INTEL EPA (ENHANCED PLATFORM AWARENESS) UPDATES FOR NFV

Alex, Wooram, Kim

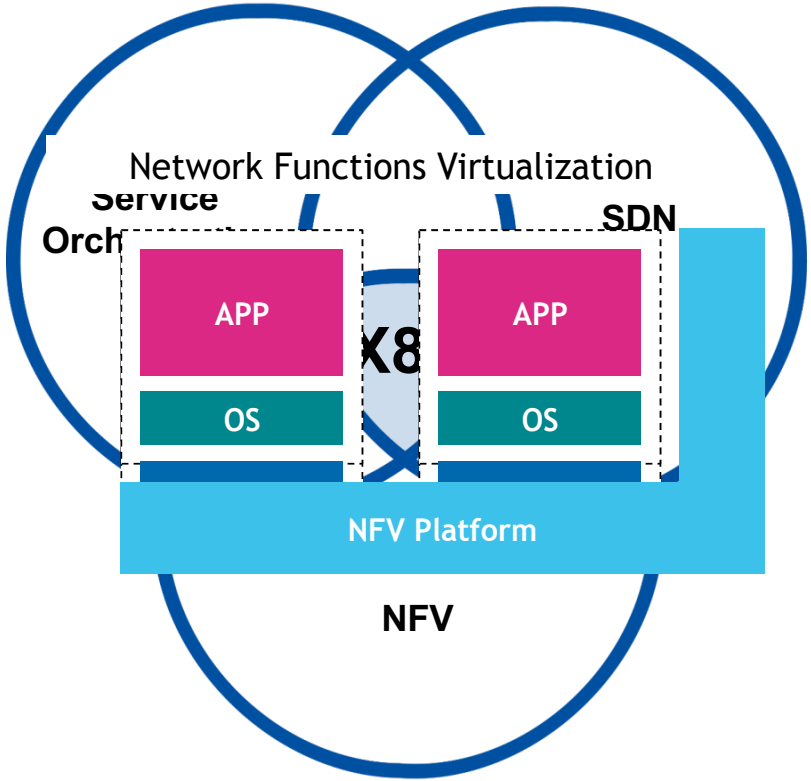
CCIE#9351/VCP5-DCV/RHCSA
Service Provider Solution Architect
alex.kim@intel.com

AGENDA

- INTEL EPA TECHNOLOGY UPDATE FOR NFV
  - INTRODUCTION OF NFV
  - WHY EPA FOR NFV?
  - EPA ROADMAP
- Q/A

Intel EPA Technology Update
: Introduction of NFV

- Initiated December 2012 from Telco/Service Provider
- Objective
  : Virtualization as part of operators network transformation with CAPEX/OPEX reductions
- NFV(Network Function Virtualization)
  : **decouples the network functions** (CPE, Router, NAT, Firewall, ADC, DPI, IPS/IDS, WAAS, SBC, BGP RR…) from ASIC, NPU appliances. to **industry standard server hardware(X86 COTS)** as Software!

