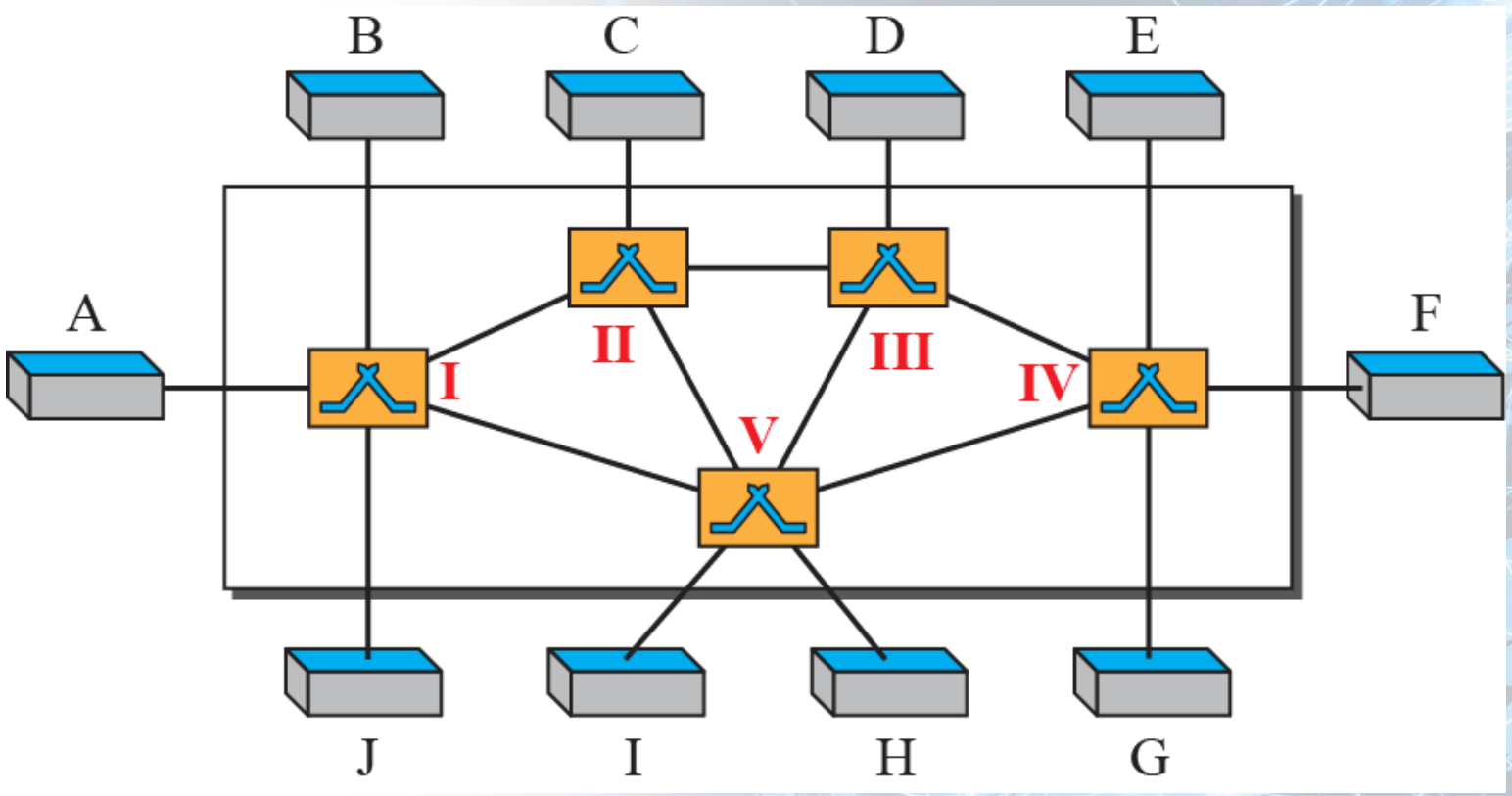
Switching

- A network is a set of connected devices
- Problem of how to connect multiple devices to make one-to-one communication possible
- The solution is Switching
- Switched network consists of a series of switches

