OVSPP: Hybrid Enhanced vSwitch for CORD-based Telco SFC

Tri Trinh, VNPT
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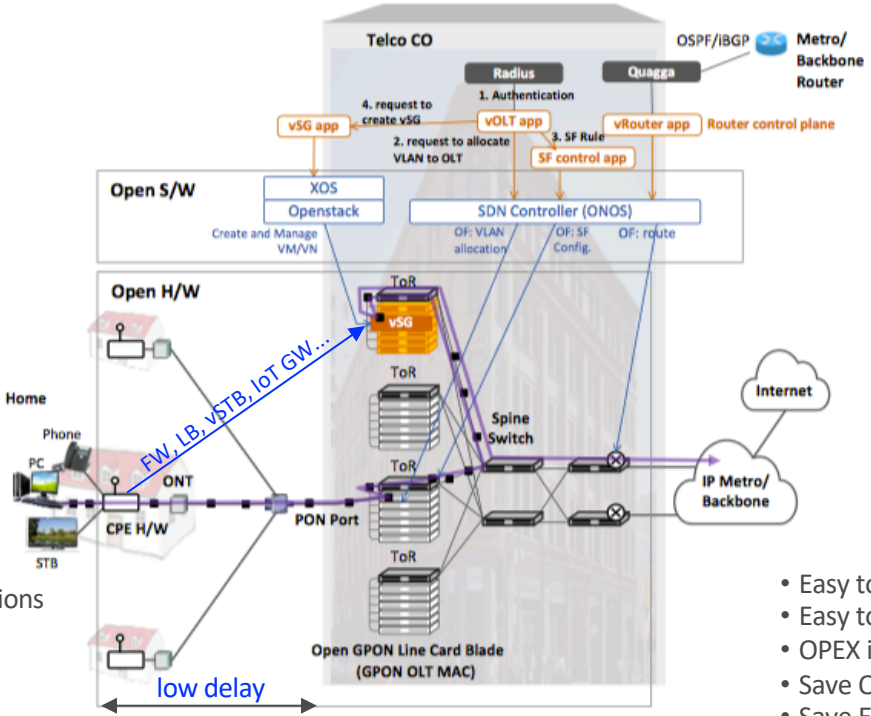
Agenda

- Importance of Service Function Chaining (SFC) for Telco
- How to Implement SFC in CORD system
- SPP (Soft Patch Panel)
- Problem Statement
- Problem Analysis
- Our Solution – OVSPP
- Experiments and Preliminary Results
- Current Status and Future Work
- Our Collaboration Activity - Overview of ATII

Importance of Service Function Chaining (SFC) for Telco



- Hard to add new functions
- Hard to maintainance
- High CAPEX
- Waste Office space
- Waste Electricity
- Noisy
- **Vendor get most of money**

- Easy to add new functions
- Easy to maintainance
- OPEX instead of CAPEX
- Save Office space
- Save Electricity
- Not noisy
- **Telcos get most of money**

[1] B. H. J. Son, “AT&T ’ s CORD - the ultimate architecture born after decades of innovation in the communications network,” *Netmanias*, pp. 1–7, 2016.

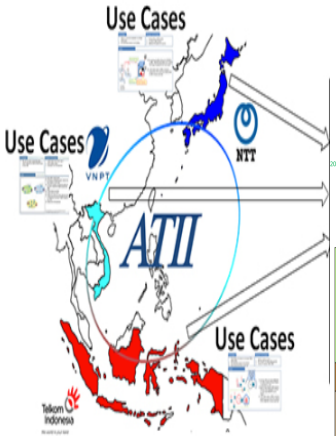
Roadmap

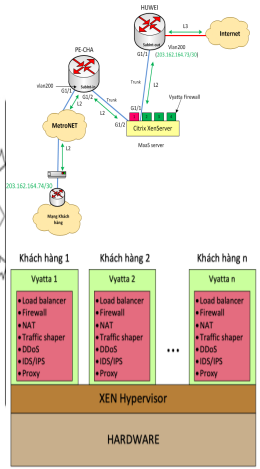
WHITEPAPER

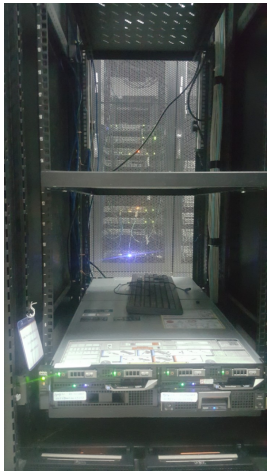
- LEASED LINE INTERNET
- XEN SERVER

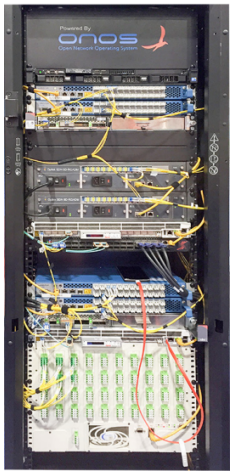
- FTTH INTERNET, AUTO PROVISIONING
- vSWITCH, SFC, vCPE, OLT

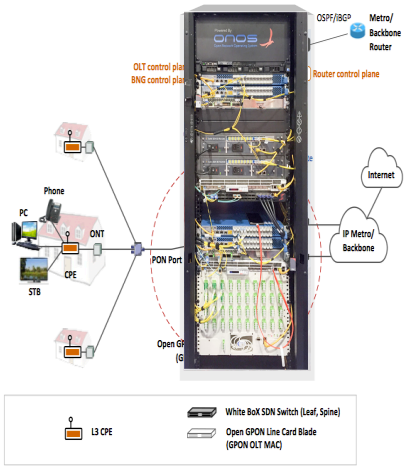
VNPT has thousands of PoPs







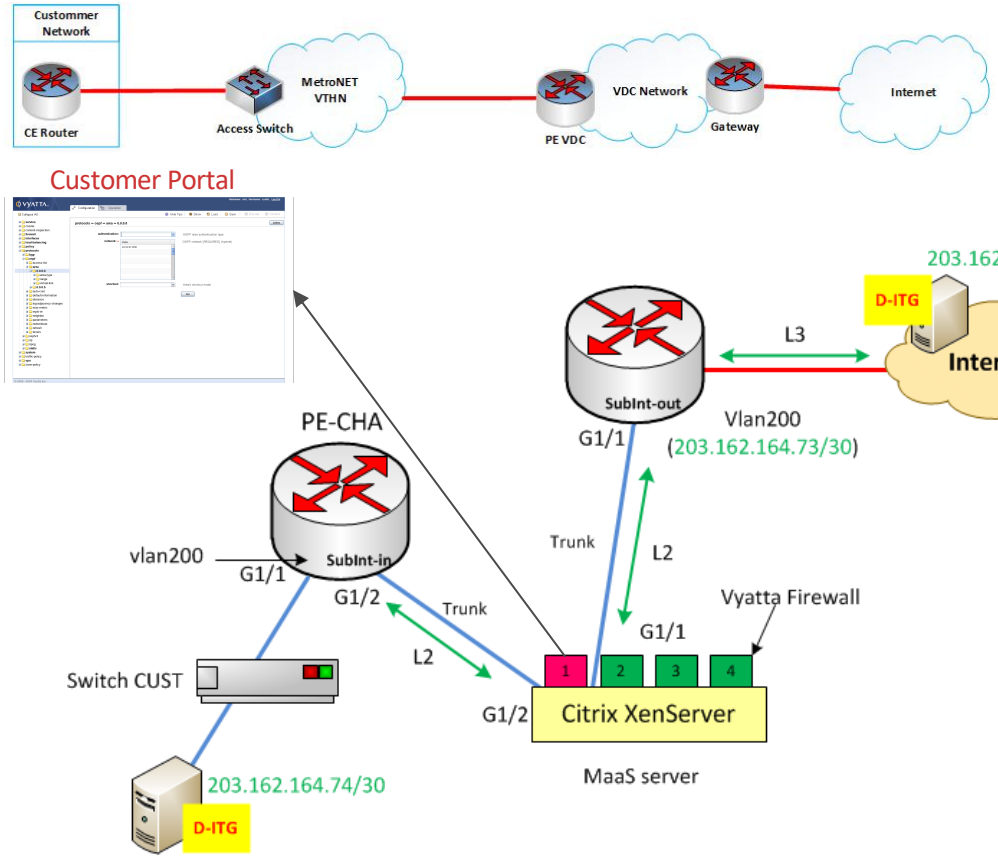




USECASES → Middlebox as a Service (MAAS) → CORD IN A BOX → CORD RACK → Commercial Deployment

Now

Research Project of vCPE Trial in VNPT



RESULTS

- Layer 3 Firewall
- Layer 4 Firewall
- Layer 7 Firewall
- IPS/IDS
- Bandwidth limit
- Performance test

PROBLEMS

- Manual control
- No Service Function Chaining
- Waste resources (VM)
- Bad performance

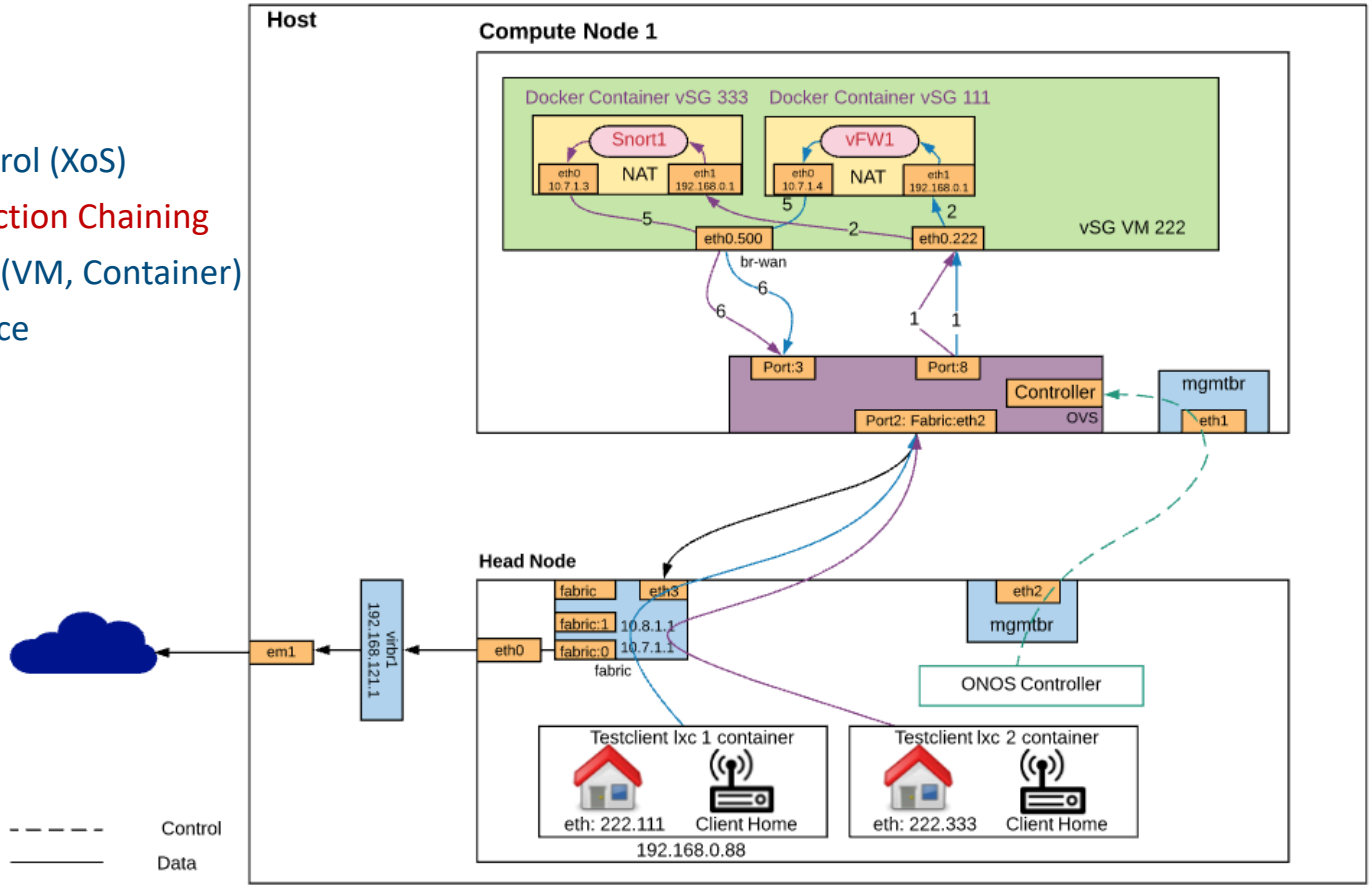
Current CORD System

Automatic control (XoS)

