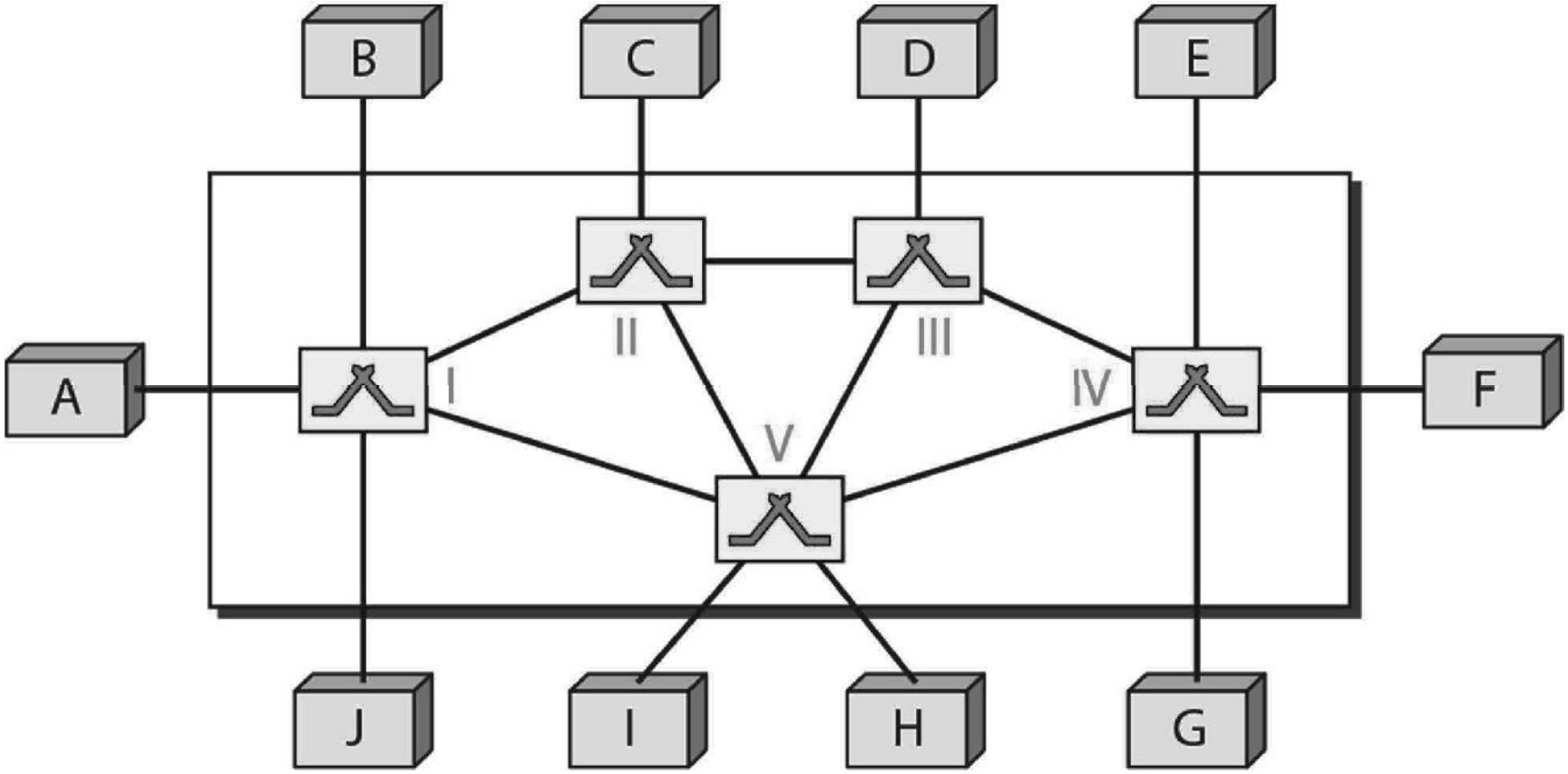
Switching

Switching Networks

- In the switched network methodology, the network consists of a set of interconnected nodes, among which information is transmitted from source to destination via different routes, which is controlled by the switching mechanism.
- Nodes not concerned with content of data
- End devices that wish to communicate with each other are called stations-

  —Computer, terminal, phone, etc.
- The switching devices are called *nodes*.
- Some nodes connect to other nodes and some are to connected to some stations.

