Enhancing TCP to support Rate-Limited Traffic

CSWS

draft-fairhurst-tcpm-newcwv-05.txt

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Rate-limited Traffic

Rate-limited apps are prevalent:

- CBR/VBR motion compensated video
- RTC-Web
- Applications that switch content between streams
- HTTP 1.1 persistent connections
- Google SPDY (persistent TCP connections)
- HTTP Adaptive Streaming (HAS)

TCP was not designed to support rate-limited apps!

- TCP reduces to RW and slow starts after idle
- TCP increases cwnd during app-limited periods

Congestion Window Validation

RFC2861 had a good motivation (protect the network)

However, too conservative for apps to benefit.

Not widely implemented or used.

Propose to obsolete RFC 2861, and define something else.

Key Features

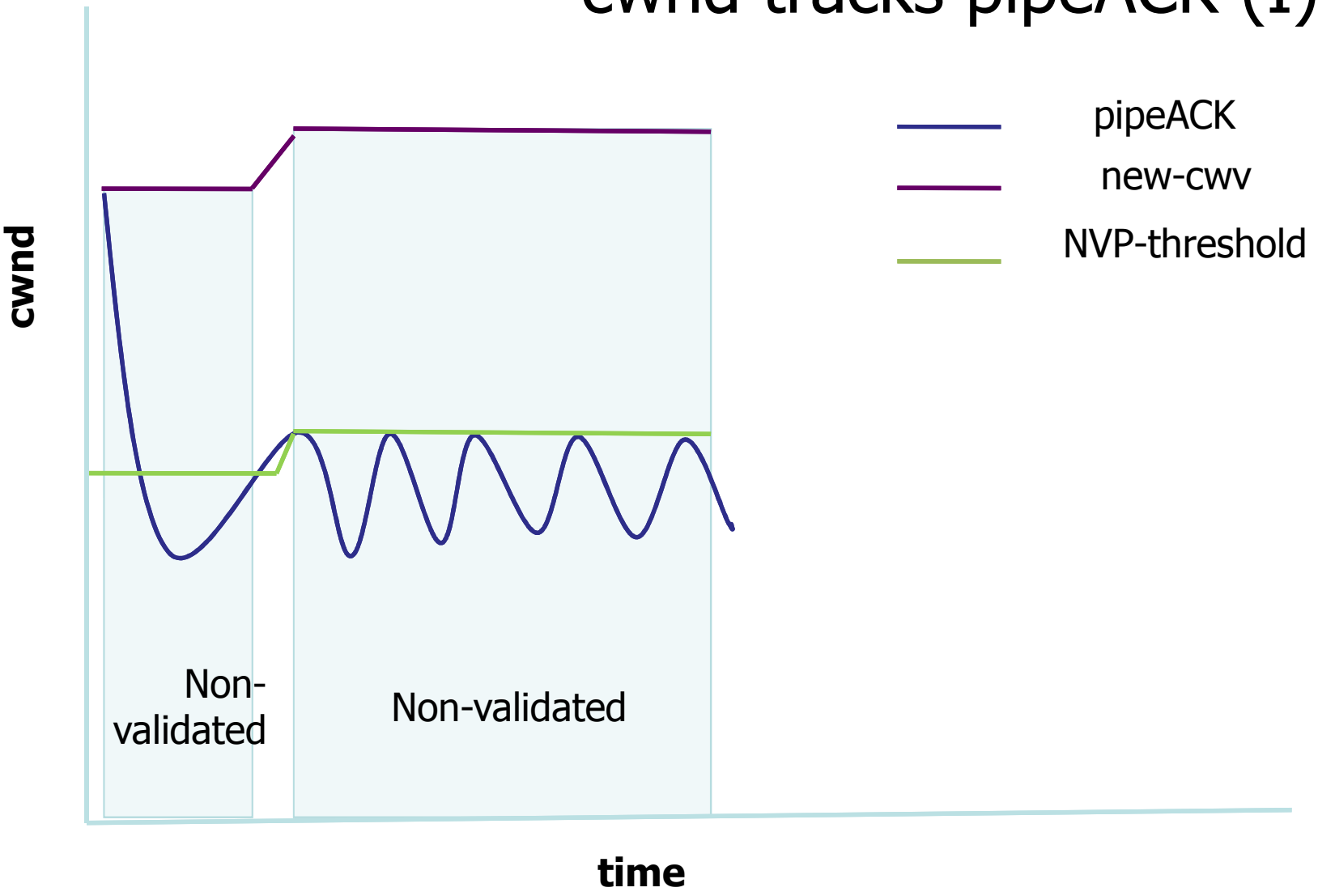
Differentiate between Validated & Non-Validated Phases

