

# Computer Networks

## Explicit Congestion Notification (§5.3.4, §6.5.10)



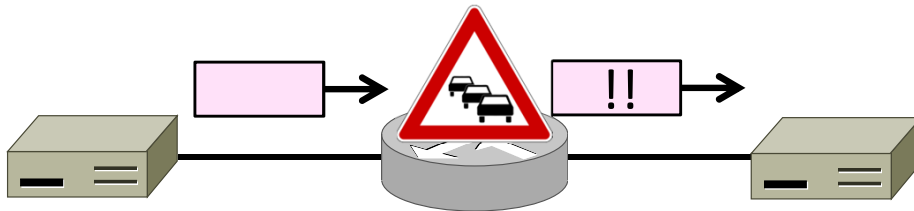
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# Topic

- How routers can help hosts to avoid congestion
  - Explicit Congestion Notification

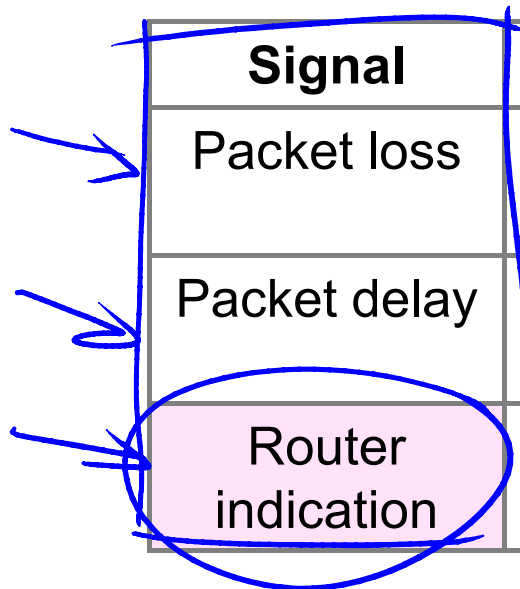


# Congestion Avoidance vs. Control

- Classic TCP drives the network into congestion and then recovers
  - Needs to see loss to slow down
- Would be better to use the network but avoid congestion altogether!
  - Reduces loss and delay
- But how can we do this?

# Feedback Signals

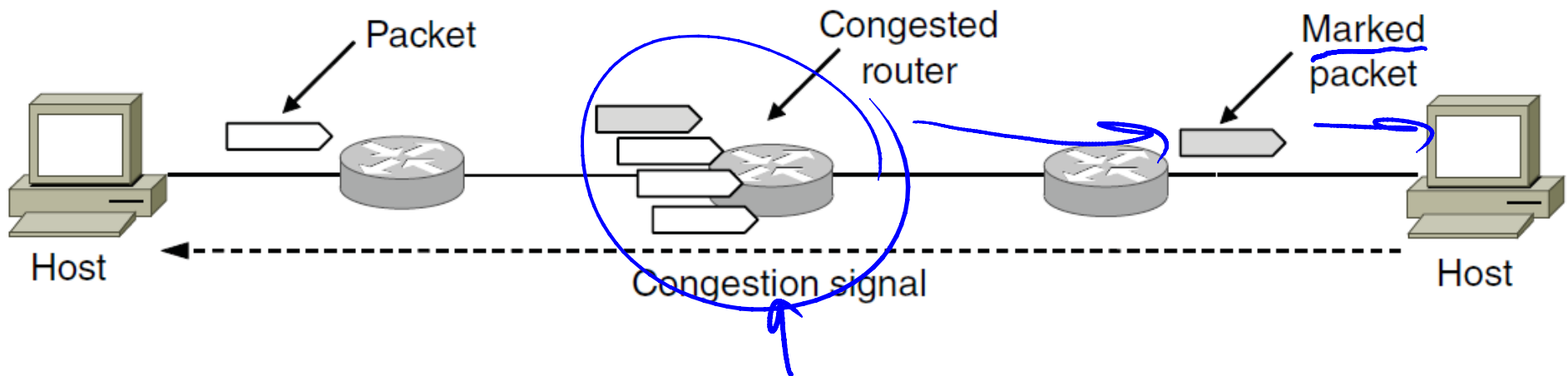
- Delay and router signals can let us avoid congestion



Signal	Example Protocol	Pros / Cons
Packet loss	Classic TCP Cubic TCP (Linux)	Hard to get wrong <u>Hear about congestion late</u>
Packet delay	Compound TCP (Windows)	<u>Hear about congestion early</u> Need to infer congestion
Router indication	TCPs with Explicit Congestion Notification	<u>Hear about congestion early</u> Require router support

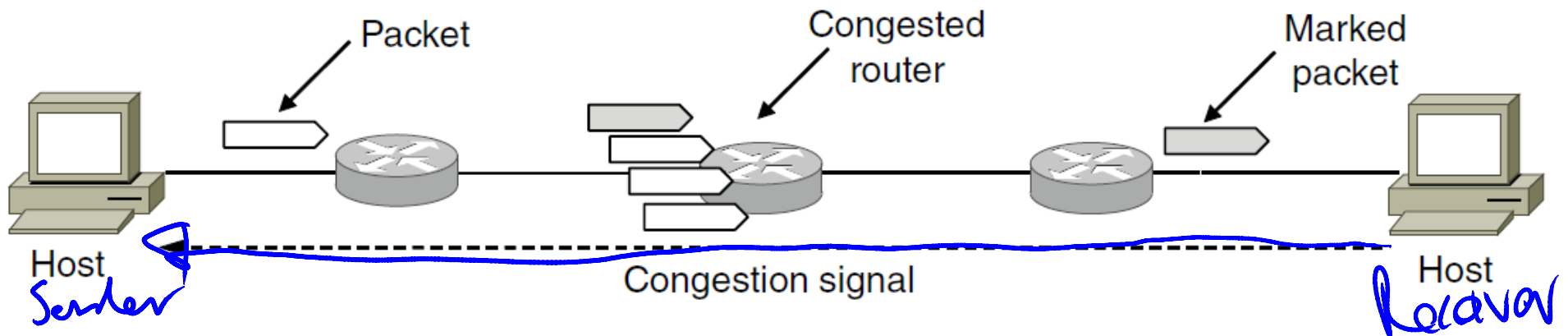
# ECN (Explicit Congestion Notification)

- Router detects the onset of congestion via its queue
  - When congested, it marks affected packets (IP header)



## ECN (2)

- Marked packets arrive at receiver; treated as loss
  - TCP receiver reliably informs TCP sender of the congestion



# ECN (3)

- Advantages:
  - ➔ Routers deliver clear signal to hosts
  - ➔ Congestion is detected early, no loss
  - ➔ No extra packets need to be sent
- Disadvantages:
  - ➔ Routers and hosts must be upgraded

# END

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