It's kind of fun to do the impossible with DPDK

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NTT Labs

Agenda

- **Motivation for fun ☺**
- **Fun with Lagopus SDN switch ☺**
- **Fun with speed ☺**
  - Smart FPGA for software dataplane
- **Fun with experience ☺**
  - SDN IX @ Interop Tokyo 2015 ShowNet

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Motivation for fun ☺

Trend

Trend shift in networking

- ✓ Closed (Vender lock-in)
- ✓ Yearly dev cycle
- ✓ Waterfall dev
- ✓ Standardization
- ✓ Protocol
- ✓ Special purpose HW / appliance
- ✓ Distributed cntrl
- ✓ Custom ASIC / FPGA
- ✓ Wired logic dataplane

- ✓ Open (lock-in free)
- ✓ Monthly dev cycle
- ✓ Agile dev
- ✓ DE fact standard
- ✓ API
- ✓ Commodity HW/ Server
- ✓ Logically centralized cntrl
- ✓ Merchant Chip
- ✓ Software dataplane

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Evaluate the benefits of SDN
by implementing control plane and switch
for fun ☺

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Lagopus SDN switch project

Goal of Lagopus project

Provide NFV/SDN-aware switch framework

- SDN switch agent (OpenFlow, REST)
- 100Gbps high-performance soft dataplane
- Flexible/extensible switch configuration datastore
- DPDK extension (library, FPGA NIC, vNIC)
- Cloud middleware integration

Expand software-based packet processing to carrier networks

- Hardware acceleration and processing offload for scalable software dataplane

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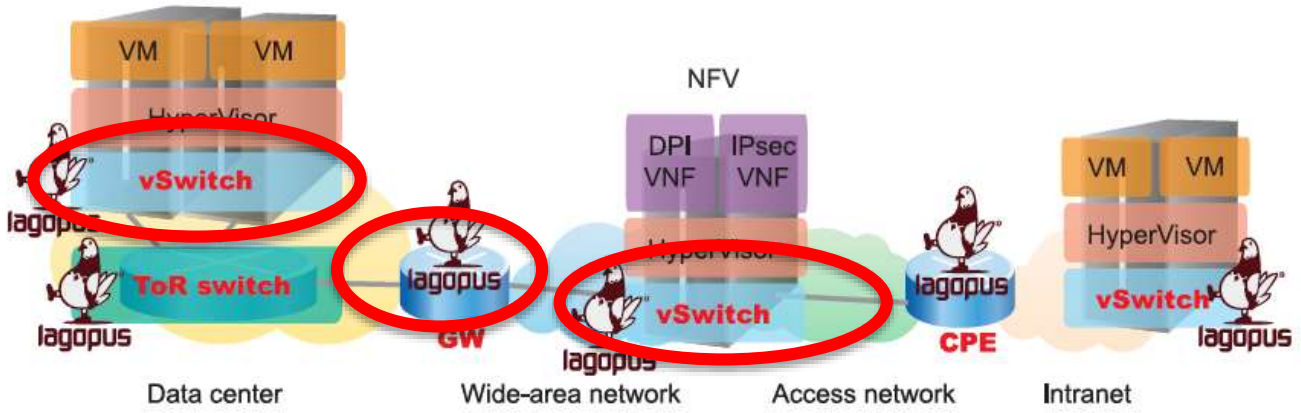
Target

High-performance SDN/OF software switch

- 40-Gbps packet processing throughput / port
- Mega-class flow entries support
- Low-latency and wire-rate speed in smaller packet size

Expands SDN to WAN, GW and NFV

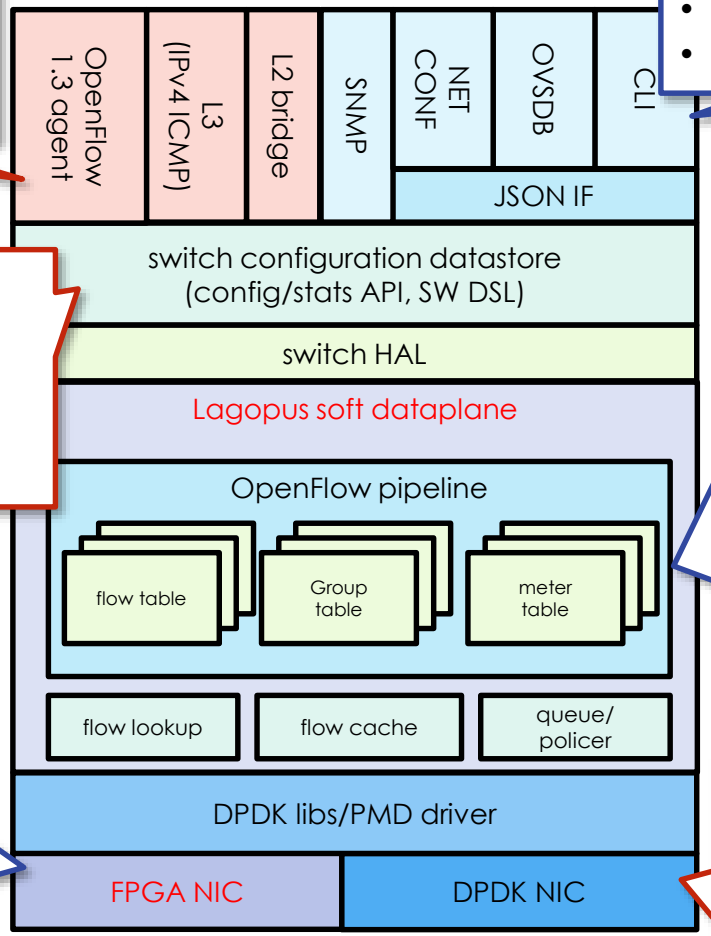
- Multiple frame format support
  - MPLS, PBB, MACinMAC, IPv4, IPv6
- Hybrid SDN support
  - REST API, OpenFlow 1.3, OVSDB, NETCONF
  - Legacy protocol support
- vSwtich for hypervisor, container virtualization



Lagopus vSwitch

SDN switch Agent
- Full OpenFlow 1.3.4 support
- Controller-less basic L2 and L3 support

SDN-aware management API
- OVSDB, REST
- Ansible support



Switch configuration datastore
- Pub/sub mechanism
- Switch config DSL
- JSON IF support

DPDK-enabled soft dataplane
- Over-10-Gbps performance
- Low latency packet processing
- high performance multi-layer flow lookup

Soft-dataplane aware FPGA NIC

DPDK-enabled vNIC for NFV (virtq-pmd)

Fun with speed

- Performance Improvement
- Smart FPGA NIC for software dataplane

(collaboration with Xilinx)

