# First L4S Interop Event (a) IETF Hackathon

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Champions: Greg White (CableLabs), Jason Livingood (Comcast), Sebnem Ozer (Comcast), Vidhi Goel (Apple), Neal Cardwell (Google)



## Hackathon/Interop Plan

- L4S Congestion Control & AQM Architecture
  - draft-ietf-tsvwg-l4s-arch
  - draft-ietf-tsvwg-ecn-l4s-id
  - draft-ietf-tsvwg-aqm-dualq-coupled
- Accurate ECN for TCP (QUIC supports accurate ECN natively)
  - draft-ietf-tcpm-accurate-ecn
- L4S involves three components
  - Congestion control @ sender
  - Congestion marking @ bottleneck
  - Marking feedback @ receiver

## Hackathon/Interop Plan – cont.

- Friday afternoon CMTS & Network setup
- Saturday Setup continues, initial testing
- Sunday some initial results to share
- Monday readout in TSVWG
- Tuesday complete testing & wrap up

## Hackathon Implementations

- Congestion control
  - Apple QUIC Prague
  - TCP Prague
  - Google BBRv2
  - NVIDIA GFN
  - Nokia RT-Prague

- Marking Feedback
  - PicoQUIC
  - Apple QUIC
  - Google AccECN/TCP
  - FreeBSD AccECN/TCP
  - NVIDIA GFN client

## Hackathon Implementations

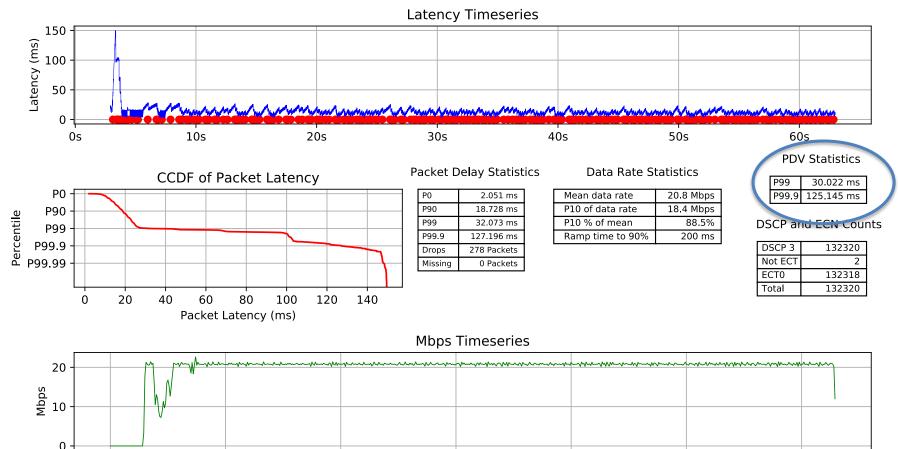
- Seven bottleneck link implementations
  - Four Low Latency DOCSIS implementations
    - 2 cable modem chipsets (Broadcom, Maxlinear)
    - 2 CMTS (Casa, Commscope)
  - Google Nest WiFi AP
  - Nokia Beacon 6 WiFi AP
  - Nokia 5G/Fixed Network Emulator

### Initial Interoperability Testing

- AppleQUIC / Commscope LLD
- AppleQUIC / Casa LLD
- AppleQUIC / Broadcom LLD
- AppleQUIC / Maxlinear LLD
- Google BBRv2 Linux / FreeBSD AccECN TCP
- NVIDIA / Nokia WiFi

- NVIDIA / Nokia RT-Prague / Nokia 5G RAN emulator
- NVIDIA / Casa LLD
- BBRv2 / TCP Prague / Nokia RT-Prague / Nokia 5G RAN emulator
- Meta Netesto / TCP Prague / Nokia WiFi

