Point-to-Point Network Switching

Computer Networks
Term A15

Network Switching Outline

- Circuit Switching, Message Switching, Packet Switching, Cell Switching
- Connection-Oriented versus Connectionless Protocols
- Virtual Circuit versus Datagram Networks
- External/Internal Subnet Abstractions

Circuit Switching

- Seeking out and establishing a physical copper path from end-to-end [historic definition] .
- Circuit switching implies the need to first set up a dedicated, end-to-end path for the connection before the information transfer takes place.
- Once the connection is made, the only delay is propagation time.

Circuit Switching

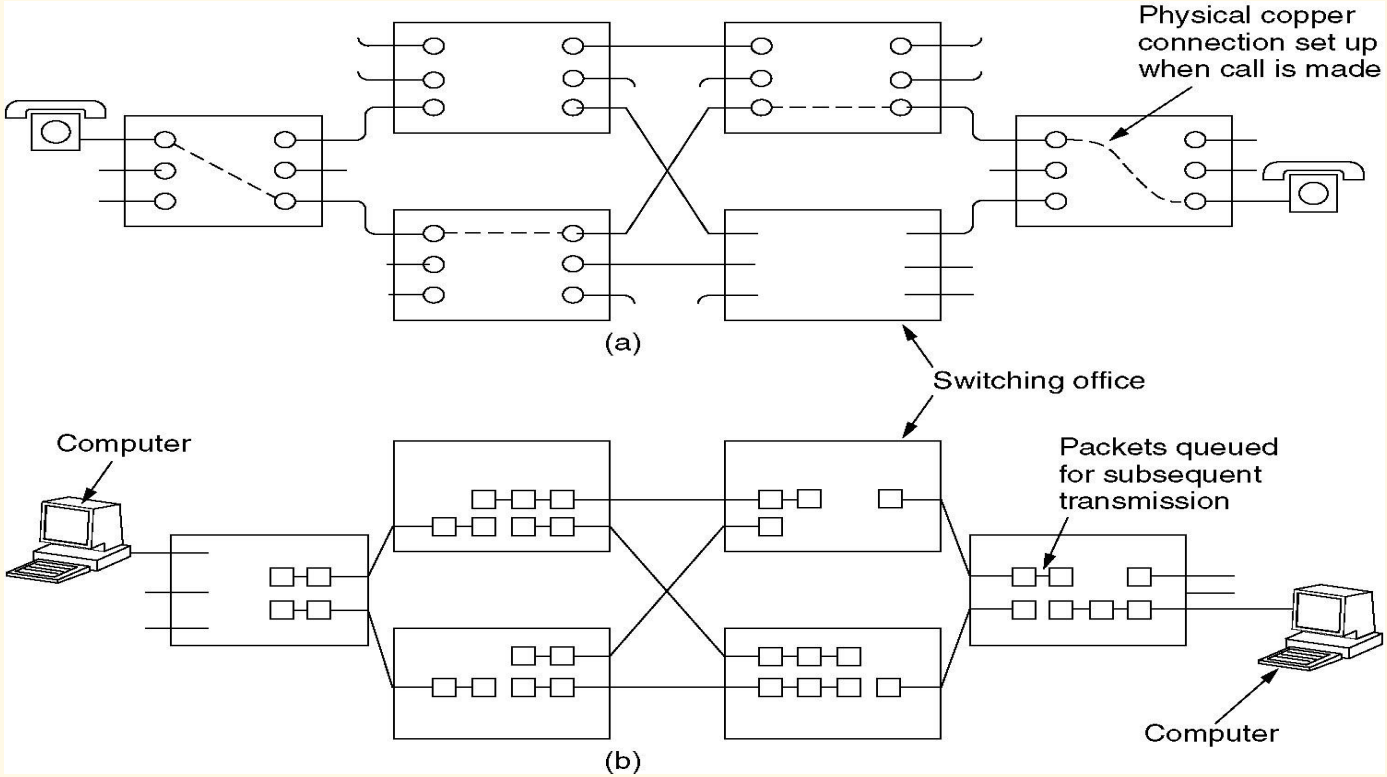

Figure 2-38. (a) Circuit switching. (b) Packet switching.