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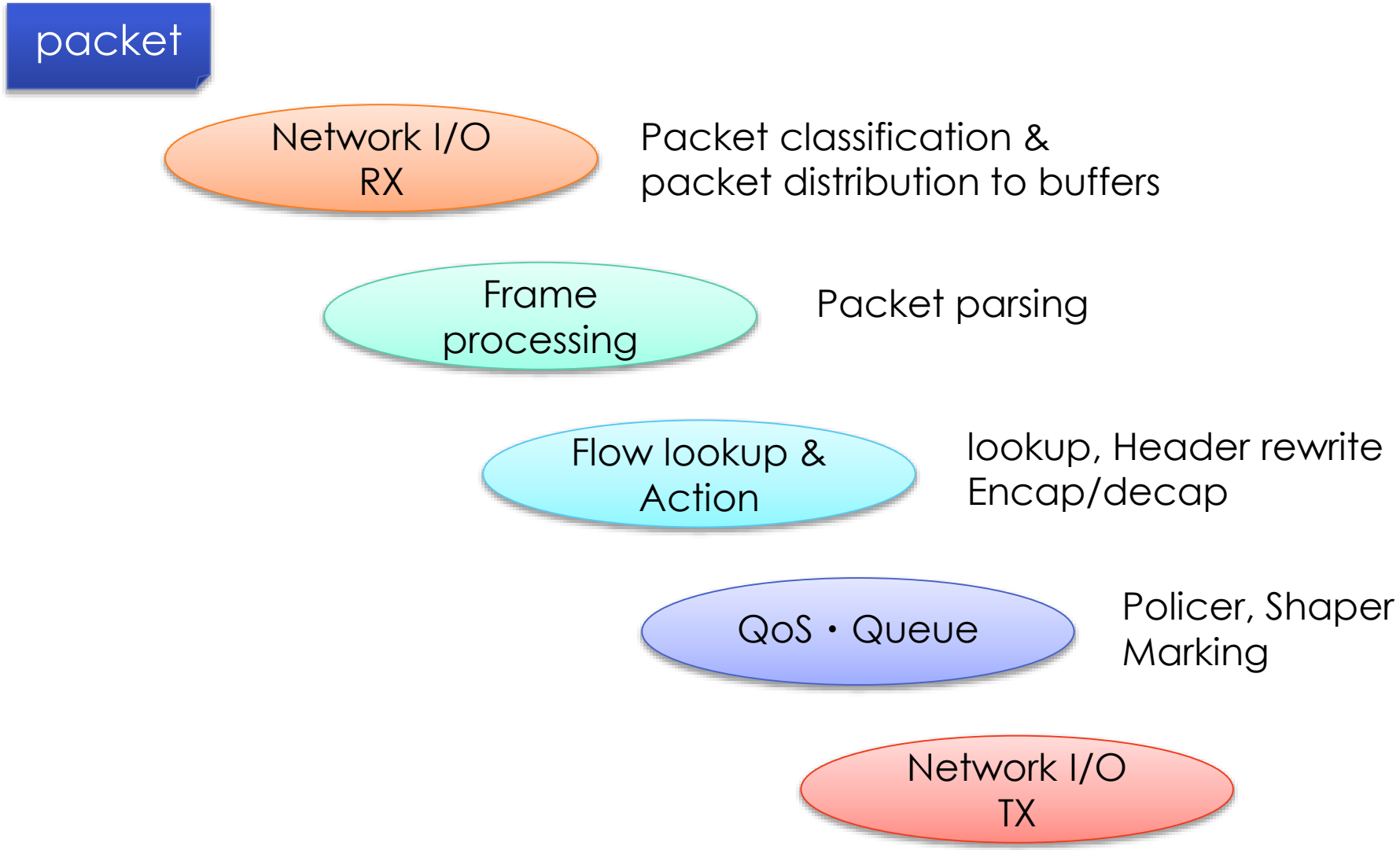
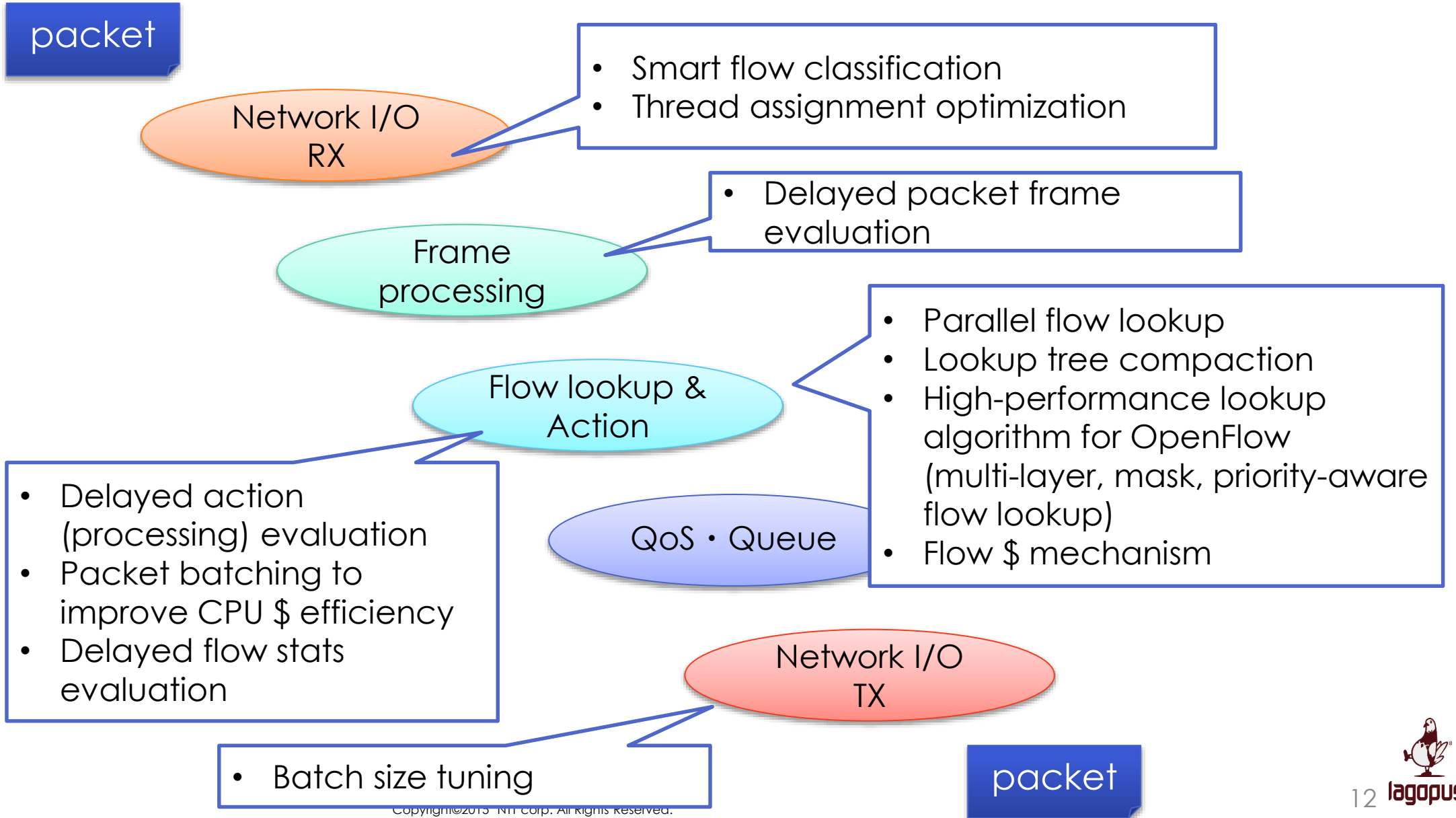
Performance Improvement