No Service Function Chaining

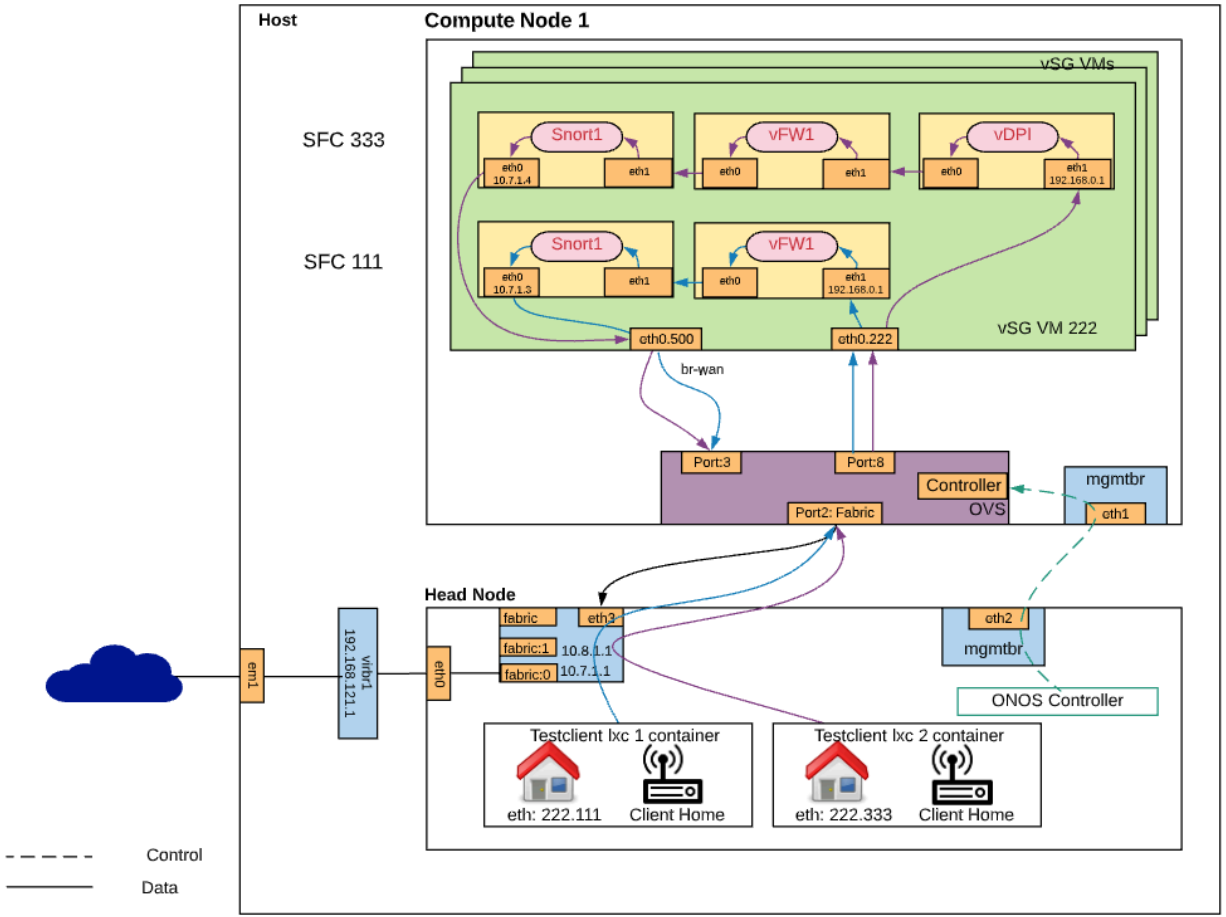
Save resources (VM, Container)

Bad performance

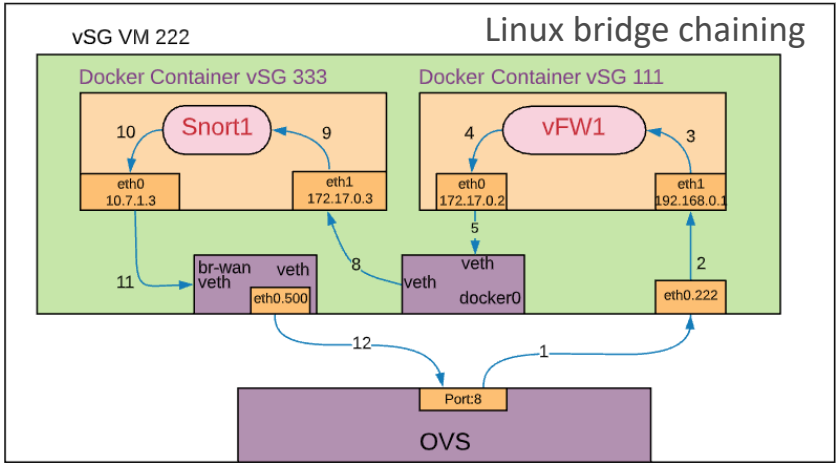


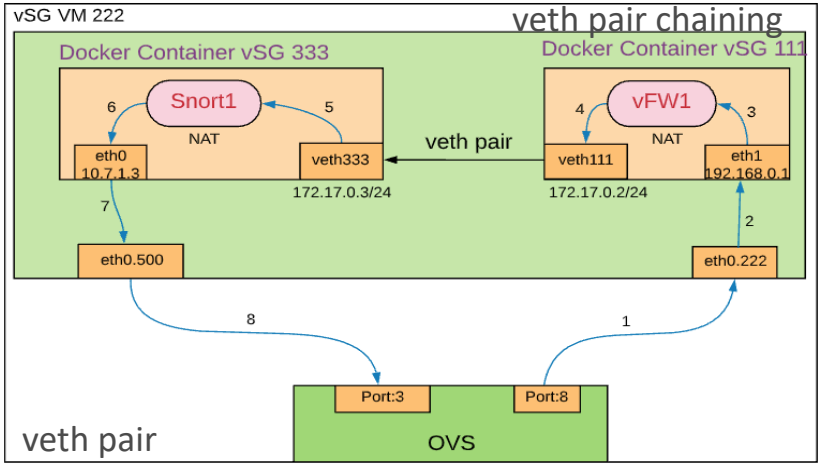
[2] L. Peterson *et al.*, "Central office re-architected as a data center," *IEEE Commun. Mag.*, vol. 54, no. 10, pp. 96–101, 2016.

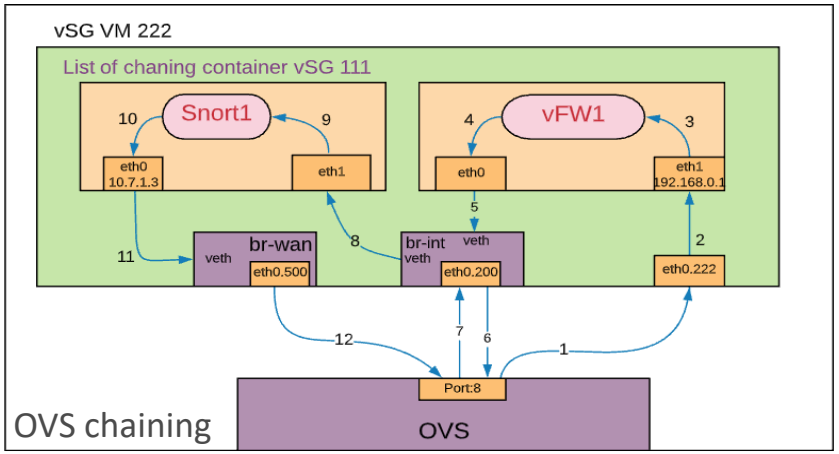
Practical Needs of Service Function Chaining

