Transport Layer

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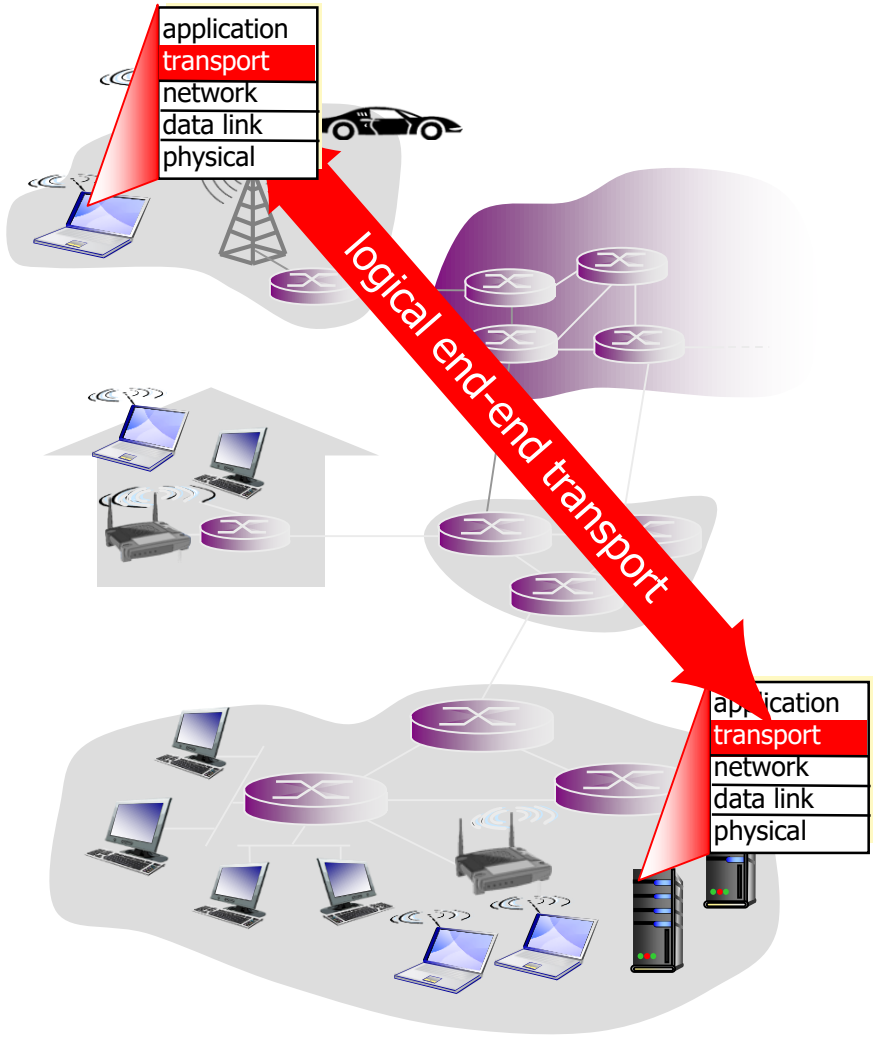
Transport level



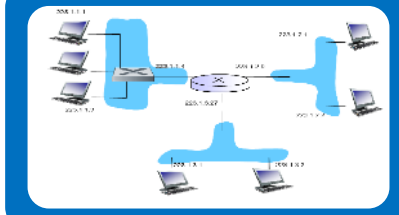
Protokol-stakken

Application

- Web (HTTP/HTTPS), Email,DNS,DHCP, FTP, ...

