Computer Networks

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Switching

- Circuit Switching
- Packet Switching

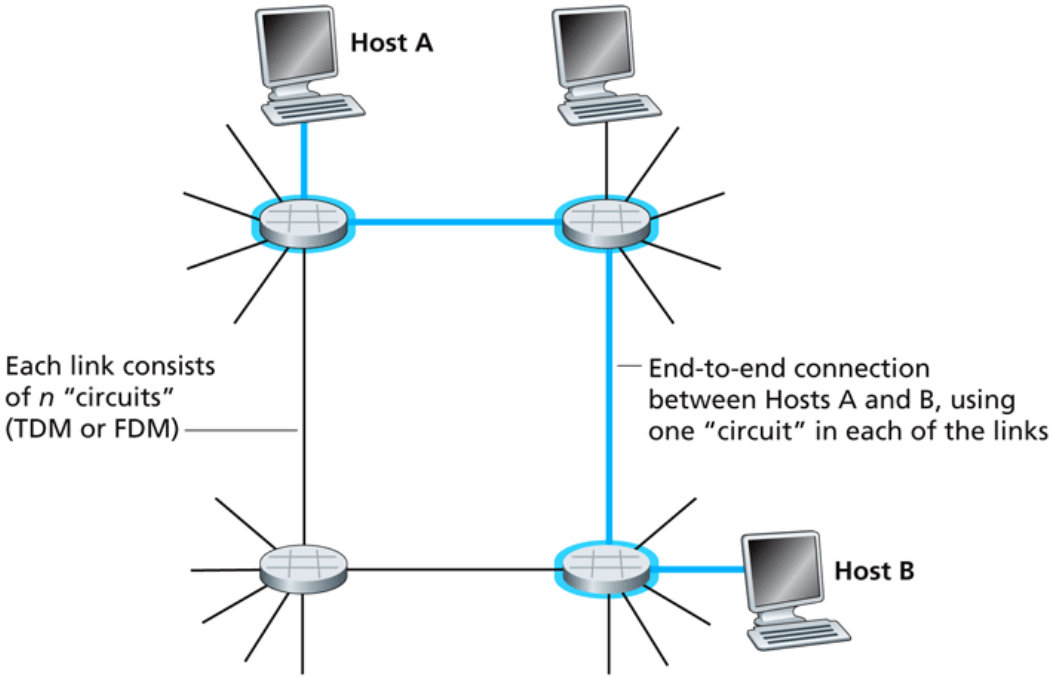


Figure 1.8 ♦ A simple circuit-switched network consisting of four switches and four links

Circuit Switching

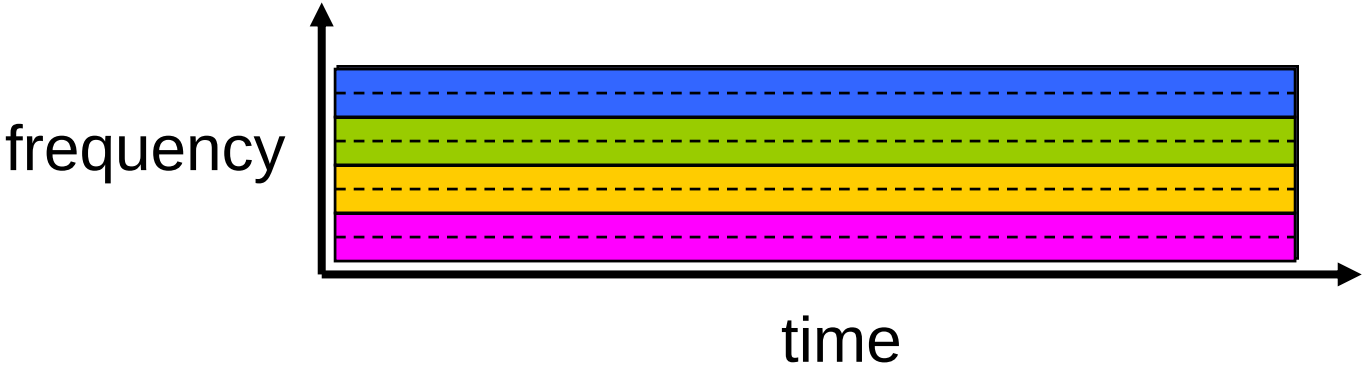
- Reserved resources
- Multiplexing
  - Frequency Division Multiplexing (FDM)
  - Time Division Multiplexing (TDM)
- Transmission Rate

