

# Analyzing the Influence of Resource Prioritization on HTTP/3 HOL Blocking and Performance

Constantin Sander, Ike Kunze, Klaus Wehrle

{sander, kunze, wehrle}@comsys.rwth-aachen.de

<https://www.comsys.rwth-aachen.de/>

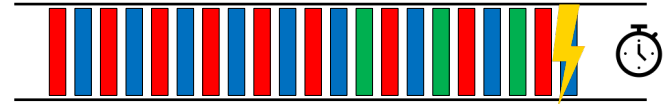
IETF 114 Meeting (maprg)  
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The screenshot shows the Nature journal homepage. At the top left is the 'nature' logo. To the right are links for 'View all journals', 'Search', and 'Login'. Below the logo are navigation links: 'Explore content', 'About the journal', 'Publish with us', and 'Subscribe'. On the right side of the navigation bar are 'Sign up for alerts' and 'RSS feed'. The main content area features five article thumbnails with titles: 'Scientists hail historic malaria vaccine approval – but point to challenges', 'Climate change, science and COP26: have your say', 'Colorimetric histology using plasmonically active microscope slides', 'Daily briefing: Inside Merck's COVID drug, molnupiravir', and a 'nature' journal cover thumbnail. A vertical copyright notice '© nature.com' is on the right side of the screenshot.

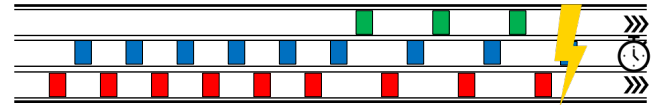
- **HTTP/2: multiplexing via TCP connection**

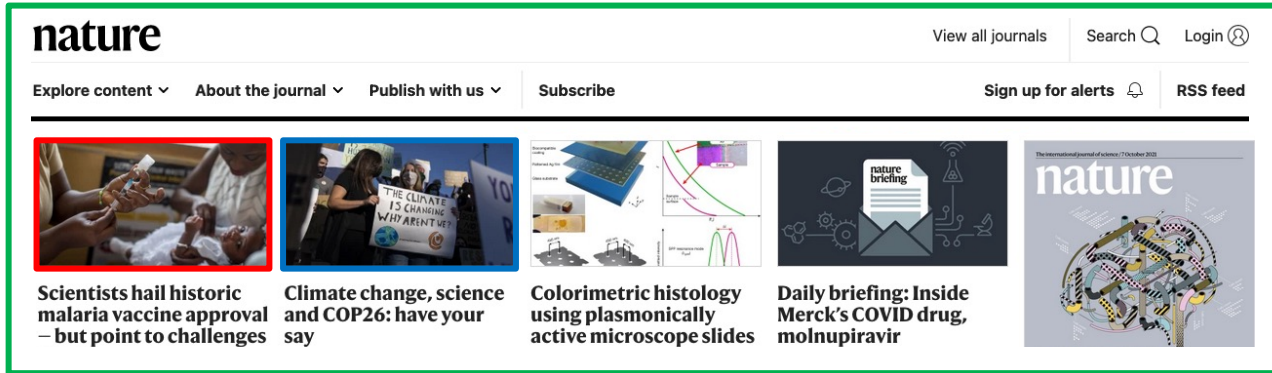
- ▶ TCP unaware of streams, transport HOL blocking



- **HTTP/3: multiple QUIC streams**

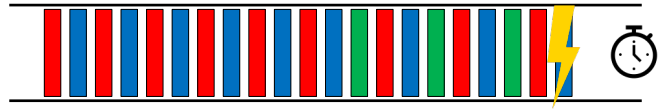
- ▶ Independent, no inter-stream HOL blocking





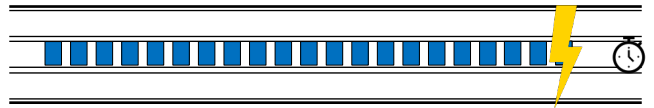
- **HTTP/2: multiplexing via TCP connection**

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- **HTTP/3: multiple QUIC streams**

- ▶ Independent, no inter-stream HOL blocking



- **Resource Prioritization: Browser signals server preferred scheduling**
  - ▶ E.g., send HTML first, then images
  - ▶ Different prioritization strategies per browser