Transport

- TCP - reliable, connection oriented
- UDP - unreliable, connectionless

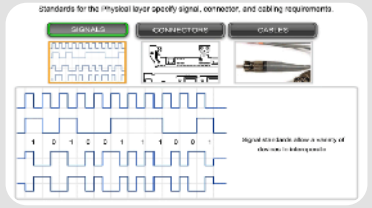


Network

- IP - IP-packets, unreliable
- IP-addresses

Datalink

- All kind of access - Wifi, Bluetooth, Ethernet, ...
- MAC-addresses



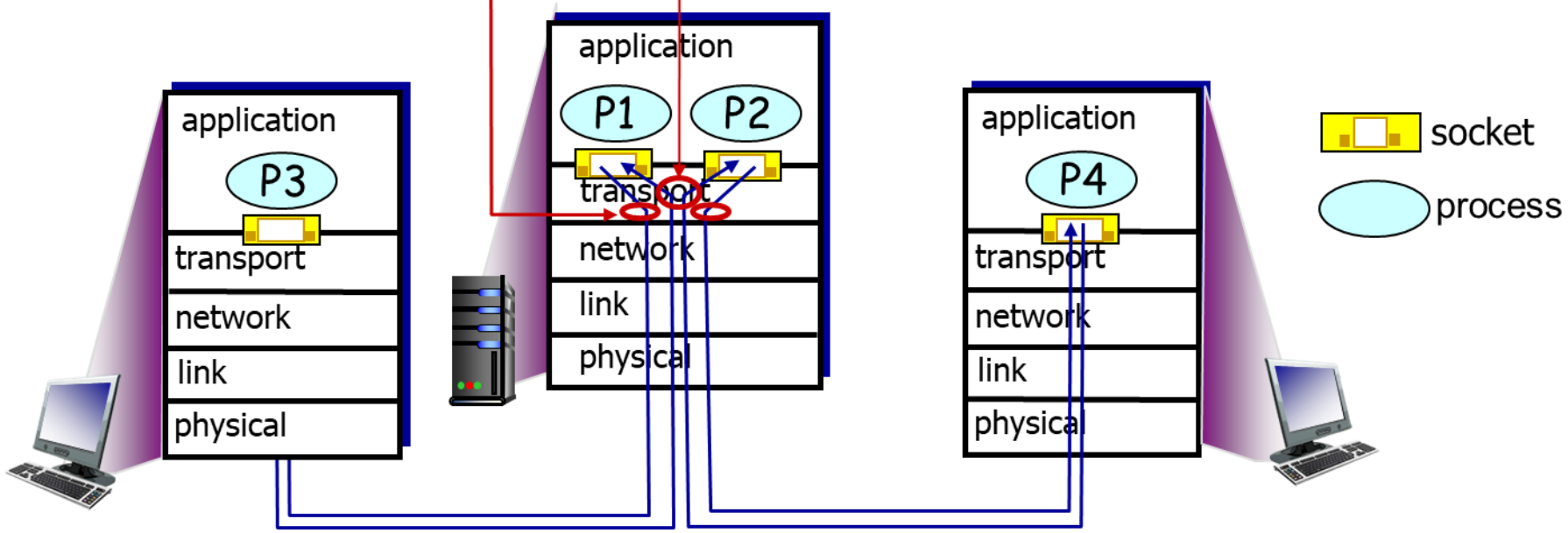
Physical

- Connectors