Validated: Standard behaviour

Non-Validated: Updated behaviour

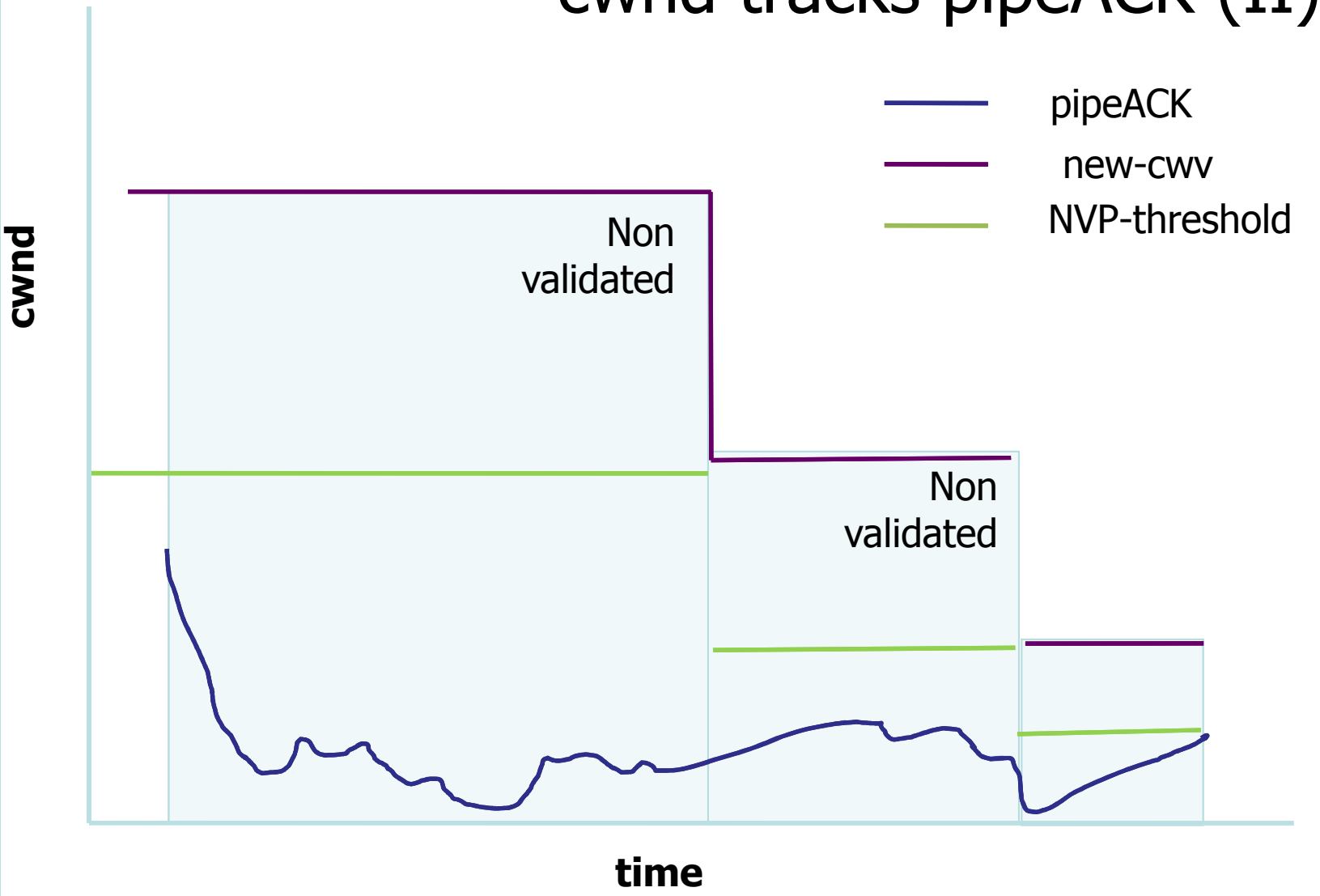
- ssthresh adjusted
- Different rate reduction for loss (D-R)/2
- cwnd does not increase
- cwnd decreases after NVP

cwnd tracks pipeACK (I)



