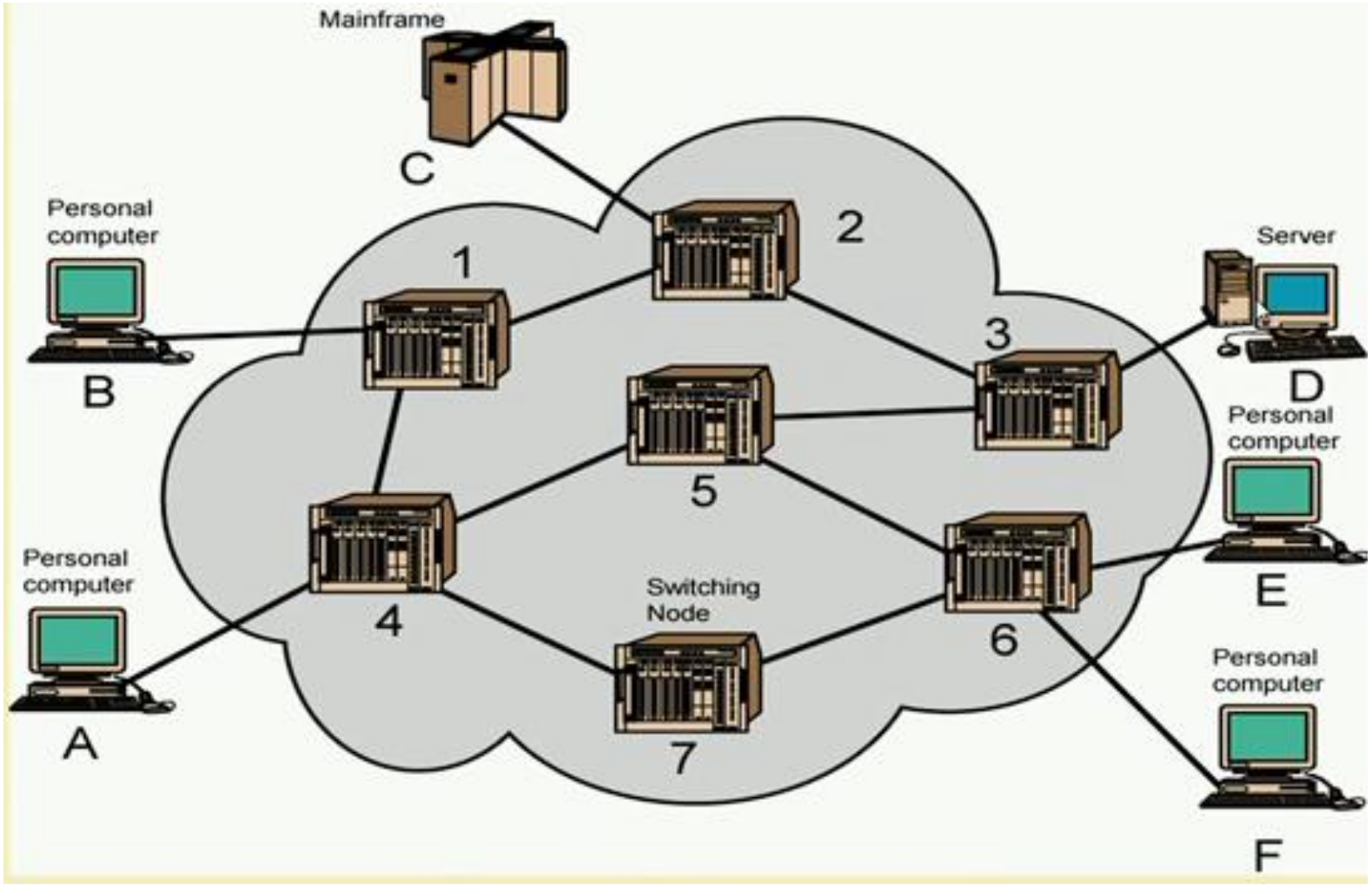
Typical Circuit Switching Network



Switching Technology

- Switching nodes may connect to other nodes, or to some stations.
- Network is usually partially connected
  - However, some redundant connections are desirable for reliability

- Two different switching technologies
  - Circuit switching
  - Packet switching

