

## TCP related work

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## Introduction to delay and rate based TCP

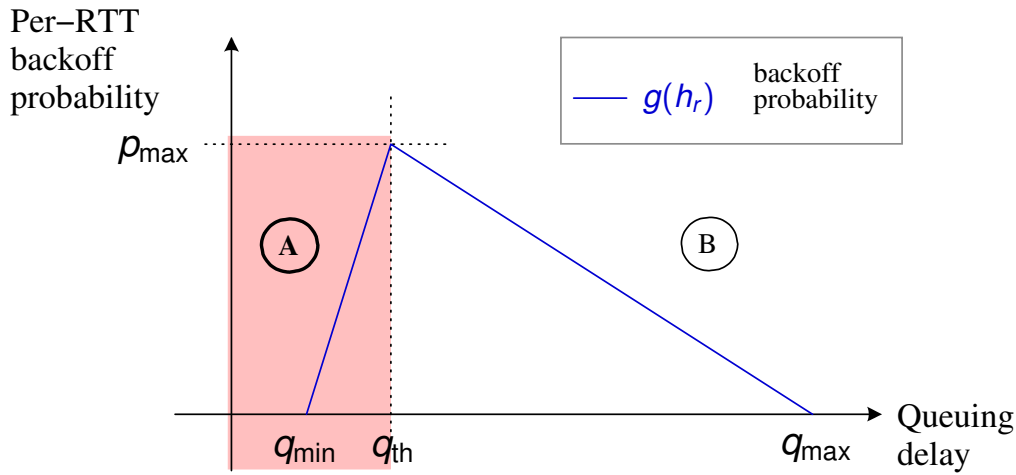


- Promise of low latency zero loss<sup>1</sup> transmission
- the congestion signal can be decoupled from packet loss
  - potential for efficient transmission on lossy paths.
- Delay based intuition:
  - $\text{delay} \uparrow \equiv \text{queue} \uparrow \implies$  indicates congestion
- Rate based intuition:
  - $\text{Send rate} > \text{receive rate} \implies$  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