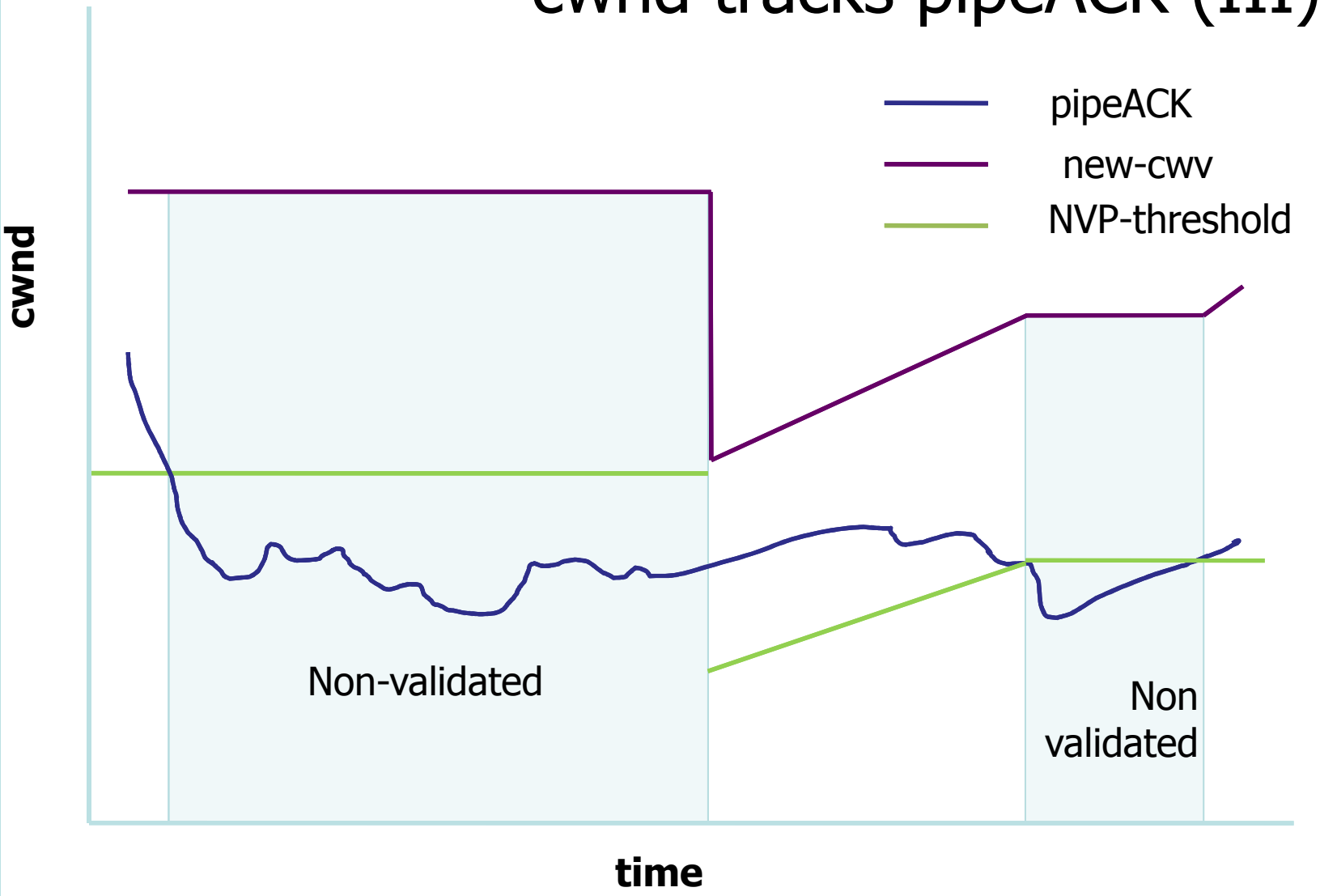
Varying pipeACK
With new-cwv, the cwnd does not grow beyond 2*pipeACK

cwnd tracks pipeACK (II)



Varying pipeACK (around ½ cwnd)
new-cwv behaviour reduces cwnd after 5 minutes by ½