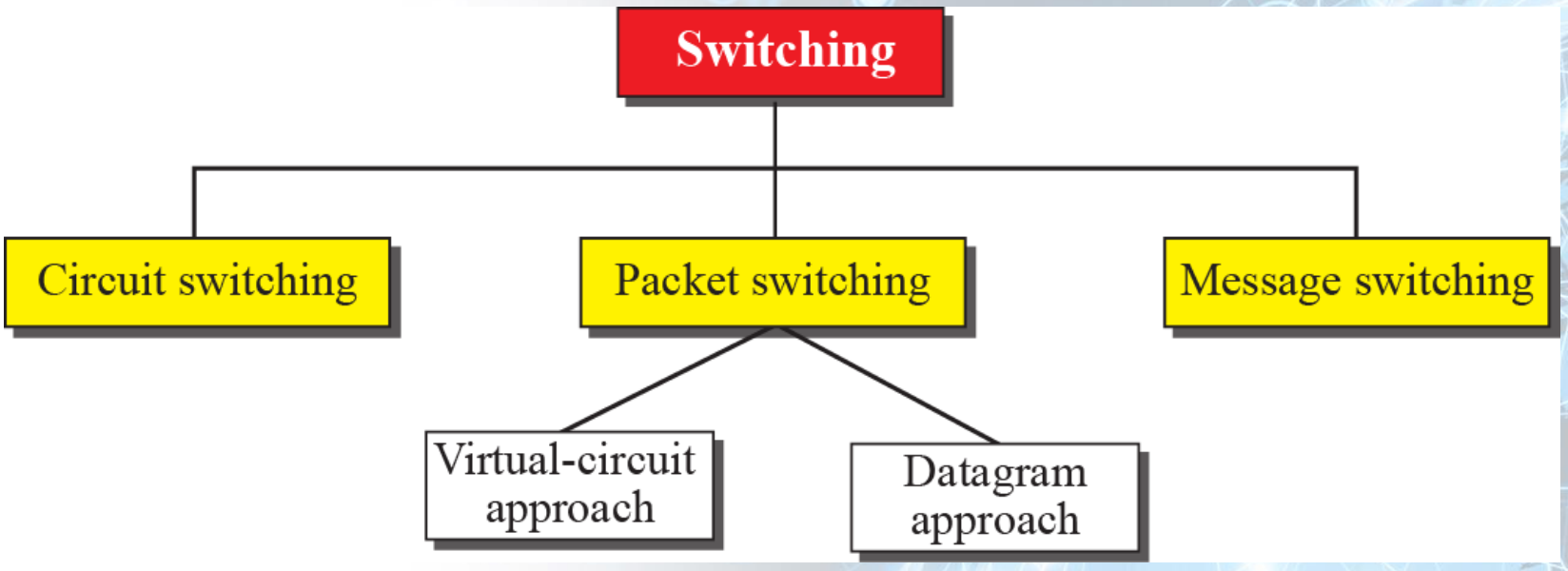
Switched Network



Three Methods of Switching

- Three Methods:
  - ✓ Circuit Switching
  - ✓ Packet Switching
  - ✓ Message switching
- The first two are commonly used today
- The third has been phased out in general communications

