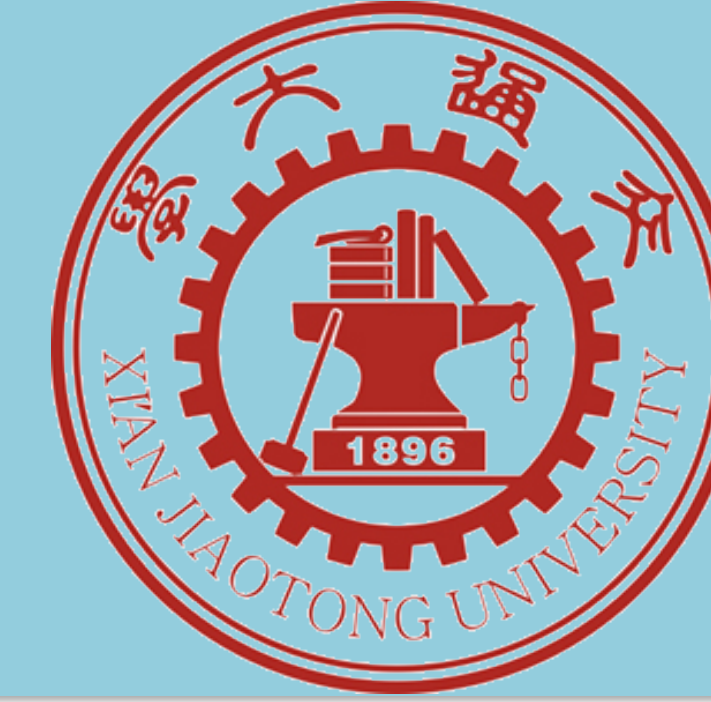


Improving Latency and Burst-tolerance for Software Rate Limiters

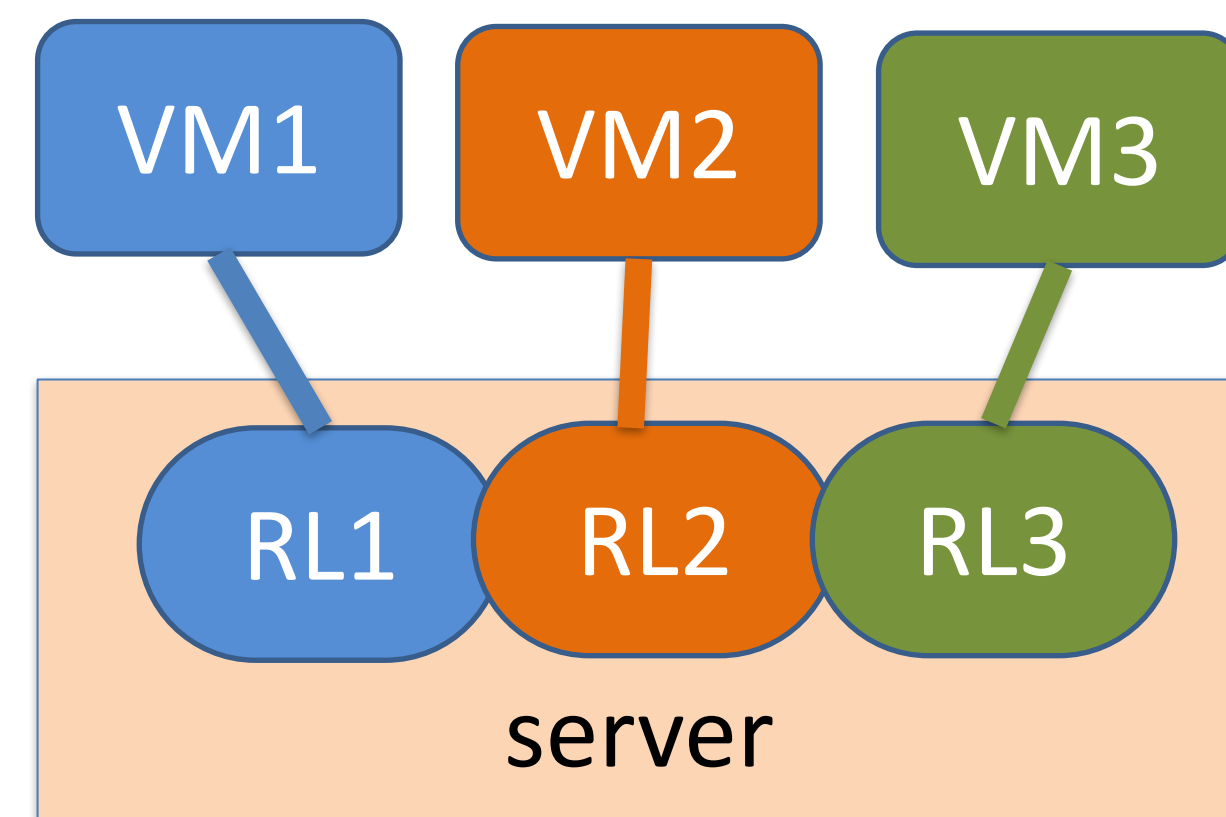
Keqiang He, Weite Qin, Qiwei Zhang, Wenfei Wu, Junjie Yang, Tian Pan, Chengchen Hu, Jiao Zhang, Aditya Akella and Ying Zhang