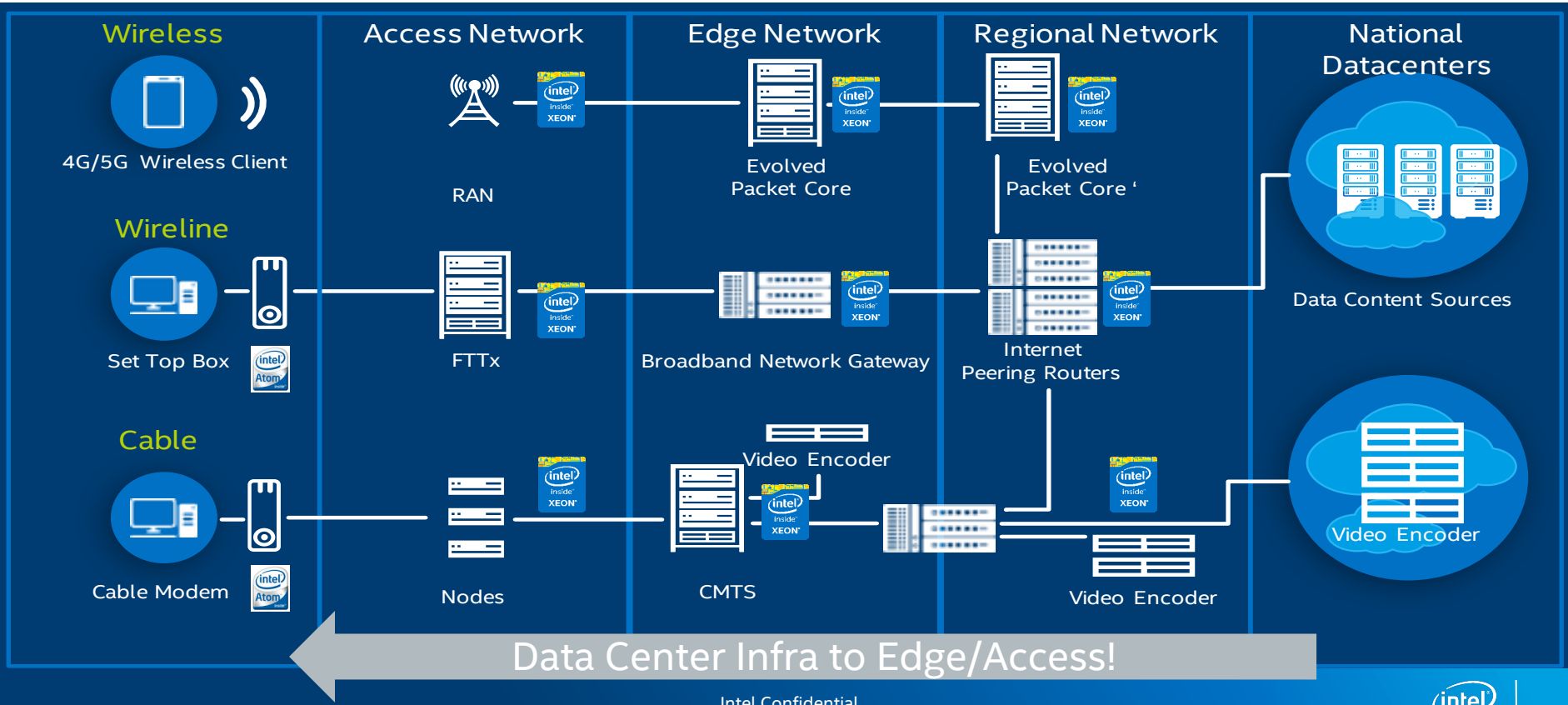


Sources:https://www.sdncentral.com/which-is-better-sdn-or-nfv/ http://portal.etsi.org/nfv/nfv_white_paper.pdf

Intel EPA Technology Update

: Introduction of NFV

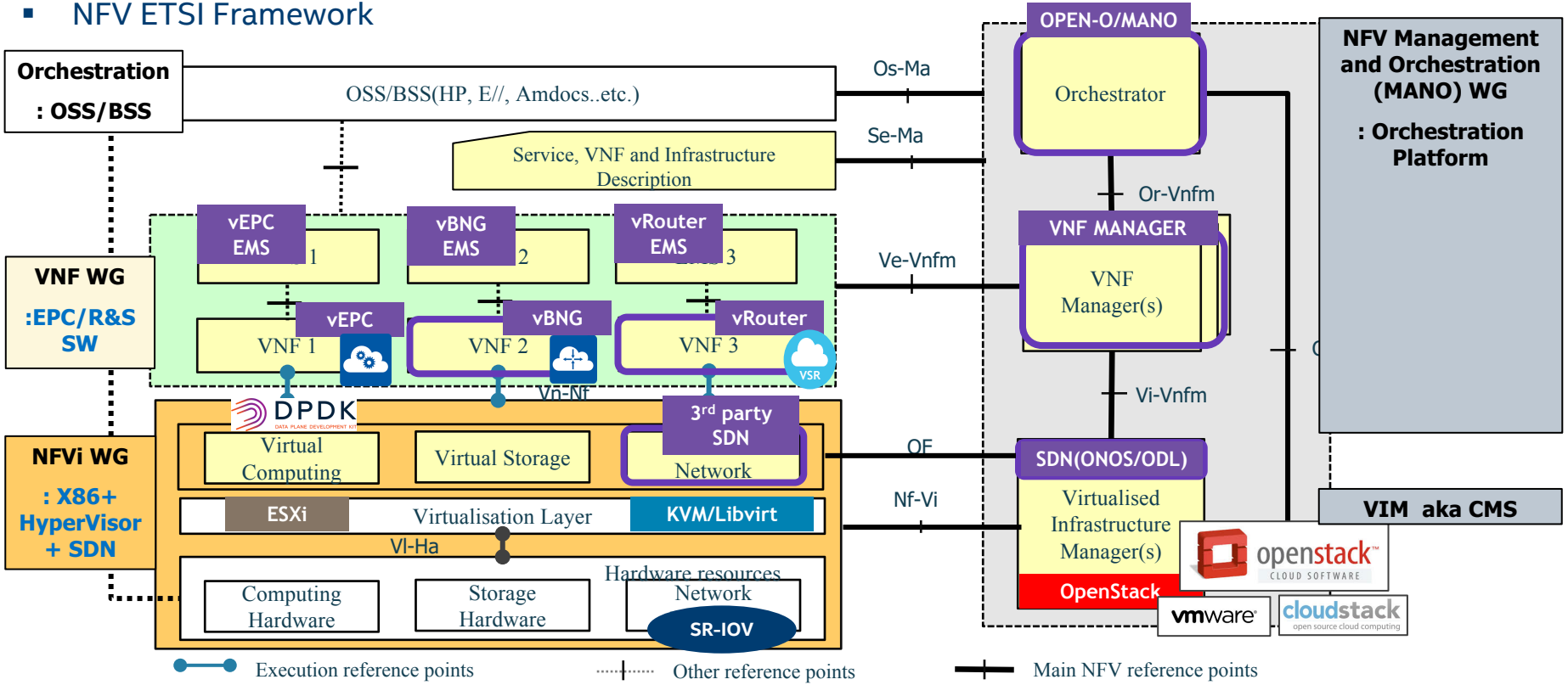
- Comparison of Wireless, Telco Broadband and MSO Network Architecture