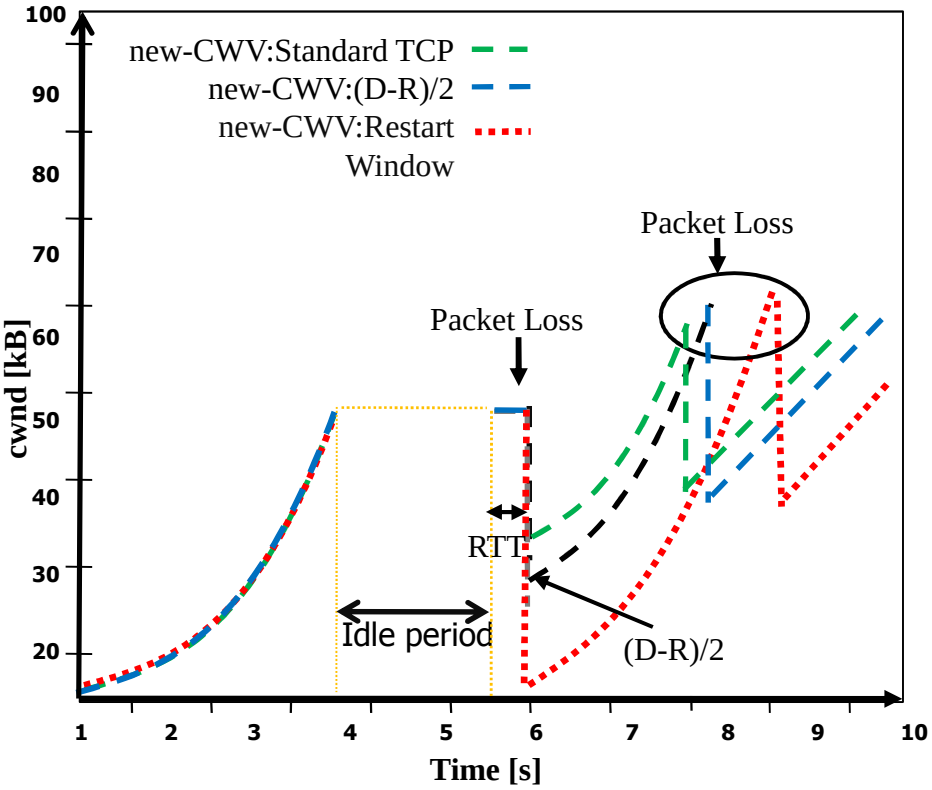
cwnd tracks pipeACK (III)



Varying pipeACK (around ½ cwnd)
new-cwv behaviour tracks pipe

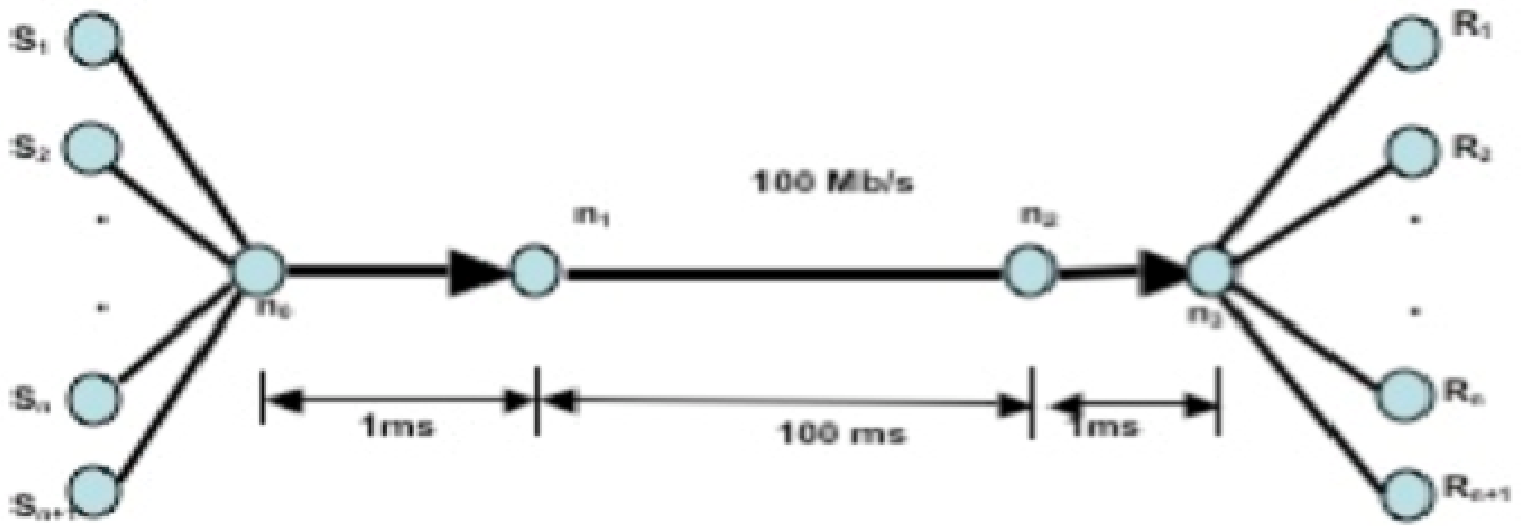
Reaction to loss..

