Switching Networks

Long distance transmission is typically done over a network of switched nodes

Nodes not concerned with content of data

End devices are stations

- Computer, terminal, phone, etc.

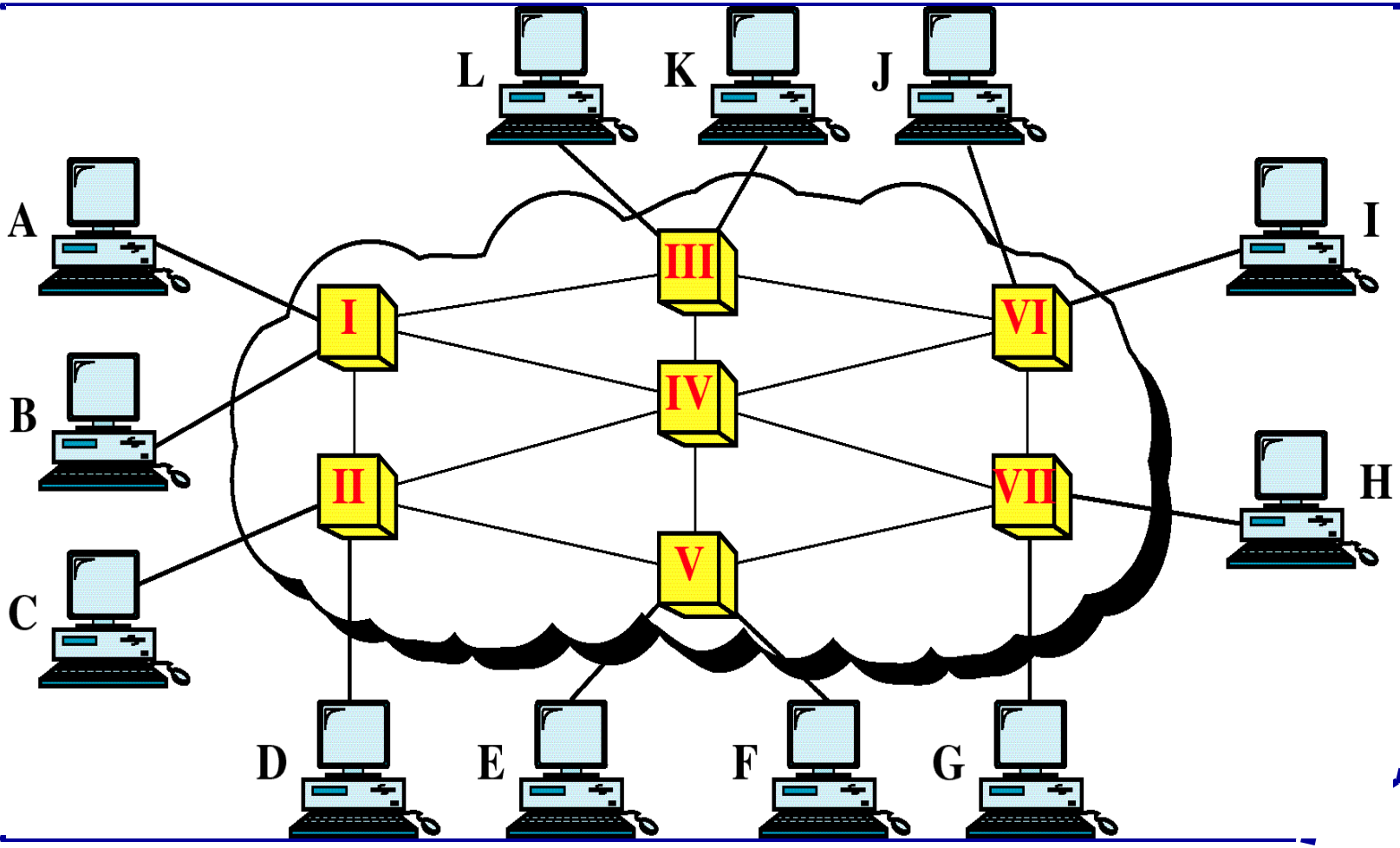
A collection of nodes and connections is a communications network