Intel EPA Technology Update
: Introduction of NFV

ETSI NFV Proof of Concept

- NFV ETSI Framework



intel

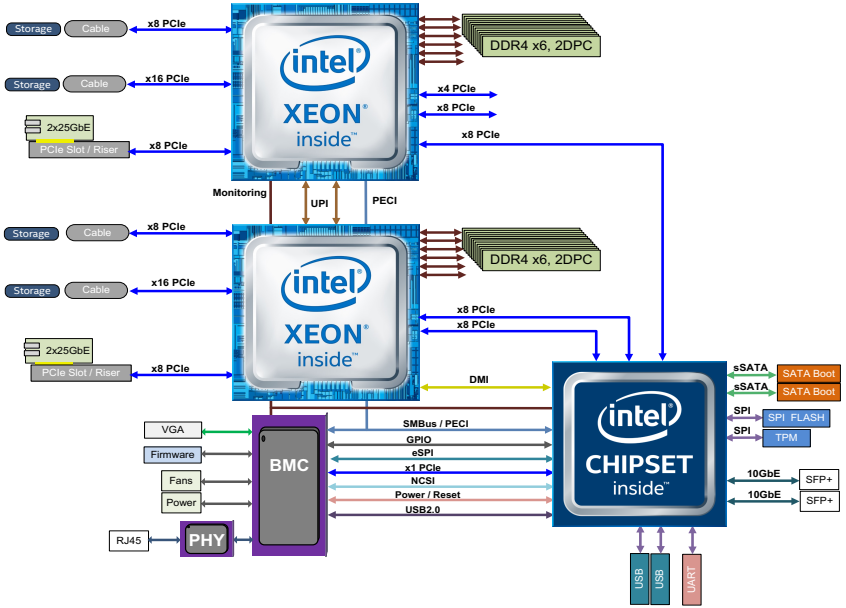
Intel EPA Technology Update
: Why EPA for NFV?

- **Requirements on NFV infrastructure, not IT**
  : deterministic behavior with High performance
  : small packet processing
  : low latency (<10µs for CPE and access functions), jitter
  : availability (detect failed VMs in <1s and autorestart, recover host failures)
  : advanced management (OSS/BSS)

- **Major Bottleneck in NFV**
  : CPU Interrupt,
  : Context switching overhead!
  : Memory copies !

- **Resolution for NFV**

DPDK
DATA PLANE DEVELOPMENT KIT



But, How to Discover, Provision and Assign right workload placement in Telco Cloud Environment?

Intel EPA Technology Update
: Why EPA for NFV?

openstack.

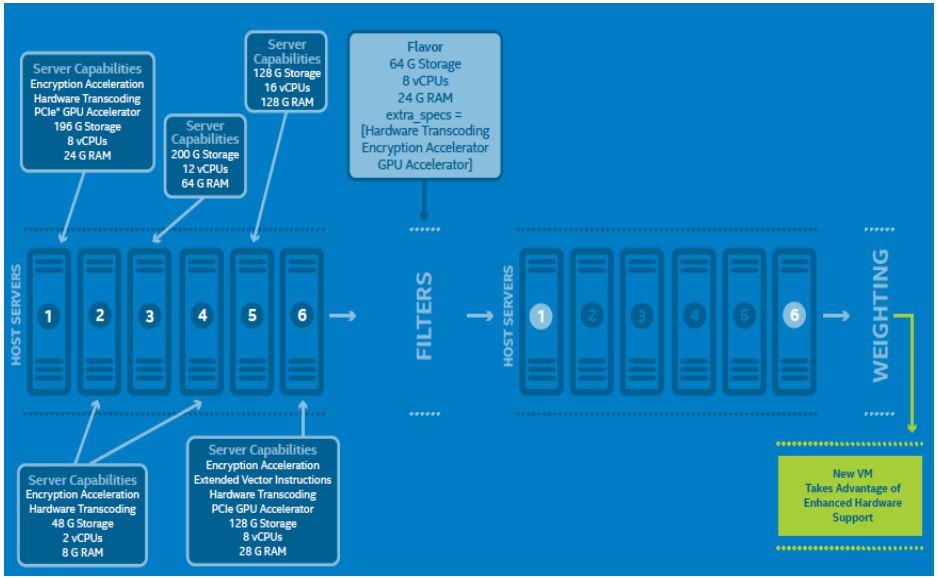
- **Openstack EPA**

- Umbrella term for Intel's contributions to OpenStack

- Exposes platform capabilities to OpenStack
  : better view of underlying platform capabilities

- OpenStack intelligence to filter platforms with specific capabilities
  : match VM workload with platform capabilities
  : finer grained view of the server platform
  assign the cloud application workload to the best virtual resource

- **EPA focus areas:**
  : Detecting NFVi platform(COTS) capabilities
  : Configuring NFVi platform(COTS) capabilities



EPA provide design advantages in Discovery, Provisioning for High Performance, Management!

Intel EPA Technology Update
: Why EPA for NFV?

openstack.

