



Classic / SEARCH / HyStart++

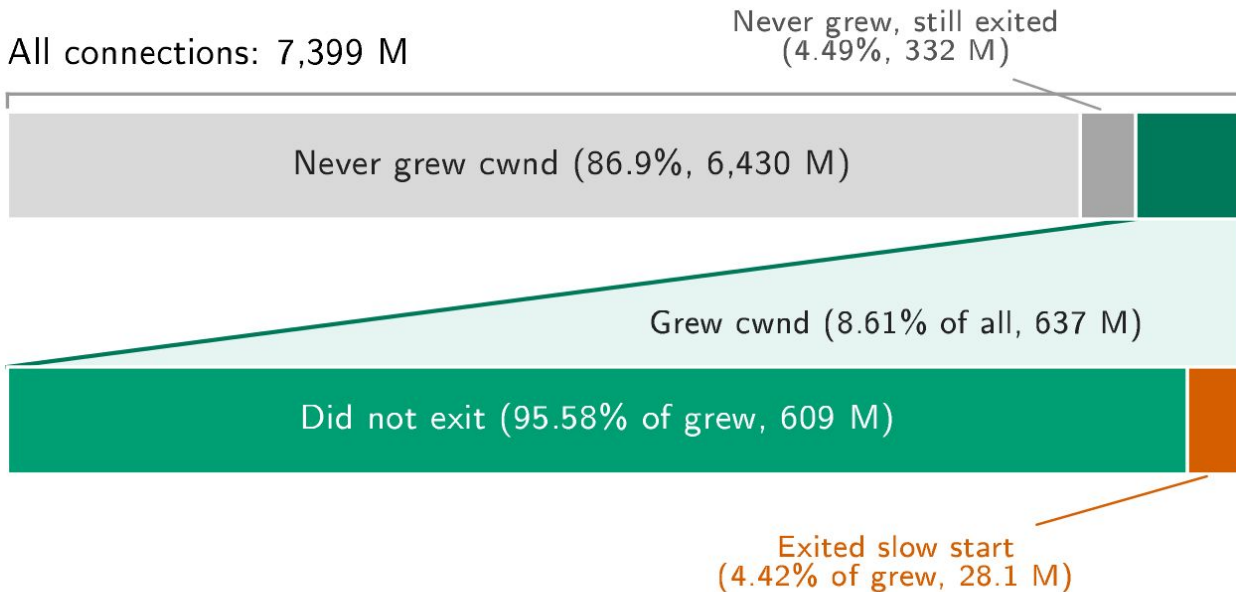
Slow Start Experimentation in Firefox's QUIC stack

What have we been doing

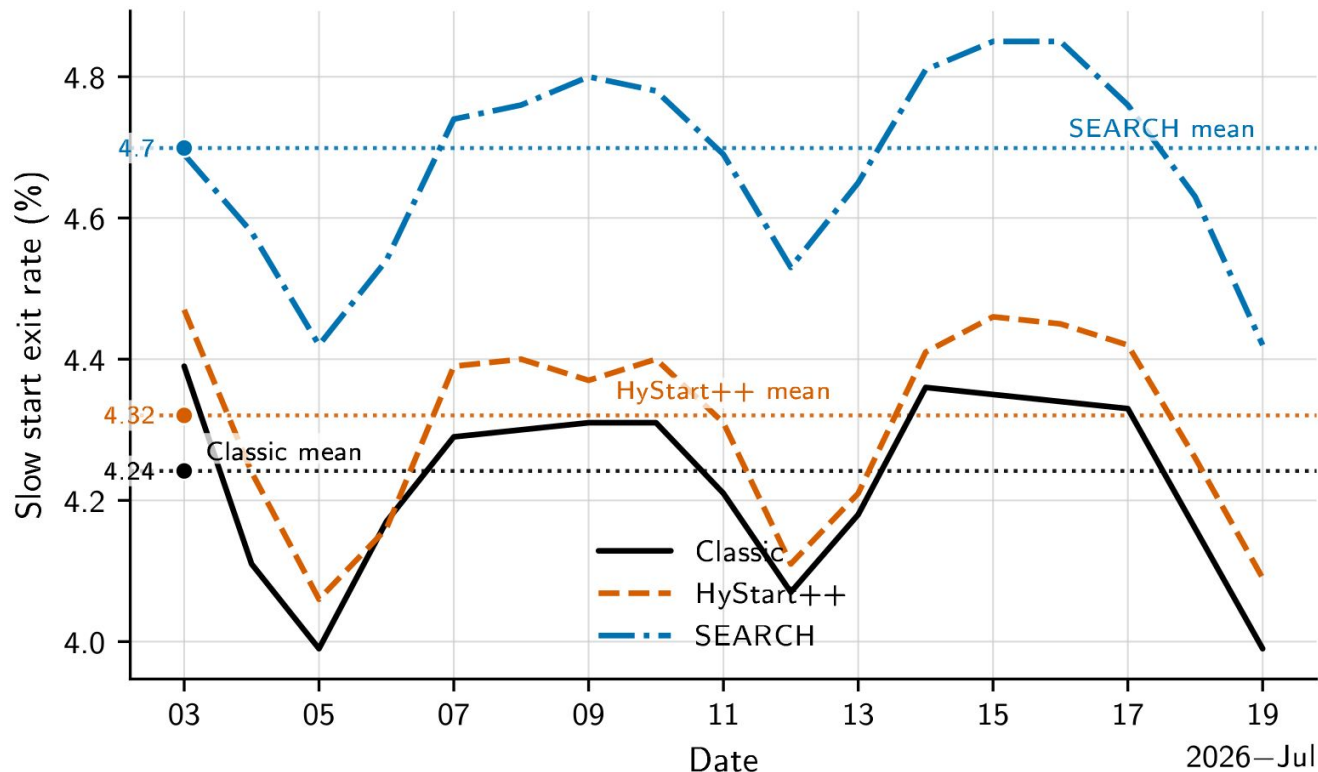
- **Nego**, Firefox's QUIC stack
- we have implemented **SEARCH** and **HyStart++** in a runtime-switchable slow start framework, in addition to our current congestion-event based default ("**Classic/Control**")
- done A/B/C experimentation on **Desktop** Nightly, Beta and now Release from **July 2nd - July 19**
- Now we bring the **results** (and **questions**)