Taxonomy of Switched Networks



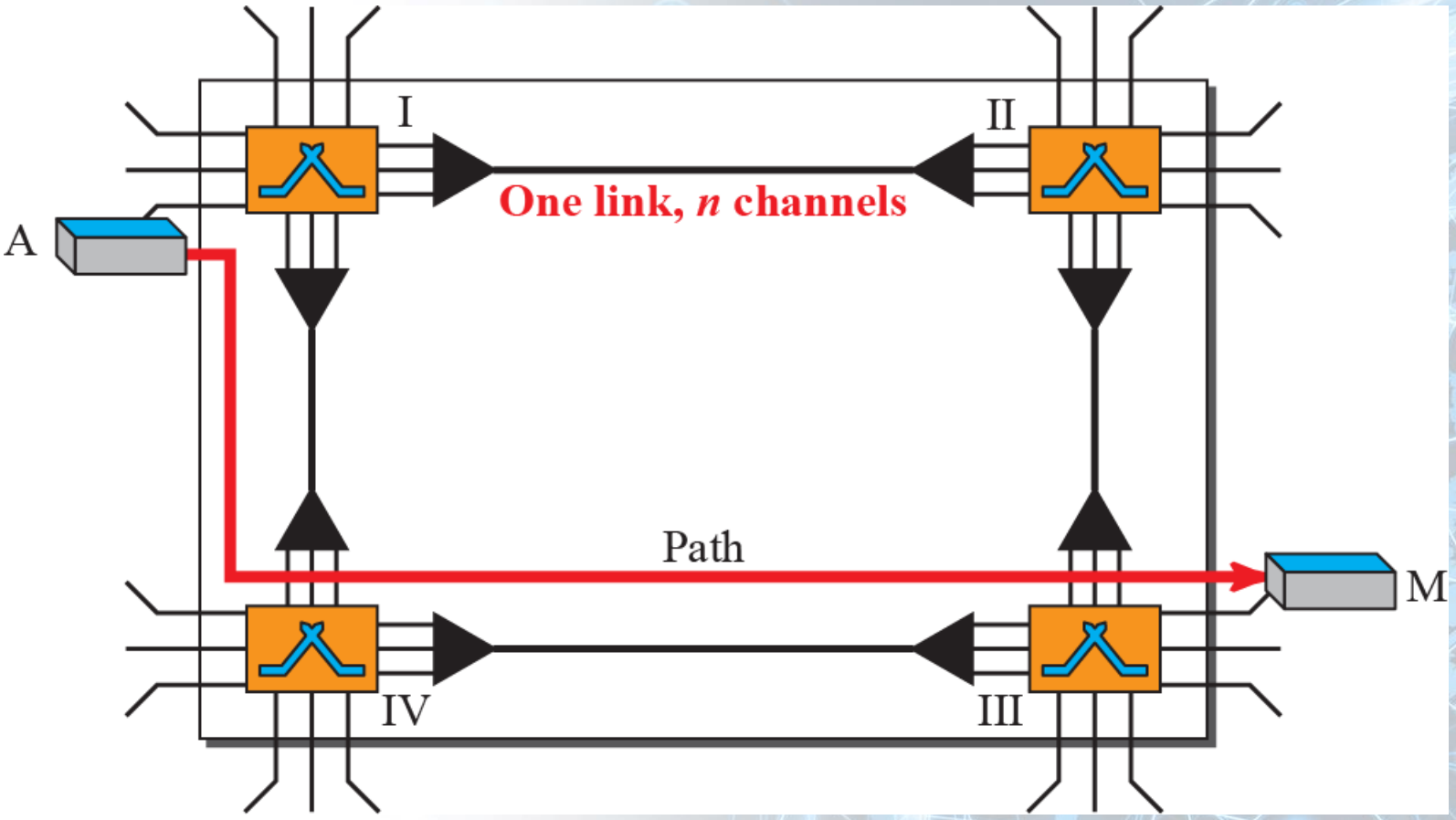
Circuit-switched Networks

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

Circuit-switched Networks

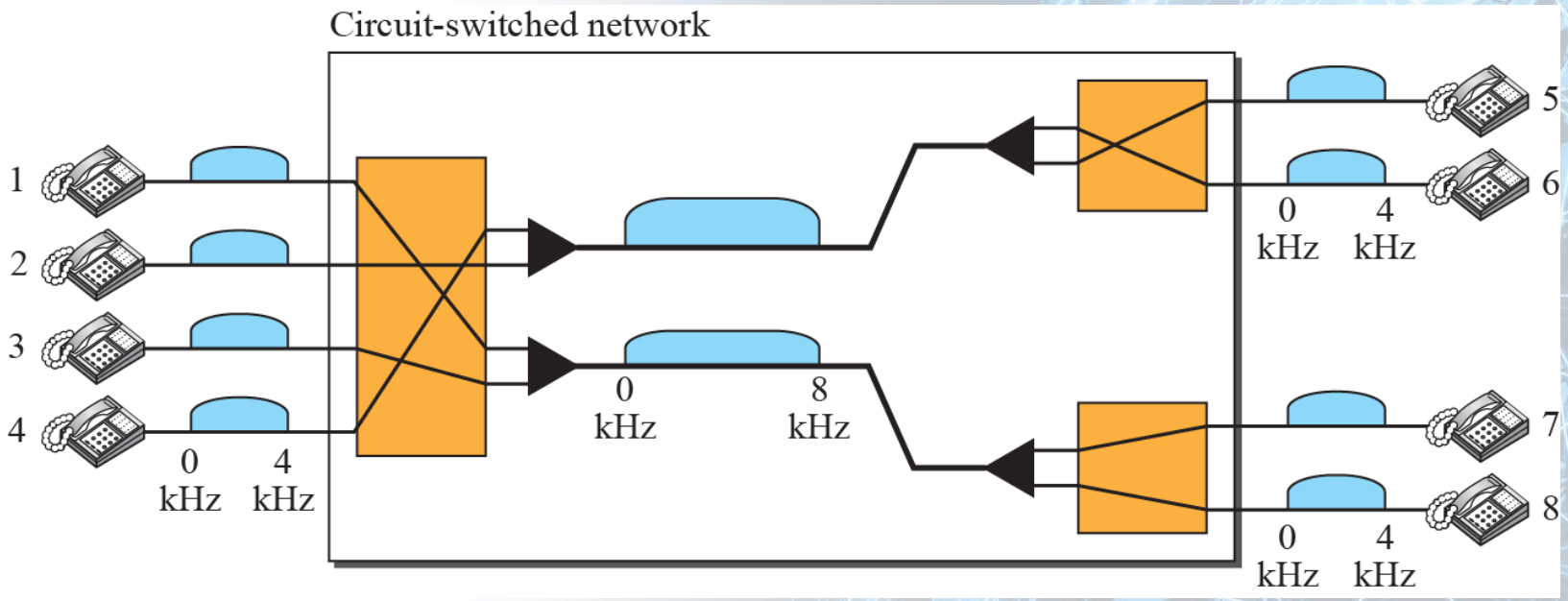
- A set of switches connected by physical links

