Introduction to delay and rate based TCP

- Promise of low latency zero loss\(^1\) transmission
- the congestion signal can be decoupled from packet loss
  - potential for efficient transmission on lossy paths.

- Delay based intuition:
  - delay\(\uparrow\) \(\equiv\) queue\(\uparrow\) \(\implies\) indicates congestion

- Rate based intuition:
  - Send rate \(>\) receive rate \(\implies\) indicates congestion

- Basic questions:
  - How is congestion determined?
  - and if congested, how should cwnd be adjusted

- Issues:
  - Noise of measurements
  - Compatibility with existing TCP algorithms
  - Tolerance to non-congestion related loss

\(^1\) congestion related
Tolerance to non-congestion related packet loss

- Ignoring packet loss when queueing delays are small (region A)

![Diagram showing Tolerance to non-congestion related losses]

- Probability of non-congestion related loss vs. Goodput (bps)
  - NewReno
  - HD
  - CHD
  - $1/\sqrt{p}$
Delay-gradient based TCP congestion control

- We investigated a delay-gradient congestion signal because:
  - it does not require an accurate estimate of base RTT
  - delay thresholds are hard to set — need to know path’s delay characteristics
- Heuristic to estimate queue full and empty states from gradients
- We have implemented it in FreeBSD, to be released soon. (waiting on a paper submission)
Stateless TCP

Proposed by Geoff Huston to mitigate a DNS server issue

Funded by APNIC and Nominet

CPU time versus DNS query arrival rate

![CPU usage graph](image-url)
Thoughts and conclusions

- Algorithms have been implemented in the FreeBSD kernel (some available caia.swin.edu.au/urp/newtcp/tools.html).
- Delay-based TCP coexistence with loss-based TCP
  - Current schemes coexist by behaving like NewReno
  - Low latency with no congestion related loss
  - Only when there are no loss-based flows sharing path
  - If switches and routers could differentiate between loss and delay-based TCP, benefits would be realised sooner.
- Delay-gradient as a congestion indication
  - Works well
  - A composite delay-based congestion indication may be better.

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Thank you!

Questions?