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FLOQ: A new queue management solution

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Assumptions

- The Internet uses **packets** to transfer information
- **Routers** help navigate the packets to their correct destination(s)
- **Buffers** exist within routers that hold the packets
- **Algorithms** that manage those buffers exist

- Basic **TCP dynamics**
  - Packet loss recovery (**retransmission timeout(RTO)**; **fast-retransmit**)

The Problem

- Web requests *sometimes* take long to complete... Even close to the caches
- In a mobile environment that is not uncommon.
- What causes this issue? How can we address it? What are the trade-offs?

Verifying Causation

- We built a simulation environment featuring:
  - TCP web
  - Long TCP (e.g., file downloads)
  - On-Off TCP (DASH streaming)
  - QUIC web (It is 2020 afterall...)
  - C.B.R. UDP

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- We created Light, Medium, and High network load scenarios by varying the number of **long TCP** connections

The Cause

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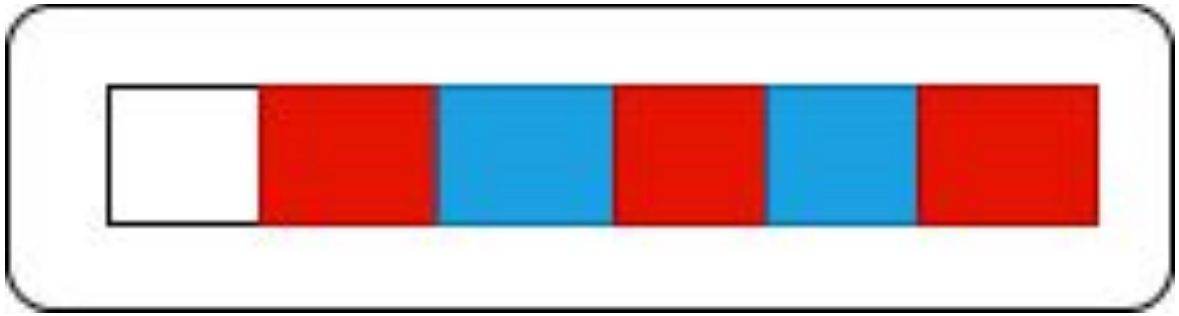
- How can we alter packet loss behaviour?

(Active) Queue Management



(Active) Queue Management Summary

- Different AQMs have different impact w.r.t. P.L.T.

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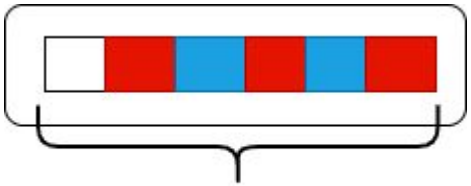
- None of the AQMs solved the initial packet loss problem.

(Active) Queue Management

- By its size?
  - Tail/front first in first out (FIFO) drop



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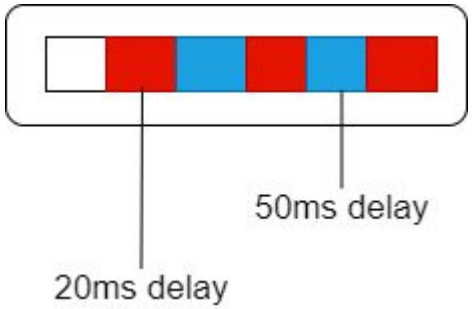

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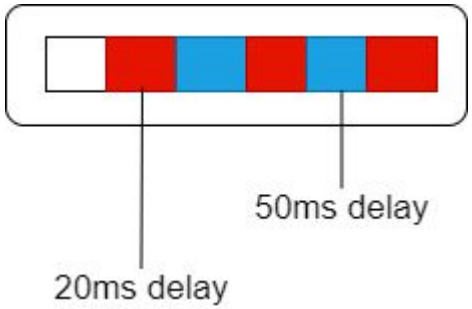