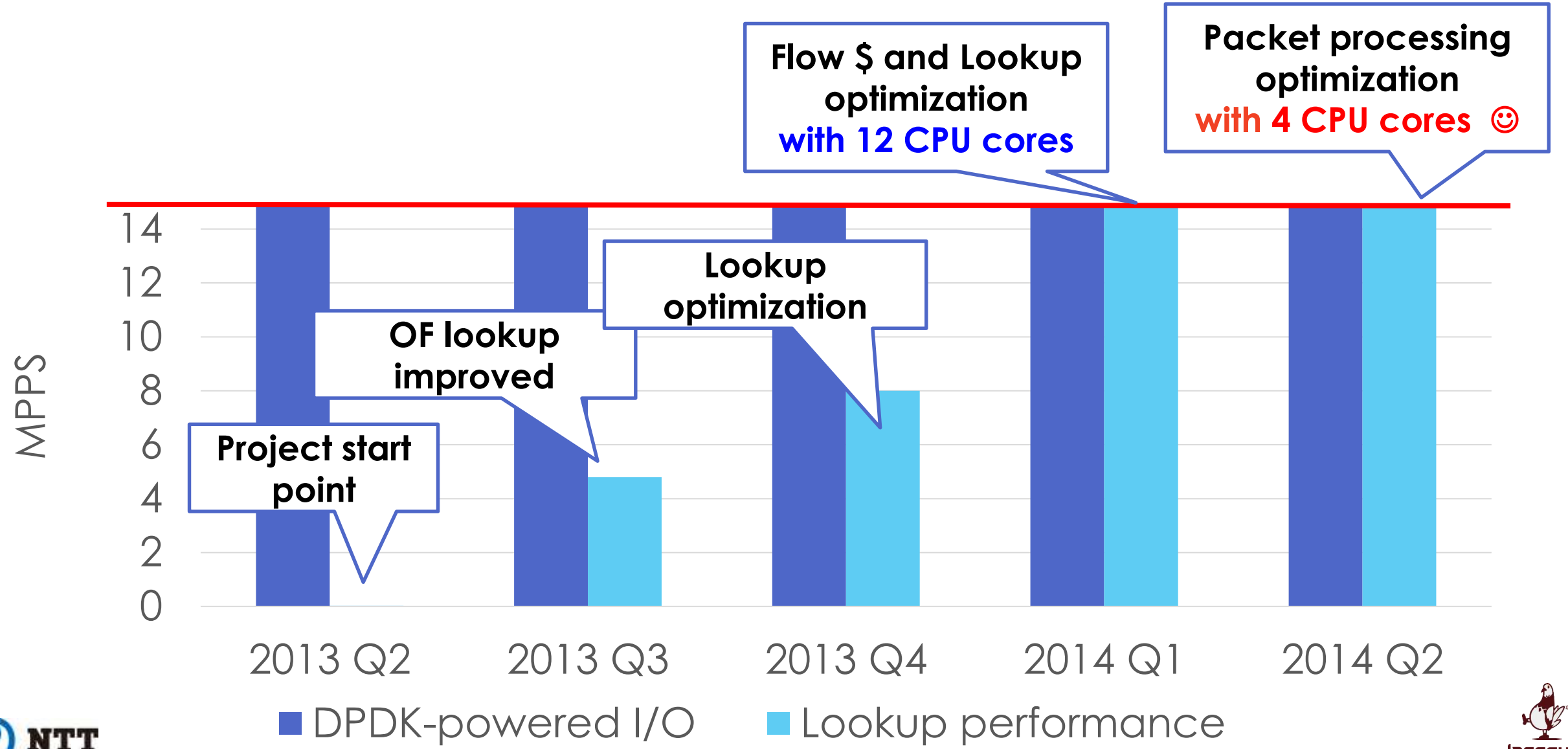
Basic packet processing



What we did for performance



Road to 10Gbps packet processing with 1M OpenFlow flow entries



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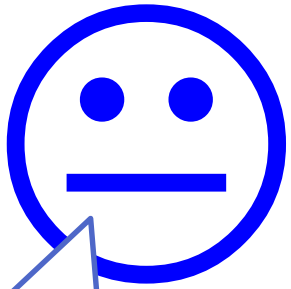
Big change from Y2013

Before project



10Gpbs by software dataplane? Impossible!!

Now

Software dataplane becomes great performance.
We try vSwitch for our usecases.

Smart FPGA NIC for software dataplane

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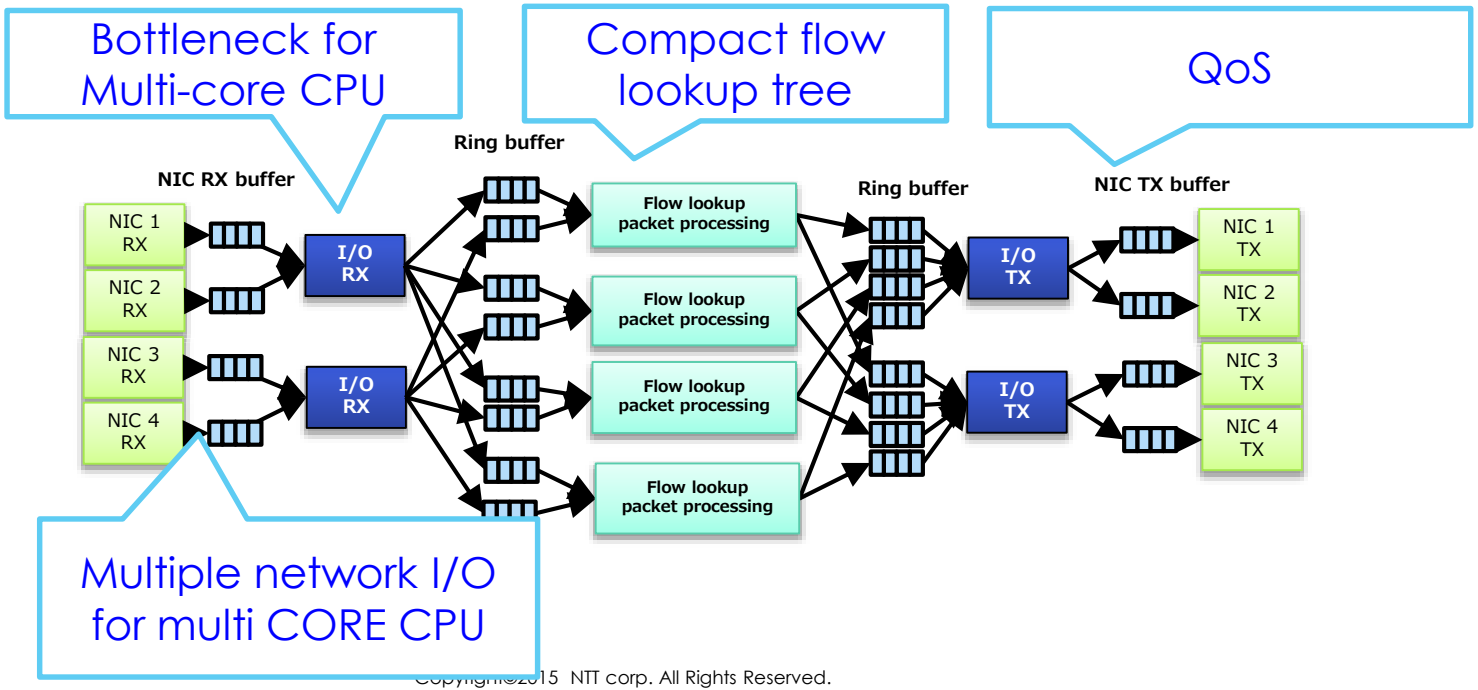
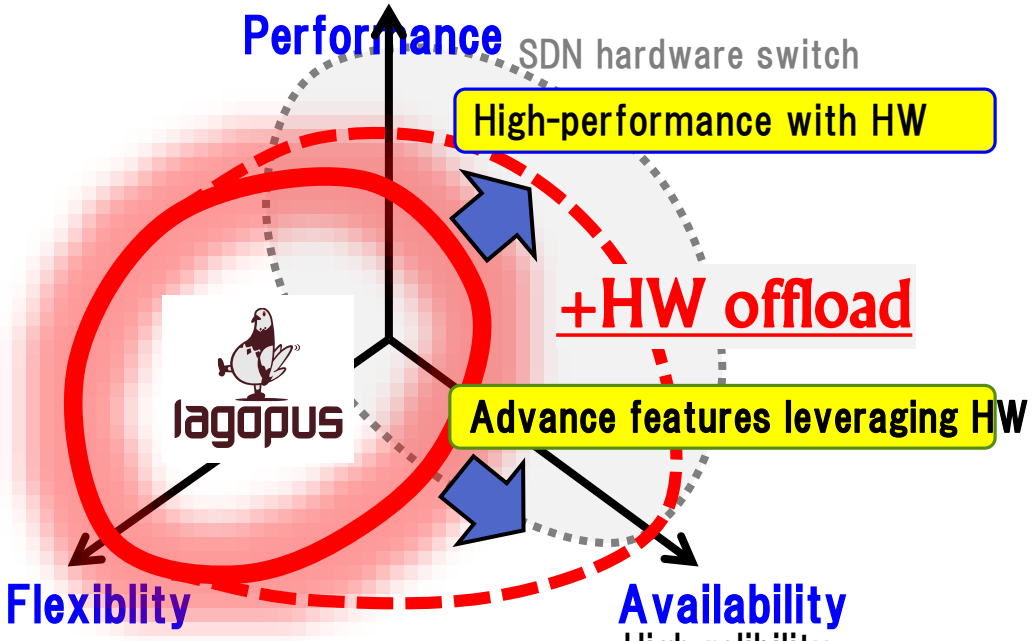
Motivation