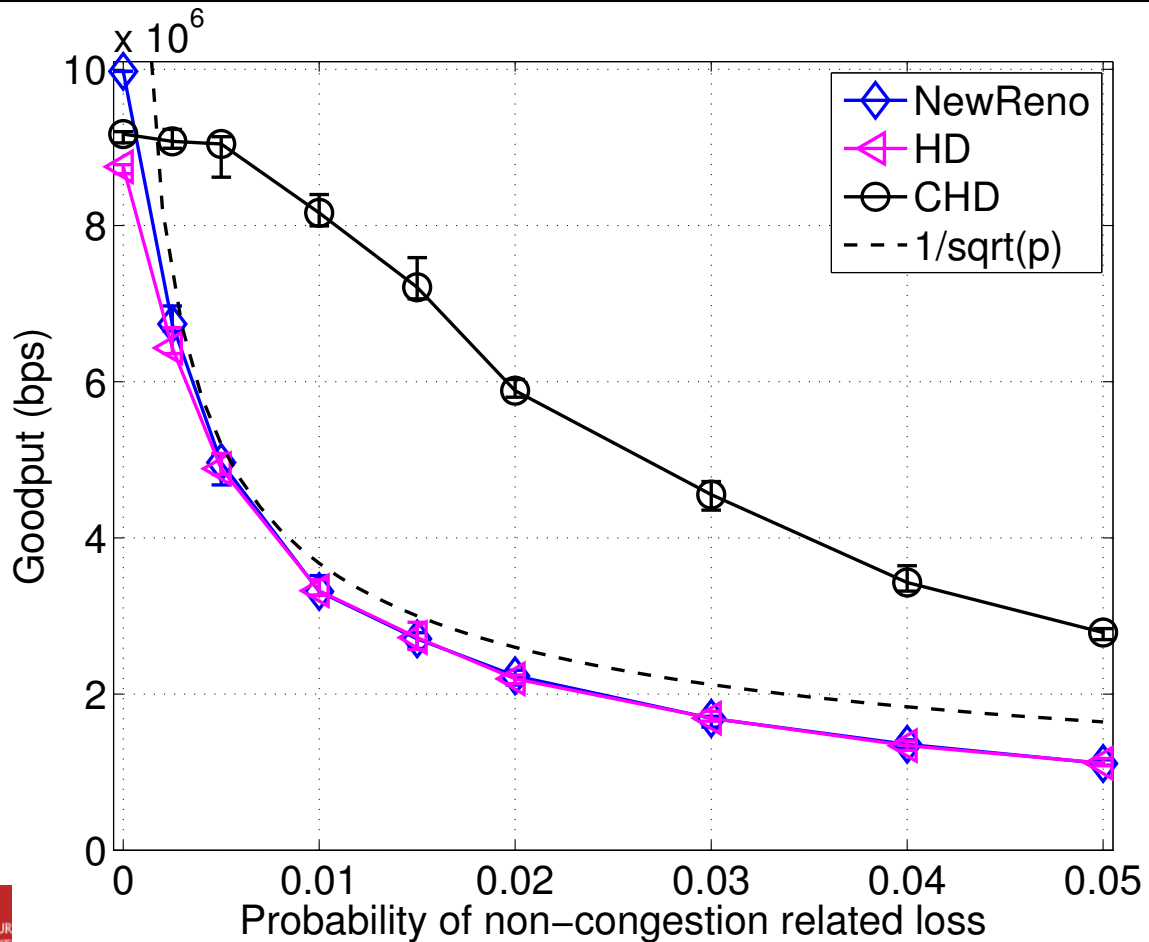
<sup>1</sup>congestion related

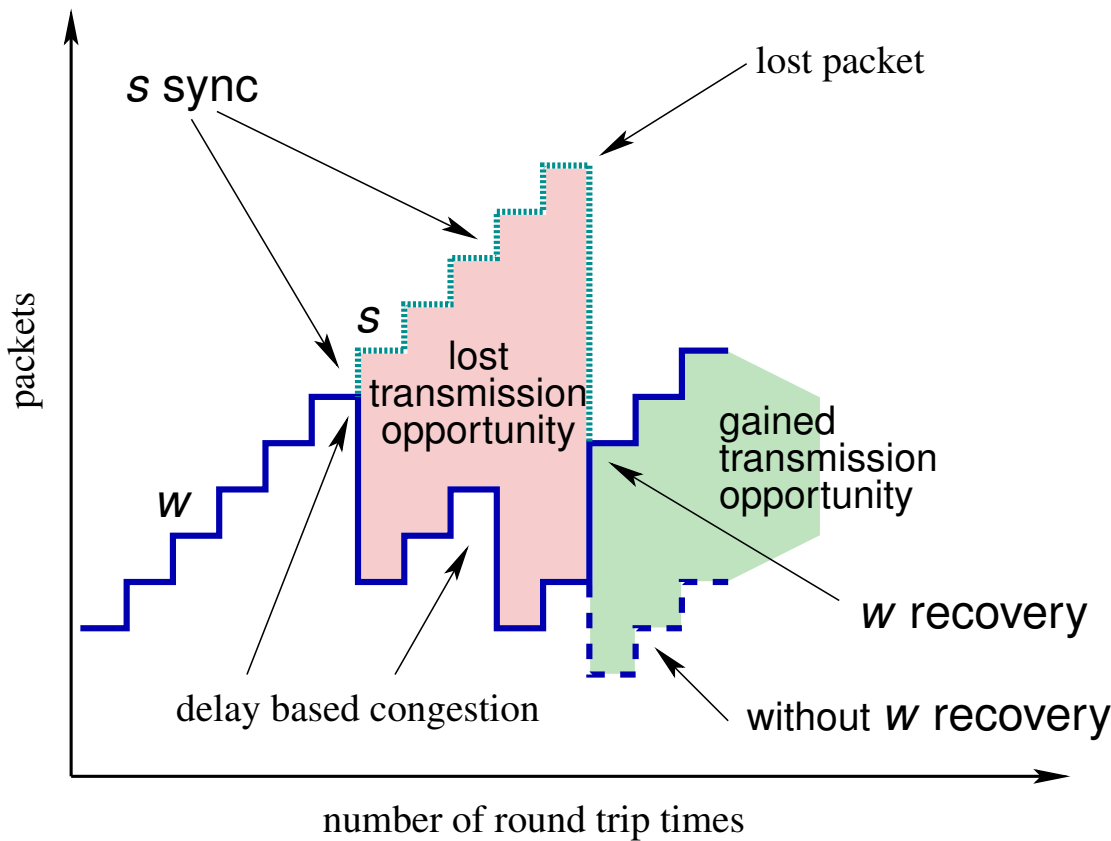


- Ignoring packet loss when queueing delays are small (region A)



