Introduction to Computer Networks

History of TCP Congestion Control (§6.5.10)

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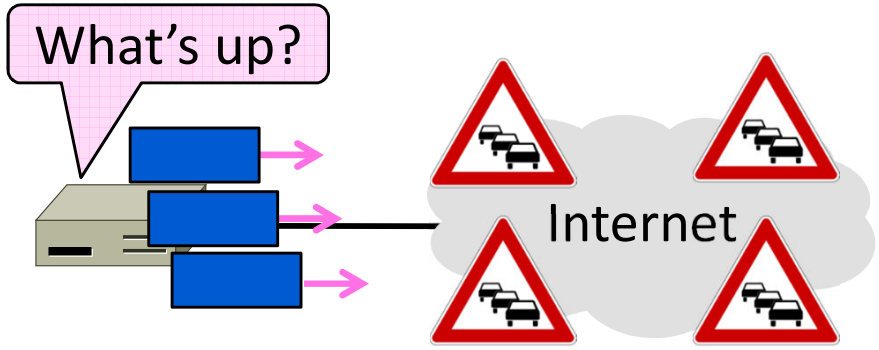
Topic

- The story of TCP congestion control
  - Collapse, control, and diversification

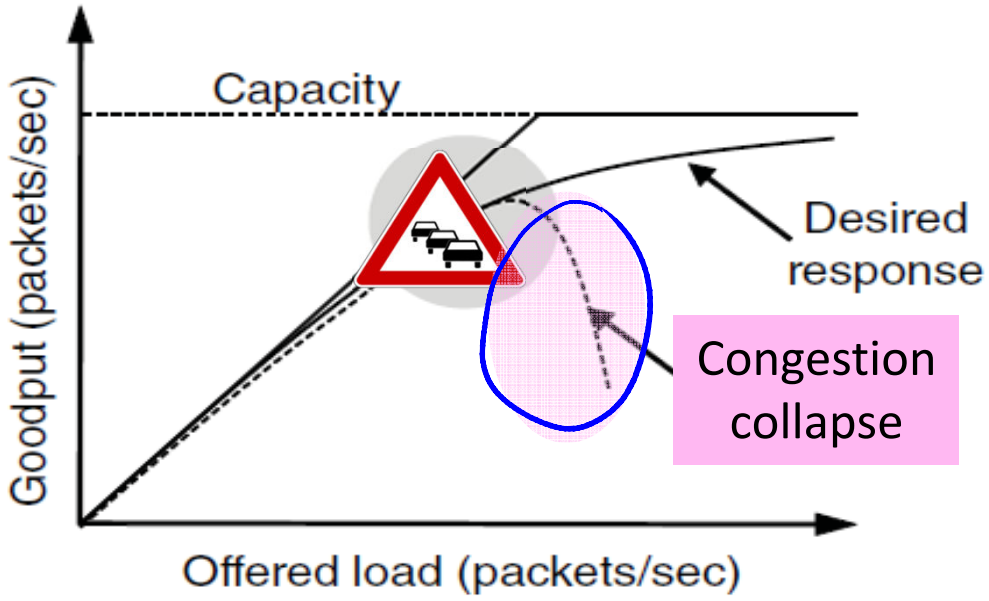


Congestion Collapse in the 1980s

- Early TCP used a fixed size sliding window (e.g., 8 packets)
  - Initially fine for reliability
- But something strange happened as the ARPANET grew
  - Links stayed busy but transfer rates fell by orders of magnitude!