- **Network I/O is not optimized for multi-core CPU**
  - Std NIC does not support RSS for WAN protocol
- **Software-based processing are heavy**
  - Packet classifier
  - Packet dispatcher are heavy
  - QoS and needs lots of CPU cycles

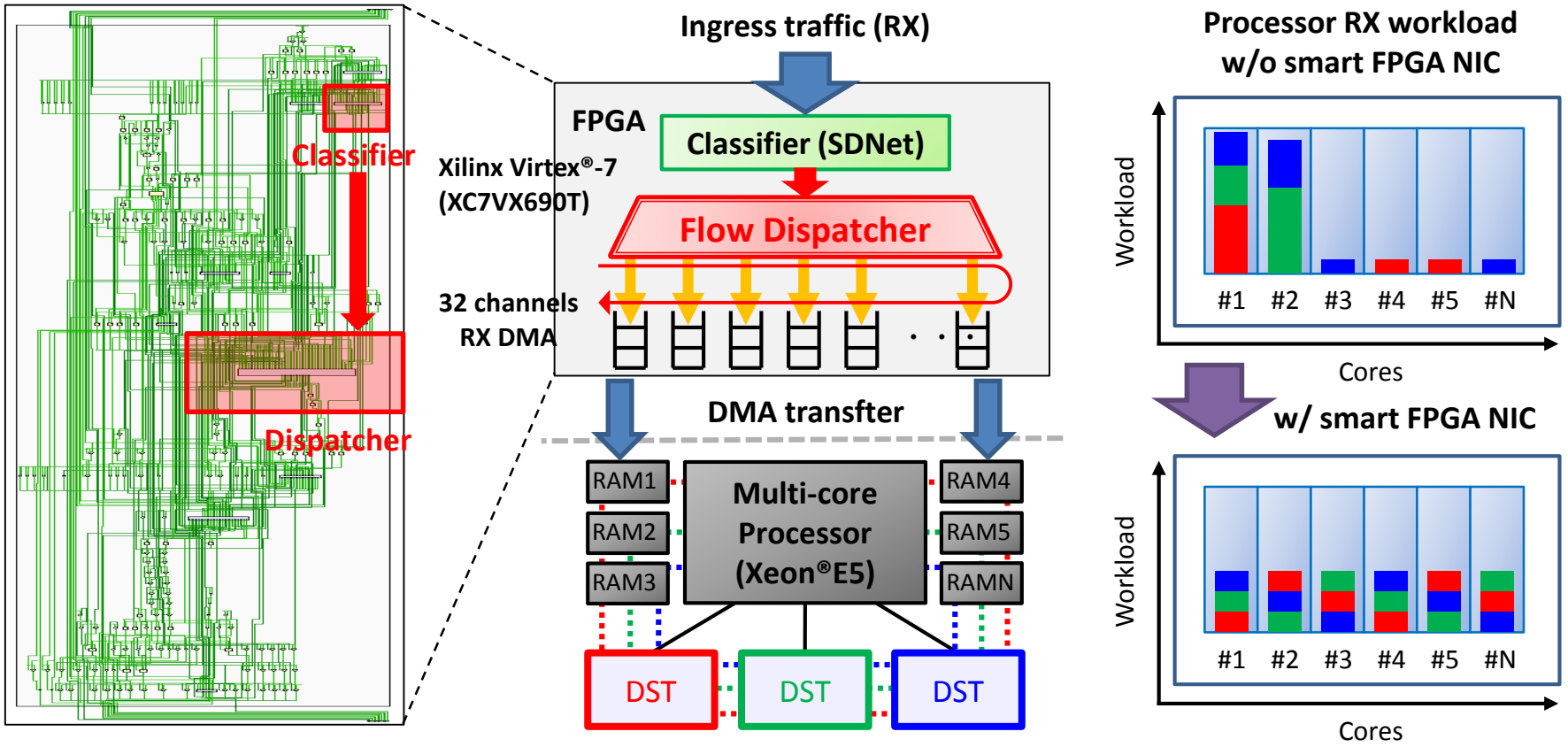


Co-design approach for performance

- **Leverage hardware offload processing of smart FPGA NIC**
  - Flexible hardware-based packet classifier & dispatcher
  - Hardware-based packet marking for post-packet-processing
- **Optimized to multi-core CPU**
  - Efficient packet processing for multi-thread