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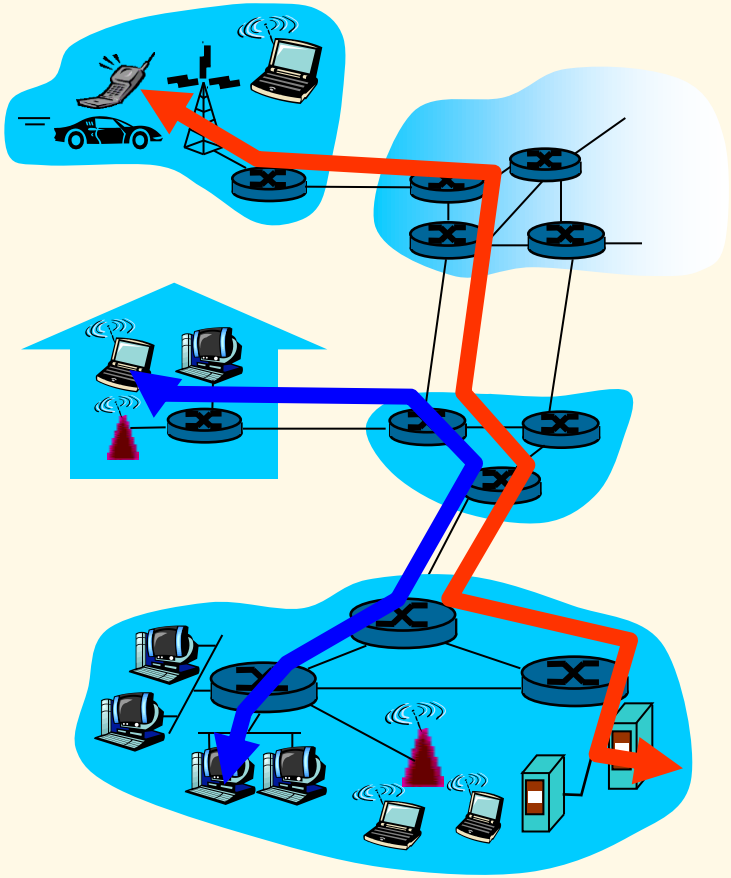
Network Core: Circuit Switching

End-end resources reserved for "call"

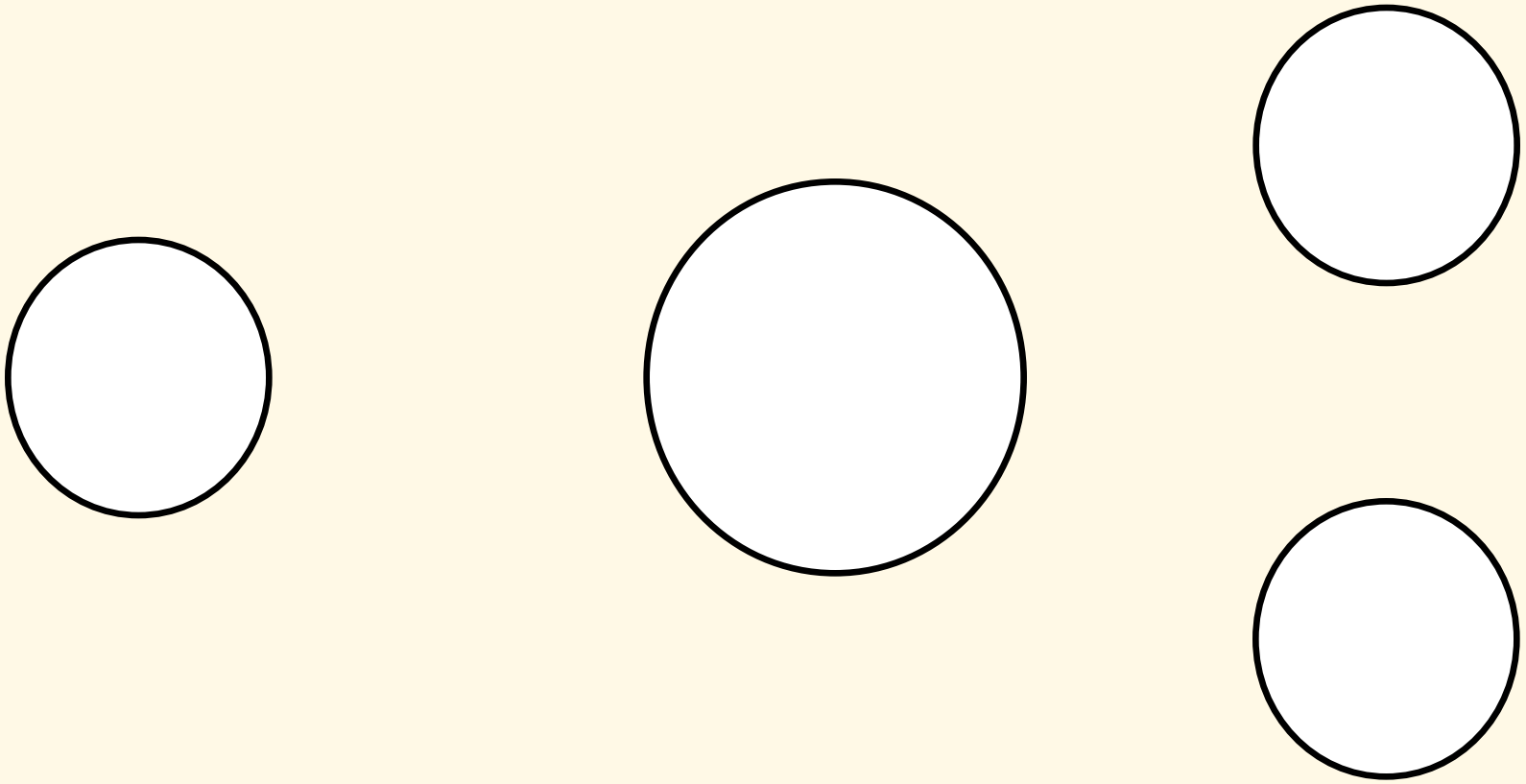
- link capacity, router buffer space
- dedicated resources: no sharing
- circuit-like (guaranteed) performance
- call setup required