- Bit encoding/decoding

Multiplexing/demultiplexing

multiplexing at sender:
handle data from multiple sockets, add transport header (later used for demultiplexing)

demultiplexing at receiver:
use header info to deliver received segments to correct socket



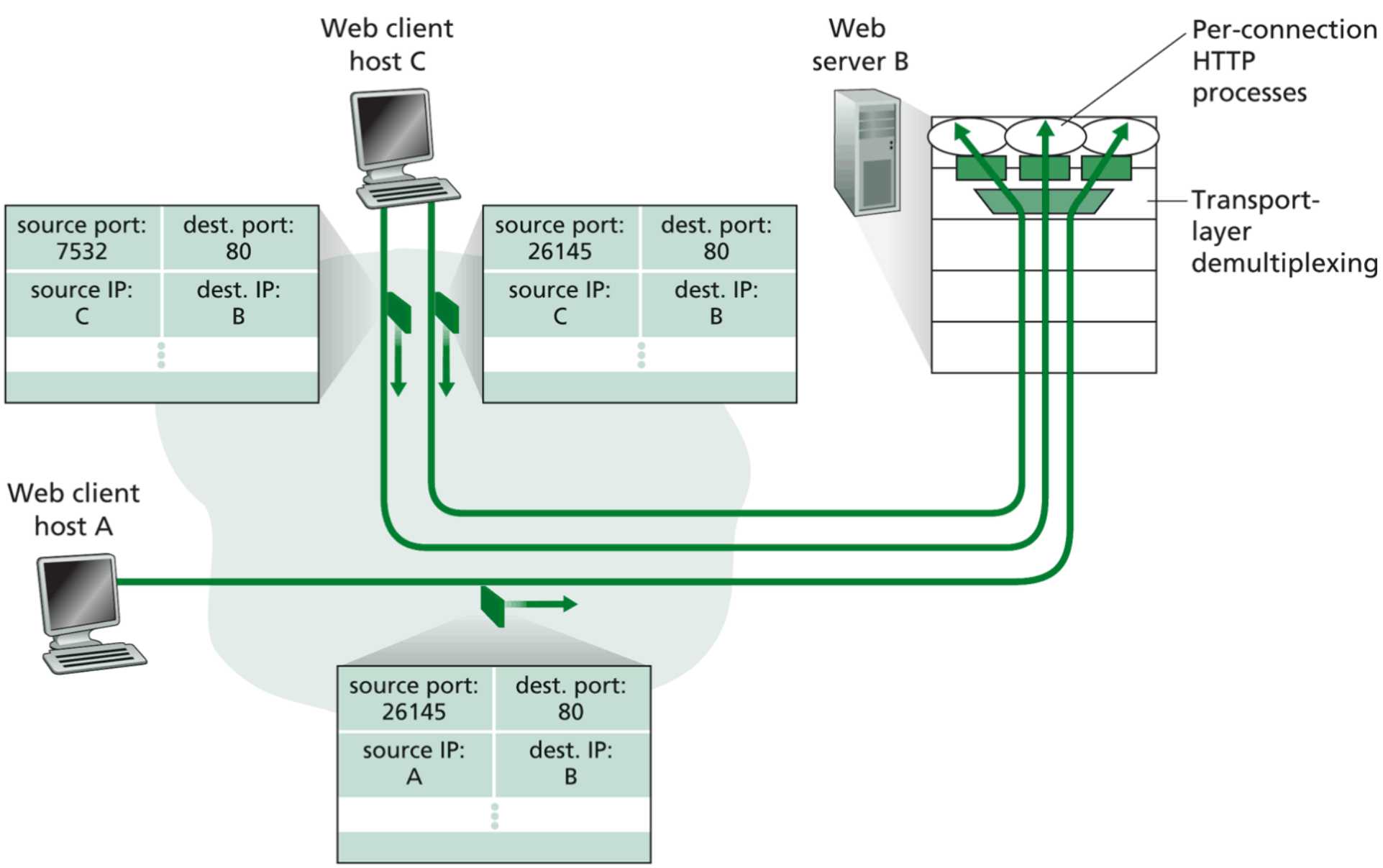
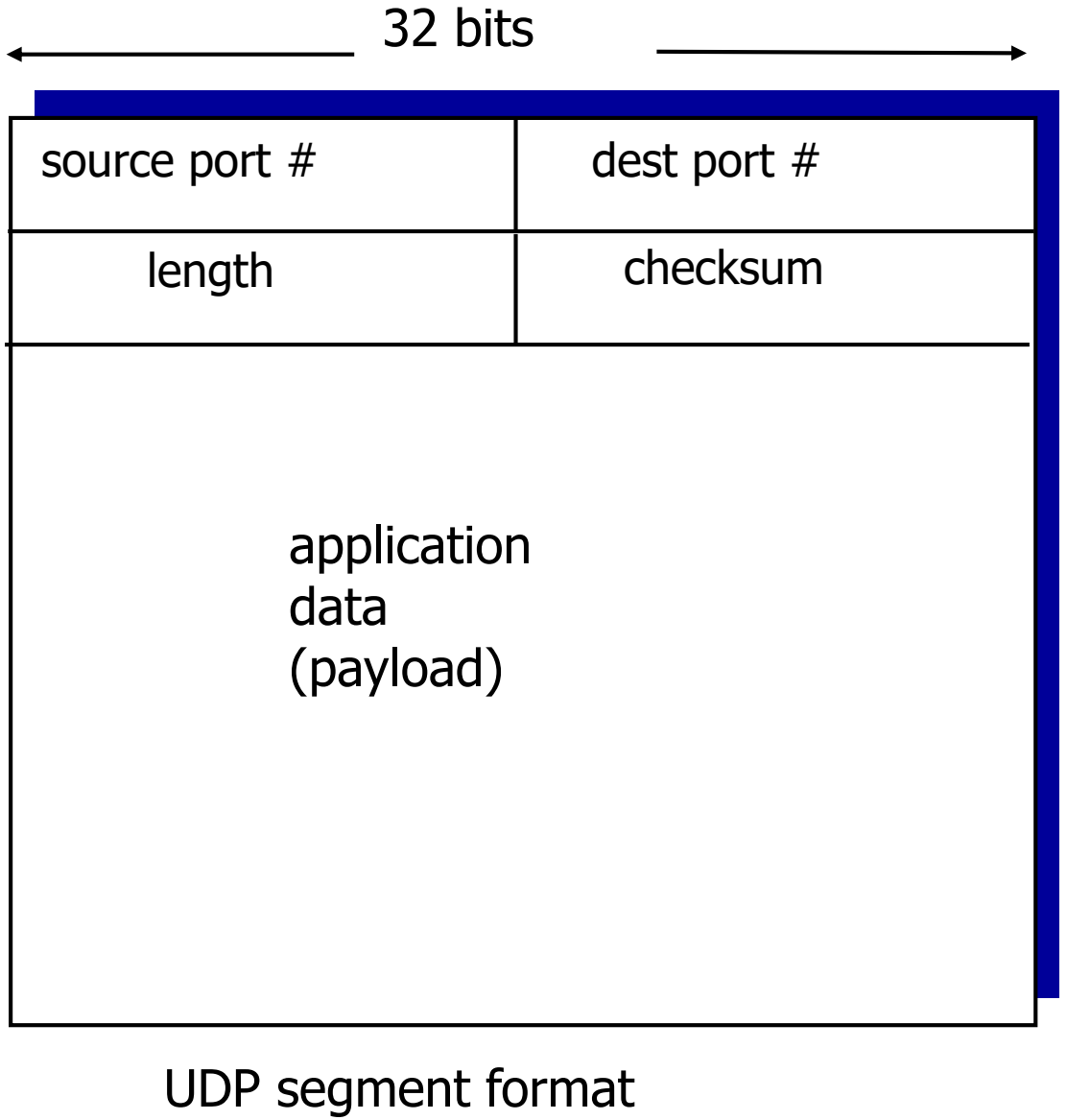


