HPCC++: Enhanced High Precision Congestion Control

draft-miao-ccwg-hpcc

draft-miao-ccwg-hpcc-info

Rui Miao, Surendra Anubolu, Rong Pan, Jeongkeun Lee, Barak Gafni, Jeff Tantsura, Allister Alemania, Yuval Shpigelman

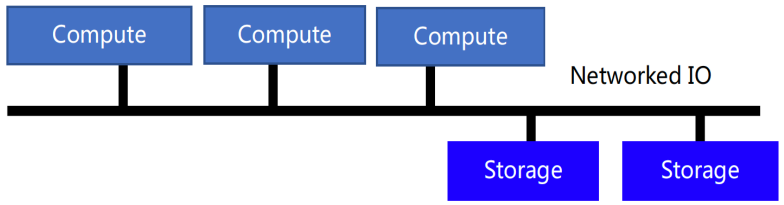
IETF-119 CCWG

Mar 2024

Cloud desires hyper-speed networking

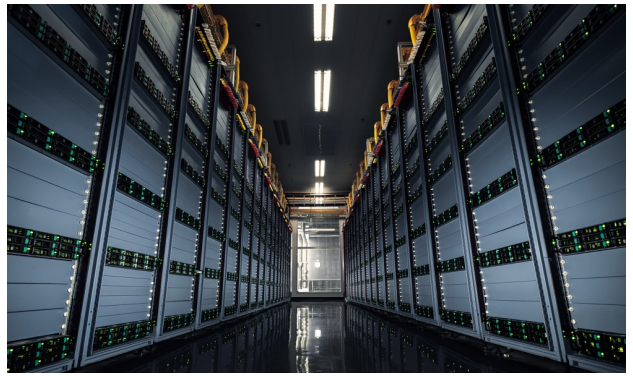
Today, clouds have
- bigger data to compute & store
- faster compute & storage devices
- more types of compute and storage resources

High-performance storage



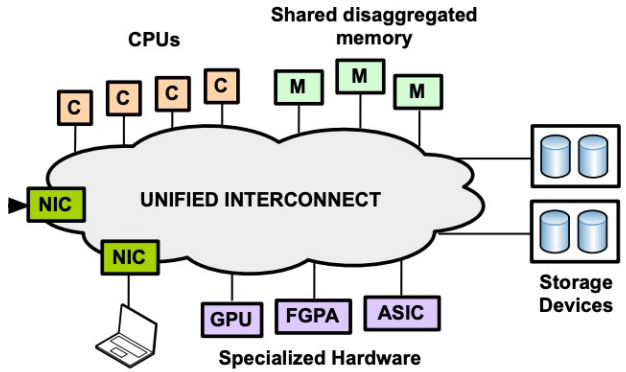
- Storage-compute separation is norm
- HDD→SSD→NVMe
- Higher-throughput, lower latency
- 1M IOPS / 50~100us

High-performance computation



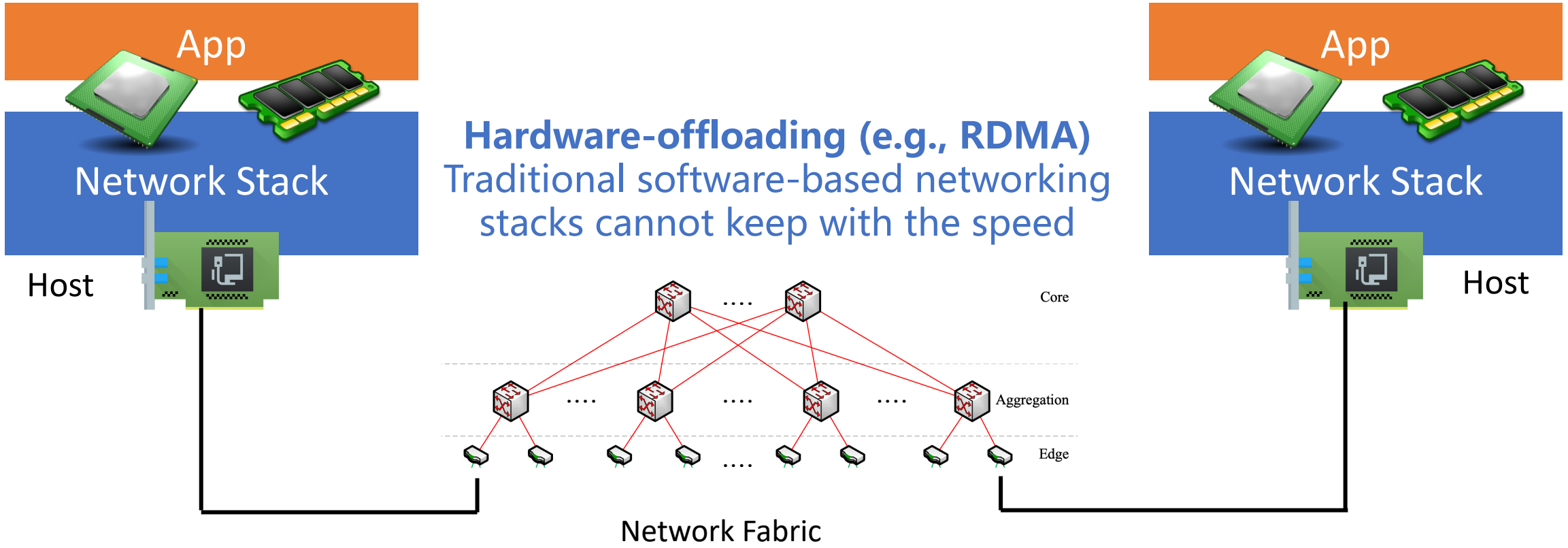
- Distributed deep learning, HPC
- CPU→GPU, FPGA, ASIC
- Faster compute, lower latency
- E.g. latency <10us