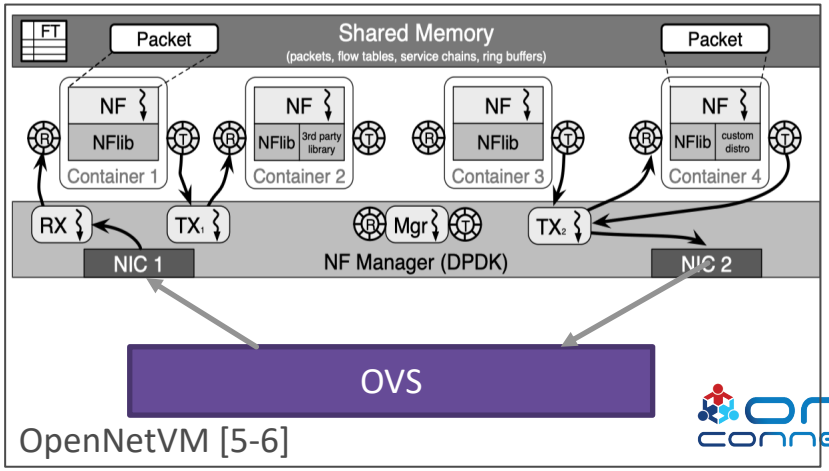


How to Implement SFC in CORD system



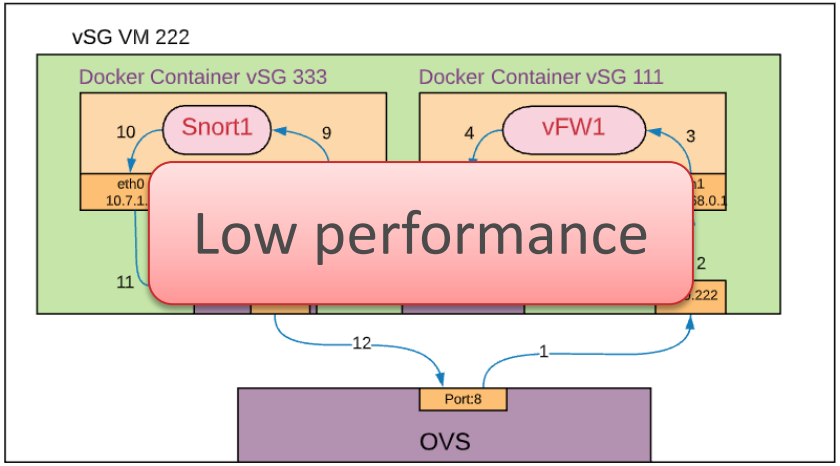




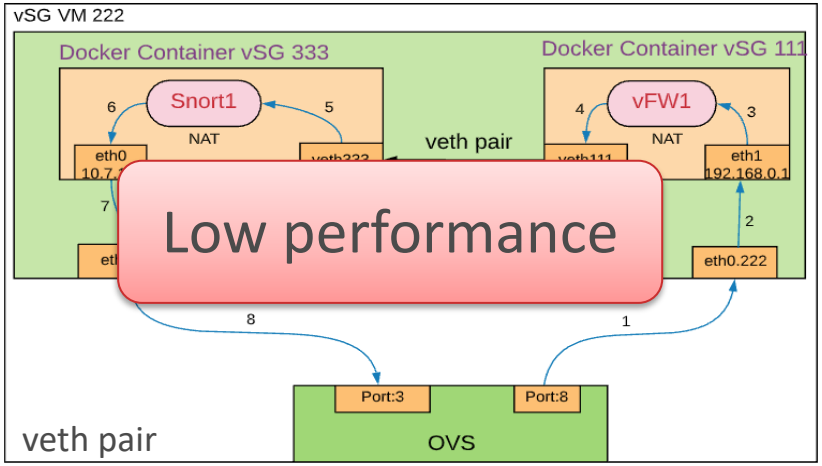


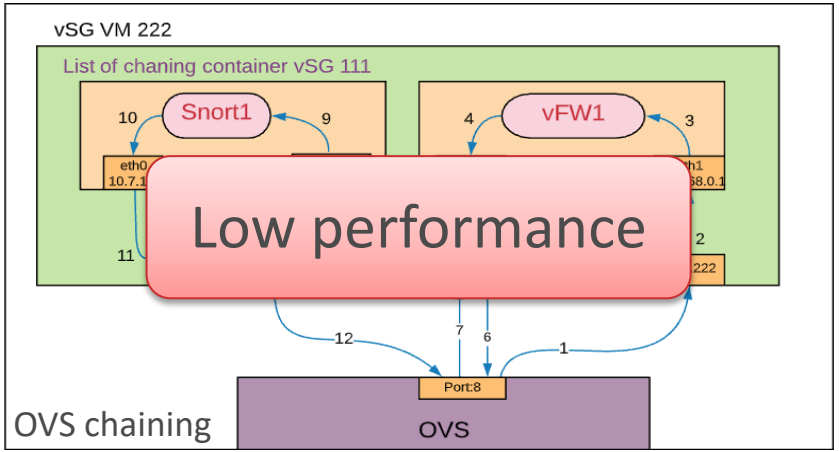
How to Implement SFC in CORD system

Linux bridge chaining

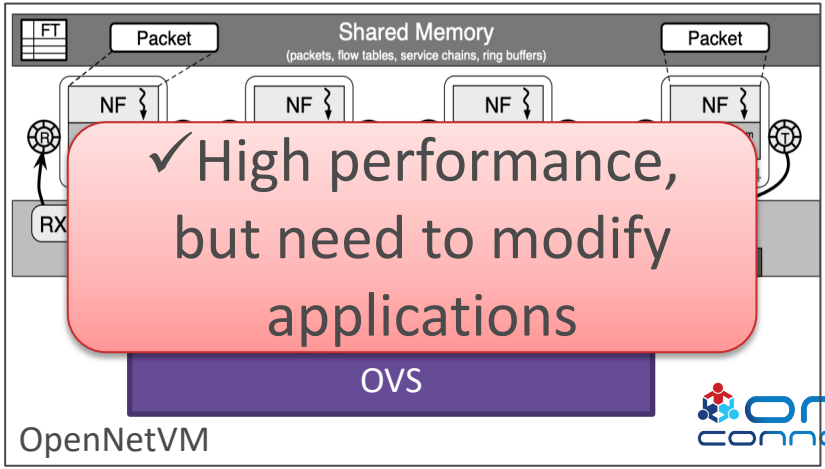


veth pair chaining



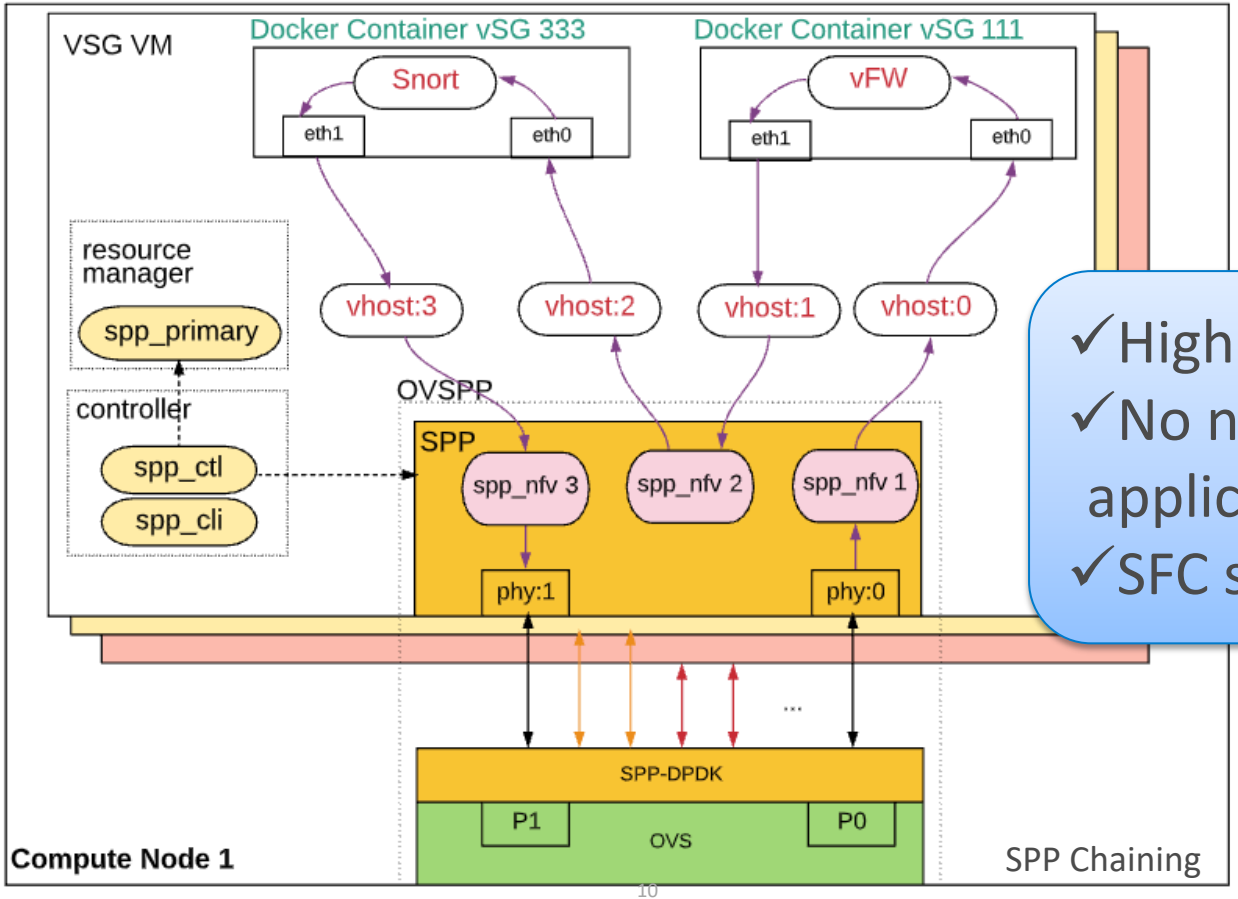


OVS chaining



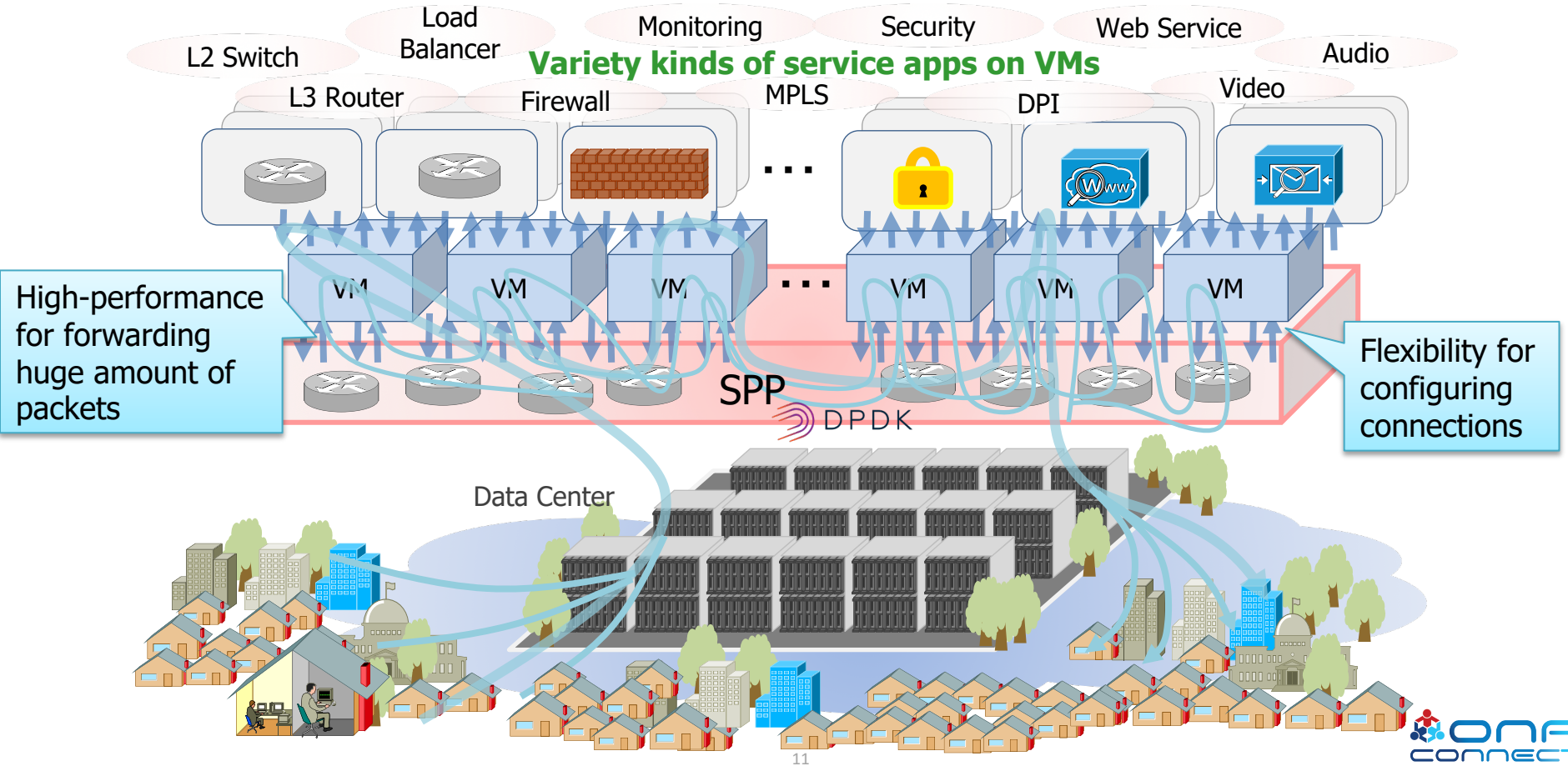
OpenNetVM

How to Implement SFC in CORD system (cont.)