## Prioritization Strategies

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Round Robin

Weighted Round Robin

Chrome (sequential)

Firefox (WRR+sequential)

- **Resource Prioritization: Browser signals server preferred scheduling**

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- ▶ Different prioritization strategies per browser

Prioritization Strategies	Wijnants et al. HTTP/2 Performance	Marx et al. HTTP/3 Performance
Round Robin	worst	worst
Weighted Round Robin	worst	worst
Chrome (sequential)	best	better
Firefox (WRR+sequential)	best	better

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A red rounded rectangle highlights the 'better' performance results for Chrome and Firefox under HTTP/3. A callout box labeled 'Website specific' points to this highlighted area.

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Worst for HOL?

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Annotations:

- A red box highlights the 'best' and 'better' results for Chrome and Firefox, with a callout box asking "Worst for HOL?".
- A callout box under the 'best' results for Chrome and Firefox asks "HTTP/2 ≠ HTTP/3".
- A callout box under the 'better' results for Chrome and Firefox asks "Premature QUIC stack constant rate / no loss".



- Evaluate impact of prioritization on HTTP/3 performance under loss

- ▶ Change Loss, Loss Burstsize, RTT, Bandwidth
- ▶ Test (W)RR, Chrome, Firefox, Firefox (EPS adapted)
  - Identify HOL blocking + performance

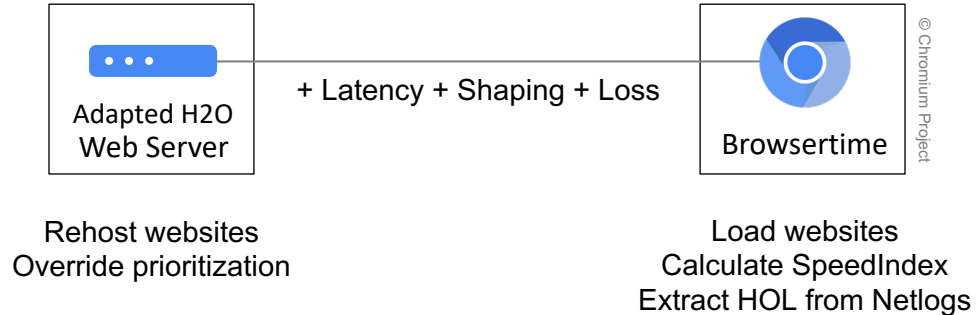
Loss	RTT	BW	Loss Burstsize
0%	10ms	1Mbps	1
1%	50ms	2Mbps	5
2%	100ms	5Mbps	10
5%		10Mbps	15

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- ↓ Download 35 websites (from 1 & 2)
- ↻ Replay websites (30 times per setting)
- ⬆️ Measure SpeedIndex & HOL bytes



- $\Delta$ : Relative median difference to Chrome / sequential baseline

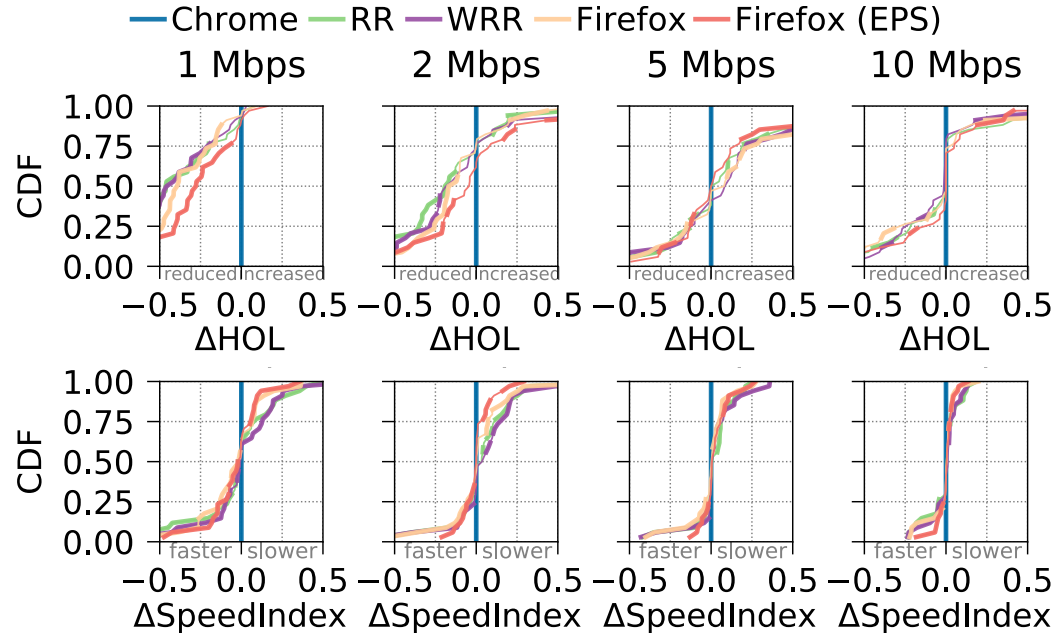
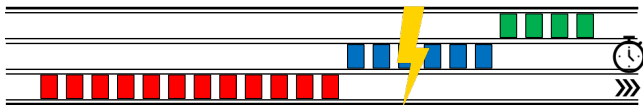
No art. loss  
100ms RTT  
1BDP Queue