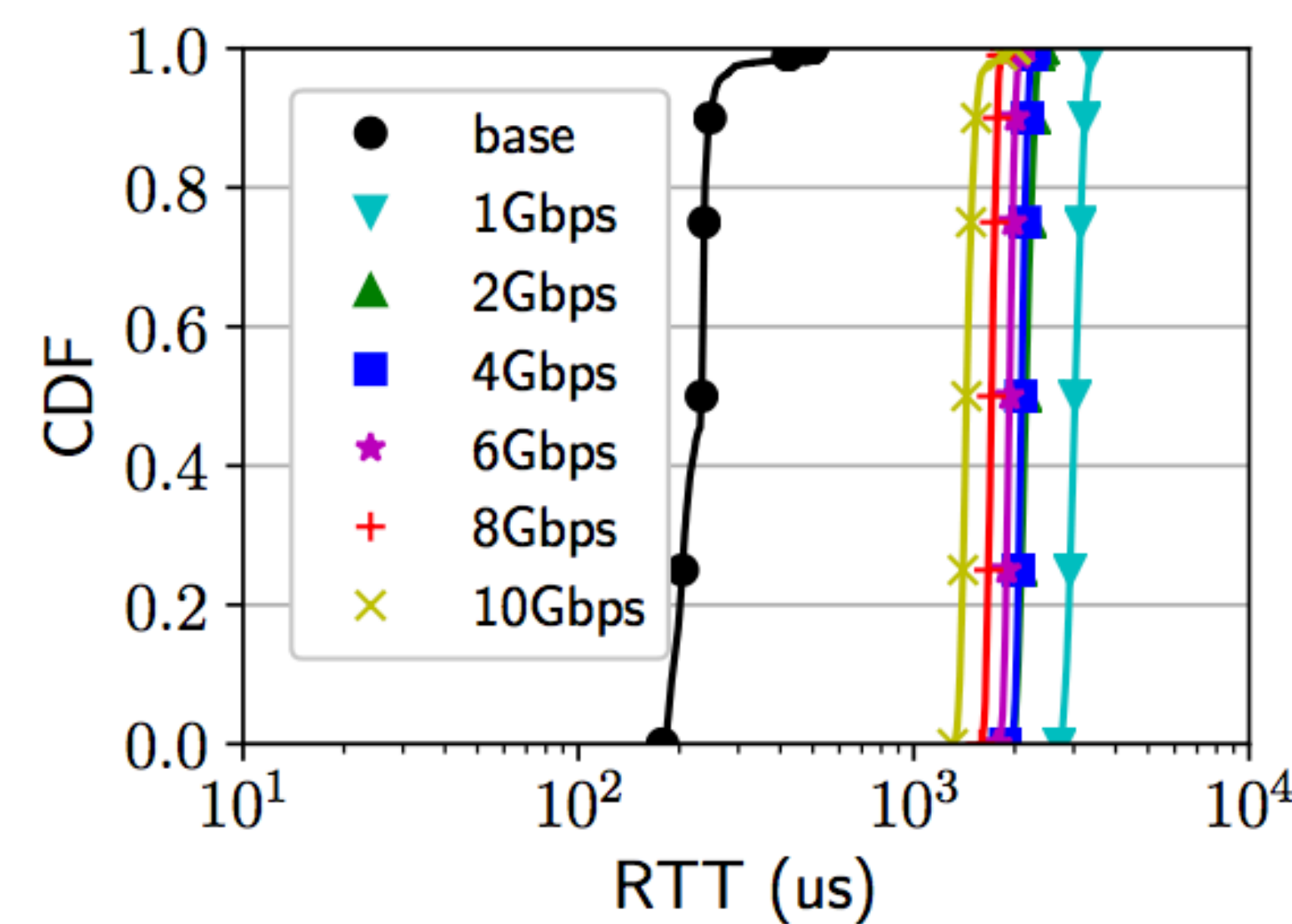
HP Labs

Introduction & Motivation

- Bandwidth allocation is a must in virtualized Datacenter networks
- Software/Hardware Rate limiters are employed to enforce bandwidth allocation
- Rate limiters increase end-to-end latency - bandwidth allocation, low latency, loss packet loss rate can not be achieved at same time.



