Packet Switching

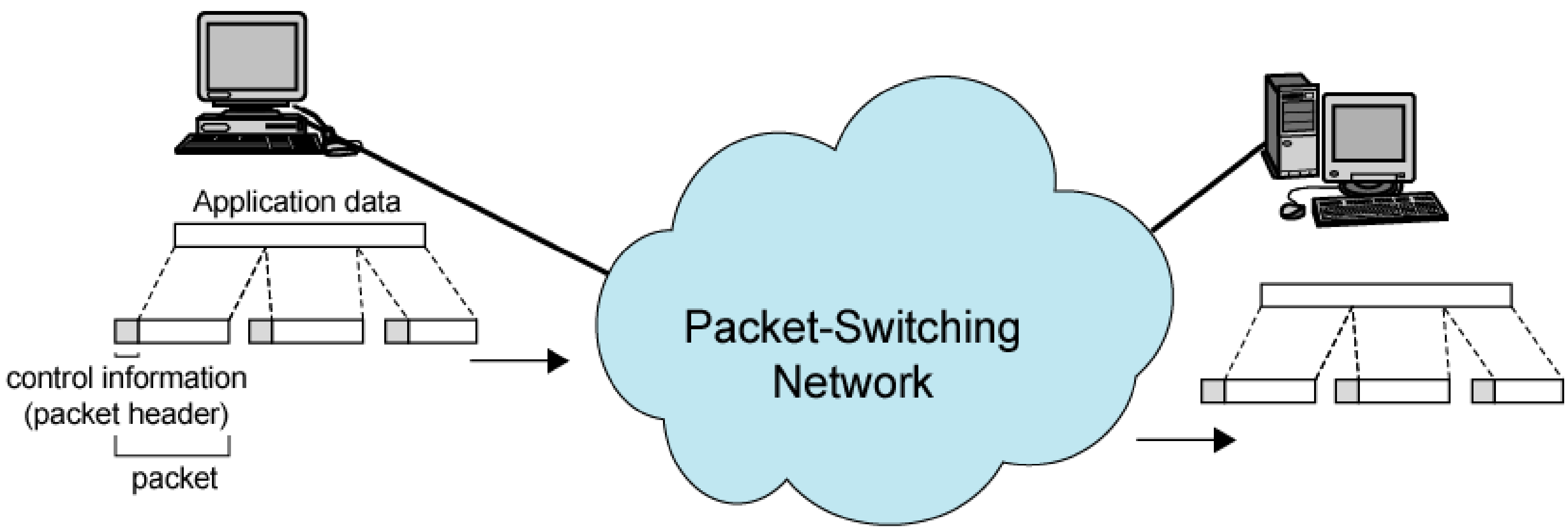
Communication via Packet Switching

(1) **message segmentation**

- longer message is broken up into series of packets
- packets contain user's data + control data
- control data (header) contains information that network requires to route the packet