A Circuit-Switched Network



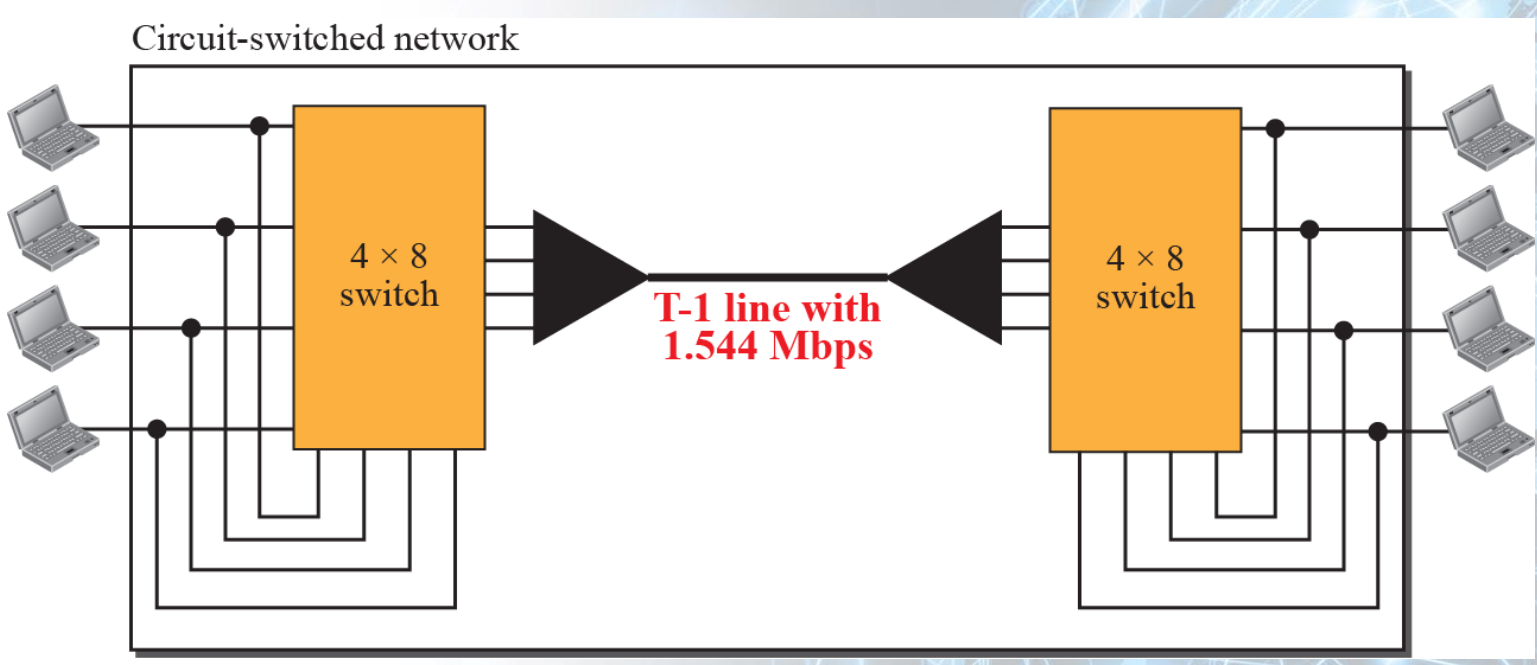
Example

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.



Example

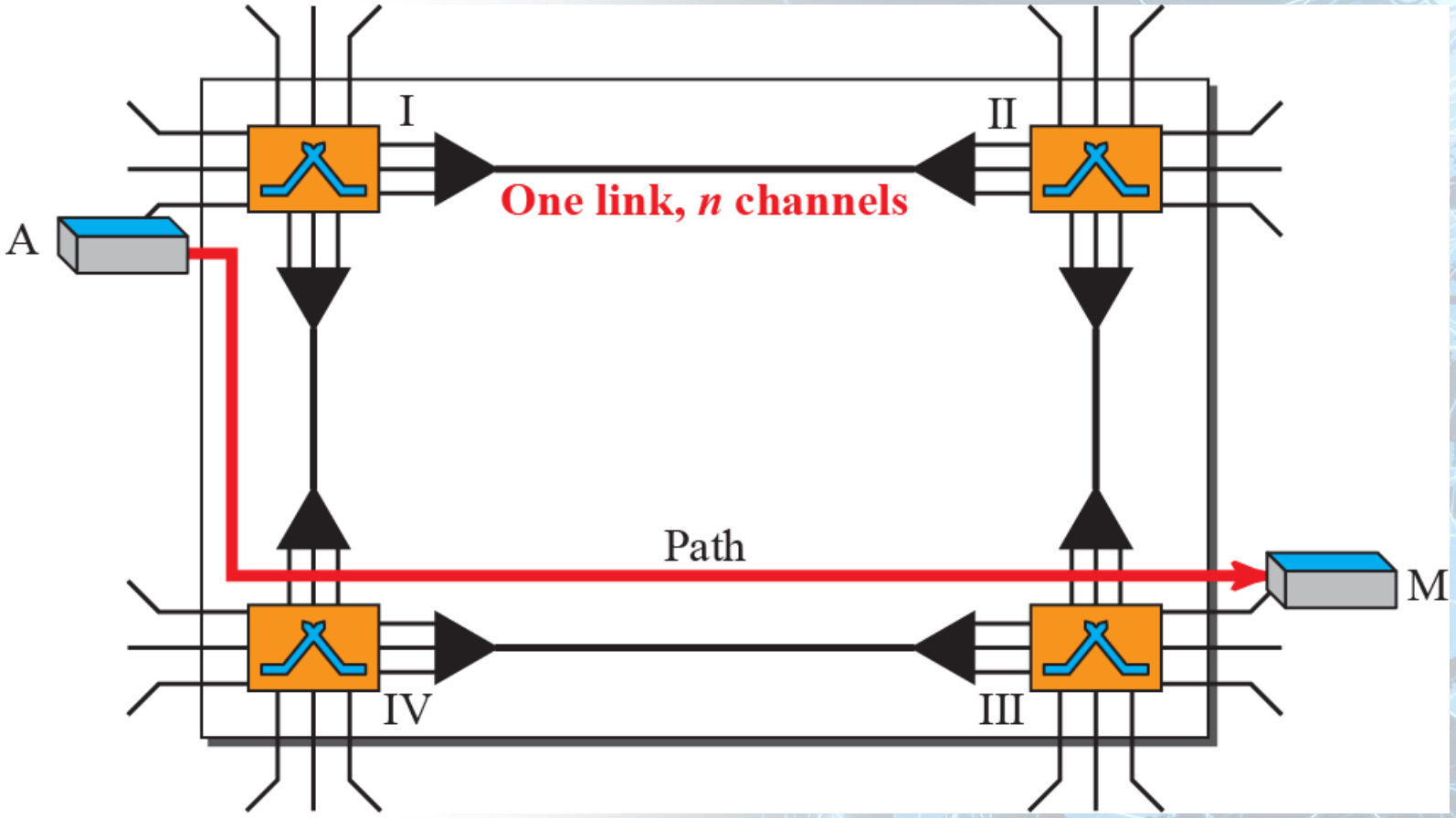
As another example, consider a circuit-switched network that connects computers in two remote offices of a private company. The offices are connected using a T-1 line leased from a communication service provider. There are two 4 × 8 (4 inputs and 8 outputs) switches in this network.