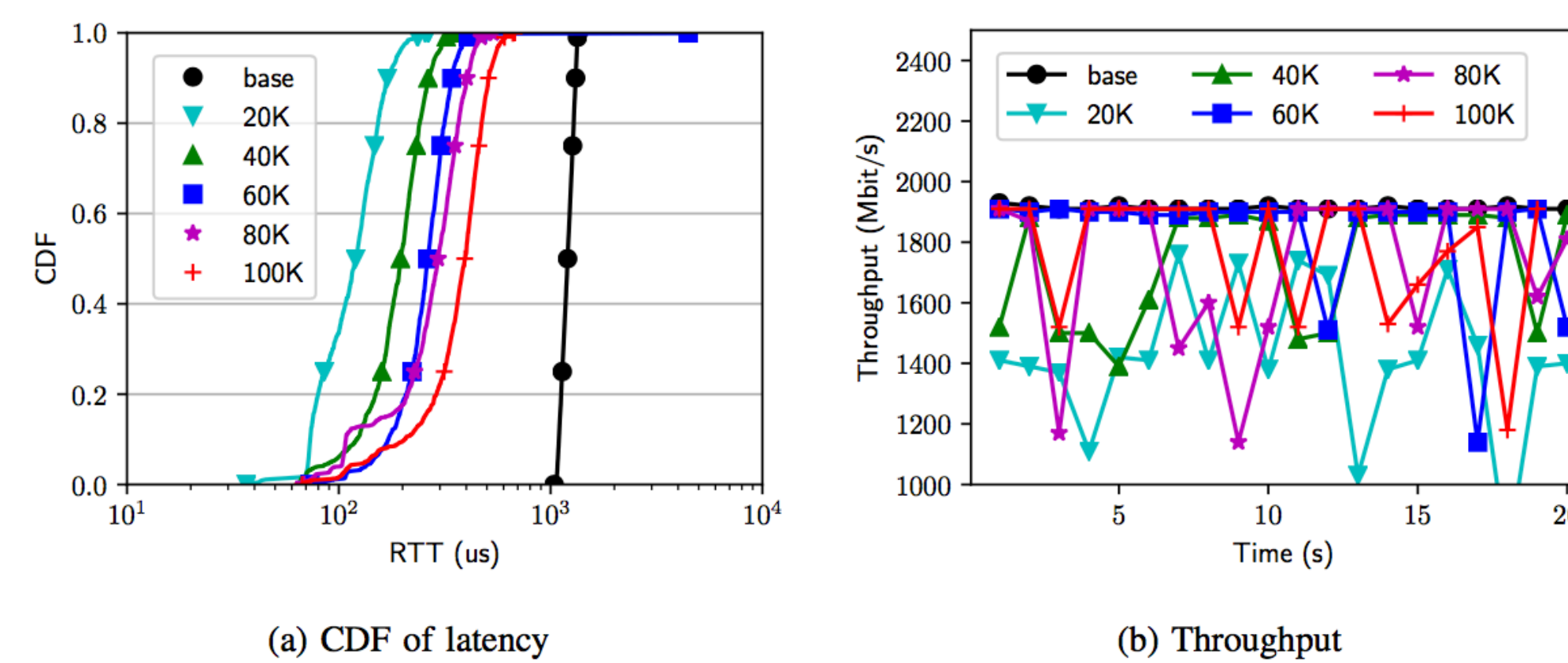
Measurement of Linux HTB



base: RTT without congestion

Design Requirements

	High Tput	Low Latency	Generic
Raw HTB	Y	N	Y
HTB with DCTCP	N	Y	N



- 2Gbps HTB rate limiter with different ECN marking thresholds
- Segment-level marking, instead of packet-level
- Large control loop latency, can be affected by "in-network" latency

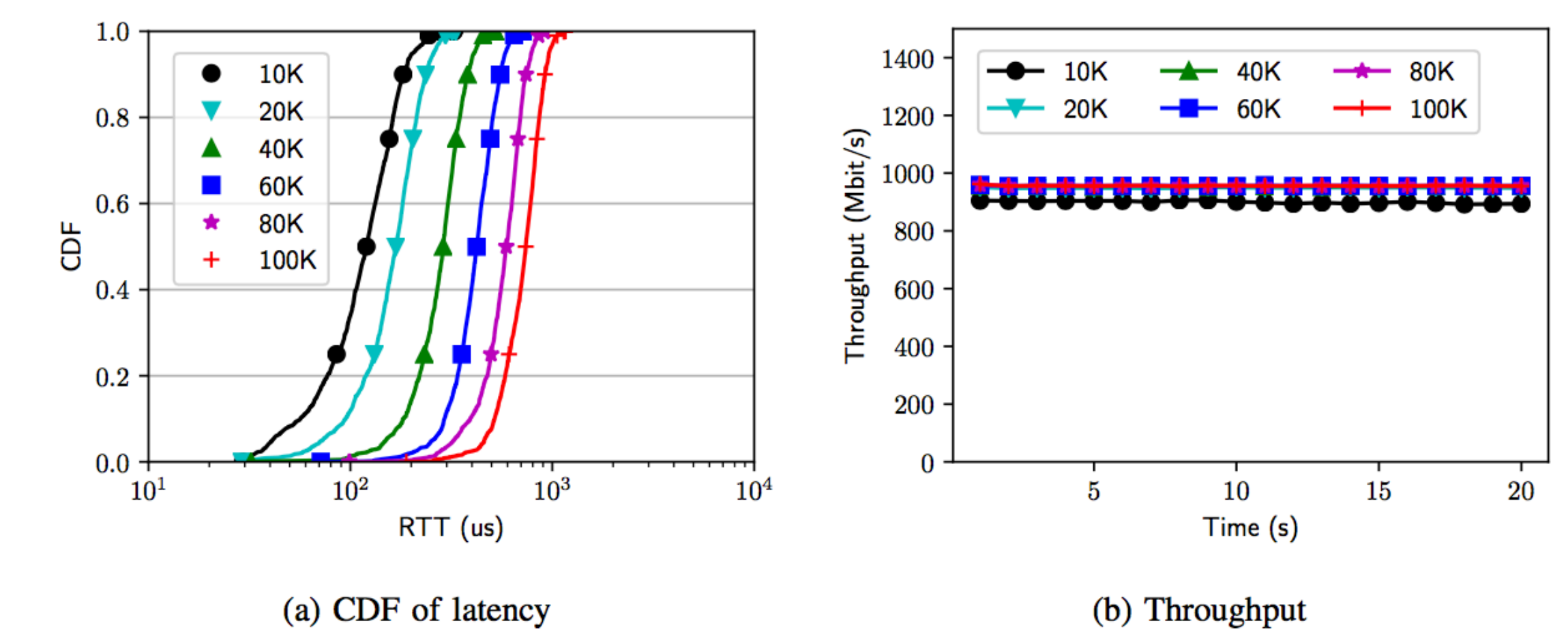
Key Ideas

- DEM (Direct ECE Marking): directly set TCP ECE bit based on real time rate limiter queue length to reduce control loop latency and avoid segment-level marking. DEM relies on DCTCP and ECN
- Spring: Window-based congestion control algorithm (e.g., TIMELY) based on real time rate limiter queue length. Enforcing congestion control decisions using RWND. Spring satisfies all design requirements.

