

Update on NADA Evaluation Results

draft-ietf-rmcat-nada-13

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Updated NADA Draft Status

- Updated to version -13 to address comments from Genart and Secdir last call reviews and Telechat reviews
- No algorithmic changes; mostly revised discussions for clarification
- Detail of revisions summarized on mailing list

Updated NADA Implementation in Mozilla

- Incorporated all algorithm features — including non-linear delay warping and loss-based congestion signal penalties — as specified in the draft
- Added similar logging mechanism to the default rate adaptation module
- Enabled on-the-fly switching between NADA-based and default rate adaptation as browser configuration
- Updated code at: <https://github.com/zhuxqing/gecko-dev/tree/nada2>

Test Setup for Browser-based Evaluations



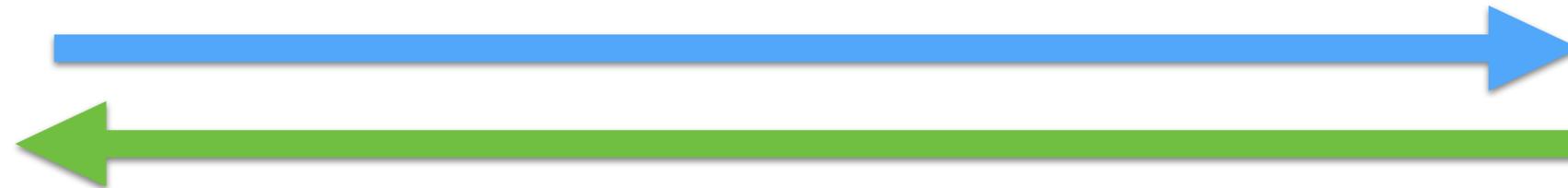
Client A



Firefox Nightly

Client B

Bi-directional audiovisual calls via appr.tc



Chrome

- On-the-fly configuration to run either default or NADA-based bandwidth adaptation algorithm
- Logging of outgoing stats and per-packet feedback info
- NADA rate limit: $R_{\max} = 3 \text{ Mbps}$, $R_{\min} = 300 \text{ Kbps}$
- Default resolution: 720 p

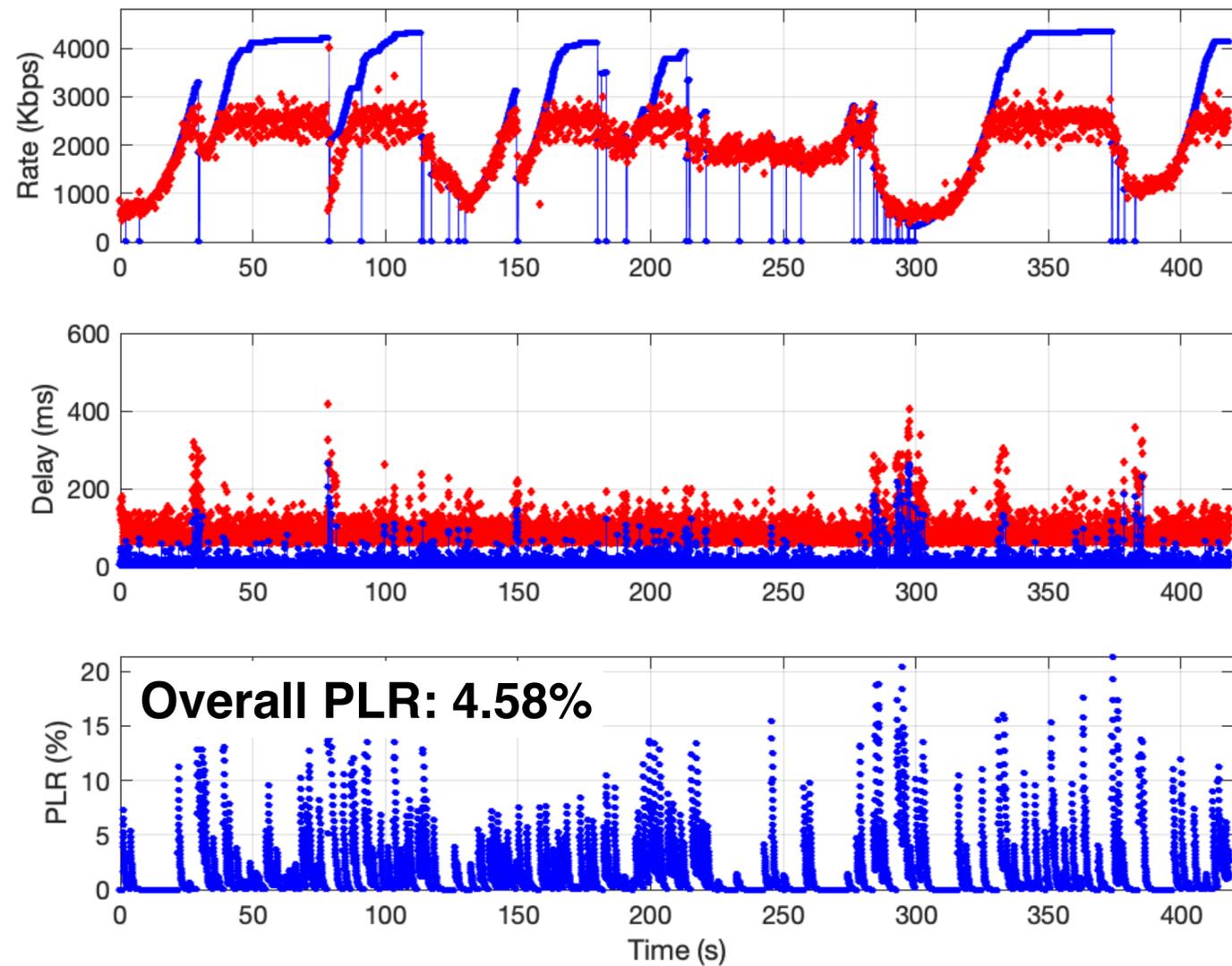
- Feedback interval @ 50ms with per-packet information (trans_cc ON)
- Stats monitoring of incoming flow displayed via *webrtc-internals* tab

Comparing Default and NADA Algorithms

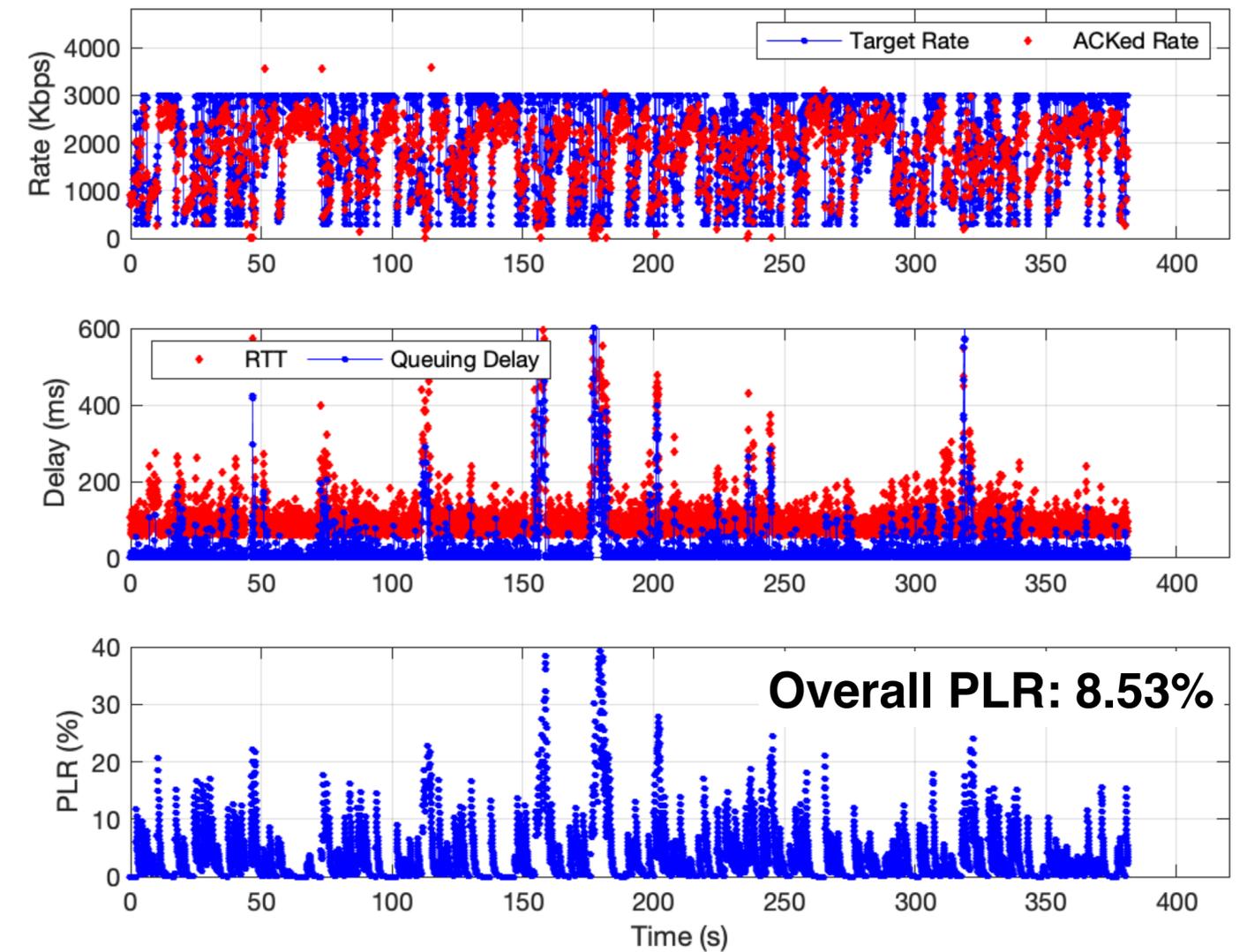
- Comparison mechanism:
 - *Back-to-back* sessions between the same sender/receiver pair
 - *Parallel* sessions sharing the same path and sender/receiver pair
- Evaluation scenarios:
 - *Cross-Continent*: between Austin, Texas and San Jose, California in US; both sides connected via enterprise-grade Wi-Fi
 - *Cross-Atlantic*: between Austin, Texas, USA (home Wi-Fi connected to Google Fiber) and Valencia, Spain (enterprise-grade Wi-Fi)

