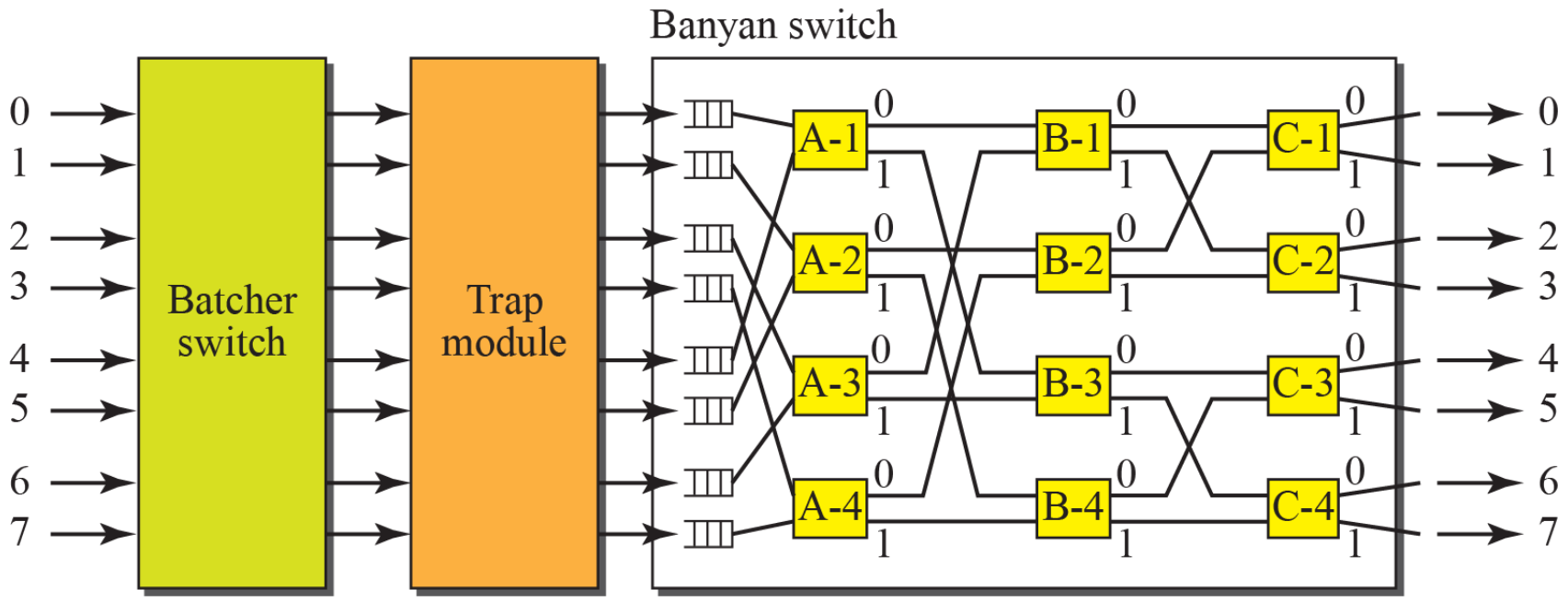
a. Input 1 sending a cell to output 6 (110)

Figure 8.25: Example of routing in a banyan switch (Part b)



b. Input 5 sending a cell to output 2 (010)

Figure 8.26: Batcher-banyan switch



Note

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