

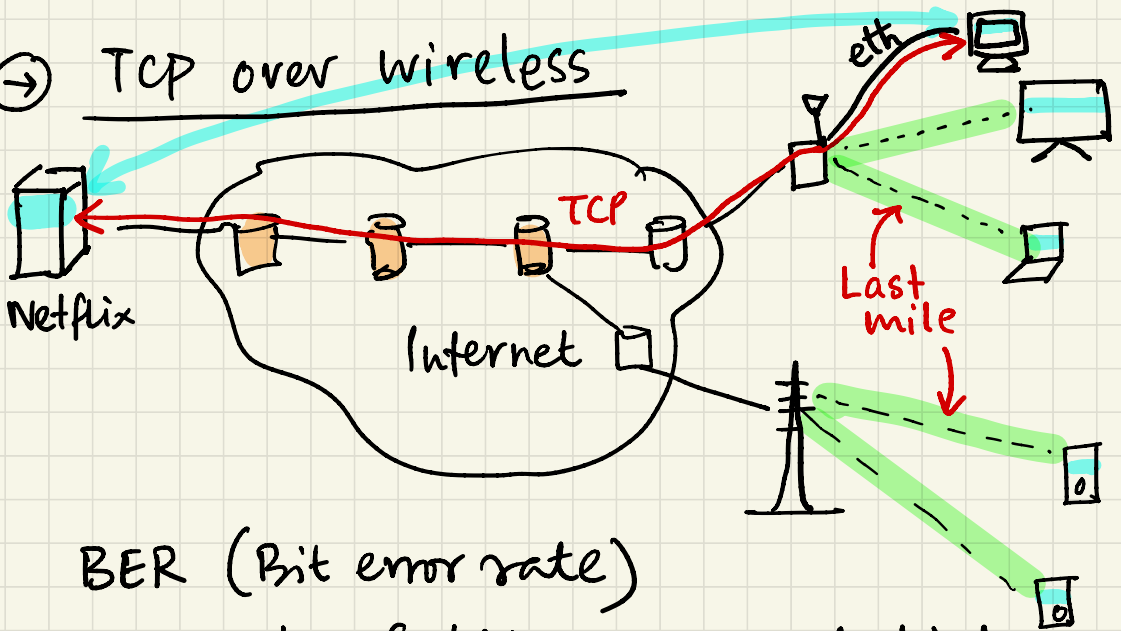
Oct 15: TCP Complete

- TCP over wireless
- TCP RED
- End to end bottleneck bandwidth estimation (pkt pair)



Network Layer

→ TCP over wireless



BER (Bit error rate)

= prob. of bit error much higher in wireless than wired.

Wireless \sim 1 bit in error every 10^{4-6} bits
 10^{-5}

wired $\sim 10^{-12}$

Packet Drop

reasons

Congestion
(Router \emptyset filled up)