Cross-Continent Sessions: *Back-to-Back*

Default



NADA

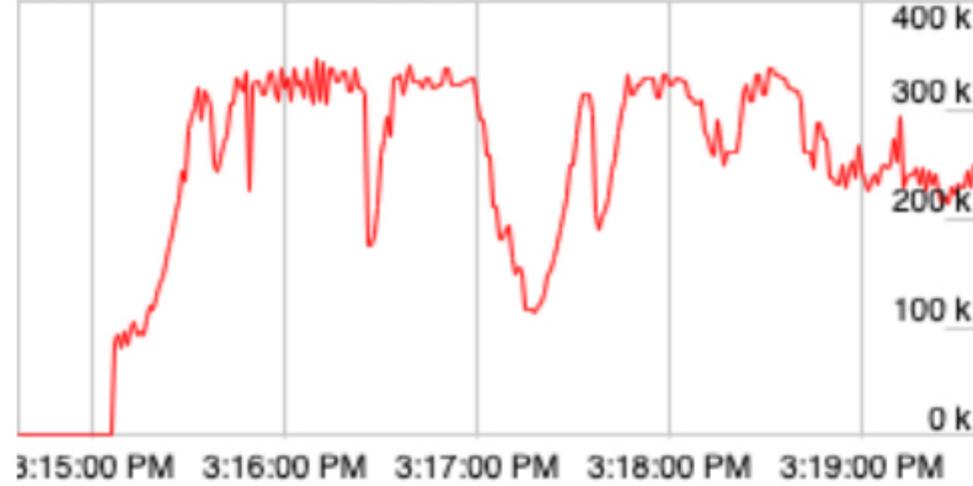


Path Characteristic: Baseline RTT: ~60ms | Max RTT: ~2.2 s
Observation: presence of out-of-order delivery

Cross-Continent Sessions: *Back-to-Back* Screenshot from Chrome Browsers

Default

[bytesReceived/s]



frameHeight

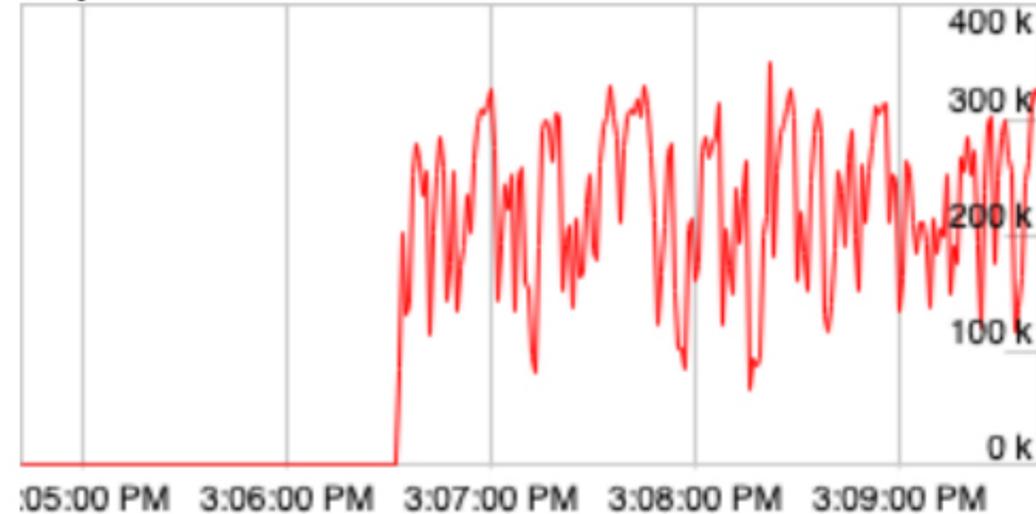


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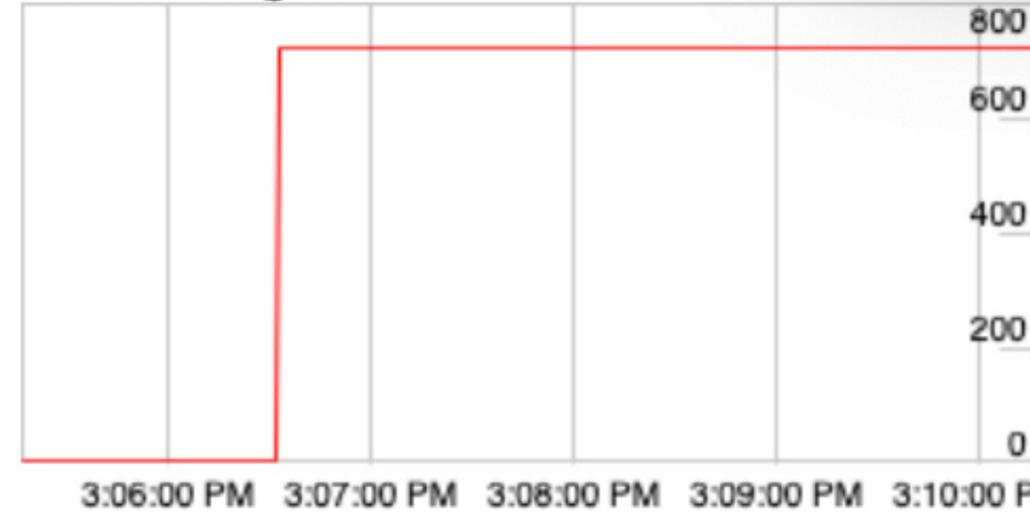


NADA

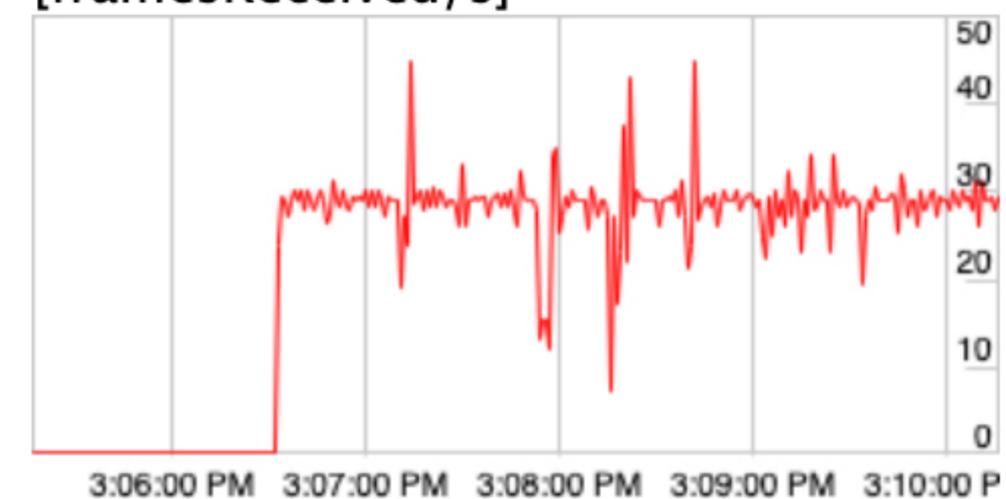
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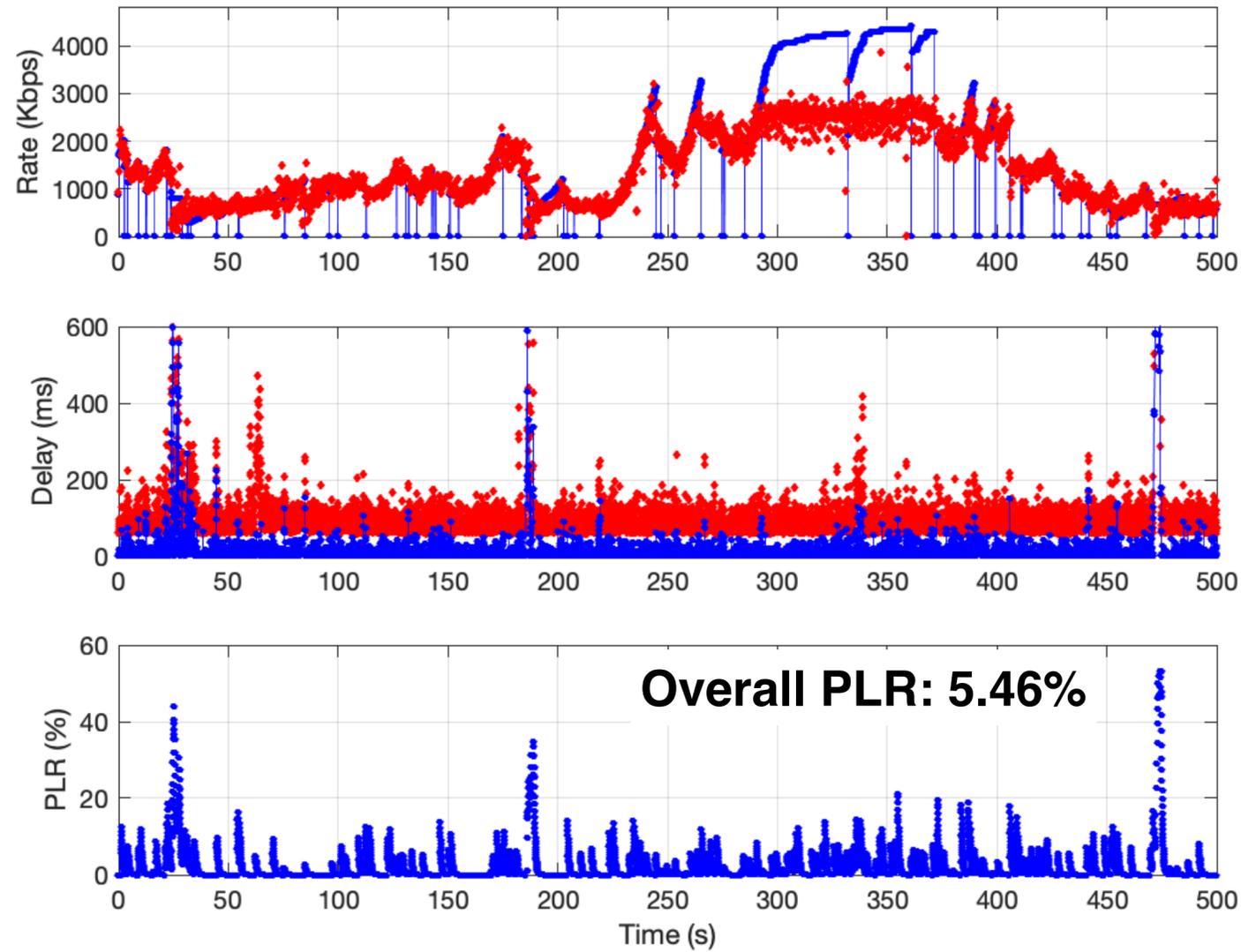