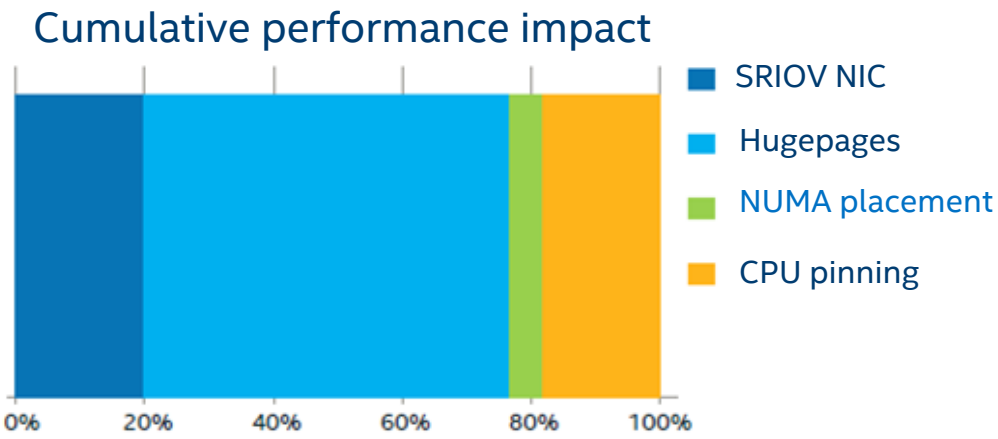
- EPA Characterizations

  - L3 forwarding Benchmark on Each Feature

  - SR-IOV NIC
  - Huge Pages
  - NUMA placement
  - CPU pinning

  - Test Condition

  - DPDK based virtual BNG(BRAS) with OpenStack
  - 2 * Intel® Xeon® processor E5-2690 v2 @ 3.0 GHz
  - L3 forwarding, 64B
  - Max throughput with no packet loss
    (Non-Drop Rate)

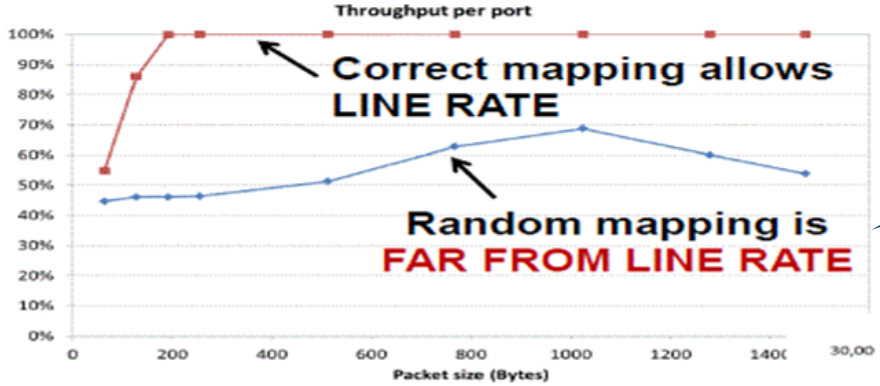


Source: Intel white paper QoS in BRAS with Linux* and IA, August 2014

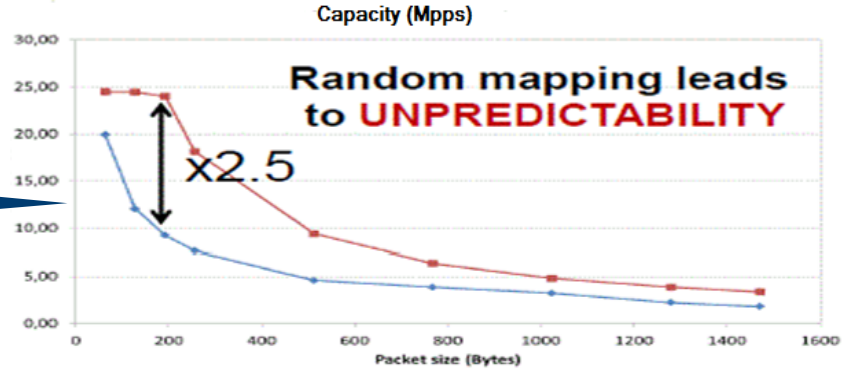
Mandatory Key Features is Hugepages, NUMA, CPU Pinning for packet processing!

Intel EPA Technology Update
: Why EPA for NFV?

- Brocade 5600 vRouter EPA Characterizations – Throughput/port & System Cpacity (Packet per Sec.)



UP to 50% TP degradation!