response

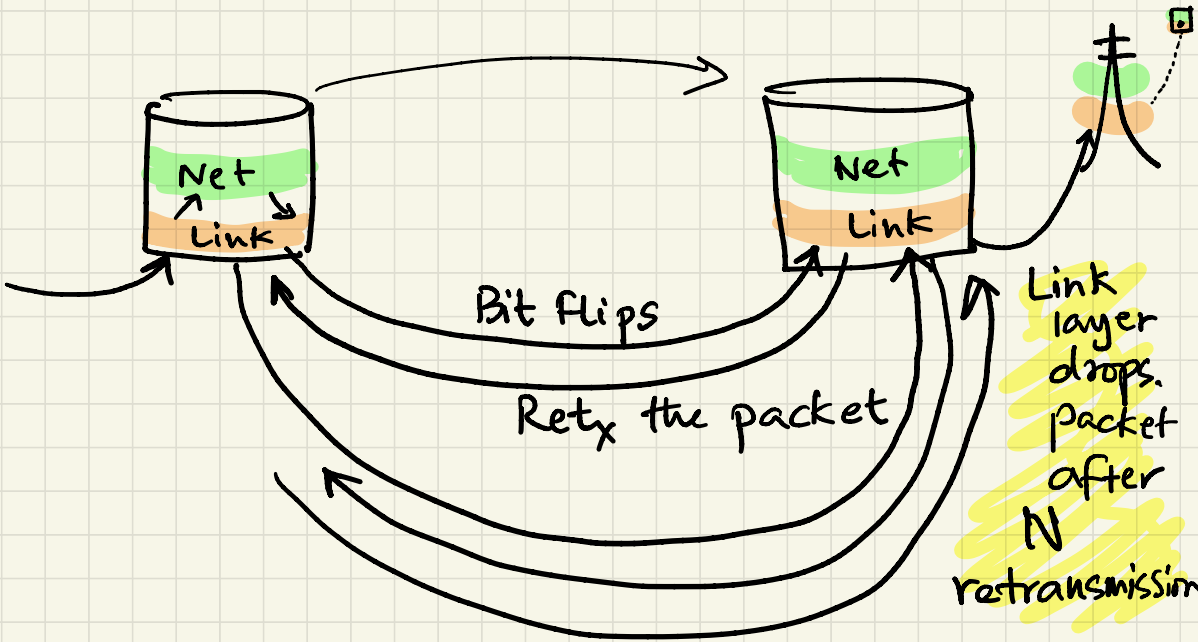
cut back CW

Wireless link failure

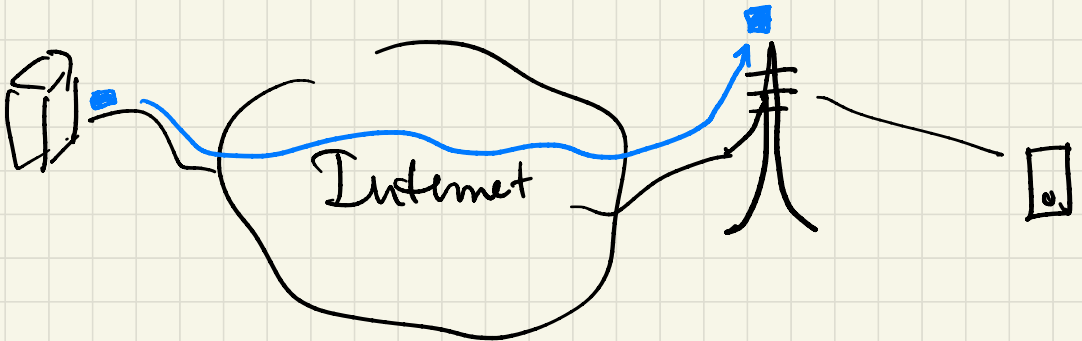
response

Just re_x.

Problem is \rightarrow TCP doesn't know the reason for packet drop.

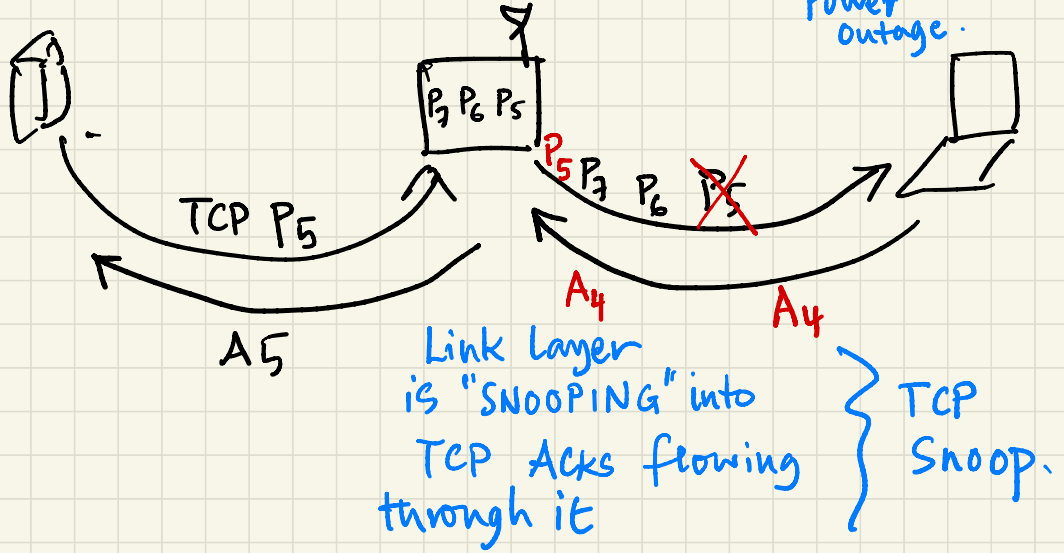
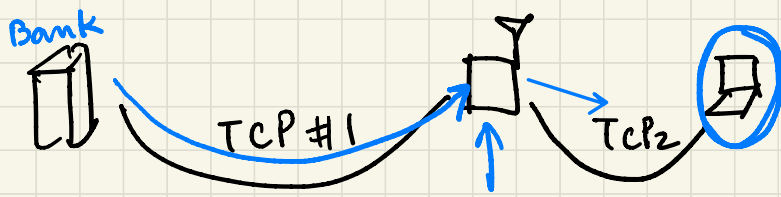


all N retx failing is very low prob.