- Radical behaviour is restart from one packet
- Standard TCP recovery mechanism
- Alternatively we can estimate successfully transmitted packets (D-R)* that provides an indication of path capacity
  - reset the cwnd after recovery by (D-R)/2



* **D** is the flight size **R** the number of packets detected as lost

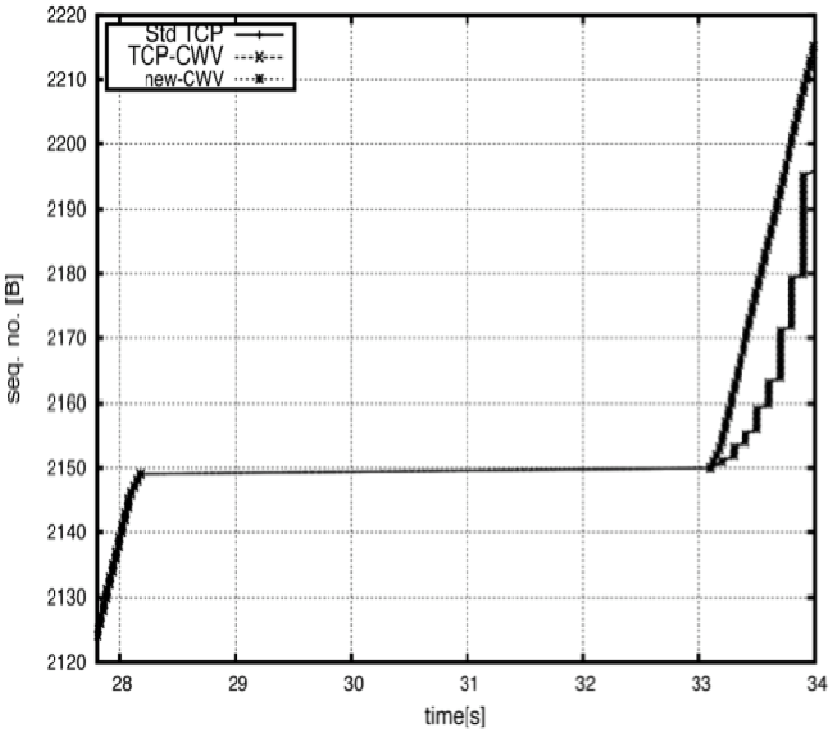
Analysing Impact - Simulation Topology



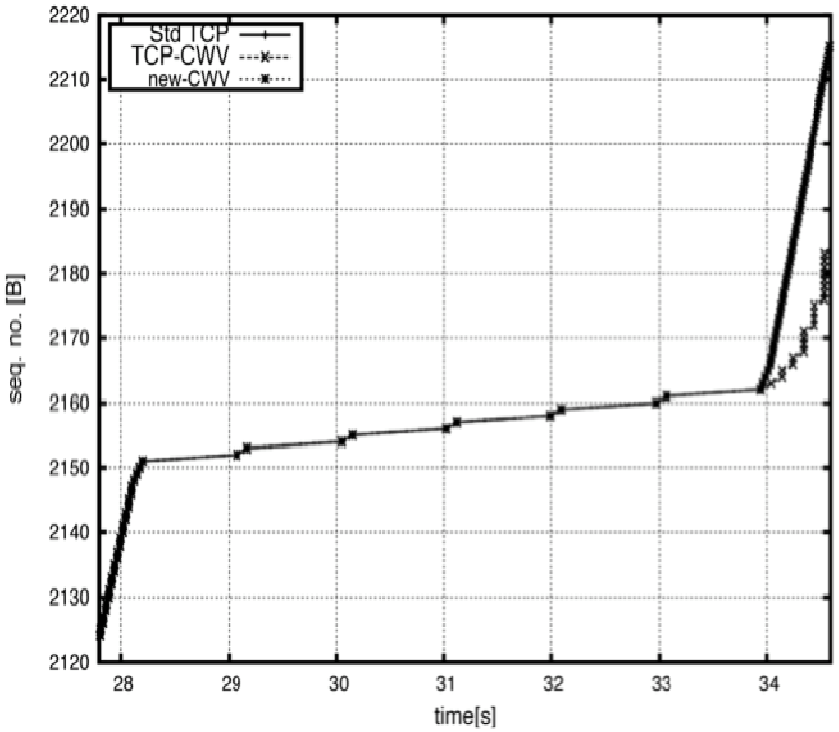
Rate-limited traffic sources (512 kb/s)

Idle (no data sent) or app-limited (reduce to 12kb/s)