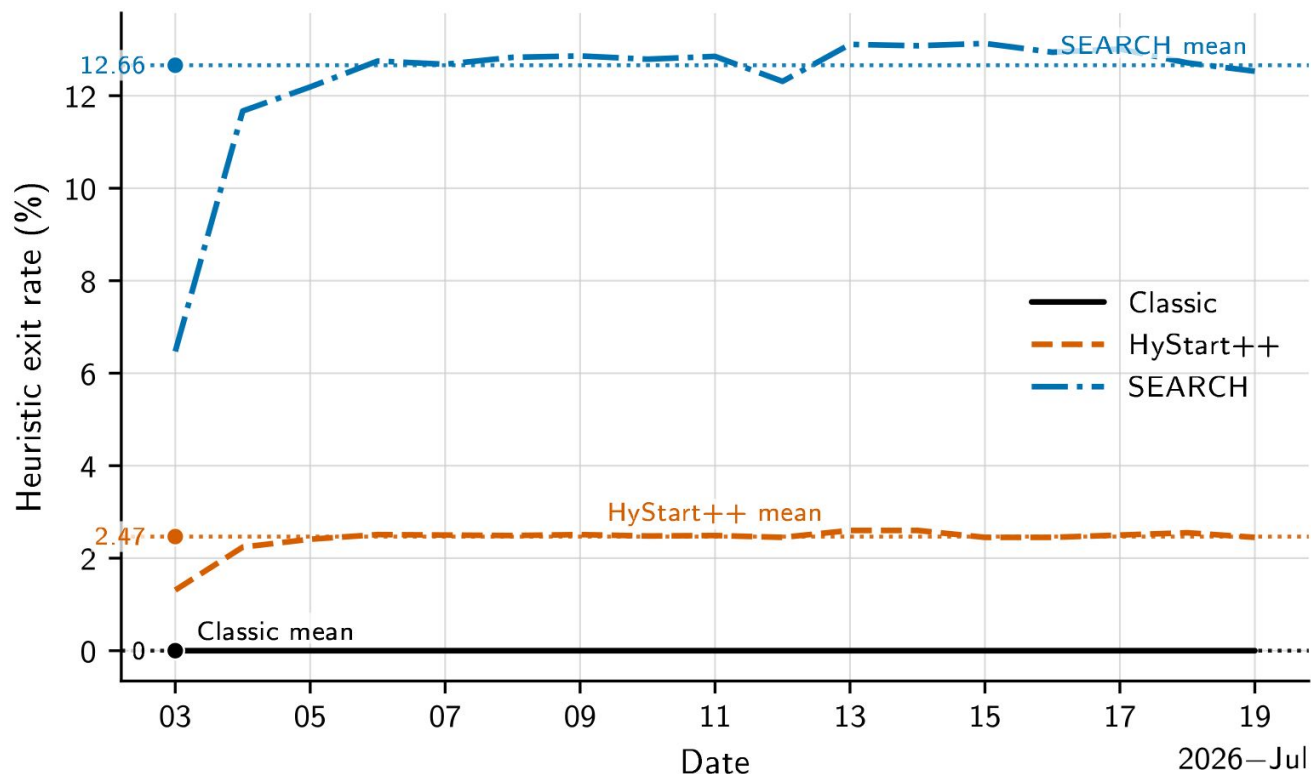
The Dataset



Slow Start Exit Rate



Slow Start Heuristic Exit Rate



Low **sssthresh** at Slow Start Exit

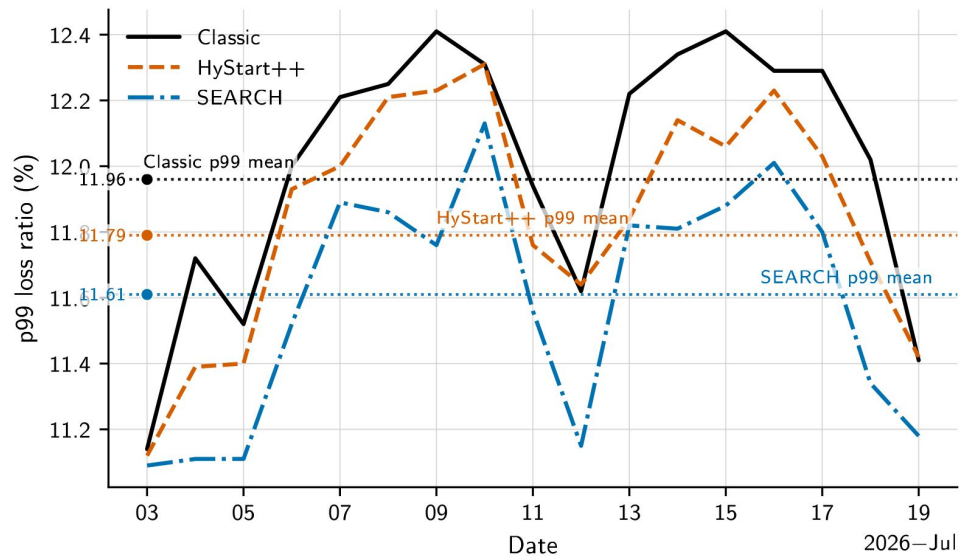
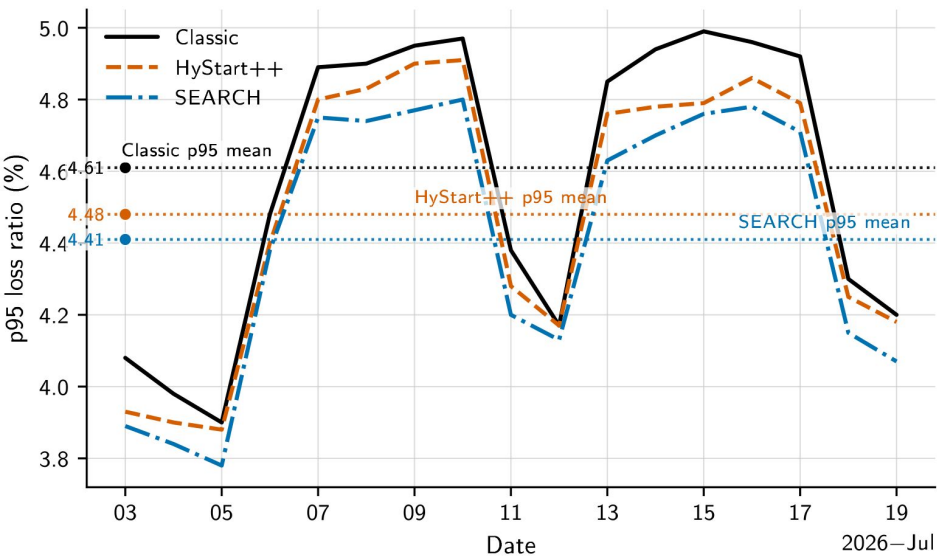
■ 99.9%	4.6M
■ 99%	962K
■ 95%	299K
■ 75%	44K
■ 50%	20K
■ 25%	14K
■ 5%	8.6K

- All of Firefox Release, no Heuristics
- **p50** at **20,000**
- **p25** at **14,000**
- **p5** at **8,600** → Congestion at IW?!

