TCP over ATM

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Recap

- Transport protocol
- TCP flow and congestion control
- TCP flow control performance

Today's lecture

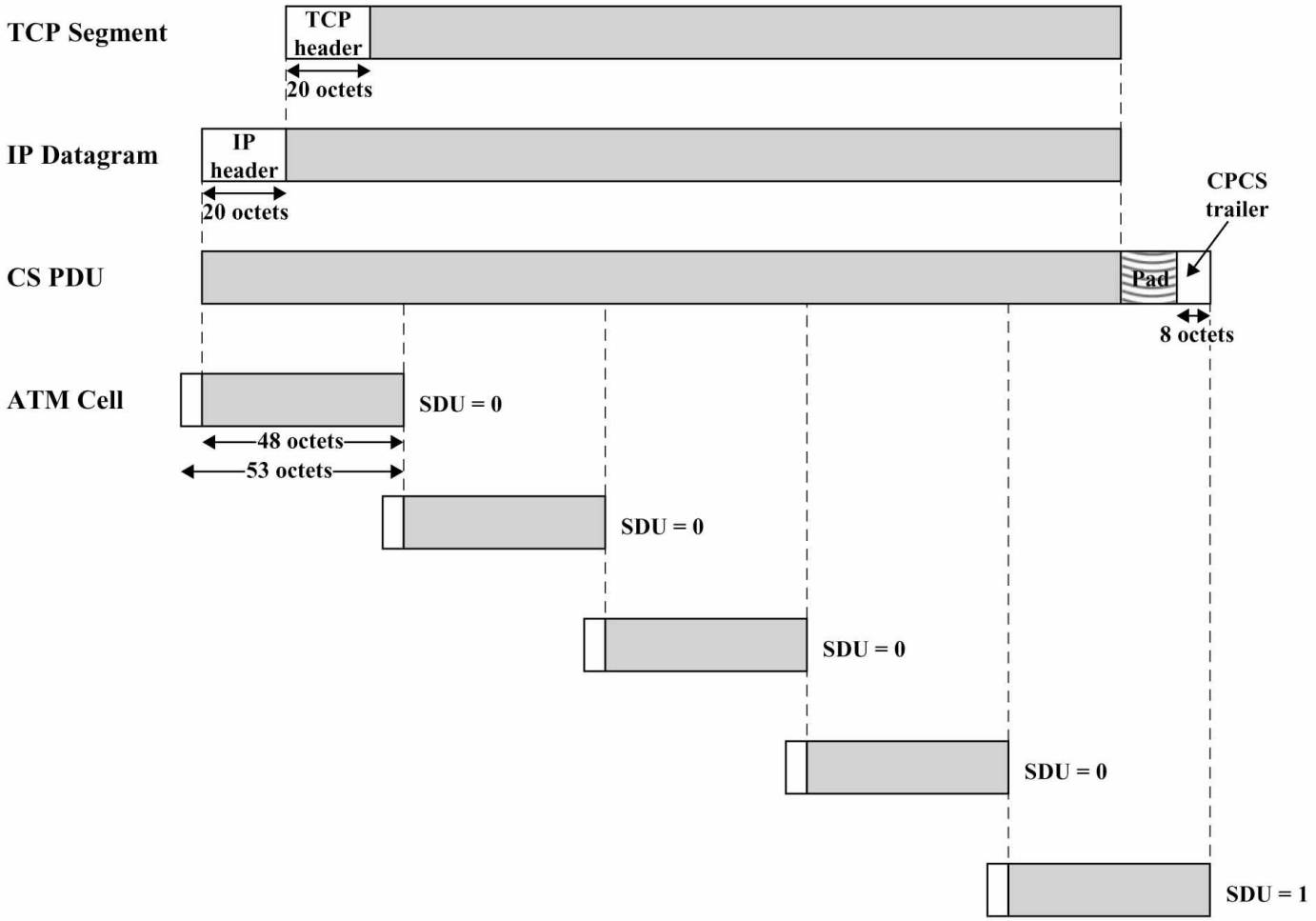
- TCP over ATM
- Possible mapping (UBR/ABR)
- Performance over UBR
- Performance over ABR

TCP over ATM

- TCP is very popular
- ATM provides WAN connectivity for high speed networking

Protocol Mapping

- TCP
- IP
- AAL5: mapping higher layer PDUs into ATM cells
  - Convergence Sublayer (CS): services to higher layers
  - Segmentation & Reassembly Sublayer (SAR): packing and unpacking of data
- ATM


TCP Segment
TCP header
20 octets
IP Datagram
IP header
20 octets
CPCS trailer
CS PDU
Pad
8 octets
ATM Cell
SDU = 0
48 octets
53 octets
SDU = 0
SDU = 0
SDU = 0
SDU = 1

TCP over UBR

- Problem of running TCP over ATM
  - TCP segments are packed into ATM cells
    - Overhead
  - If a cell is lost, segment is useless
    - Resource waste
    - Undesirable delays
  - Segment size impacts the throughput
    - Lager segments tolerate more to discard

Packet Discard

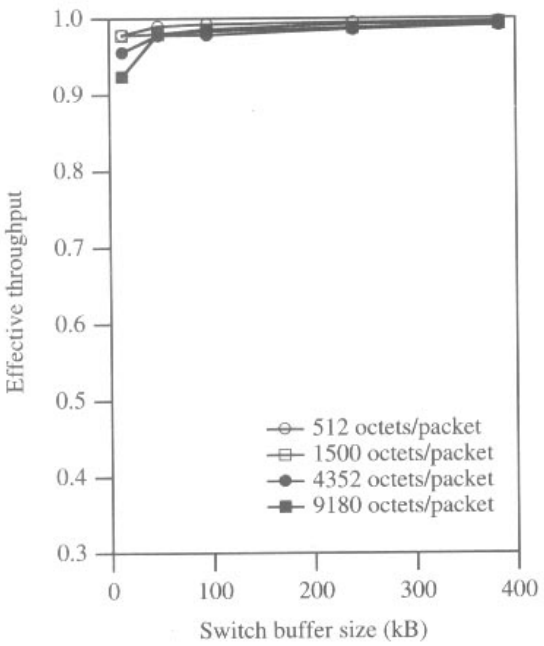
- To increase throughput, ATM switch buffer sizes can be increased (?)
- Alternatively, ATM switches can be smart and reduce waste via discard strategies:
  - Partial Packet Discard (PPD)
  - Early Packet Discard (EPD)