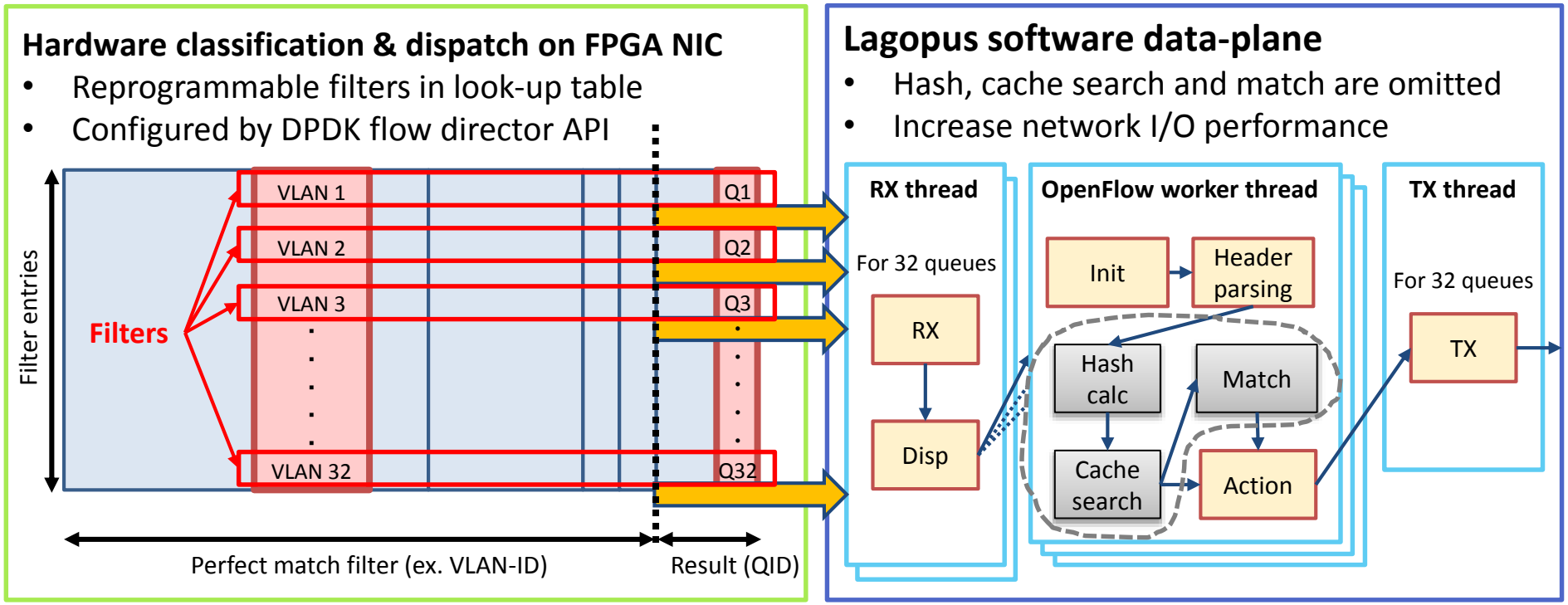
FPGA Flow Classification & Dispatch



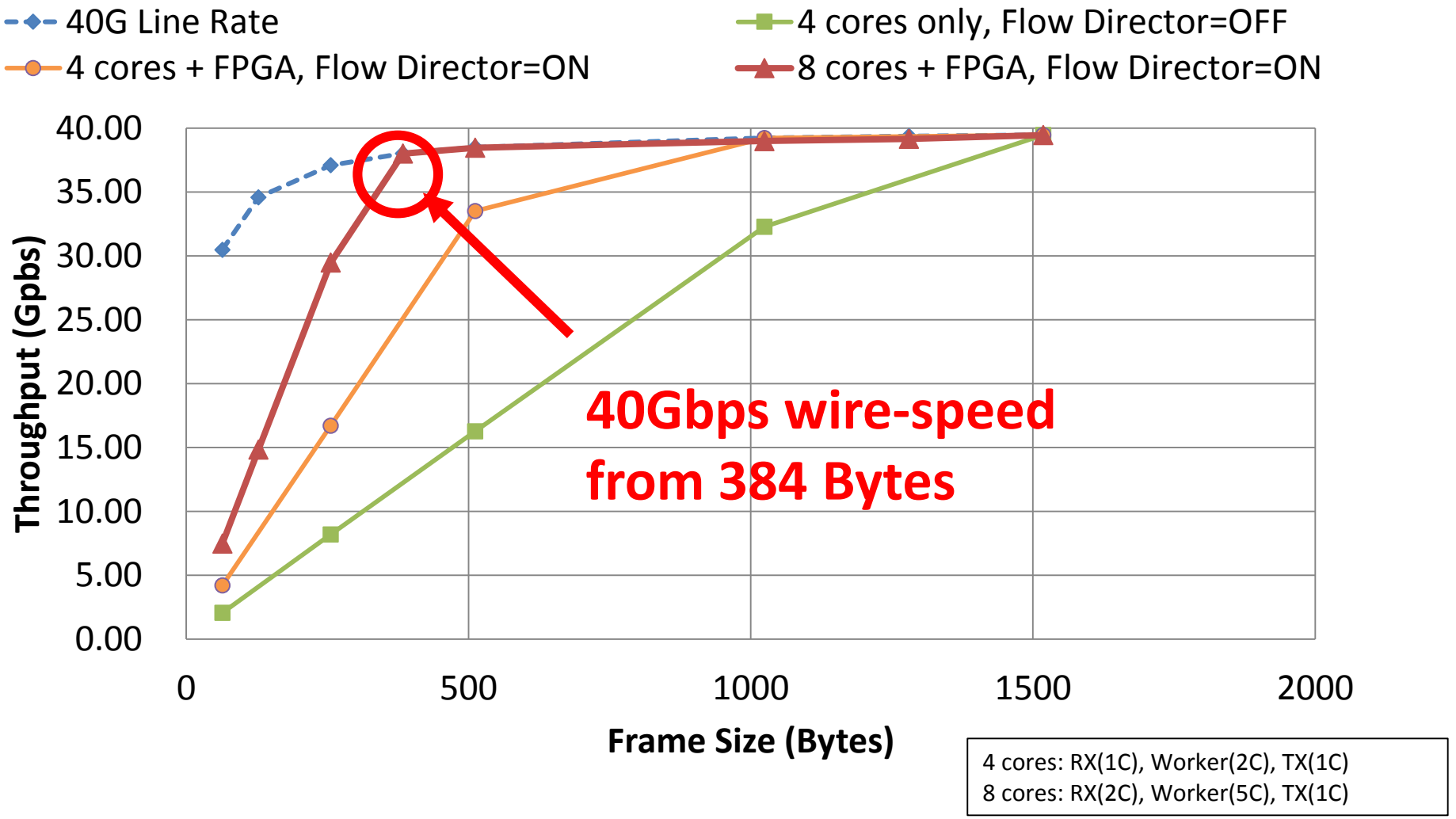
FPGA NIC and soft dataplane

Front-end hardware-based packet classification and packet dispatcher

- Reconfigurable packet filter for dynamic load balance for worker thread
- DPDK flow director API compatible



Improved performance with Smart FPGA NIC



ETH/VLAN/IPV4, 1 Flow, Intel Xeon® E5-2680 v2 (Ivy Bridge-EP)@ 2.8GHz, 10C/20T, Xilinx FPGA NIC, DPDK-1.7.1

Summery

- **Small extension of NIC give great benefit for software dataplane**
  - Performance improvement
  - Save CPU cycle for important processing
  - Save CPU cores for the same processing with standard NIC

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Fun with experience

SDN IX

Innovative R&D by NTT

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SDN IX
@ Interop Tokyo 2015 ShowNet

Interop Tokyo is
the biggest Internet-related technology show in Japan.