Cross layer approaches. \rightarrow TCP asking Link layer for hints.

Split TCP.



② TCP RED (Random Early Drop).

random Drop packet when Q is beginning to fill up, say $> 60\%$.

Drop.



CW \rightarrow increasing.

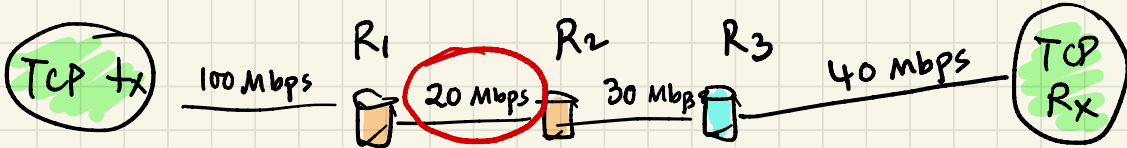
RED is a nice way for the network layer in the router to tell TCP Transmitter

that Q is filling up, so cut back on CW (via Fast Recovery).

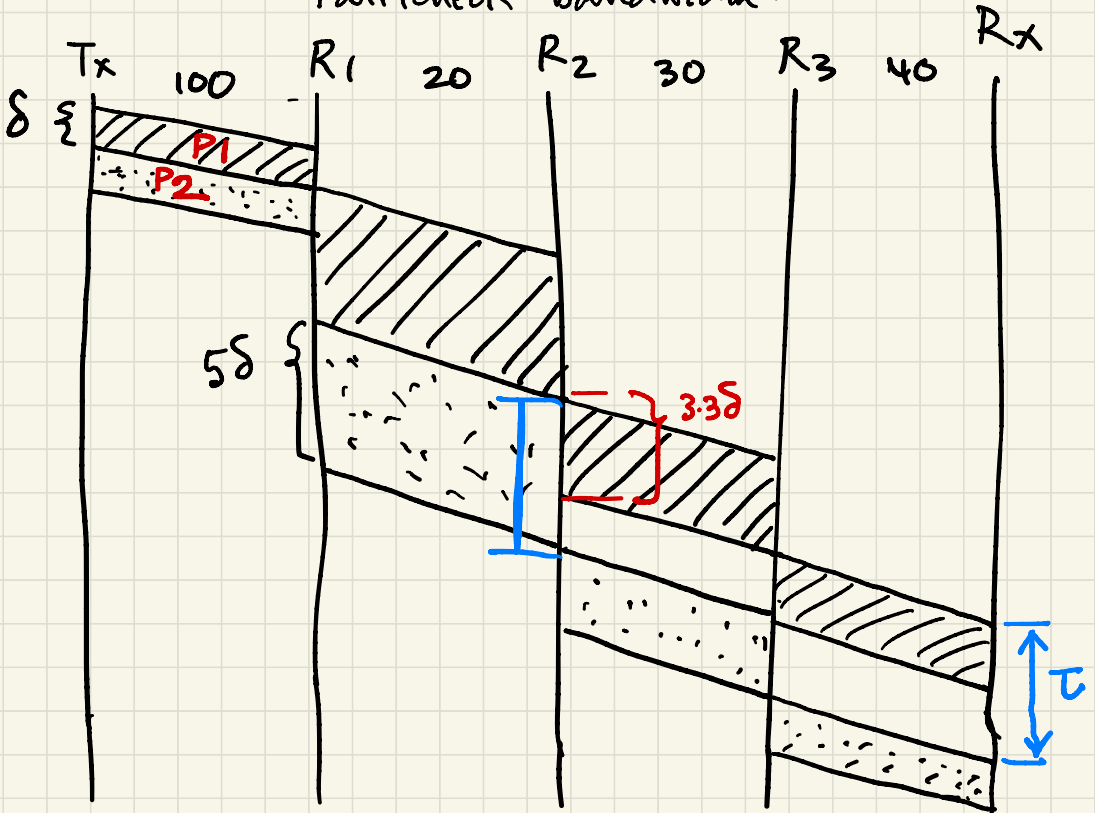


Note: Does not violate layering.

➔ Packet Pair



Bottleneck bandwidth.



$$\tau^{\checkmark} = \frac{\text{Packet Size}^{\checkmark}}{\text{Bottleneck B/w}}$$

Transport
Layer done.