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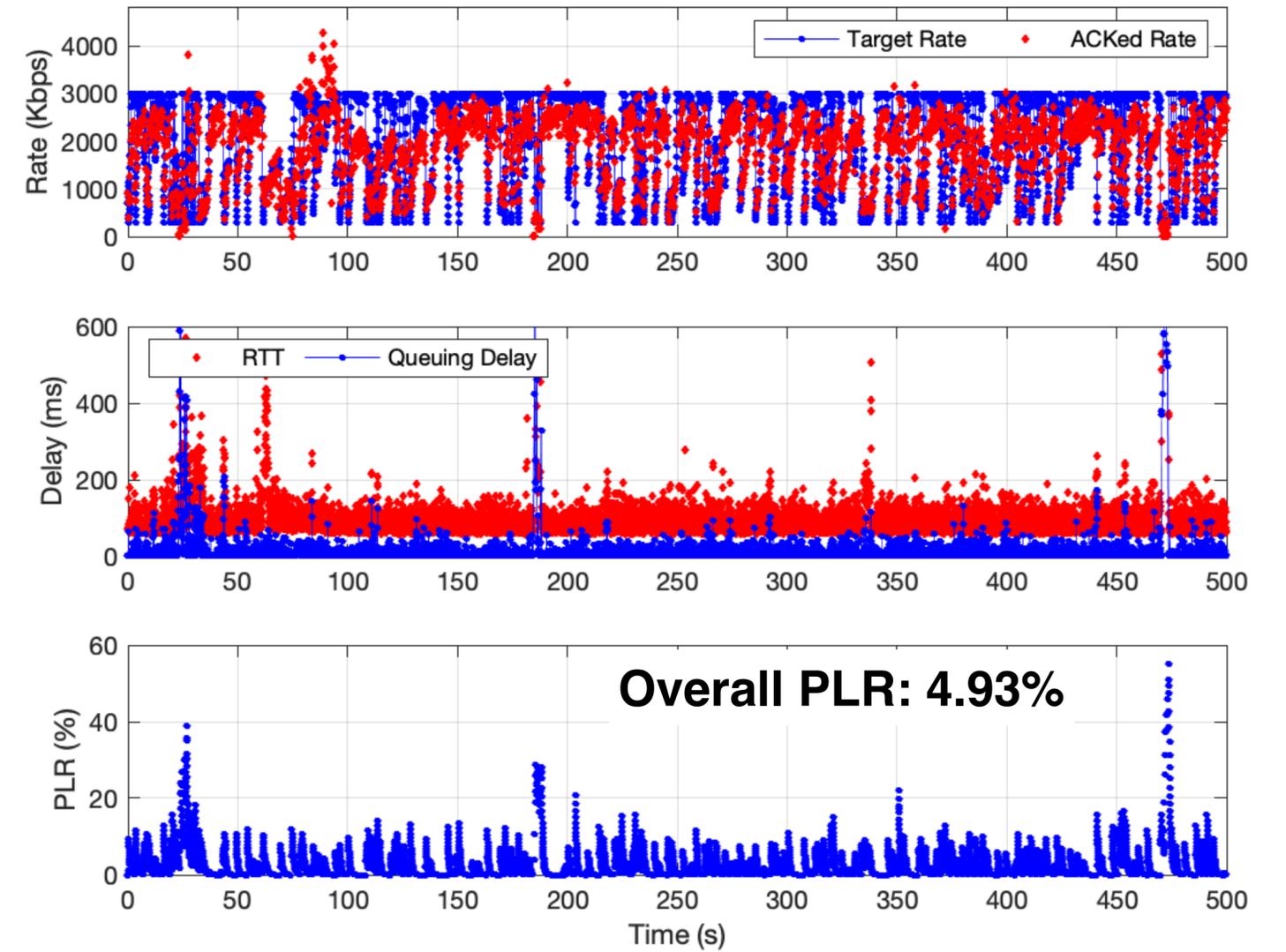


Cross-Continent Sessions: *Parallel*

Default



NADA

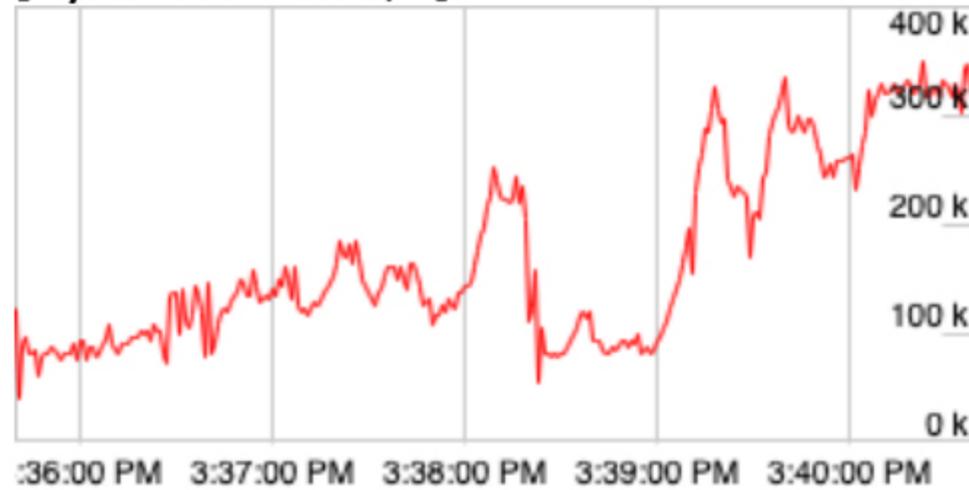


Path Characteristic: Baseline RTT: ~60ms | Max RTT: ~2.2 s
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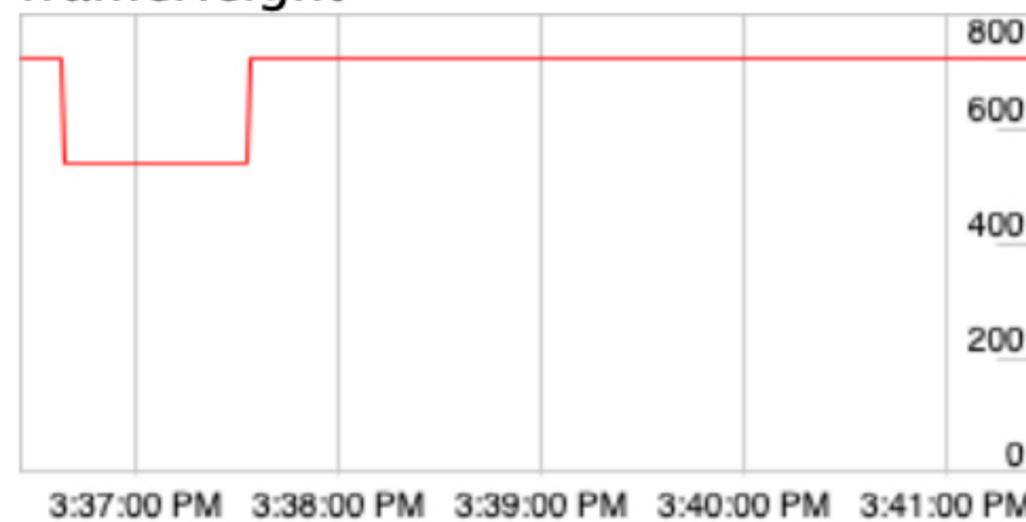
Cross-Continent Sessions: *Parallel* Screenshot from Chrome Browsers