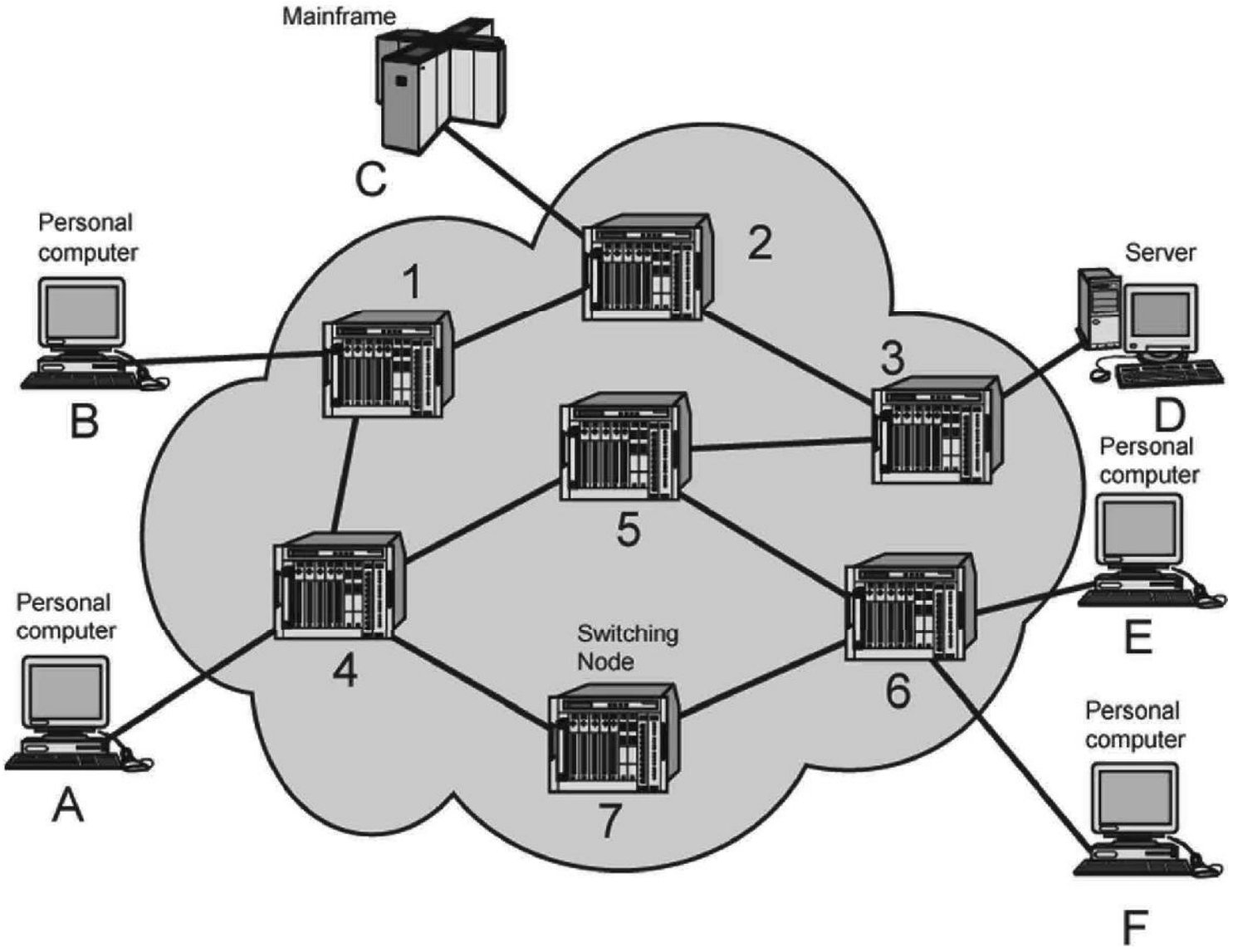
Simple Switched Network



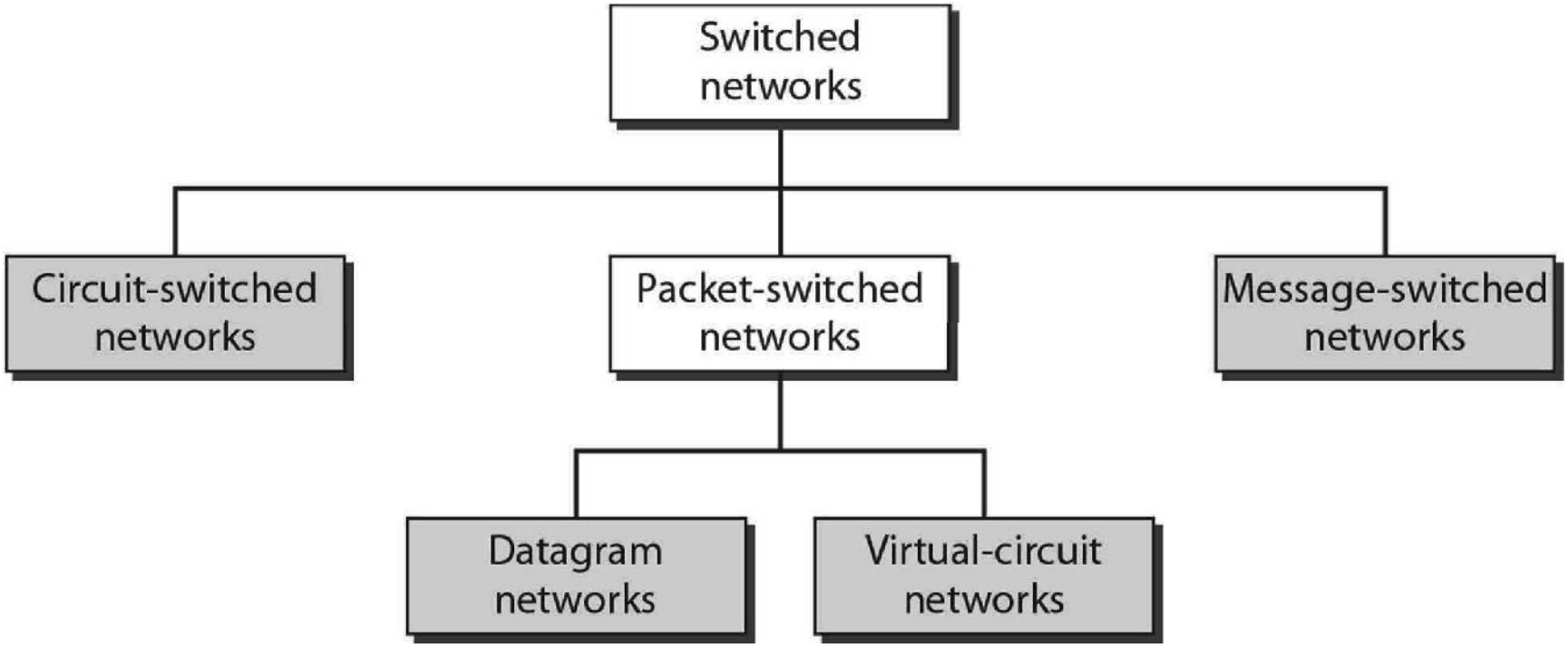
Nodes

- Nodes may connect to other nodes only, or to stations and other nodes
- Node to node links usually multiplexed.
- Node-station links are generally dedicated point-to-point links.
- Network is usually not fully connected.
  - —Some redundant connections are desirable for reliability

Simple Switched Network



