



An Implementation of Bandwidth Emulation of DEMU

Chayapon Puakalong¹, Vasaka Visoottiviseth¹, Ryousei Takano²

Assadarat Khurat¹, Wudichart Sawangphol¹

¹ Faculty of Information and Communication Technology, Mahidol University

² Information Technology Research Institute, National Institute of Advanced Industrial Science and Technology

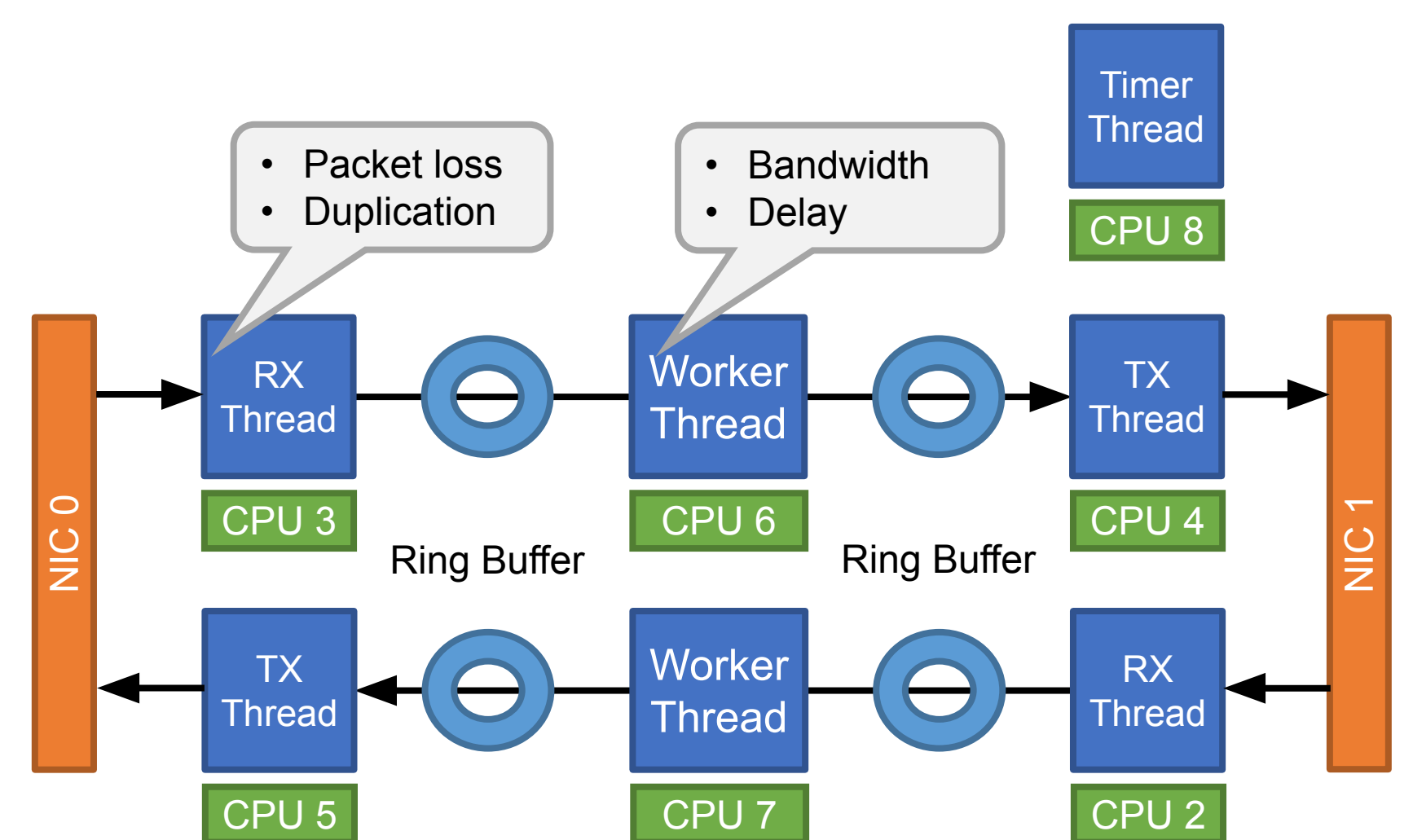
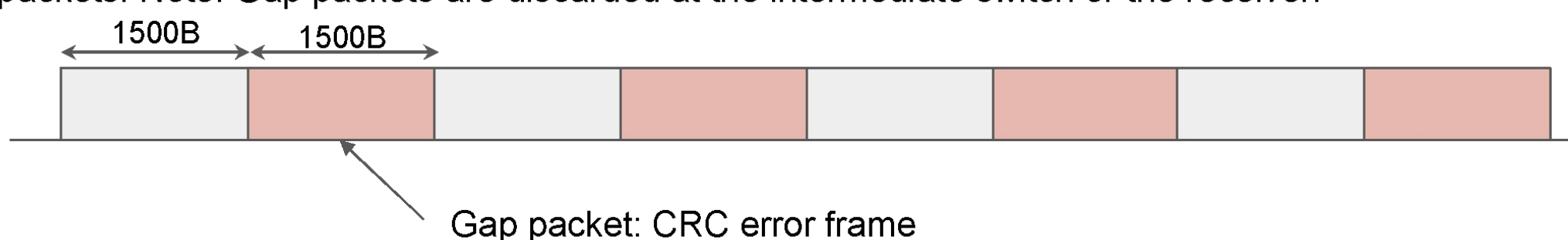
Abstract