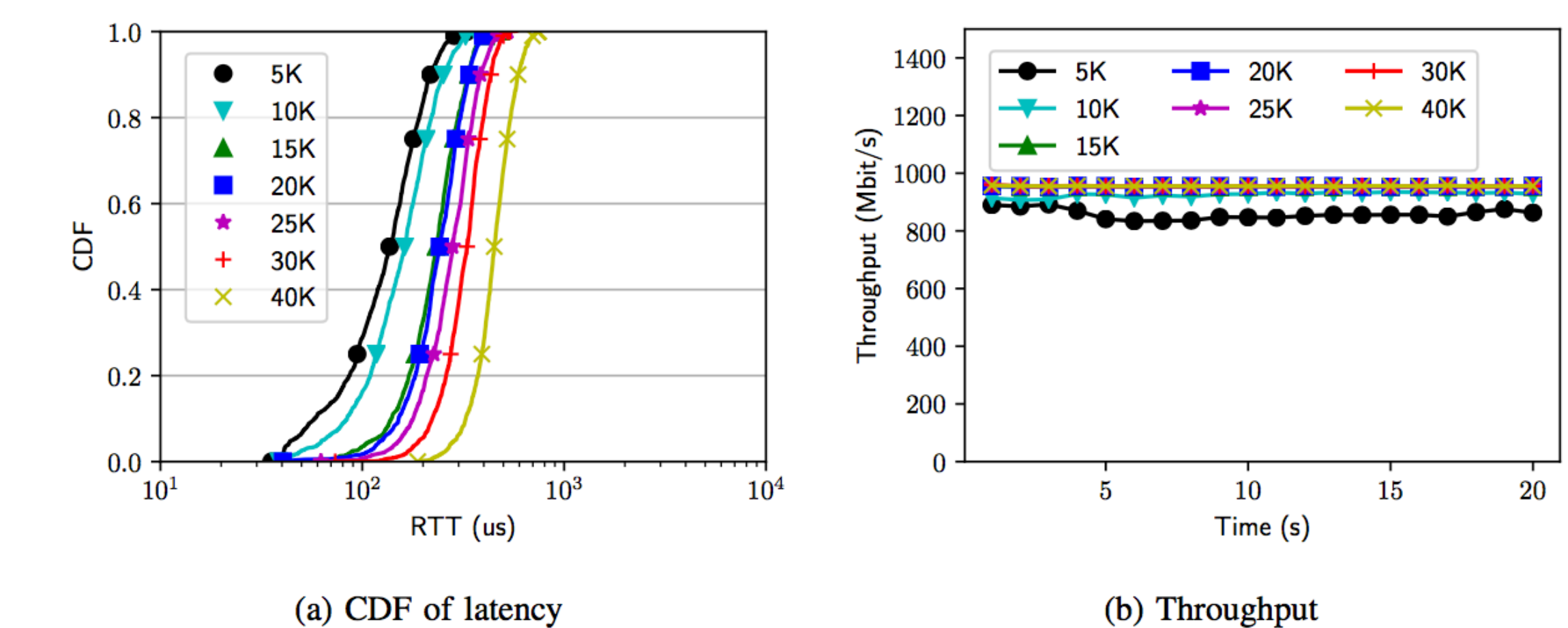
Implementation

- Implemented in Linux HTB and OVS
- Tested in CloudLab

Evaluation



DEM performance



Spring performance

Conclusion

- Rate limiters are employed to enforce bandwidth allocation but raw rate limiters inflate network latency significantly
- Design requirements: high throughput, low latency and generic.
- DEM and Spring improve performance for software rate limiters. DEM relies on DCTCP/ECN support while Spring is a generic solution