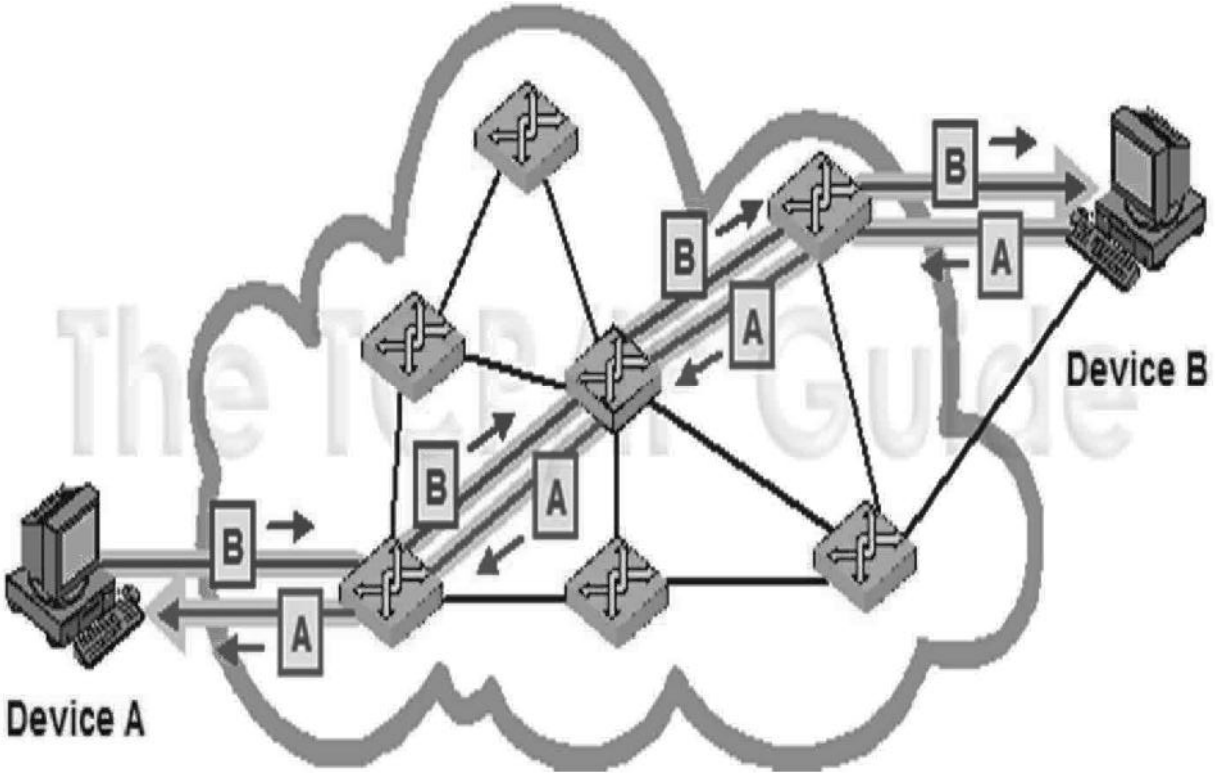
Taxonomy of Switched Networks



Circuit Switching

- A switching technology that establishes an electrical connection between stations using a dedicated path.
- Dedicated communication path between two stations
- Three phases
  - —Establish
  - —Transfer
  - —Disconnect
- Must have switching capacity and channel capacity to establish connection
- Must have intelligence to work out routing