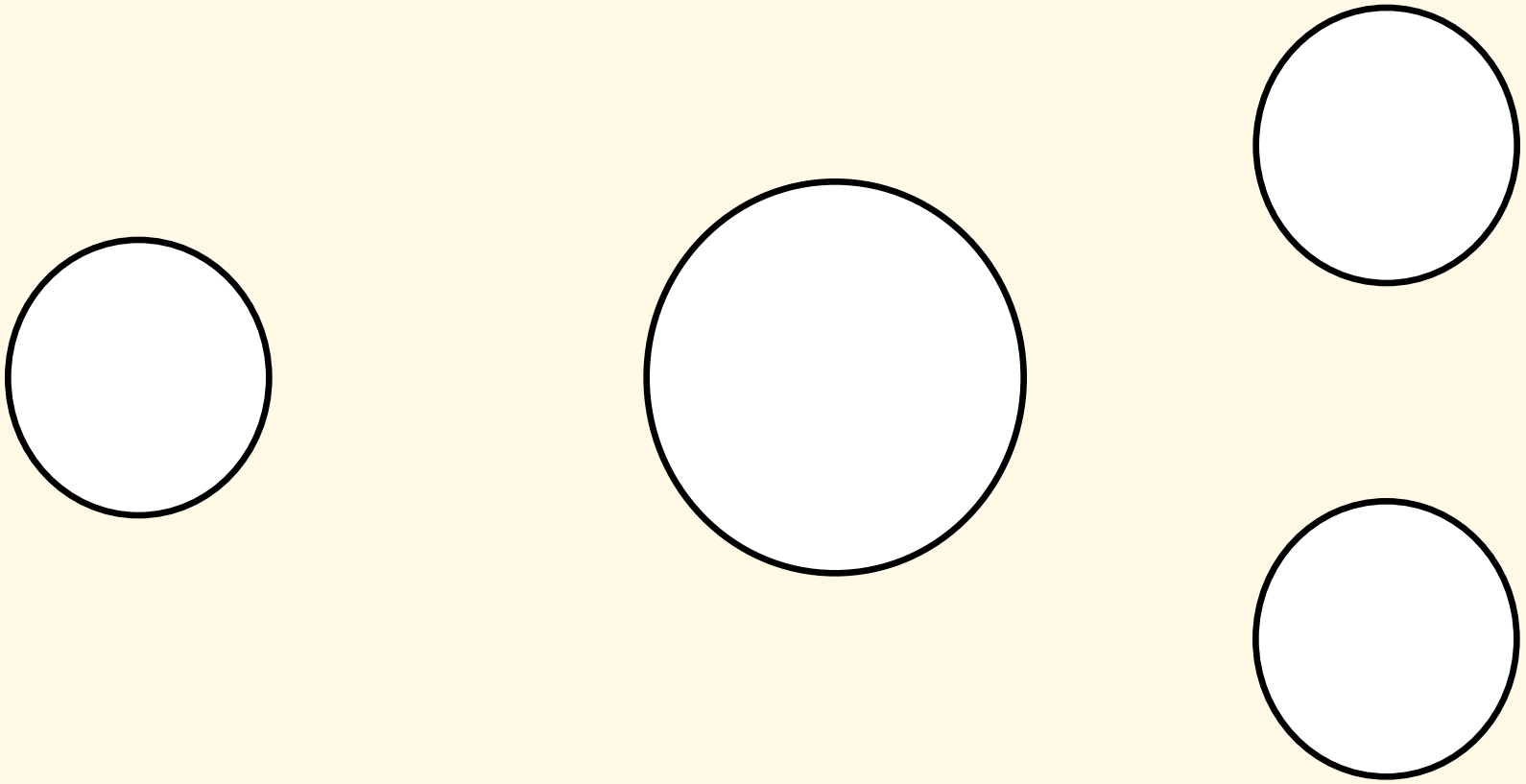
Store-and-Forward Networks

- Intermediate processors (IMPS, nodes, routers, gateways, switches) along the path store the incoming block of data.
- Each block is received in its entirety at the router, inspected for errors, and retransmitted along the path to the destination.
- This implies buffering at the router and one transmission time per hop.