Congestion Collapse (2)

- Queues became full, retransmissions clogged the network, and goodput fell



Van Jacobson (1950—)

- Widely credited with saving the Internet from congestion collapse in the late 80s
  - Introduced congestion control principles
  - Practical solutions (TCP Tahoe/Reno)
- Much other pioneering work:
  - Tools like traceroute, tcpdump, pathchar
  - IP header compression, multicast tools

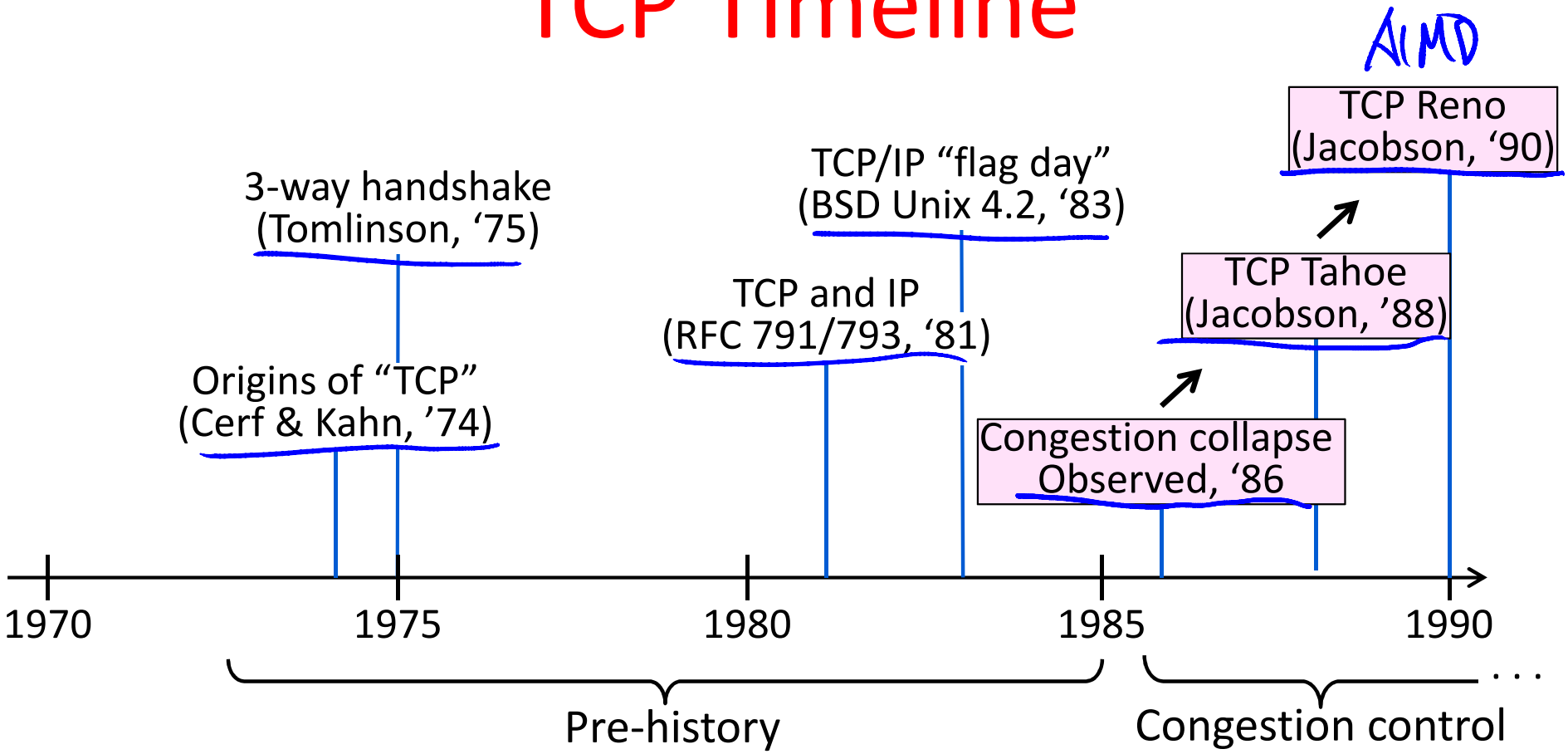
TCP Tahoe/Reno

- Avoid congestion collapse without changing routers (or even receivers)
- Idea is to fix timeouts and introduce a congestion window (cwnd) over the sliding window to limit queues/loss
- TCP Tahoe/Reno implements AIMD by adapting cwnd using packet loss as the network feedback signal

