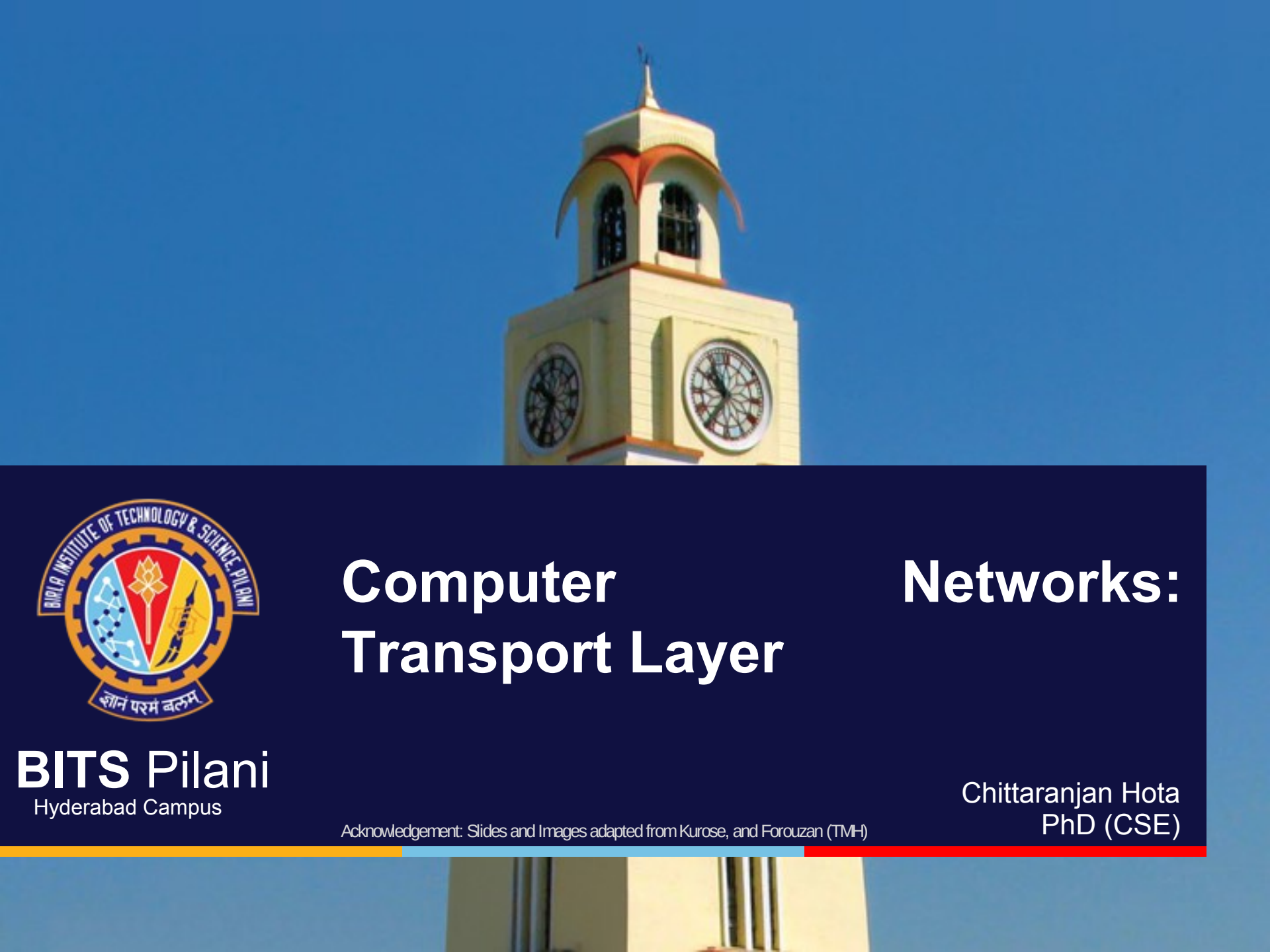

Computer Networks: Transport Layer