Three Phases in a Circuit Switched Network

- The actual communication in a circuit-switched network requires 3 phases:
  - ✓ Connection Setup
  - ✓ Data Transfer
  - ✓ Connection Teardown

Three Phases in a Circuit Switched Network



Efficiency of a Circuit-Switched Network

- Not as efficient as packet switching because resources are allocated during the entire duration of the connection and these resources are unavailable to other connections

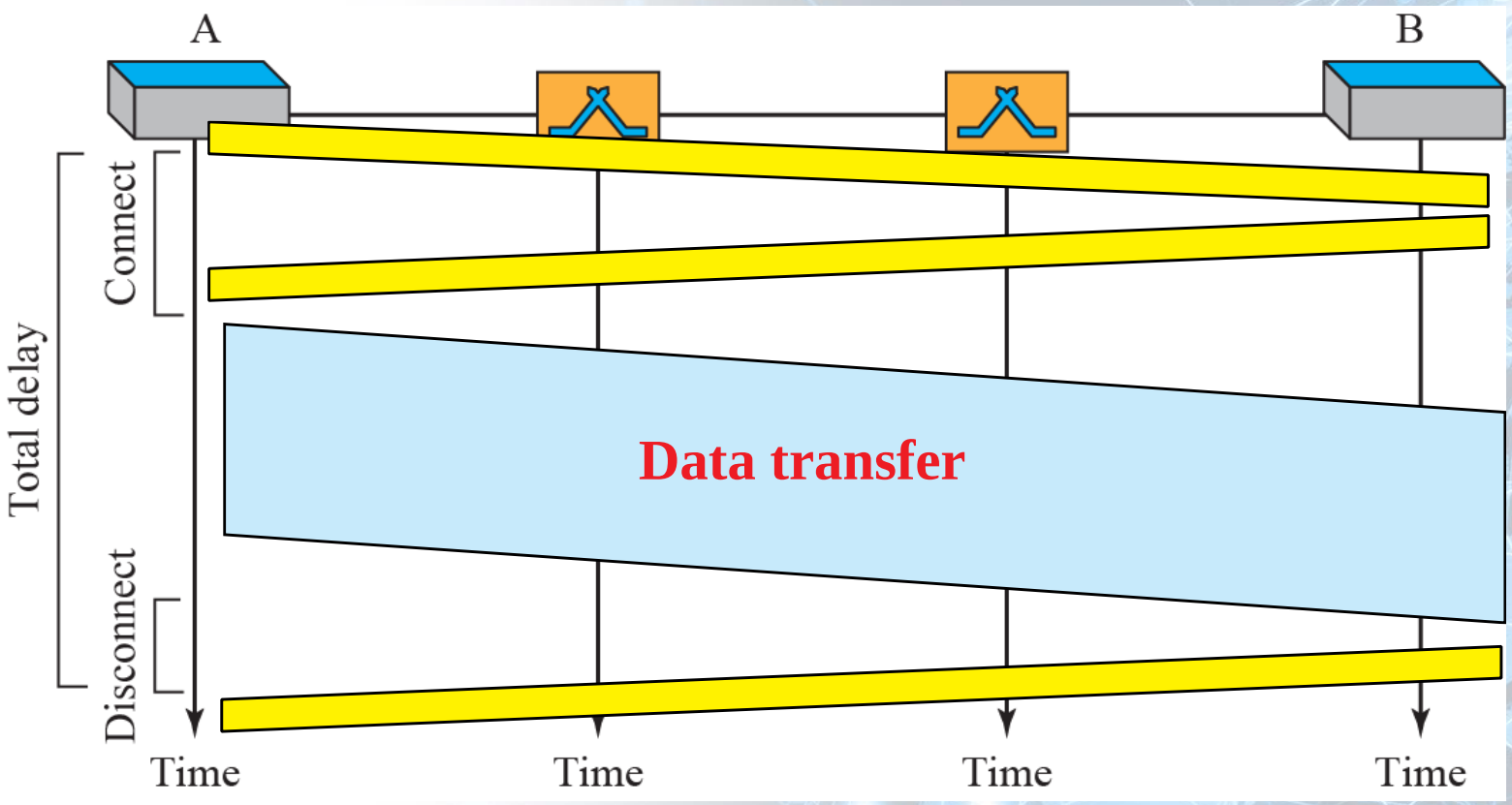
Efficiency of a Circuit-Switched Network

- In a telephone network, people normally terminate the communication when they have finished their conversation
- Data Network is an issue

Delay in a Circuit-Switched Network

- Circuit switched networks have low efficiency but minimal delay
- Data is not delayed at each switch; the resources are allocated for the duration of the connection