This trial was collaboration with NECOMA project
(NAIST & University of Tokyo)

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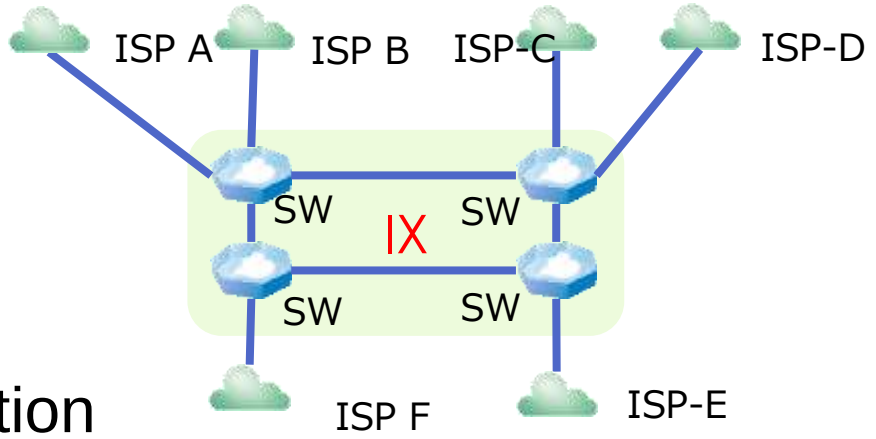
Motivation

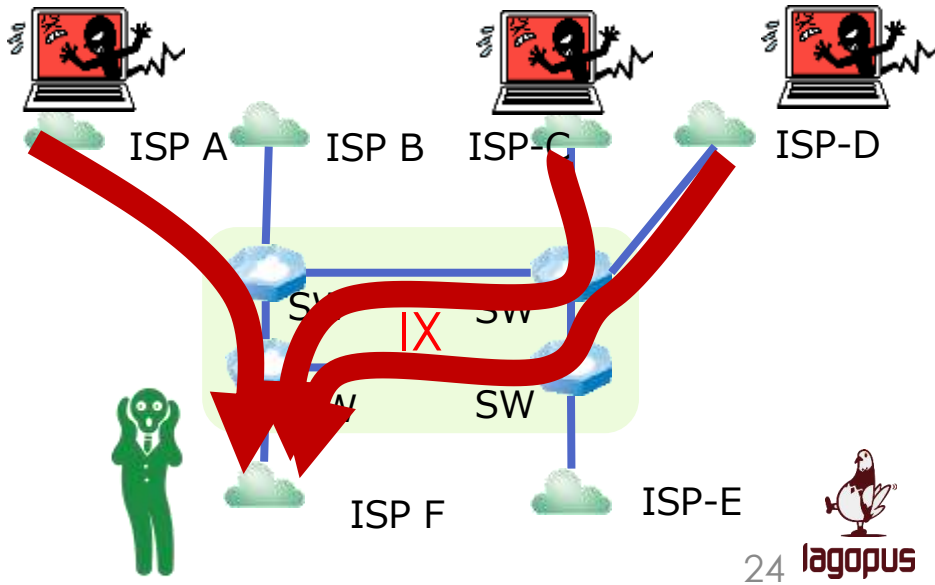
IX (Internet eXchange)

- Packet exchange point between ISP and DC-SP
- Boarder router of ISP exchanges route information



Issue

- Enhance automation in provisioning and configuration
- DDoS attack is one of the most critical issues
  - ISP wants to reduce DDoS-related traffic in origin
  - DDoS traffic occupies link bandwidth



What is SDN IX?

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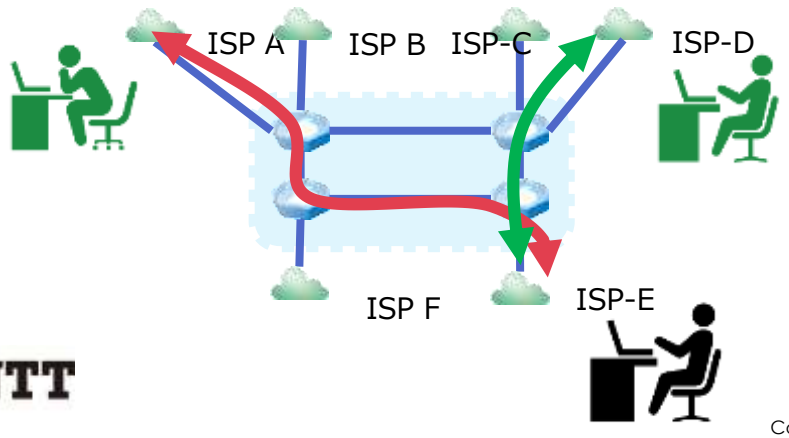
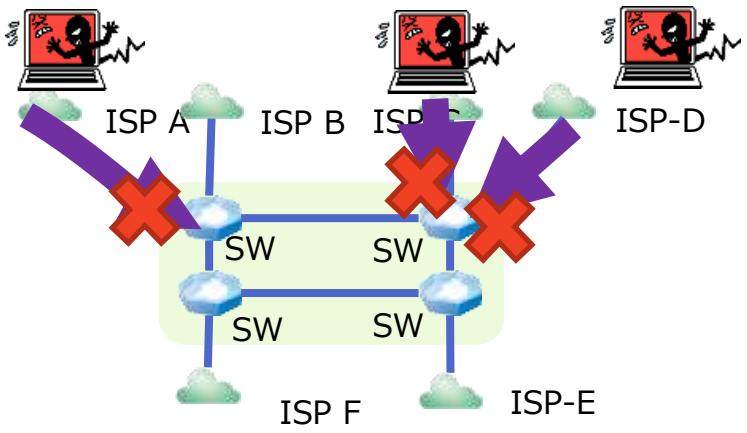
Developed by NECOMA project
(NAIST and University of Tokyo)

Next generation IX with SDN technology

- Web portal-based path provisioning between ISPs
  - Inter-AS L2 connectivity
    - VLAN-based path provisioning
    - Private peer provisioning
- Protect network from DDoS attack
  - On-demand 5-tuple-baesd packet filtering
- SDN IX controller and distributed SDN/OpenFlow IX core switch