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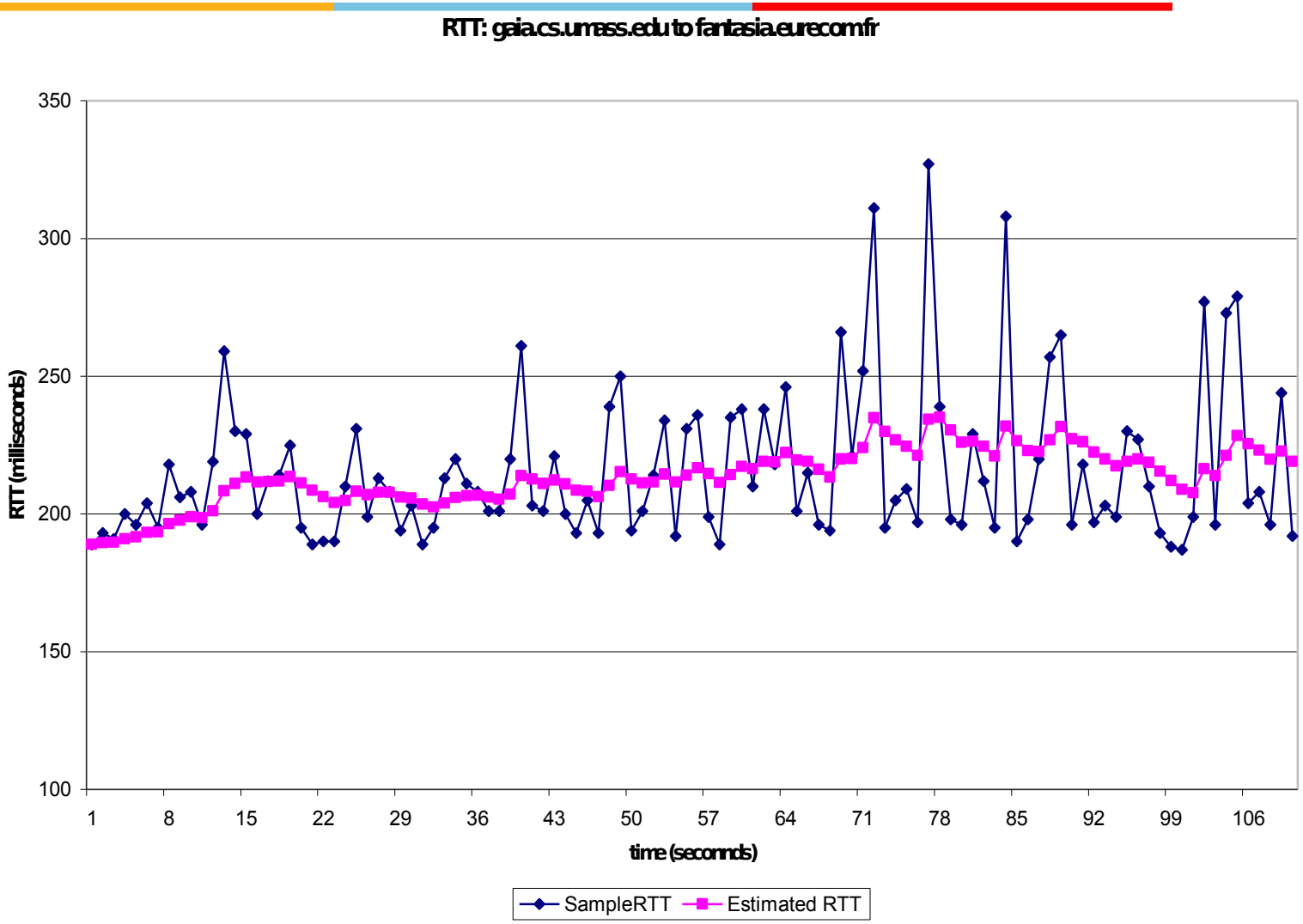
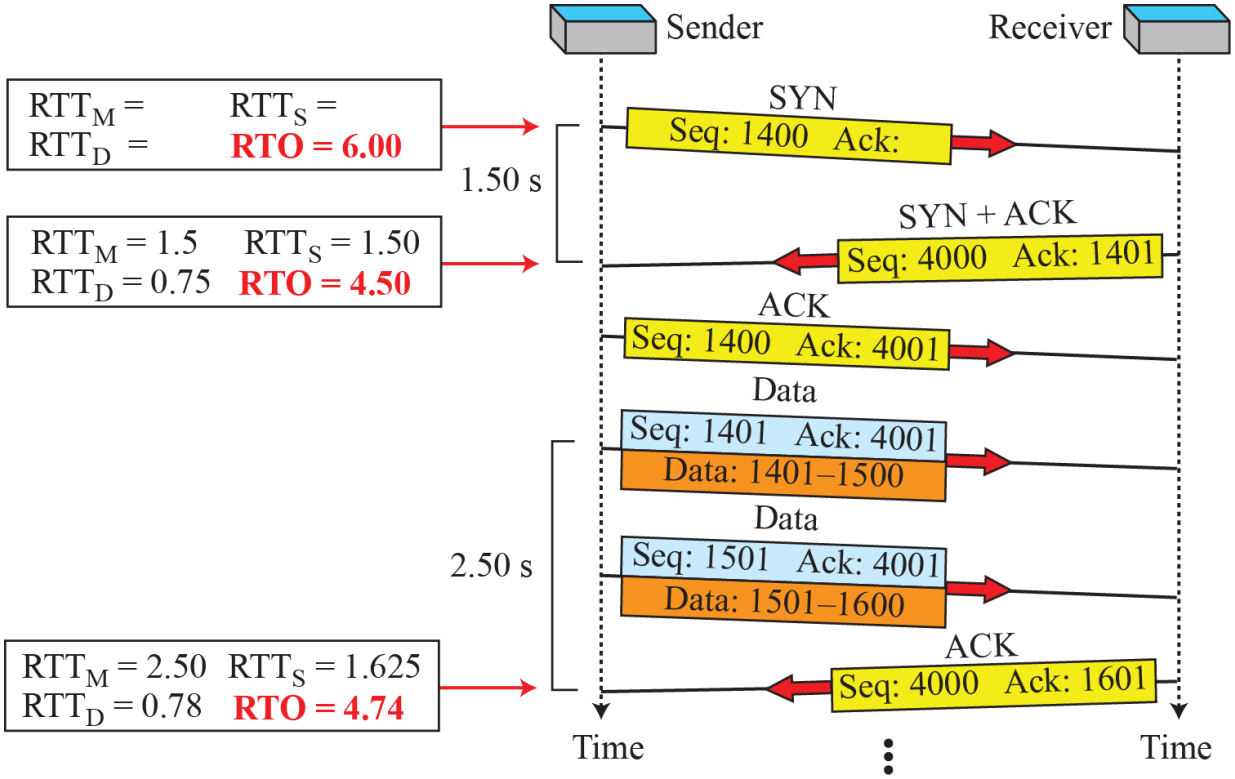
Acknowledgement: Slides and Images adapted from Kurose, and Forouzan (TMH)