A network emulator is essential for testing the performance of the network especially in a place that requires very high performance such as data centers. It should have features that emulate the important characteristics of the network such as delay, packet loss, bandwidth. A DPDK-based network emulator (DEMU) is one of software-based network emulators [1]. DEMU has primitive features to emulate a network, including delay, packet duplication, and packet loss. This poster presents a bandwidth emulation feature of DEMU. We propose two methods to do bandwidth limitation on DEMU, token bucket-based conventional mechanism and a gap packet-based packet pacing mechanism. We have demonstrated the accurate bandwidth limitation on a 10GbE network environment.

DEMU: DPDK-based Network Emulator

- DEMU** is a software-based network emulator implemented as a DPDK application. It contains three threads and two ring buffers for each direction.
- We have implemented two methods for bandwidth emulation in the worker thread: (1) token bucket and (2) gap packet-based packet pacing.
- Token bucket method:** the timer thread adds tokens to a bucket every 1 microsecond as follows: $\text{tokens per } \mu\text{s} = \text{bandwidth (bps)} / 10^6$. The worker thread keeps packets in a ring buffer until sufficient tokens are accumulated in the bucket.
- Gap packet method:** the worker thread inserts gap packets between the target flow's packets, where the total length of gap packets depends on the target rate. We use a CRC error packet as a gap packet like MoonGen [2].

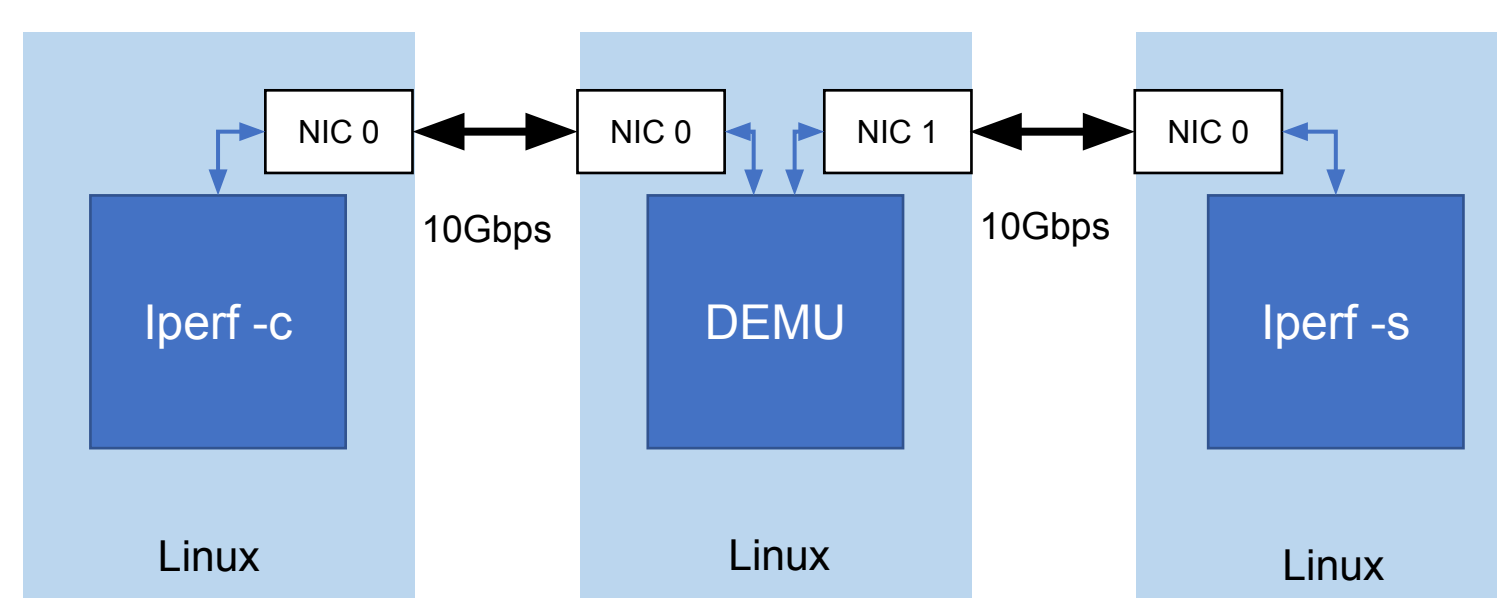
When the target rate is half of the physical rate, the sender inserts gap packets between the target flow's packets. Note: Gap packets are discarded at the intermediate switch or the receiver.