Resource disaggregation



- More network load
- Need ultra-lower latency: 3-5us, > 40Gbps (Gao Et.al. OSDI'16)

Hyper-speed network chips to form hyper-speed networking

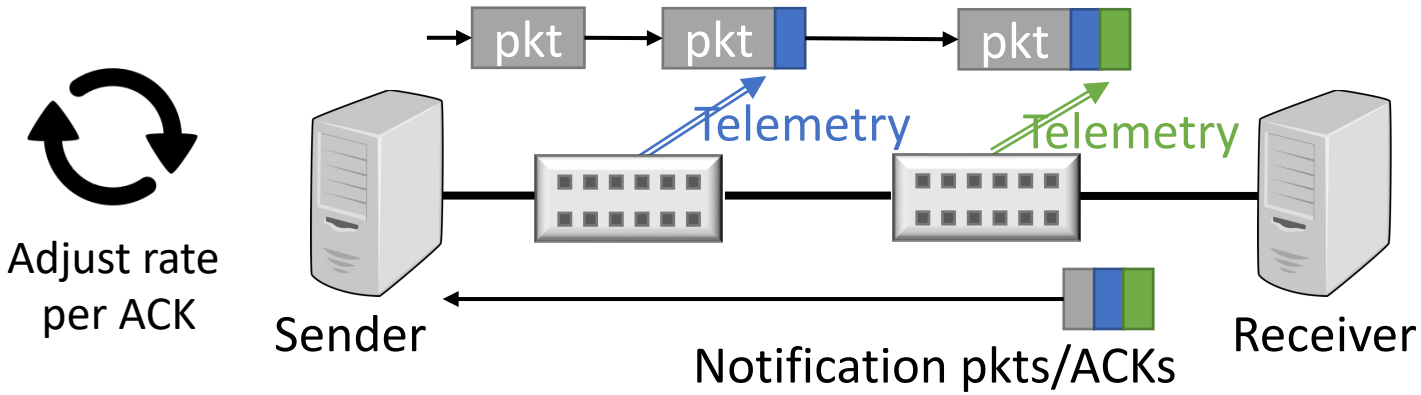


Hardware-offloading (e.g., RDMA)
Traditional software-based networking stacks cannot keep with the speed

Real-time Congestion control (CC)
Lots of data and communication => more pressure on the network

HPCC++: Enhanced High Precision Congestion Control

- New networking ASICs have in-band telemetry capabilities
- Packets collect telemetry on their route
- Can we use in-band telemetry as precise feedback for congestion control?