TCP Timers


RTT: gaia.cs.umass.edu to fantasia.eurecom.fr
RTT (milliseconds)
350
300
250
200
150
100
1
8
15
22
29
36
43
50
57
64
71
78
85
92
99
106
time (seconnds)
SampleRTT
Estimated RTT

RTO Computation Example



$RTT_M = 1.5$

$RTT_S = 1.5$

$RTT_D = (1.5)/2 = 0.75$

$RTO = 1.5 + 4 \times 0.75 = 4.5$

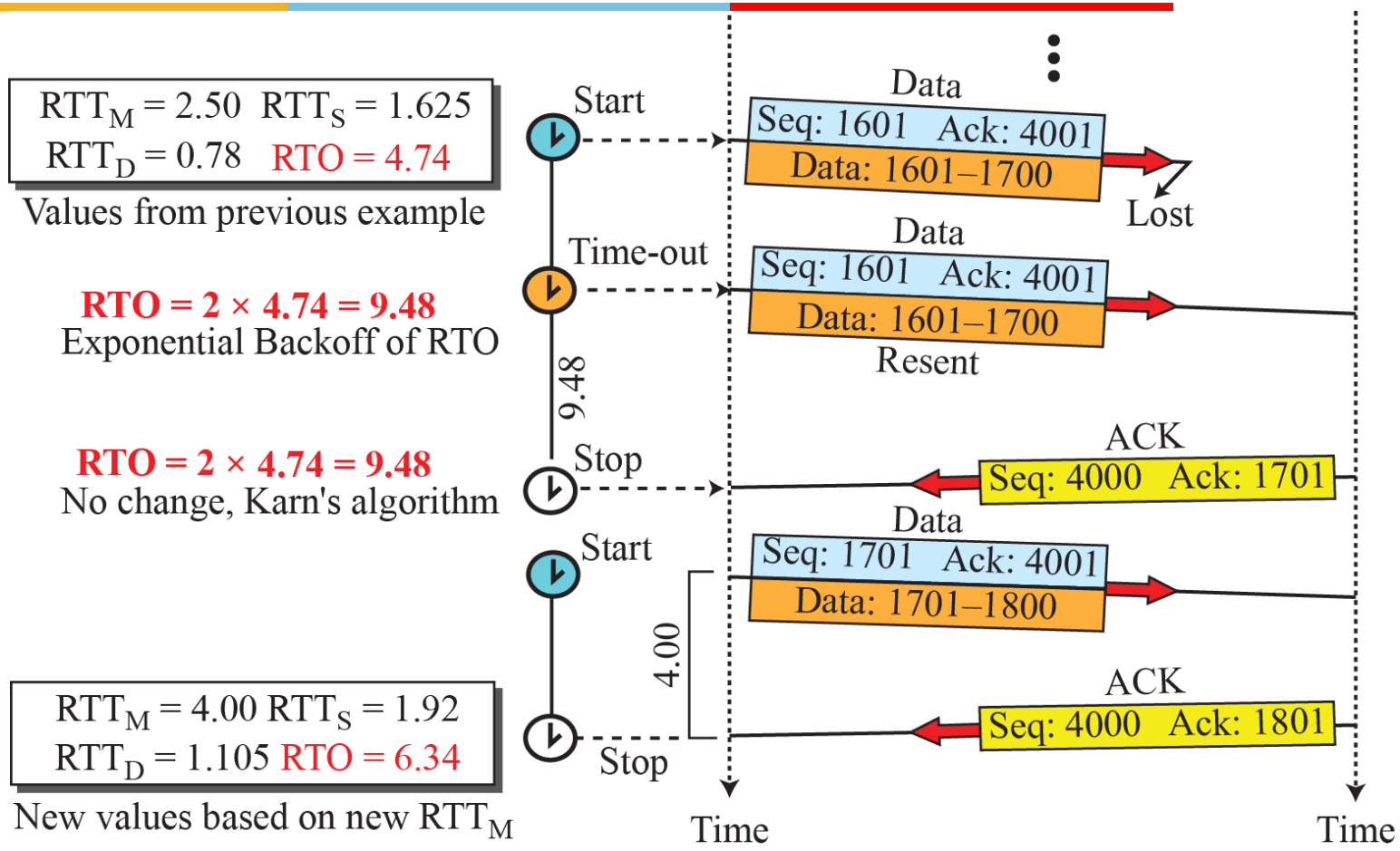
$RTT_M = 2.5$

$RTT_S = (7/8) \times (1.5) + (1/8) \times (2.5) = 1.625$

$RTT_D = (3/4) \times (0.75) + (1/4) \times |1.625 - 2.5| = 0.78$

$RTO = 1.625 + 4 \times (0.78) = 4.74$

Exponential Backoff and Karn's algo



Other timers: Persistence Timer, Keep-Alive Timer, Time-wait Timer.