Default

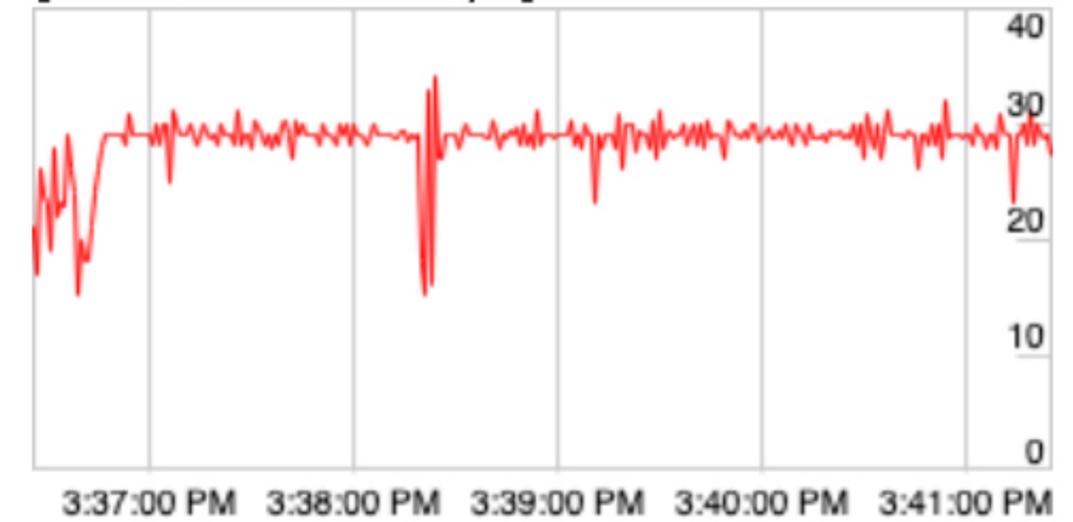
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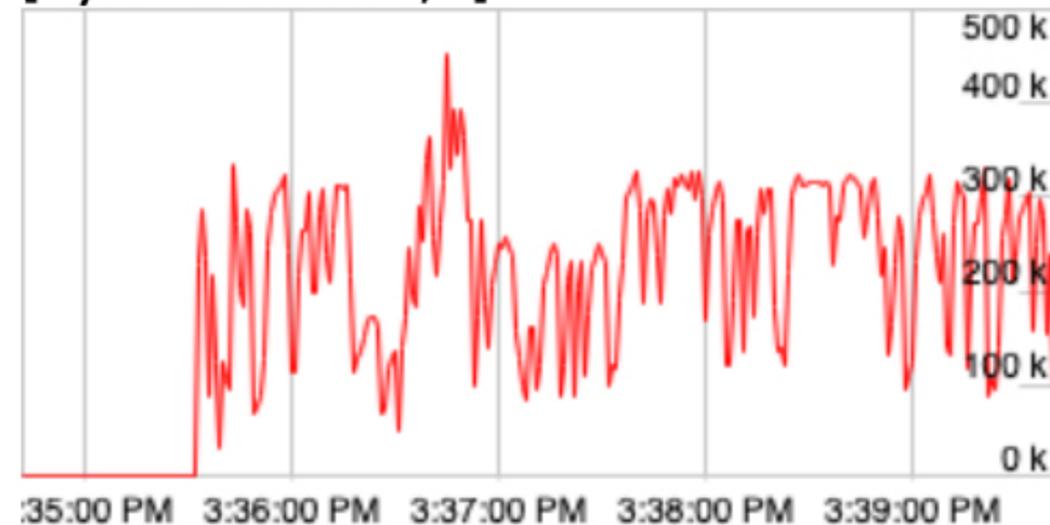


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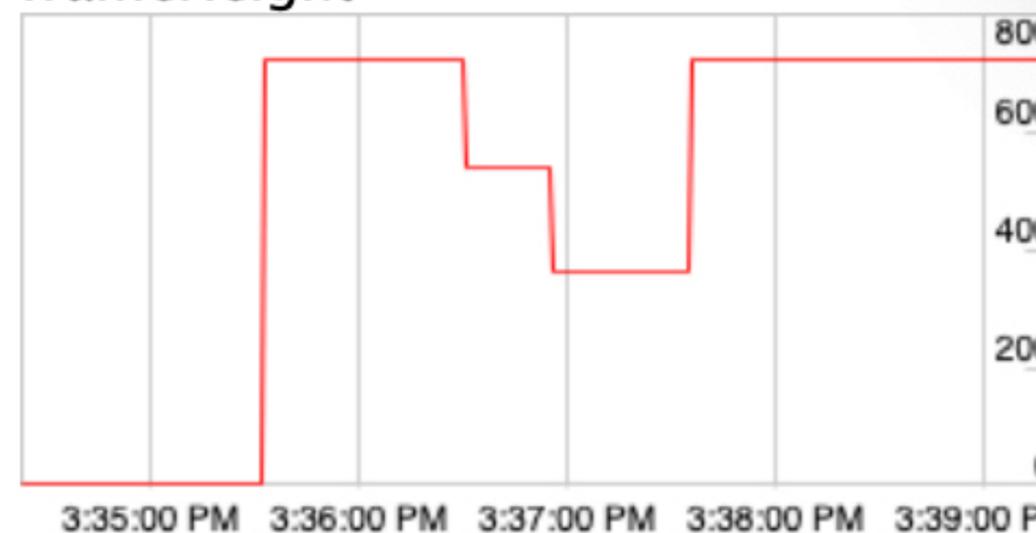


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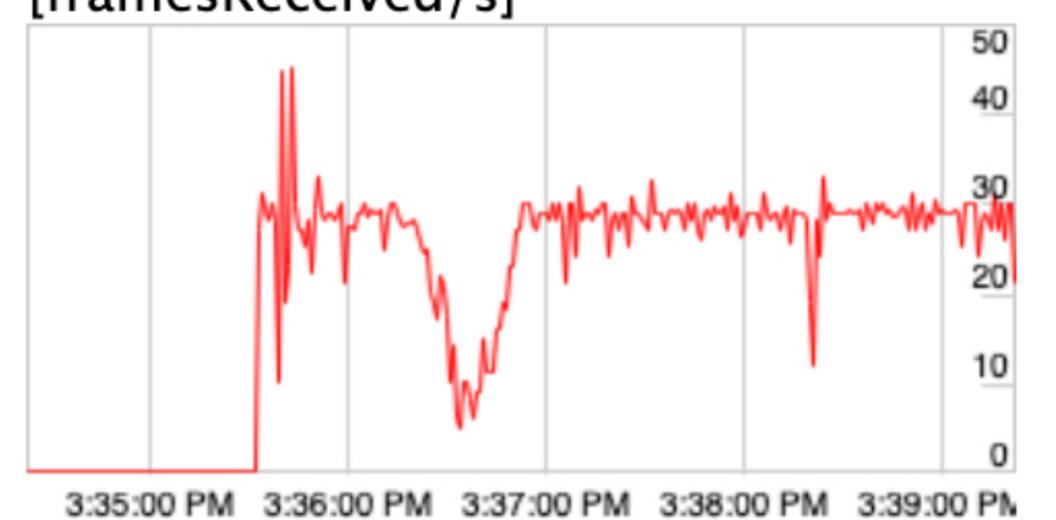
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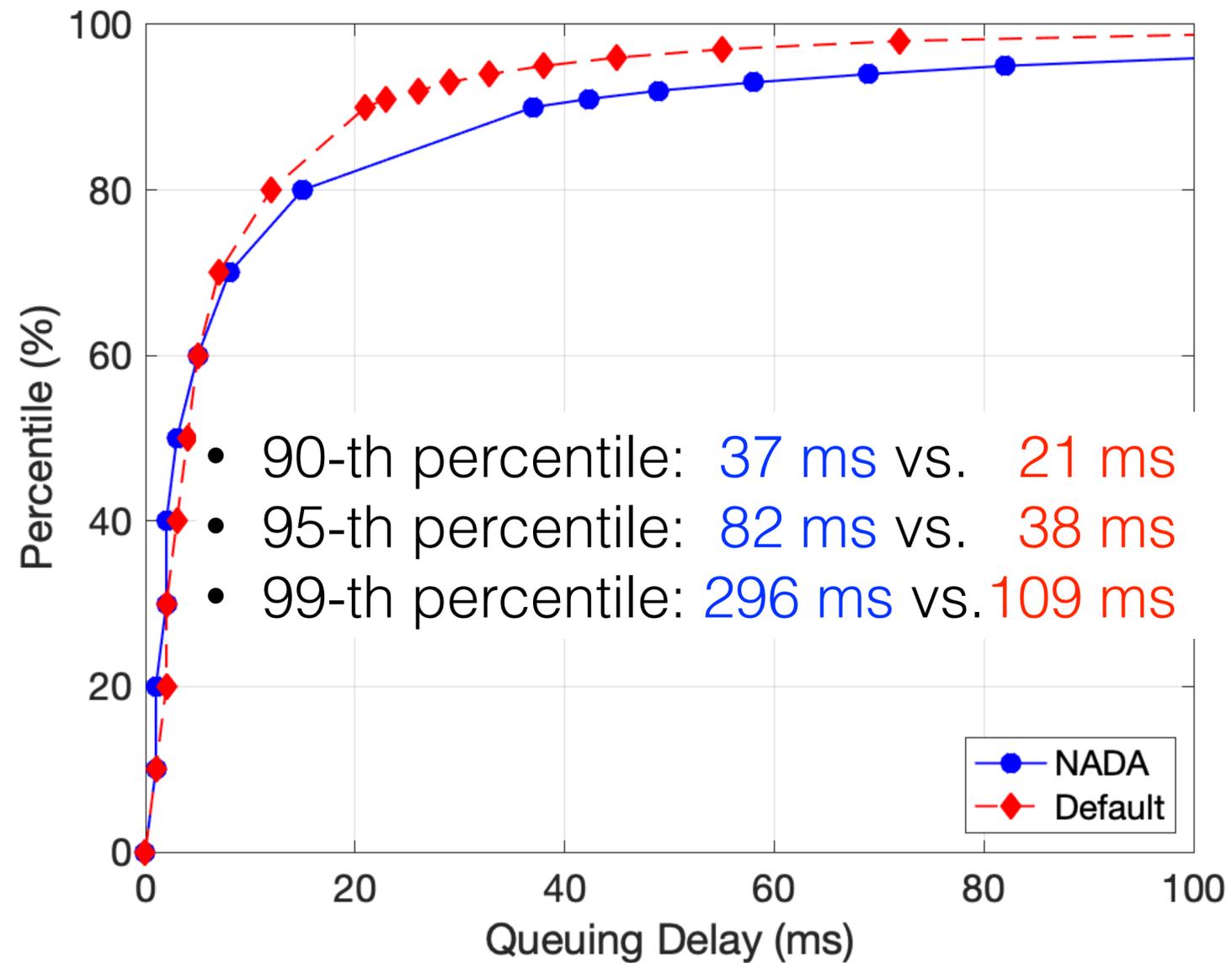