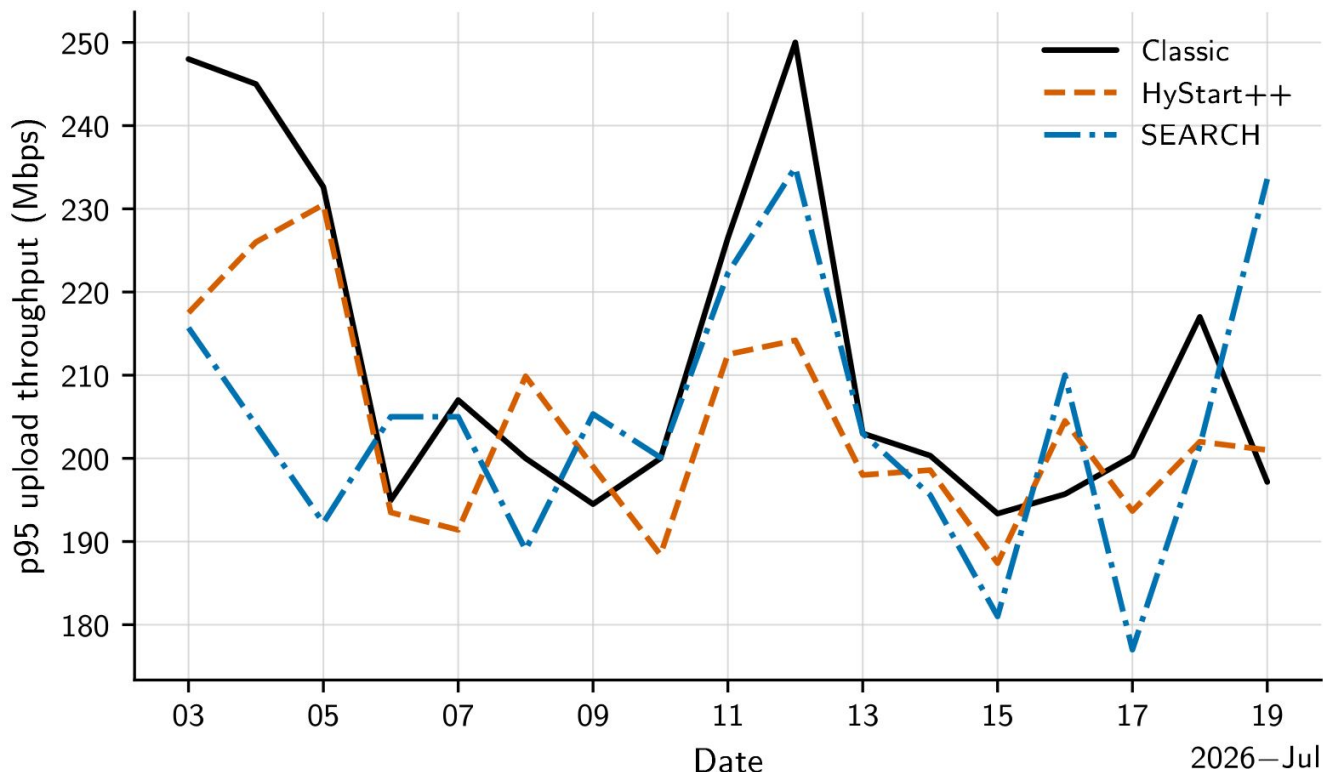
This is too early for heuristics to work