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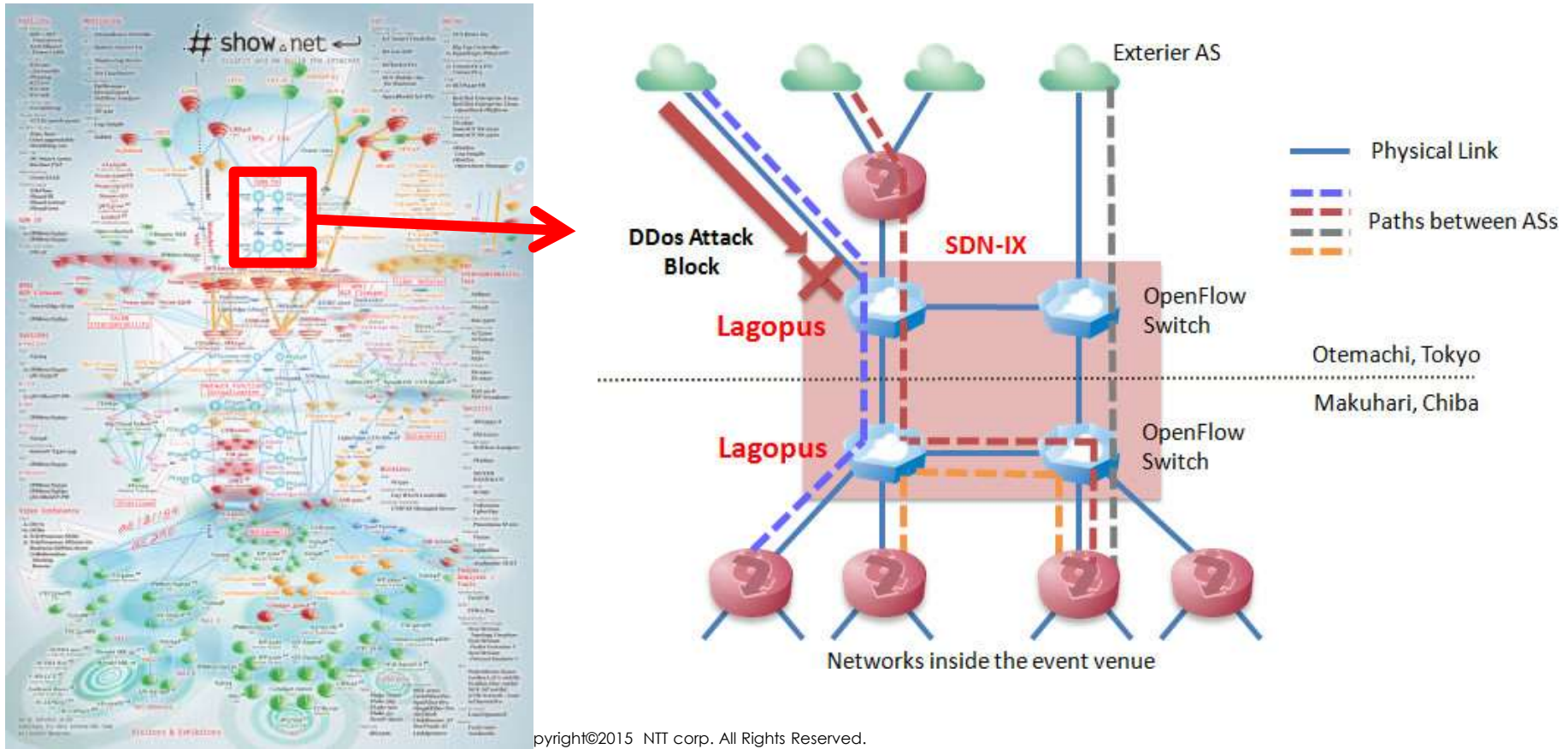
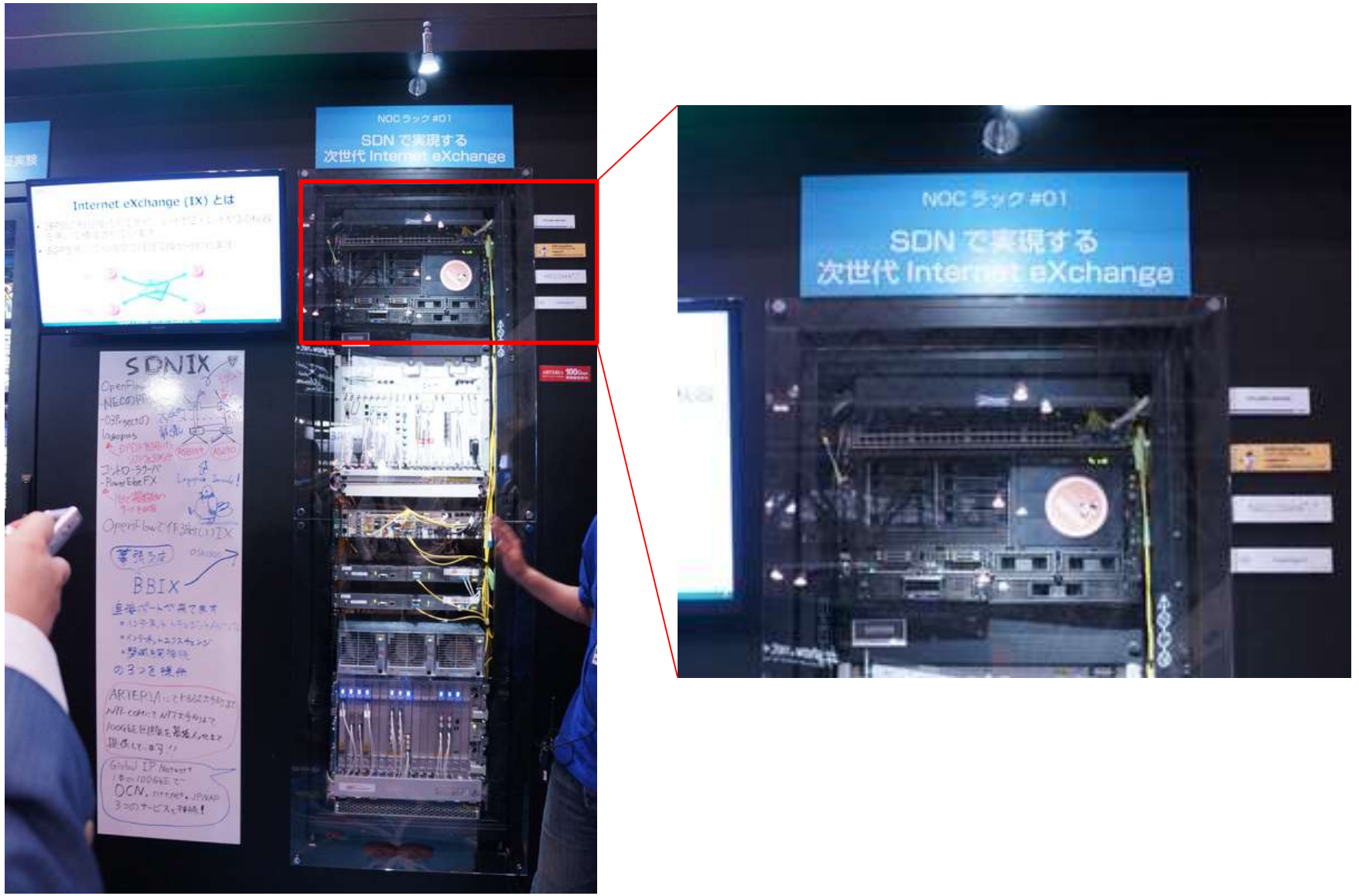
Lagopus @ ShowNet 2015

