Flow Queue PIE: A Hybrid Packet Scheduler and Active Queue Management Algorithm

draft-tahiliani-tsvwg-fq-pie-02

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TSVWG, IETF 123

Overview of the draft

- Combines "flow queuing" and PIE algorithm
  - Similar to how FQ-CoDel combines FQ and CoDel
- The functioning of FQ is similar to RFC 8290
  - Incoming packets are hashed into buckets, each having its own queue
  - Packets are dequeued using a DRR-based packet scheduler
- The functioning of PIE is similar to RFC 8033 with minor modifications
  - Uses timestamps to calculate queue delay
- Implementations of FQ-PIE
  - Linux
    - Supported in multiple Linux distributions
  - FreeBSD (thanks to Grenville Armitage and team!)
  - network simulator - 3 (ns-3)

Status of FQ-PIE

	CoDel	FQ-CoDel	PIE	FQ-PIE
Linux/FreeBSD implementation	Yes	Yes	Yes	Yes
Specification	RFC 8289	RFC 8290	RFC 8033	Not available

Thanks: Michael Welzl

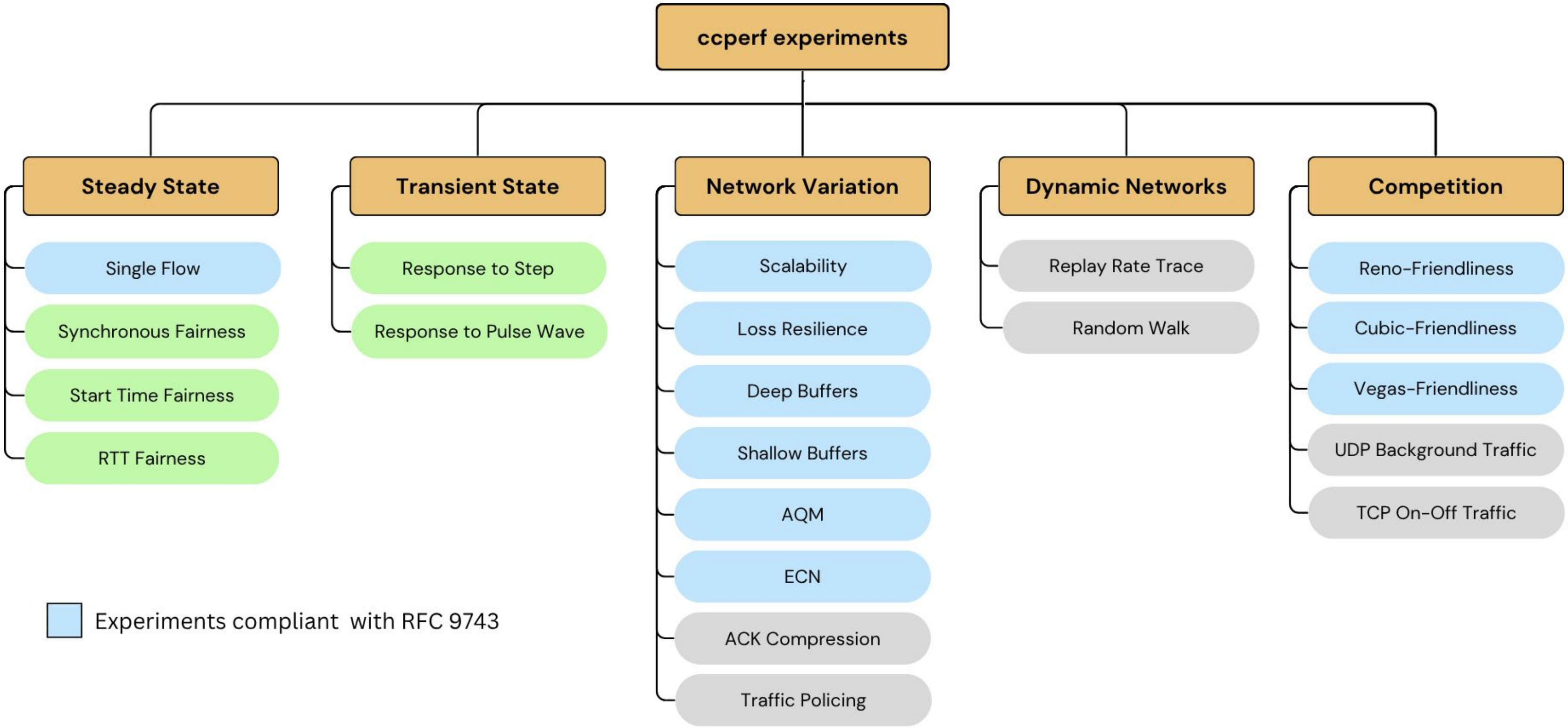
History of the document

- -00 draft described FQ-PIE
- -01 draft updated the scope of experimentation by adding scenarios from RFC 7928
- -02 draft adds text about the FreeBSD implementation of FQ-PIE

Collaborations for testing in real deployments

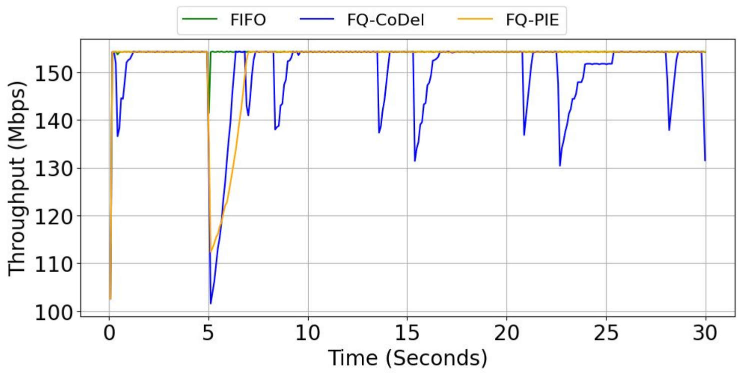
- Quantum Networks (https://www.qntmnet.com/)
  - WiFi access point: QQ-IW-235
    - OpenWrt 23
    - Linux kernel: 5.15.153
    - iproute2: 6.3.0
- LibreQoS (https://libreqos.io/)
  - Willing to add the support of FQ-PIE in the next releases
  - Join us for the discussions on Zulip Chat
- Looking for more collaborations!

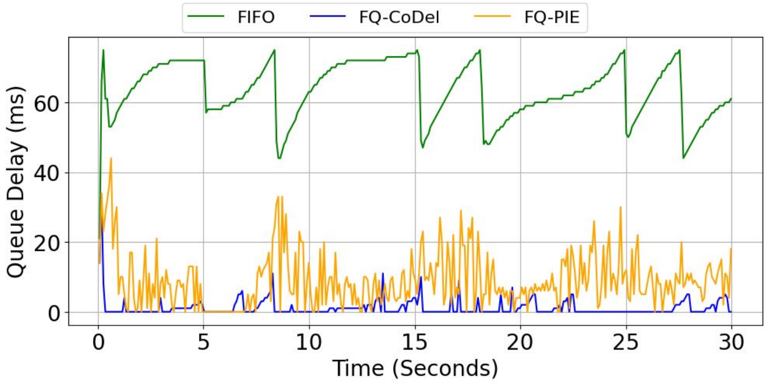
Additional slides (IETF 123)



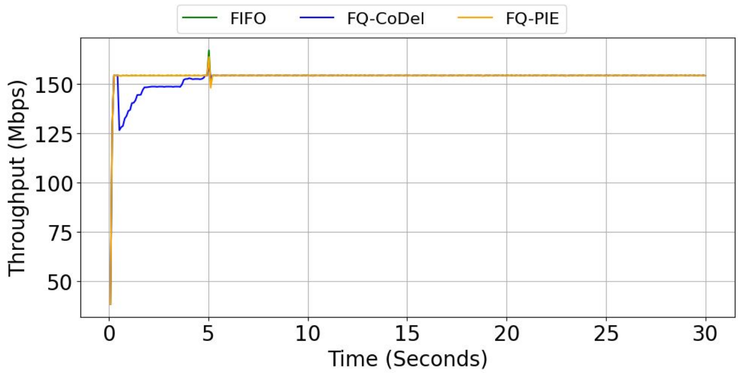
Credits: Deepa Kumari, Suvam Mukherjee and Vivek Jain