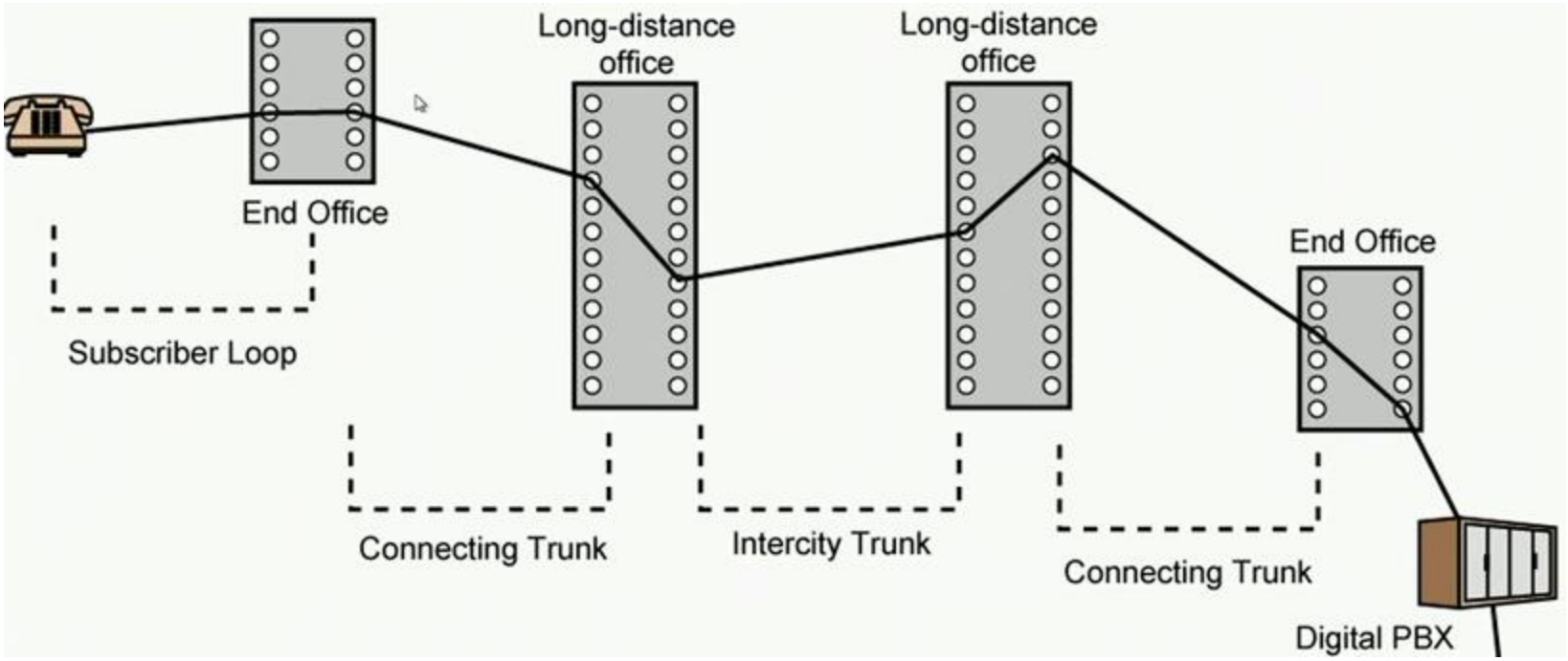
Circuit Switching

- 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

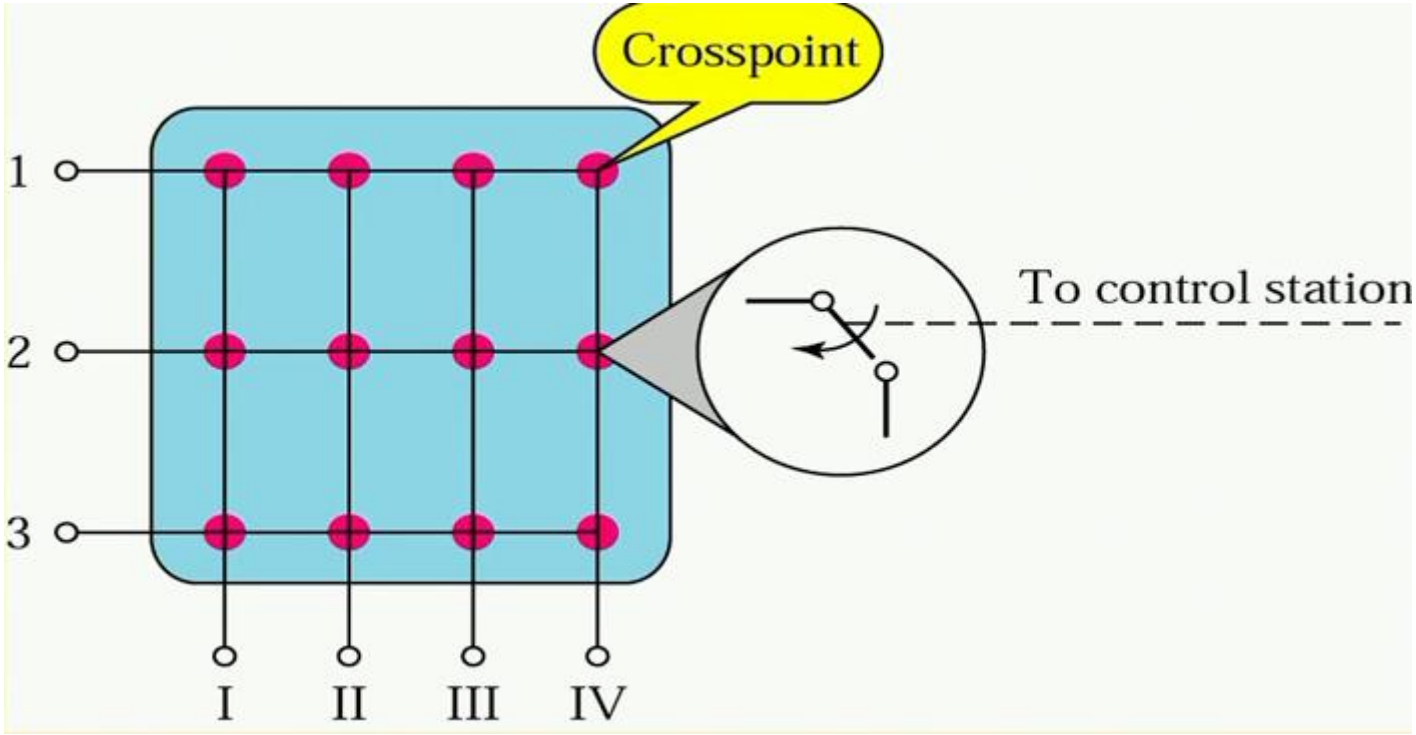
Packet Switching

- A station breaks long message into packets
- Packets are sent out to the network sequentially, one at a time
- The stream of packets are routed through the network and are delivered to the intended destination?
  - Two approaches
    - **Datagram** approach
    - **Virtual circuit** approach