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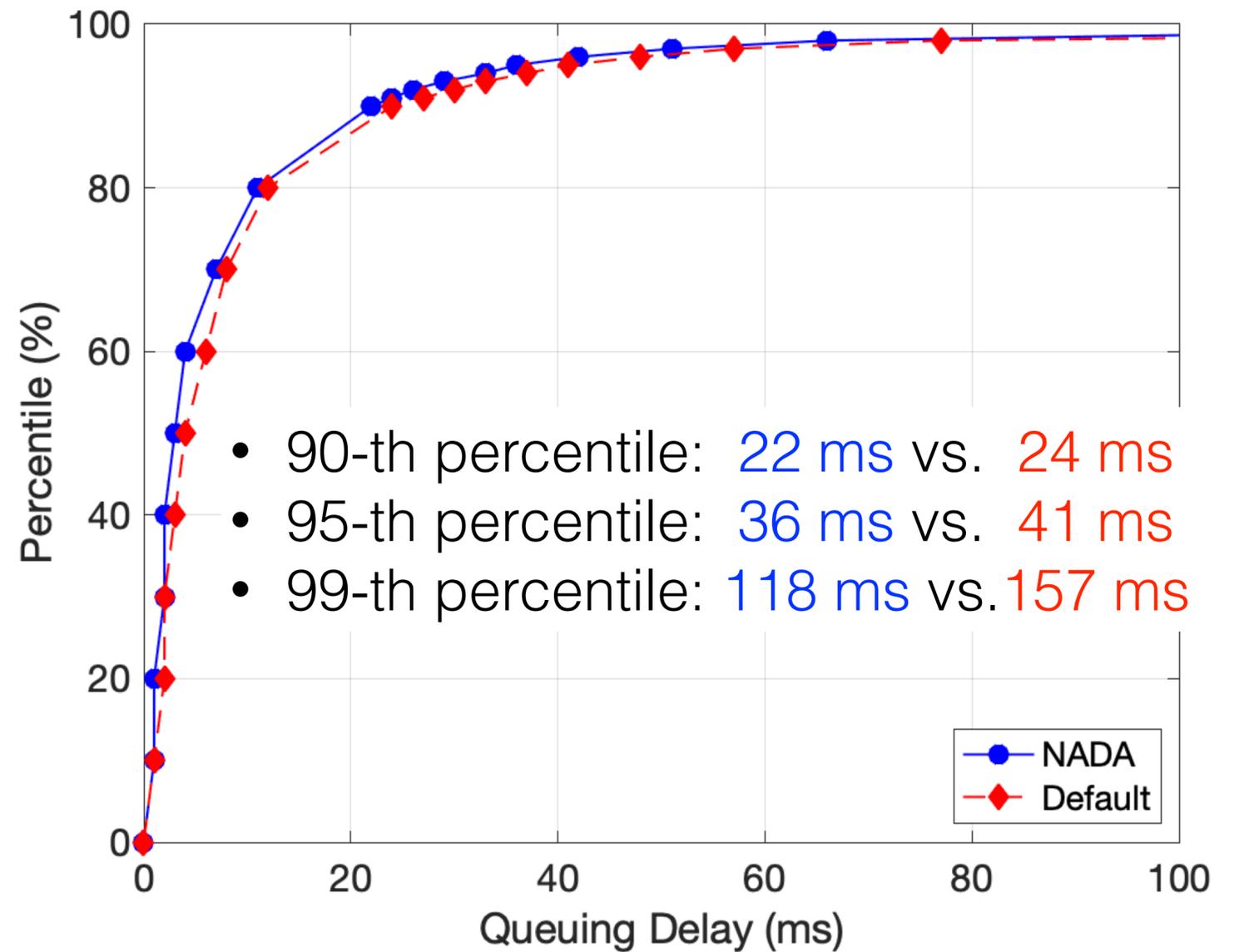