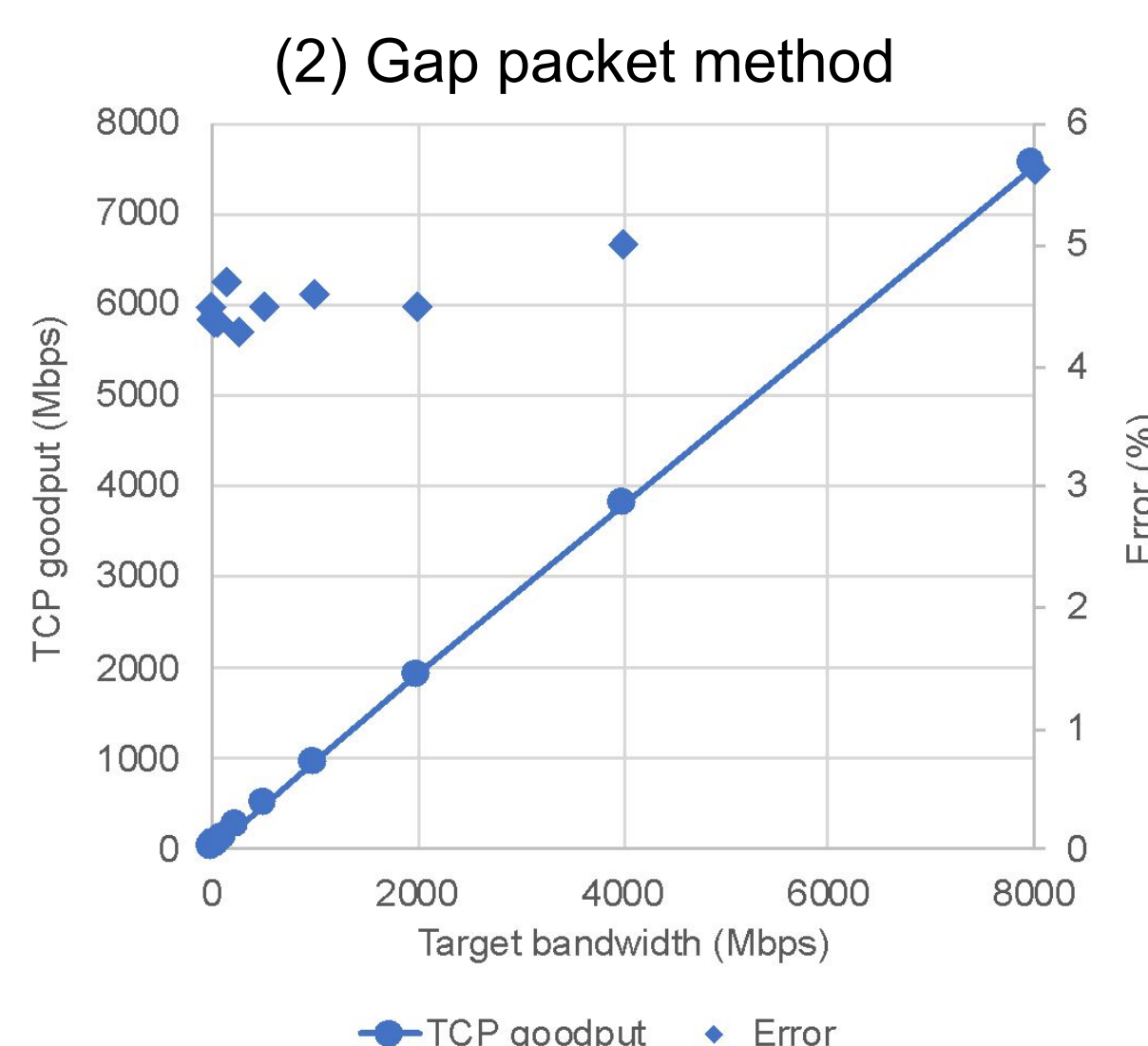
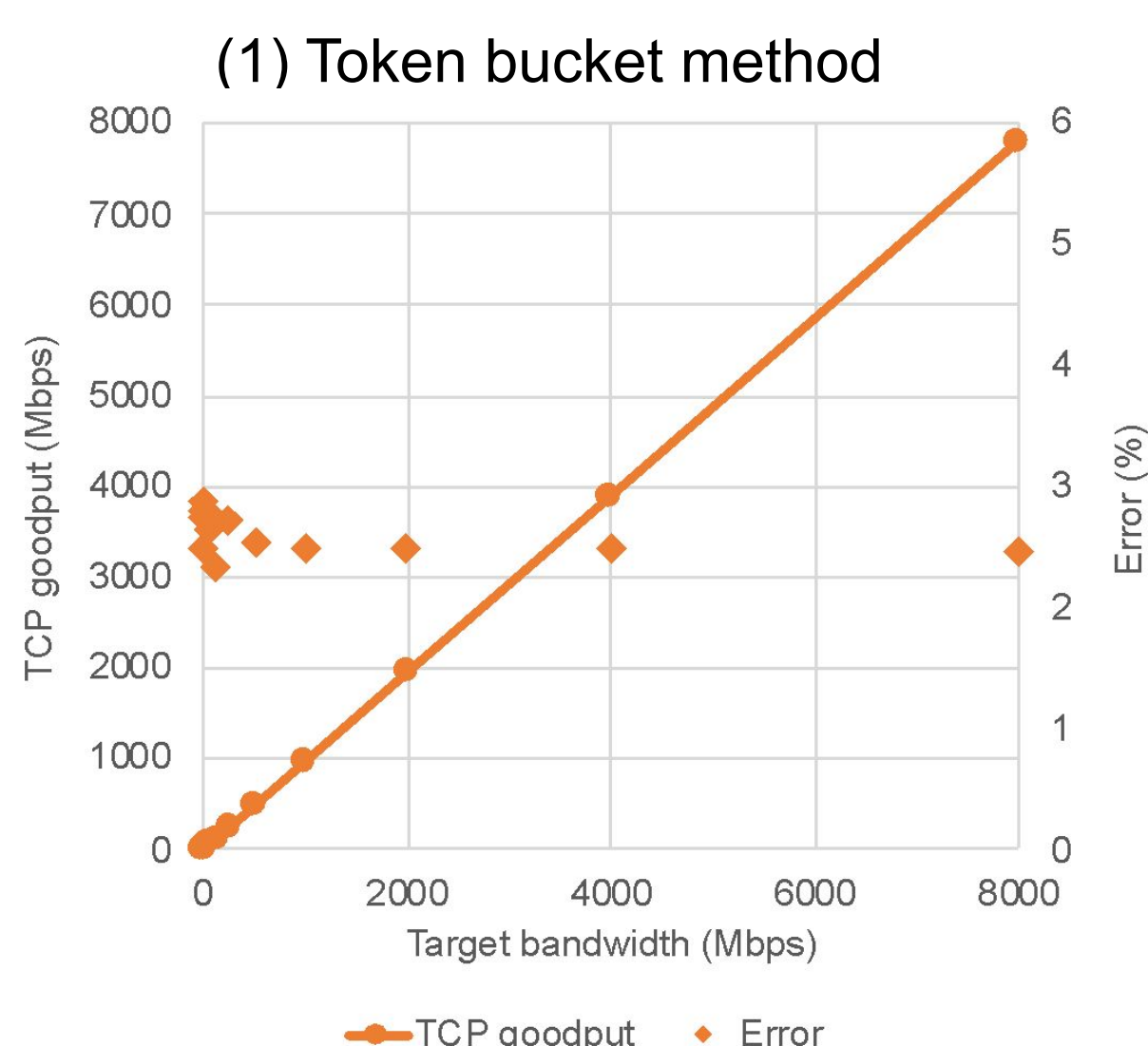
The overview of DEMU

Experimental Setting and Results

We set up three Linux machines that were connected through 10GbE. Iperf was running for 60 seconds under several bandwidth limitation conditions with both token bucket-based and gap packet-based methods. The average TCP goodput was calculated from three trials for each condition.



Experimental Setting



Conclusion

Through experiments of TCP/IP performance on our emulated network environment, we have confirmed the error rate comparing to the target bandwidth is small enough, i.e., 3% with token bucket method and 5% with gap packet method.

We continue to develop DEMU toward a production-level tool.

The source code is available from <https://github.com/ryousei/demu/>.

Reference

- [1] S. Aketa, T. Hirofuchi and R. Takano, "DEMU: A DPDK-based network latency emulator," IEEE International Symposium on Local and Metropolitan Area Networks (LANMAN), 2017.
- [2] P. Emmerich, S. Gallenmüller, D. Raumer, F. Wohlfart, and G. Carle, "MoonGen: A Scriptable High-Speed Packet Generator," ACM Internet Measurement Conference (IMC), 2015.