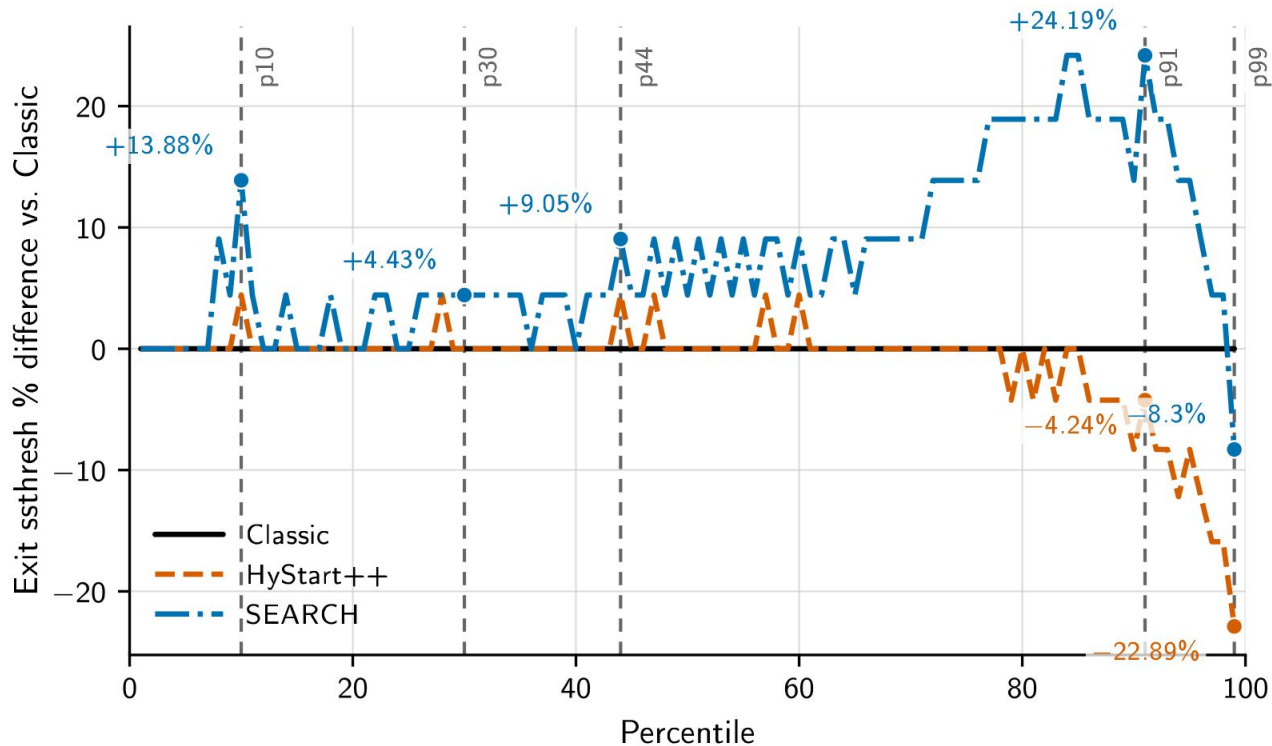
Packet Loss Ratio p95 and p99



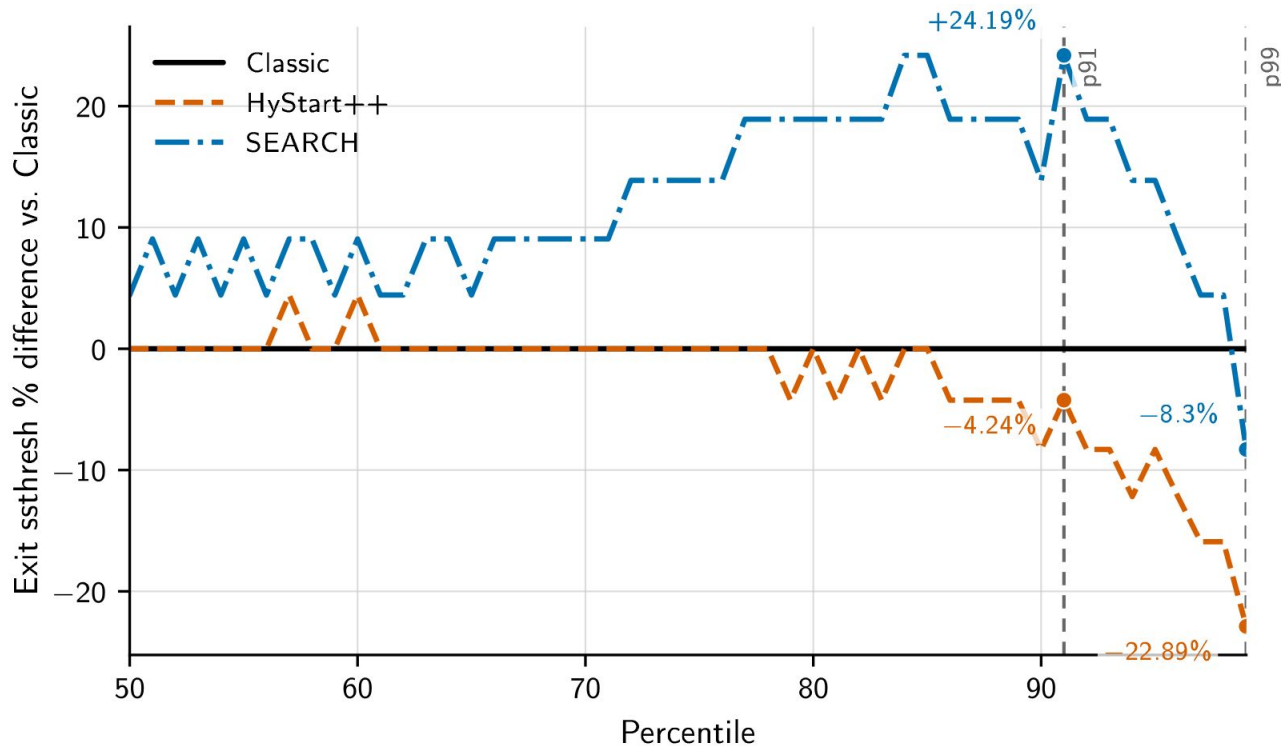
Upload Throughput p95 for 10MB+



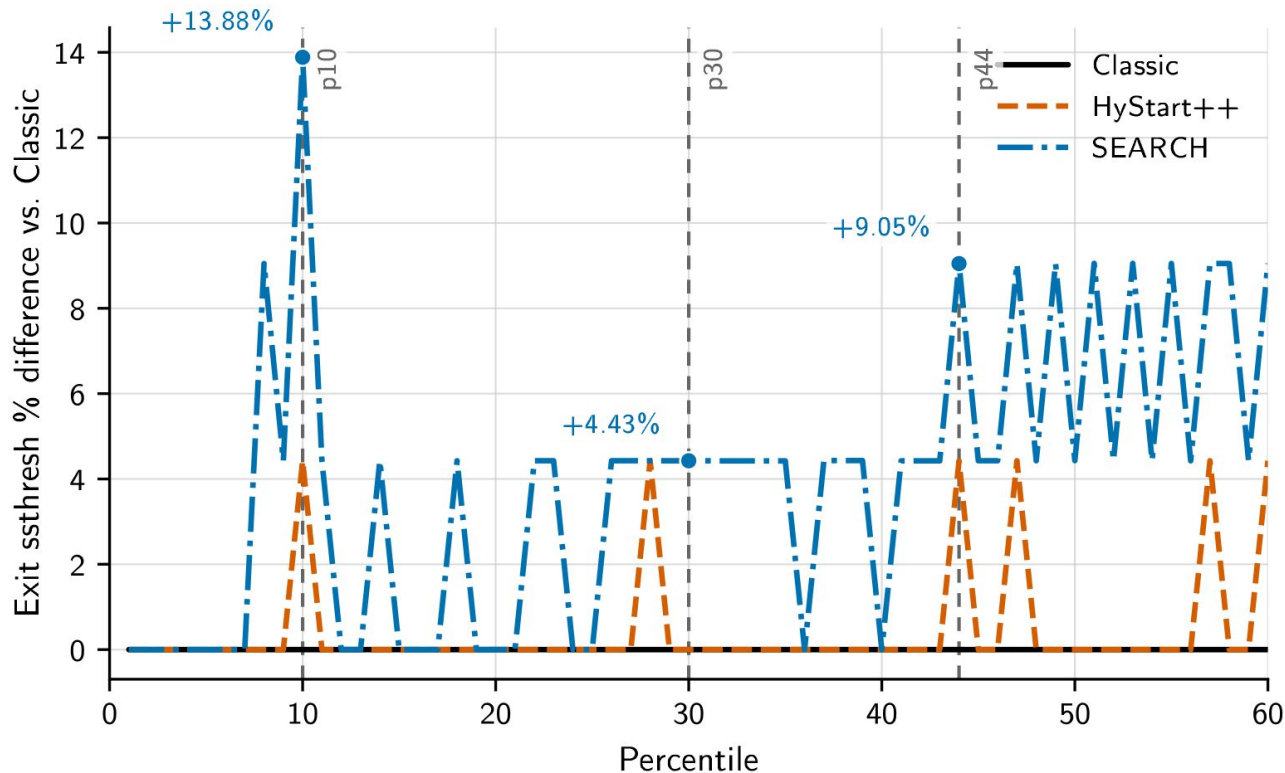
Exit ssthresh % difference to Classic



Exit ssthresh % difference to Classic



Exit ssthresh % difference to Classic



SEARCH Low CWND Exits

- We think SEARCH might be struggling with **app-limited** traffic patterns seen in the browser
- If we are **not continuously sending** this breaks assumptions and might mess up the byte tracking logic, causing it to **exit early**



Questions!

- How do our connection patterns (% **never growing cwnd**, % **exiting slow start**) match up with others experiences?
- Why are we seeing many **low ssthresh congestion events** at 8,600 - 20,000 bytes?



Are we seeing AQM?

- Theory: Our bottleneck is the **home router**
- All of Release, no Heuristics:
 - **10-20%** of our Congestion Events are **ECN-CE**
- This could mean we see Congestion Events (both loss and ECN-CE) earlier than with large buffers and tail-drop



Questions?