Store-and-Forward Routers



'Cut Through' Routers



Message Switching

- A store-and-forward network where the block of transfer is a complete *message*.

- Since messages can be quite large, this can cause:
  - buffering problems at the router.
  - high mean delay times.

Packet Switching

- A store-and-forward network where the block of transfer is a complete packet**.

- A packet is a variable length block of data with a fixed upper bound.

**Using packets improves mean message delay.

Cell Switching

53 bytes

- A network where the unit of transfer is a small, fixed-size block of data (i.e., a cell).
- ATM (Asynchronous Transfer Mode) networks use 53-byte cells.

Packet Switched Networks

Connection-Oriented Protocols

- A setup stage is used to determine the end-to-end path before a connection is established.
- Data flow streams are identified by some type of connection indicator (e.g. OSI, X.25, SNA, ATM).

Connection-Oriented Virtual Circuits

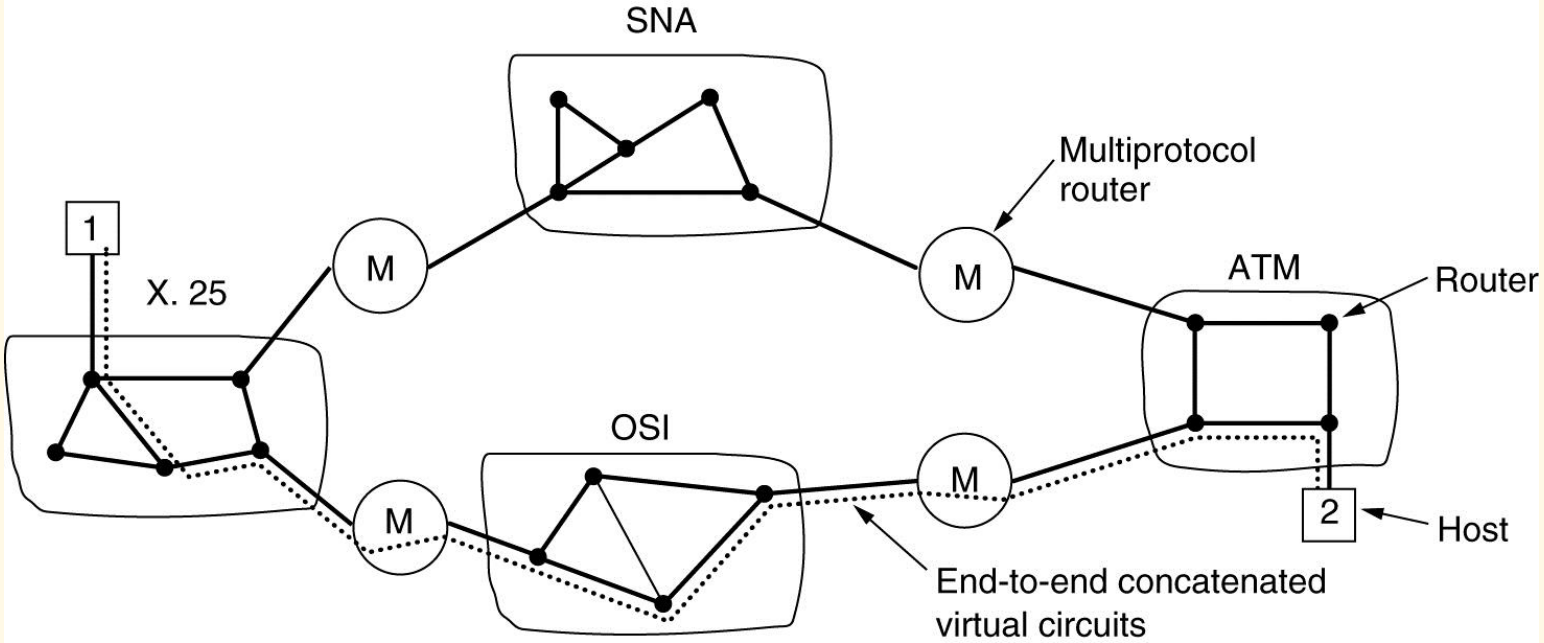


Figure 5-45.Internetworking using concatenated virtual circuits.

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Packet Switched Networks

Connectionless Protocols

- No set up is needed.
- Each packet contains information which allows the packet to be individually routed hop-by-hop through the network.
- Bifurcated and adaptive routing techniques are possible.