Delay in a Circuit-Switched Network



Packet Switching

- 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

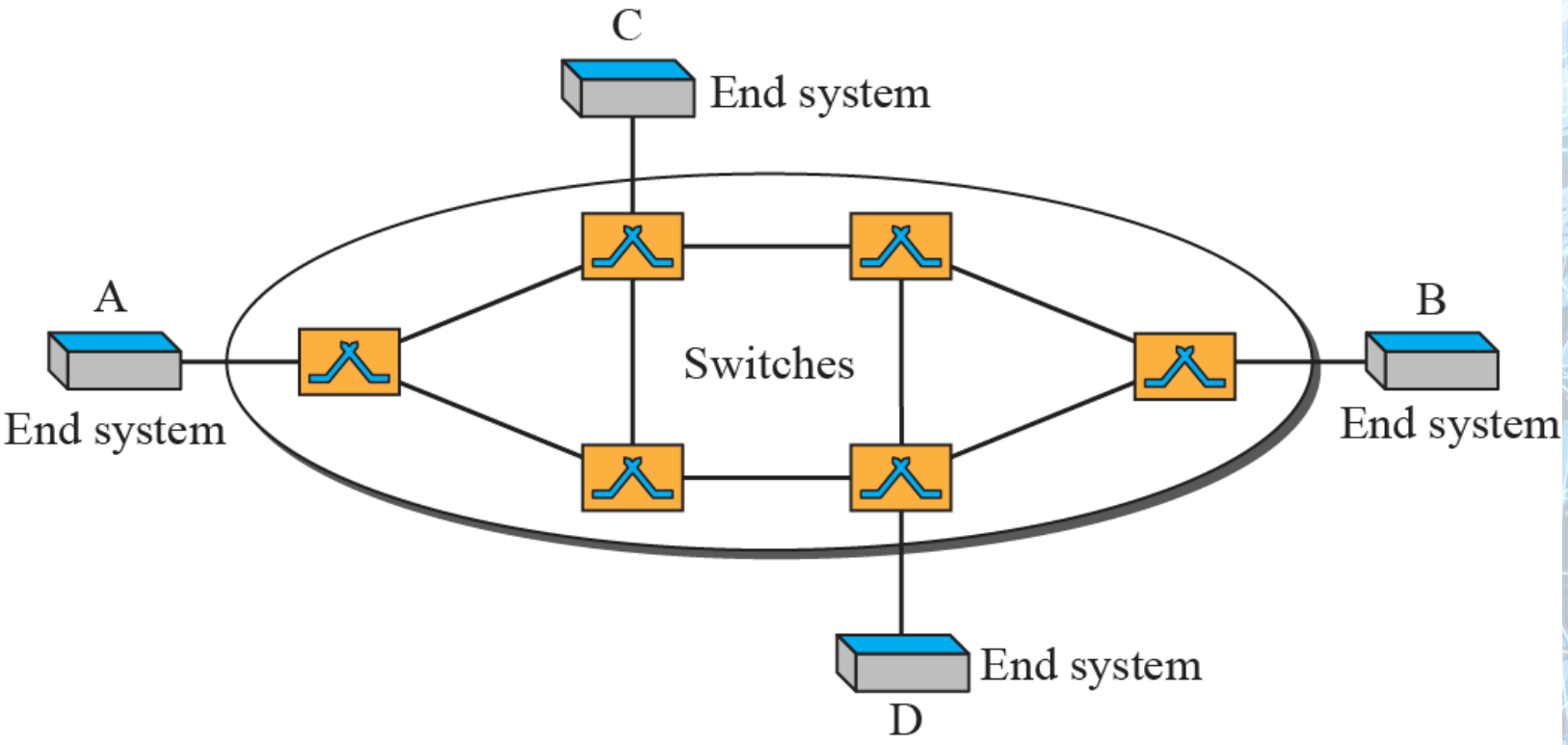
Datagram Networks

- Each packet is treated independently of all others.
- Even if a packet is part of a multi-packet transmission, the network treats it as though it existed alone
- Packets are referred to as datagrams

Virtual-Circuit Networks

- A virtual-circuit network is a cross between a circuit-switched network and a datagram network

Virtual-circuit network



Virtual-Circuit Networks

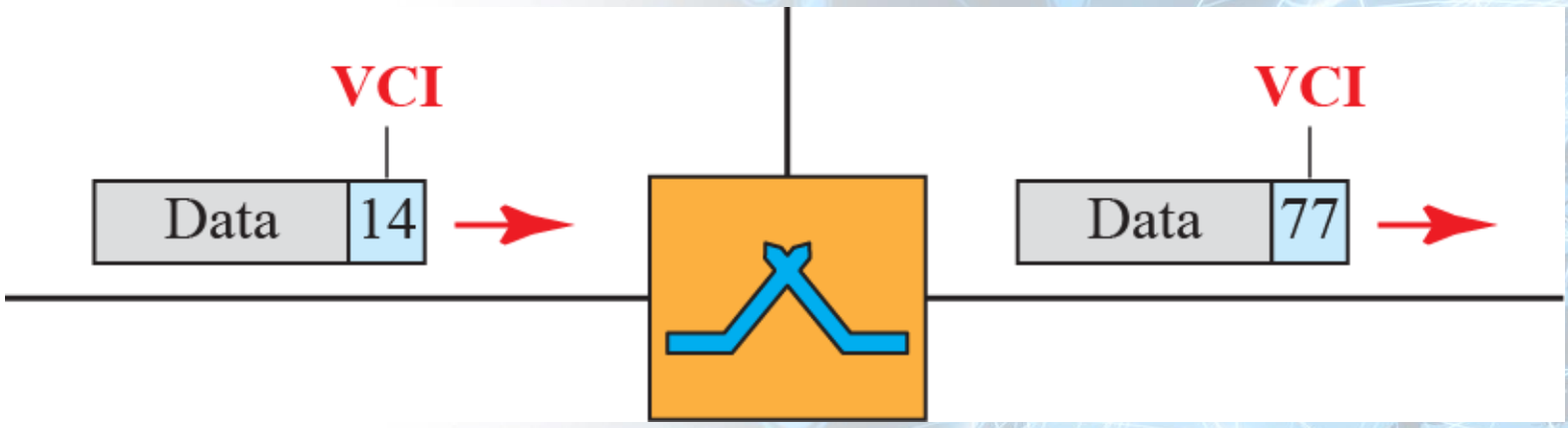
- A virtual-circuit network is a cross between a circuit-switched network and a datagram network