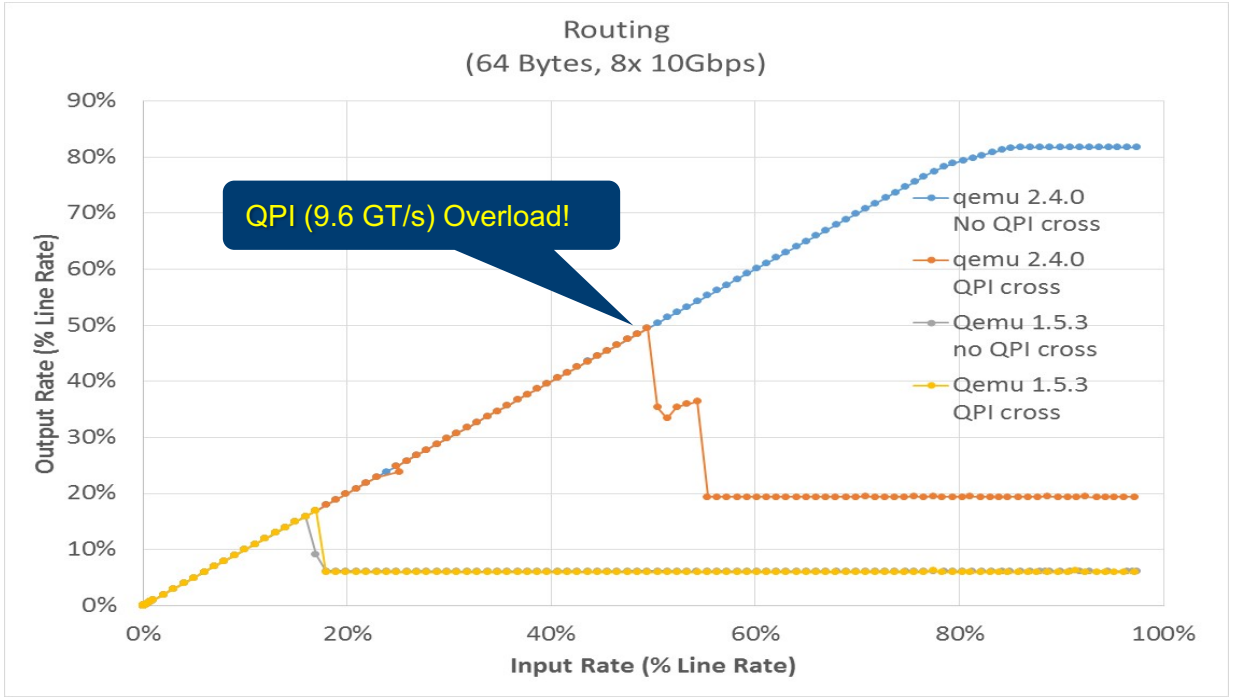
250% System capacity degradation!

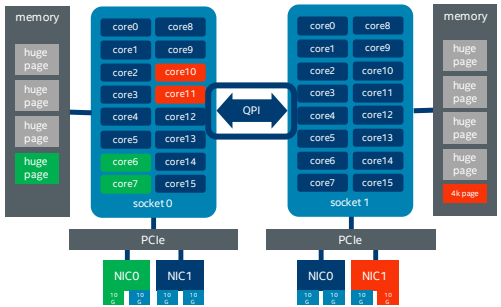
Poor Design is Leads to Poor Performance under Multi Tenancy Environment.!

Intel EPA Technology Update
: Why EPA for NFV?

openstack.

- Brocade 5600 vRouter EPA Characterizations - Quick Path Interconnect (QPI), CPU to CPU connection