Cross-Continent Sessions: Comparison of Queuing Delays

Back-to-Back Sessions

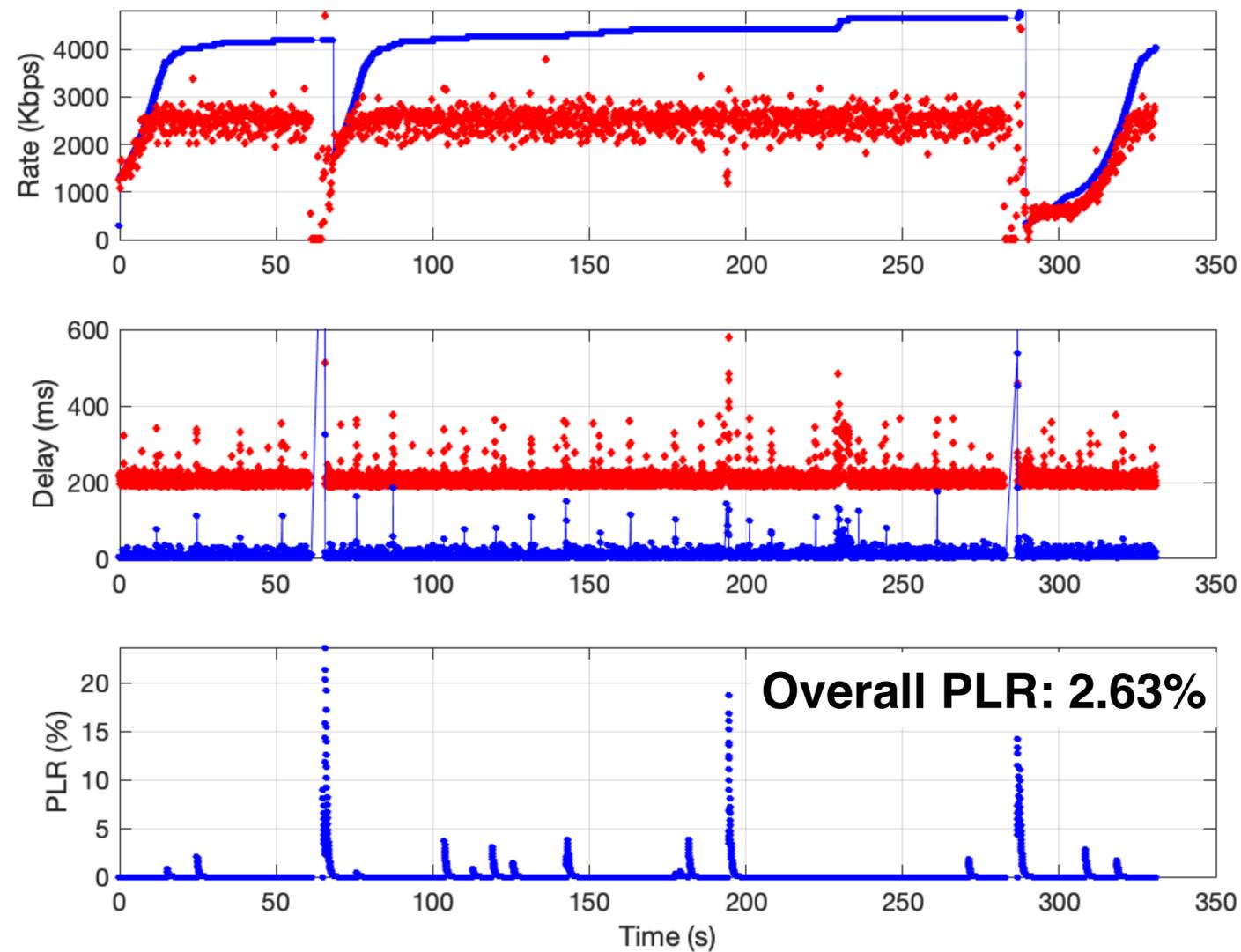


Parallel Sessions

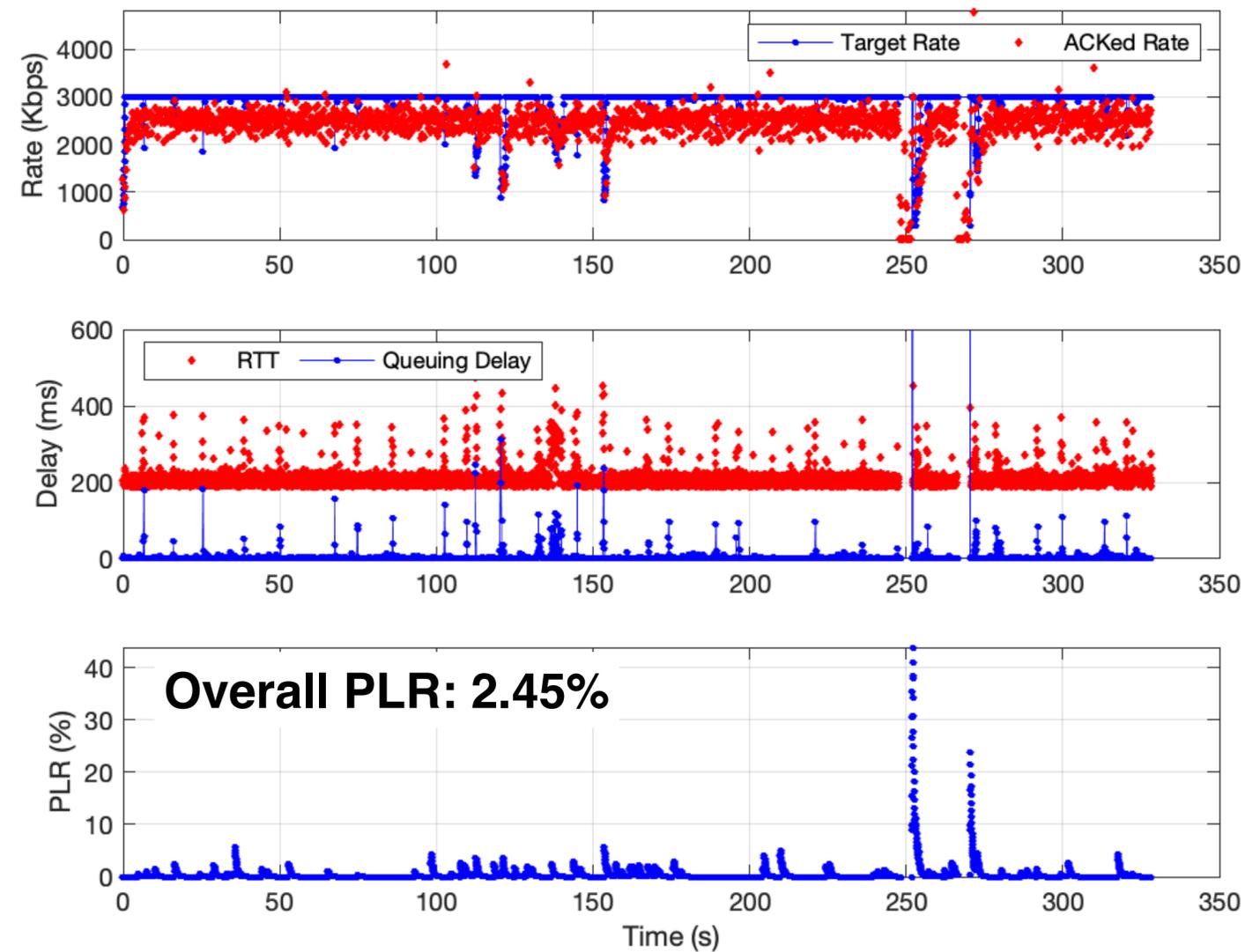


Cross-Atlantic Sessions: *Back-to-Back*

Default



NADA

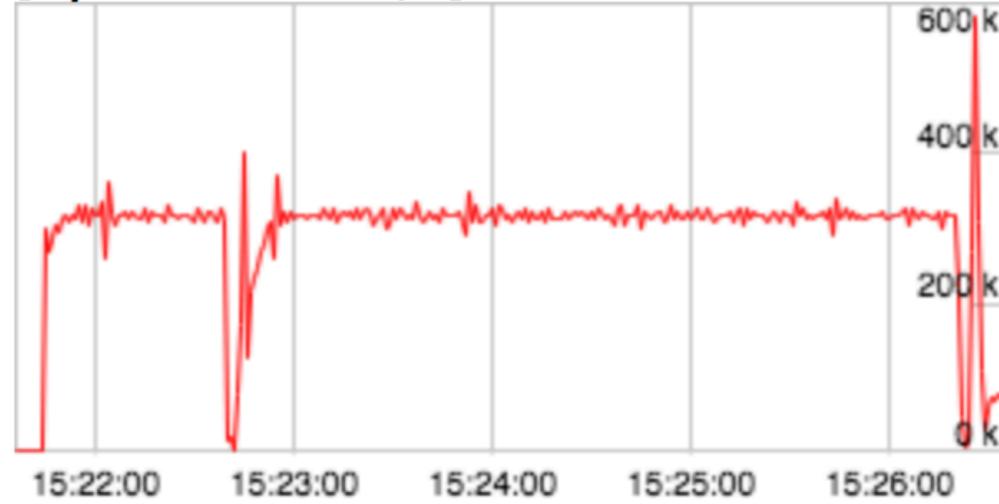


Path Characteristic: Baseline RTT: ~190ms | Max RTT: ~4.5 s
Observation: no out-of-order delivery

Cross-Atlantic Sessions: *Back-to-Back* Screenshots from Chrome Browser

Default

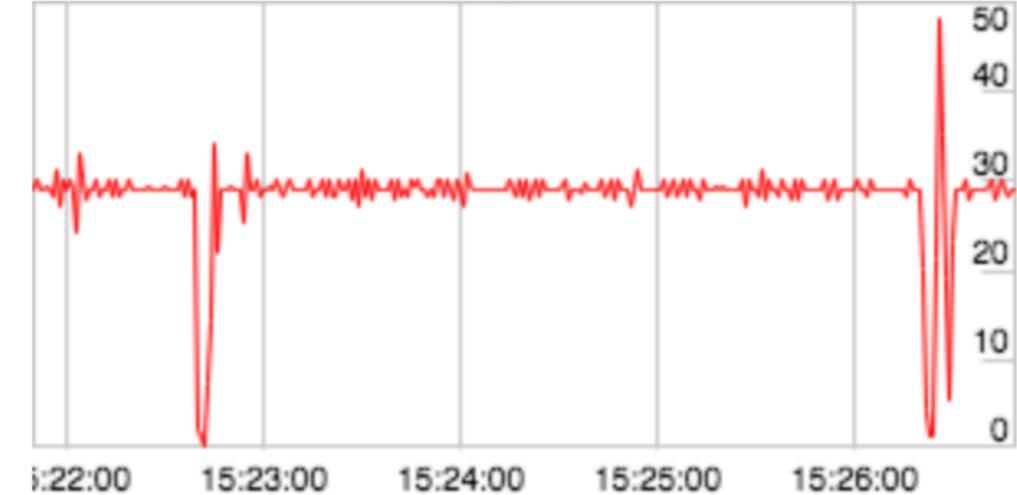
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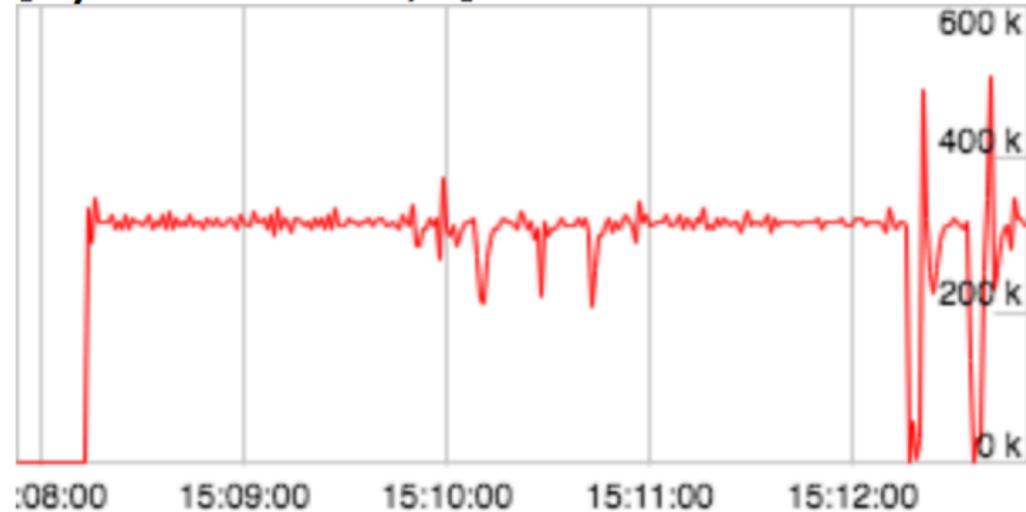


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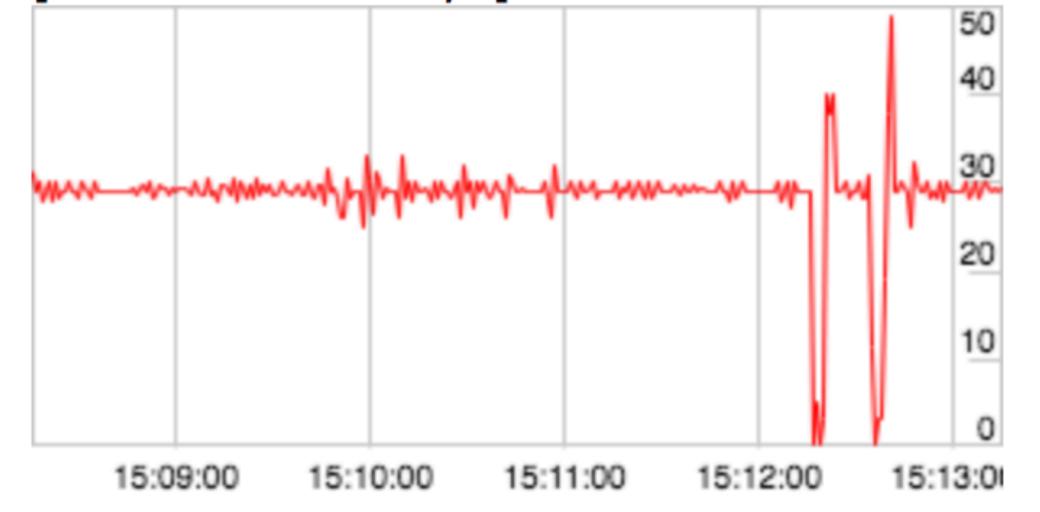
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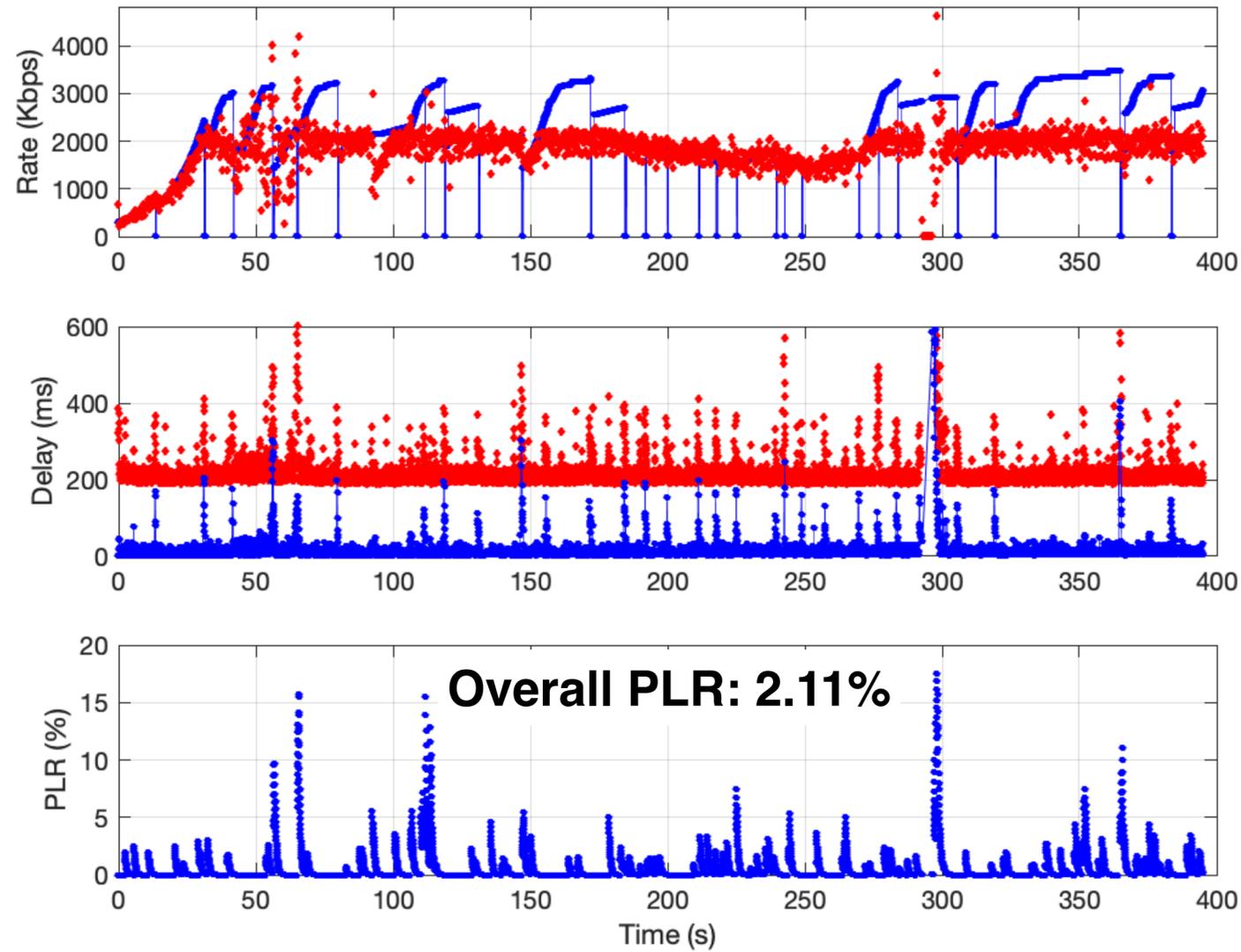