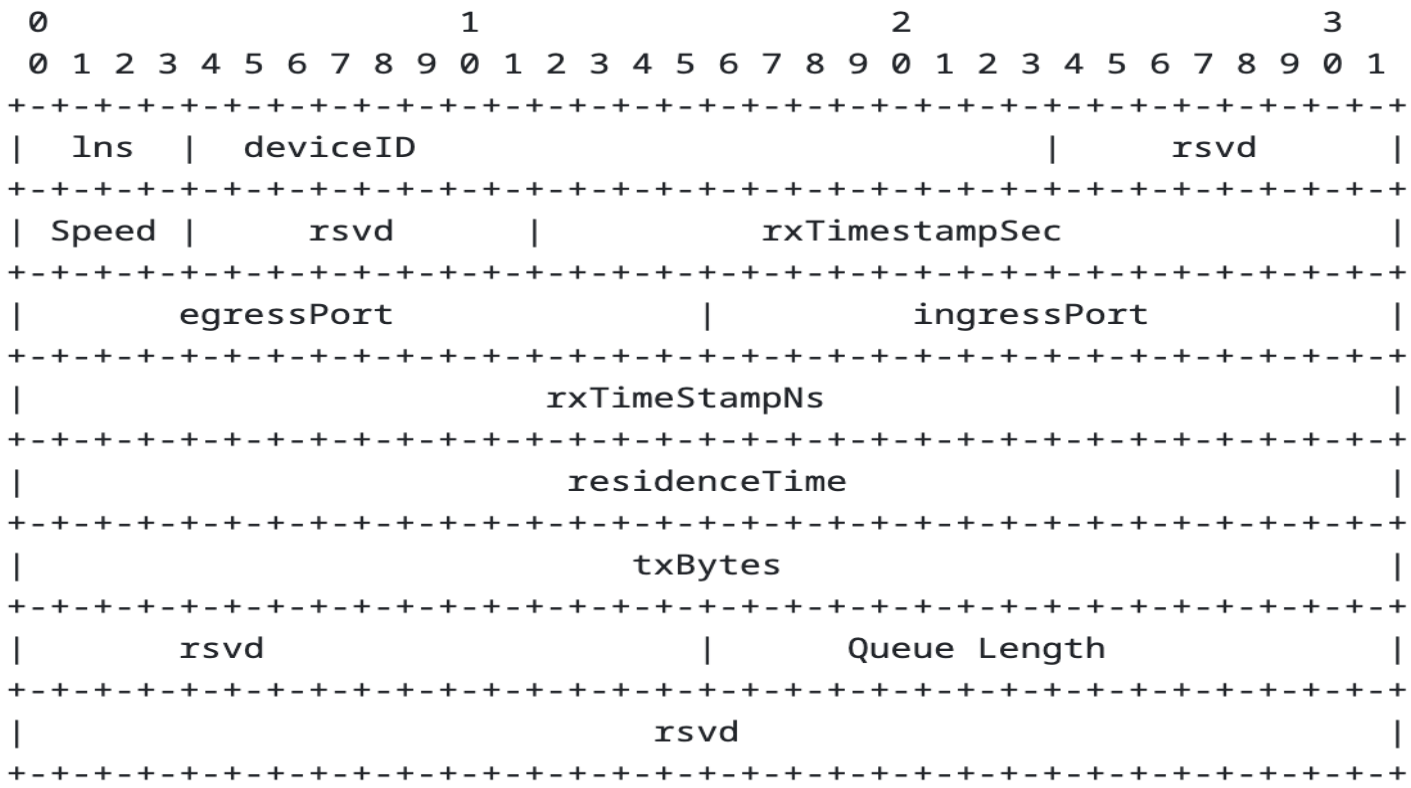
HPCC++ provides ideal performance

Using in-band telemetry as the precise feedback

- Fast convergence
  - Sender knows the precise rate to adjust to
- Near-zero queue
  - Feedback does not only rely on queue
- Few parameters
  - Rich and precise feedback, reduces heuristics which requires more parameters