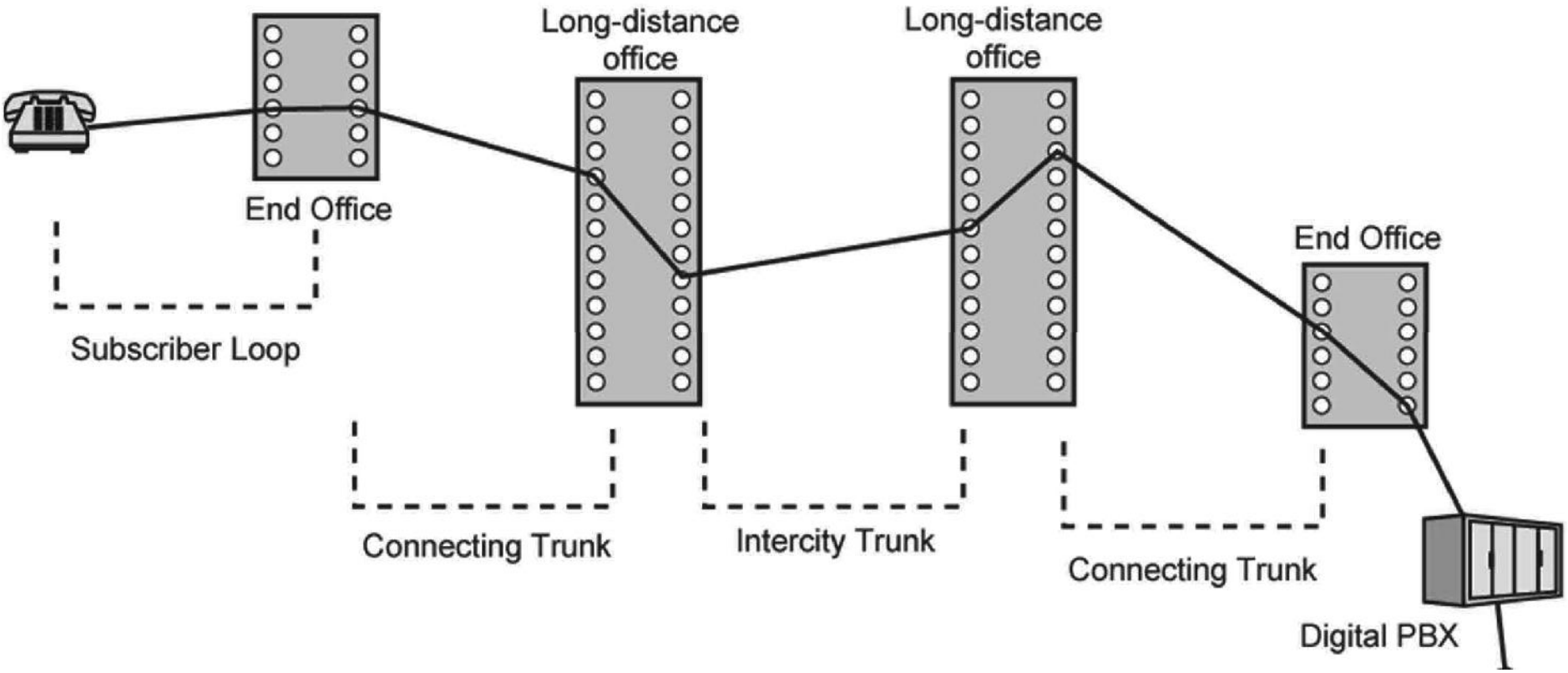
Circuit Switching



Circuit Switching

- Inefficient
  - —Channel capacity dedicated for duration of connection
  - —If no data, capacity wasted
- Set up (connection) takes time
- Once connected, transfer is transparent
- Circuit switching designed for voice
  - —Resources dedicated to a particular call
  - —Much of the time a data connection is idle
  - —Data rate is fixed
    - Both ends must operate at the same rate