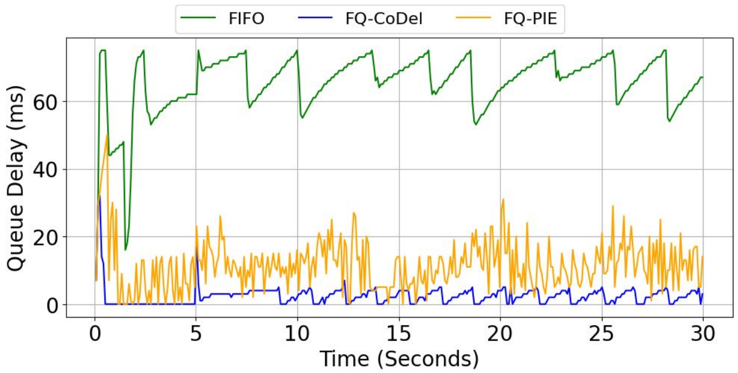
FQ-*: Increasing RTT from 15ms to 30ms





FQ-*: Decreasing RTT from 30ms to 15ms





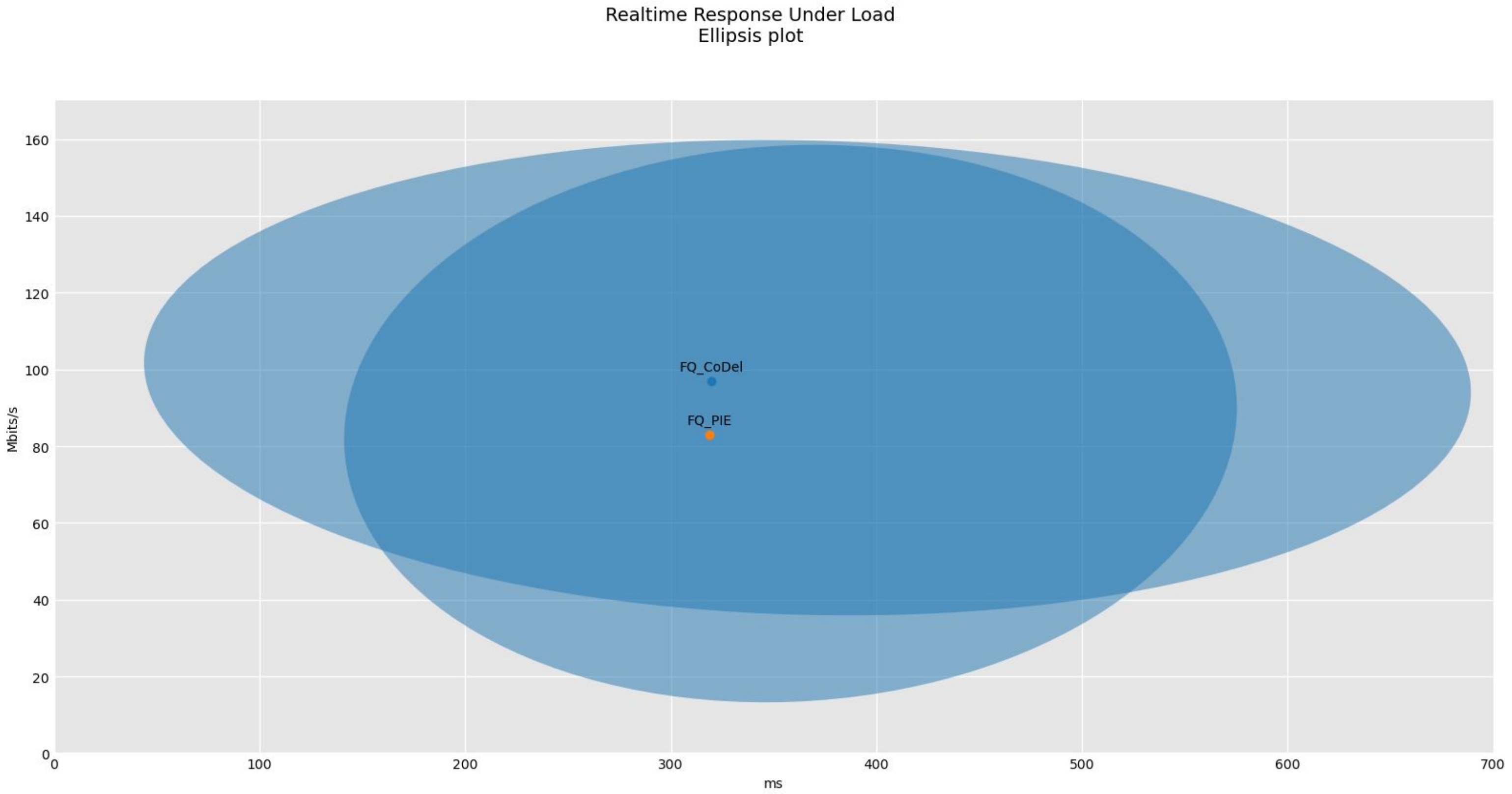
Additional slides (IETF 122)

