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Towards Scalable SDN Switches:
Enabling Faster Flow Table Entries Installation

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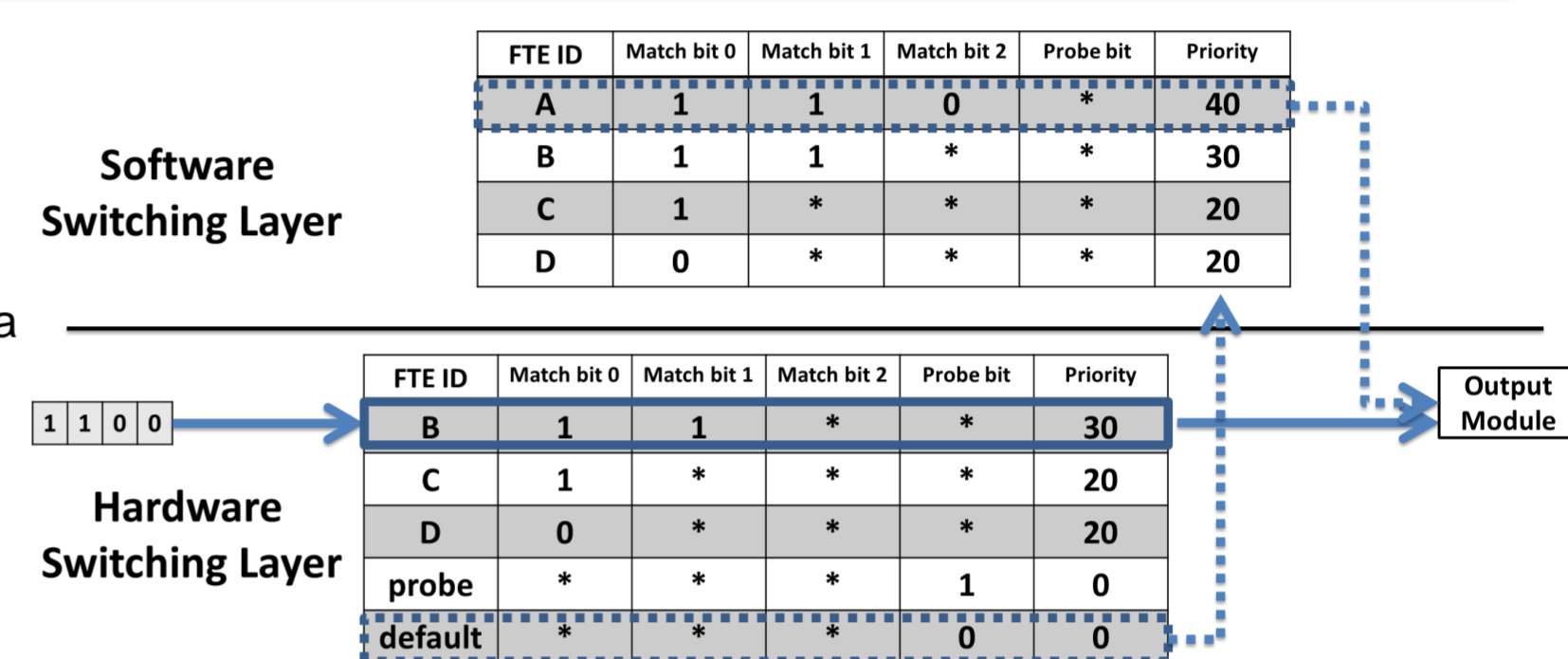
Motivation

- ➢ SDN Swtiches that use merchant silicon are slow in updating their forwarding tables
- ➢ Flexible lookups may require the writing of more than one entry in the memory:
  - • this may increase the installation time even more

Related Work

- ➢ Combination of software and hardware forwarders [1], [2]:
  - • focuses on overcoming flow table size limitations

- ➢ Commodity white box switches [3]:
  - • powerful CPUs allow a hybrid software-hardware architecture

Key Observation –Table Updates

- ➢ Software tables are much faster to be updated than hardware ones
- ➢ A hybrid architecture can exploit the following logic:
  - • Forwarding tables updates always happen in software first
 - • Entries are eventually moved to the hardware forwarding tables, offloading the Software forwarder