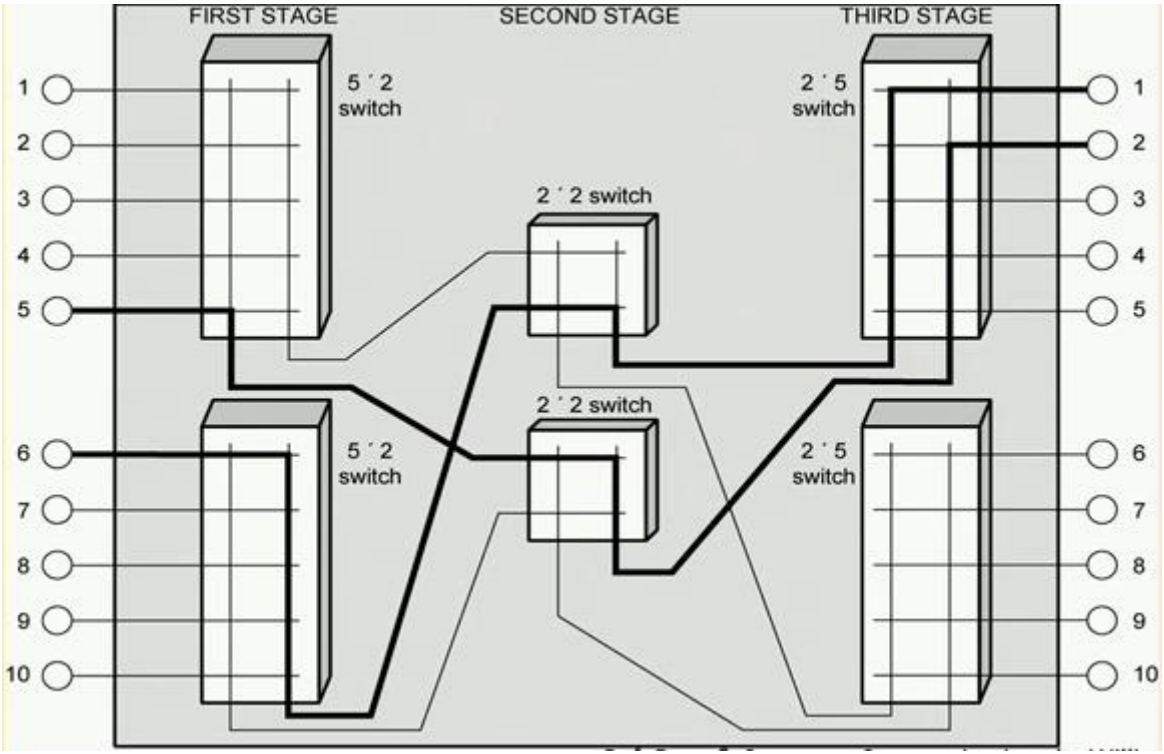
Circuit Switching - Approach



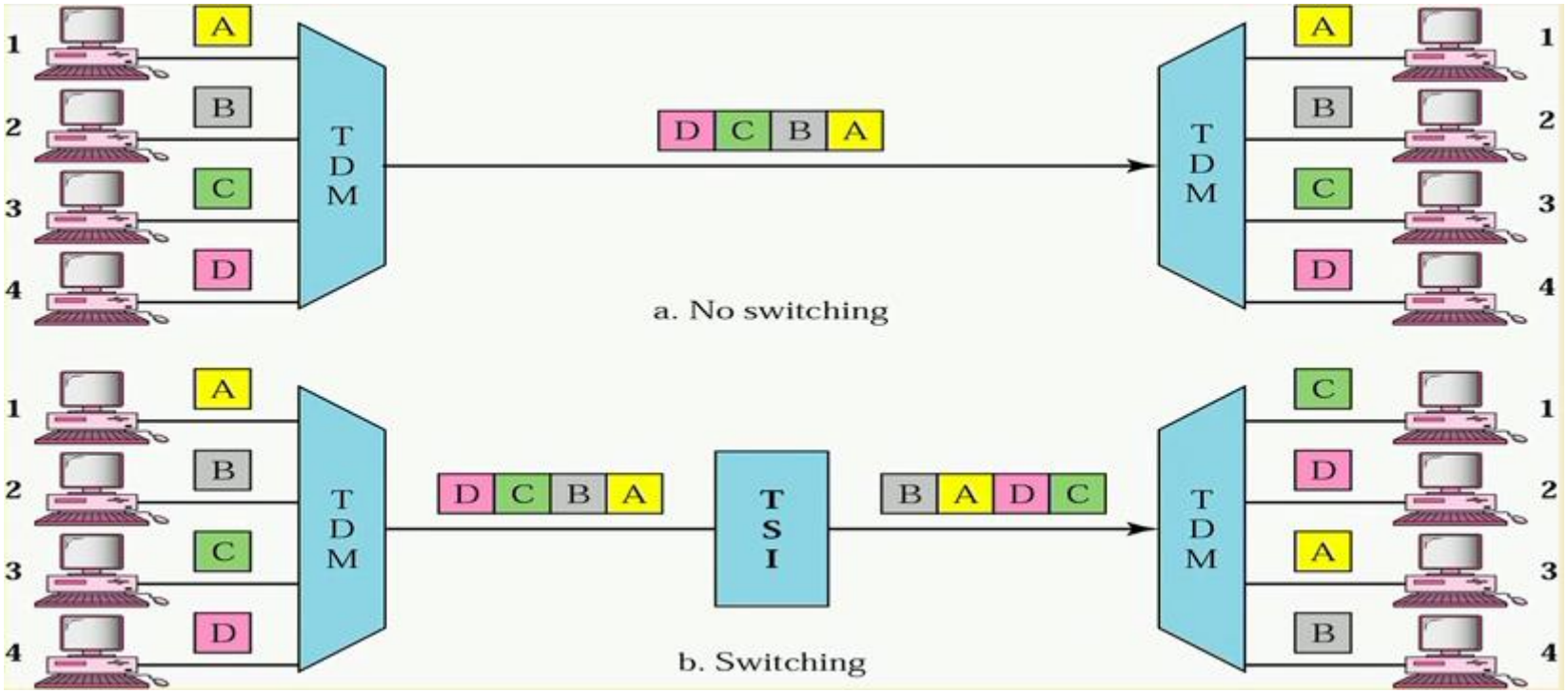
Circuit Switching – Space Division Switch