Flexible Network Tester (Flent)

- WiFi APs provided by Quantum Networks for testing: QQ-IW-235 model
    - OpenWrt 23
    - Linux kernel: 5.15.153
    - iproute2: 6.3.0
- Realtime Response Under Load (RRUL)
    - Specifications of this test: https://www.bufferbloat.net/projects/bloat/wiki/RRUL_Spec/
    - Runs RTT measurement using ICMP ping and UDP round trip time measurement
    - Loads up the link with eight TCP streams (four downloads, four uploads)

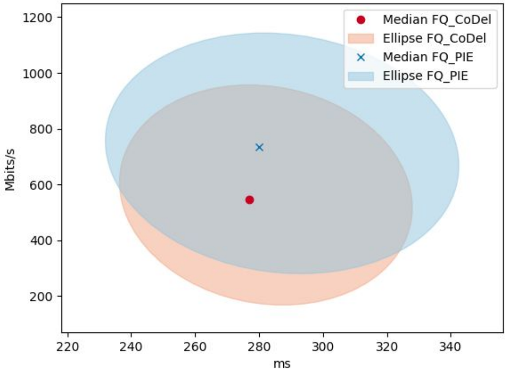
Credits: Vishal Kamath, Rian Pinto, Alen Basil and Smit Rathod