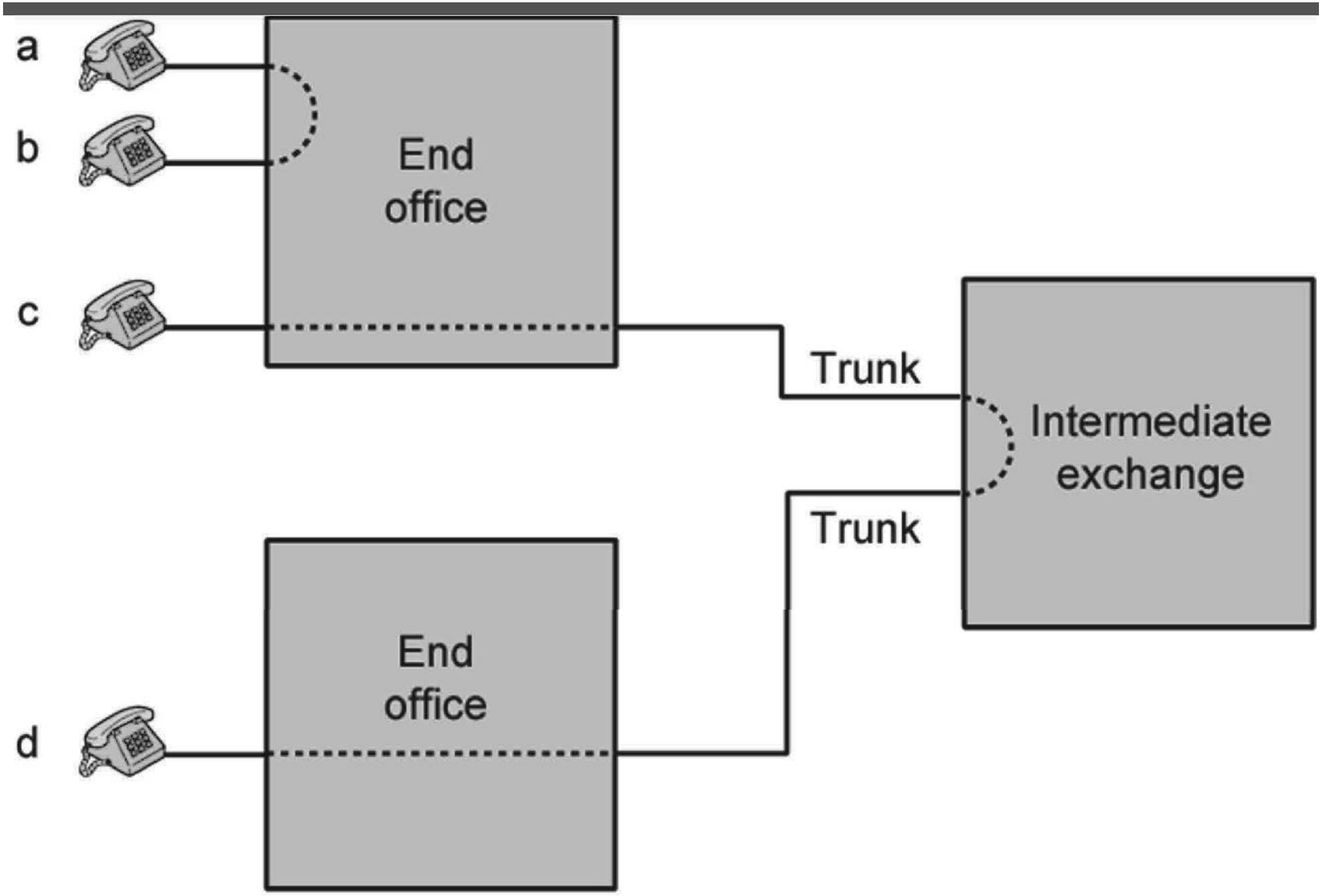
Public Circuit Switched Network



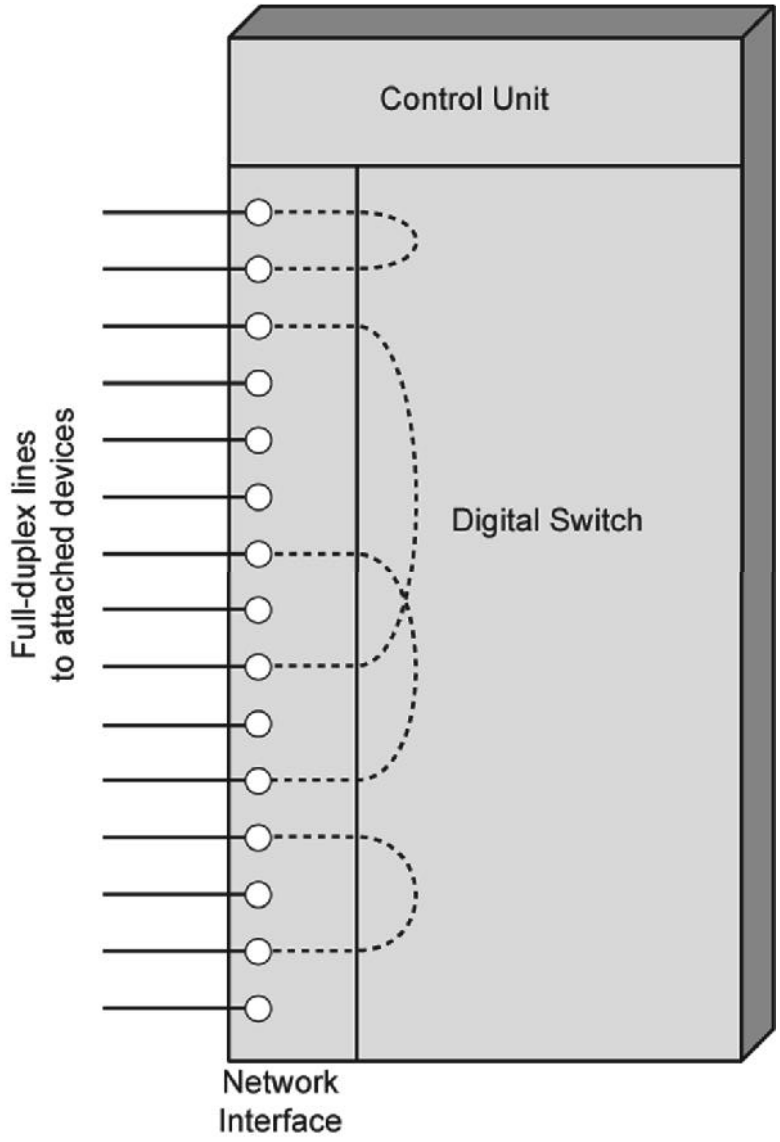
Telecommunication Components

- Subscriber
  - —Devices attached to network
- Subscriber line
  - —The link between the subscriber and the network
  - —Known as Local Loop or Subscriber loop
  - —Few km up to few tens of km
- Exchange
  - —Switching centers in the network.
  - —A switching center that directly supports subscribers is known as an end office.
- Trunks
  - —Branches between exchanges
  - —Trunks carry multiple voice frequency circuits using either FDM or synchronous TDM

