L4S
A gradually deployable simplifying clean-slate opportunity

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Know the competition

The benefits of big standing queues:

- Keeps links fully utilized, by keeping backup packets for the dip in the big saw-teeth
- Allows bursts by delaying congestion response (AQM smoothing)
- Reduces the loss rate, by increasing RTT
- Reduces RTT dependency on throughput, by equalizing RTT
- Absorbs minimum window sizes
  Every flows emits at least 2 packets:
  \[
  \frac{100\text{ms} + 0}{1\text{ms} + 0} = 100 \times \frac{100\text{ms} + 100}{1\text{ms} + 100} = 2 \times \]
  - No queue
  - Big queue
Alternative solutions?

Removing queues for ultra low latency needs alternative solutions.

End-to-End principle: Try in end system first (a big buffer was the network solution)

- Reduce saw-teeth
- Remove NW smoothing, smooth in the TCP sender
- Use ECN, support lots of signaling AND scalability
- Reduce RTT dependency on throughput in the end-system
- Remove minimum window sizes

\[ p.r \approx C \]
\[ r \approx \frac{x}{p.RTT} \]
L4S and DualQ

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ect(1) reuse of ECN

think twice: coupling rule for marking

simplifies classic AQM control