Figure 3.5 ♦ Two clients, using the same destination port number (80) to communicate with the same Web server application

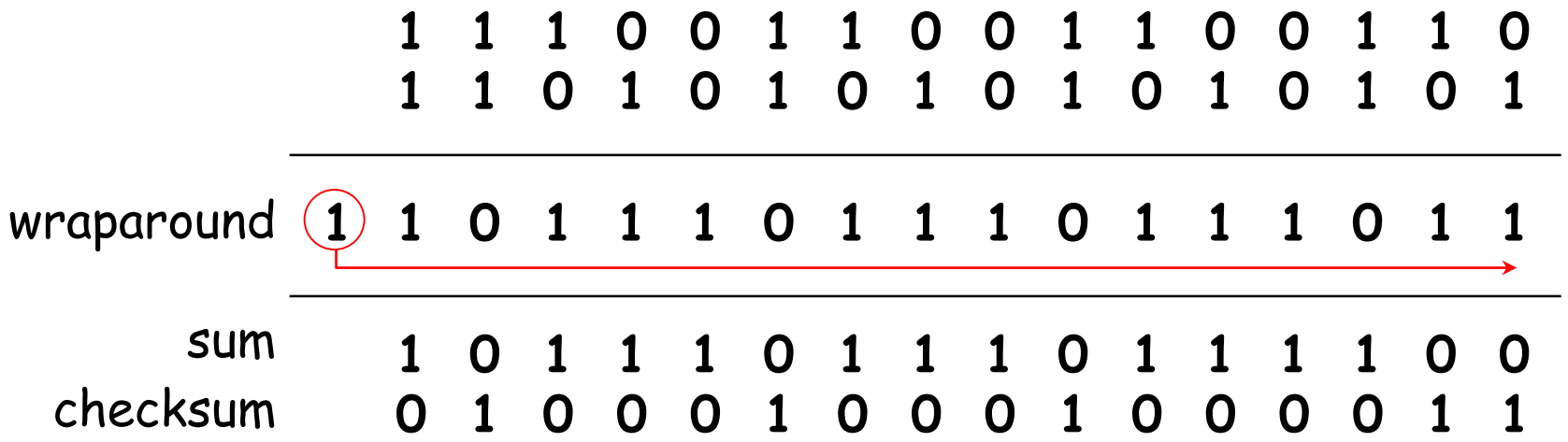
UDP: segment header



UDP segment format

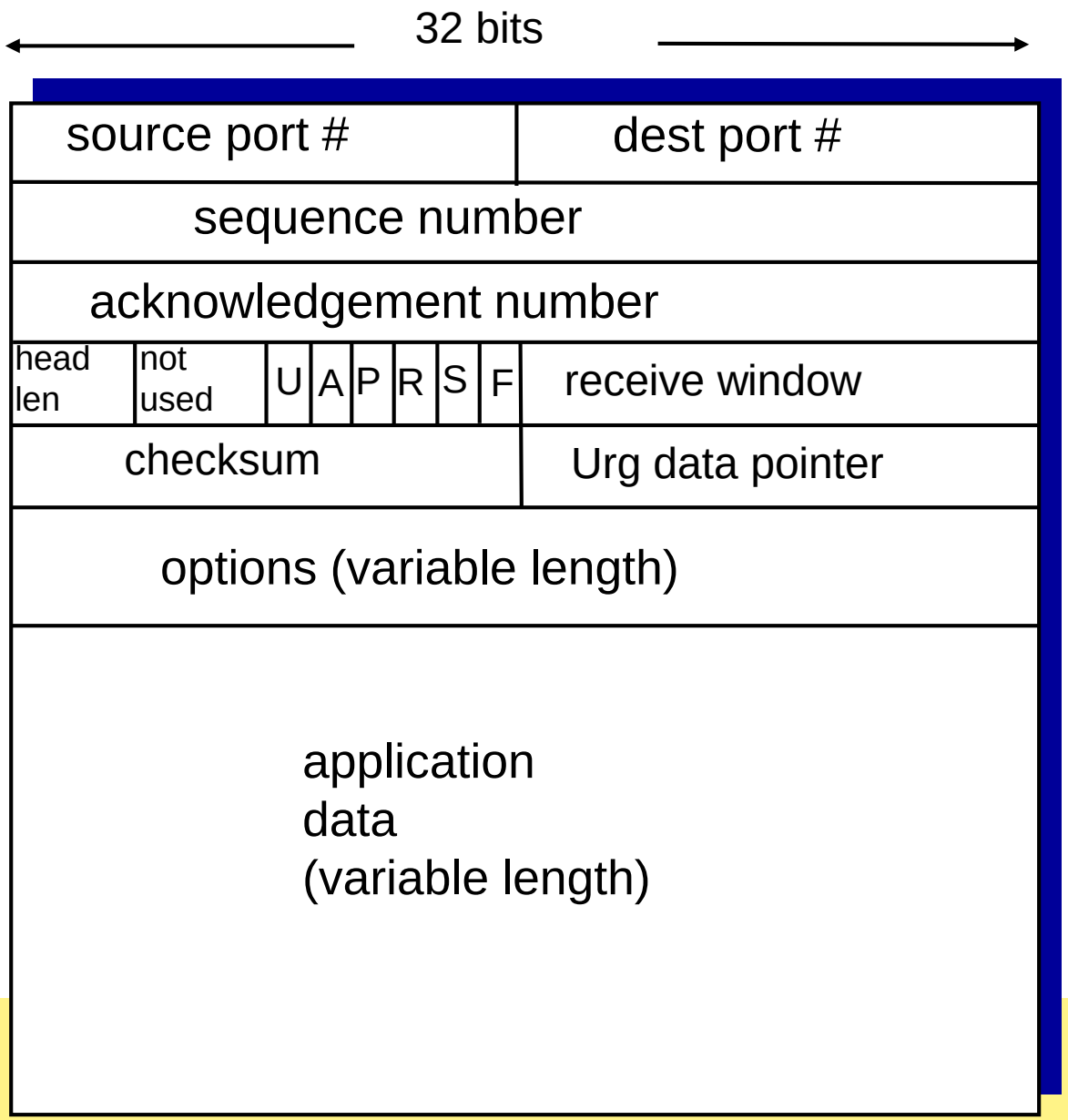
Internet checksum: example

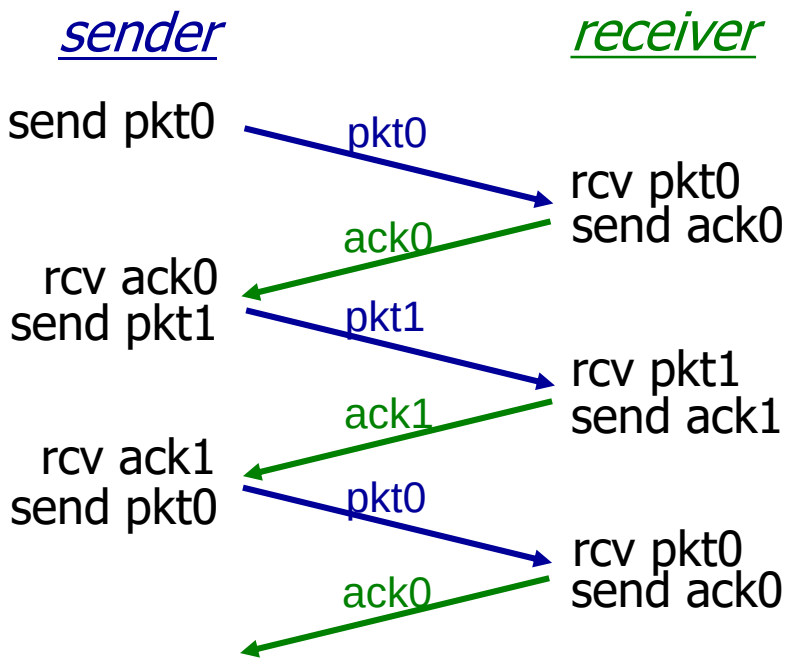
example: add two 16-bit integers



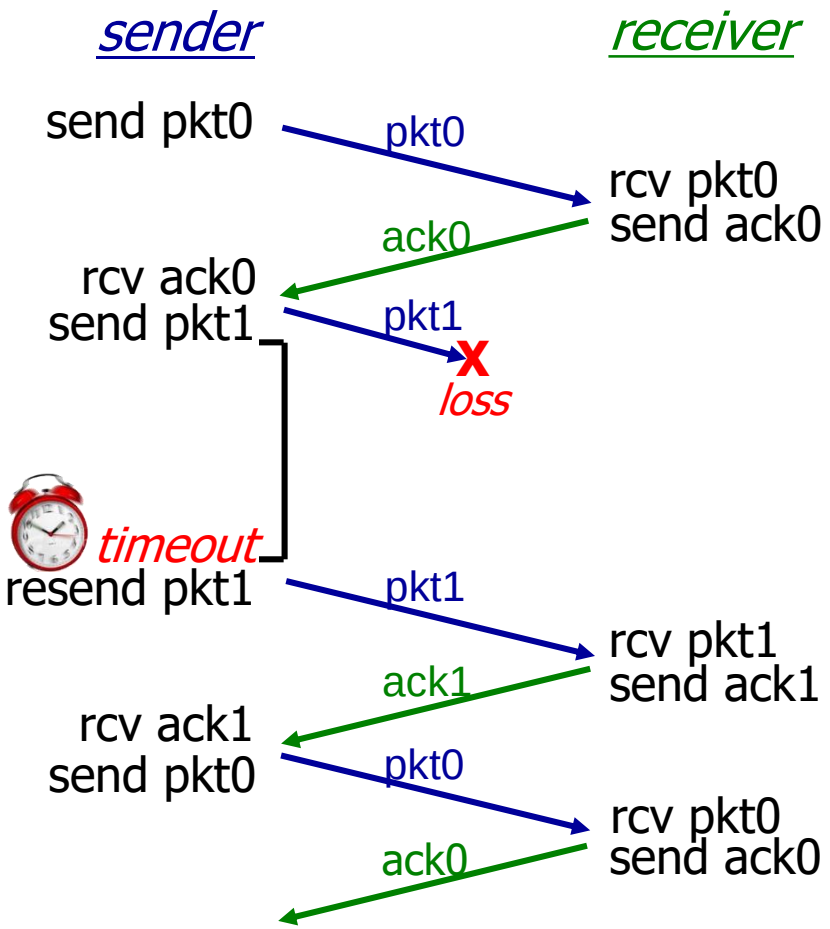
Note: when adding numbers, a carryout from the most significant bit needs to be added to the result