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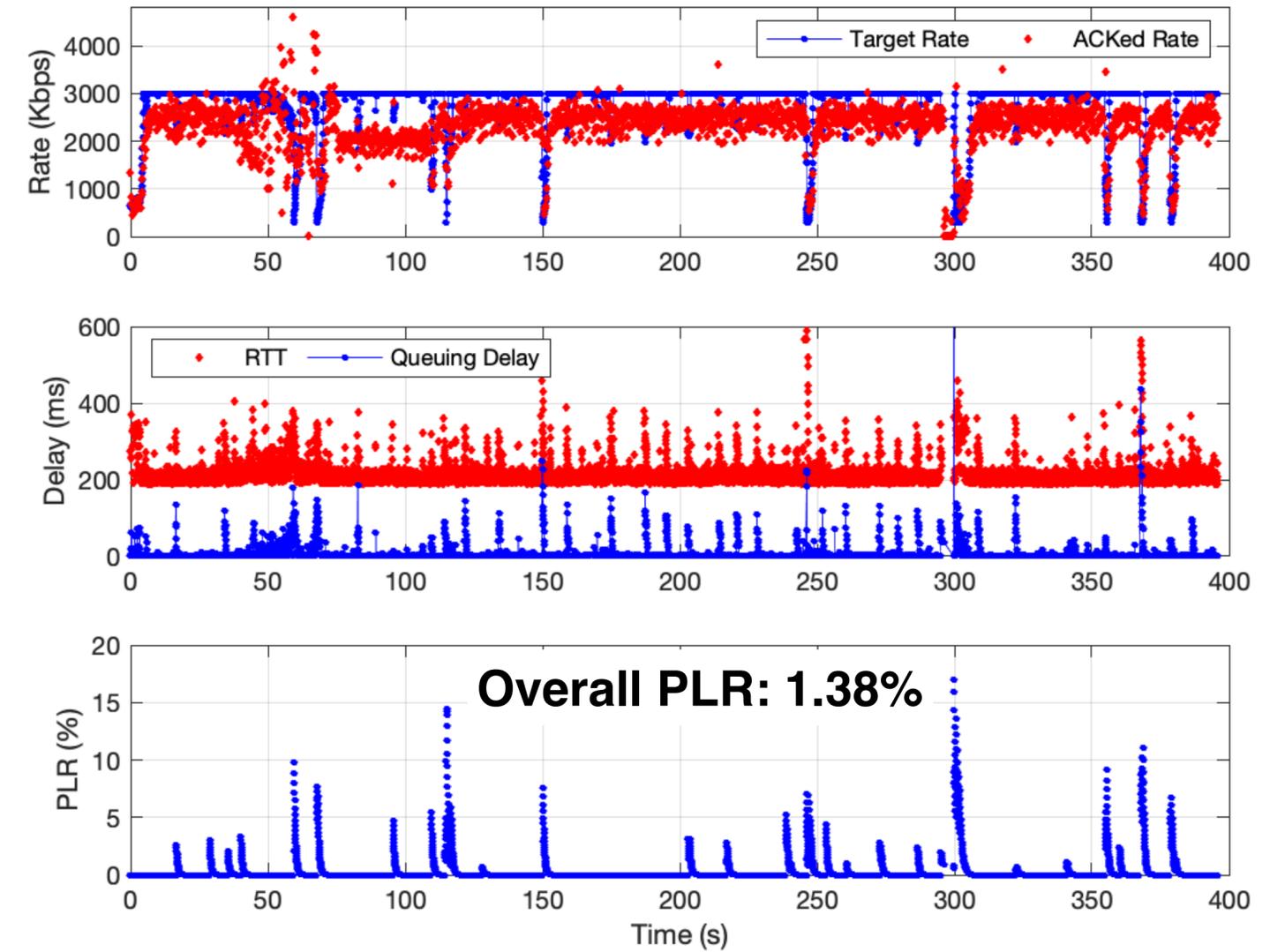


Cross-Atlantic Sessions: *Parallel*

Default



NADA



Path Characteristic: Baseline RTT: ~190ms | Max RTT: ~4.5 s
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Cross-Atlantic Sessions: *Parallel* Screenshots from Chrome Browser

Default

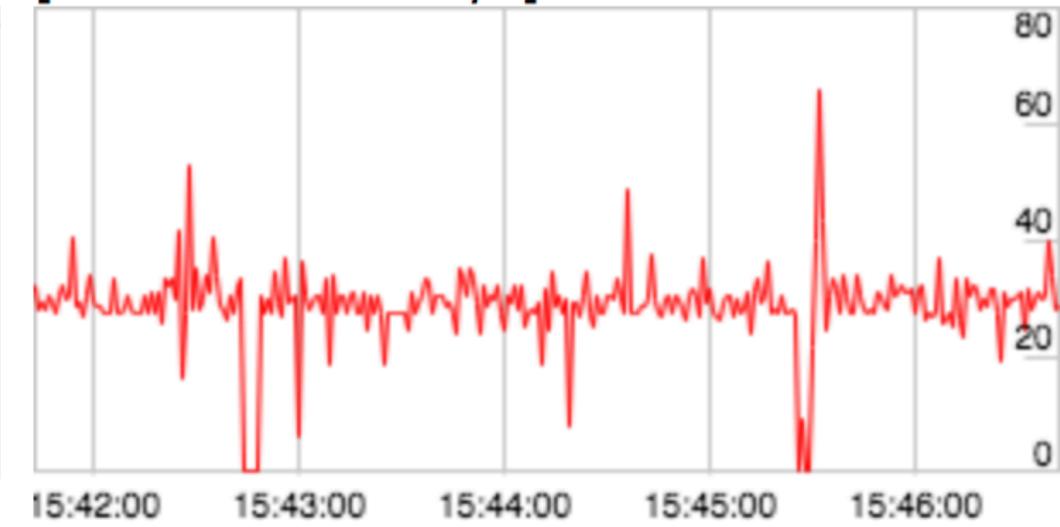
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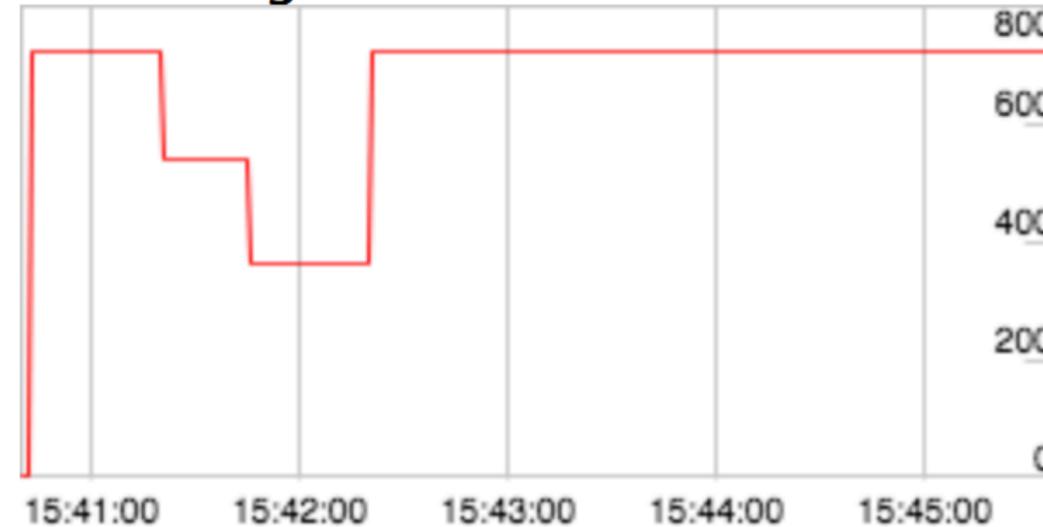
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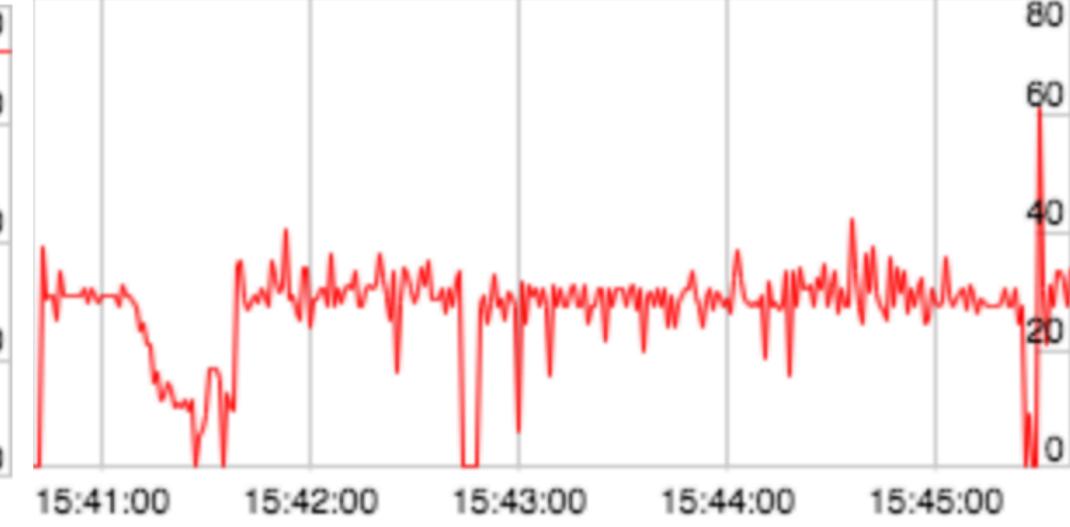
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Forgot to capture