Key Observation – Overlapping entries

- ➢ Overlapping entries may break the forwarding decisions in respect to their priorities
- ➢ Deleting entries from hardware tables is usually much faster than adding them:
  - • Installation in hardware tables may require a reorganization of the previously installed Flow Table Entries
- ➢ A hybrid architecture can translate an entry installation into a mix of installation in software tables and deletion from hardware tables

Software Switching Layer

FTE ID	Match bit 0	Match bit 1	Match bit 2	Probe bit	Priority
A	1	1	0	*	40
B	1	1	*	*	30
C	1	*	*	*	20
D	0	*	*	*	20

Hardware Switching Layer

`1 1 0 0` →

FTE ID	Match bit 0	Match bit 1	Match bit 2	Probe bit	Priority
B	1	1	*	*	30
C	1	*	*	*	20
D	0	*	*	*	20
probe	*	*	*	1	0
default	*	*	*	0	0

→ **Output Module**

ShadowSwitch's Architecture

- ➢ High-performance software switching layer (SwSw)
- ➢ SwSw runs on a general purpose system including:
- ➢ ShadowSwitch Logic (sSwLogic) manages the FTEs installation
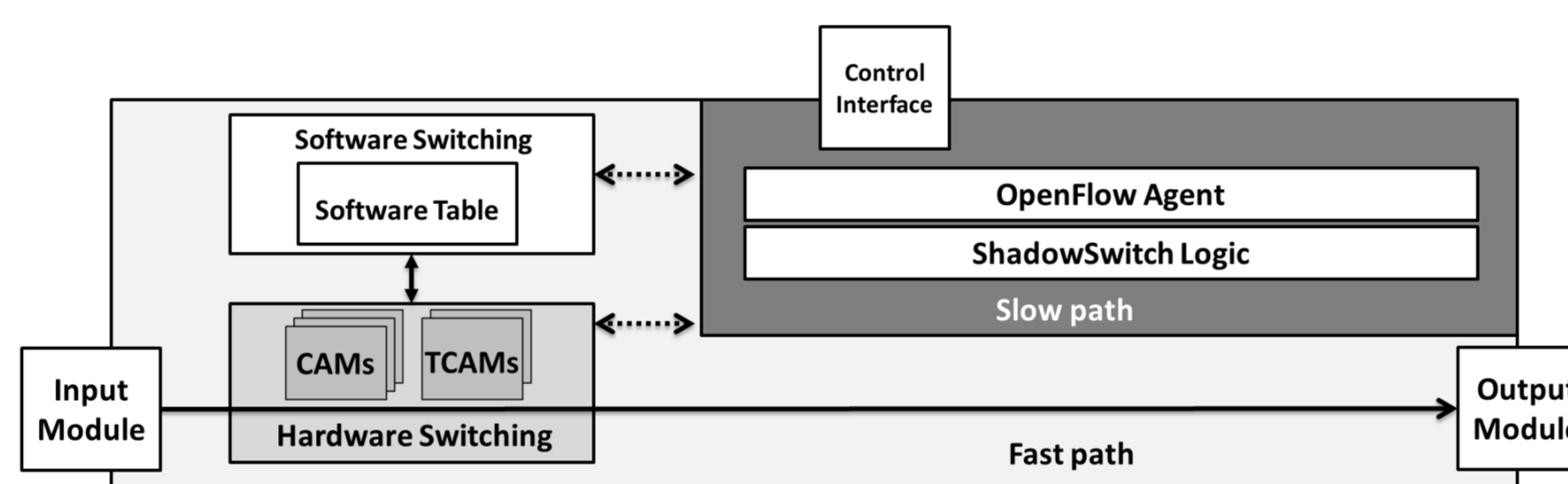