TCP segment structure (TCP Header)

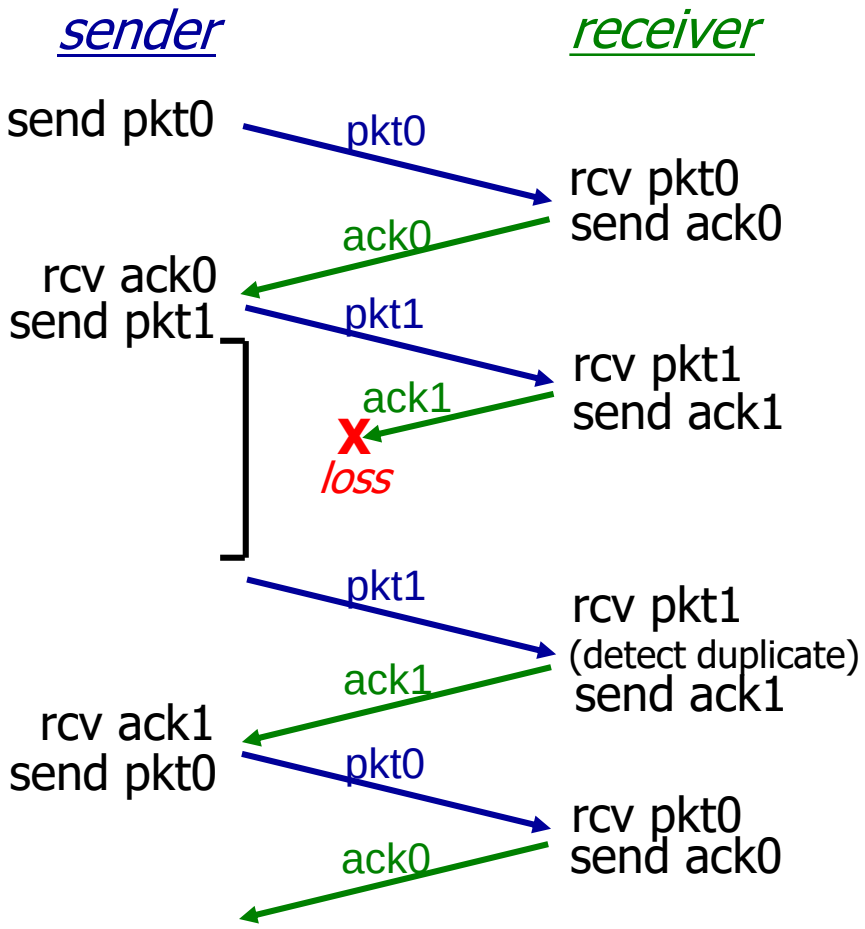




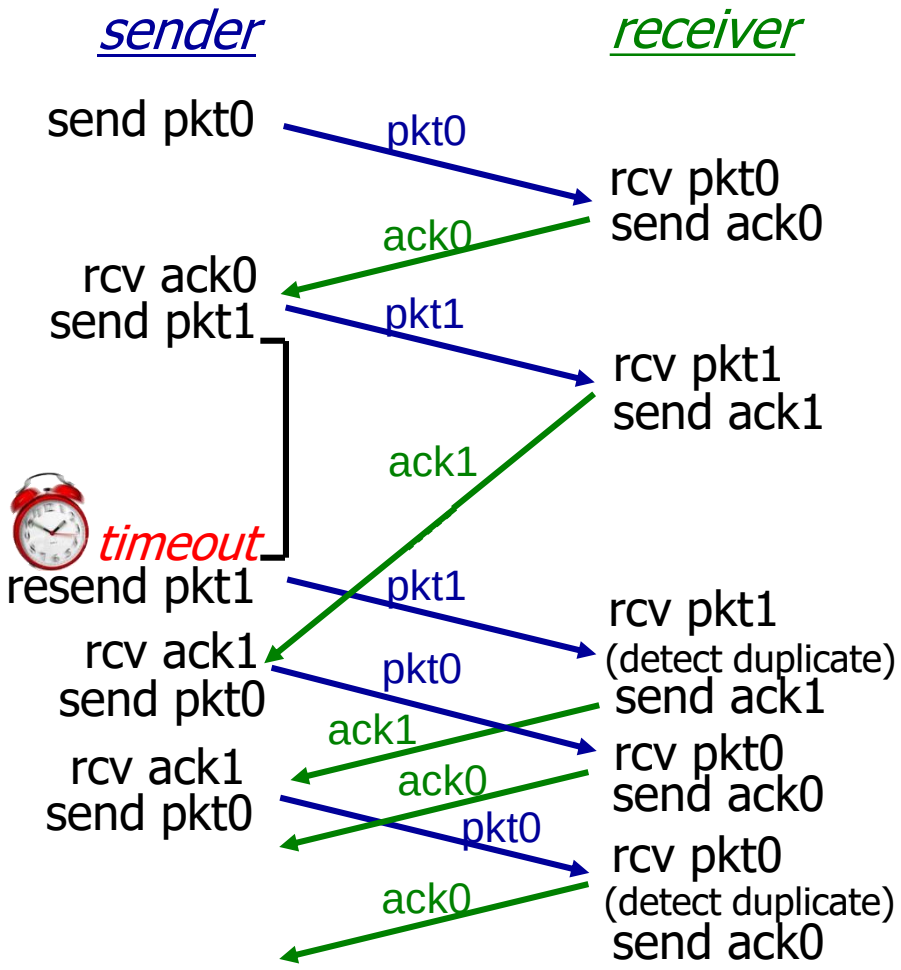
(a) no loss



(b) packet loss

