draft-ietf-tsvwg-aqm-dualq-coupled

Disproof of 'Throughput Bonus' or 'Fast-Lane' Objection

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Background

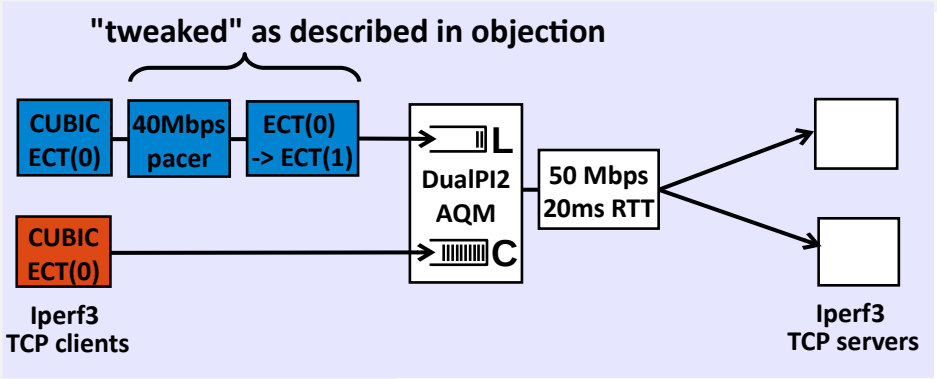
- The objection* claimed the DualQ offers a 'fast-lane' or 'throughput bonus' and

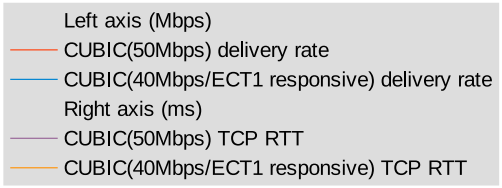
  "the bonus is easily exploited by unscrupulous senders without disabling congestion control"

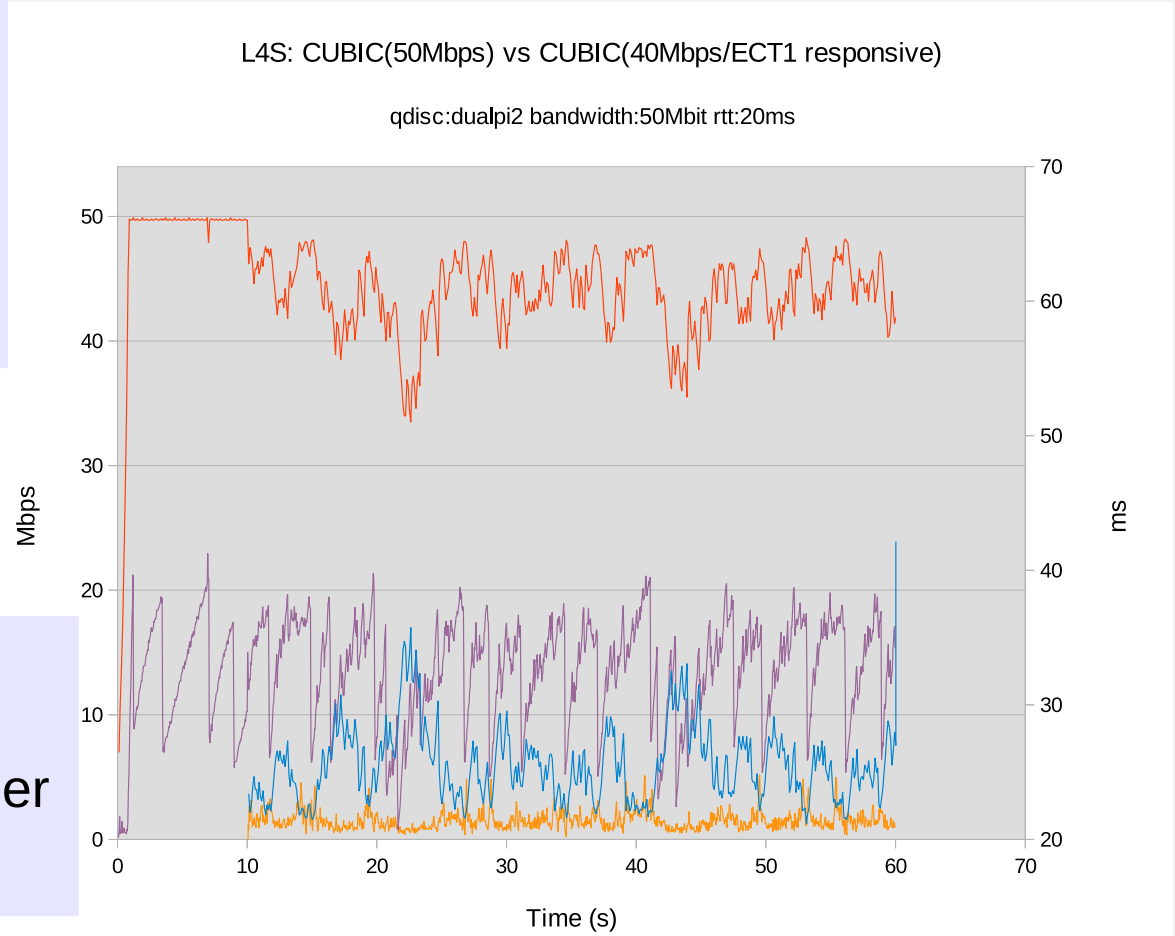
- These claims were based on
  - a single experiment run with
  - no control experiment to check whether the alleged 'fast lane' was any faster than the other lane
- The following experiments aim to reproduce the objectors' experiment precisely
  - and to add control experiments