Results from RRUL test

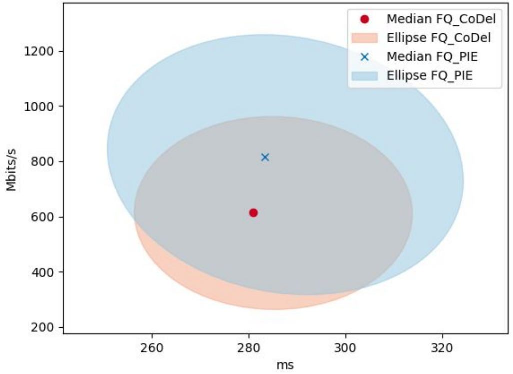


Results from tcp_n down tests

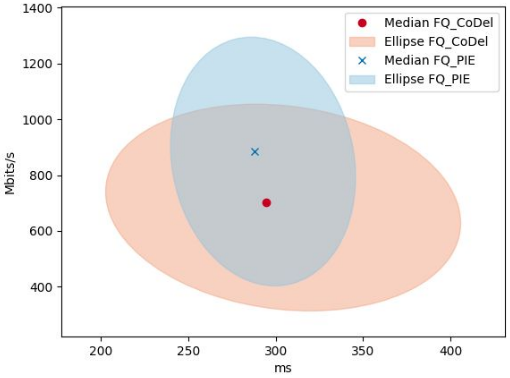
n = 50



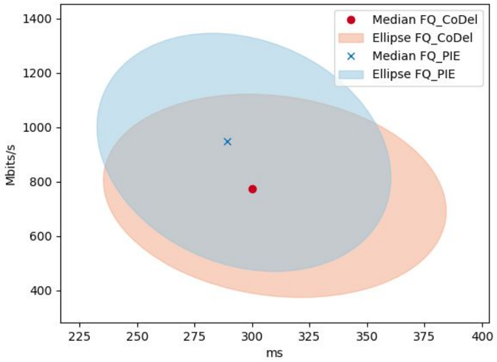
n = 100

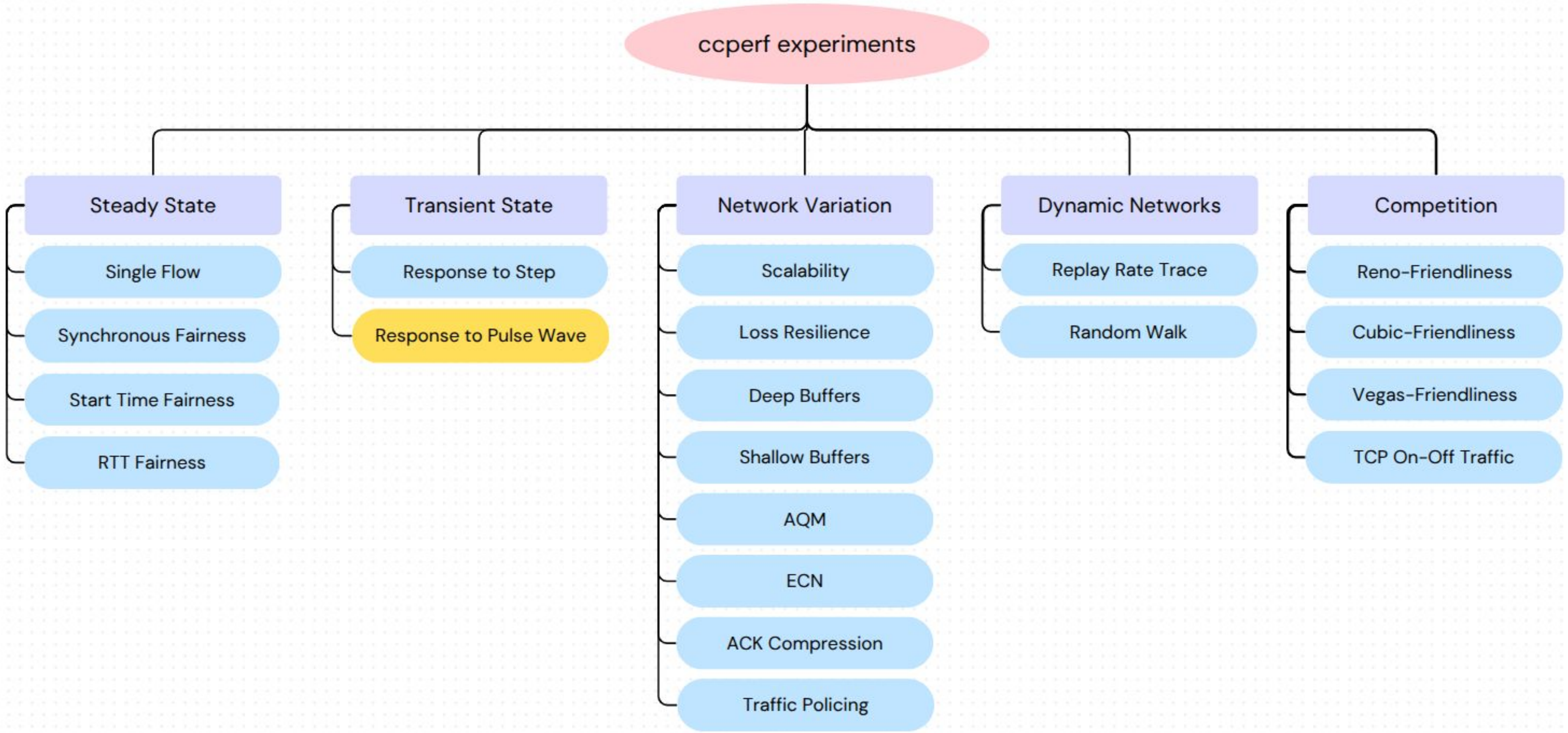