Circuit Establishment



Circuit Switch Elements



Circuit Switching Concepts

- Digital Switch
  - —Provide transparent signal path between devices
- Network Interface Element
  - represents the functions and hardware needed to connect digital devices, such as data processing devices and digital telephones.
- Control Unit
  - —Establish connections
    - Generally on demand
    - Handle and acknowledge requests
    - Determine if destination is free
    - construct path
  - —Maintain connection
  - —Disconnect

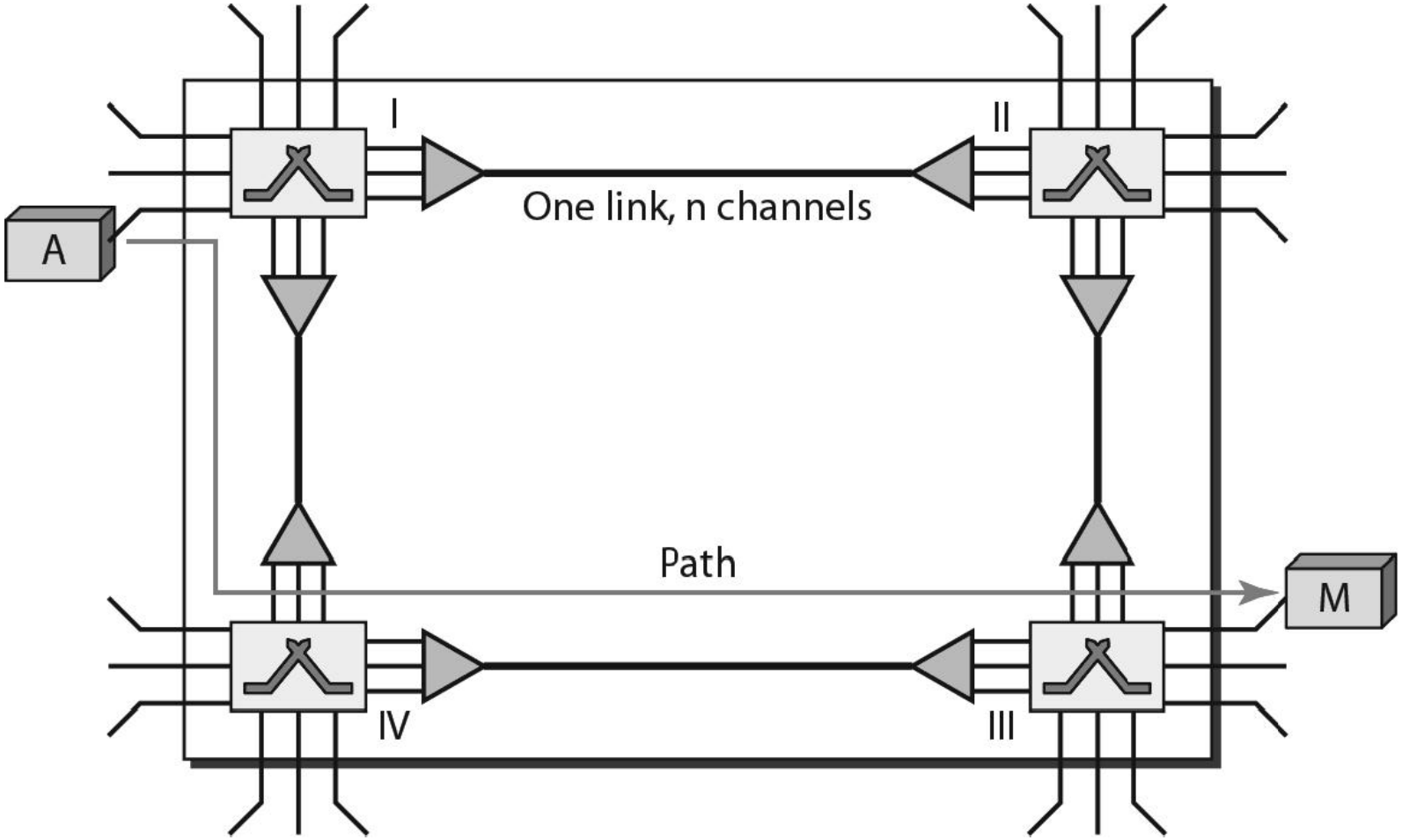
Characteristics of Circuit Switching

- Blocking
  - —A network is unable to connect stations because all paths are in use
  - —Used on voice systems
    - Short duration calls
- Non-blocking
  - —Permits all stations to connect (in pairs) at once
  - —Used for some data connections

Note

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 8.3 *A trivial circuit-switched network*