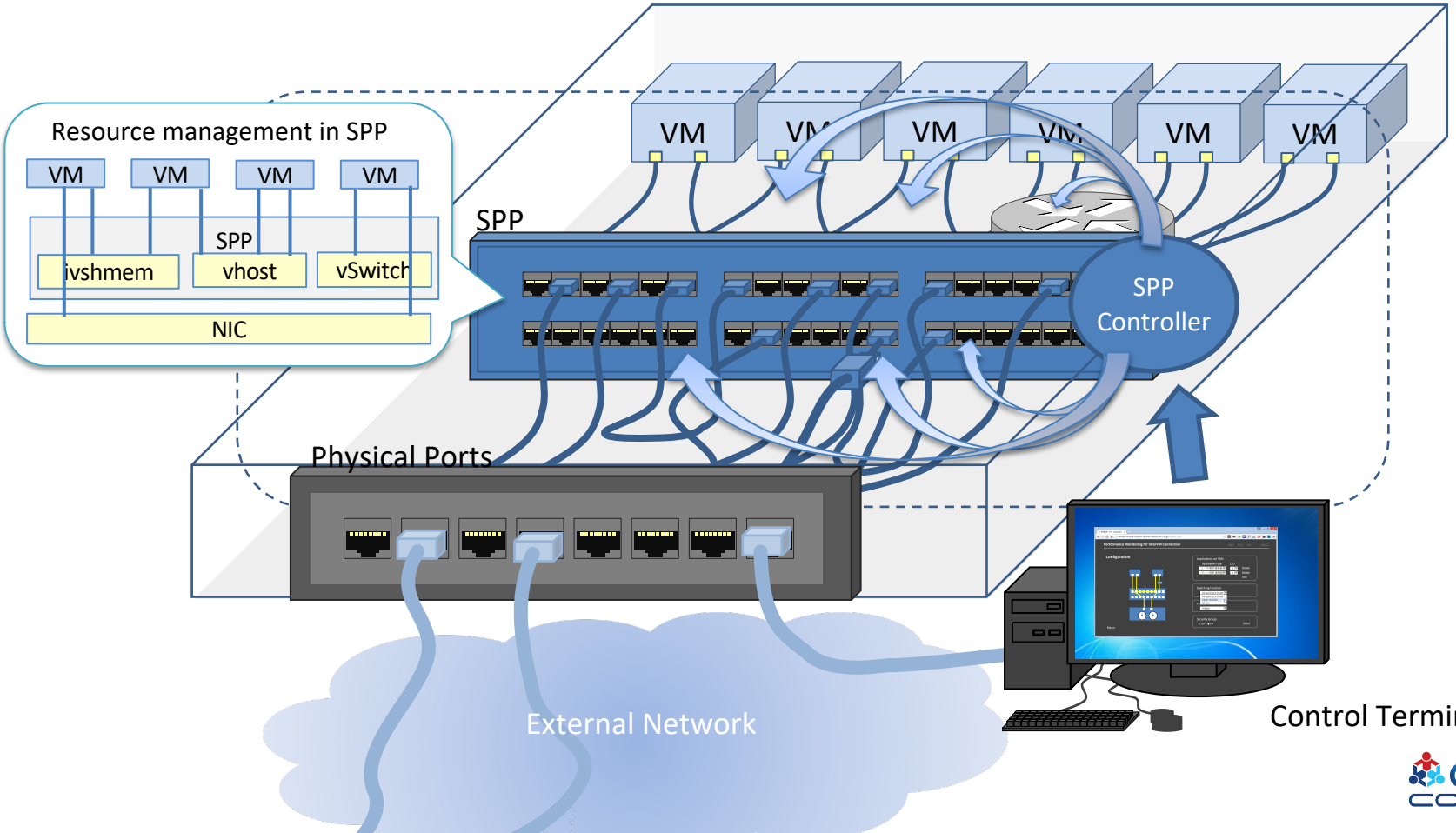


- ✓High performance
- ✓No need to modify applications
- ✓SFC span many vSG VMs

SPP (Soft Patch Panel)



SPP Features

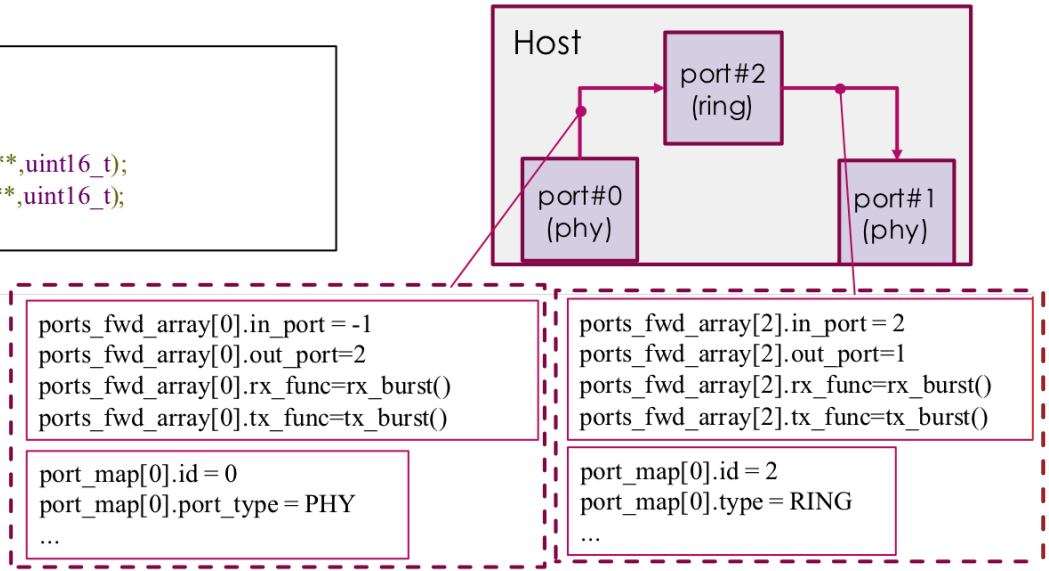


SPP Features

- Very simple mechanism - just connects the ports
- High performance - using DPDK and above simplicity

```
struct port {
  int in_port_id;
  int out_port_id;
  uint16_t (*rx_func)(uint8_t,uint16_t,struct rte_mbuf **,uint16_t);
  uint16_t (*tx_func)(uint8_t,uint16_t,struct rte_mbuf **,uint16_t);
};
```

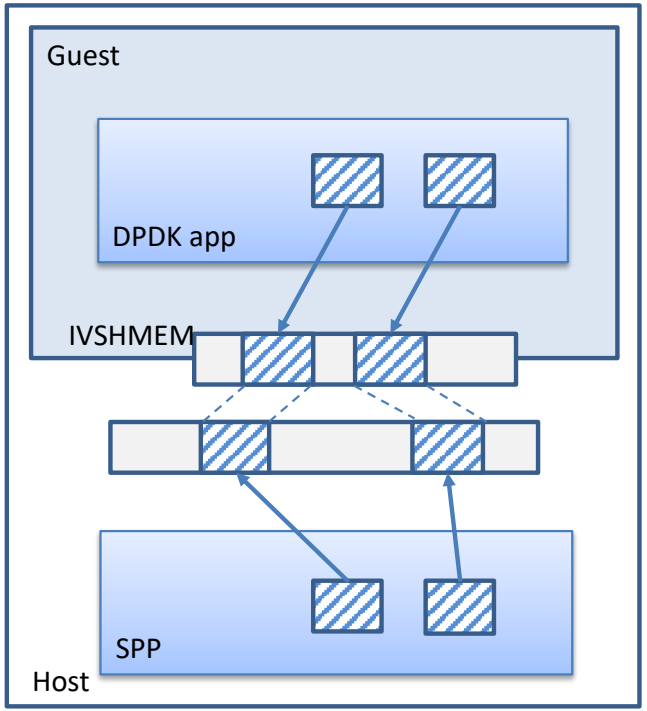
```
struct port_map {
  int id;
  enum port_type port_type;
  struct stats *stats;
  struct stats default_stats;
};
```



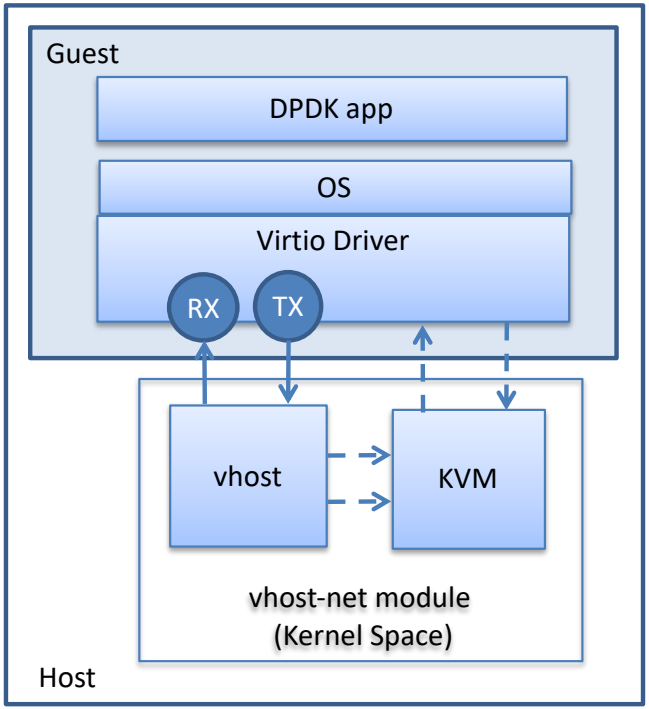
SPP Features

- SPP provides two interfaces of DPDK, ring and vhost.

(a) SPP (ring)

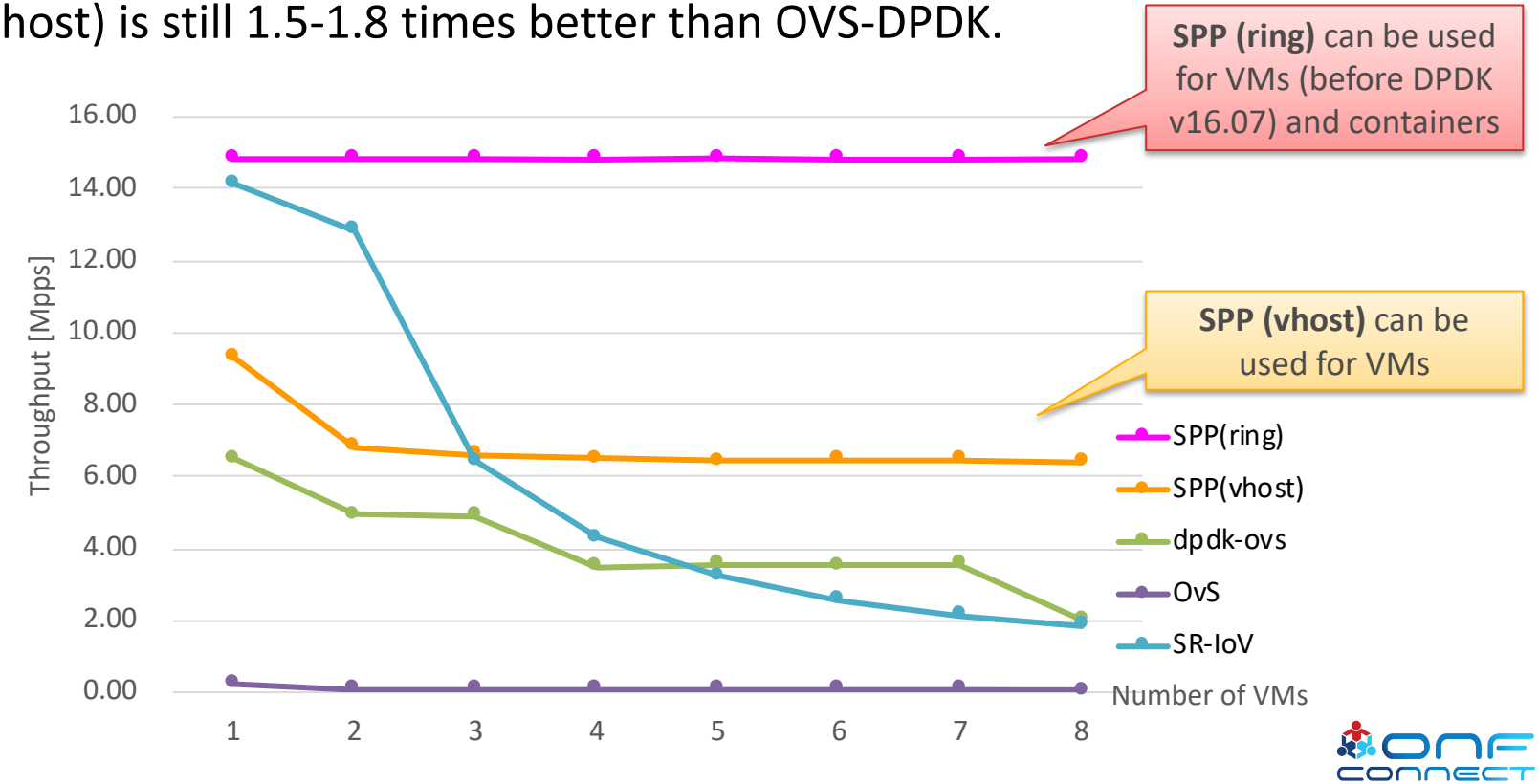


(b) SPP (vhost)