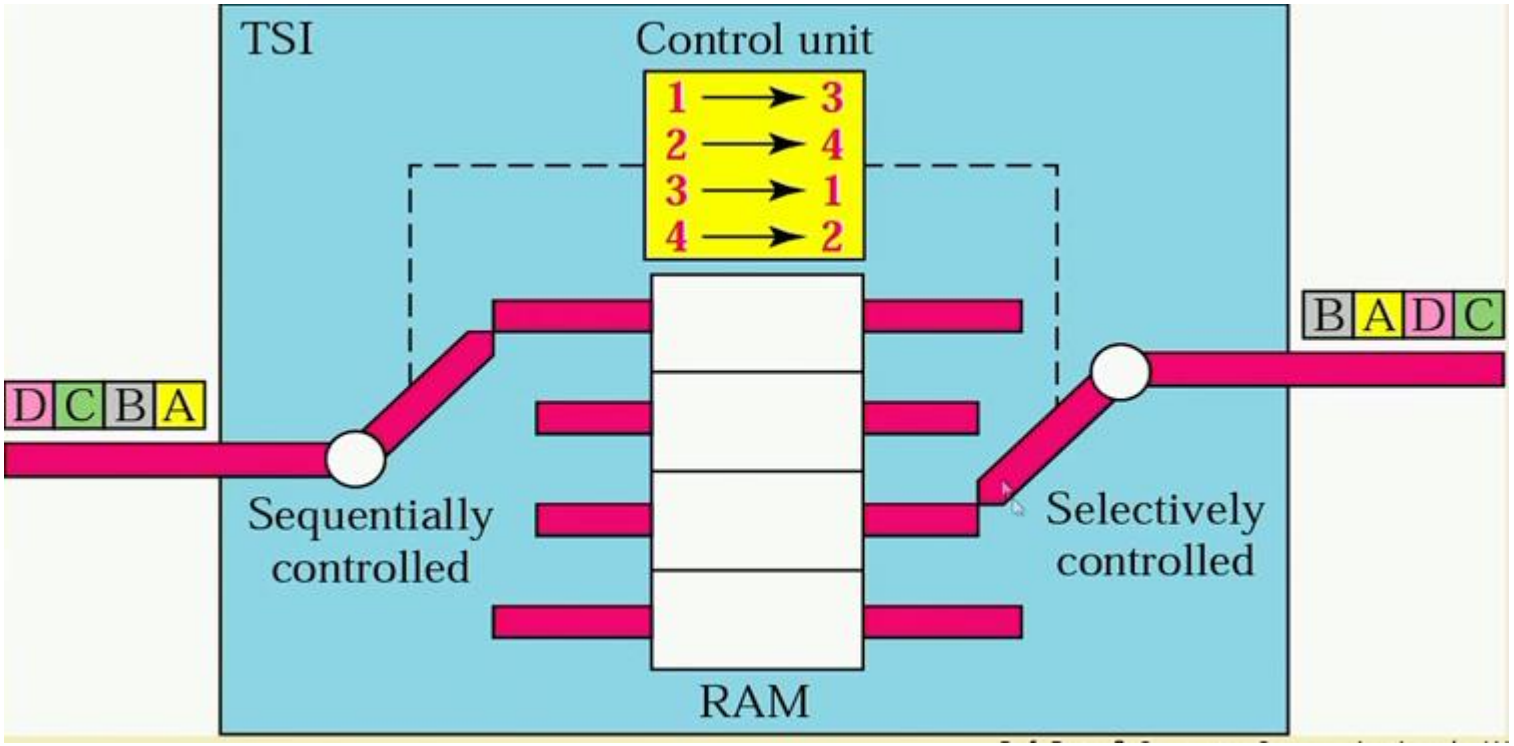
Circuit Switching – Multi-stage Space Division Switch