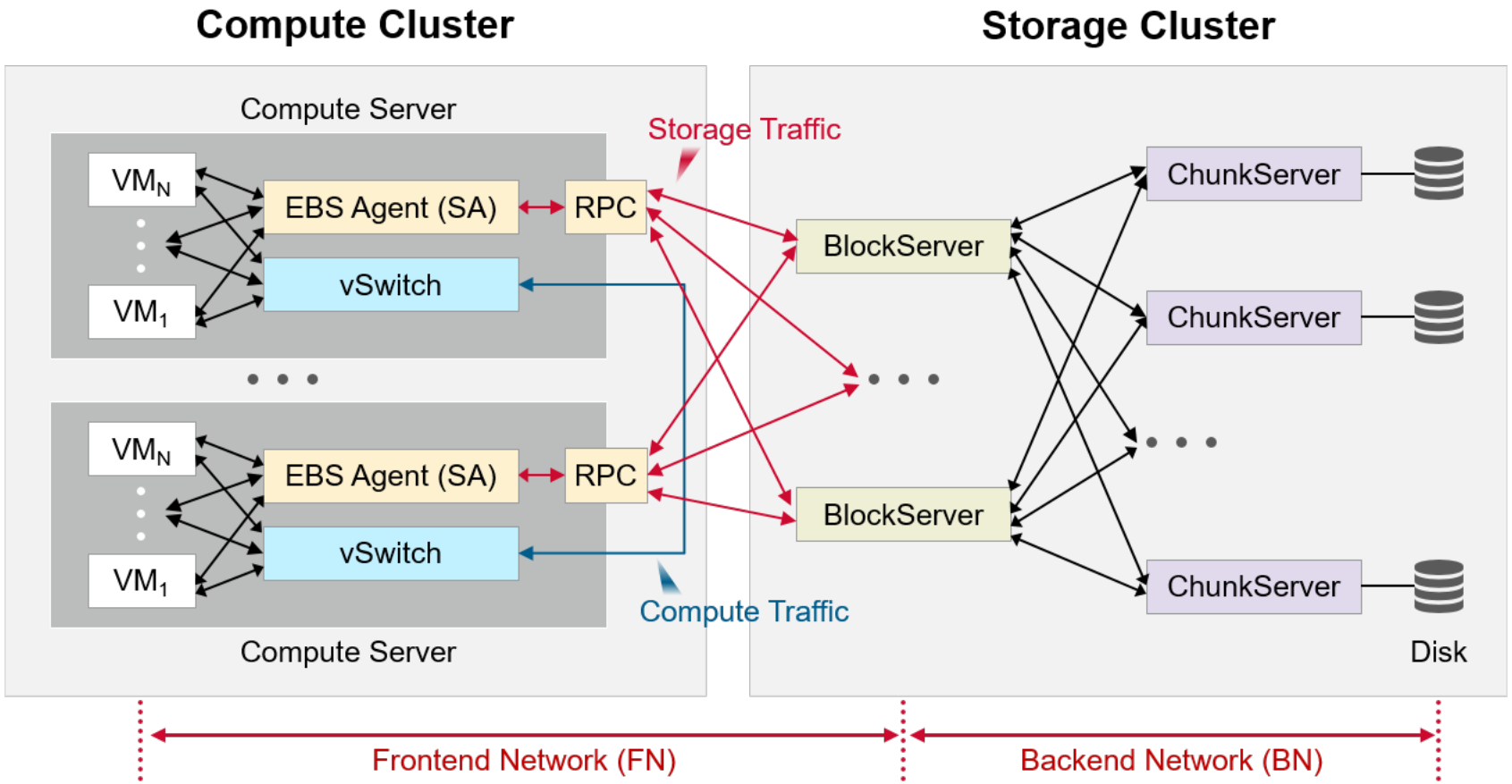
Our proposals

- draft-miao-ccwg-hpcc
  - Defines the algorithm using telemetry information, including queue length, transmitted bytes, timestamp, link capacity, etc.
- draft-miao-ccwg-hpcc-info
  - Provides environment-dependent packet formats of telemetry encodings, including IFA2.0, IOAM, P4.org



Deployment experience

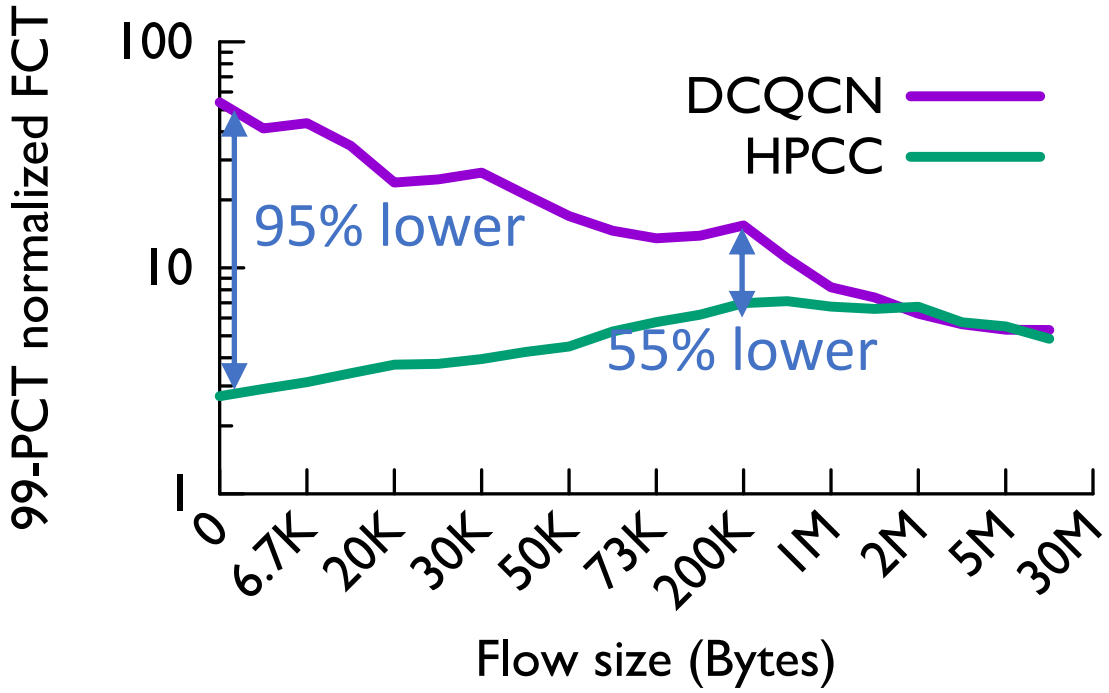
- Deployed widely for storage, AI training, and database applications in one of the major cloud providers
- Achieved significant boosts in throughput and latency