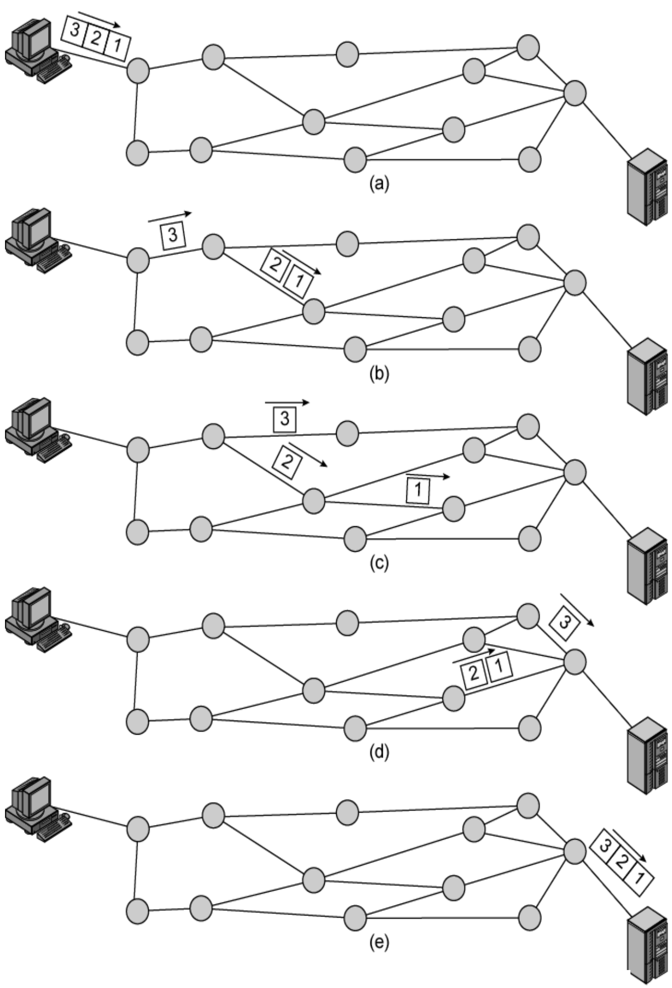
(2) **data transfer = packet switching**

- intermediate nodes perform following operations:
  (a) receive entire packet & queue in input buffer
  (b) determine next node and link using routing tables
  (c) transmit packet over the best outgoing link



Packet Switching (cont.)

Further Details of Packet Switching



– each packet is treated independently with no reference to packets that have gone before!

- each packet contains the full (IP) address its destination as well as its source
- each packet switch has a forwarding (routing) table that maps destination addresses to an output link
- when packet arrives at a packet switch, the switch examines packet's destination address and chooses the next node on packet's path based on current traffic, line failure, etc.
- packets with the same destination address do not necessarily follow the same route
  ⇒ packets may arrive out of sequence at the destination !
- if packets arrive out of order, resequencing must be performed at the destination

Packet Switching (cont.)

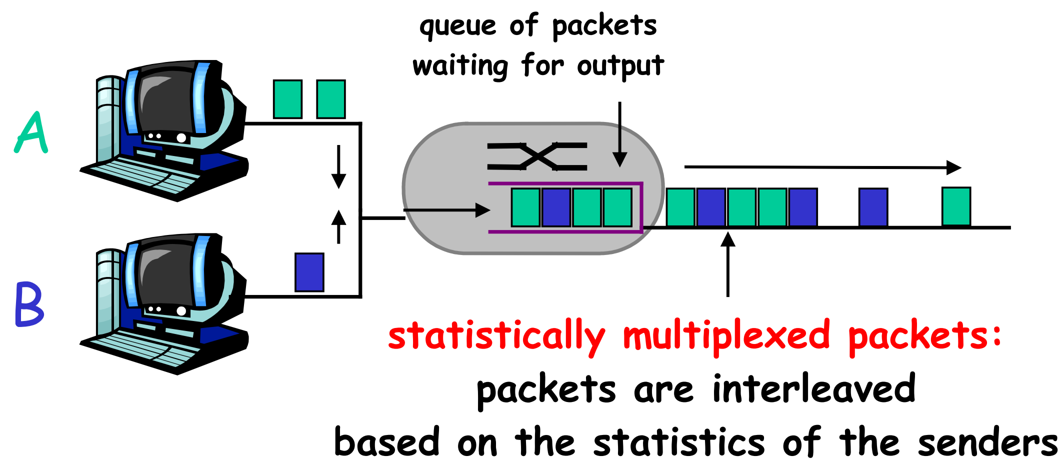
Main Principle of Packet Switching

- **statistical multiplexing** (☺) on-demand rather than pre-allocated sharing of resources – **link capacity is shared on packet-to-packet basis only among those users who have packets that need to be transmitted over the link**

  (1) router buffers packets and arranges them in a queue

  (2) as the transmission line becomes available, packets are transmitted one by one …