- **HOL:** (lower=better)

- ▶ Reduced with parallelism
- ▶ Vanishing differences for higher bandwidths

- **SpeedIndex:** (lower=faster/better)

- ▶ Fewer benefits of parallelism for higher bandwidth / cwnd

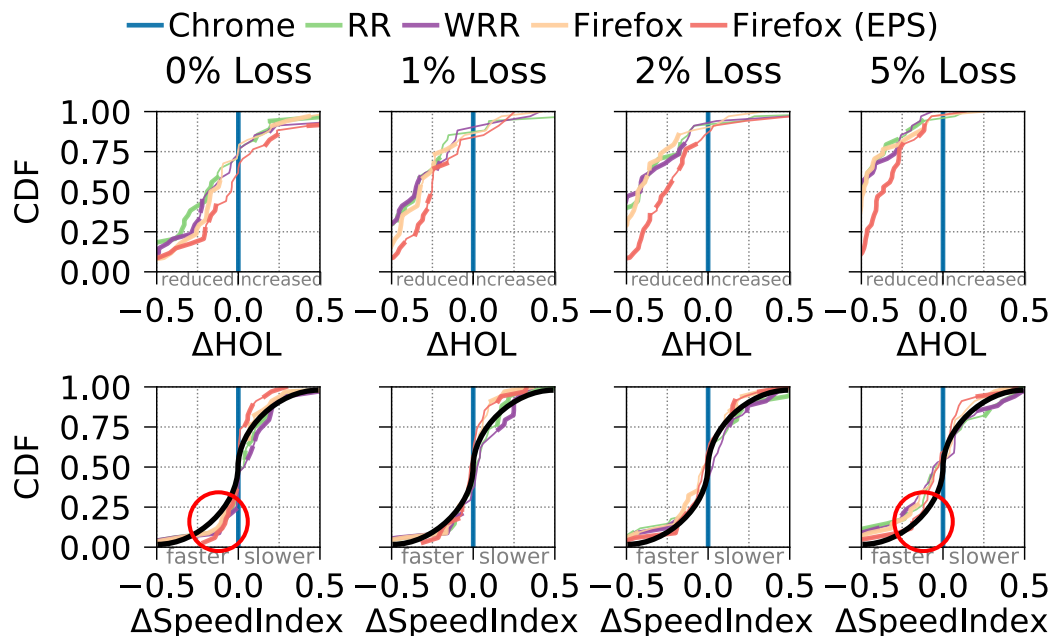


- **HOL:**

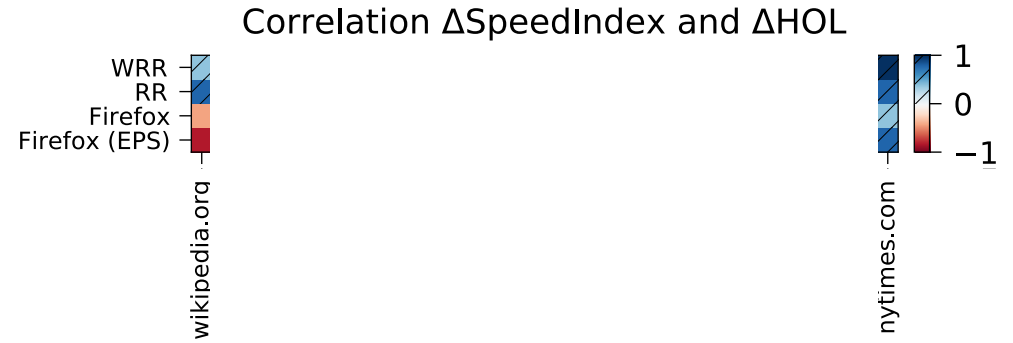
- ▶ Less HOL blocking for higher loss (as expected)
- ▶ Loss stopping many streams for sequential scheduling