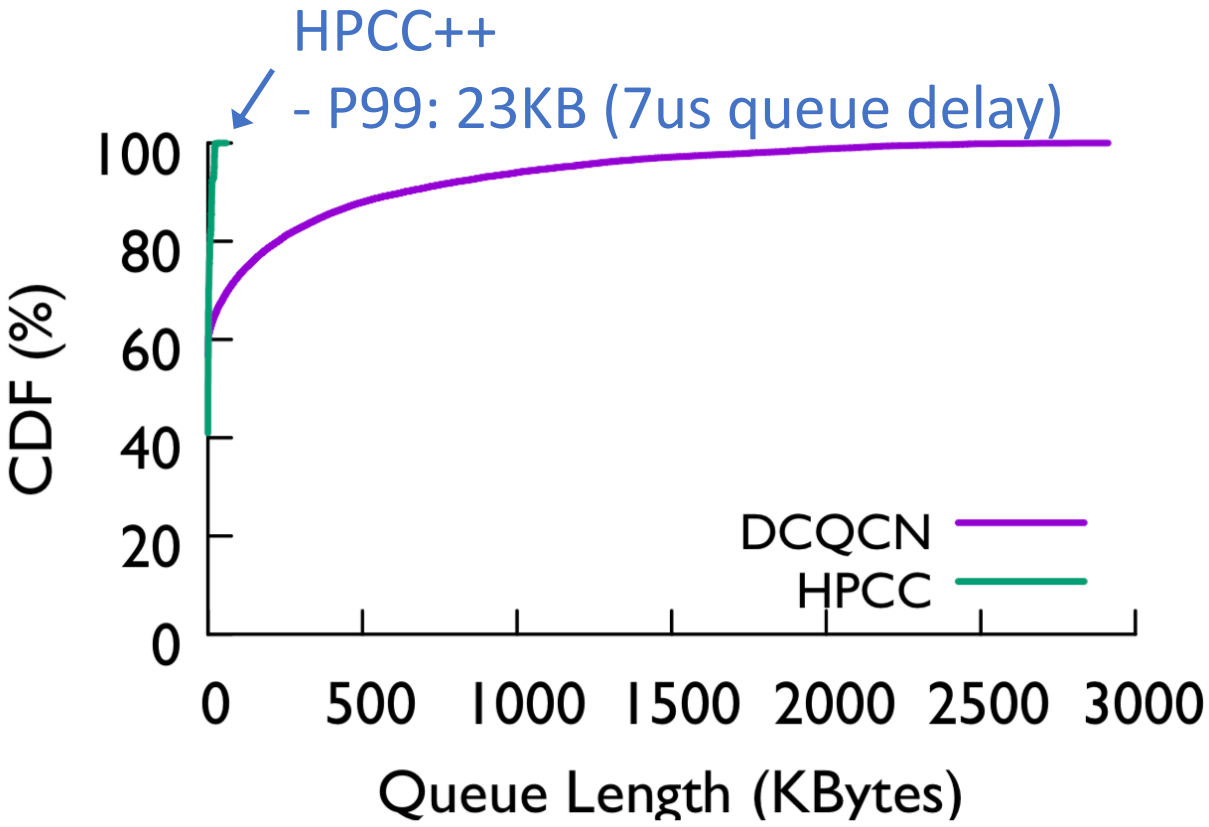


Source: https://www.broadcom.com/blog/high-precision-congestion-control

HPCC++ achieves lower FCT and near-zero queue

- In testbed, vs. DCQCN (hardware-based, widely used in industry)
  - Web search traffic at 50% load
- Extensive tests compared with other CC in simulation. HPCC performs better





Your Feedback is Appreciated!

Thank You