User Datagram Protocol (UDP)

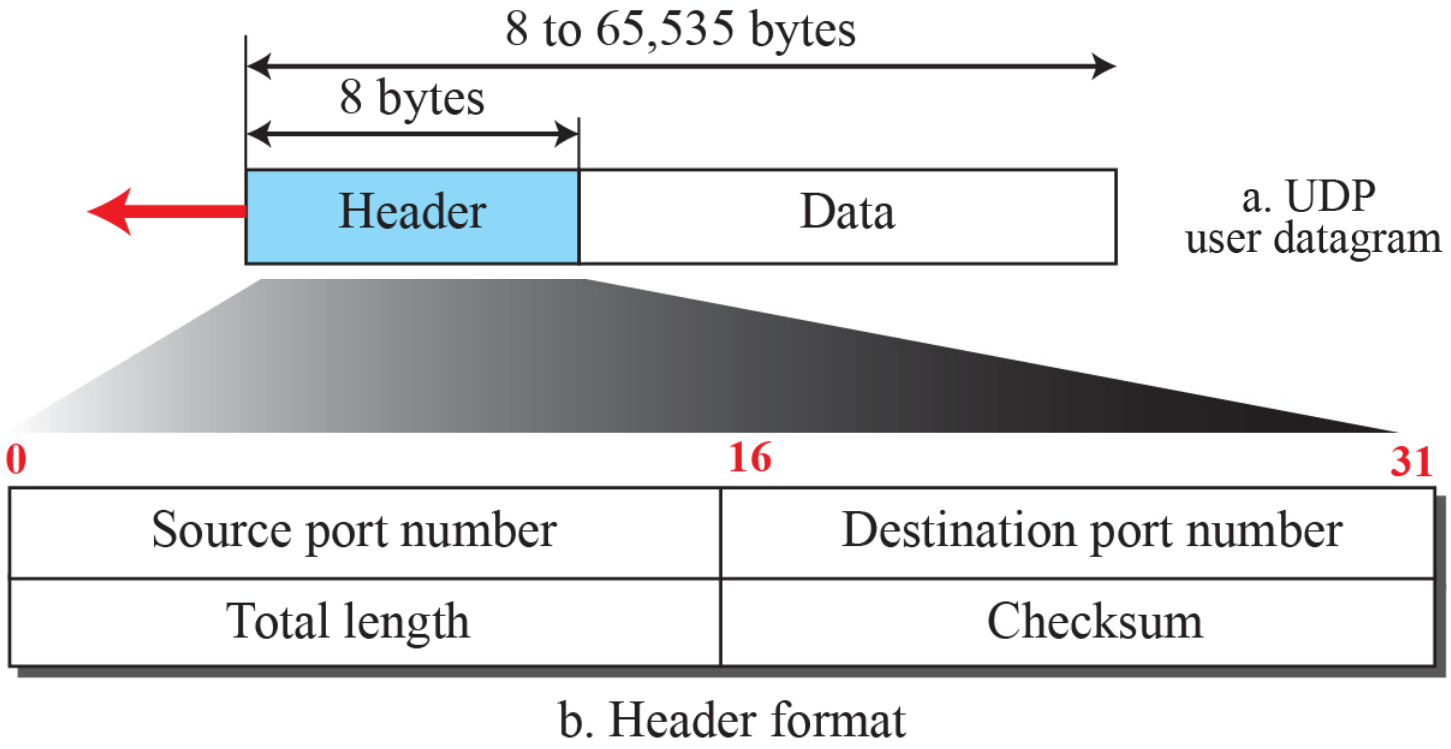
- "bare bones" Internet transport protocol
- "best effort" service, UDP segments may be:
  - lost
  - delivered out of order to app

- often used for streaming multimedia
  - loss tolerant
  - rate sensitive
- other UDP uses
  - DNS
  - SNMP
- Reliable transfer over UDP:
  - add reliability at application layer

Why is there a UDP?

- no connection establishment (which can add delay)
- simple: no connection state at sender, receiver
- small segment header
- no congestion control: UDP can blast away as fast as desired

UDP Packet Format



UDP Checksum