Connectionless Internetworking

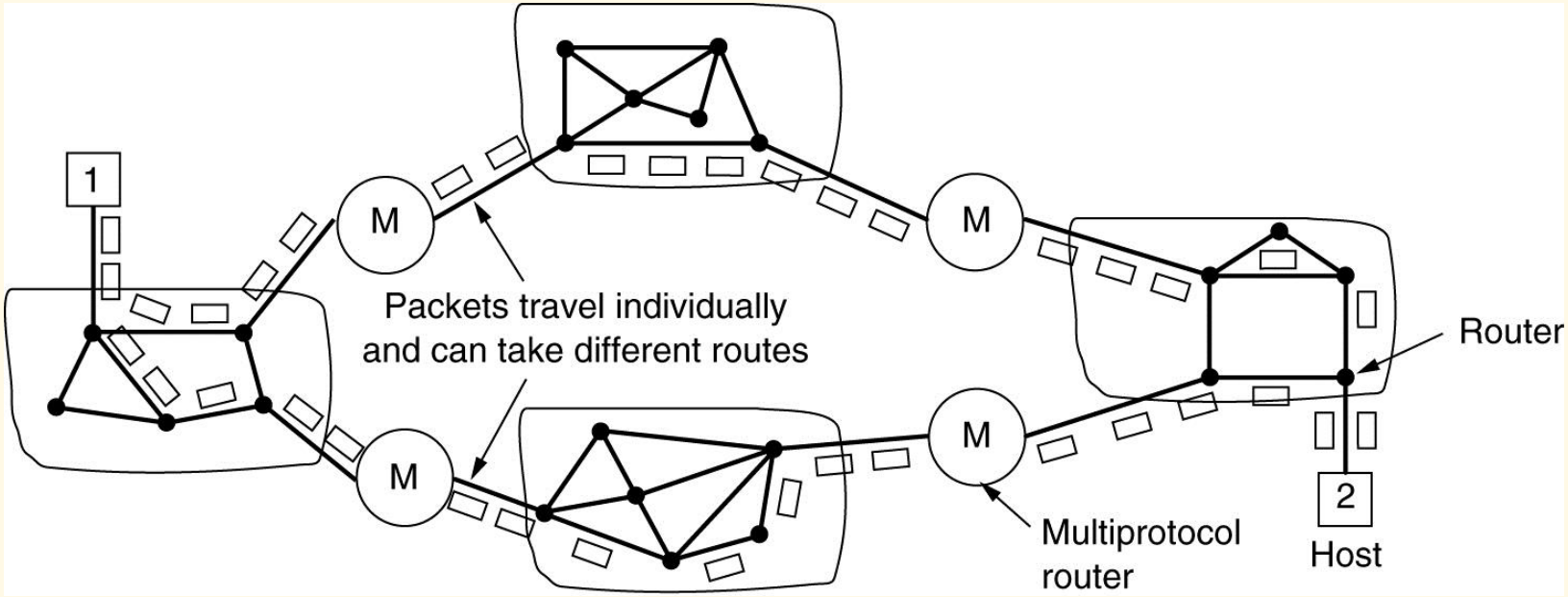

Figure 5-46. A connectionless internet.