Data routed by being switched from node to node

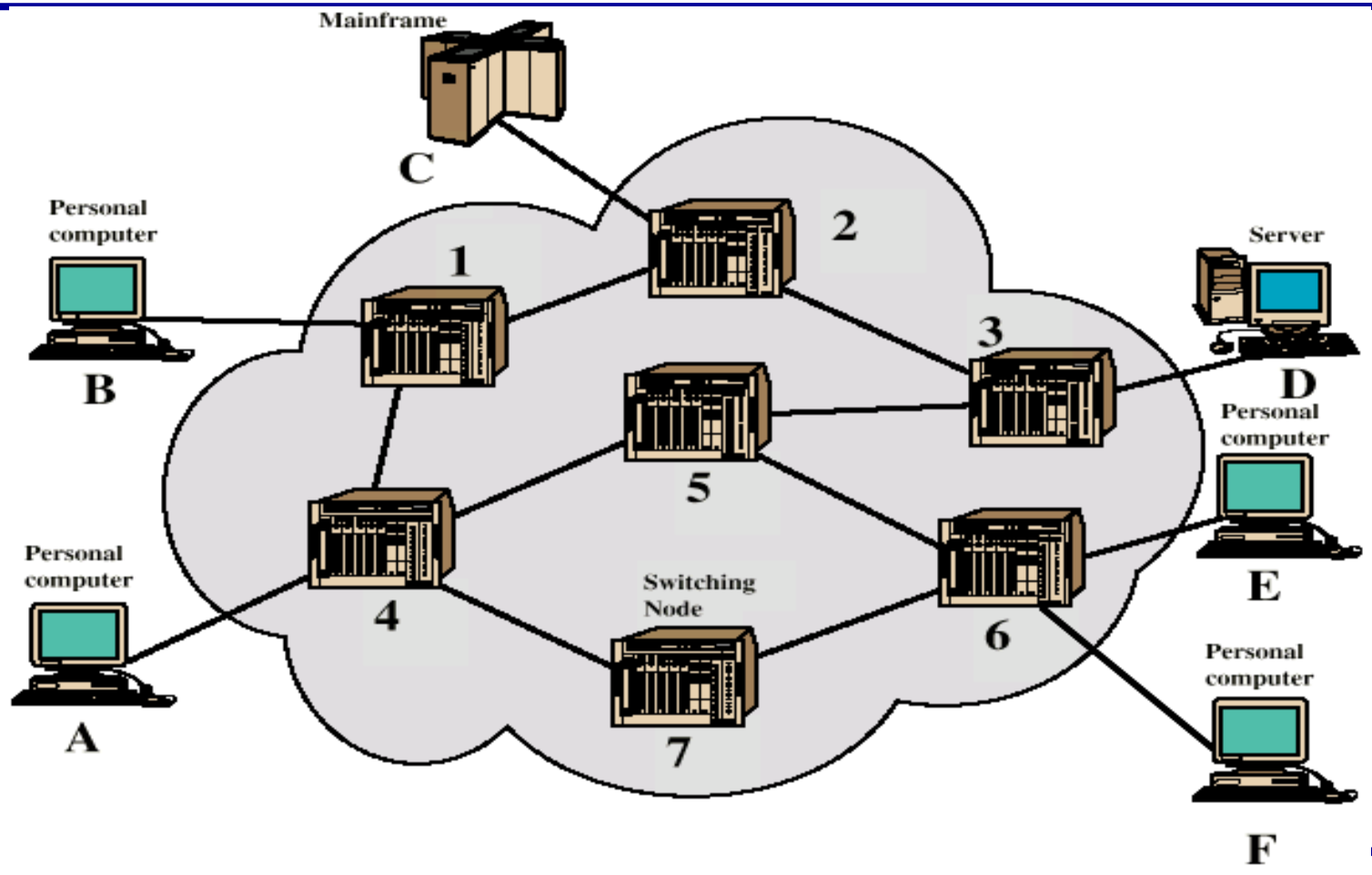
Nodes

- Nodes may connect to other nodes only, or to stations and other nodes
- Node to node links usually multiplexed
- Network is usually partially connected
  - Some redundant connections are desirable for reliability
- Two different switching technologies
  - Circuit switching
  - Packet switching