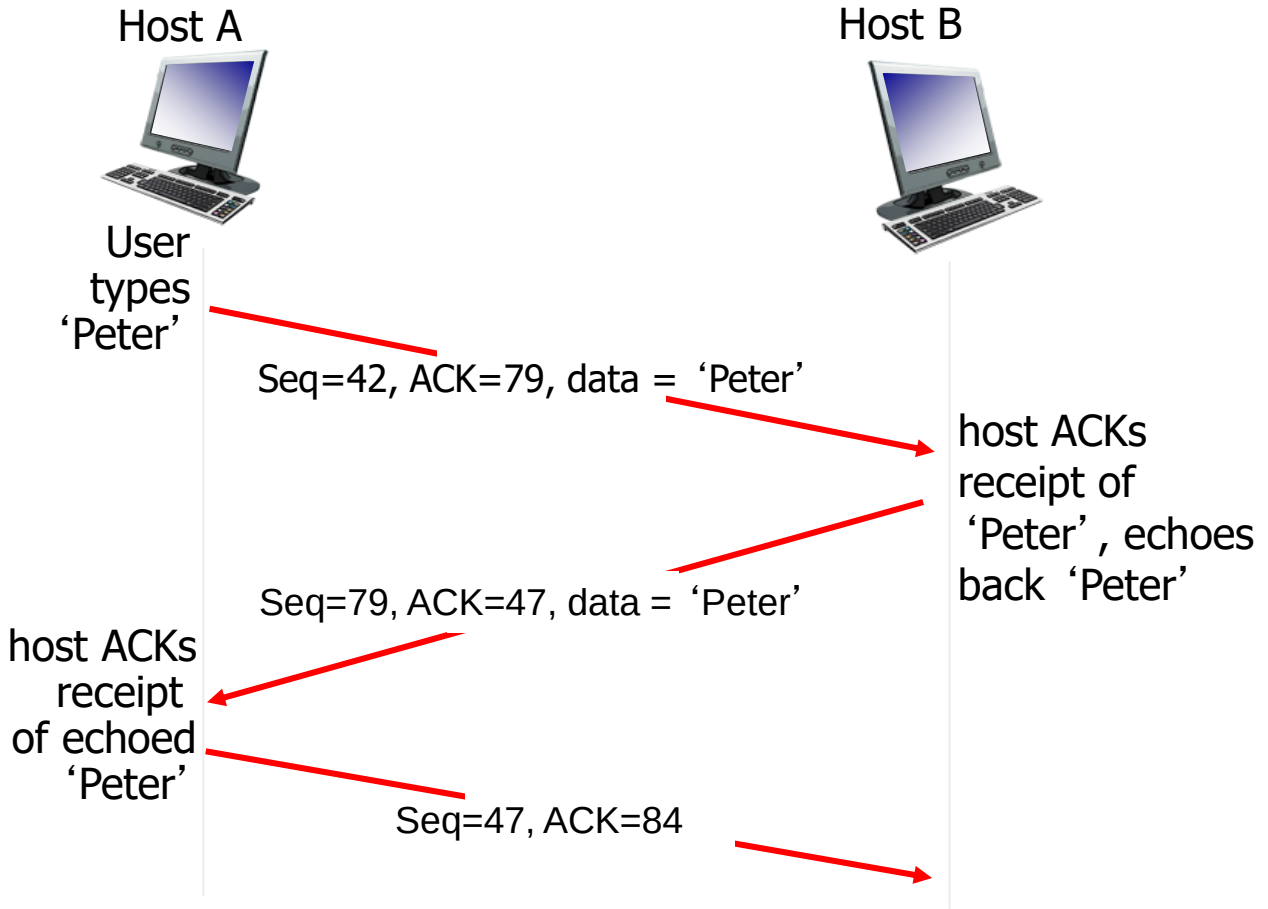


(c) ACK loss



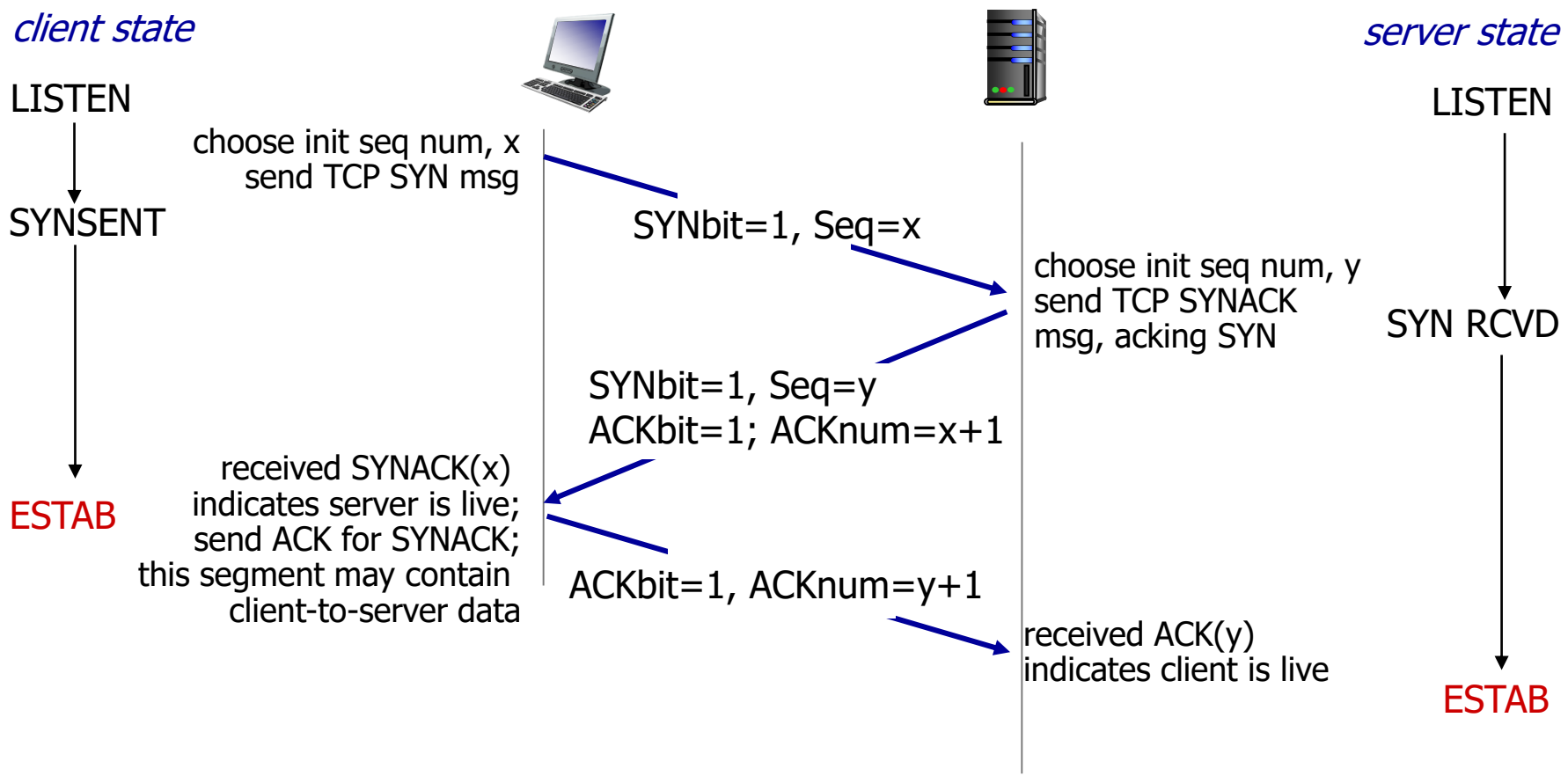
(d) premature timeout/ delayed ACK

TCP seq. numbers, ACKs



simple telnet scenario