Two Lagopus (soft switch) are deployed for SDN-IX core switch

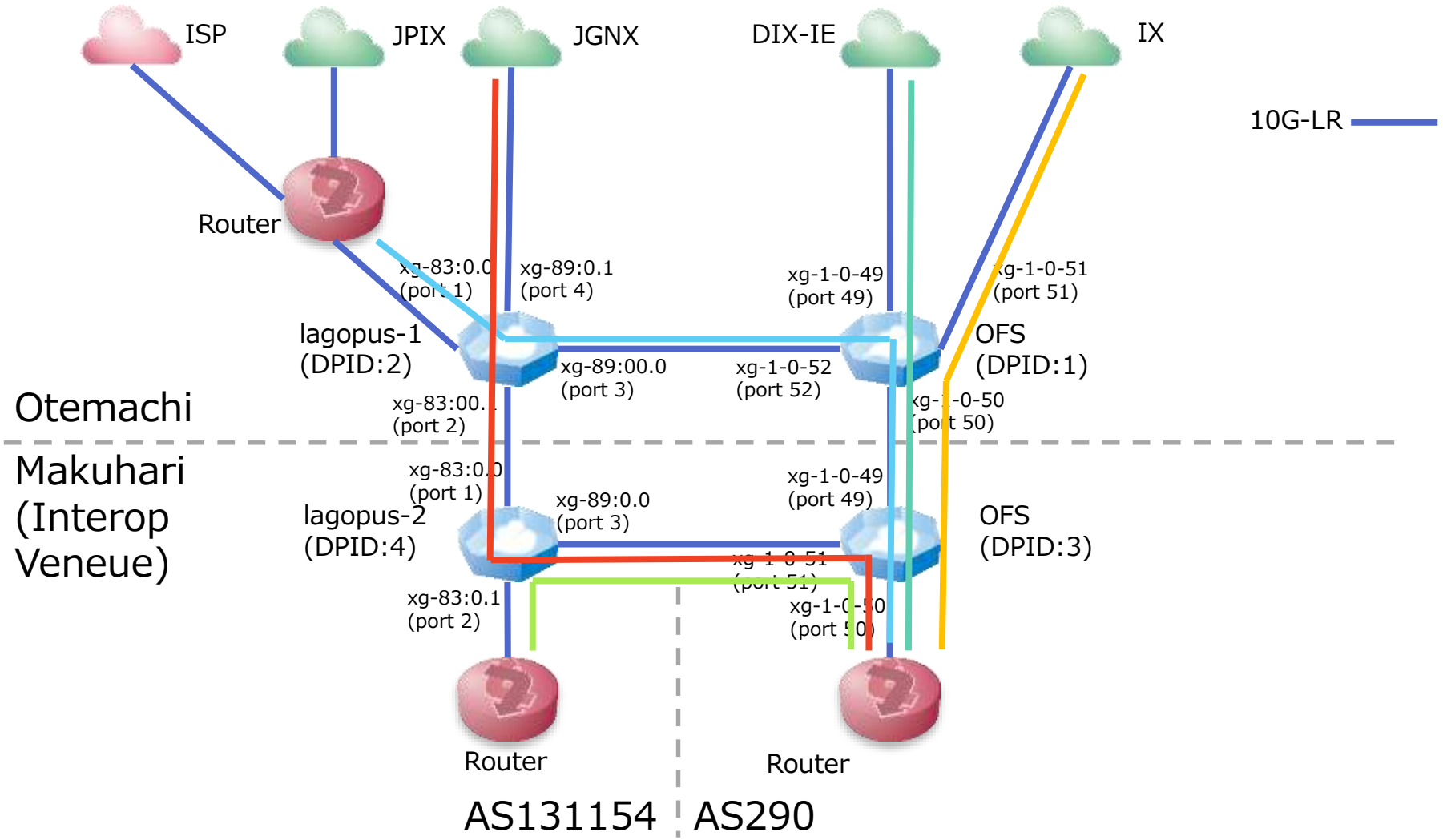
- Multiple 10Gbps links
- Dual Xeon E5 8core CPUs



Lagopus @ ShowNet rack



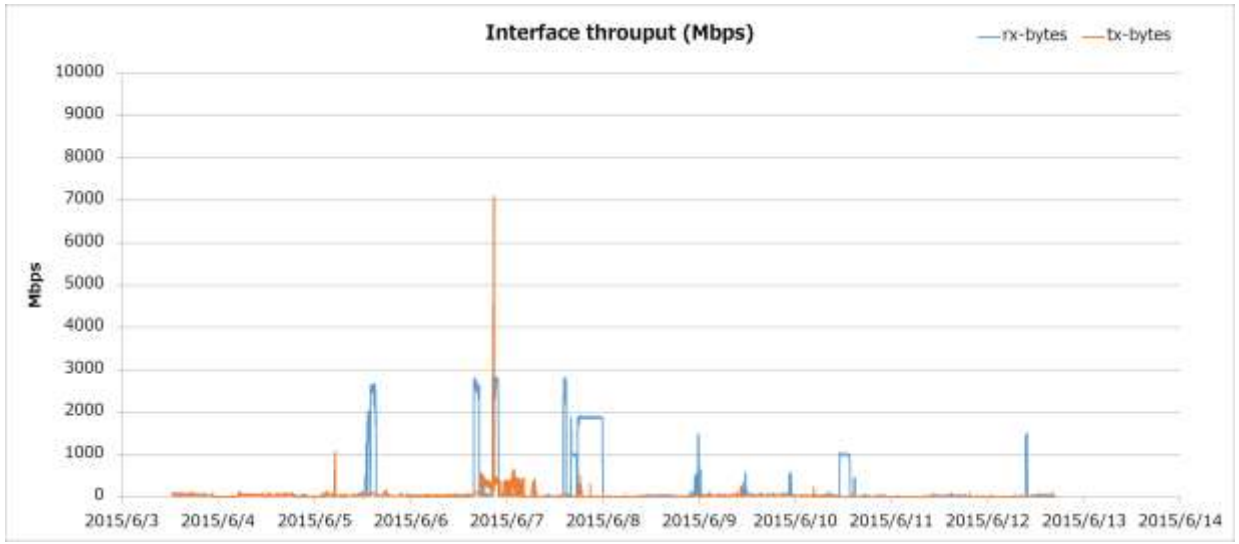
Path provisioning

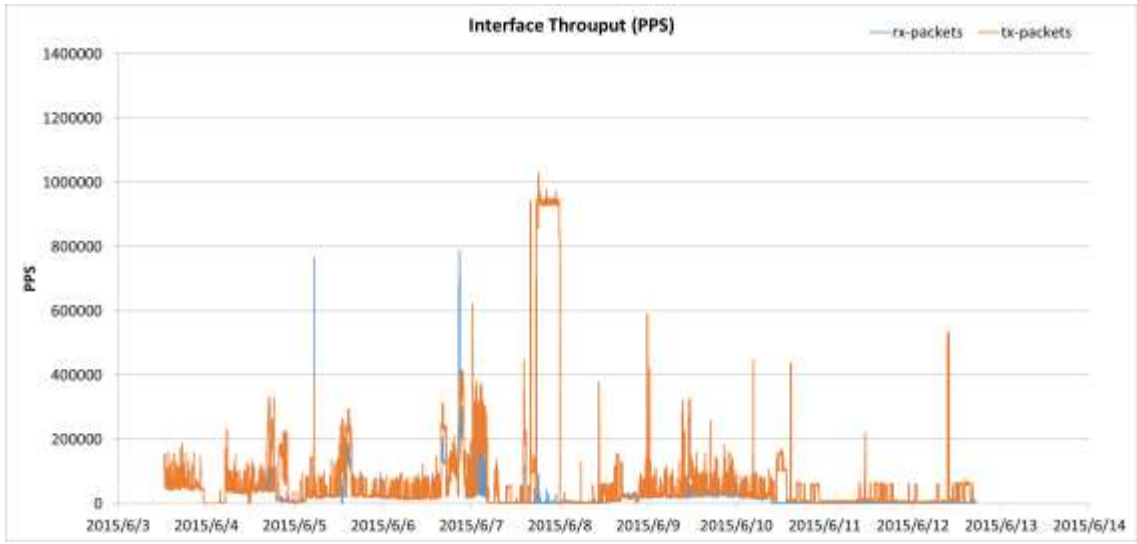


Traffic on Lagopus @Makuhari

Average 2Gbps throughput

- No packet drop
- No reboot & no trouble for 1 week during Interop Tokyo
- Sometimes 10Gbps burst traffic





Big change happened

Before

vSwitch has lots of issues on performance, scalability, stability, ...

INTEROP TOKYO | 10 – 12 JUNE, 2015

After

vSwitch works well without any trouble!

Good performance, Good stability.

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Conclusion

- **It's kind of fun to do the impossible with DPDK**
  - Enjoy hacking with DPDK for your networking!
  - Performance optimization is fun ☺
- **Lagopus project commit to high-performance vswitch development for fun ☺**
  - We still have lots of issues for fun ☺
    - Lookup optimization, performance improvement, ….
- **Changing one's mind is great fun ☺**
  - Real experience change their mind ☺

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Visit our booth #172 in IDF15SFO

Lagopus demonstration

- vSwitch performance benchmark
  - Haswell-EP and Fortville
  - Carrier usecase
- MPLS-based segment routing (source routing) and NFV integration

https://github.com/lagopus/

vSwitch, DPDK extension, and more…

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