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Datagram vs Virtual Circuit

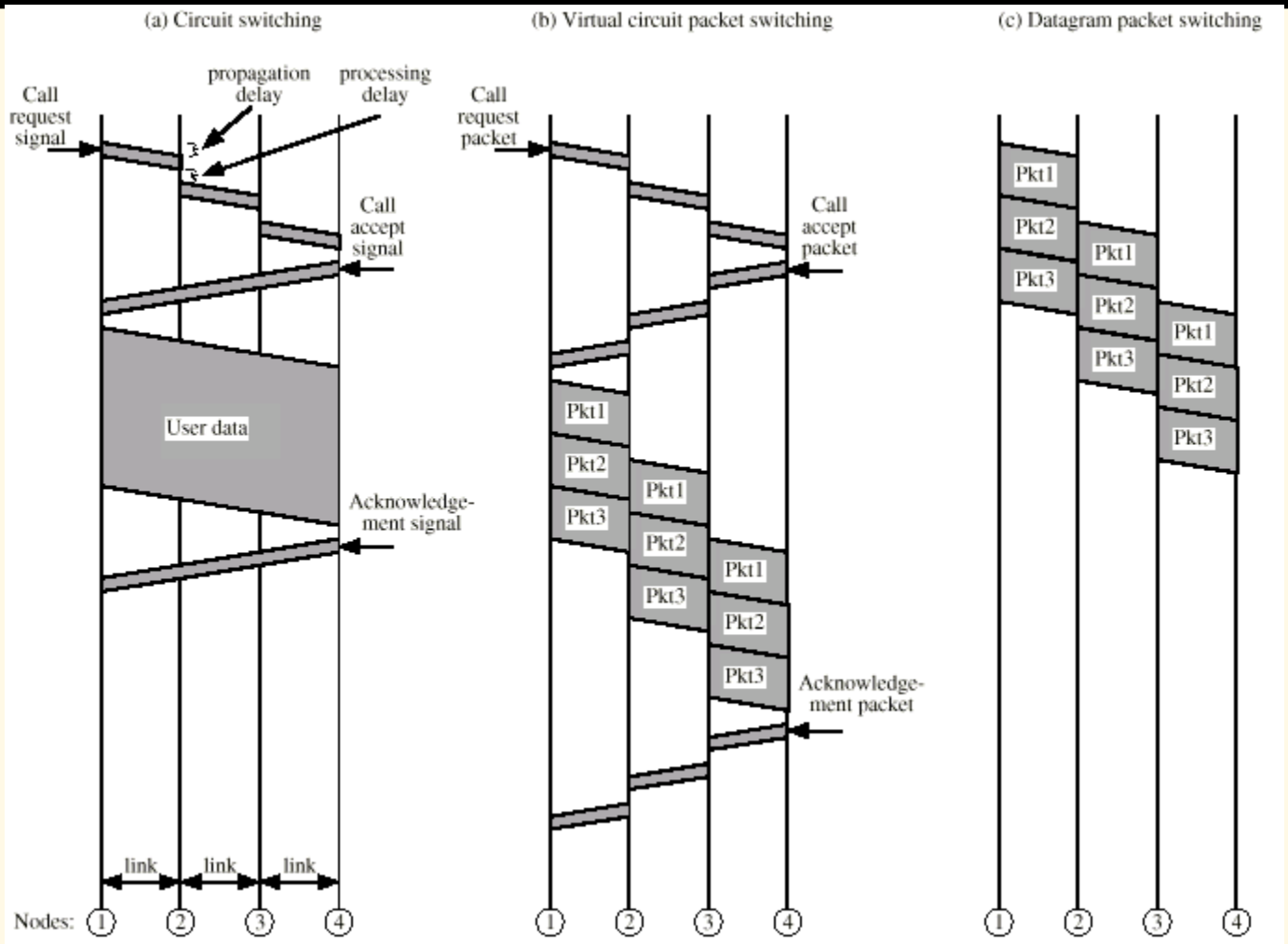
Datagram Routing

- Each datagram packet may be individually routed.

Virtual Circuit Routing

- In virtual circuit, set up is required.
- All packets in a virtual circuit follow the same path through the network.