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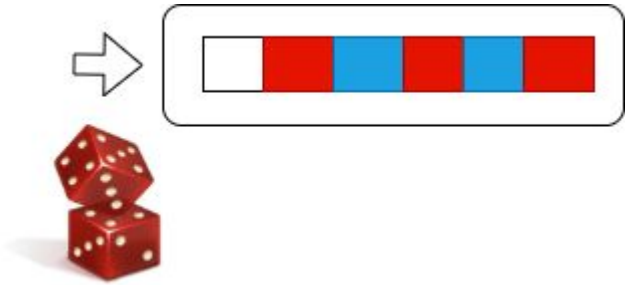

- By using stochastic functions?
  - Random Early Detection (RED)

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- What if that new AQM was designed to target initial packet loss?
- What would be the impact for all other traffic?

FLow Optimised Queuing (FLOQ)

- Use traffic metadata
  - Divide traffic into responsive (congestion-controlled) and unresponsive (not congestion-controlled)
  - Keep state if connection is in setup phase

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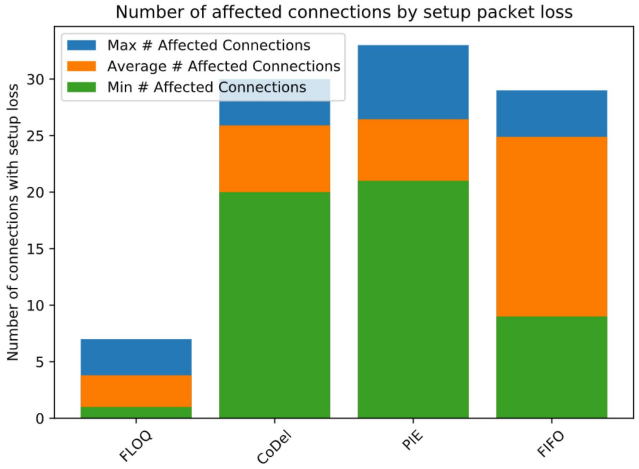
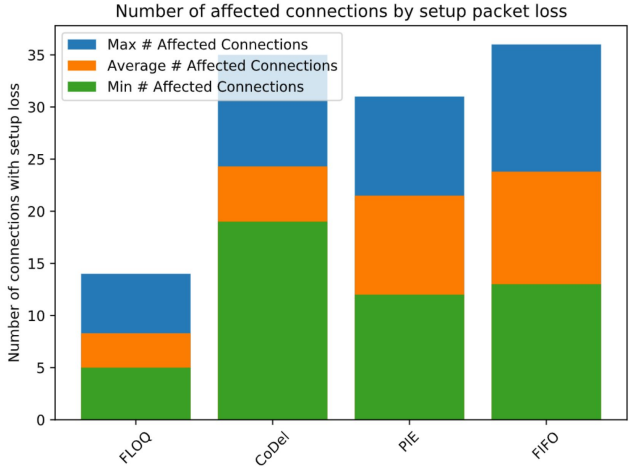
- Use this metadata to calculate a drop chance when capacity exceeds a threshold (like RED)

What Is The Impact?
(A portion of stats)

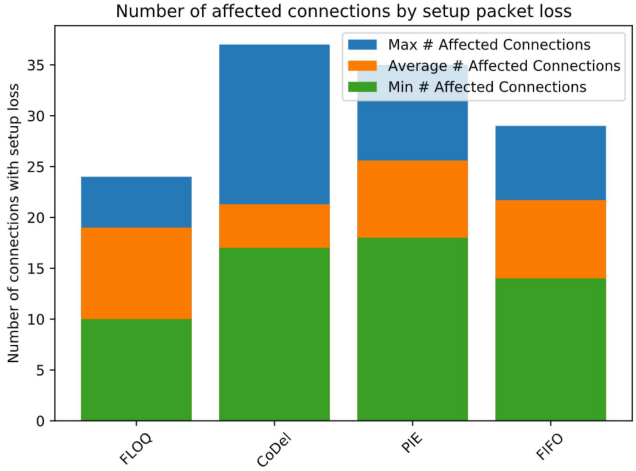
Page Load Time (PLT)