Performance Evaluation

- SPP (ring) achieves the highest performance nearly 14.88 Mpps
- SPP (vhost) is still 1.5-1.8 times better than OVS-DPDK.



vSwitch Comparison

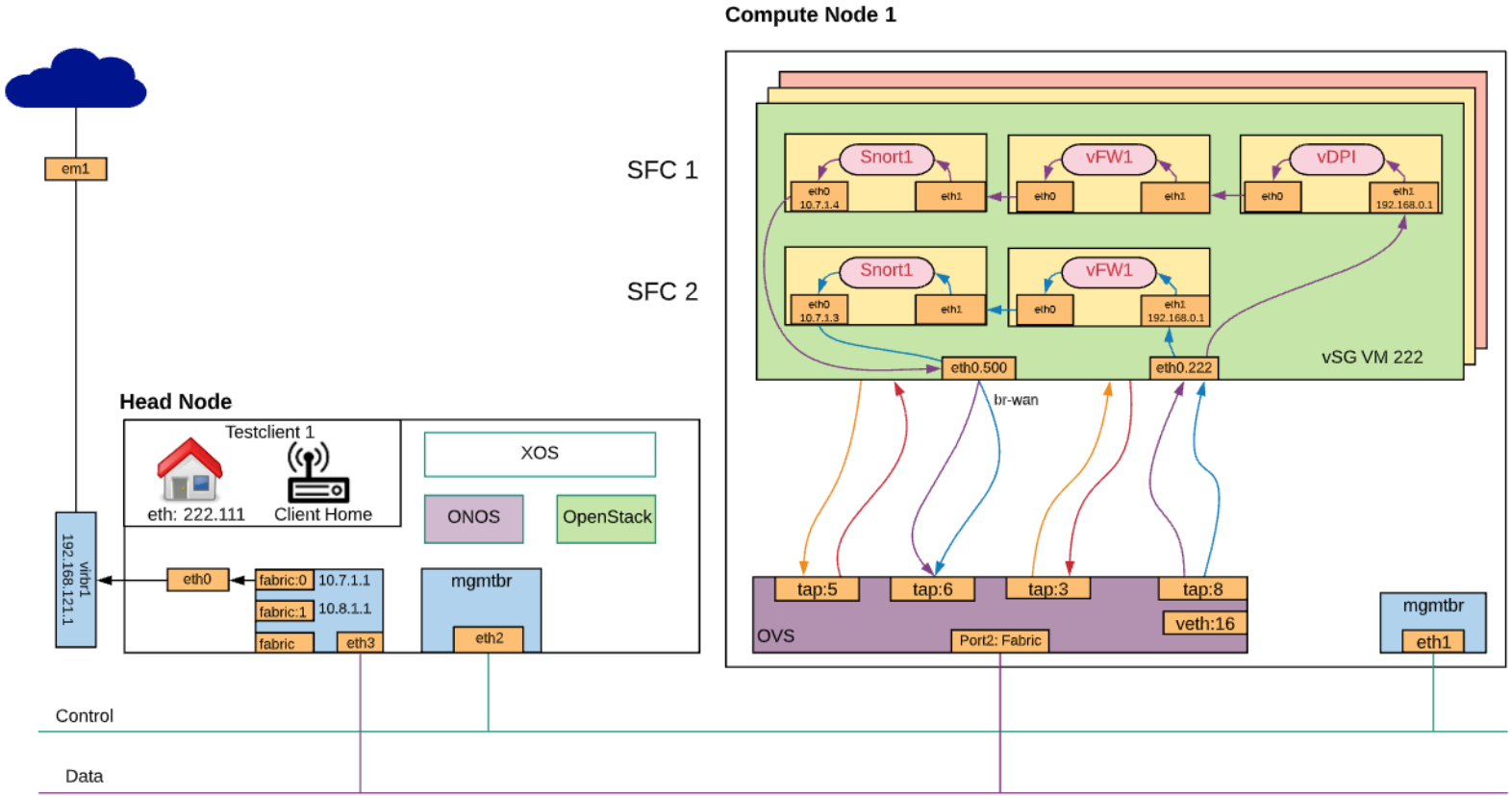
		SR-IOV	OVS	OVS-DPDK	SPP
Speed	Speed for packet processing	**Good**	**Poor**	**OK**	**Good** 10 Gbps to 12 Gbps or more
Flexibility	Hardware limitation	**OK** NIC limited	**Good**	**Good** DPDK is now common	**Good** DPDK is now common
	Live migration	**Poor**	**Good**	**OK**	**OK** (not yet verified)
Operability	Packet capture on host side	**Poor** pass through	**OK** duplicate: yes (less performance from 800Mbps) capture: no	**OK** duplicate: yes capture: no	**Good** duplicate: yes capture: yes (under test)

Problem Statement

SFC when implemented on CORD platform, suffers a serious performance issue of the overwhelmed switching entries it adds to CORD's Open vSwitch (OVS)

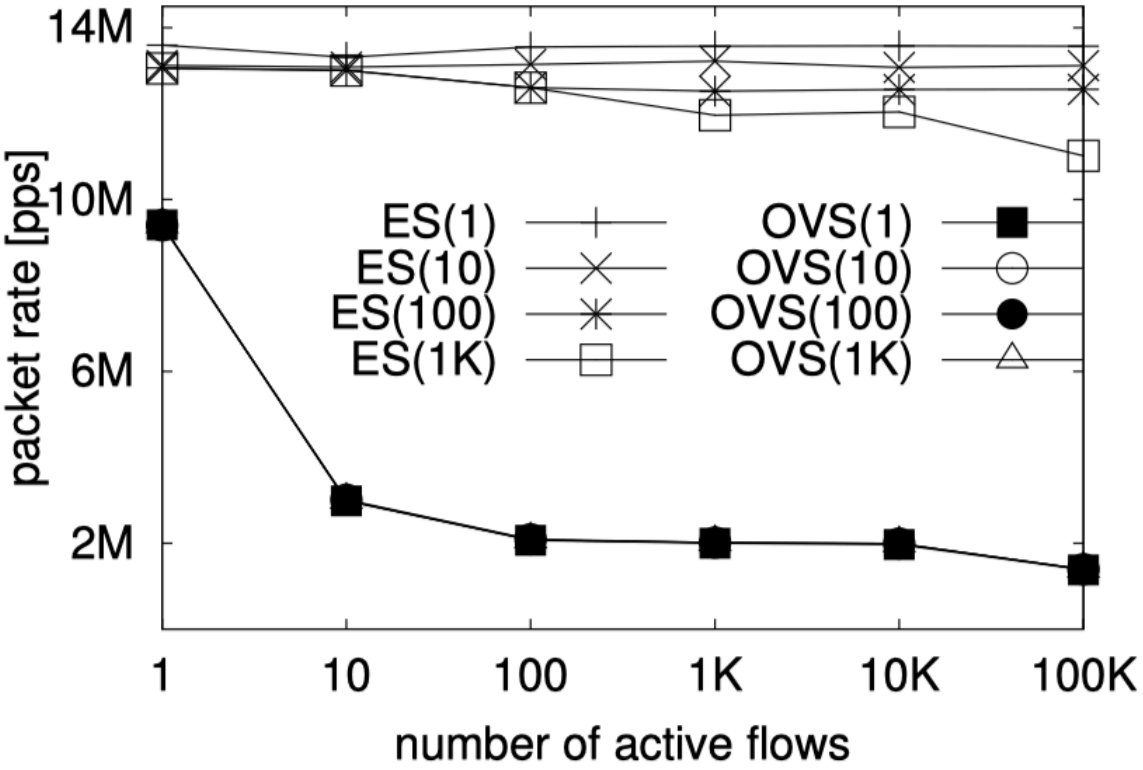
Problem Analysis

SFC adds a lot of flow entries to OVS



Problem Analysis

OVS performance decreases when # of active flow increases

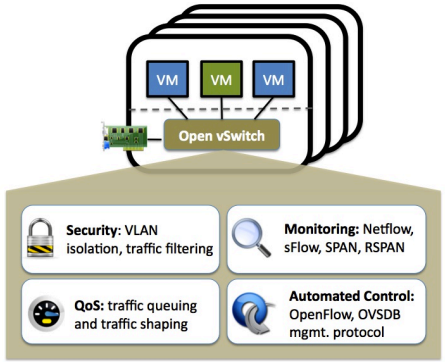


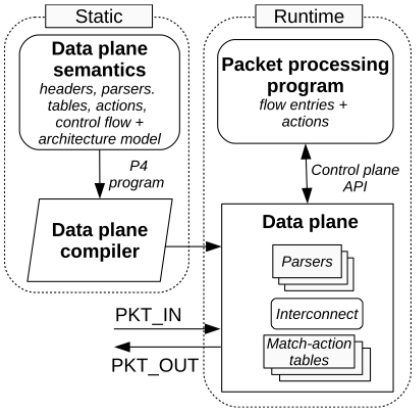
[2] L. Molnár *et al.*, "Dataplane Specialization for High-performance OpenFlow Software Switching," pp. 539–552, 2016

[7] B. Pfaff *et al.*, "The Design and Implementation of Open vSwitch," *Proc. 12th USENIX Symp. Networked Syst. Des. Implement. (NSDI '15)*, 2015