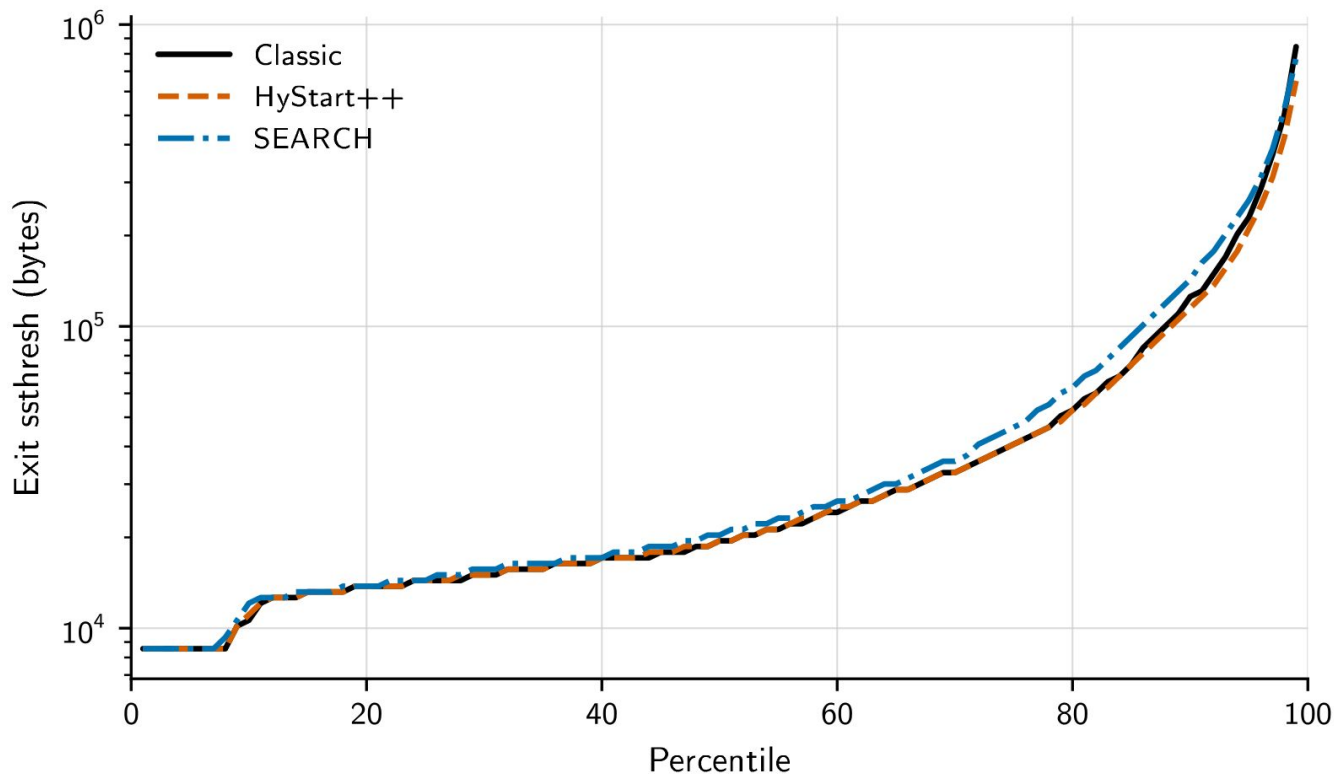
- How do our connection patterns (**% never growing cwnd**, **% exiting slow start**) match up with others experiences?
- Why are we seeing many **low ssthresh congestion events** at 8,600 - 20,000 bytes? → AQM?
- More questions, have opinions or want to talk?
 - Find me in the **hallway**, or
 - omansfeld@mozilla.com (me) and necko@mozilla.com (team)