Bandwidth division into “pieces”
Dedicated allocation
Resource reservation



- **store-and-forward** (☹) **switch must receive entire packet before it can begin to transmit the first bit of the packet onto the outbound link**

TDM System

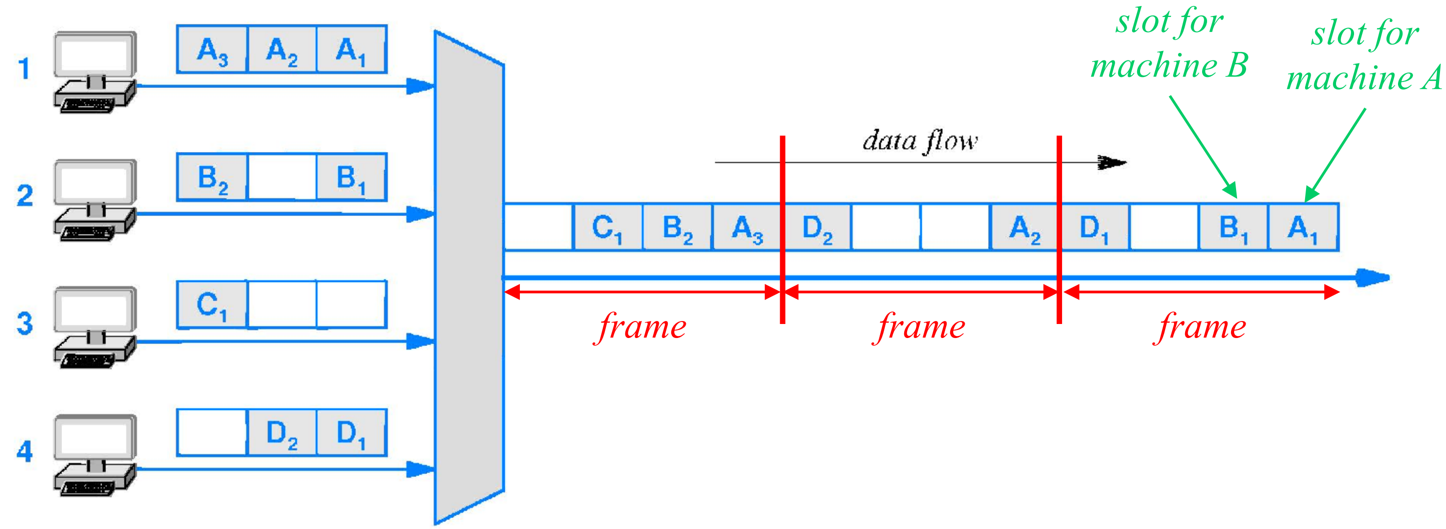


Figure 11.12 Illustration of a synchronous TDM system leaving slots unfilled when a source does not have a data item ready in time.