n = 200



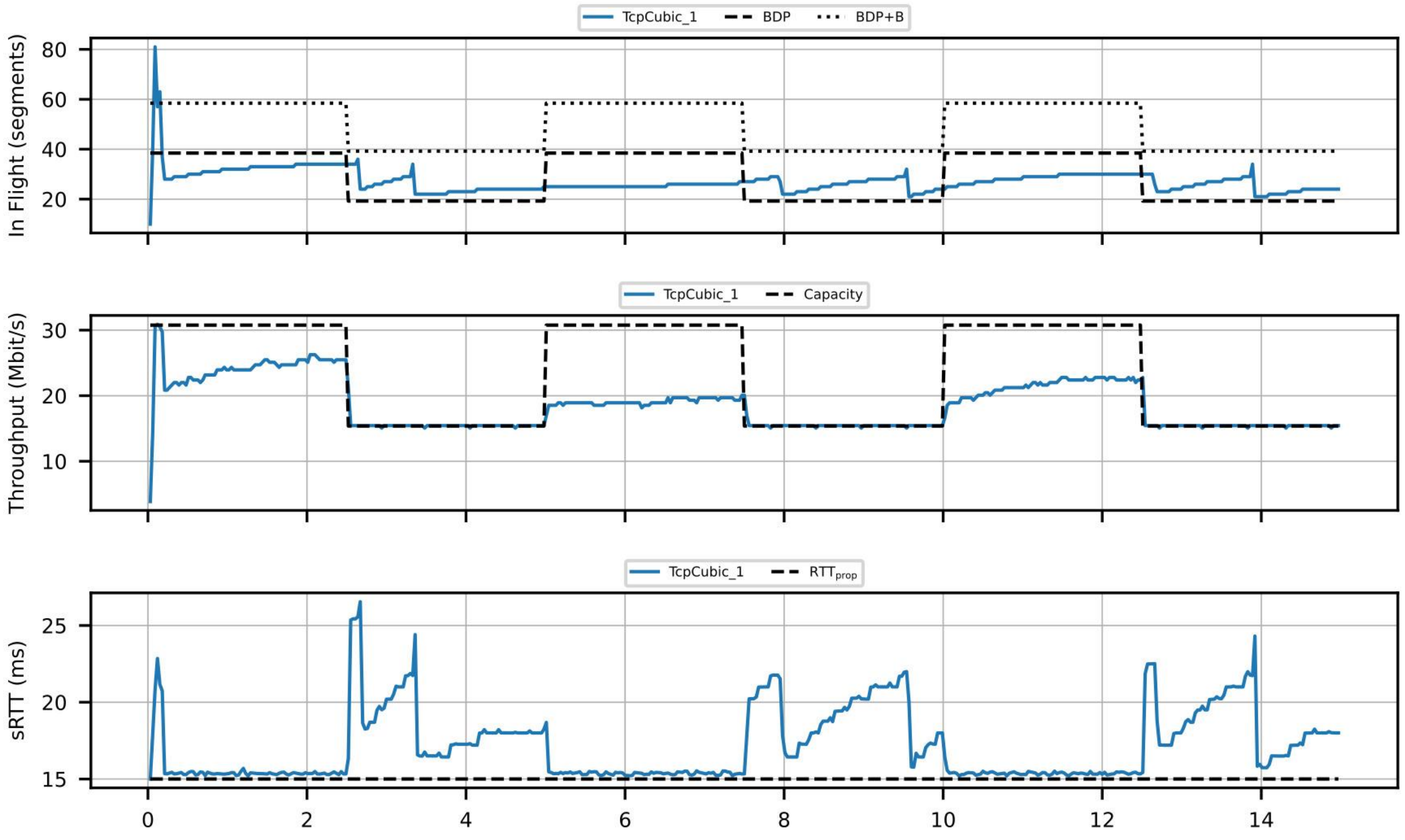
n = 300





Credits: Mahati A. Kalale, Anuhya Murki, Shriya Anil, Rati Preethi S and Y. Supradha Bhat

Response to Pulse wave: FQ-CoDel



Response to Pulse wave: FQ-PIE