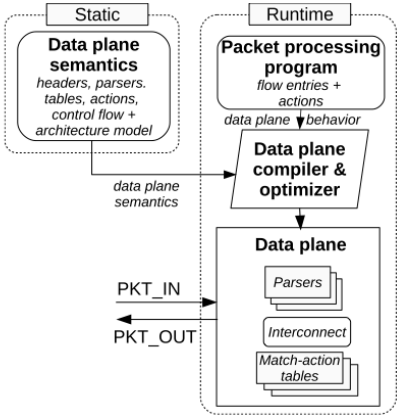
Problem Analysis

Customize dataplane for flow entries

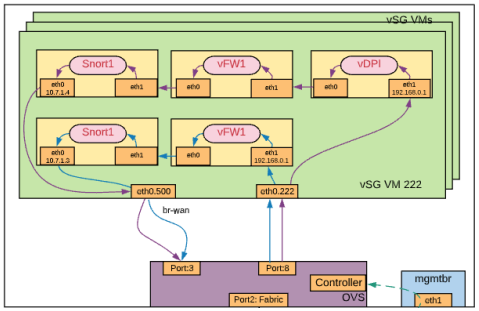


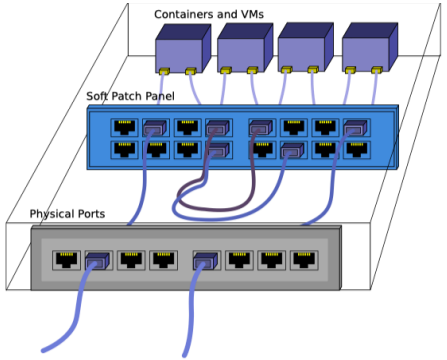


(a) static compilation



(b) dynamic compilation

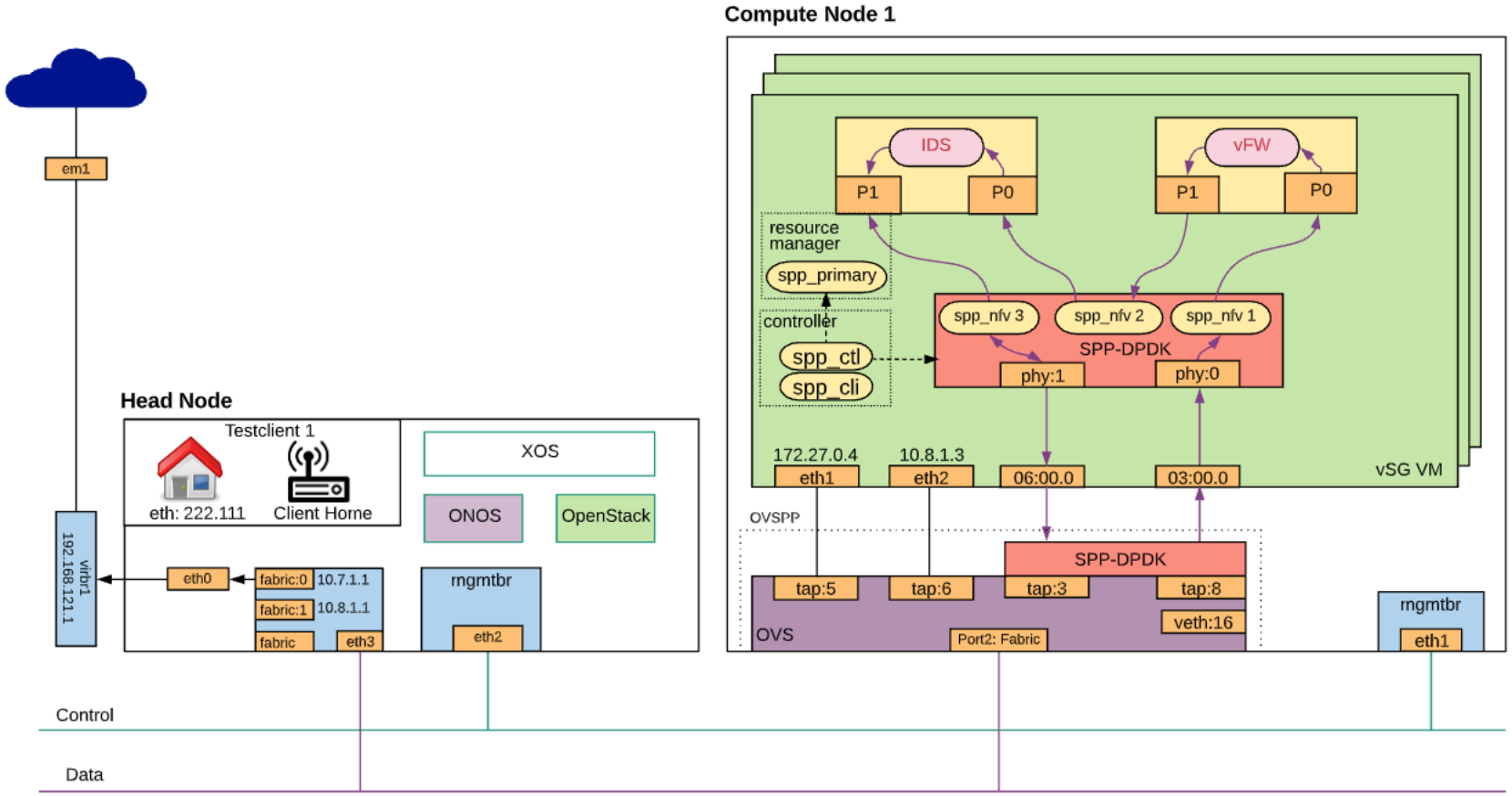




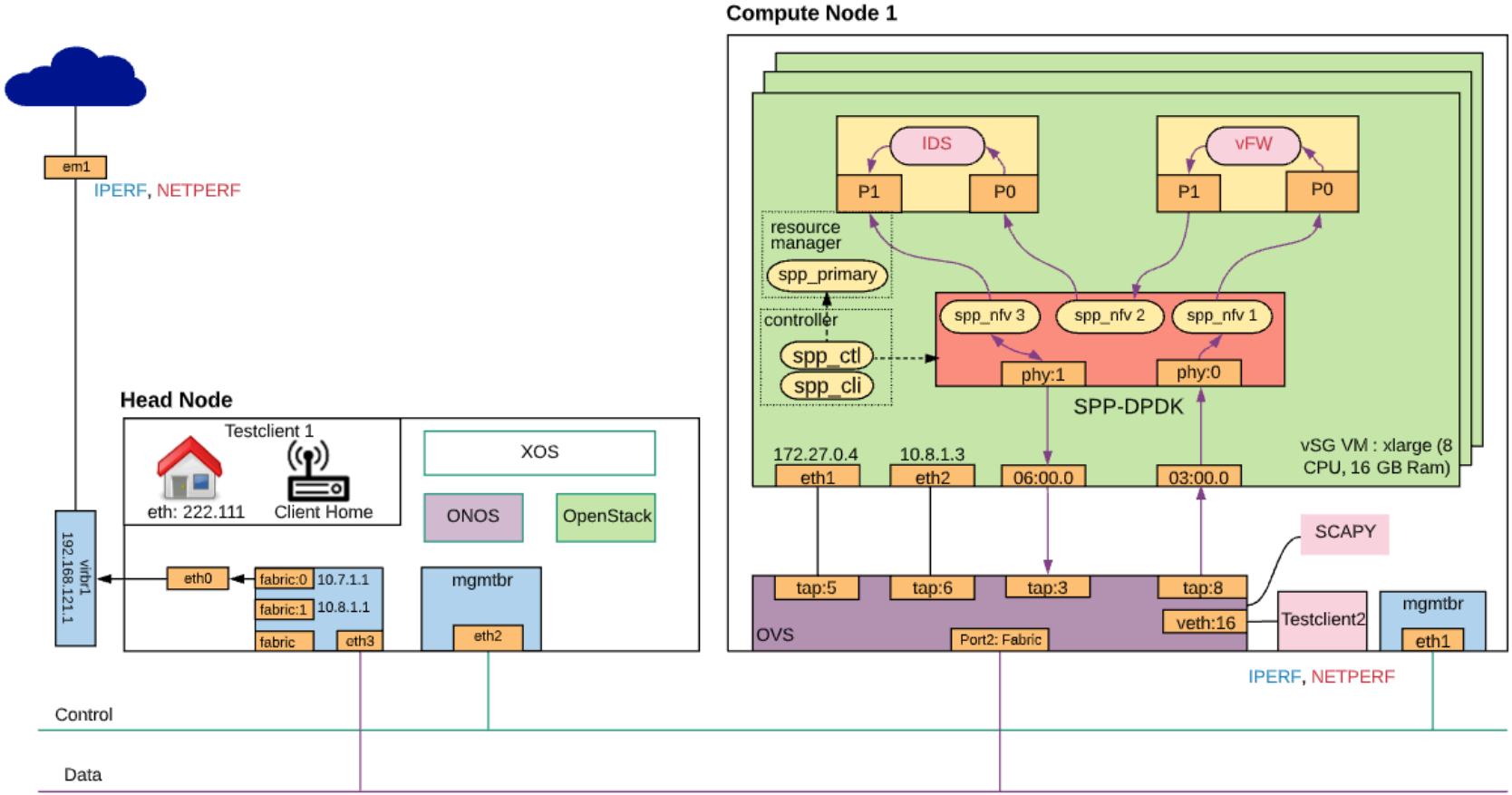
[3] G. Rétvári, L. Molnár, G. Enyedi, and G. Pongrácz, "Dynamic Compilation and Optimization of Packet Processing Programs," pp. 6–7.

[4] L. Molnár *et al.*, "Dataplane Specialization for High-performance OpenFlow Software Switching," pp. 539–552, 2016.