Switched Networks

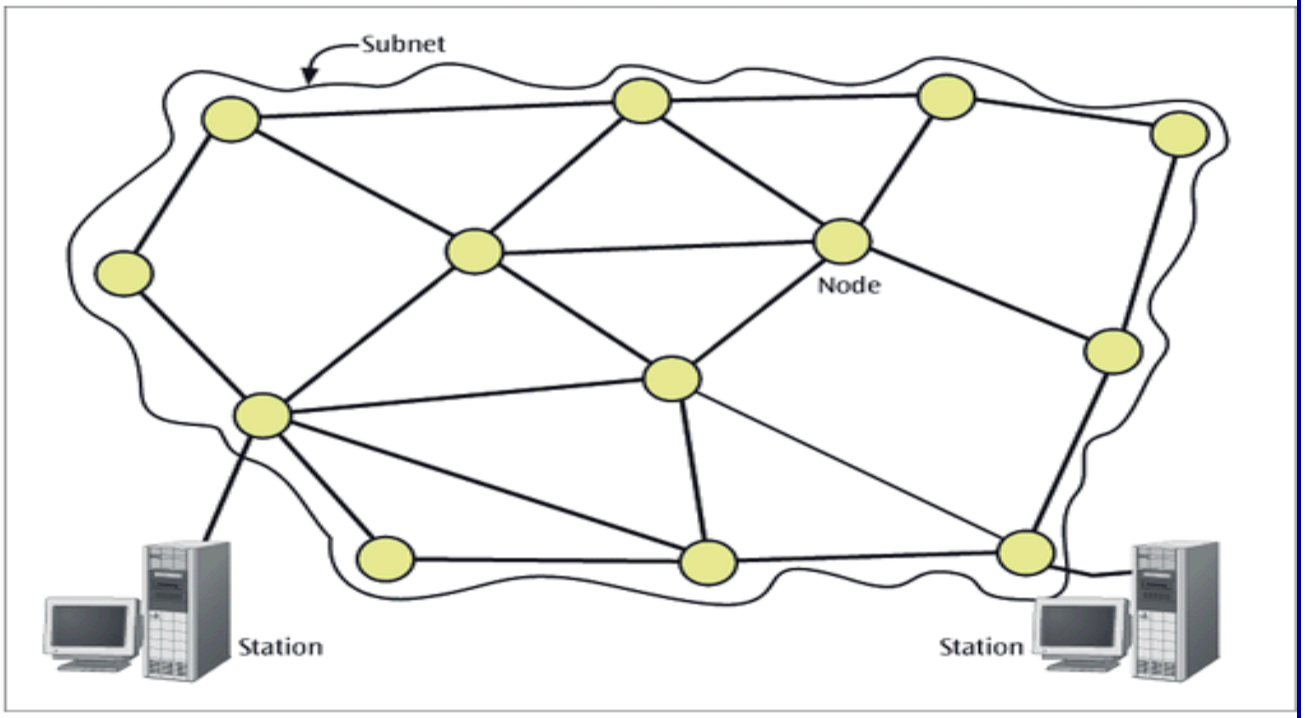


Simple Switched Network



Switched Network

Figure 10-5
Network subnet, nodes, and two end stations

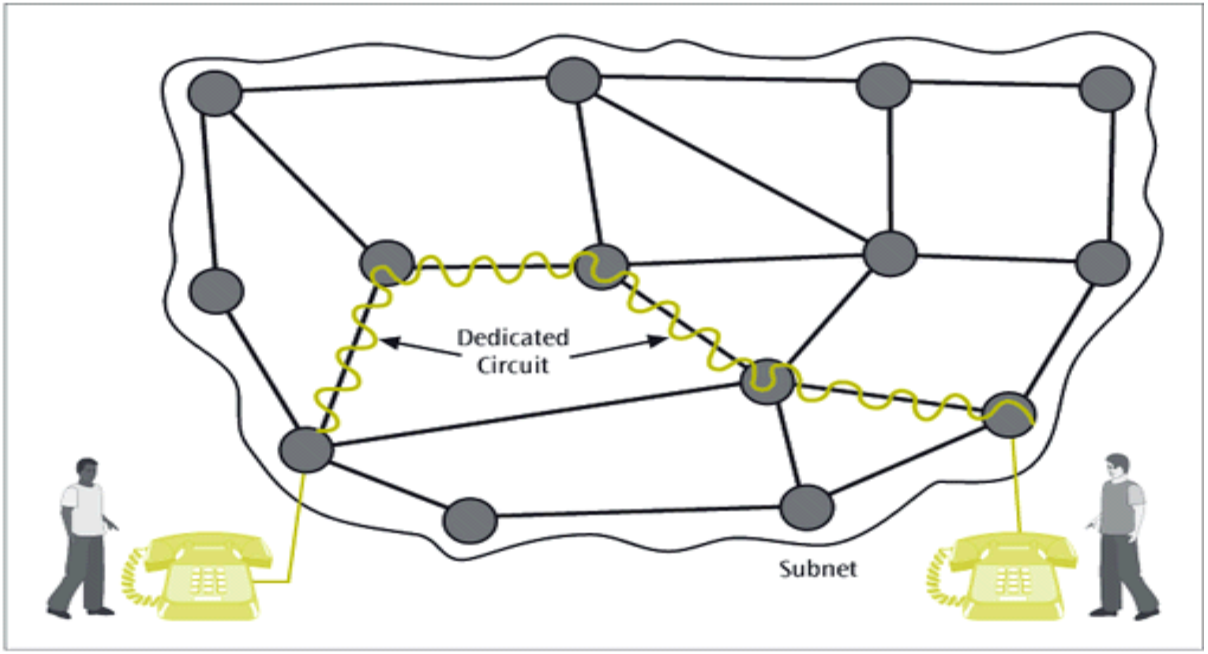


Circuit Switched Network

- Circuit switched network - a network in which a dedicated circuit is established between sender and receiver and all data passes over this circuit.
- The telephone system is a common example.
- The connection is dedicated until one party or another terminates the connection.