Prototype

- ➢ Commercial hardware OpenFlow switch (HwSw)
- ➢ HP DL380G7 (Intel Xeon L5640 (6 cores @ 2.26 GHz)) contains:
  - • OpenvSwitch (OVS)
  - • 1Gbit/s ports between the server and the HwSw
  - • sSwLogic as a user-level application
  - • POX openflow controller
- ➢ Traffic generator and receiver on an another server
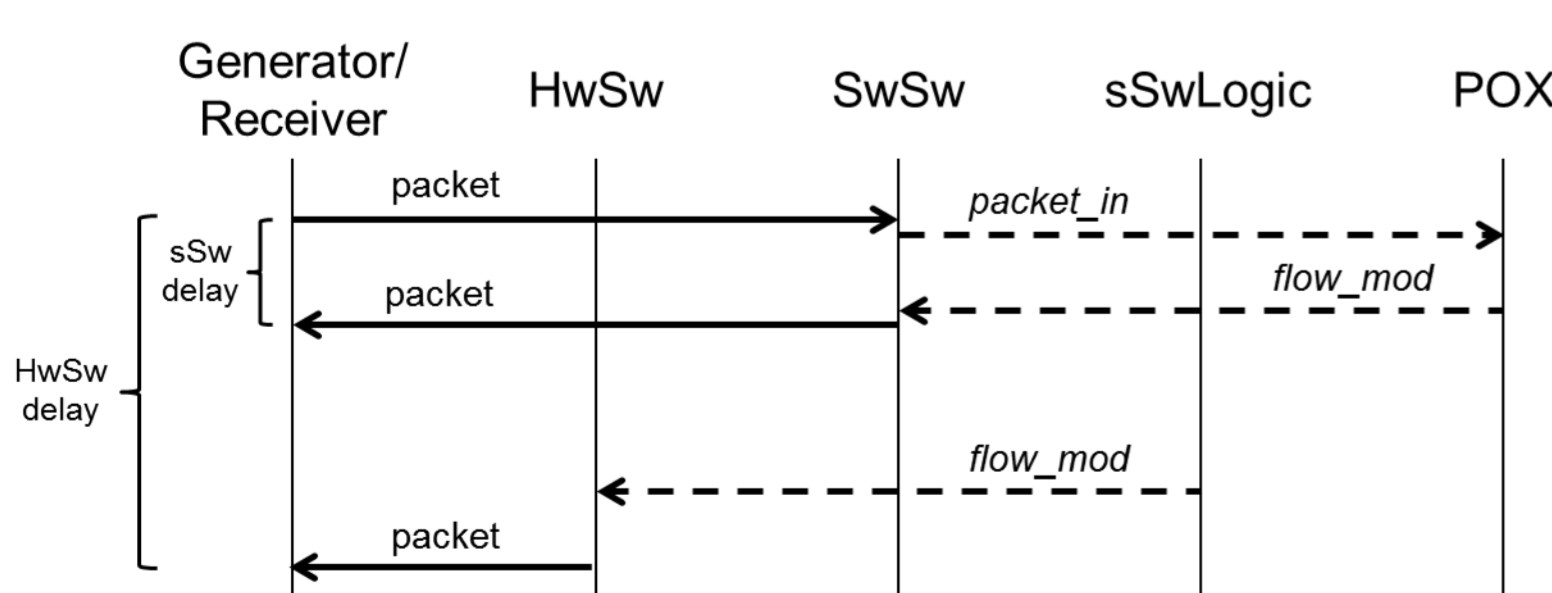
Evaluation –Forwarding Tables Updates
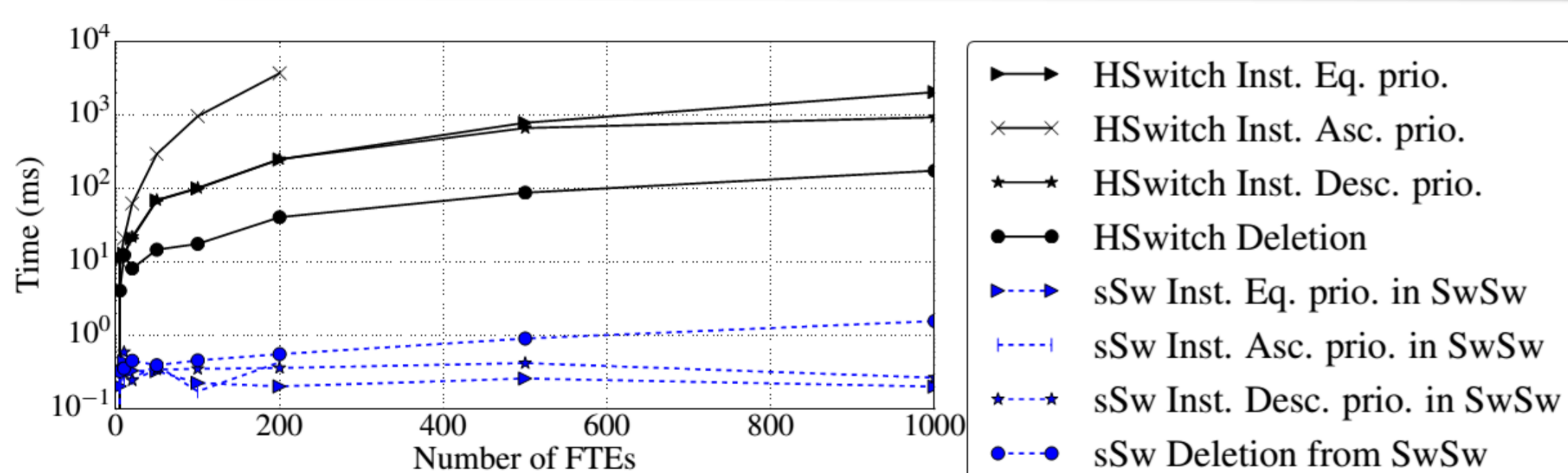
Forwarding table updates when installing/deleting a variable number of entries