*p4-5 of https://sce.dnsmgr.net/downloads/L4S-WGLC2-objection-details.pdf

2 CUBIC flows; 1 "tweaked" flow joins after 10s

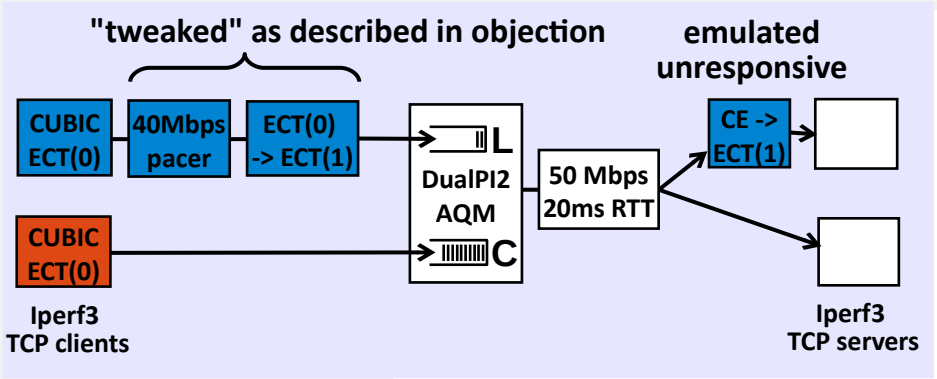


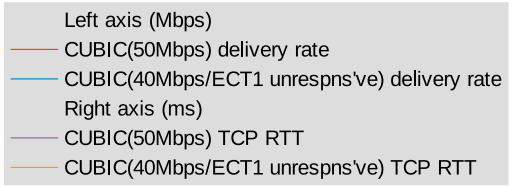


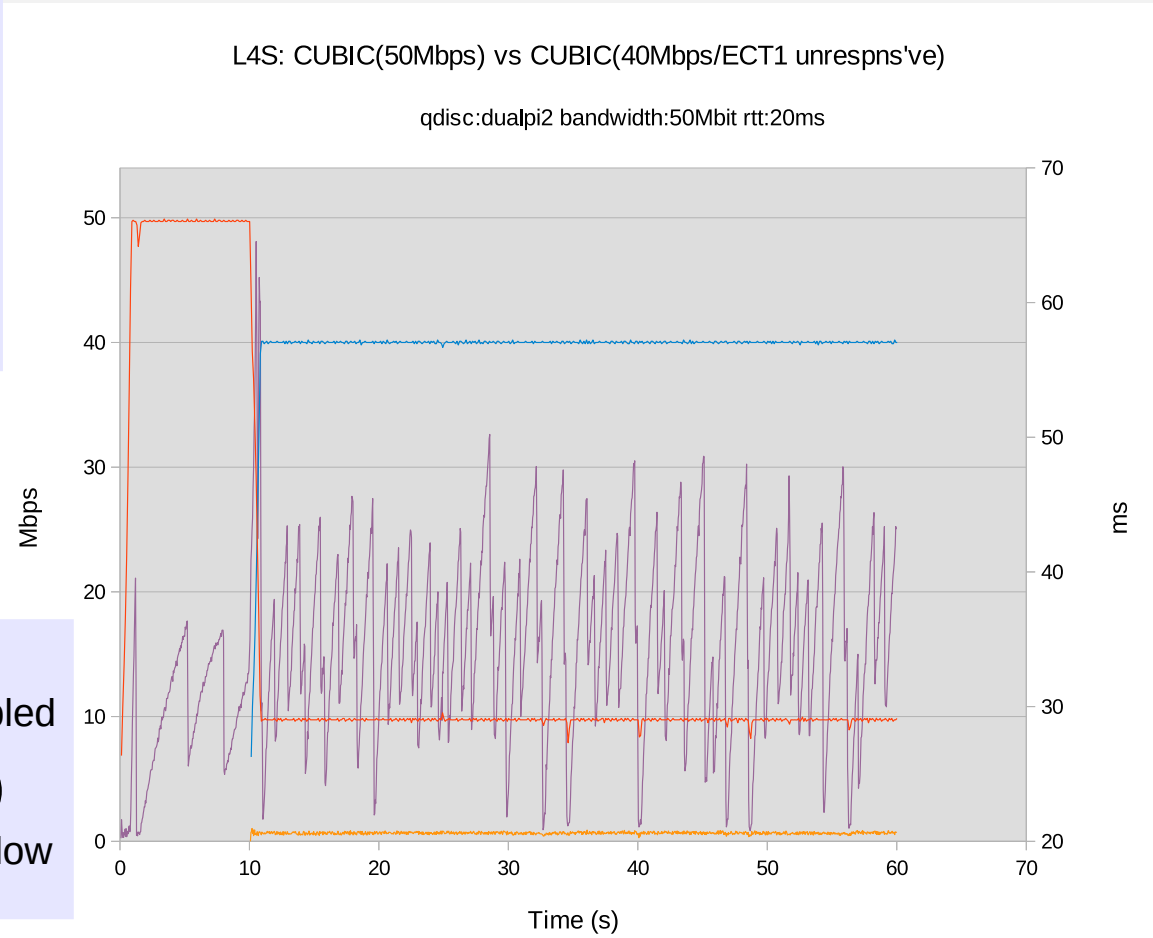


- Does not reproduce objection
- Tweaked flow gets significantly smaller capacity share (blue), not larger