Circuit Switching

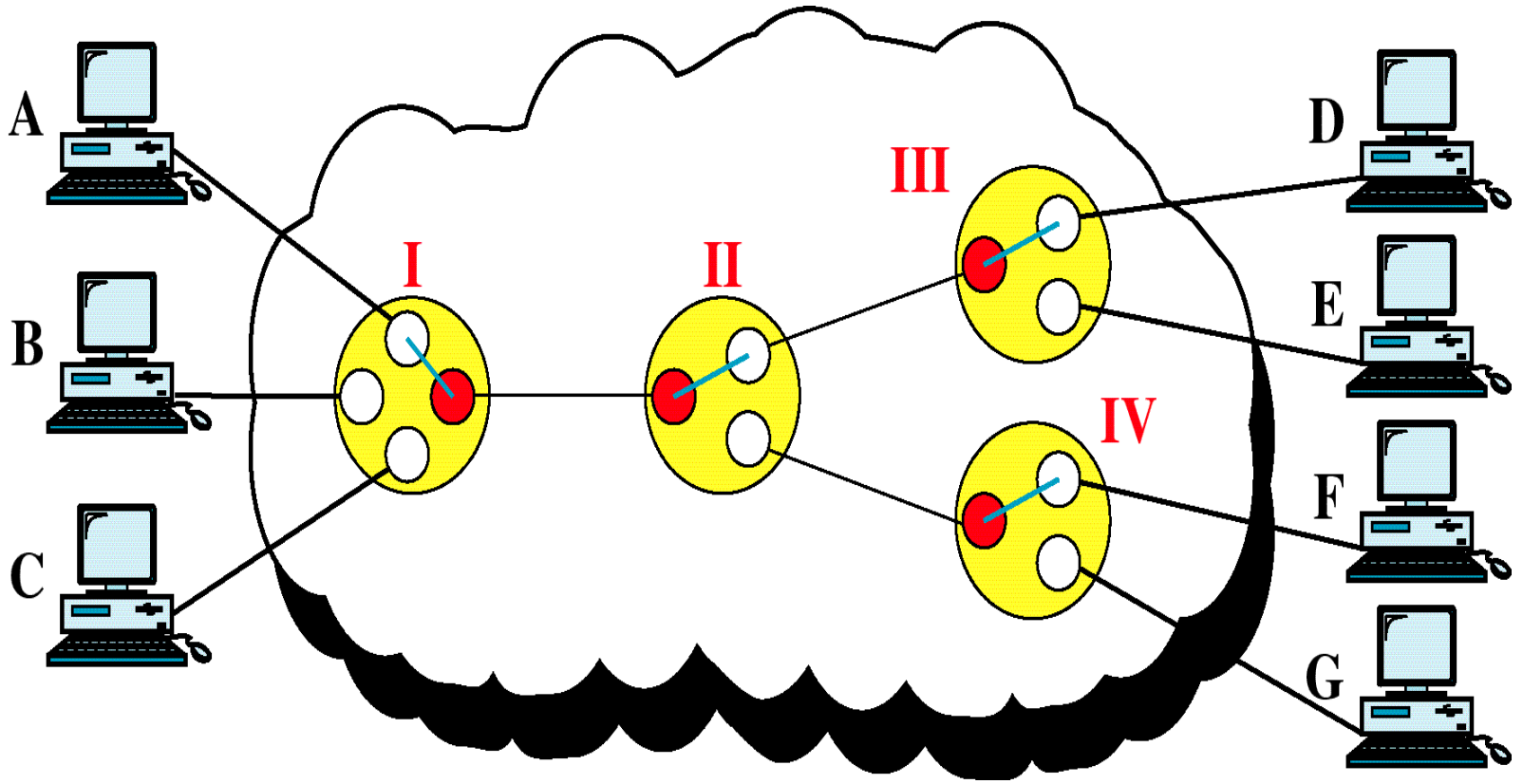
Figure 10-6
Two people carrying on a telephone conversation using a circuit-switched network