PPD

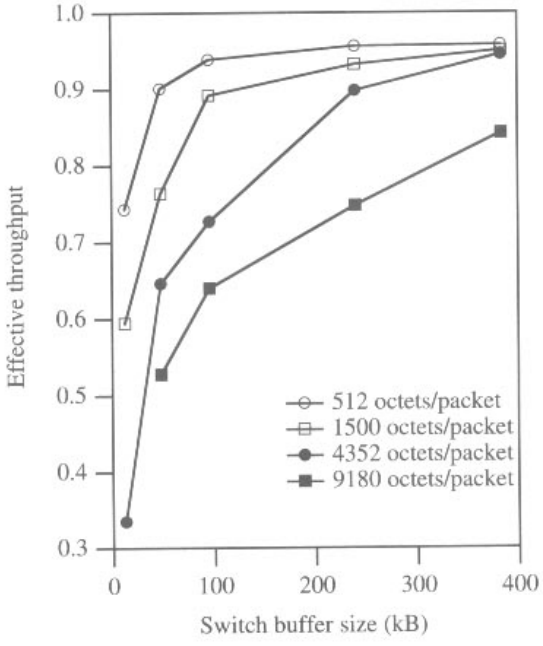
- If a cell belonging to a packet is dropped, subsequent cells are also dropped
  - The last cell is not dropped since it designates the end of packet and should be carried all the way to destination
- Still, there is some waste!

EPD

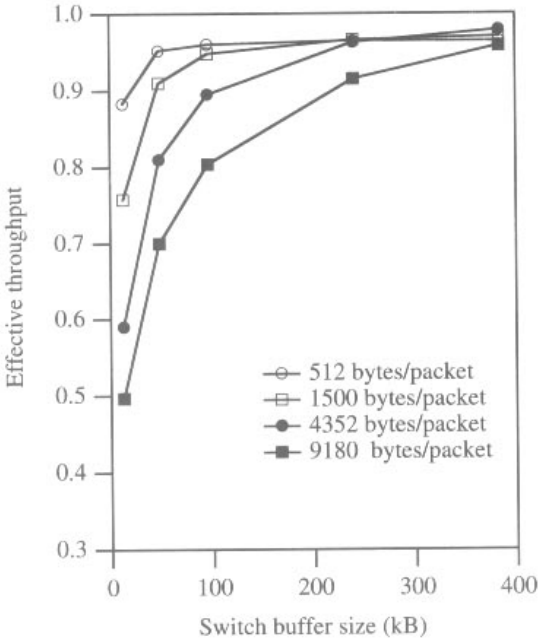
- Instead of buffering partial packets, a packet size is checked before it is accepted
  - If the packet size is less than the remaining buffer capacity, then accept
  - However if the packet size is larger than free buffer, packet is dropped.



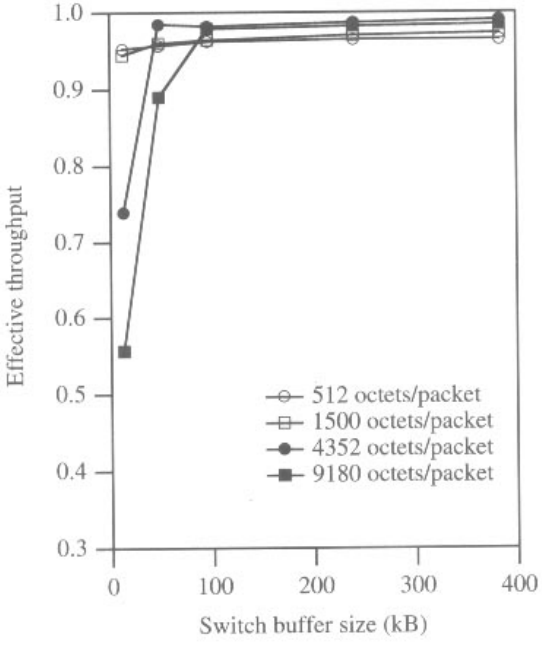
(a) Packet TCP over non-ATM



(b) TCP over plain ATM



(c) Partial packet discard



(d) Early packet discard

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TCP over ABR

- ABR provides flow control
- TCP can utilize this control
- ABR will increase throughput and maximize utilization
- Also ABR maximizes fairness and sharing.

ABR Flow Control

- Two modes:
  - Binary mode: a switch indicates a congestion where a source has to change its rate up/down incrementally.
  - Explicit rate mode: a switch will run an algorithm to find the rate at which the source should send data.

TCP over ABR, again…

- Two modes of operation:
  - Window-limited mode: ABR will provide the maximum possible rate a source can transmit with. However TCP will slowly start and congestion window will grow to use all rate.
  - Rate-limited mode: once congestion occurs, rate will be limited and TCP acks rate will be reduced that will reduce the rate at which TCP source sends segments.

Performance

- ABR is very sensitive to parameters which in turn will affect performance and fairness
- ABR could be comparable to UBR
- ABR needs smaller buffer sizes from the switches to guarantee higher throughput than UBR which requires buffering proportional to number of TCP connections