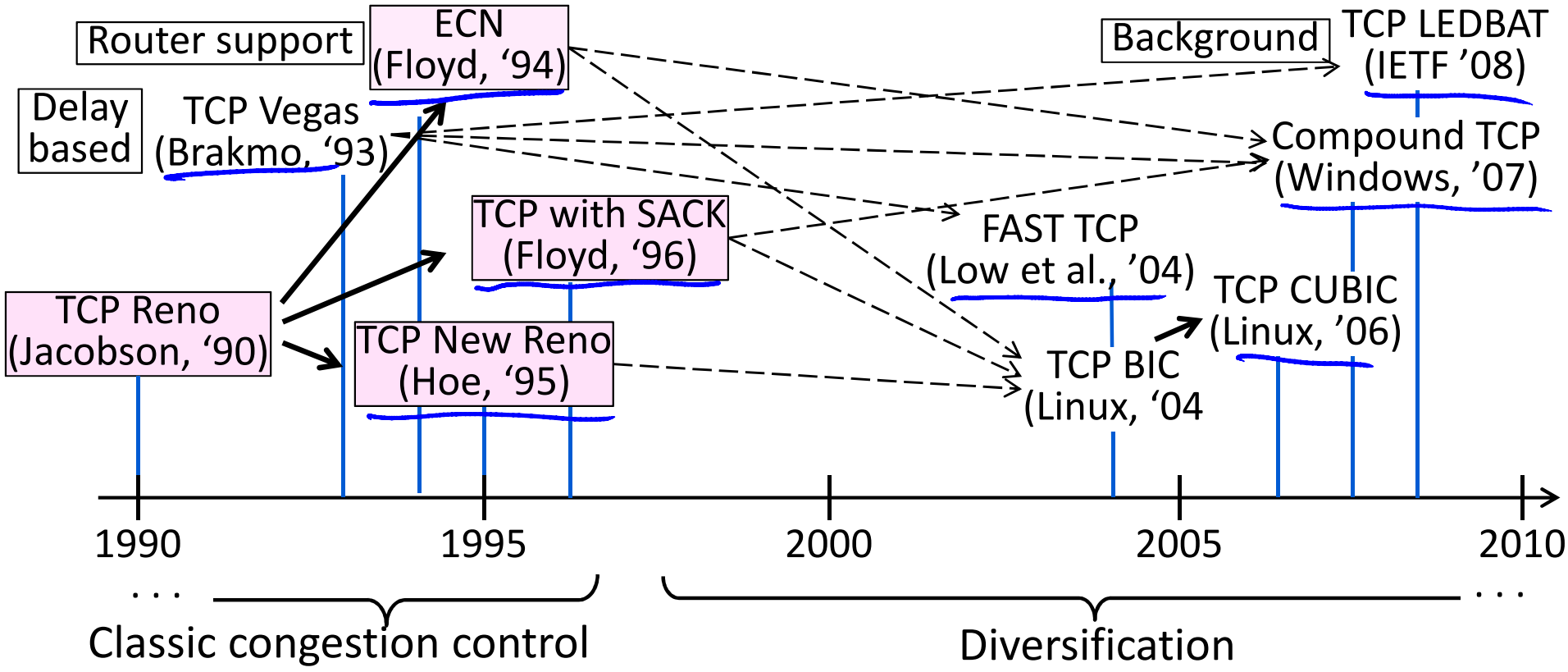
TCP Tahoe/Reno (2)

- TCP behaviors we will study:
  - ACK clocking
  - Adaptive timeout (mean and variance)
  - Slow-start
  - Fast Retransmission
  - Fast Recovery
- Together, they implement AIMD

TCP Timeline



TCP Timeline (2)



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