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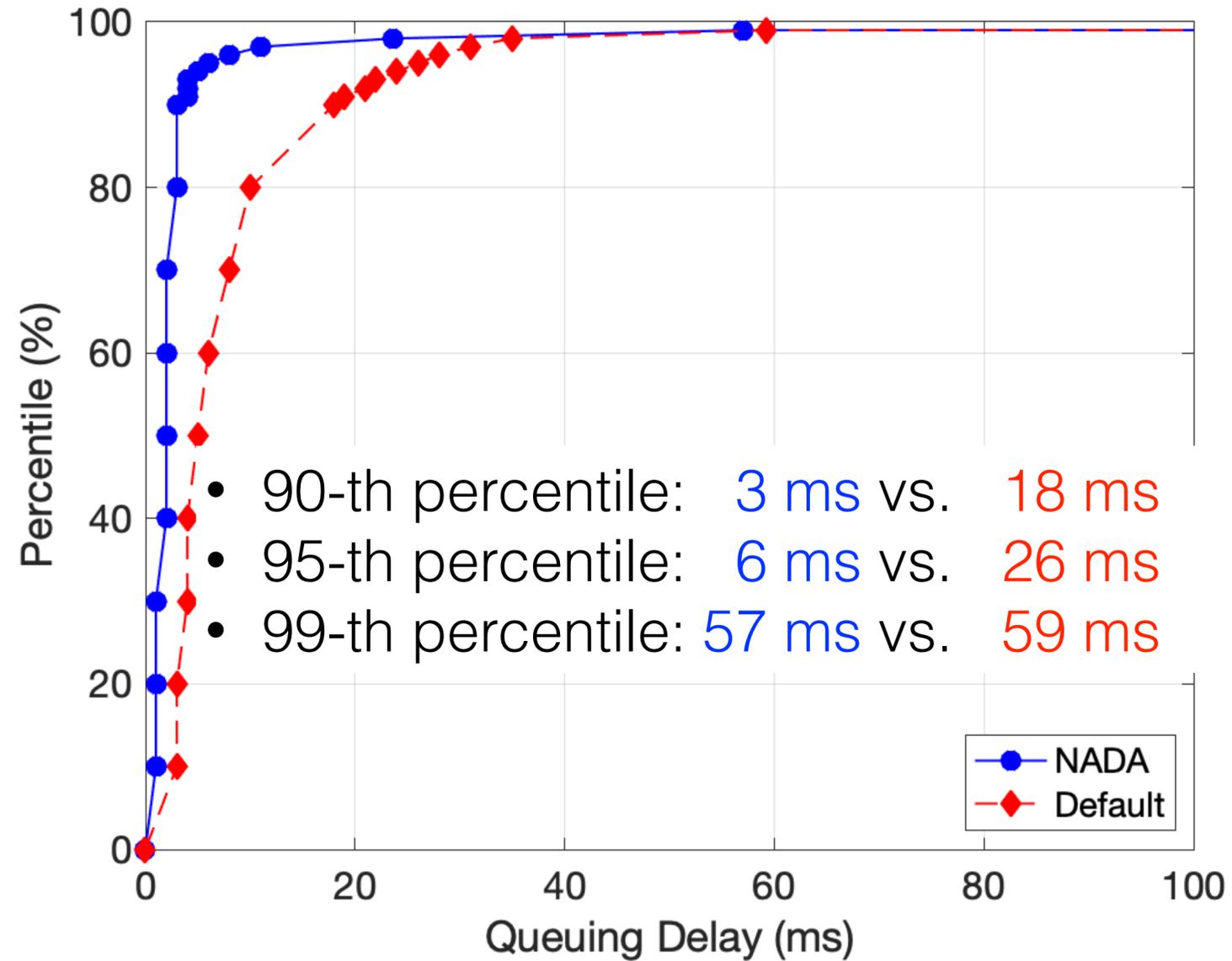


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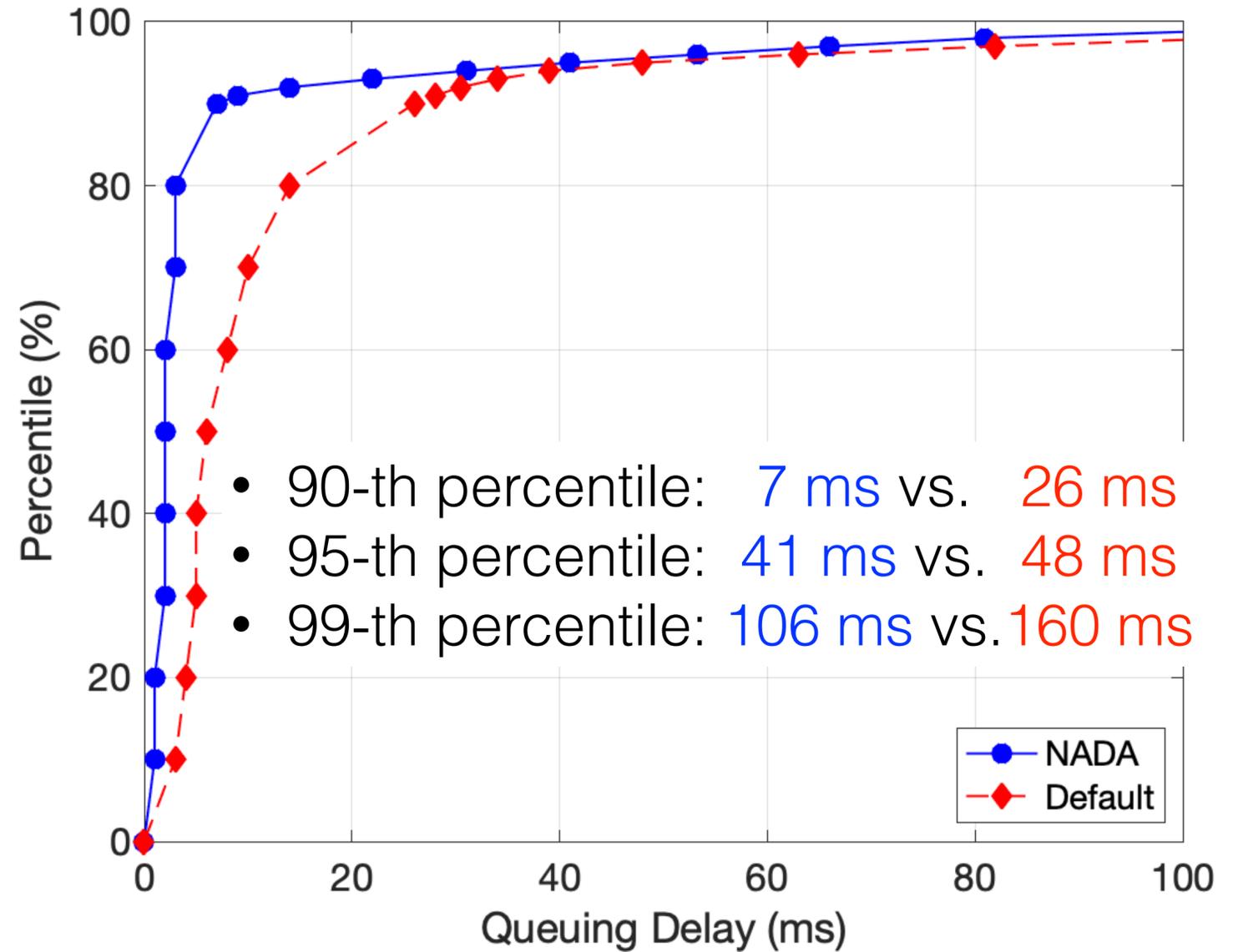


Cross-Atlantic Connection: Comparison of Queuing Delays

Back-to-Back Sessions



Parallel Sessions



Observations and Next Steps

- Fast initial ramp up to maximum allowed rate, typically within a few seconds
- Recovers quickly from temporary losses and queuing delay spikes
- Effectively limits queuing delay build up (95-th percentile below 100 ms)
- Does not starve competing WebRTC flows with default rate adaptation behavior
- Further investigations:
 - Performance over bandwidth-limited connections, e.g., over LTE links
 - Coexistence of multiple NADA-based streams
 - Coexistence with TCP-like background traffic