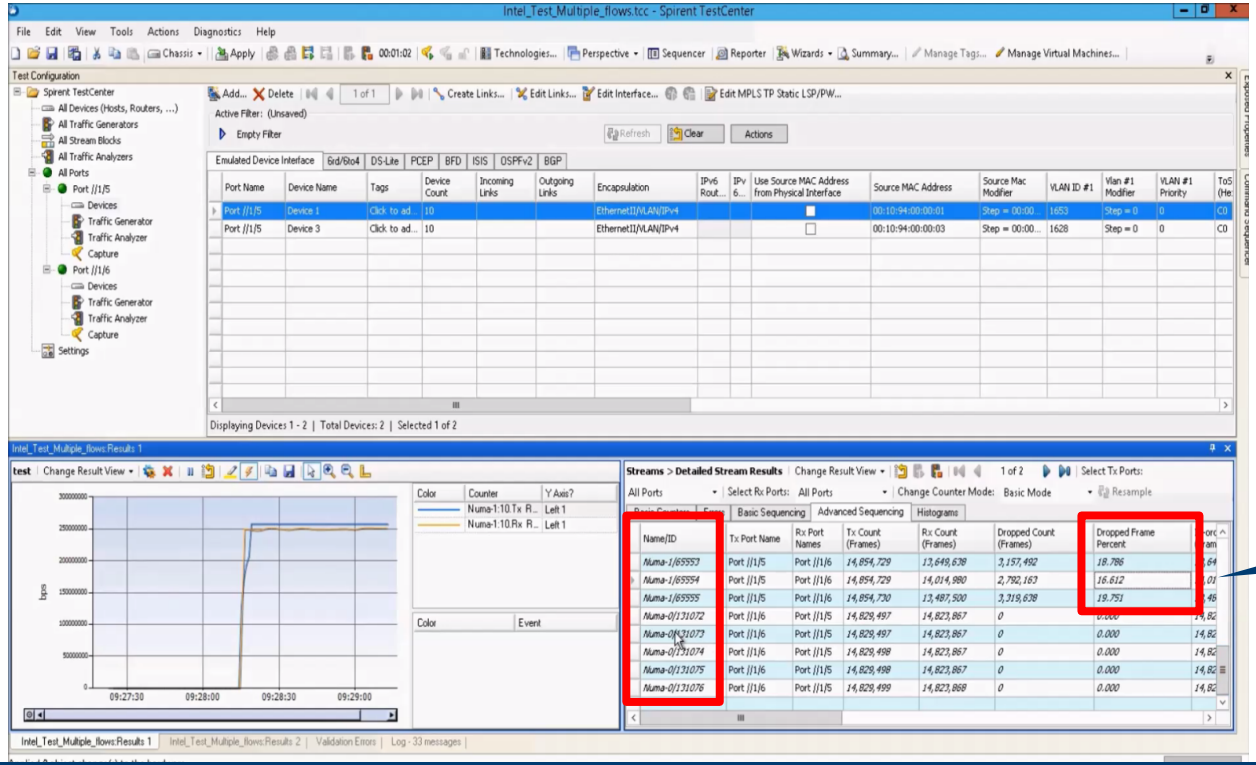


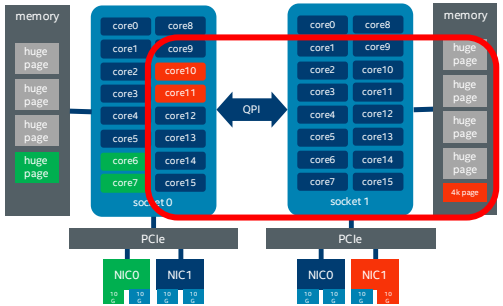


Crossing QPI causes problematic overload behavior!

Intel EPA Technology Update
: Why EPA for NFV?

- Brocade 5600 vRouter EPA Characterizations - NUMA(Non Uniform Memory Access)





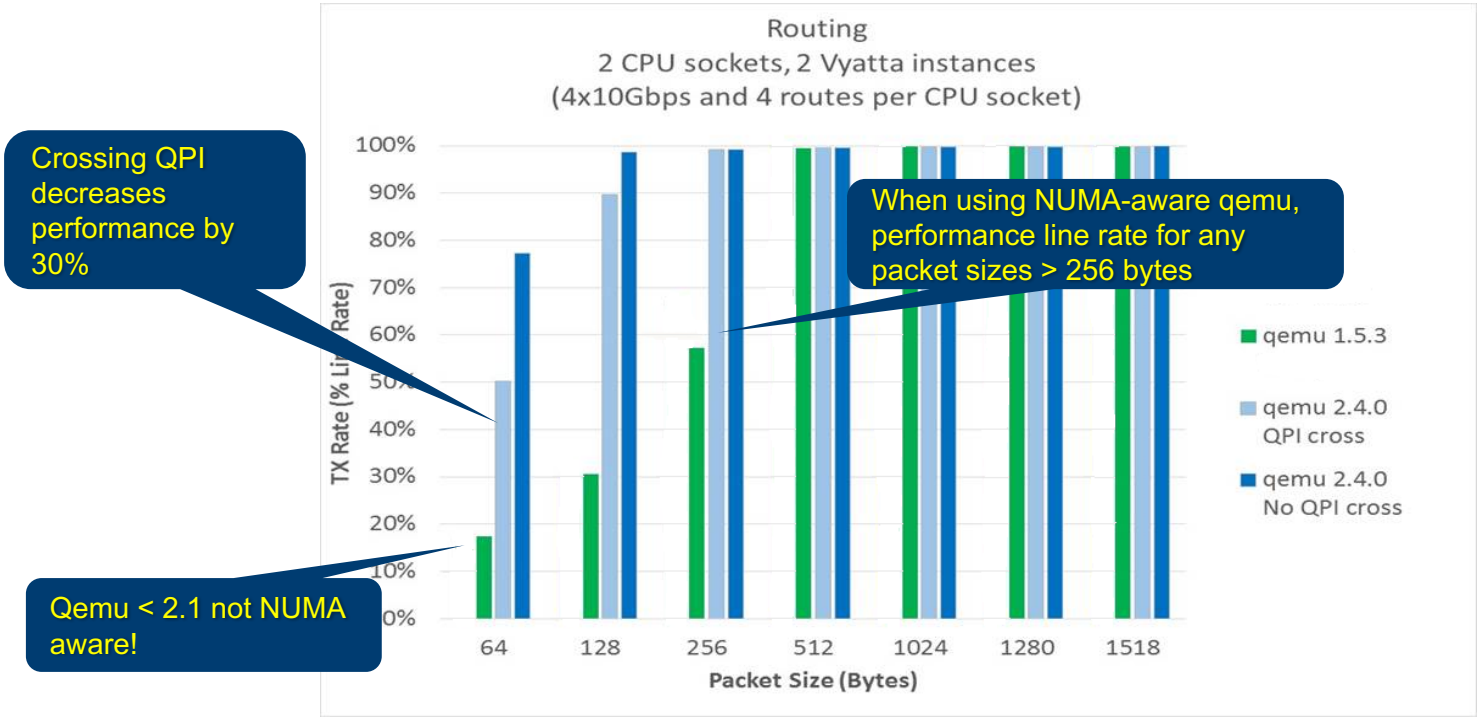
NUMA Misconfigurations!

NUMA unaware VNF causes problematic packet drop behavior!

Intel EPA Technology Update
: Why EPA for NFV?

openstack.