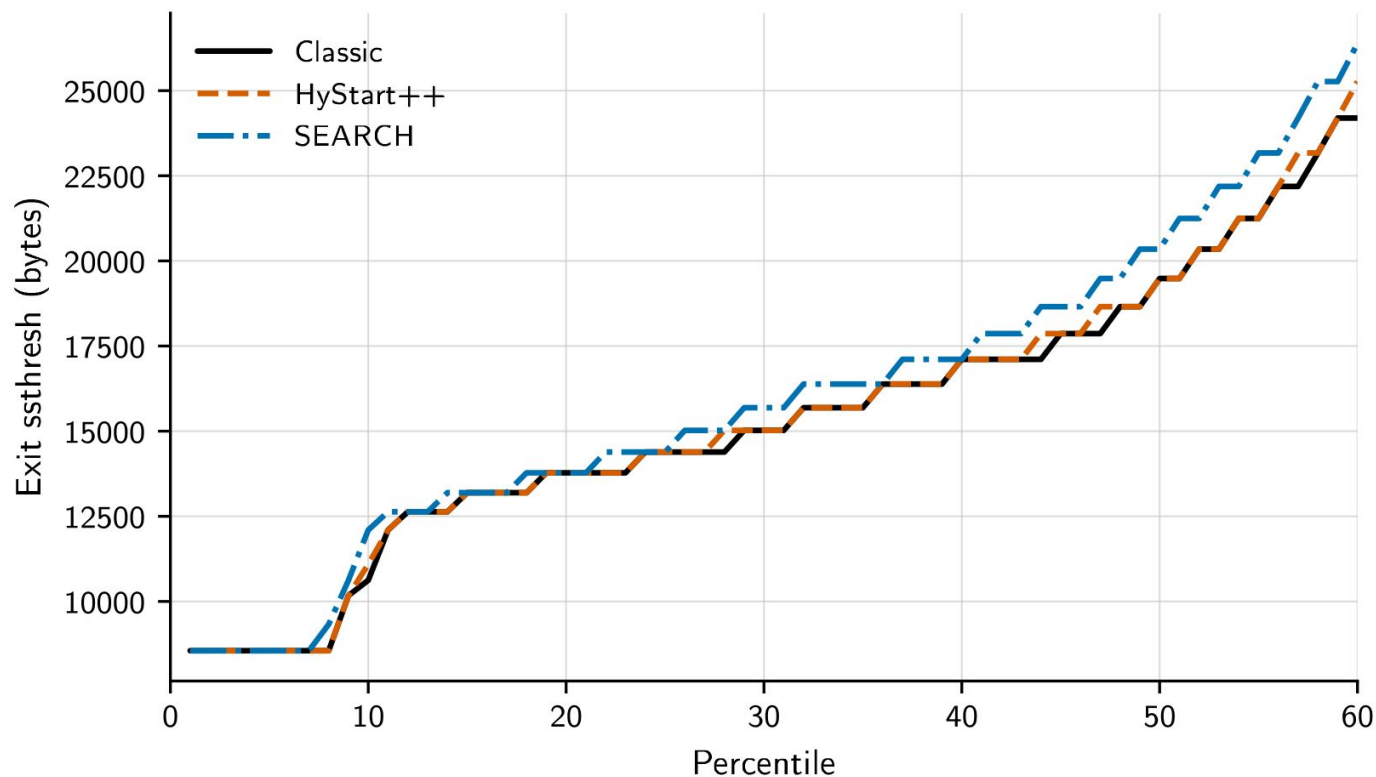


BONUS SLIDES

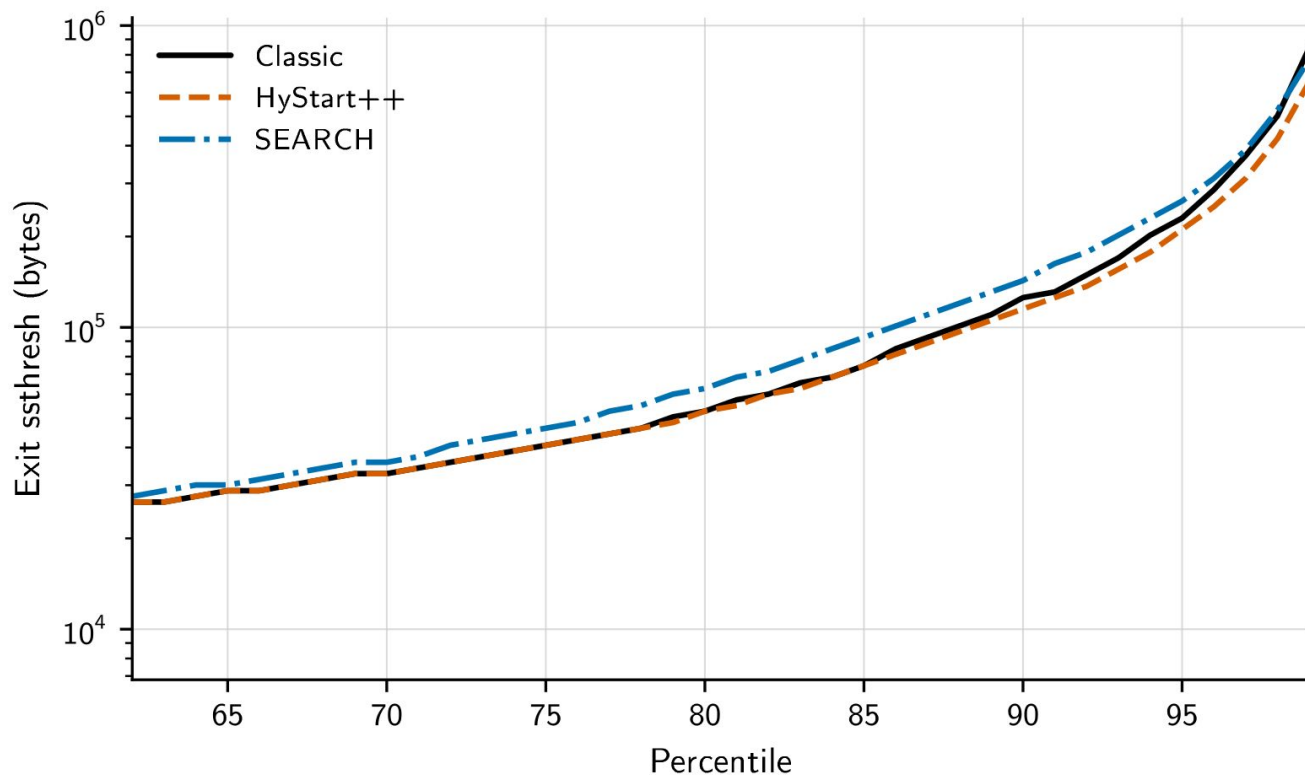
Exit ssthresh percentiles (all)



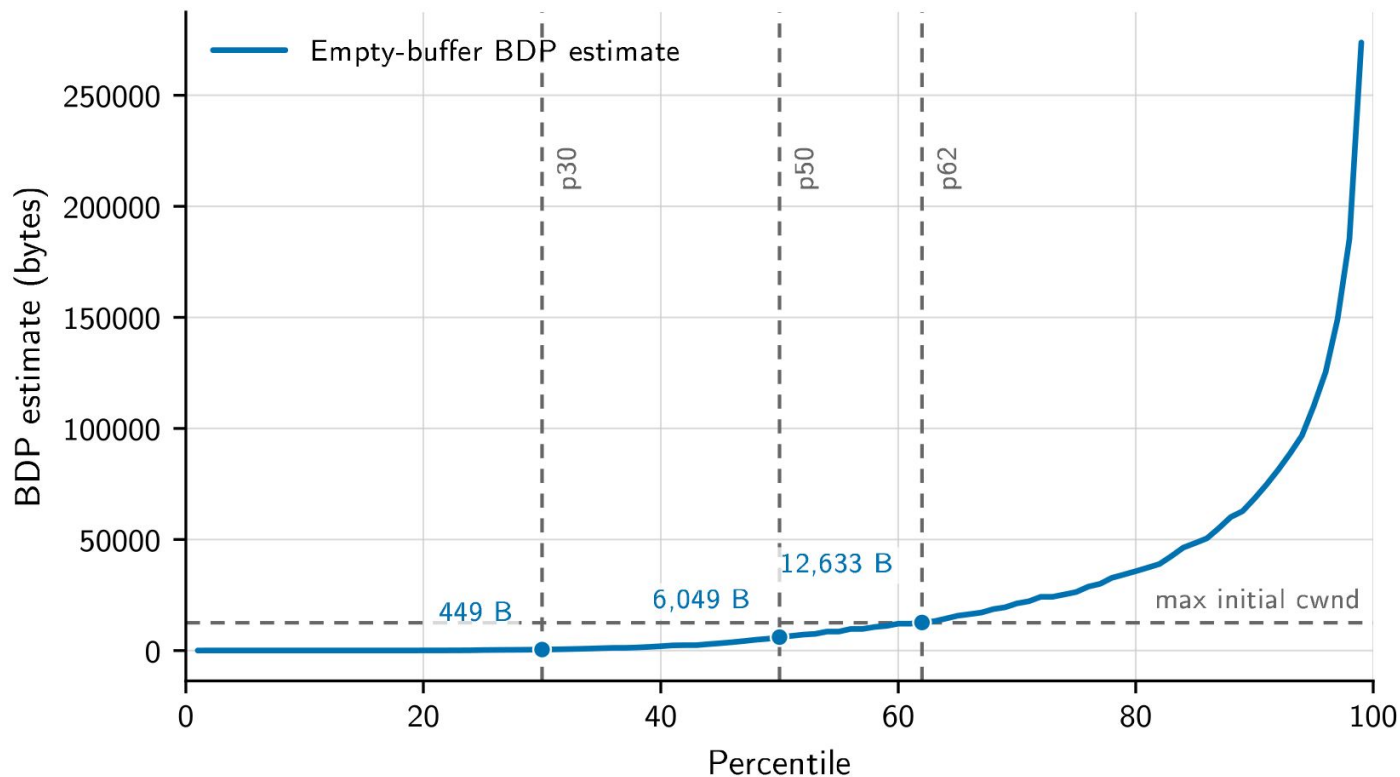
Exit ssthresh percentiles (lower)