Tweaked flow then also made unresponsive

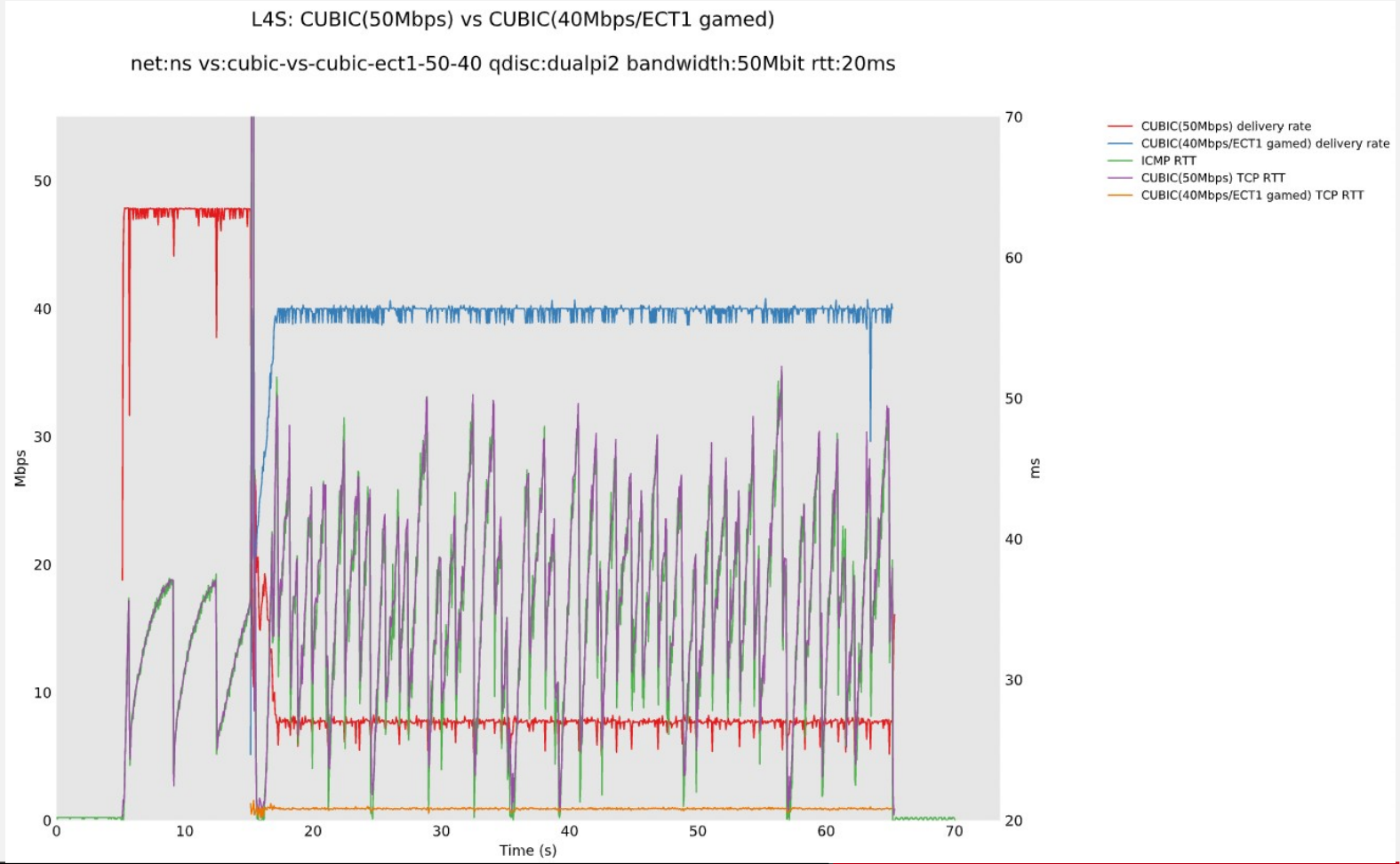






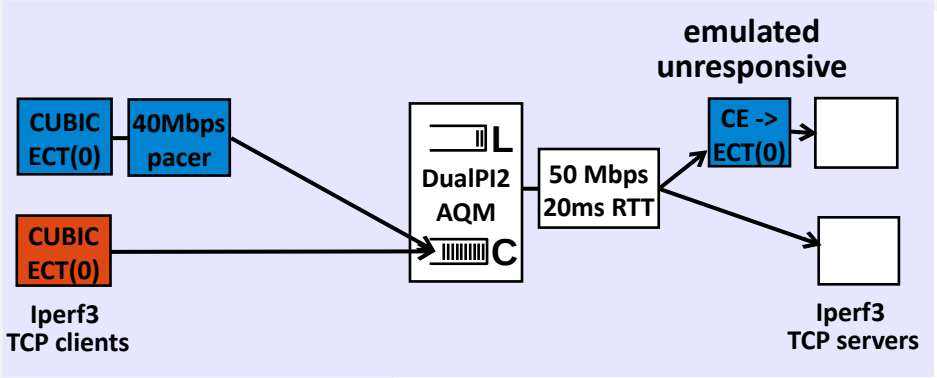
- Reproduces objection very closely
  - but objection claimed cong. ctrl was not disabled
- Tweaked flow now gets 40Mbps (blue)
  - as expected for 40Mbps paced unrespns've flow