Evaluation – Updates with Overlapping FTEs
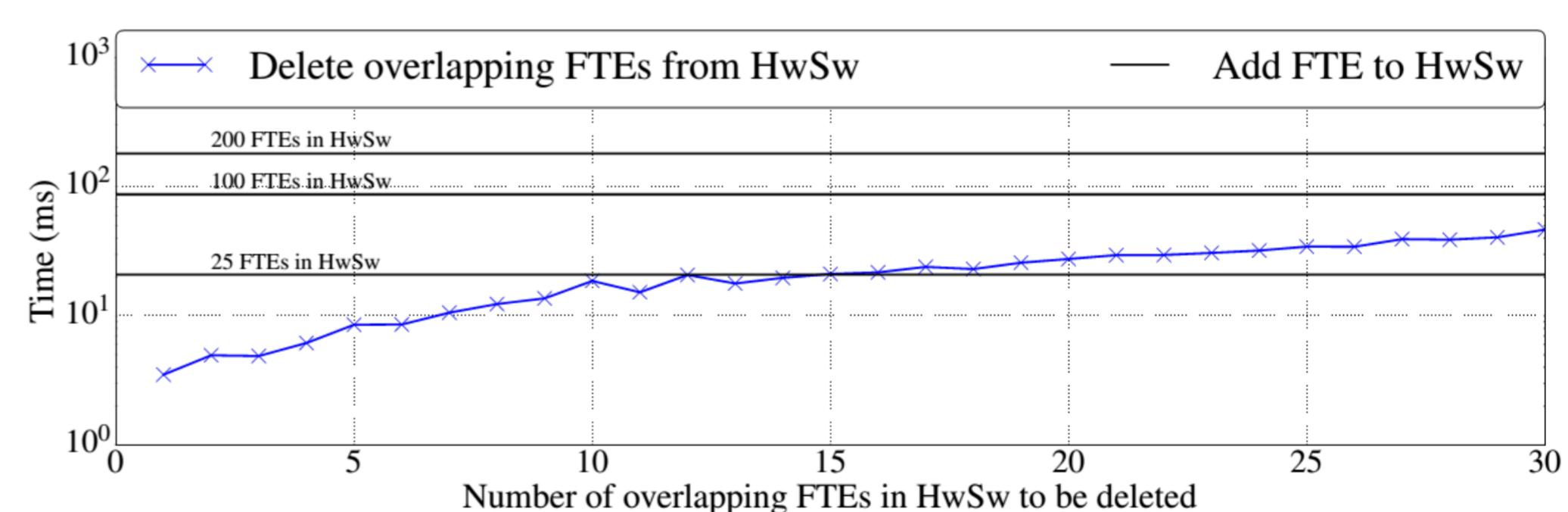
Deletion a group of FTEs vs addition of a single higher priority FTE to the HwSw