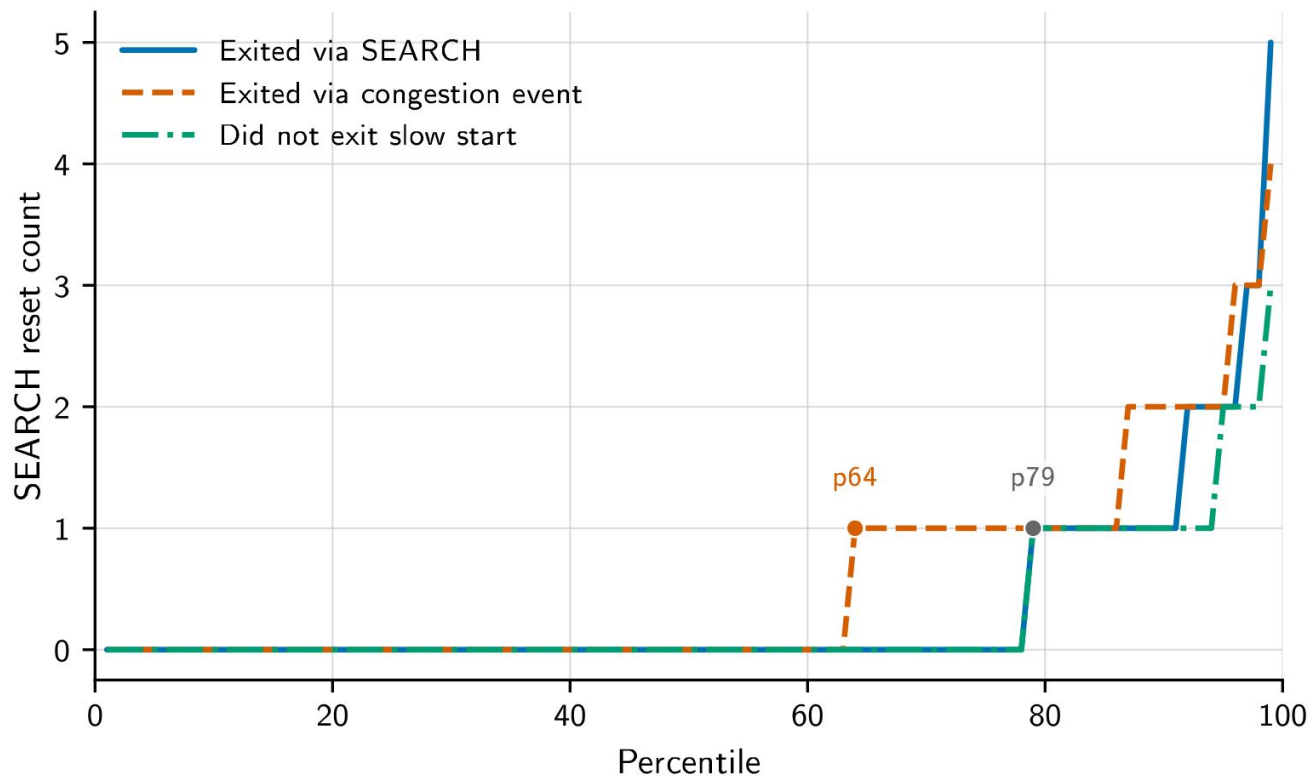
Exit ssthresh percentiles (higher)