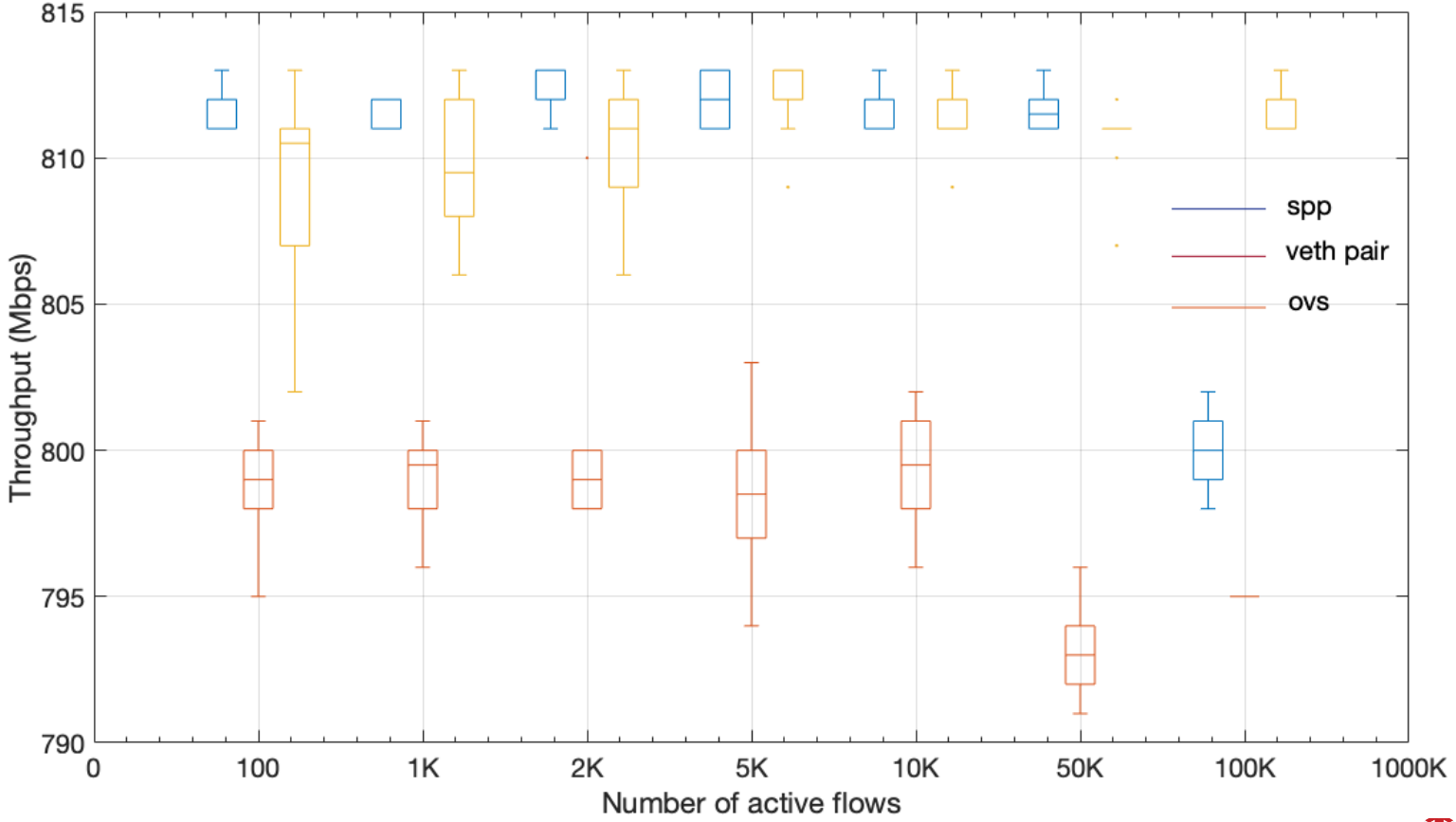
Our Solution - OVSPP -



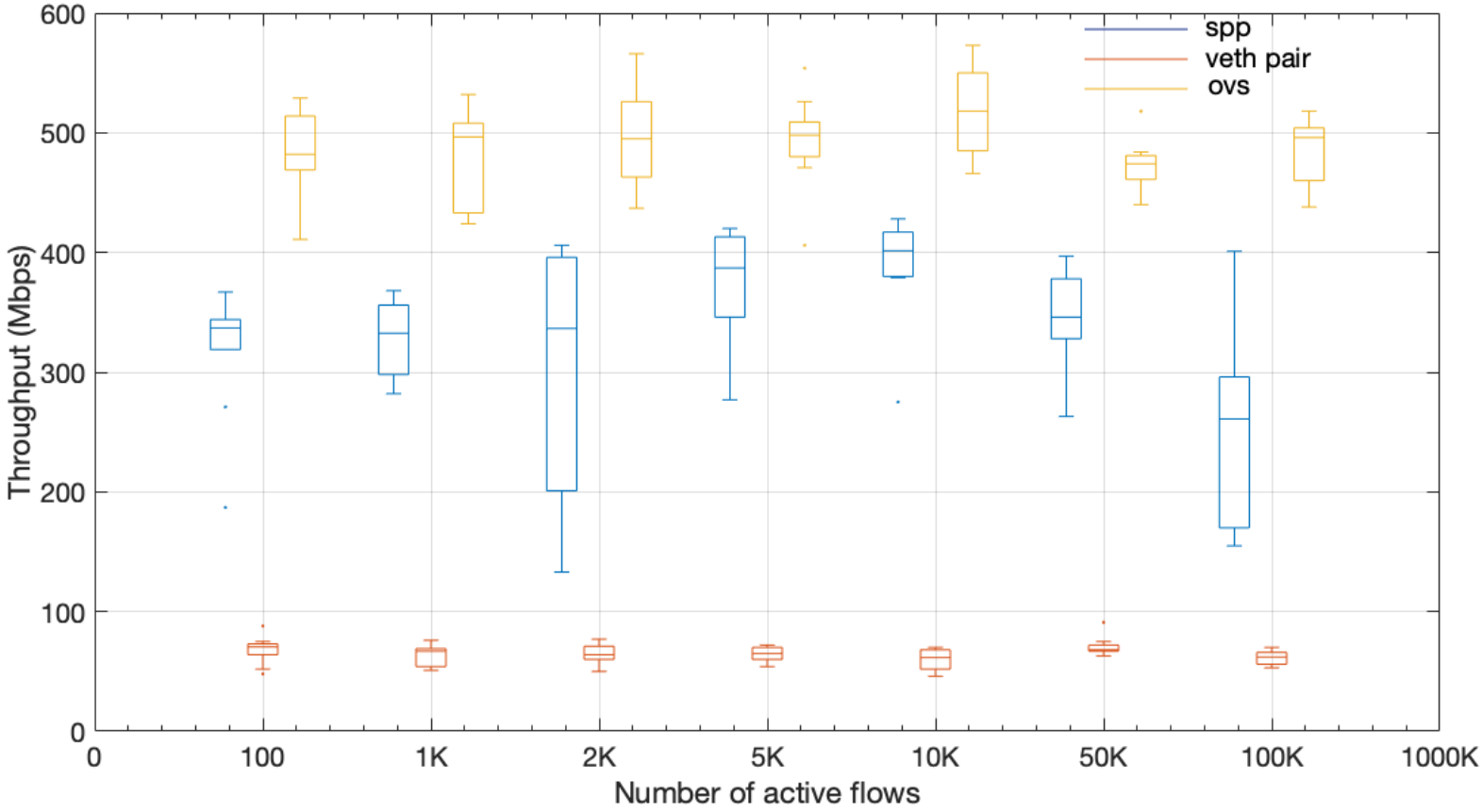
Experiments and Preliminary Results



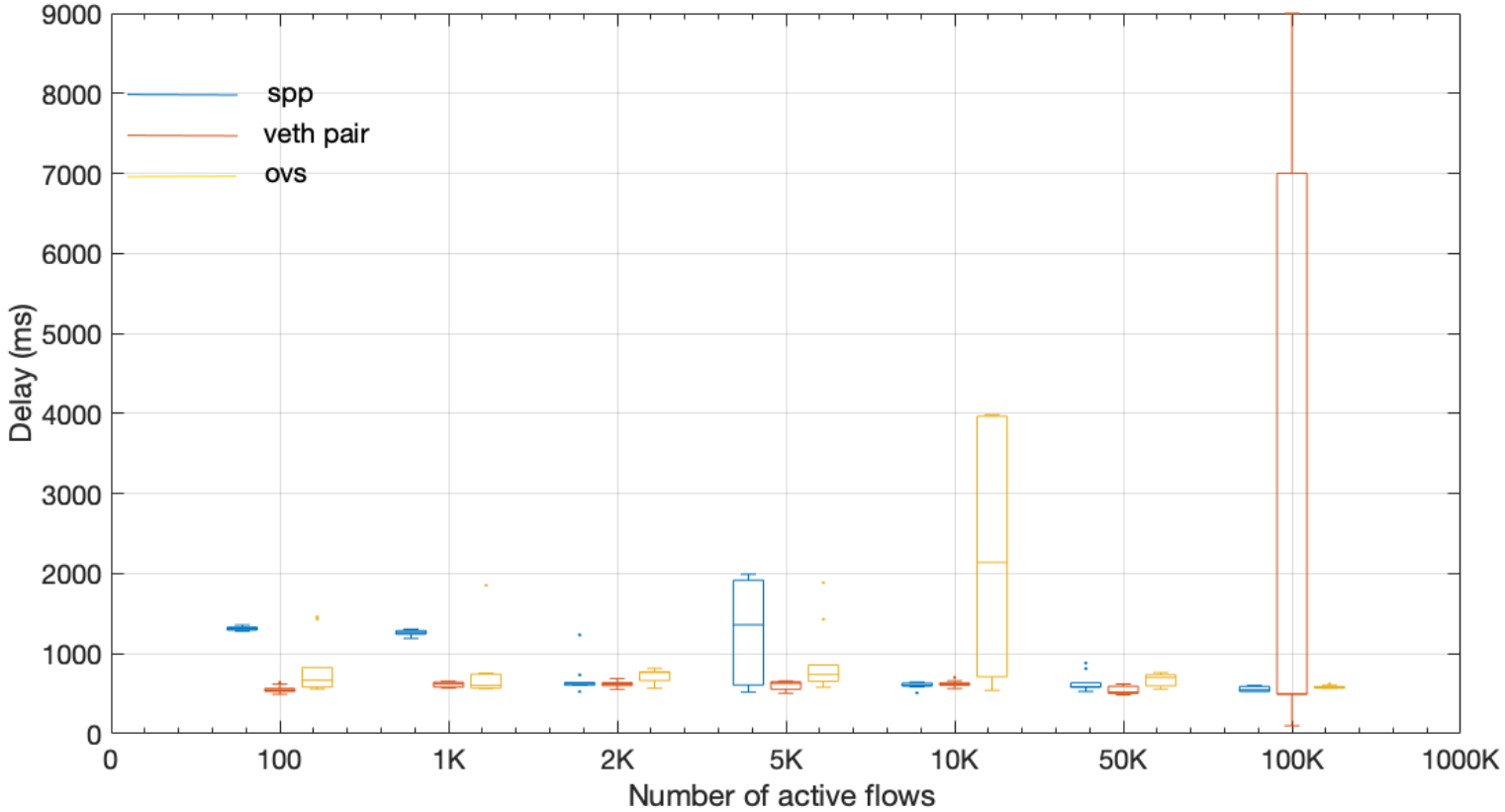
UDP throughput of different chaining scenarios



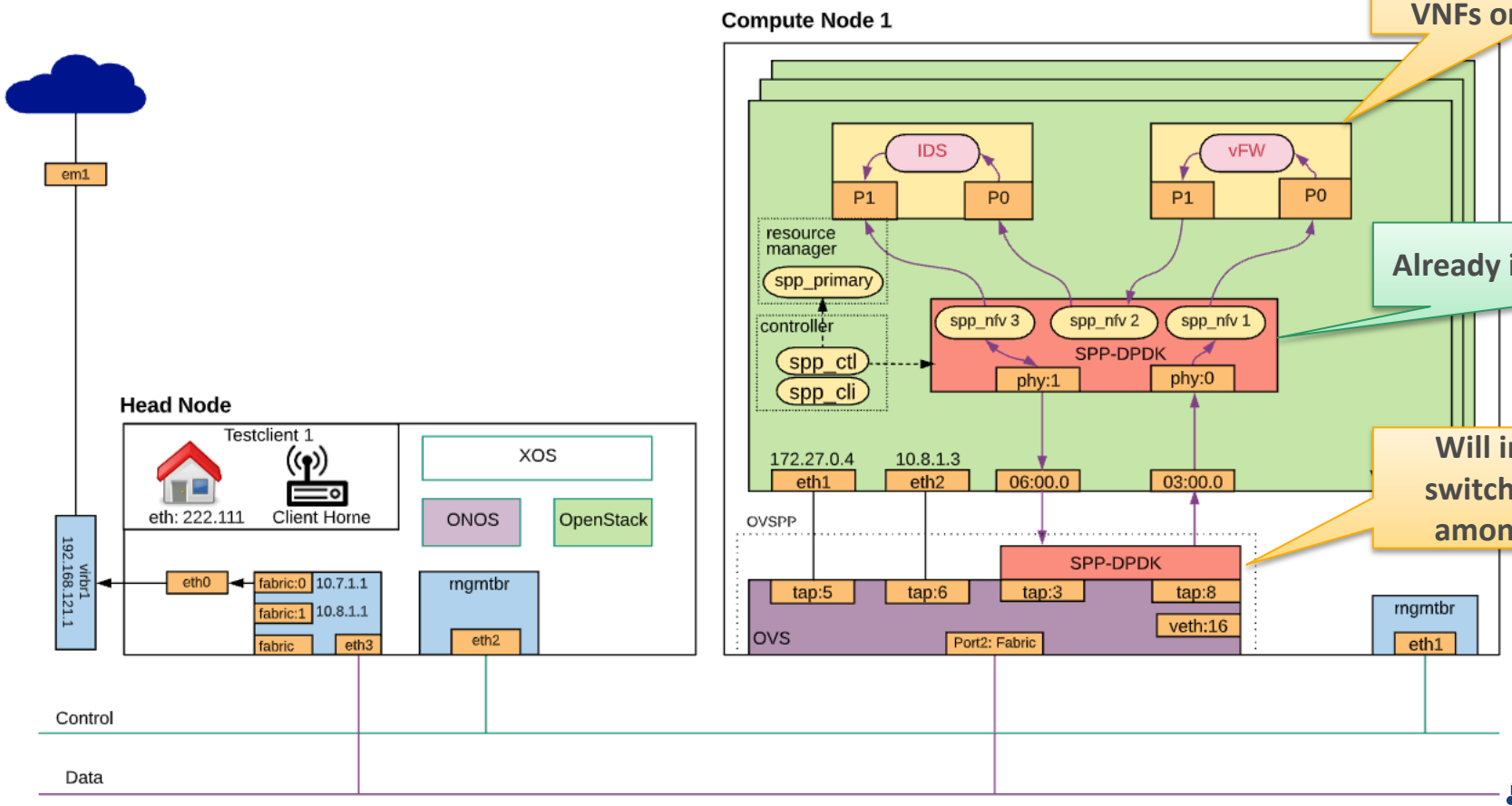
TCP throughput of different chaining scenarios