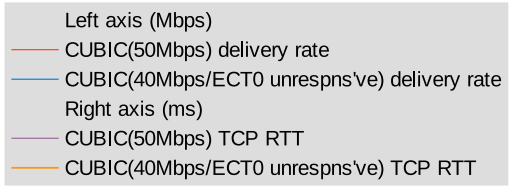
plot from objection for comparison

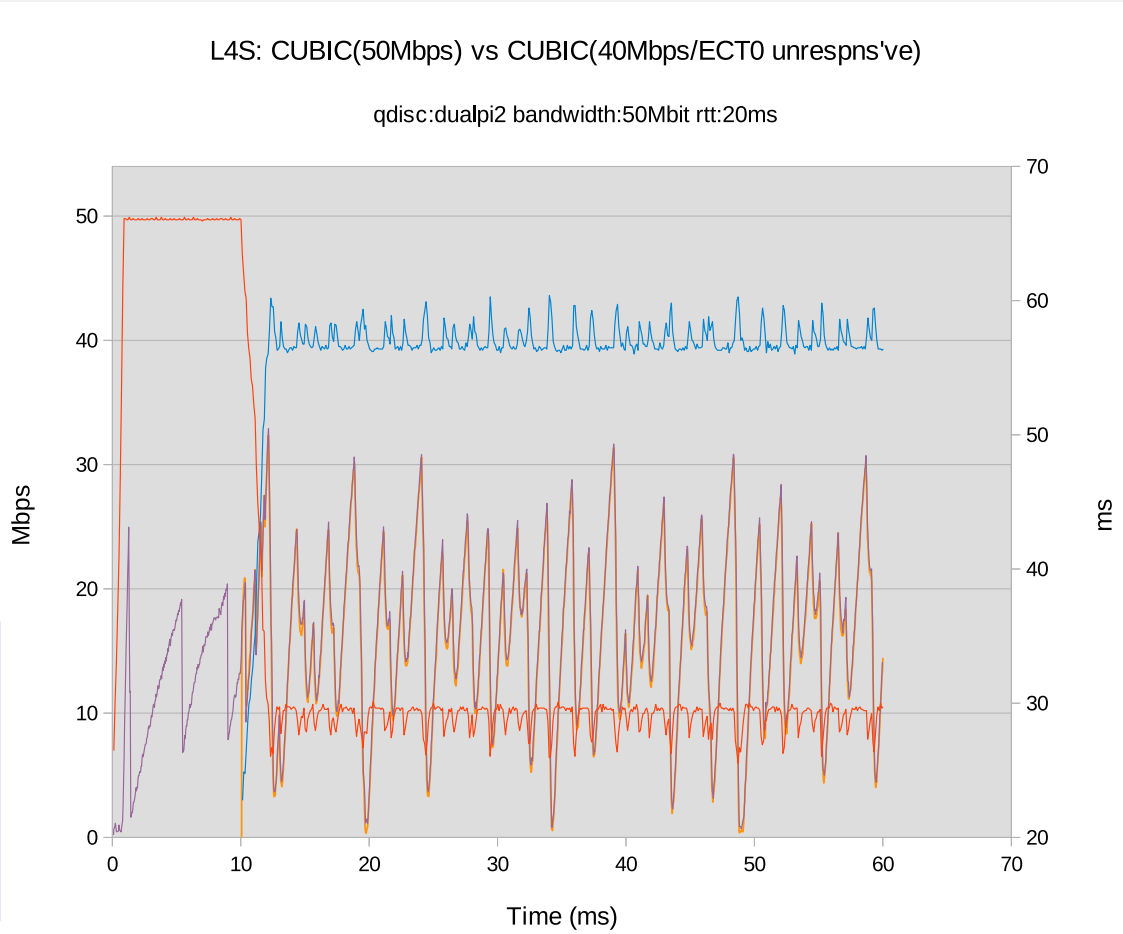


*p4-5 of https://sce.dnsmgr.net/downloads/L4S-WGLC2-objection-details.pdf

Control experiment: Tweaked flow unresponsive but ECT(0)







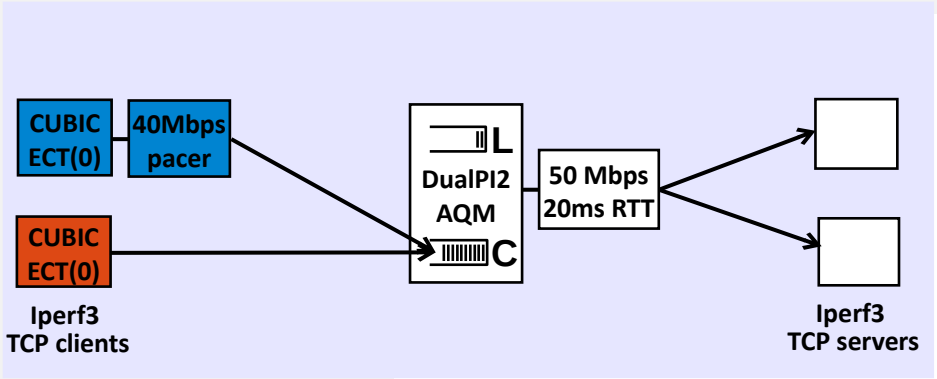
- Proves thru'put advantage is due to unresponsiveness, not DualPI2
- because tweaked flow (blue) gets same advantage in either queue