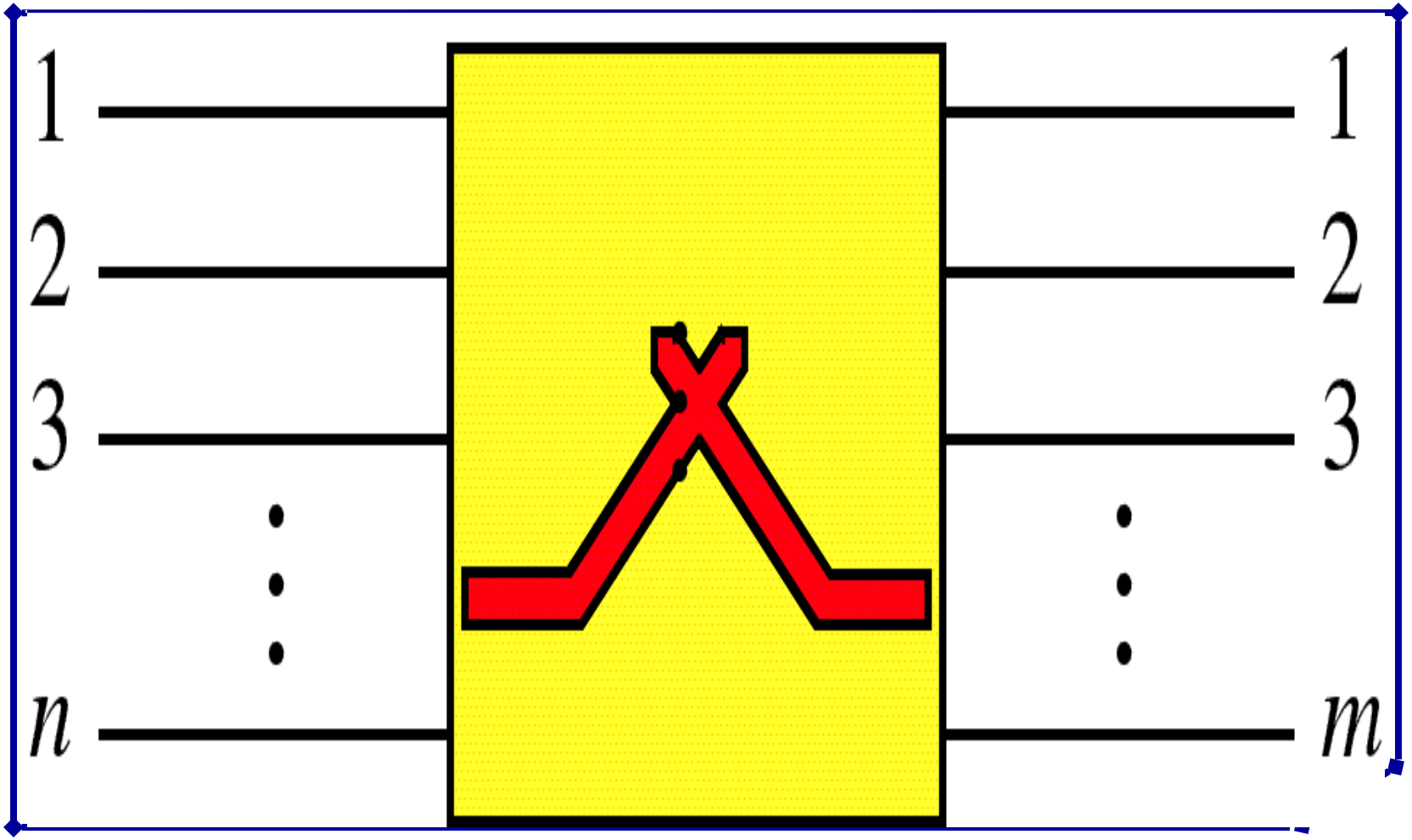
Circuit Switching

- 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

Circuit Switched Networks



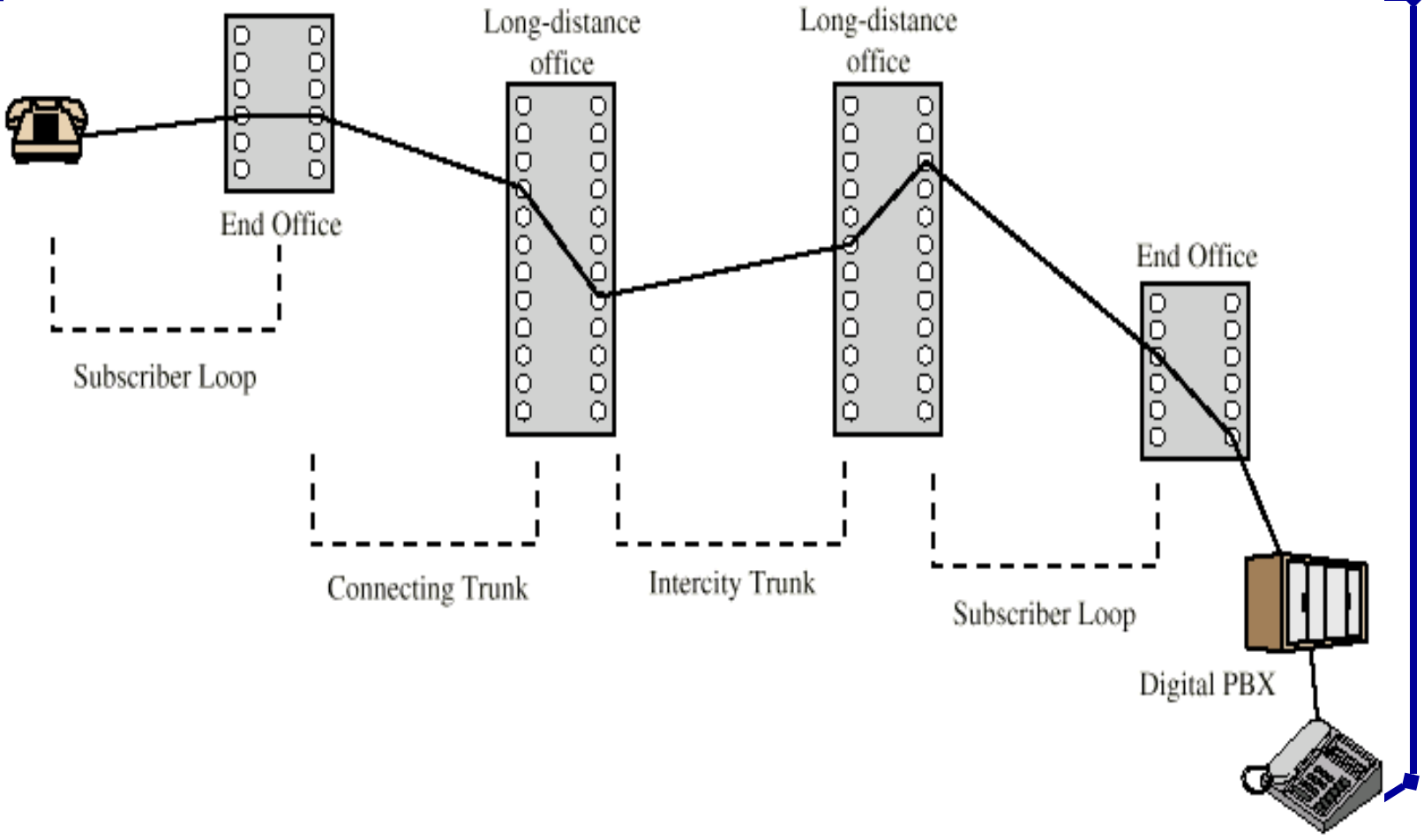
Switch



Circuit Switching Applications

- Inefficient
  - Channel capacity dedicated for duration of connection
  - If no data, capacity wasted
- Set up (connection) takes time
- Once connected, transfer is transparent