Evaluation - Flow installation delay

- • 10K flows in a reactive installation
- • 1K flows per sec. over a 10 sec. period
- • FTEs: non-overlapping with equal priorities

- ➢ HwSw:
  - • drops ~75% of flows
  - • installation delay: 5 ms - 1.1 s
- ➢ sSw:
  - • 0% flow drops
  - • installation delay: <22 ms (95%)
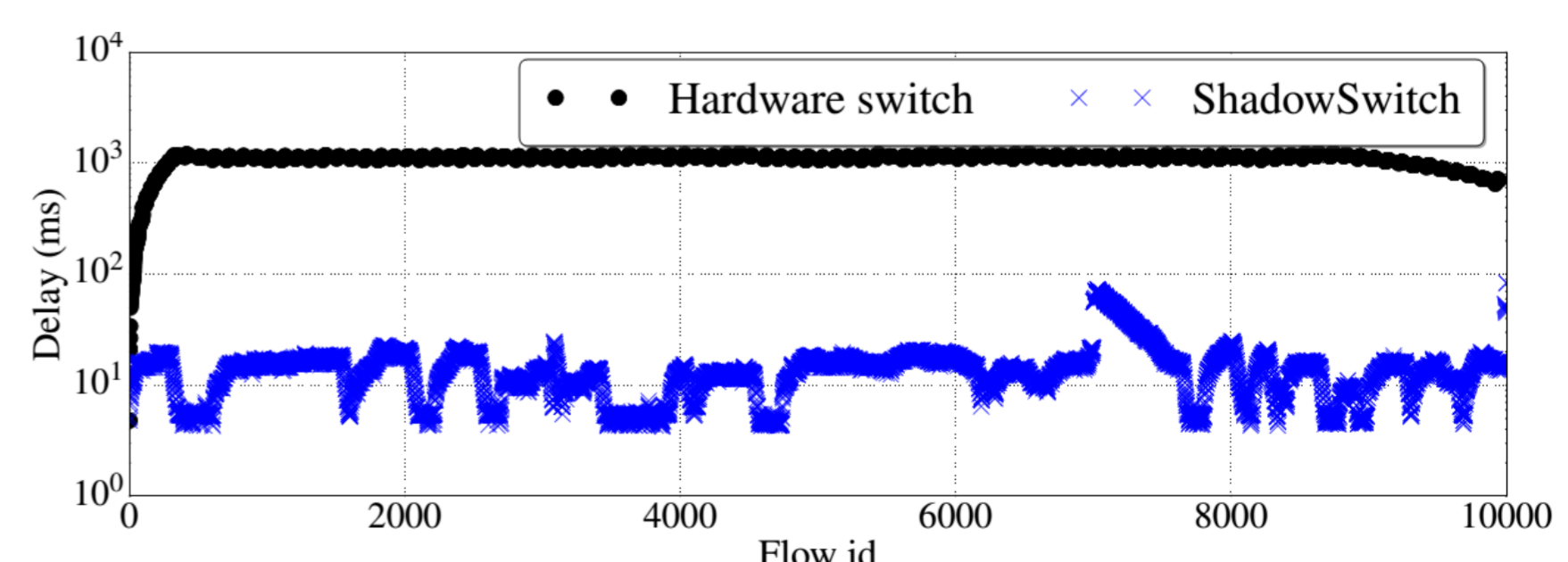
Future Work

- ➢ Evaluate the system behavior under various:
  - • traffic patterns
  - • software-to-hardware forwarding ratios
  - • dependencies between flow entries
- ➢ Design smart offloading algorithms

Acknowledgment

Beba
BEhavioural BAsed forwarding

References

[1] N. Katta, J. Rexford, and D. Walker. Infinite CacheFlow in software-defined networks. Proceedings of ACM SIGCOMM HotSDN, 2014.
[2] N. Sarrar, S. Uhlig, A. Feldmann, R. Sherwood, and X. Huang. Leveraging zipf's law for traffic offloading. SIGCOMM Comput. Commun. Rev., 2012.
[3] Open Compute Networking Project. http://www.opencompute.org/projects/networking/