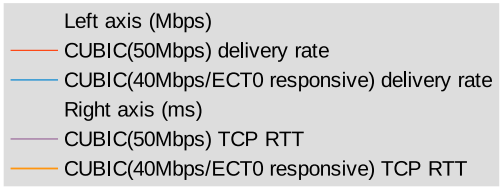
Summary

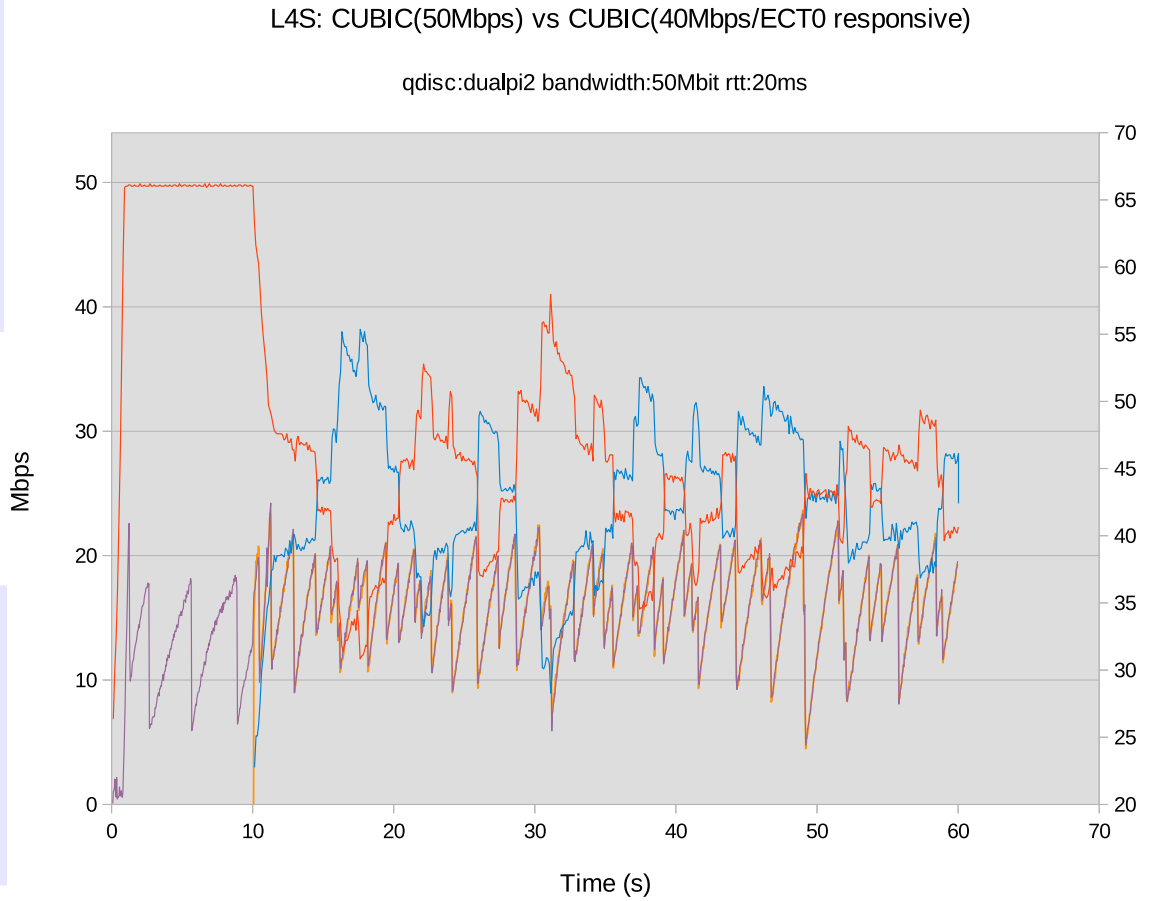
- No evidence for objectors' 'fast-lane' claim by reproducing their experiment
- The result can be reproduced v closely by suppressing congestion control
  - But objectors stated "bonus is easily exploited ... without disabling congestion control"
  - Objectors' experiment was likely faulty, and somehow suppressed congestion control
- Our experiments include a control run
  - Claimed 'fast lane' is no faster than the other lane
  - Dual Queue Coupled AQM meets its stated goal of not allowing unresponsive flows to cause more harm to existing traffic than in a single queue
    - unresponsive thru'put: same in either queue
    - unresponsive delay: lower in L than C queue, but not at the expense of anyone else's delay