- Developed for voice traffic (phone)

Public Circuit Switched Network



Telecomm Components

- Subscriber
  - Devices attached to network
- Local Loop
  - Subscriber loop
  - Connection to network
- Exchange
  - Switching centers
  - End office - supports subscribers
- Trunks
  - Branches between exchanges
  - Multiplexed

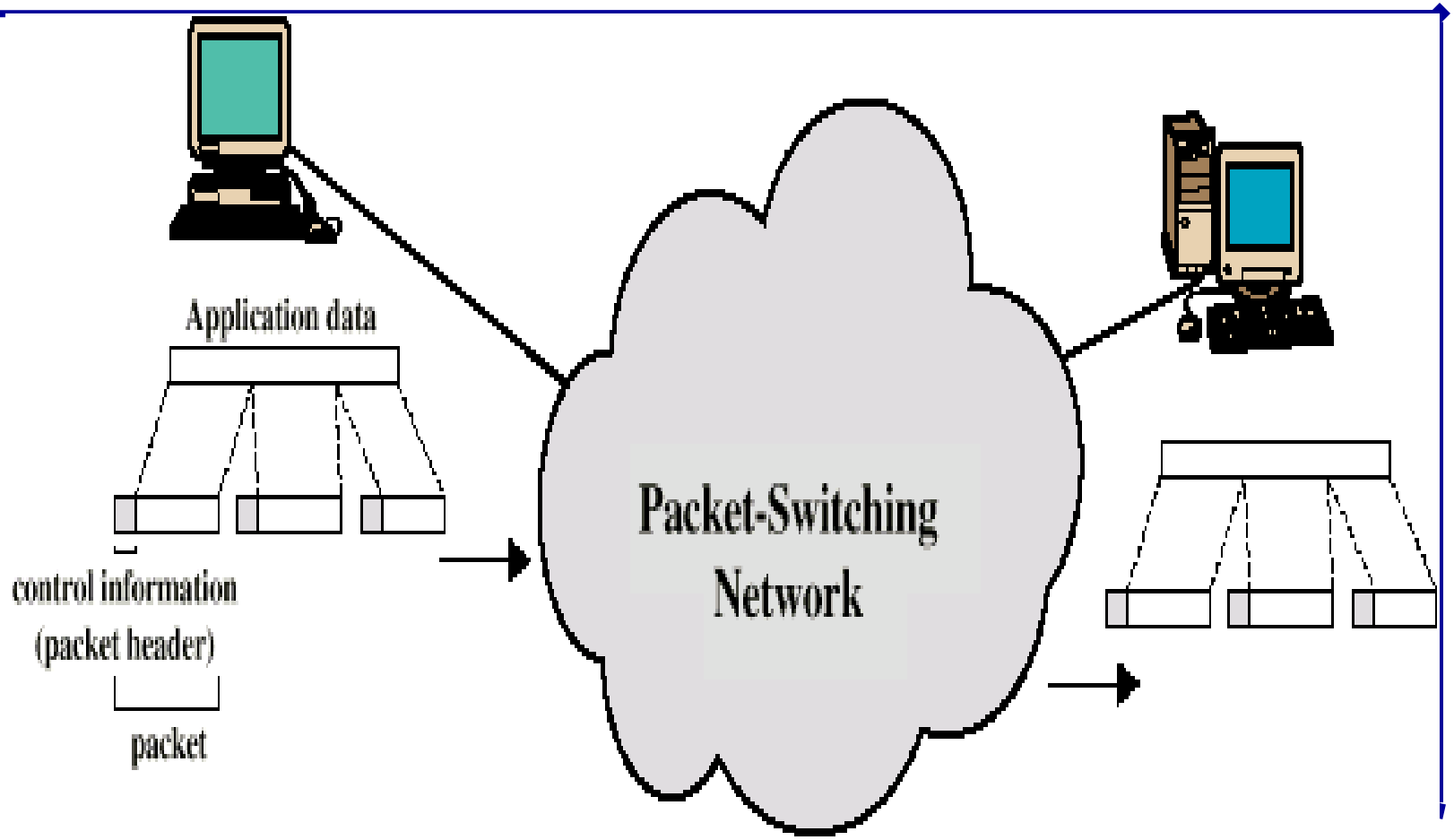
Shortcoming of Circuit Switching Technique