#### Upstream Classic (DOCSIS & AppleQUIC)



30s

40s

50s

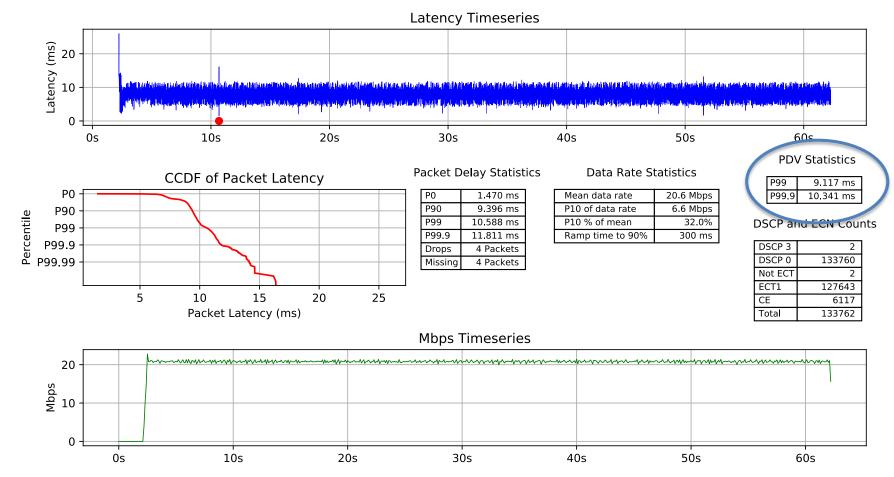
60s

0s

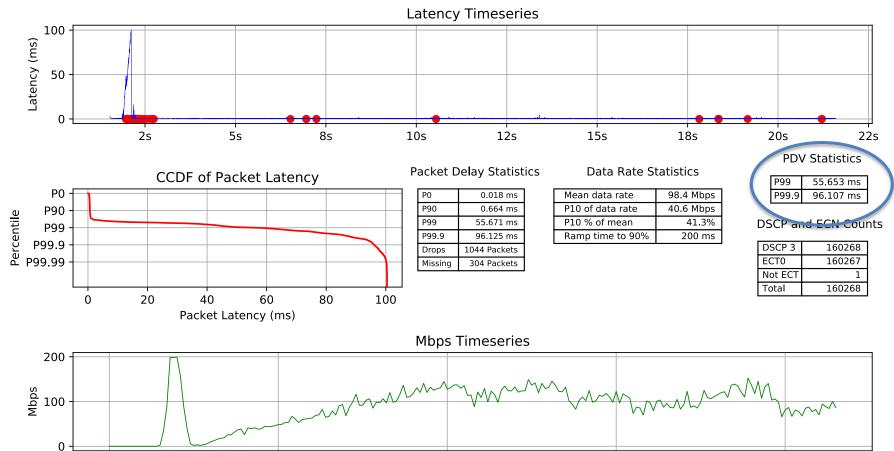
10s

20s

## Upstream L4S (DOCSIS & AppleQUIC)



#### Downstream Classic (DOCSIS & AppleQUIC)



10s

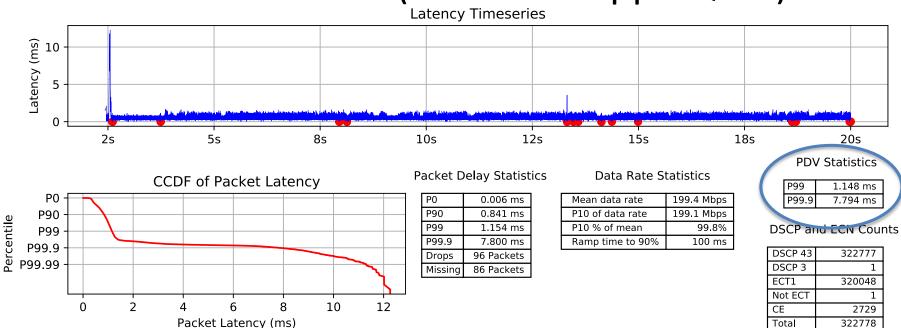
15s

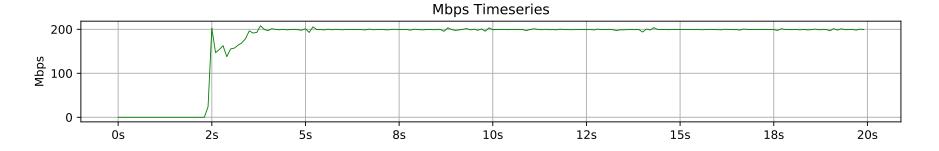
20s

5s

0s

#### Downstream L4S (DOCSIS & AppleQUIC)





## Participating Organizations (15)

Apple

CableLabs

Casa

Charter

Comcast

Commscope

Google

Independent

Kyrio

Meta

Nokia

Netapp

Netflix

**NVIDIA** 

ETH Zurich

## Participants (31)

Shamim Akhtar

Radhouan Allani

Chris Box

Bob Briscoe

Justin Cardones

Neal Cardwell

Chia-Yu Chang

Stuart Cheshire

Koen De Schepper

Glenn Deen

Wesley Eddy

Bilgehan Erman

Vidhi Goel

**Edward Grinshpun** 

Milap Rajeshkumar Joshi Richard Scheffenegger

Carl Klatsky

**Jason Livingood** 

Colin McIntosh

Charles Moyer

Murat Mugan

Sebnem Ozer

Ram Ranganathan

Nicola Rustignoli

Dan Rice

Ermin Sakic

**Greg White** 

**Guoye Zhang** 

Hongbiao Zhang

Shawn Zhang

Lei 7hou