Multiplexing Examples

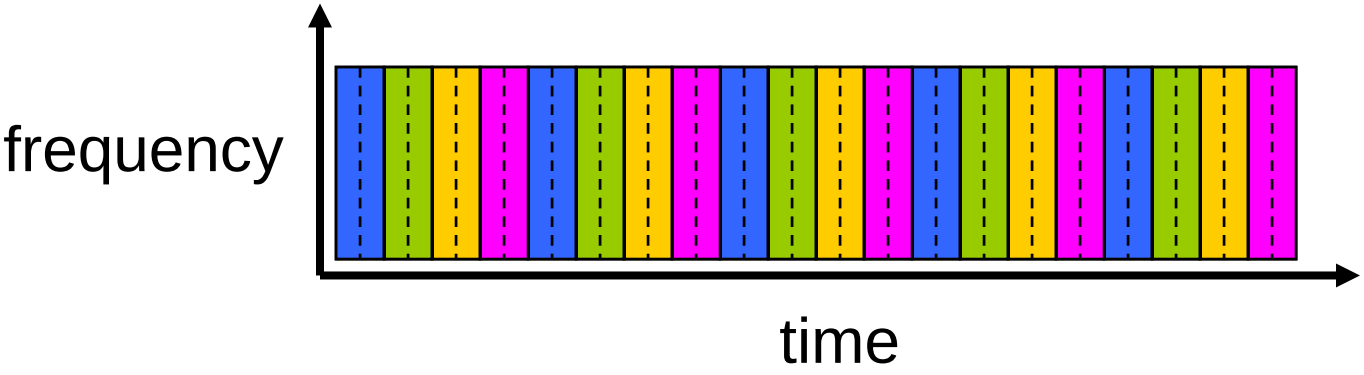
Example:

4 users

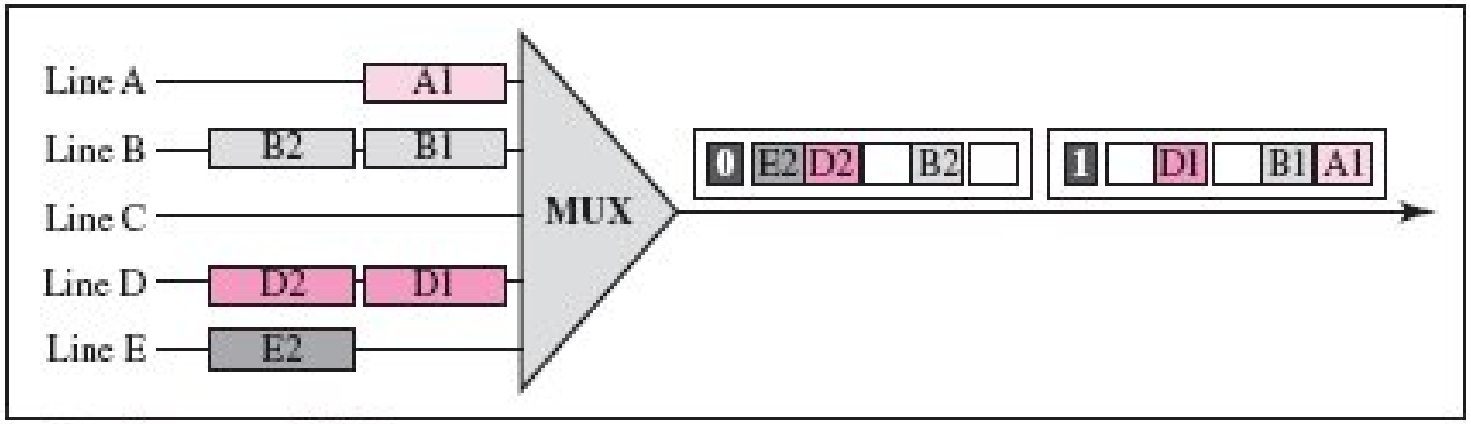
FDM



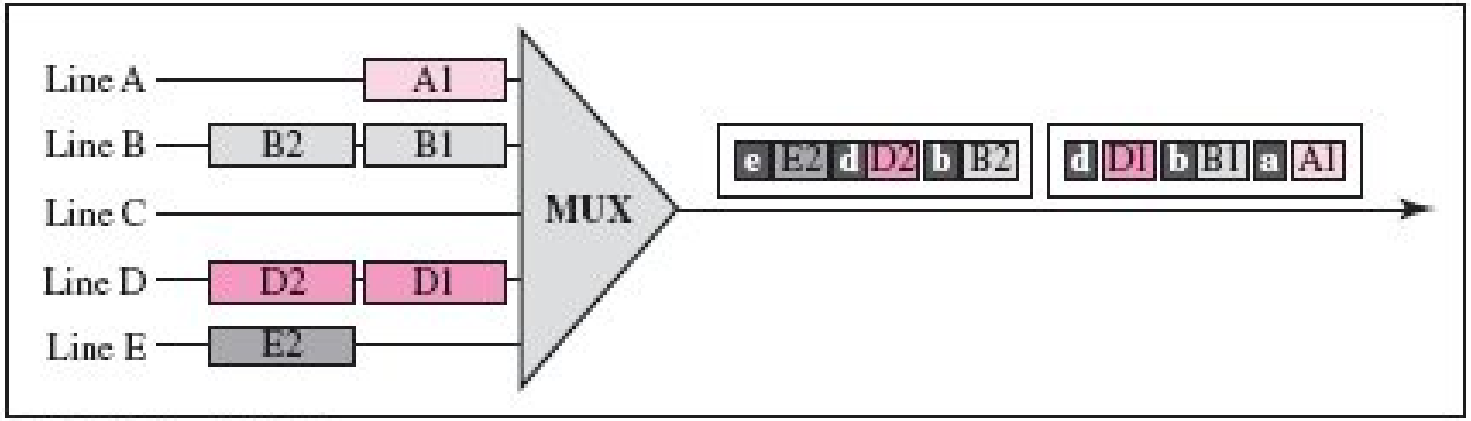
TDM



Statistical Multiplexing



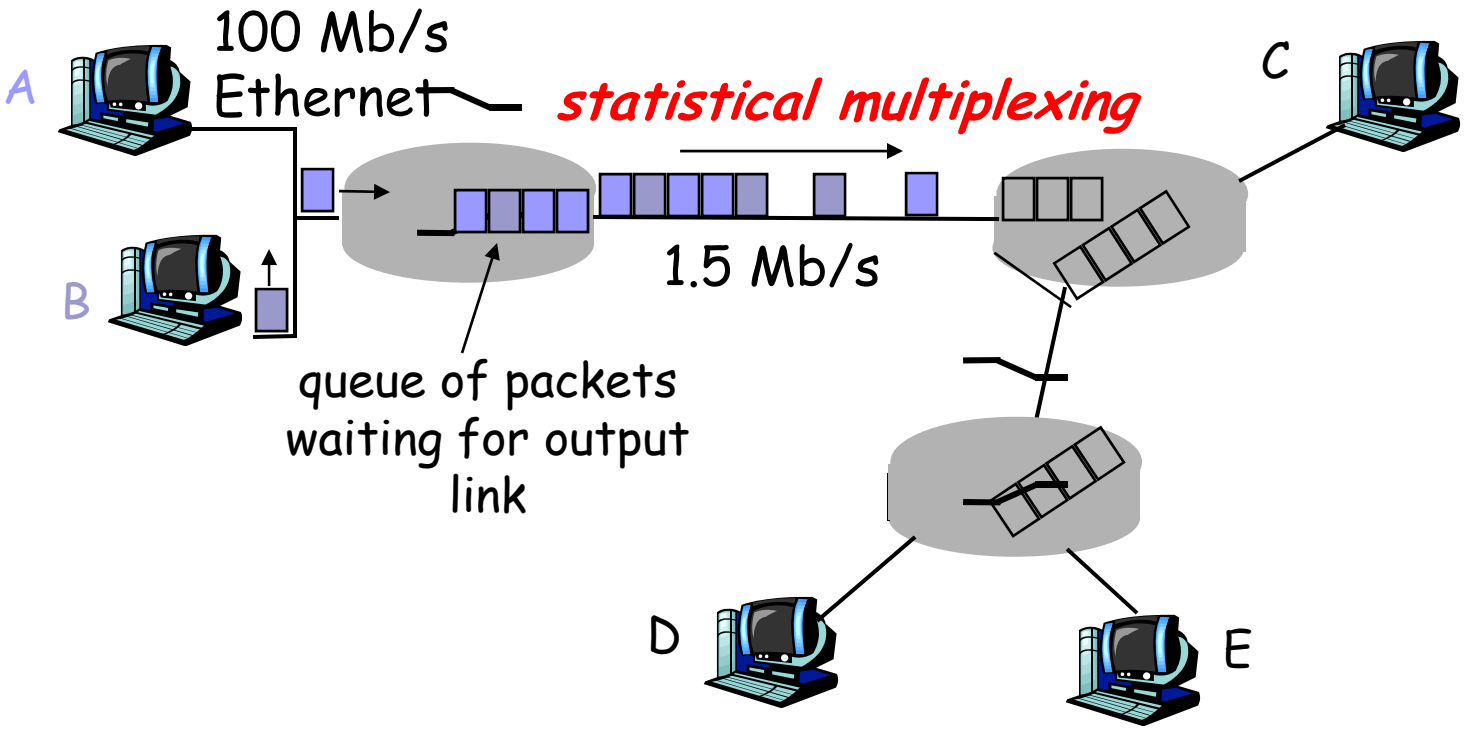
a. Synchronous TDM



b. Statistical TDM

Circuit Switching Example

- Send a file of 640 Kbits from host A to host B
- All of the links in the network:
  - TDM with 24 slots
  - Bit rate of 1.536 Mbits
- It takes 500 Msec to establish an end-to-end link before A can transmit to B
- How long does it take to send the file?



Sequence of A & B packets does not have fixed pattern, bandwidth shared on demand ➔ ***statistical multiplexing***.

Packet Switching

- Unreserved Resources
- Store and Forward Transmission
- Queuing Delays
- Packet Loss
- Message Switching

Packet Switching vs. Circuit Switching

- Real-time Services
- Better bandwidth
- Simpler, more efficient, less costly

Packet Switching Efficiency

- Uses share 1 Mbps link
- Users are active 10% of the time

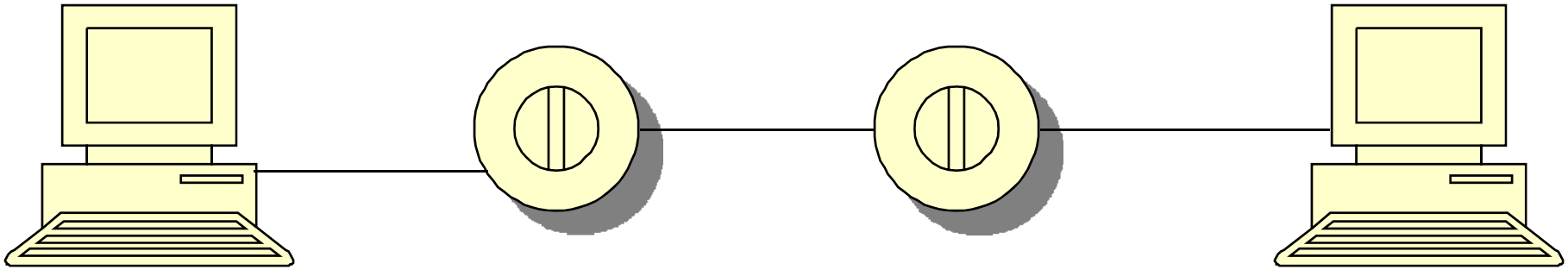
- How many simultaneous users can each type support?

- Suppose that all of the network resources send data at a constant bit rate. Would packet-switching or circuit-switching be more desirable in this case?
  1. Circuit-switching
  2. Packet-switching

- Suppose that all of the network sources are bursty – that they only occasionally have data to send. Would packet-switching or circuit-switching be more desirable in this case?
  1. Circuit-switching
  2. Packet-switching

- What advantage does a circuit-switched network have over a packet-switched network?
  1. Less overhead
  2. More efficient
  3. Bandwidth guarantees

Packet Switching vs. Message Switching



Message Switching: 15 seconds

Packet Switching: 5.002 seconds

Routing in Data Networks

- Virtual Circuit Network
  - Routes packets according to virtual circuit numbers
- Datagram Network
  - Routes packets according to host destination addresses

Virtual Circuit Components

- Path between source and destination
- Virtual circuit numbers
- Entries in a Virtual-circuit number translation table

Datagram Networks

- Uses addresses similar to postal services.
- Hierarchical structure.
- Packet switch contains routing table.
- No connection-state information is maintained.

Fitting it all Together