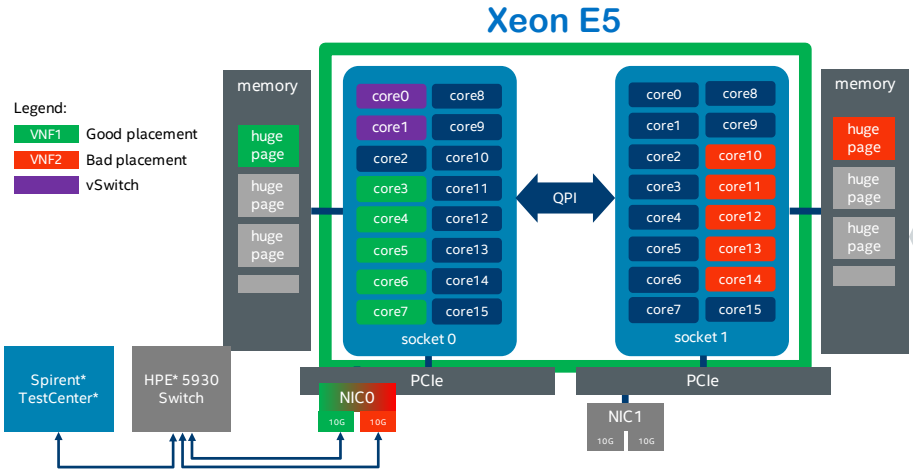
- Brocade 5600 vRouter EPA Characterizations - NUMA(Non Uniform Memory Access)



Best Known Configuration/Reference architecture is Essential!

Intel EPA Technology Update
: Why EPA for NFV?

- Best Known EPA Configuration



CONFIGURATION GUIDE

intel

Enabling Enhanced Platform Awareness for Superior Packet Processing in OpenStack*

Intel Corporation
Datacenter Network Solutions Group

Authors

Shivapriya Hiremath
Solution Software Engineer, Intel Corporation

Vaidyanathan Krishnamoorthy
Solution Software Engineer, Intel Corporation

Andrew Duignan
Solution Software Engineer, Intel Corporation

James Chapman
Solution Software Engineer, Intel Corporation

1.0 Introduction

Network functions virtualization (NFV) emerged in response to the problems that network operators face when developing and maintaining their infrastructures built with traditional hardware appliances. The growing demands for new services, constantly increasing network traffic, and the need for rapid service delivery are just some of the challenges that industry cannot overcome with the traditional network architectures. Moreover, the technological advancements cause the hardware life cycle to shorten. This leads to long-lasting procure-design-deploy cycles that require unique human skills.

NFV is a network architecture concept designed by a group of telecommunications industry representatives of the European Telecommunications Standards Institute (ETSI). NFV primarily aims to leverage the existing technologies to virtualize entire classes of network nodes that in turn may be connected to form compound infrastructures. Designed with modularity, reliability, and scalability in mind, such infrastructures are capable of running complex services.

The architecture of NFV consists of three blocks: virtualized network functions (VNFs), NFV infrastructure (NFVI), and NFV management and orchestration (MANO). One of the MANO components of the ETSI NFV model, virtualized infrastructure manager (VIM), is responsible for managing and orchestrating the NFVI.

https://builders.intel.com/docs/networkbuilders/EPA_Enablement_Guide_V2.pdf

Knowing Server architecture and Assigning Right Resources to VNF!

Intel EPA Technology Update
: EPA in MAN-O

openstack.

- TOSCA EPA Example - vRouter

```
interfaces:
        Standard:
          configure: scripts/vdu/data_configure.sh # included in the CSAR
      requirements:
        - dependency:
            node: data_host
            relationship:
              type: vnfsdk.VirtualHostedOn
              properties:
                performance_hints:
                  cpu_affinity:
                    value: 'true'
                  container:
                    value: 'false'
                    priority: 1.0 # hints that it's absolutely required
capabilities:
        nfv_compute:
                        # This is the "standard" way to define performance
                        optimization in the # NFV profile
          properties:
            mem_page_size: large
            cpu_allocation:
              core_count: 4
            numa_node_count: 2
            numa_nodes:
              primary:
                id: 0
                mem_size: 16 GB
                vcpus:
                  a: 2
                  b: 3
              secondary:
                id: 1
                mem_size: 2 GB
```

- YANG EPA Example - Open Source MANO VNFD

```
732       leaf mempage-size {
733         description
734             "Memory page allocation size. If a VM requires
735              hugepages, it should choose LARGE or SIZE_2MB
736              or SIZE_1GB. If the VM prefers hugepages it
737              should choose PREFER_LARGE.
738              LARGE        : Require hugepages (either 2MB or 1GB)
739              SMALL        : Doesn't require hugepages
740              SIZE_2MB     : Requires 2MB hugepages
741              SIZE_1GB     : Requires 1GB hugepages
742              PREFER_LARGE : Application prefers hugepages";
743         type enumeration {
744           enum LARGE;
745           enum SMALL;
746           enum SIZE_2MB;
747           enum SIZE_1GB;
748           enum PREFER_LARGE;
749         }
750       }
752       leaf cpu-pinning-policy {
753         description
754             "CPU pinning policy describes association
755              between virtual CPUs in guest and the
756              physical CPUs in the host.
757              DEDICATED : Virtual CPUs are pinned to
758                          physical CPUs
759              SHARED    : Multiple VMs may share the
760                          same physical CPUs.
761              ANY       : Any policy is acceptable for the VM";
762         type enumeration {
763           enum DEDICATED;
764           enum SHARED;
765           enum ANY;
766         }
767         default "ANY";
768       }
769
```

