Update on NADA Evaluation Results

draft-ietf-rmcat-nada-13

Xiaoqing Zhu, Rong Pan, Michael A. Ramalho, and Sergio Mena,
November 2019 | IETF 106 | Singapore
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

Firefox Nightly
- 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: \( R_{\text{max}} = 3 \text{ Mbps}, R_{\text{min}} = 300 \text{ Kbps} \)
- Default resolution: 720 p

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

Bi-directional audiovisual calls via appr.tc
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**
- **Path Characteristic:** Baseline RTT: ~60ms | Max RTT: ~2.2 s
- **Observation:** presence of out-of-order delivery

**NADA**
- **Overall PLR:** 8.53%

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
- [framesReceived/s]

**NADA**

- [bytesReceived/s]
- frameHeight
- [framesReceived/s]
Cross-Continent Sessions: *Parallel*

**Default**

- Overall PLR: 5.46%

**NADA**

- Overall PLR: 4.93%

Path Characteristic: Baseline RTT: ~60ms | Max RTT: ~2.2 s

Observation: presence of out-of-order delivery
Cross-Continent Sessions: *Parallel*
Screenshot from Chrome Browsers
Cross-Continent Sessions: Comparison of Queuing Delays

Back-to-Back Sessions
- 90-th percentile: 37 ms vs. 21 ms
- 95-th percentile: 82 ms vs. 38 ms
- 99-th percentile: 296 ms vs. 109 ms

Parallel Sessions
- 90-th percentile: 22 ms vs. 24 ms
- 95-th percentile: 36 ms vs. 41 ms
- 99-th percentile: 118 ms vs. 157 ms
Cross-Atlantic Sessions: *Back-to-Back*

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

**Default**

- Overall PLR: 2.63%

**NADA**

- Overall PLR: 2.45%
Cross-Atlantic Sessions: *Back-to-Back*

Screenshots from Chrome Browser

**Default**

- [bytesReceived/s]
- frameHeight
- [framesReceived/s]

**NADA**

- [bytesReceived/s]
- frameHeight
- [framesReceived/s]
Cross-Atlantic Sessions: *Parallel*

**Default**

- **Path Characteristic:** Baseline RTT: ~190ms | Max RTT: ~4.5 s
- **Observation:** no out-of-order delivery
- **Overall PLR:** 2.11%

**NADA**

- **Path Characteristic:** Baseline RTT: ~190ms | Max RTT: ~4.5 s
- **Observation:** no out-of-order delivery
- **Overall PLR:** 1.38%
Cross-Atlantic Sessions: *Parallel*
Screenshots from Chrome Browser

Default

NADA

Forgot to capture
Cross-Atlantic Connection: Comparison of Queuing Delays

Back-to-Back Sessions

- 90-th percentile: 3 ms vs. 18 ms
- 95-th percentile: 6 ms vs. 26 ms
- 99-th percentile: 57 ms vs. 59 ms

Parallel Sessions

- 90-th percentile: 7 ms vs. 26 ms
- 95-th percentile: 41 ms vs. 48 ms
- 99-th percentile: 106 ms vs. 160 ms
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