Packet Switching System

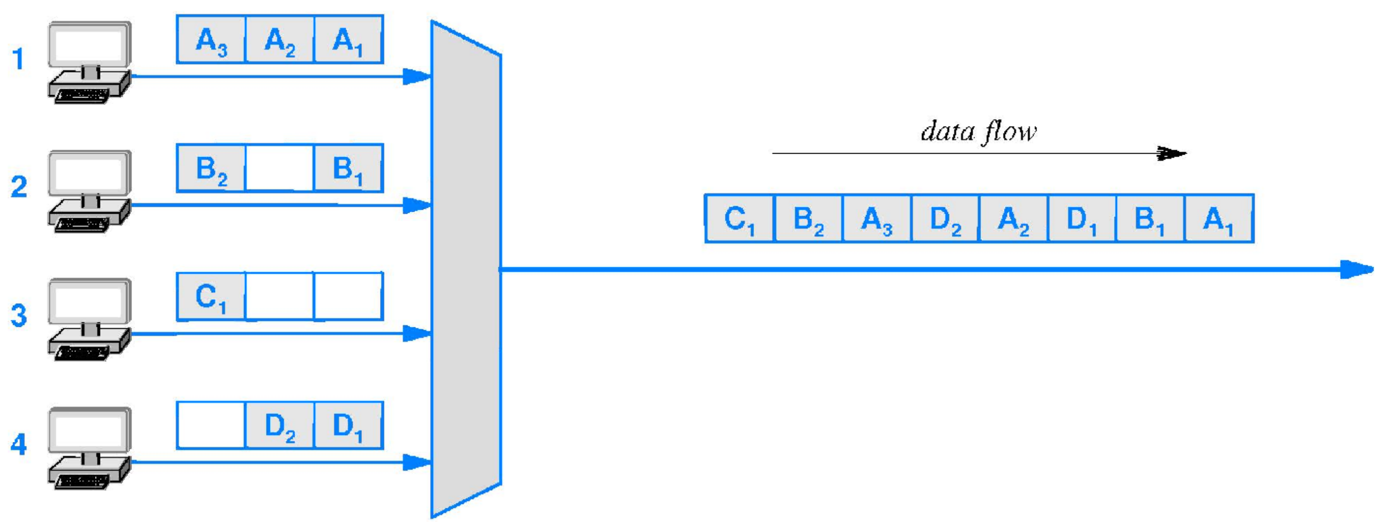


Figure 11.13 Illustration that shows how statistical multiplexing avoids unfilled slots and takes less time to send data.

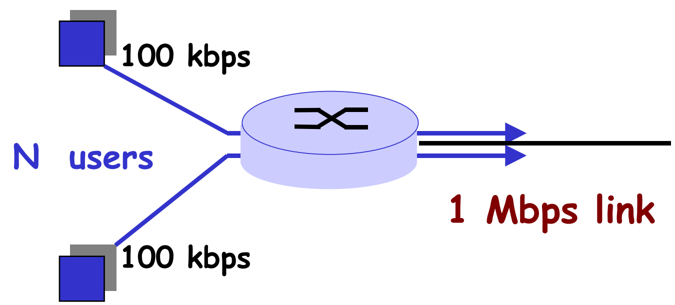
https://www.cs.csustan.edu/~john/classes/previous_semesters/CS3000_Communication_Networks/2017_02_Spring/Notes/chap11.html

Packet Switching (cont.)

Example [circuit switching vs. packet switching]

- N=35 users share a 1 Mbps link
- each user generates 100kbps when "active"
- each user is active 10% of time

How many users can be supported with circuit and how many with packet switching?



Circuit Switching

With circuit switching, 100kbps must be reserved for each user at all times. Hence, the output link can support 1Mbps/100kbps = 10 simultaneous users.

Packet Switching

- 10 or fewer simultaneously active users ⇒ aggregate rate ≤ 1 Mbps ⇒ users' packets flow through output link without delay, as in case of circuit switching
- more than 10 simultaneously active users ⇒ aggregate rate exceeds output capacity

With 35 users, probability of 10 or less simultaneously active users = 0.9996.
Thus, packet switching can support all 35 users with virtually no delay!

Packet Switching (cont.)

Advantages of Packet Switching

- **greater line efficiency** – node-to-node link dynamically shared by many packets / connections
- **data rate conversion** – two stations of different data rates can exchange packets, because each connects to its node at its proper data rate ⇒ nodes act as buffers
- **no blocked calls** – packets are accepted even under heavy traffic, but delivery delay increases

Disadvantages of Packet Switching

- **transmission delay** – each time a packet passes through a packet-switching node, it incurs a delay not present in circuit switching = the time it takes to absorb the packet into an internal buffer
- **variable delay** – each node introduces additional variable delay due to processing and queueing
- **overhead** – to route packets through a packet-switching network, overhead information including the address of destination and/or sequence information must be added to each packet