Comparing delay of different chaining scenarios



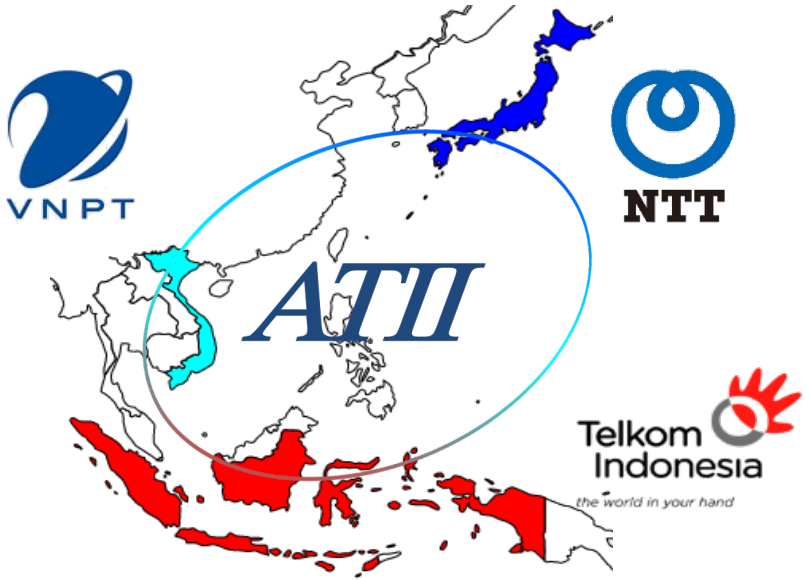
Current Status and Future Works



Our Collaboration Activity

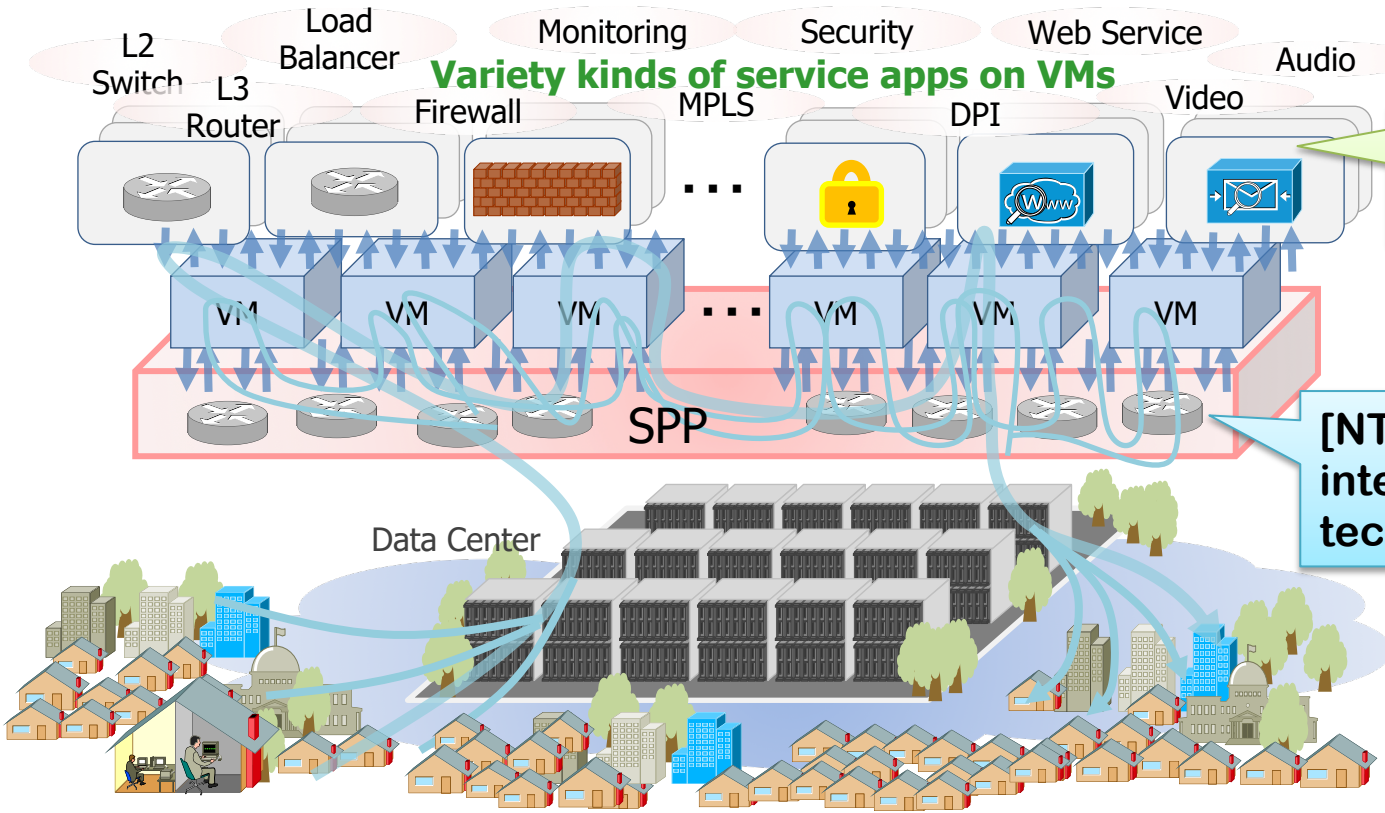
ATII: APAC Telecom Innovation Initiative

- NTT and Telkom Indonesia established ATII in April 2017, to promote the creation of new network services considering social problems in the APAC region and to promote technical studies. ATII has extended to three operators structure with VNPT's joining.



Project	Theme	Member
WP1	High value-added network services	NTT, Telkom
WP2	Server platform virtualization	Telkom, NTT
WP3	Flexible access network virtualization	NTT, Telkom, VNPT
WP4	vSwitch for service function chaining	NTT, Telkom, VNPT
WP5	Ensuring the reliability of ICT equipment by reducing lightning malfunction	NTT, Telkom

ATII WP4: Study on vSwitch for Service Function Chaining (S^{3}FC)



Telkom Indonesia
the world in your hand

VNPT

[Telkom/VNPT] Services, Use cases

Apply & Evaluate

[NTT] High-performance inter-VM communication technology (SPP)

NTT

ONF CONNECT

References

[1] B. H. J. Son, “AT&T ’ s CORD - the ultimate architecture born after decades of innovation in the communications network,” Netmanias, pp. 1–7, 2016.

[2] L. Peterson *et al.*, “Central office re-architected as a data center,” *IEEE Commun. Mag.*, vol. 54, no. 10, pp. 96–101, 2016.

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[4] L. Molnár *et al.*, “Dataplane Specialization for High-performance OpenFlow Software Switching,” pp. 539–552, 2016.

[5] W. Zhang *et al.*, “OpenNetVM: A Platform for High Performance Network Service Chains,” *HotMiddlebox 2016*, pp. 26–31, 2016.

[6] J. Hwang, T. George, K. K. Ramakrishnan, T. Wood, T. George, and I. Nsdi, “NetVM : High Performance and Flexible Networking Using Virtualization on Commodity Platforms This paper is included in the Proceedings of the,” *Proc. 11th USENIX Symp. Networked Syst. Des. Implement. (NSDI 14)*, pp. 445–458, 2014.

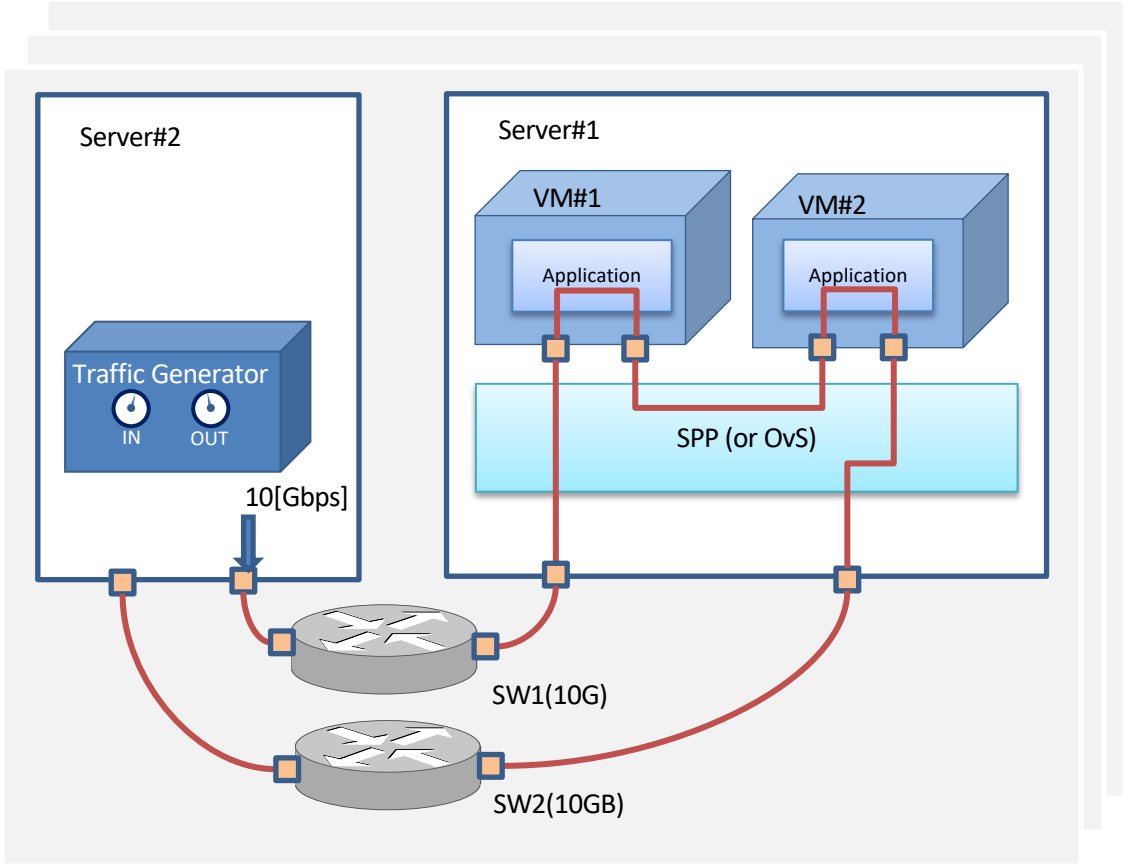
[7] B. Pfaff *et al.*, “The Design and Implementation of Open vSwitch,” *Proc. 12th USENIX Symp. Networked Syst. Des. Implement. (NSDI ’15)*, 2015.

[8] G. P. Katsikas, “NFV Service Chains at the Speed of the Underlying Commodity Hardware,” Doctoral Thesis in Information and Communication Technology School of Electrical Engineering and Computer Science KTH Royal Institute of Technology Stockholm, 2018.

Thank You

(Backup) Performance Evaluation Environments

Configuration for SPP (same as OVS and SR-IOV)



Details

Hardware

(1)Physical server

CPU	model	Xeon E5-2690v3
	freq	2.60[GHz]
	cores	12
	L3 Cache	30[MB]
	processors	2
memory	capacity	96[GB]
NIC	10G port	4
	1G port	4

(2) Switch

SW1(10GB)	AX3830S
SW2(10GB)	Nexus3524X

Software

OS	Linux(Ubuntu 14.04 LTS)
Kernel	3.19.0-33-generic
OpenStack	Kilo
Qemu	v1.6.2
DPDK	2.1.0-rc4
Traffic Generator	Pktgen(with DPDK)
Application	l2fwd(modified DPDK sample)