Back-up Slides

Control expt #2: Tweaked flow ECT(0) and responsive





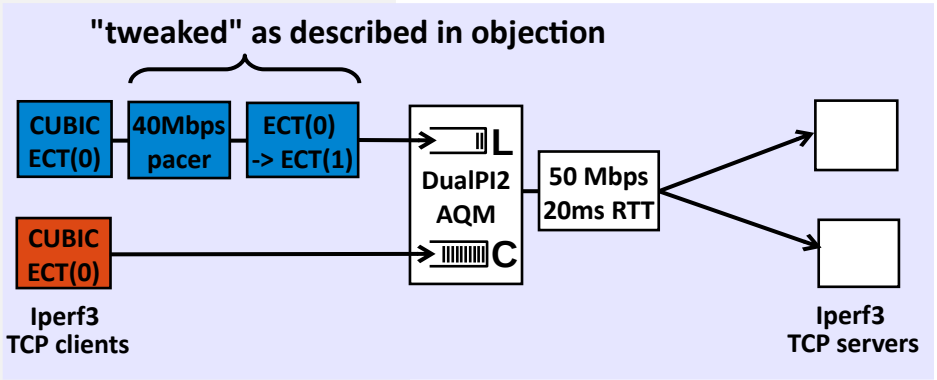


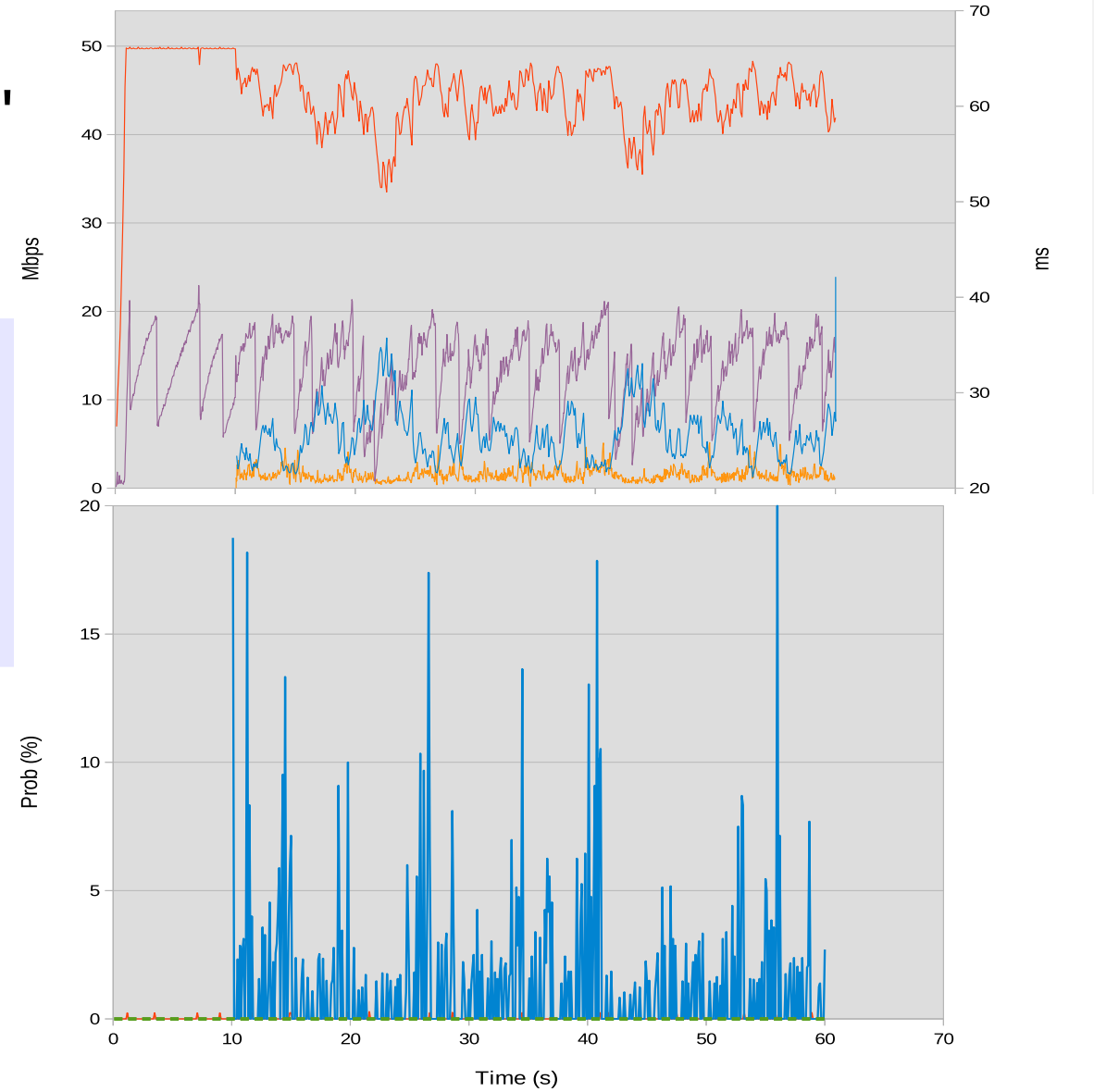
- Proves 40Mbps pacing is only a cap
- Because tweaked flow behaves:
  - as normal, given stable rate below 40Mb/s