Virtual-Circuit Networks

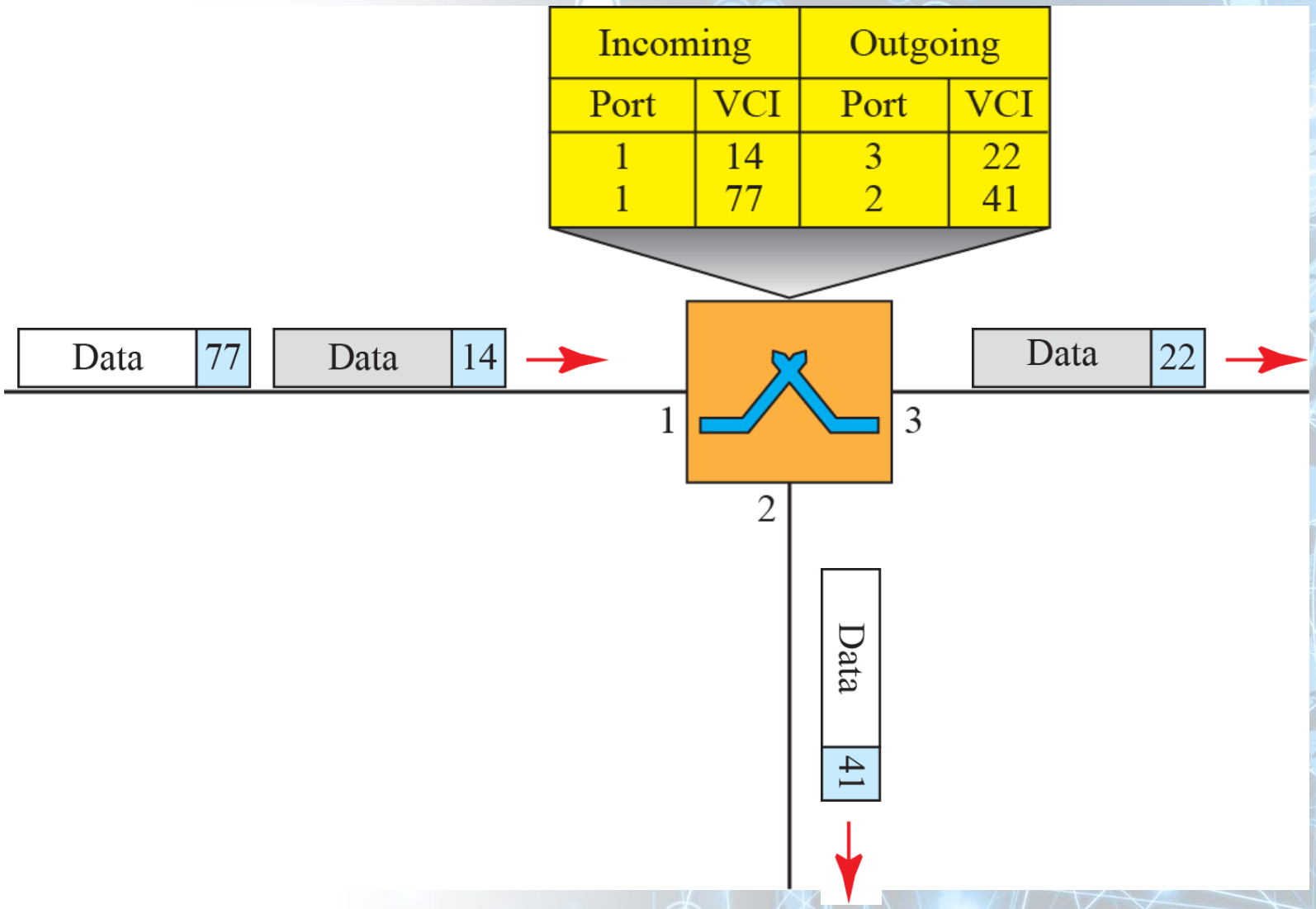
Virtual-Circuit Networks

- A virtual-circuit network is a cross between a circuit-switched network and a datagram network