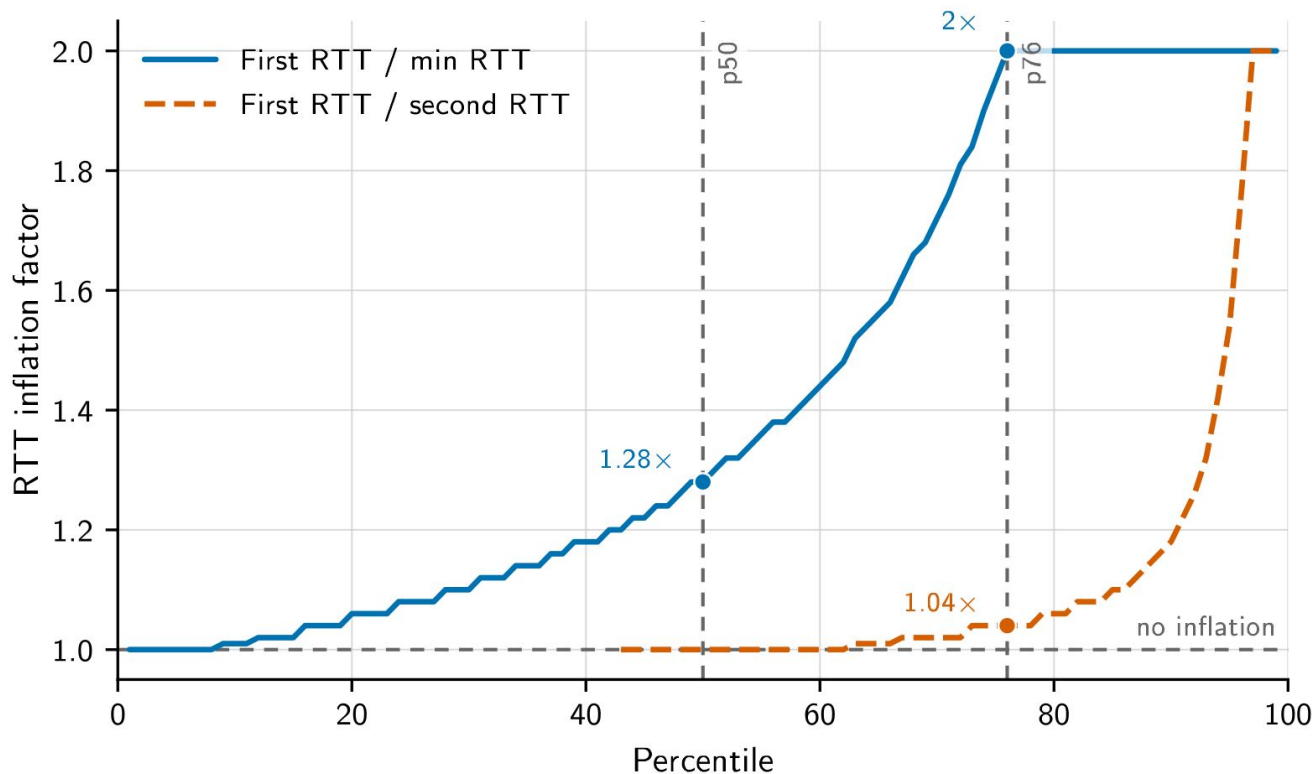
SEARCH BDP estimate



SEARCH Reset Count

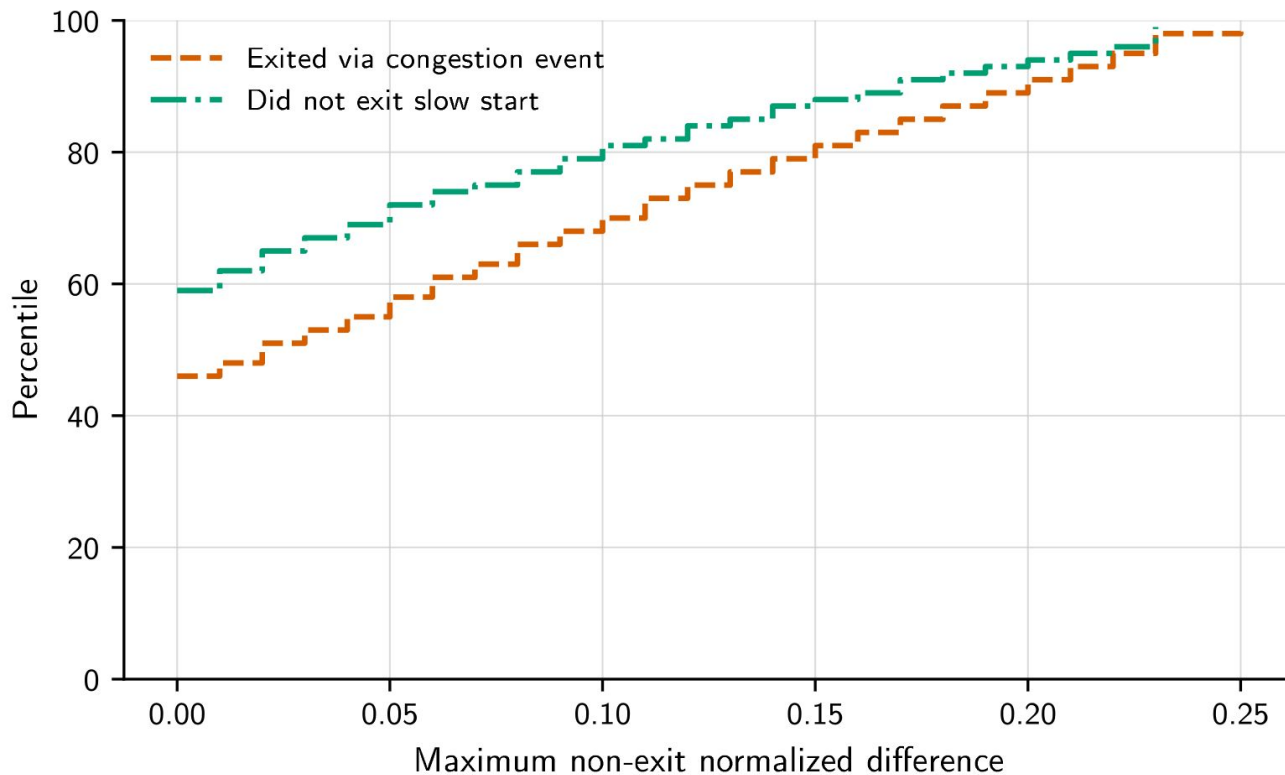


SEARCH Initial RTT Sample Inflation*

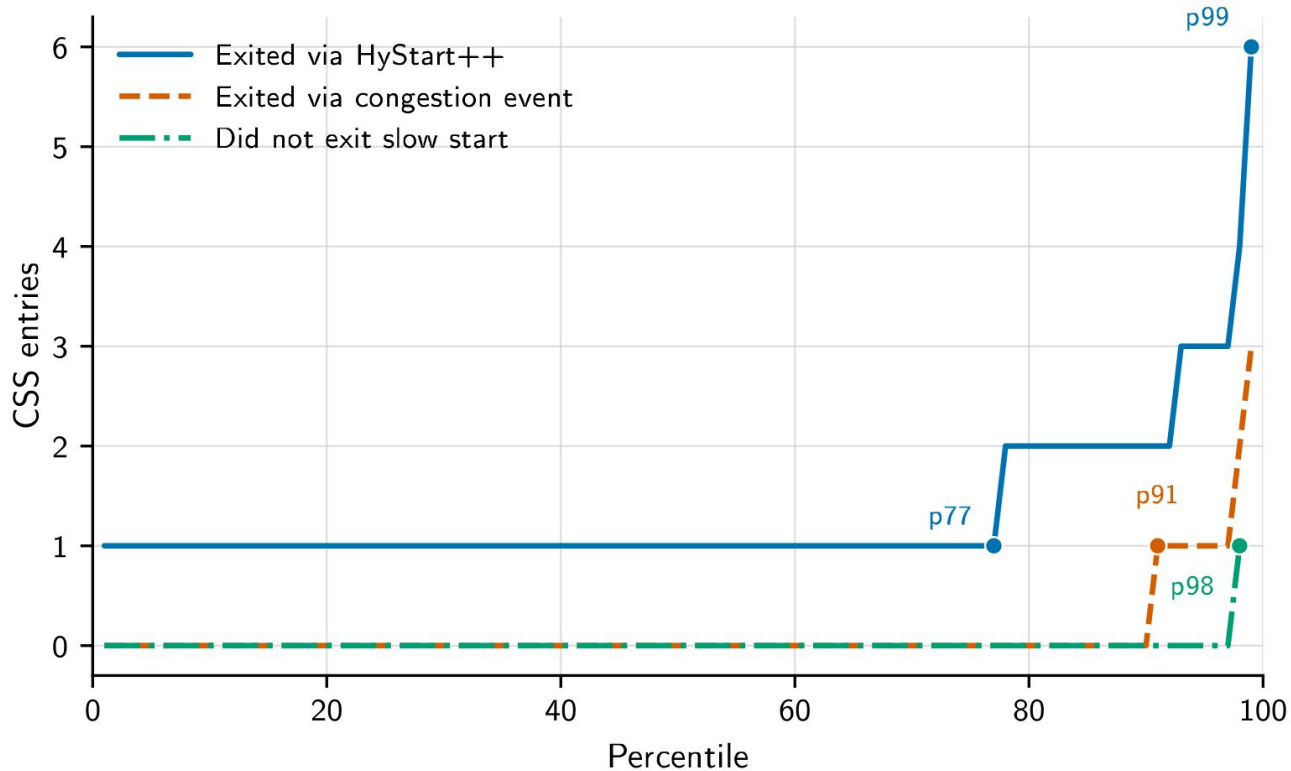


* "second RTT" refers to the second RTT sample seen by SEARCH, not the second round-trip

SEARCH Maximum Non-Exit Normalized Diff



HyStart++ CSS Entries



HyStart++ CSS Rounds Finished