- Circuit switching designed for voice
  - Resources dedicated to a particular call
  - Inefficient approach (for data traffic)
    - Much of the time a data connection is idle
  - Constant Data rate
    - Both ends must operate at the same rate

Packet Switching

- Data transmitted in small packets
  - 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 past on to the next node
  - Store and forward

Use of Packets



Advantages

- 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

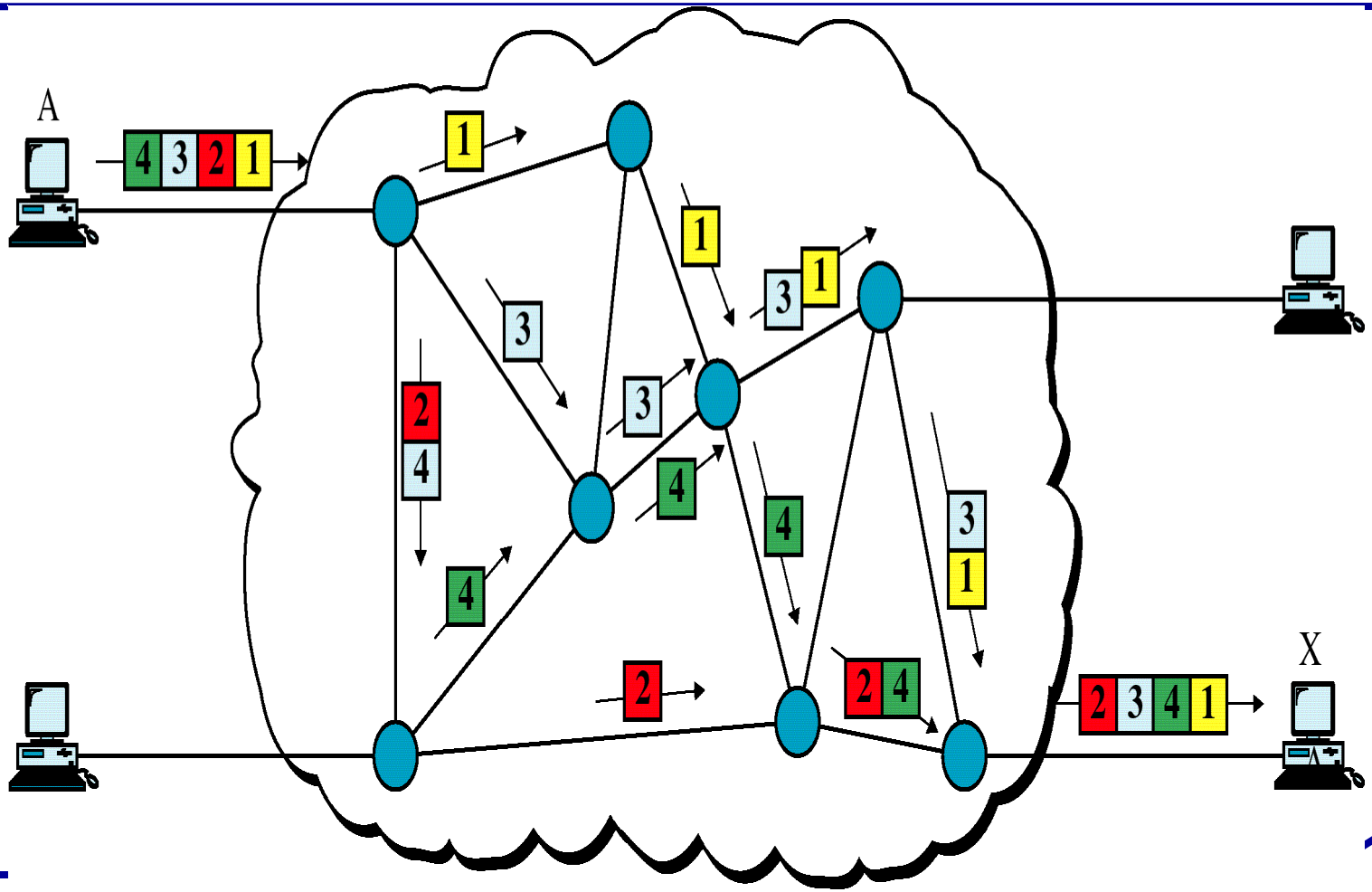
Switching Technique

- Packet switched network - a network in which all data messages are transmitted using short packages (typically size is not more than 1000 bytes), called packets.
- More efficient use of a telecommunications line since packets from multiple sources can share the medium.
- Station breaks long message into packets
- Packets sent one at a time to the network
- Packets handled in two ways
  - Datagram
  - Virtual circuit