Virtual-Circuit Identifier



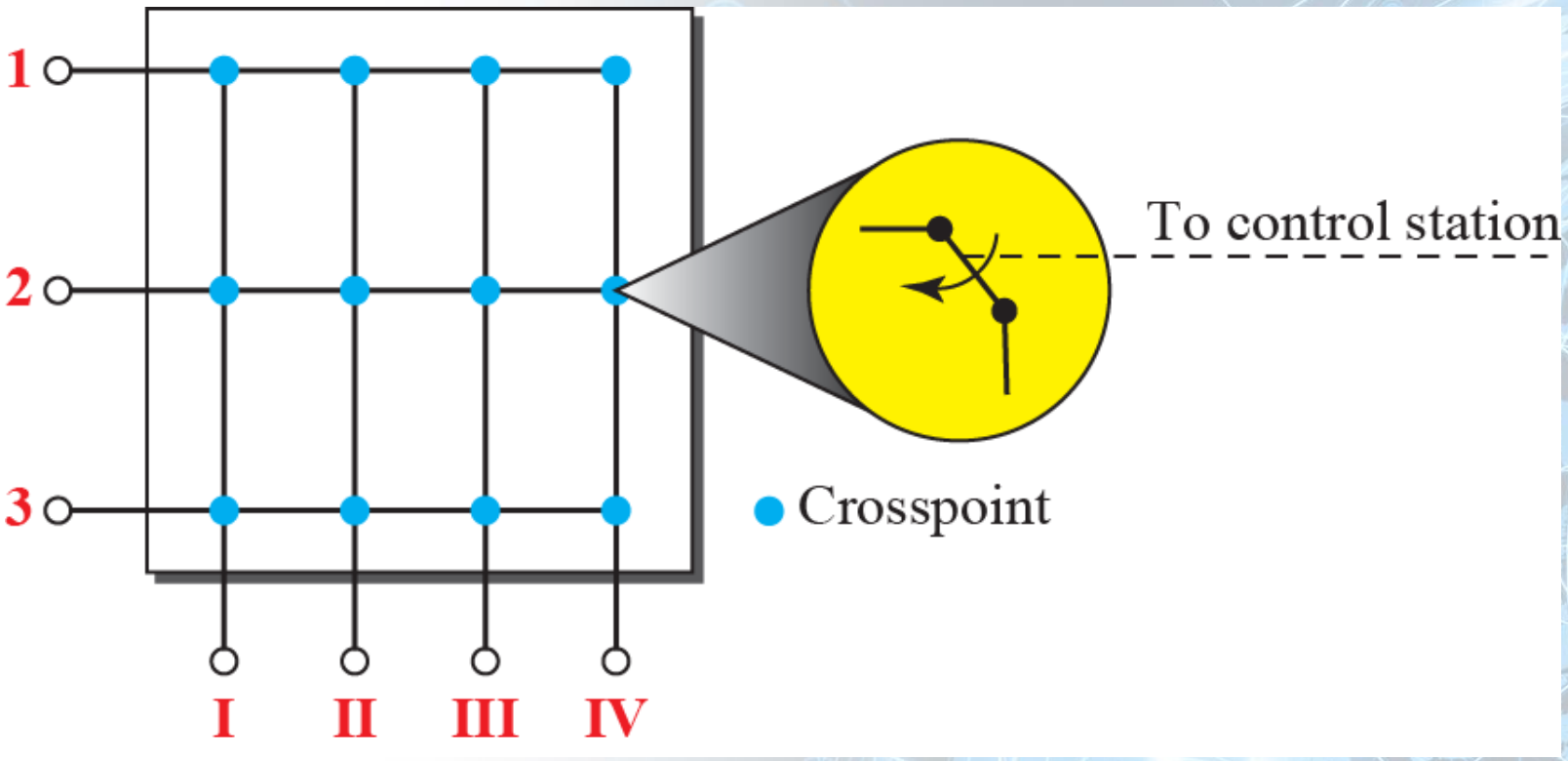
Switch & table for a virtual-circuit network



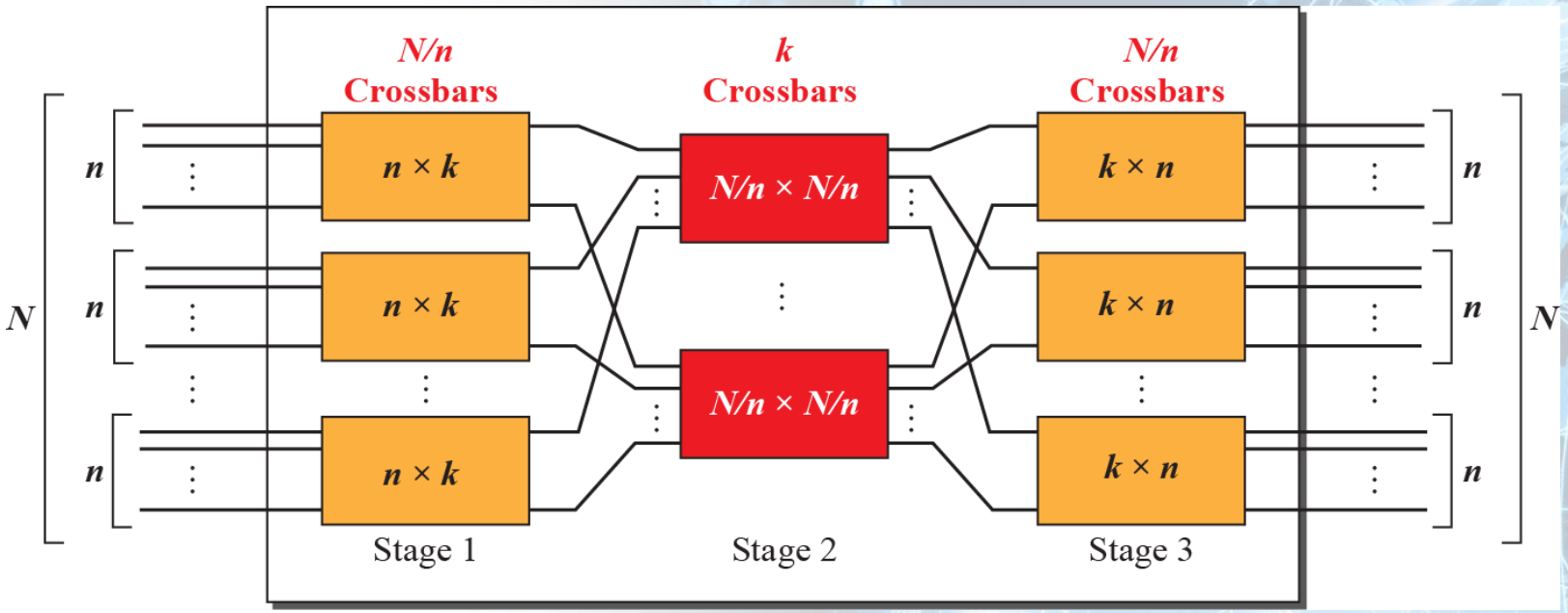
Structure Of A Circuit Switch

- Circuit switching today can use either of two technologies:
  - ✓ The Space-Division switch
  - ✓ The Time-Division switch

Crossbar switch with 3 inputs & 4 outputs



Multistage Switch



Time-Division Switch

- Uses TDM inside a switch
- Most popular technology is Time-Slot Interchange (TSI)

Time-Division Switch