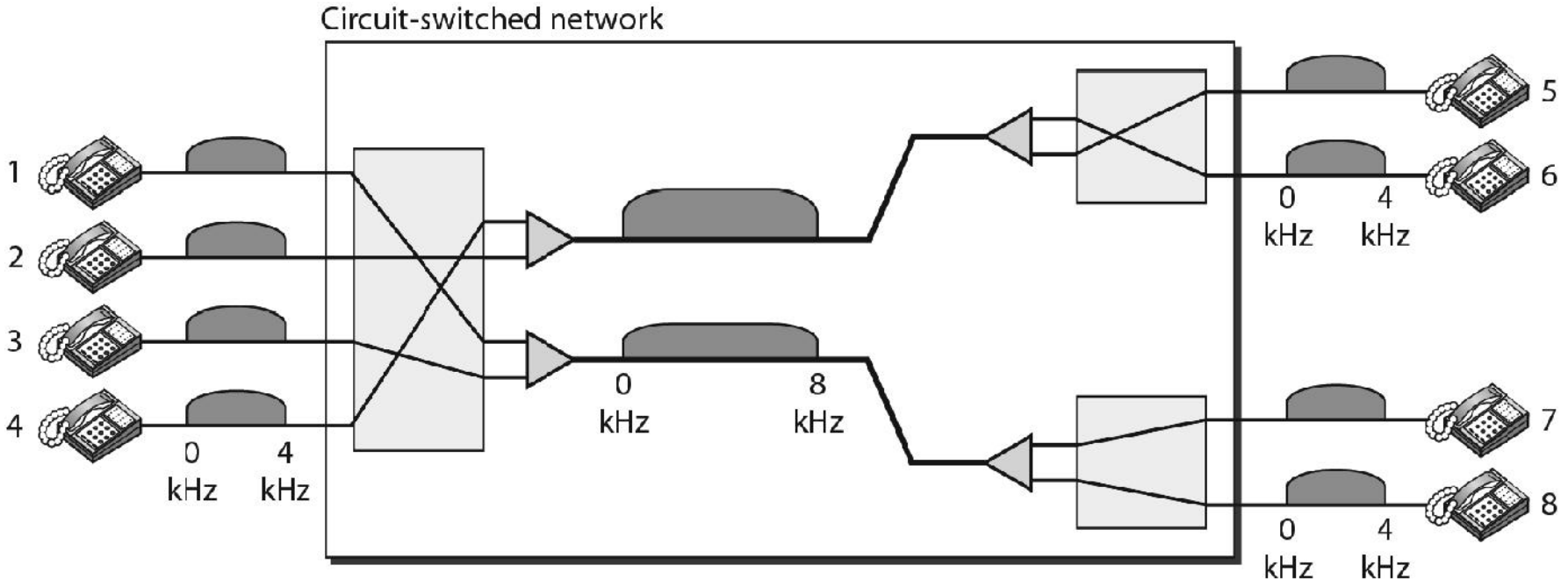
Note

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.

Example 8.1

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 8.4 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 8.4 *Circuit-switched network used in Example 8.1*



Example 8.2

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 8.5 *Circuit-switched network used in Example 8.2*