Circuit Switching – Time Division Multiplexing



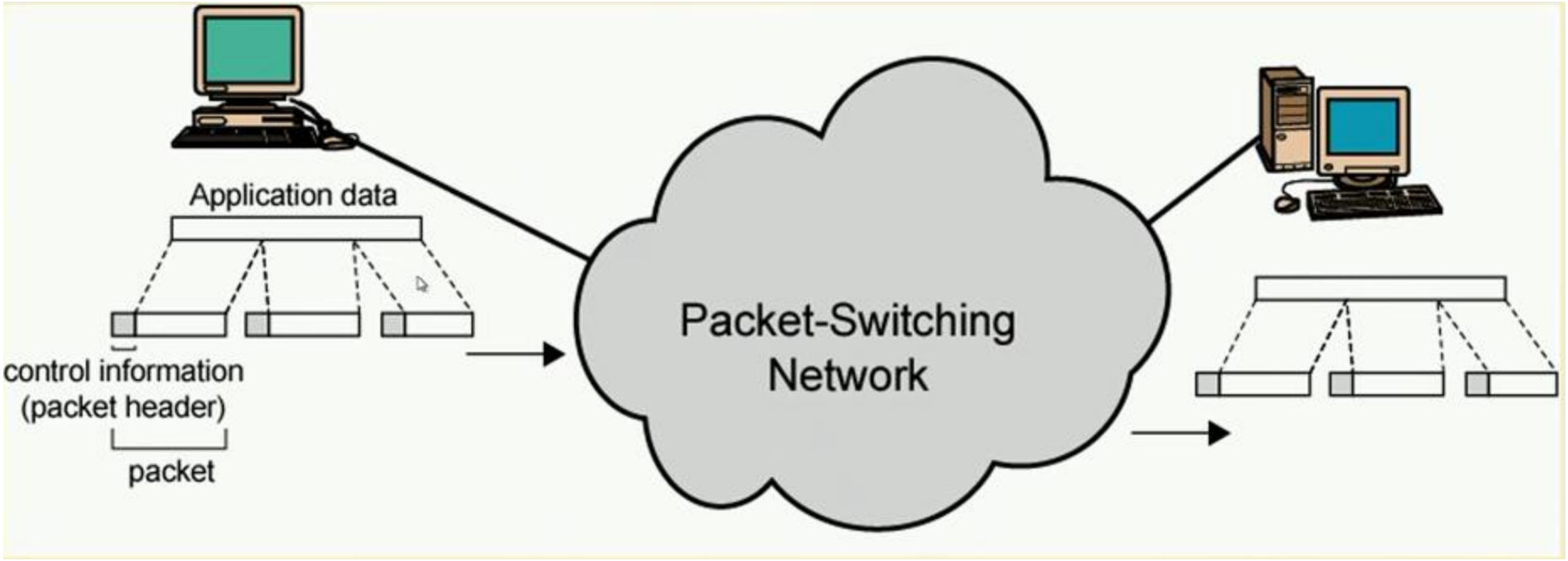
Circuit Switching – Time Slot Exchange



Packet Switching

- Data transmitted in small packets
  - Typically 1000 octets (8 bit byte)
  - Longer messages split into series of packets
  - Each packet contains a portion of user data plus some control info
- Control info
  - Routing (addressing) info
- Packets are received, stored briefly (buffered) and passed on to the next node
  - Store and forward

Packet Switched Networks



Advantages of Packet Switching

- Line efficiency
  - Single node to node link can be shared by many packets over time
  - Packets queued and transmitted as fast as possible
- Data rate conversion
  - Each station connects to the local node at its own speed
  - Nodes buffer data if required to equalize rates
- Packets are accepted even when network is busy
  - Delivery may slow down
- Priorities can be used