- **SpeedIndex:**

- ▶ Growing benefits for higher loss
- ▶ Not as strongly as for HOL

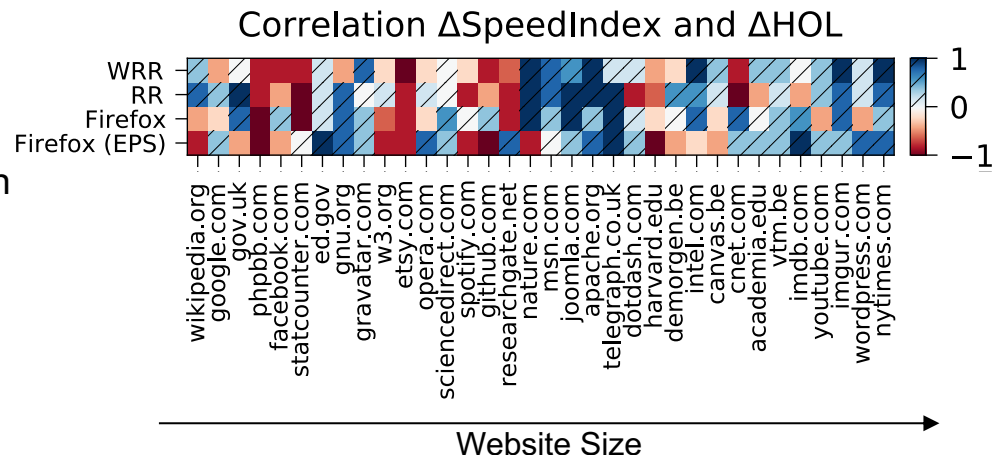


2Mbps BW  
100ms RTT  
1BDP Queue



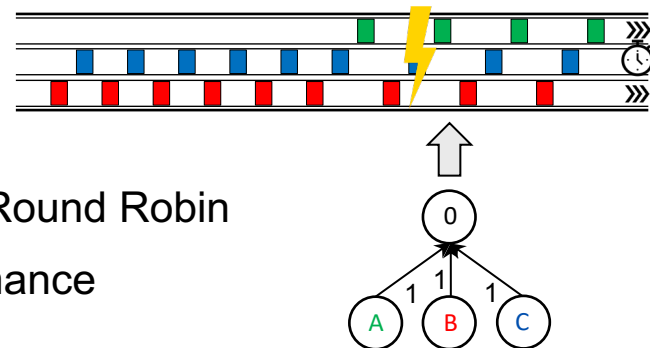
- **Correlation SpeedIndex and HOL:**

- ▶ Negative for smaller websites
  - HOL reduced, but only slightly
  - Negative effect of parallel prioritization
- ▶ Positive for larger websites
  - HOL reduced more strongly
  - Negative effect outweighed



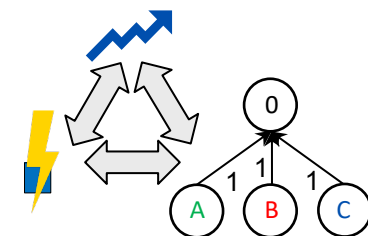
- **Reduced HOL Blocking via QUIC**

- ▶ Multiple streams need to be active in parallel
- ▶ HTTP Prioritization influences active streams: use Round Robin
- ▶ Related Work: Round Robin detrimental for performance



- **New performance interplay between prioritization and network**

- ▶ Round Robin can improve HOL and thus performance
- ▶ Mainly for large websites / small BW / high RTT / random loss
- ▶ No strong difference when using EPS



- **Overall: HTTP/3 prioritization still website + now also network dependent**