TCP 3-way handshake



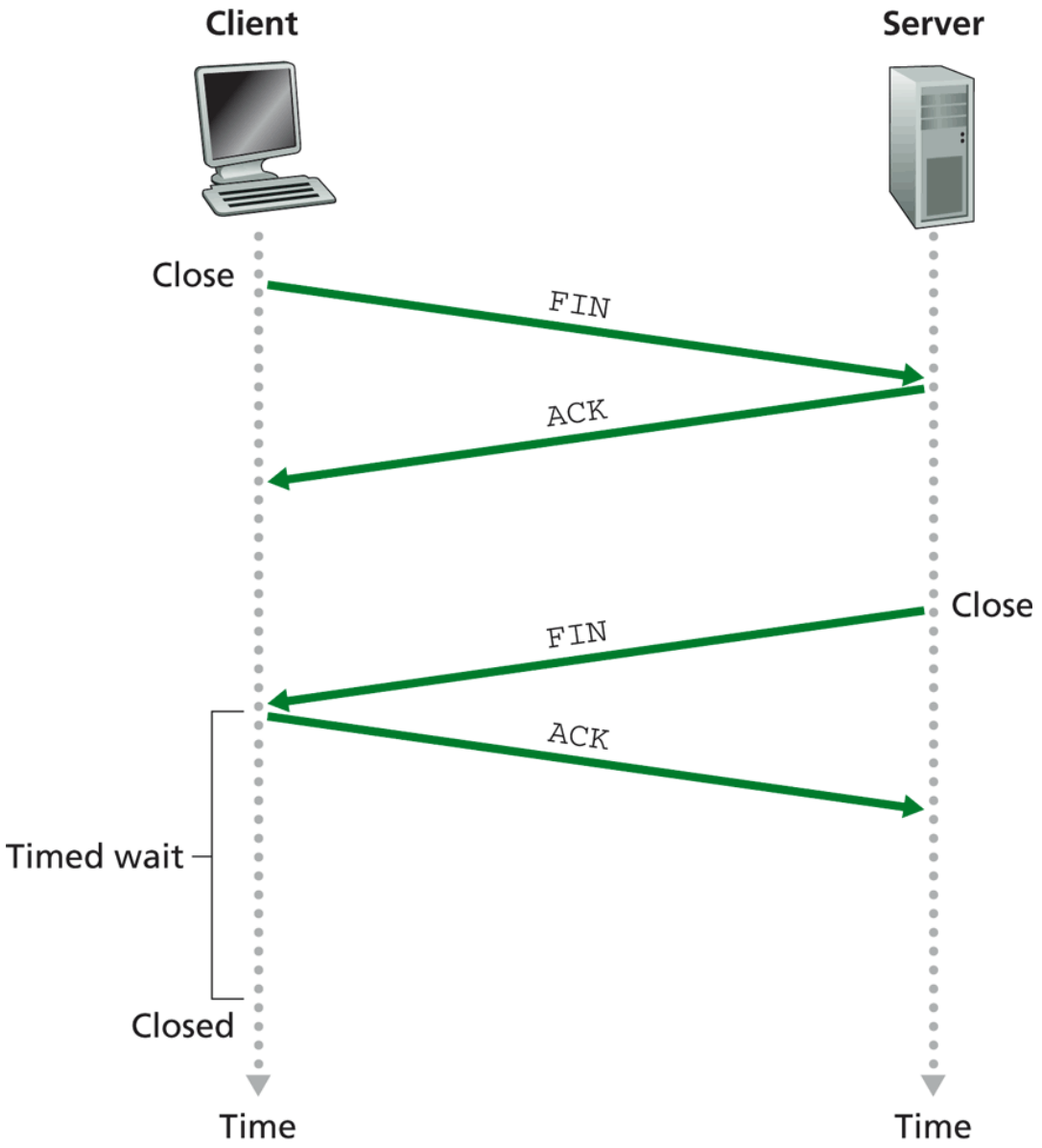
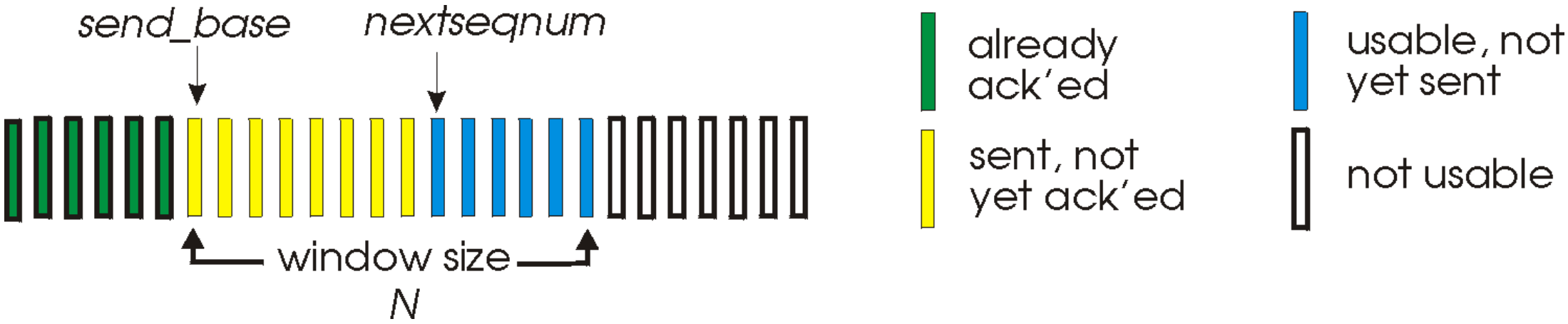
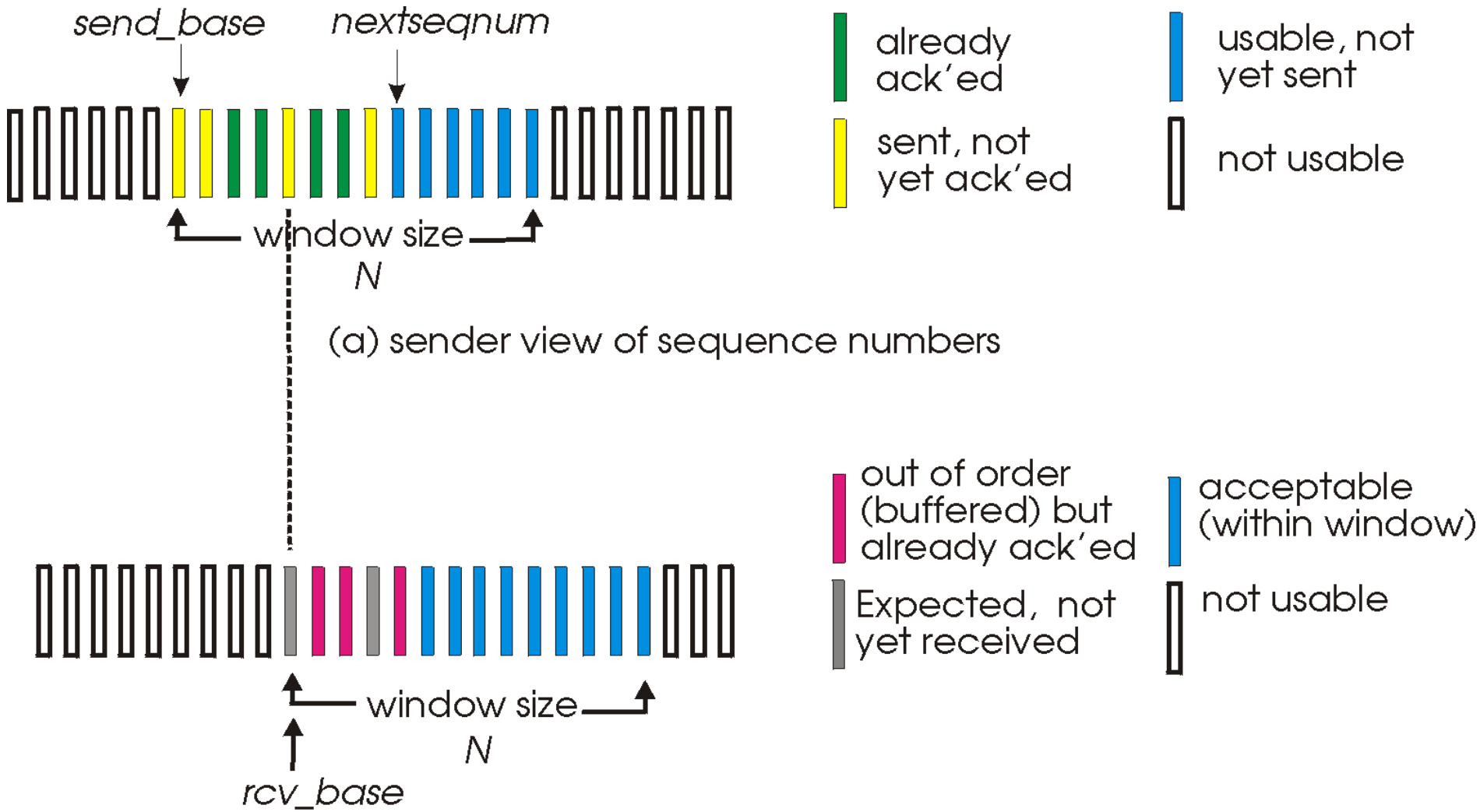


Figure 3.39 ♦ Closing a TCP connection

Go Back N


send_base
nextseqnum
window size
N
already ack'ed
sent, not yet ack'ed
usable, not yet sent
not usable

Selective Repeat



TCP segment structure

TCP Header