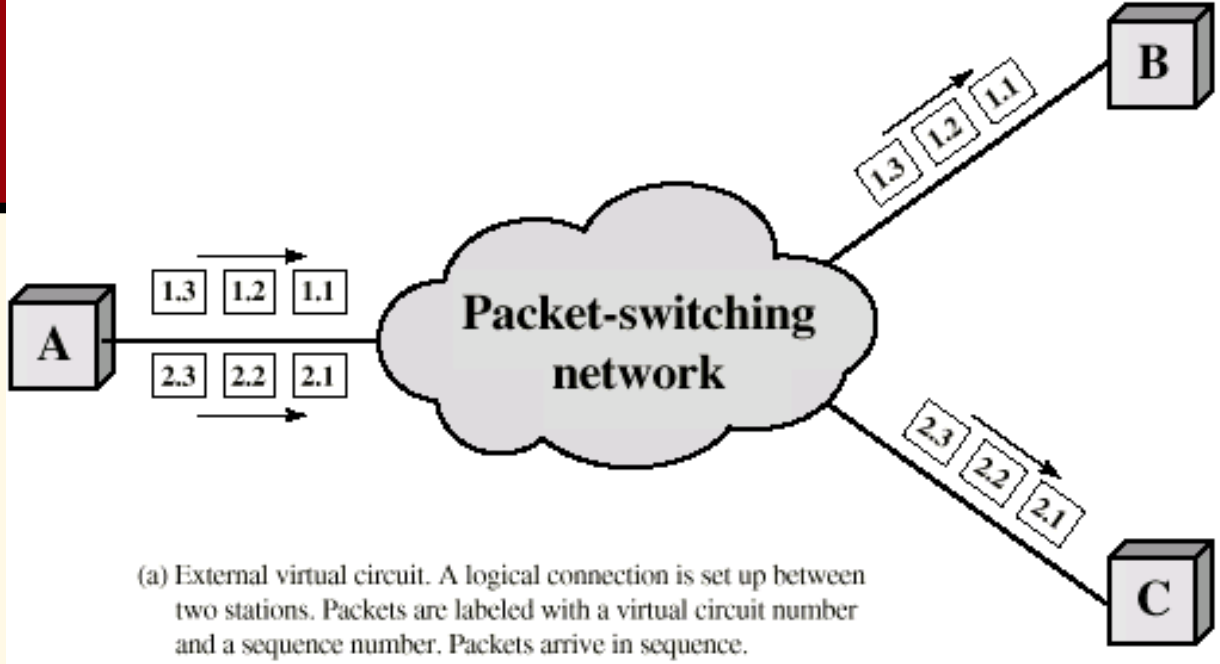
Transmission Event Timing



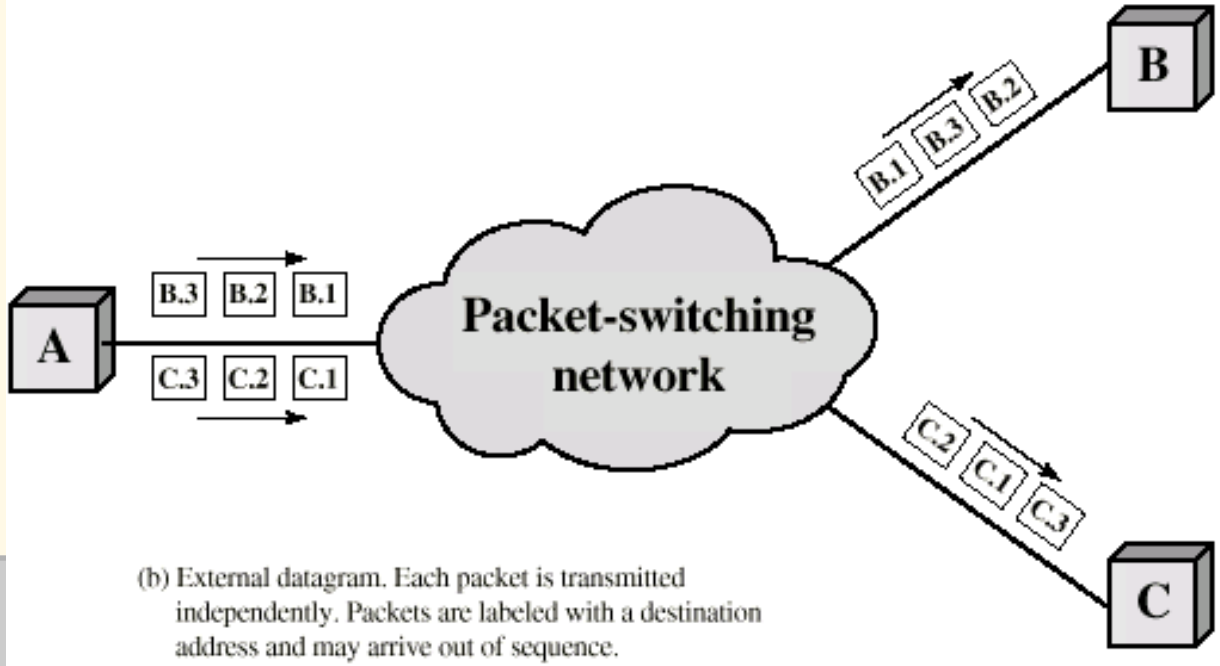
DCC 6th Ed., W. Stallings, Figure 10.3

External

Virtual Circuit And Datagram Operation



(a) External virtual circuit. A logical connection is set up between two stations. Packets are labeled with a virtual circuit number and a sequence number. Packets arrive in sequence.