App benefit



5 sec Idle period

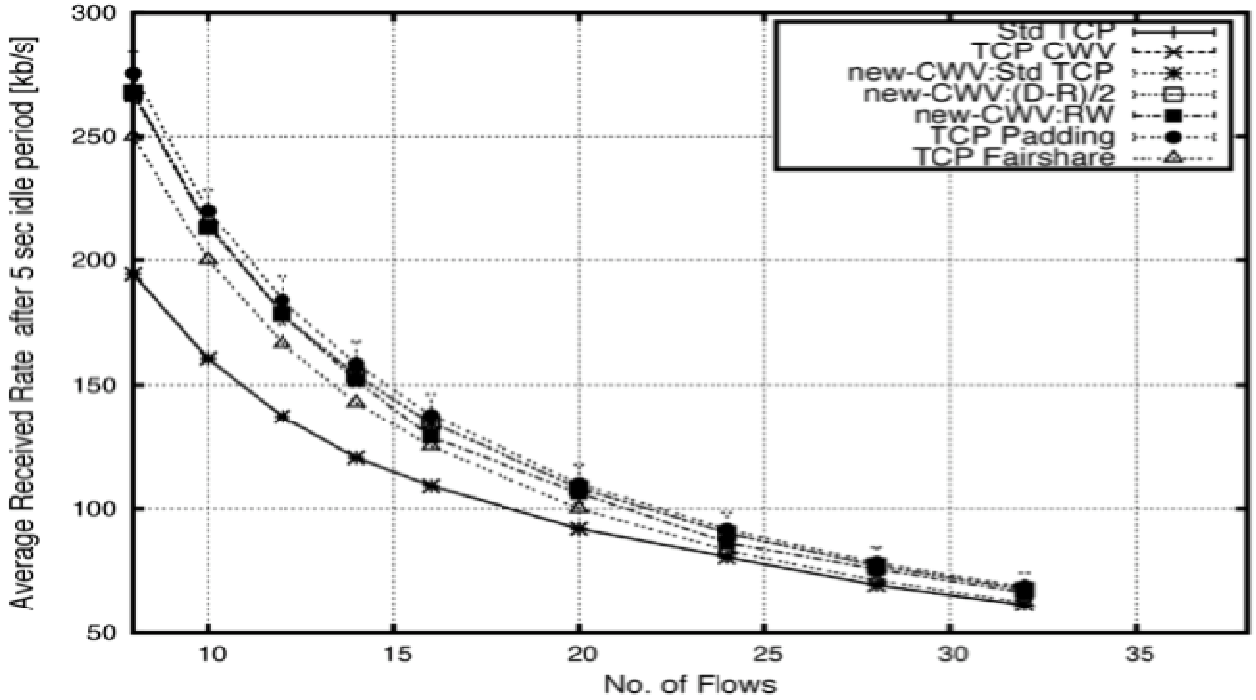


5 sec app-limited period

new-cwv promptly resumes without reducing cwnd
app benefits

Pathology: Path capacity while idle

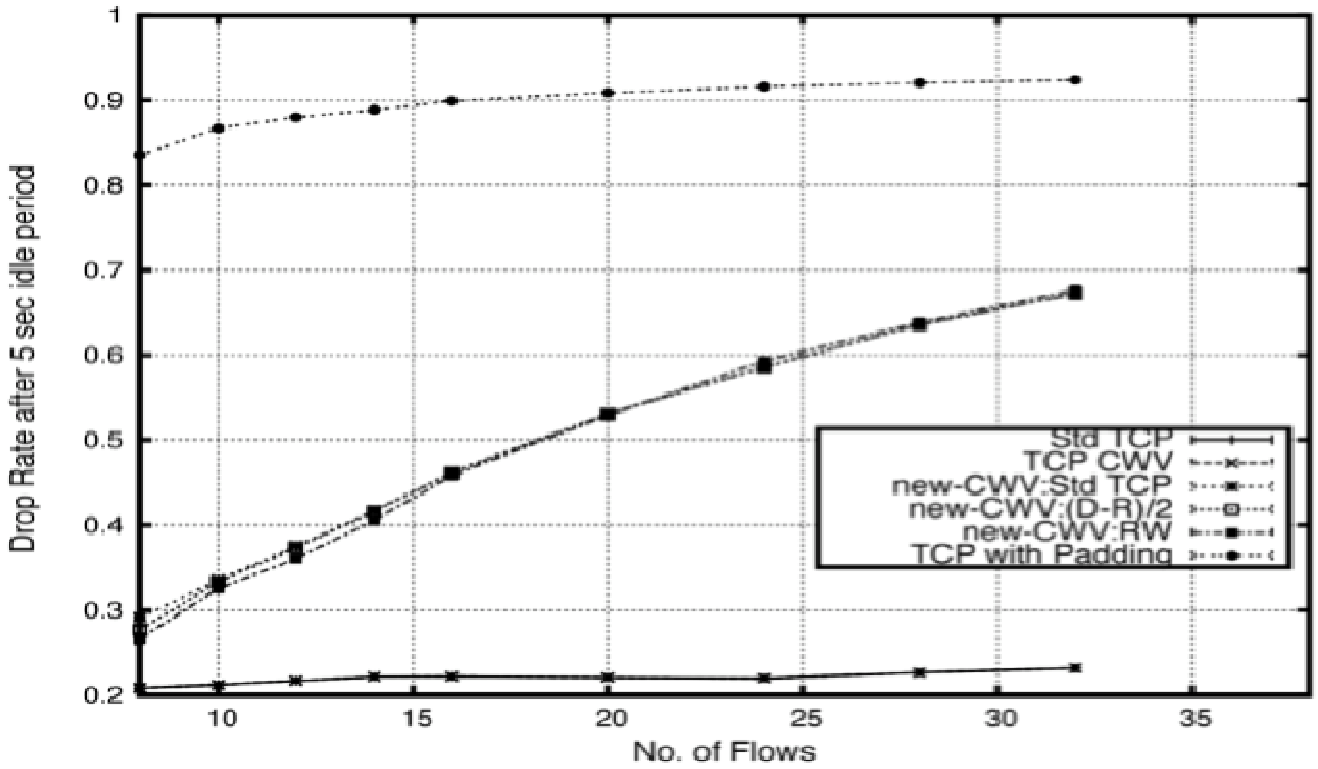
200 ms path RTT, BDP router buffer, 100 Mbps capacity, app rate 512kbps,
5 sec idle period,
Capacity changes to 2 Mbps , Flow monitor duration 10RTT



new-cwv flows only ~3% higher than TCP fair share during heavy congestion (from 16 flows)
Average receive rate of all new-cwv flows
<= TCP Fair share (less than 0.1% difference).

Pathology: Path capacity change while idle

200 ms path RTT, BDP router buffer, 100 Mbps capacity, app rate 512kbps
with a 5 sec idle period,
Capacity changes to 2 Mbps , Flow monitor duration 10RTT



new-cwv quickly reduces cwnd after first RTT

Reduced drop rate at bottleneck router compared to padding

Conclusions

We think this is a problem we should address

Capacity sharing with rate-limited apps is important

- Benefits the rate-limited apps
- Protects other apps from collateral damage

Outstanding issues:

- Tail loss can also be an issue for bursty apps
- Need to implement the method!
- Pacing (at least coarse-pacing) may help?

http://trac.tools.ietf.org/group/irtf/trac/wiki/ICCRG_newcwv