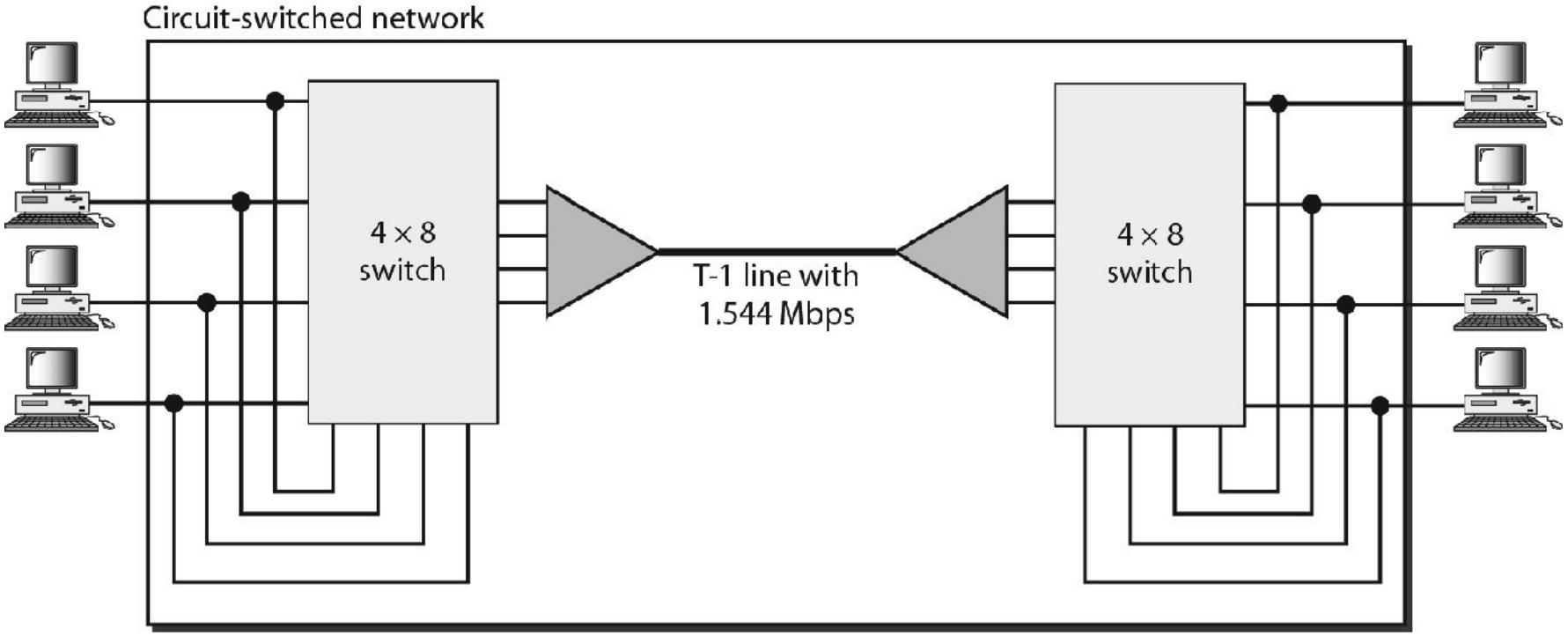
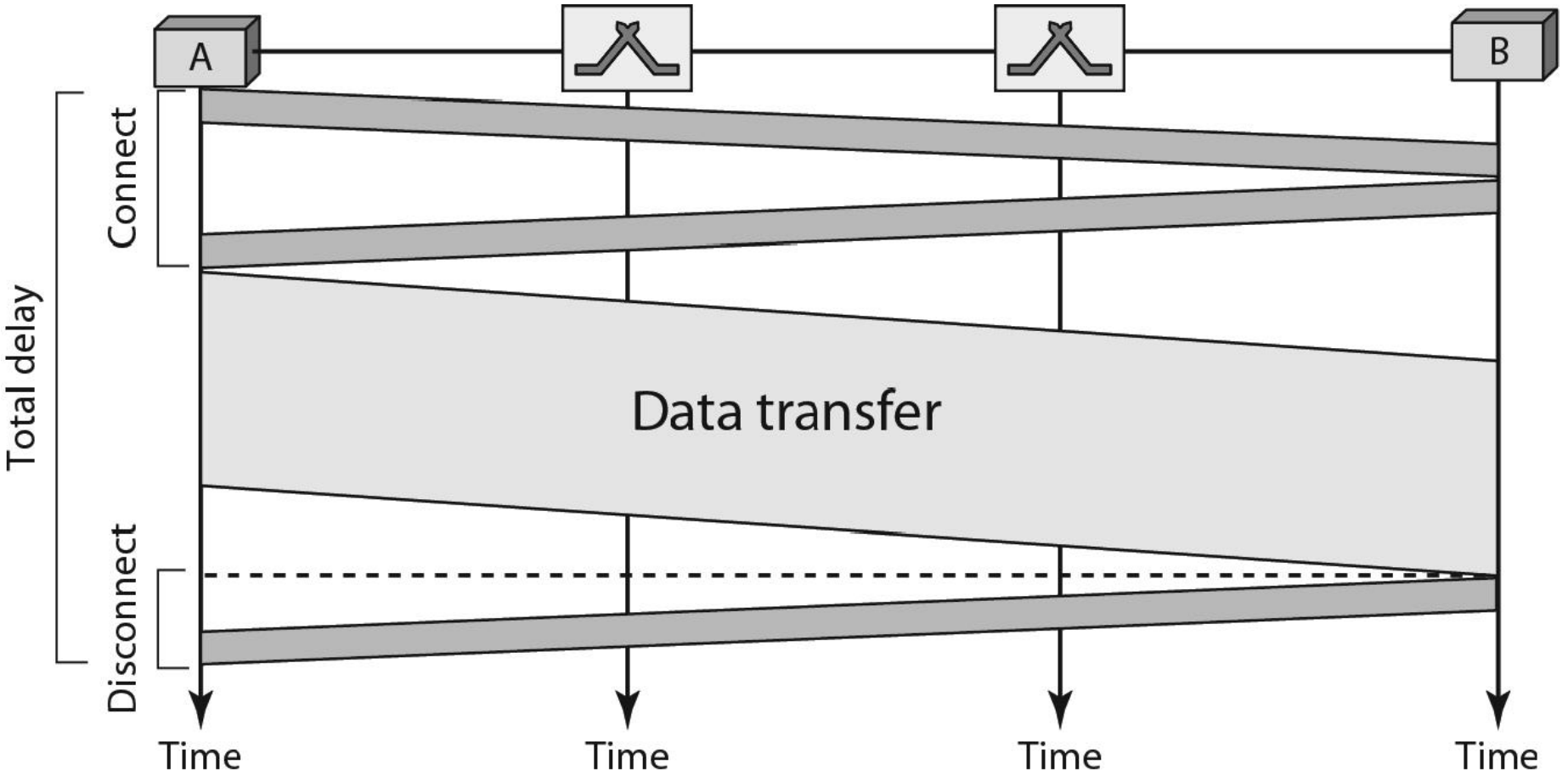


Figure 8.6 *Delay in a circuit-switched network*



Note

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