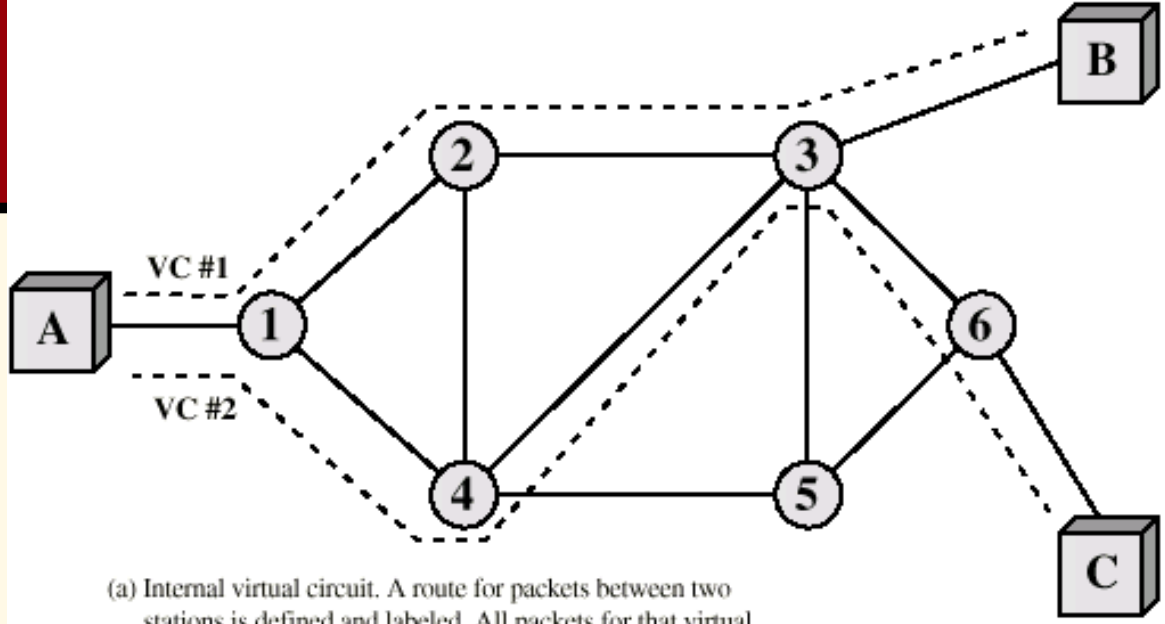


(b) External datagram. Each packet is transmitted independently. Packets are labeled with a destination address and may arrive out of sequence.

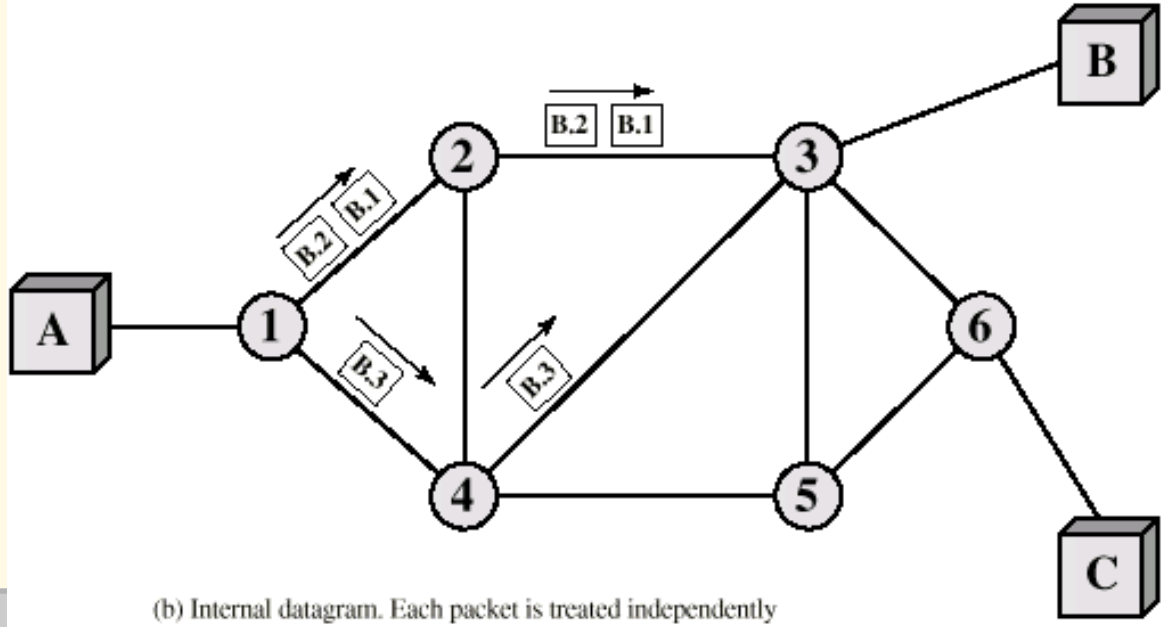
DCC 6th Ed., W. Stallings, Figure 10.4

Internal

Virtual Circuit And Datagram Operation



(a) Internal virtual circuit. A route for packets between two stations is defined and labeled. All packets for that virtual circuit follow the same route and arrive in the same sequence.



(b) Internal datagram. Each packet is treated independently by the network. Packets are labeled with a destination address and may arrive at the destination node out of sequence.

DCC 6th Ed., W. Stallings, Figure 10.5

WPI

Networking Switching Summary

- Circuit-switching and message switching are now obsolete!!
- Store-and- forward, datagram packet switching (IP routers) dominates the Internet.
- Cell switching and virtual circuits (ATM switches) still exists in ATM networks.
- The external protocol abstraction to the subnet may differ from the internal subnet view.
  - e.g. TCP is connection-oriented protocol that runs on top of a datagram IP protocol.