Light



Medium



Heavy

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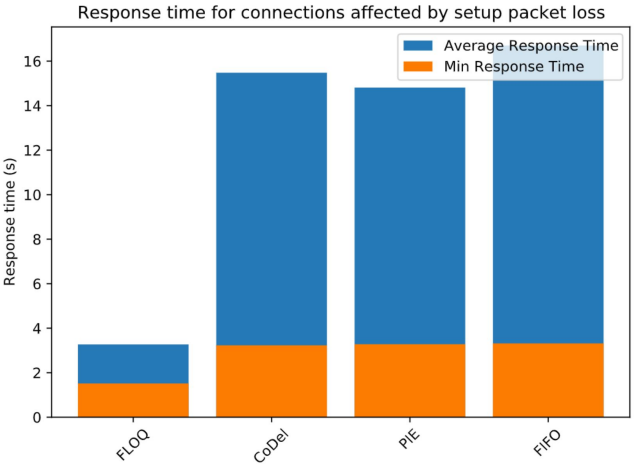

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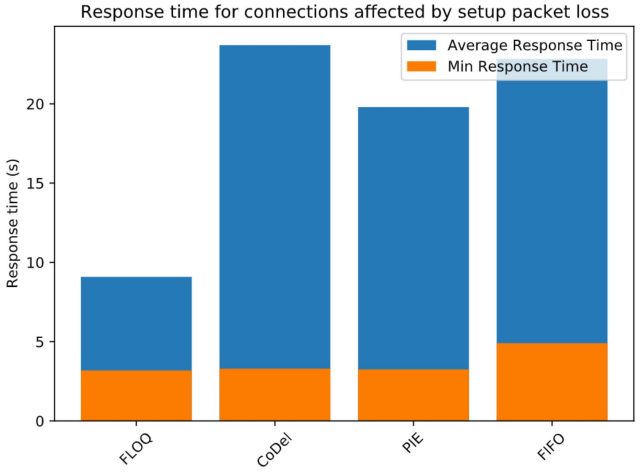

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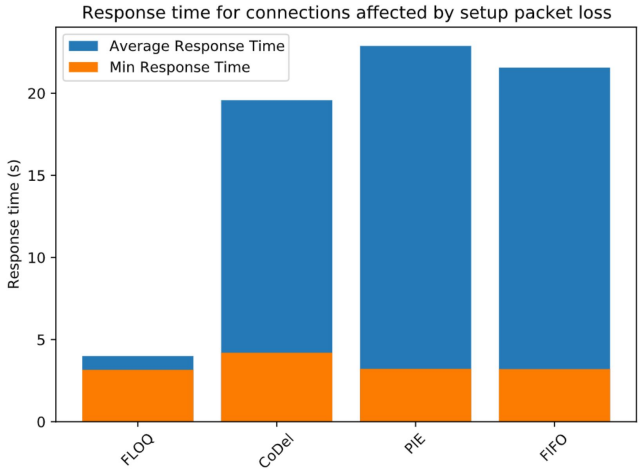

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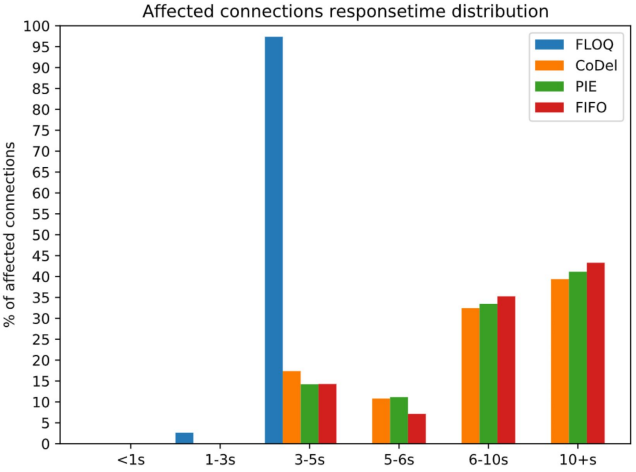