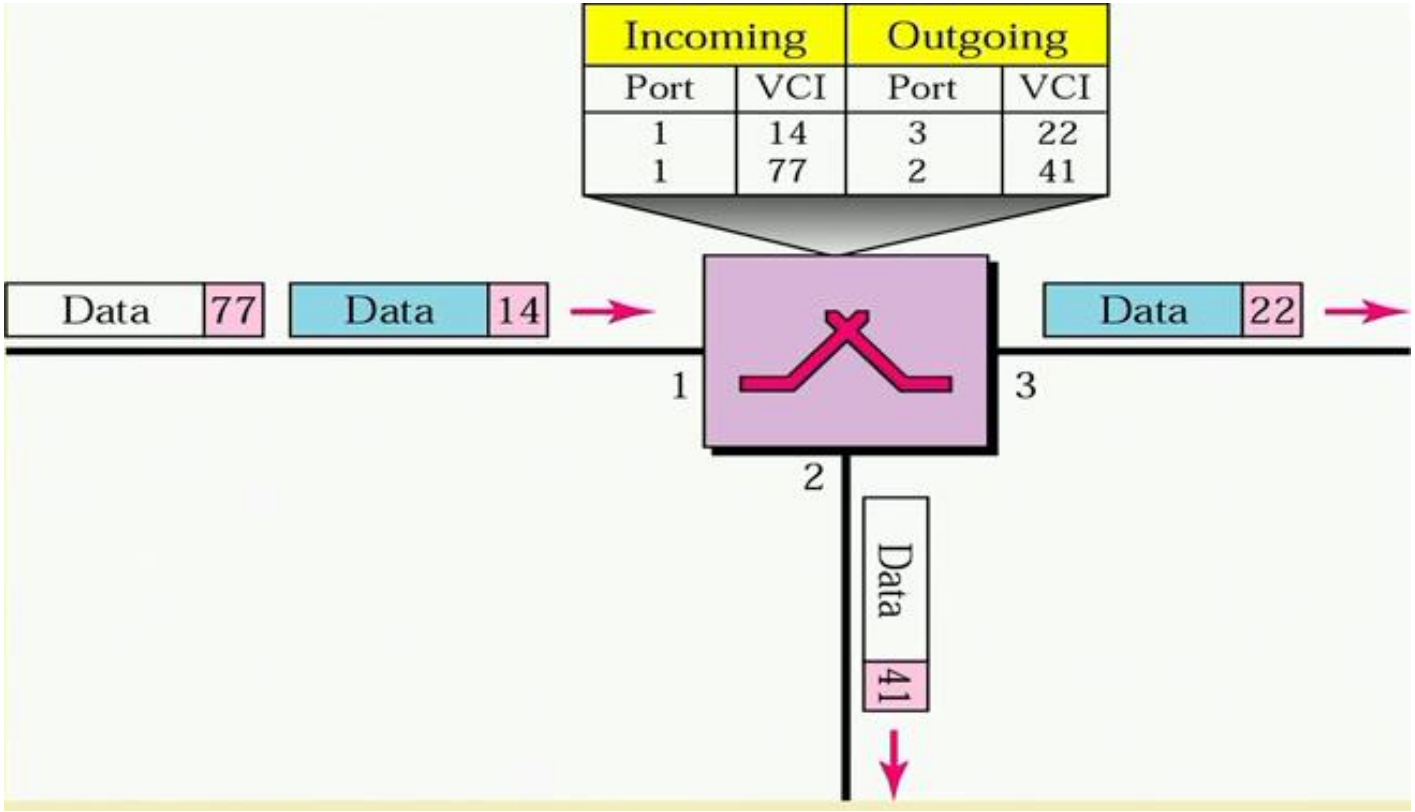
Packet Switching Datagram

- 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

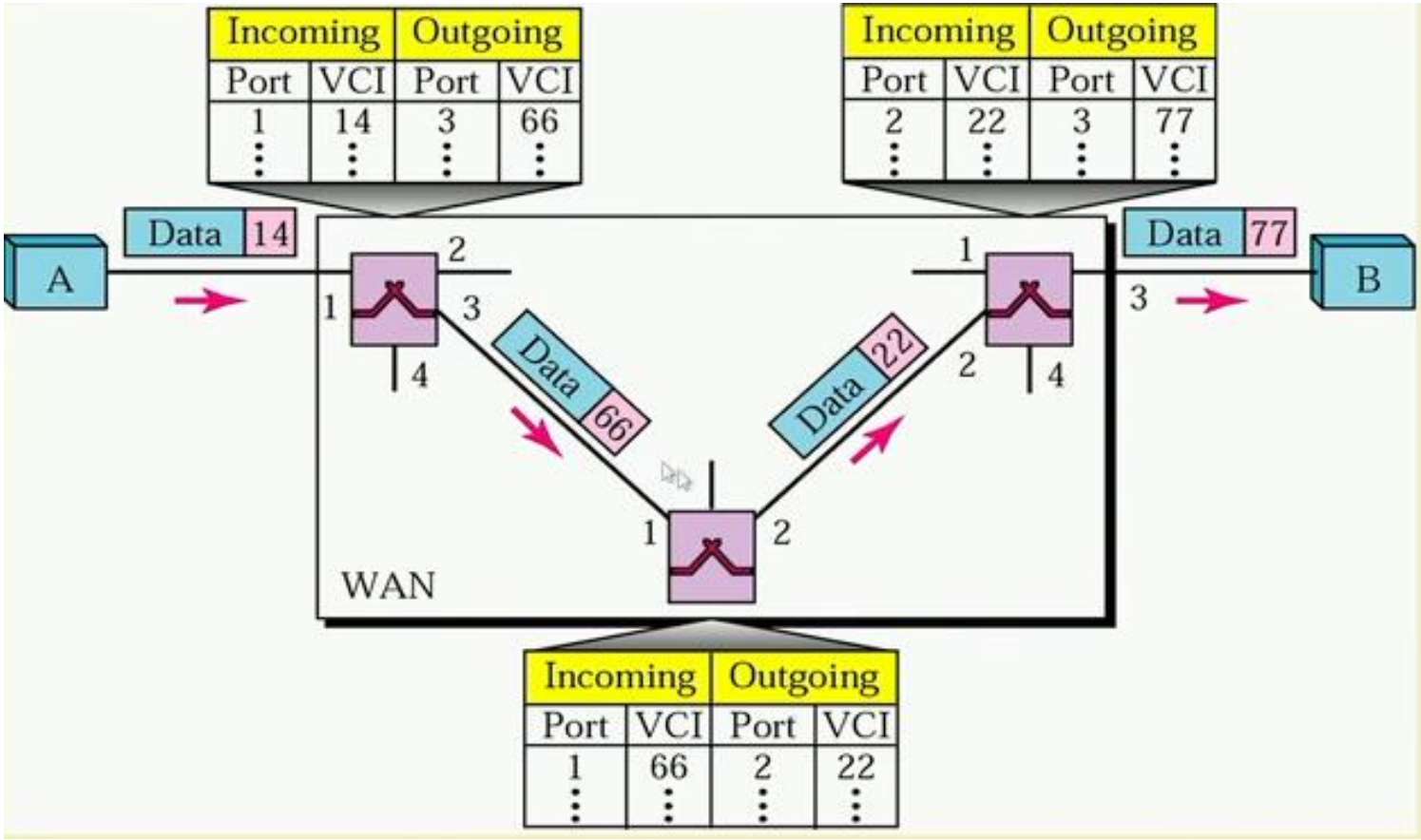
Virtual Circuit

- 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 path

VC Switching Table



Virtual circuit source-destination



Virtual circuit vs Datagram

- Virtual circuits
  - Network can provide sequencing and error control
  - Packets are forwarded more quickly
    - No routing decisions to make
  - Less reliable
    - Loss of a node loses all circuits through that node
- Datagram
  - No call setup phase
    - Better if few packets
  - More flexible
    - Routing can be used to avoid congested parts of the network

Circuit Switched vs Packet Switched

Circuit Switched

- Bandwidth guaranteed
- Circuit capacity not reduced by other network traffic
- Circuit costs independent of amount of data transmitted, resulting in wasted bandwidth
- Suitable for voice communication

Packet Switched

- Bandwidth dynamically allocated on as-needed basis
- May have concurrent transmissions over physical channel
- May have delays and congestion
- More cost-effective, offer better performance
- Suitable for data communication