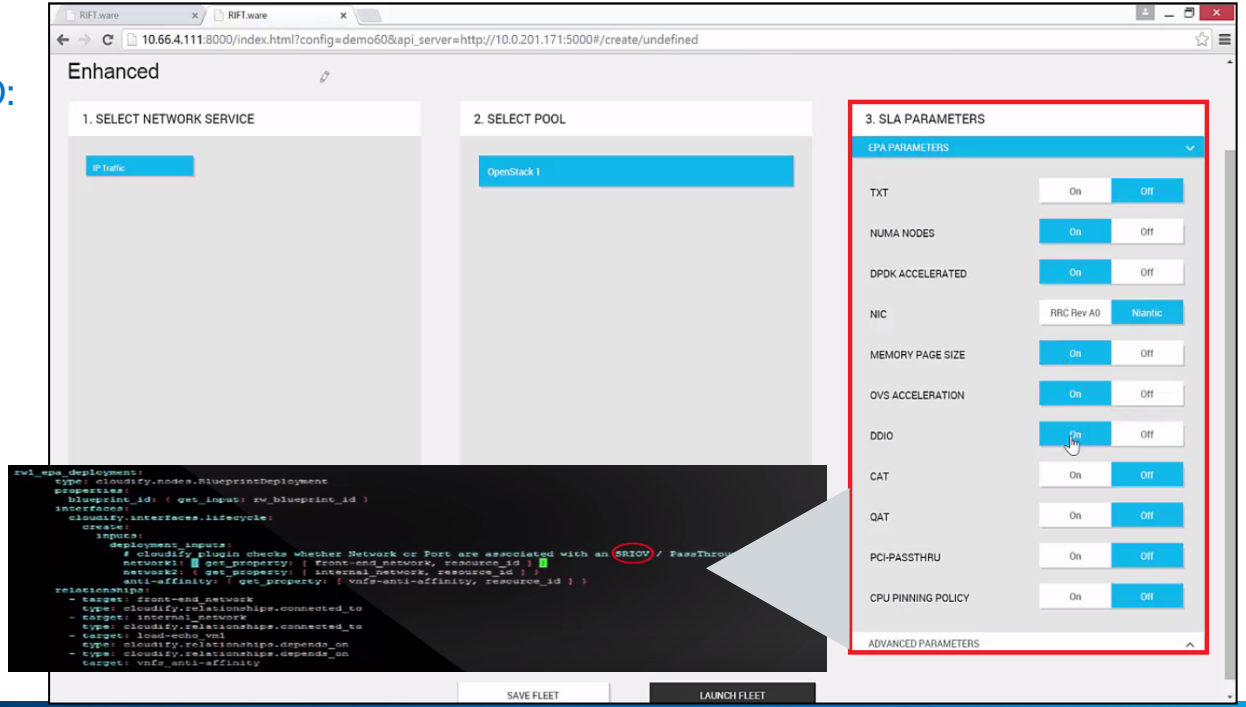

intel

Intel EPA Technology Update
: EPA in MANO

- EPA at NFV-Orchestrator

- EPA enabled open source NFV-O:

- Rift.io* Rift.ware*
- GigaSpaces* Cloudify*
  - http://getcloudify.org/



Intel EPA Technology Update
: Why EPA for NFV?

- EPA supported Openstack and NFV Orchestrator

Intel EPA Technology Update

: EPA Roadmap

- EPA Feature

Feature	Software Dependencies
Host CPU feature request	Havana
PCI passthrough & SR-IOV Support	Havana
NUMA awareness and placement	Juno
Hugepage support	Kilo
CPU pinning	Kilo
Security Groups for OVS+DPDK (Stateless)	Mitaka
Telemetry Capture (via collectd)	Mitaka
OVS+DPDK (Merged with OVS agent)	Mitaka
OVS+DPDK controlled by ODL	Mitaka
OVF Meta-Data Import	Mitaka
Power management	Newton
Resource Director Technology	Newton

Intel EPA Technology Update
: EPA Roadmap

- Next EPA Feature

- Resource Director Technology
: Assigned cache and memory bandwidth for better packet processing performance!

Feature	Software Dependencies	Silicon Dependencies
RDT: Cache Monitoring Technology (CMT)	OpenStack Newton, Linux 4.4	Haswell Server
RDT: Cache Allocation Technology (CAT)	OpenStack Ocata, Linux 4.8 (likely), TBD	Haswell Server
RDT: Code and Data Prioritization (CDP)	OpenStack Ocata, Linux 4.8 (Likely)	Haswell Server
RDT: Memory Bandwidth Monitoring (MBM)	OpenStack Ocata, Linux 4.6, Libvirt 1.3.5 (likely)	Broadwell Server
RDT: Memory Bandwidth Allocation (MBA)	**OpenStack "P" Release, Linux TBD, Libvirt TBD**	**Skylake Server**

RDT help to greatly reduce the network latencies and maintain the throughput in OVS-DPDK!

Intel EPA Technology Update
: Additional Resources

https://builders.intel.com/university/networkbuilders/coursescategory/openstack-1#openstack-enhanced-platform-awareness-101

https://builders.intel.com/university/networkbuilders/coursescategory/openstack-1#openstack-enhanced-platform-awareness-102

Please visit:

OSM: https://osm.etsi.org

OSM YouTube Channel: https://www.youtube.com/channel/UC5yIvBvph7Eg8deWTPzKOjg

ONAP: https://www.onap.org/