Experiment details

- All nodes:
  - Ubuntu 18.04.4 LTS
  - Linux kernel 5.10.31-3cc3851880a1-prague-37
  - iproute2-5.9.0
  - Commit ID: testing/6e042bcd4158

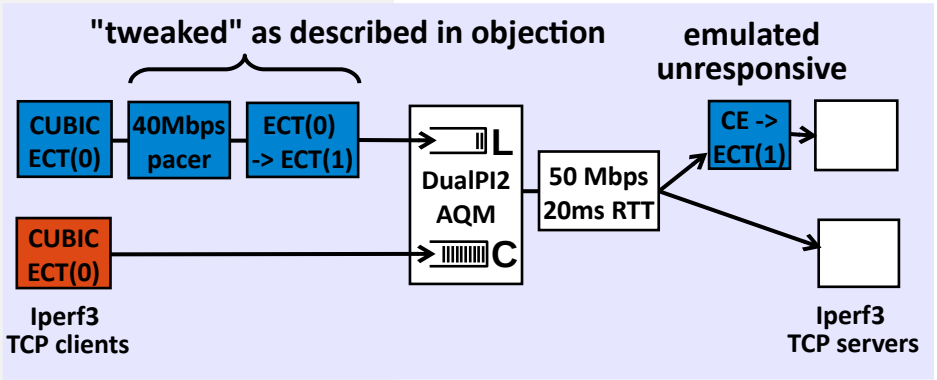
Inside slide #3
2 CUBIC flows; 1 "tweaked"