# Tolerance to non-congestion related losses





► Results

## Delay-gradient based TCP congestion control

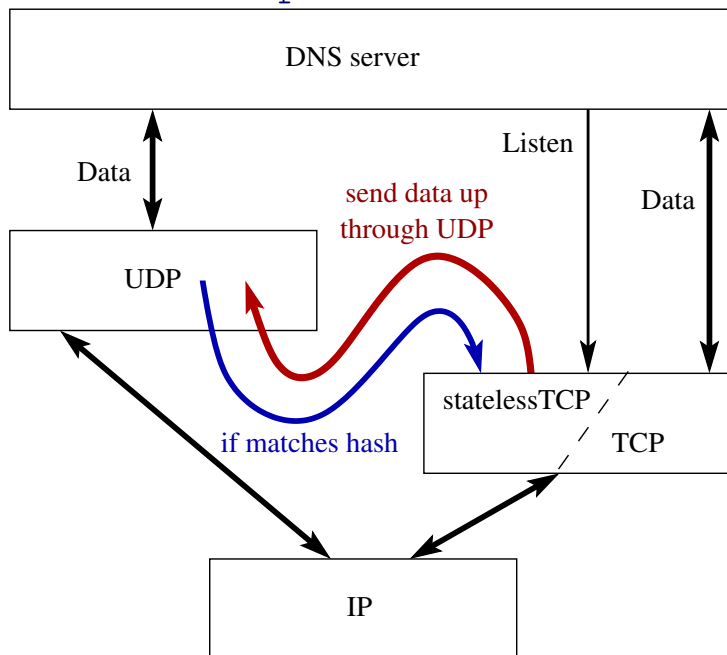


- We investigated a delay-gradient congestion signal because:
  - it does not require an accurate estimate of base RTT
  - delay thresholds are hard to set — need to know path's delay characteristics
- Heuristic to estimate queue full and empty states from gradients
- We have implemented it in FreeBSD,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



Proposed by Geoff Huston to mitigate a DNS server issue

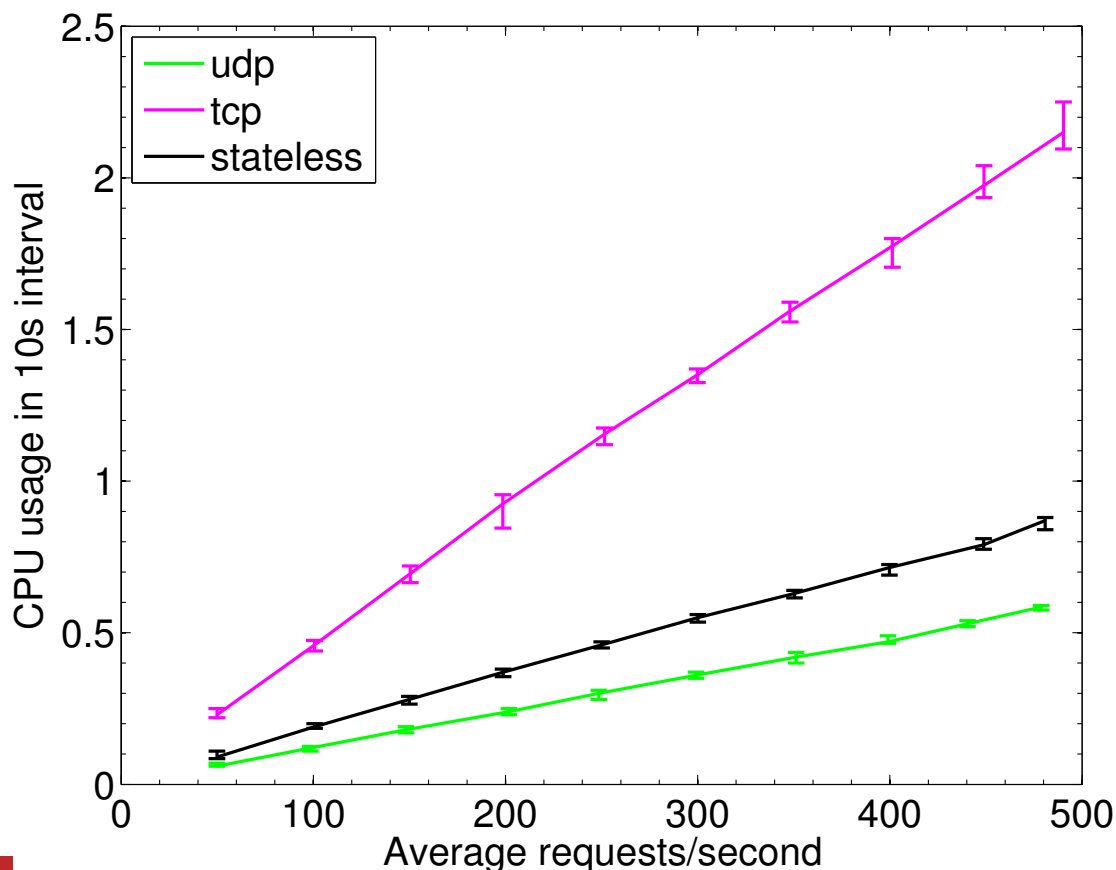
<http://www.potaroo.net/ispcol/2009-11/stateless.pdf>



Funded by APNIC and Nominet



## CPU time versus DNS query arrival rate





- Algorithms have been implemented in the FreeBSD kernel (some available [caia.swin.edu.au/urp/newtcp/tools.html](http://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

Work on delay-based TCP was made possible in part by a grant from the Cisco University Research Program Fund at Community Foundation Silicon Valley



## Thank you!

## Questions?