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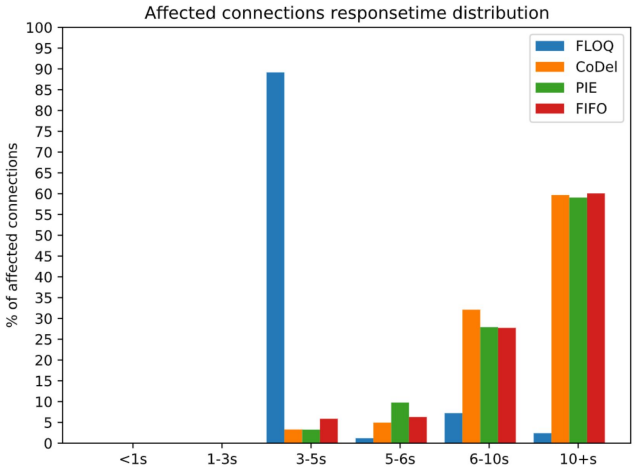

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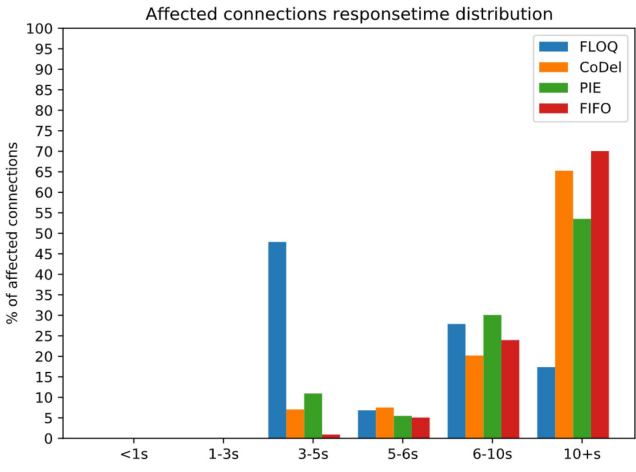

Heavy

TCP Throughput

Light

	FLOQ	CoDel	PIE	FIFO
Avg. Throughput	1.78 (-29.9%)	2.54	2.5	2.51
Jain's Fairness	0.999	0.993	0.995	0.996

Medium

	FLOQ	CoDel	PIE	FIFO
Avg. Throughput	1.7 (+27.06%)	1.25	1.24	1.25
Jain's Fairness	1.000	0.989	0.989	0.984

High

	FLOQ	CoDel	PIE	FIFO
Avg. Throughput	1.04 (+29.81%)	0.73	0.73	0.73
Jain's Fairness	0.998	0.987	0.983	0.988

UDP Packet Loss

Light

	FLOQ	CoDel	PIE	FIFO
Avg. Pkt Loss	40.3 (+21.13%)	33.29	32.23	33.30

Medium

	FLOQ	CoDel	PIE	FIFO
Avg. Pkt Loss	12.16 (-65.8%)	38.36	37.71	34.54

High

	FLOQ	CoDel	PIE	FIFO
Avg. Pkt Loss	17.64 (-52.51%)	37.14	41.95	39.94

Summary

- Using FLOQ observed PLTs is faster.
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- Using FLOQ observed PLTs is faster.
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- When affected by initial loss, connections respond faster.
- TCP throughput and non congestion controlled traffic packet loss is also improved in some network scenarios.

Future Work

- Deeper analysis of collected data. What about DASH?
- Improved simulation (sandbox) environment. More accurate approximations of VoIP, real-time video.
- Breaking the sandbox - study of FLOQ in the wild.
- Interaction with different congestion control algorithms.