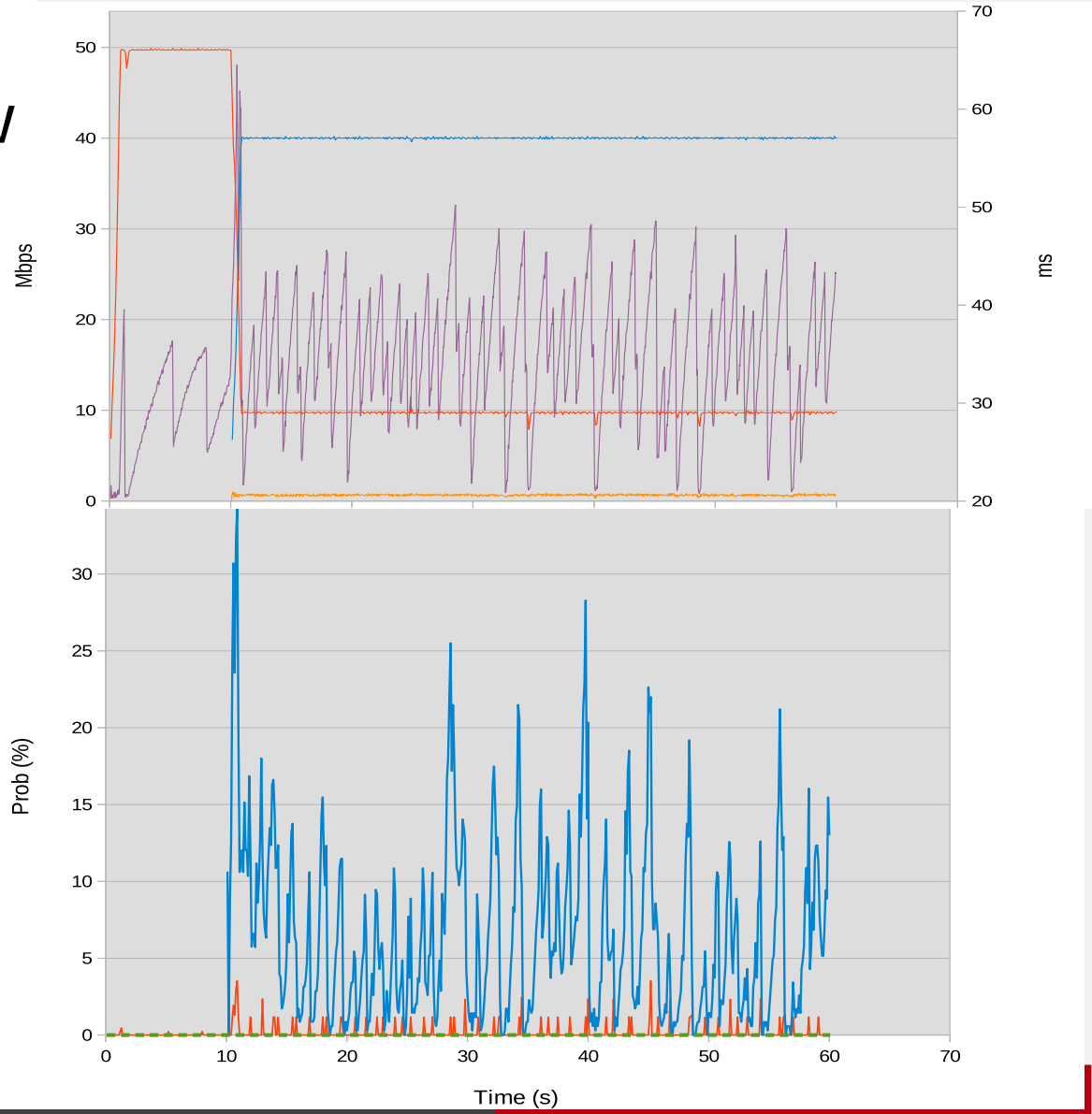




- Lower plot explains low thru'put of tweaked flow, due to its response to deliberately aggressive coupled marking (blue) instead of the Classic marking (red) intended for CUBIC
- zero native L4S marking (green dashed)

Inside slide #4
Tweaked and unresps'v flow





- Lower plot shows that the unresponsive L flow squeezes the C flow into less capacity by causing
  - higher C congestion (red) and
  - in turn, higher coupled L congestion (blue) which it ignores
- Still zero native L4S marking (green dashed)