HyStart++: Modified Slow Start for TCP

draft-balasubramanian-tcpm-hystartplusplus-03

TCPM interim meeting
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Praveen Balasubramanian, Yi Huang, Matt Olson
HyStart++ Recap

• Slow Start can overshoot ideal send rate and cause massive packet loss

• HyStart: Exit slow start early based on Delay Increase algorithm
  • Inter-Packet Arrival algorithm does not perform well due to ACK compression

• Compensate for premature slow start exit
  • Congestion Avoidance algorithm can take time to ramp up

• Use maximum of cwnd computed by Limited Slow Start (RFC3742) and Congestion Avoidance, until next congestion signal
Performance data

• Large scale A/B test covering billions of flows on Windows systems
  • Reduction in retransmission timeouts
    • 99% of connections have fewer than 2 RTOs over lifetime
    • 0.64% connections moved from 1 RTO to 0 RTOs over lifetime
    • 0.7% connections moved from 2 RTOs to 1 RTO over lifetime
  • Working on getting more production data and metrics

• Lab data
  • Fair towards non-HyStart++ flows
  • 100 Mbps bandwidth, BDP size bottleneck buffer
  • For large RTT flows (100 msec)
    • Up to 39% improvement in average and P90 goodput for short flows
    • Up to 14% improvement in average and P90 goodput for long flow
  • No noticeable improvement for small RTT flows (50 msec, 25 msec)
  • Across all tests
    • Number of bytes retransmitted reduced by 50%
    • Number of RTOs reduced by 36%
    • Loss recovery success rate improves 43.48% -> 52%
Changes in draft-03

• Incorporated review feedback from Neal Cardwell, Martin Duke, Ilpo Järvinen, Christoph Paasch, and Junho Choi
  • Thanks for the reviews!

• Summary of changes
  • Clarified relationship with Appropriate Byte Counting
  • Clarified when HyStart++ ends
  • Fixed some equations that used bytes versus segments
  • Variable name changes in pseudocode
Status & Next Steps

• HyStart++ is deployed on by default for all connections
  • Windows 10 May 2019 Update onwards
  • Windows Server 2019 1903 version onwards

• Look into usage of bandwidth or throughput estimate

• Future: compare HyStart++, BBR STARTUP phase, and Paced Chirping

• Adopt document in tcpm