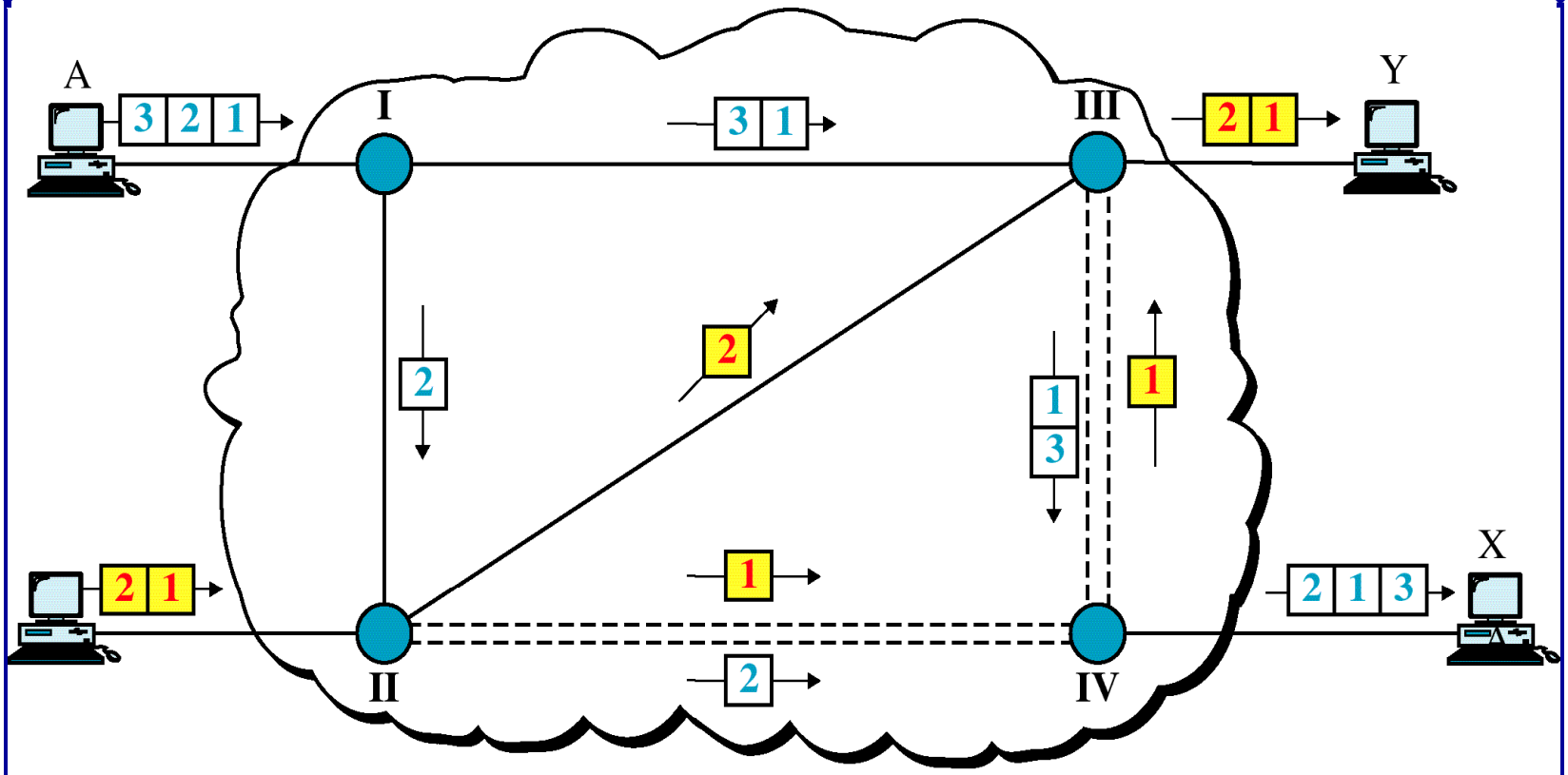
Datagram

- One form of packet switched network is the datagram. With a datagram, each packet is on its own and may follow its own path.
- Each packet treated independently
- Packets can take any practical route
- Packets may arrive out of order
- Packets may go missing
- Up to receiver to re-order packets and recover from missing packets

Datagram Approach



Datagram Approach



Virtual Circuit

- Virtual circuit packet switched network create a logical path through the subnet and all packets from one connection follow this path.
- 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

Virtual Circuits vs. Datagram

- Virtual Circuits Approach
  - Network can provide sequencing and error control
  - Packets are forwarded more quickly
    - No routing decisions to make
  - Less reliable
    - Loss of a node looses all circuits through that node
- Datagram Approach
  - No call setup phase
    - Better if few packets
  - More flexible
    - Routing can be used to avoid congested parts of the network
  - More reliable
    - If a node fails, subsequent packets may find an alternate route that bypass that node

Circuit Switching vs. Virtual Circuits

- Path
  - A dedicated path is established between two devices for the duration of session.
- Reserved Resources
  - The link (multiplexed / not multiplexed) that makes the path are dedicated, and cannot be used by other connections
- The entire information is to be transmitted at a constant data rate.

- Route
  - No dedicated path is established. Only a route is defined. Each switch creates an entry in its routing table for the duration of virtual circuit
- Shared Links
  - The link that makes a route can be shard by other connections
- Each packet follows the same route to reach the destination