INTRODUCTION TO vCPE USE CASES AND OPPORTUNITIES

APF-DES-T2464

GARY CHU
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SECURE CONNECTIONS FOR A SMARTER WORLD

Agenda

- NFV – Key Technology and Adoption Trends
- NXP Differentiation for NFV
- NFV Solution offering from NXP

Key message

- Network Function Virtualization will be deployed throughout the network
  - At the Server, Data-center Cloud
  - At the Intelligent Network Edge and Appliance

- Both will share a common ecosystem
  - Common compute, IO and network virtualization mechanisms, APIs
  - Common orchestration and management mechanisms
  - Share provisioning and installation mechanisms

- Both will be optimized as per needs
  - Compute optimization
  - Networking and acceleration optimization
  - Storage optimization

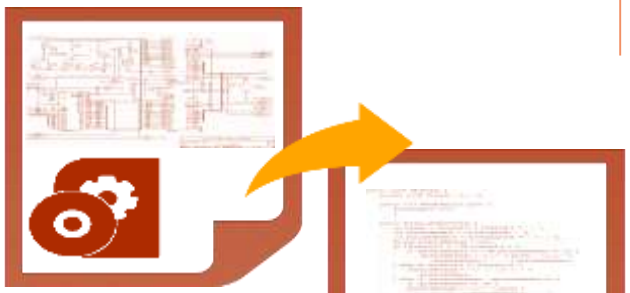
NFV – KEY TECHNOLOGY AND ADOPTION TRENDS

Network market shifting to virtualization (SDN/NFV)

NFV Promises Three Benefits to Operators

Service Velocity

1

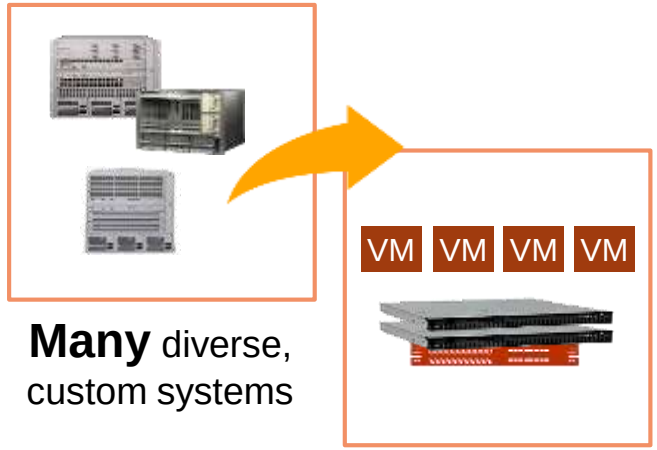


Designing custom **hardware & software**

Writing **code** you can run and test in a VM

Capex and Opex Reduction

2

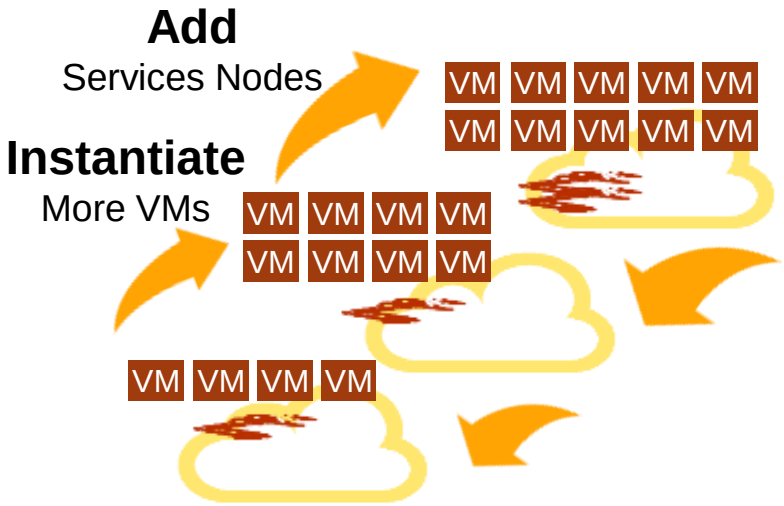


Many diverse, custom systems

Fewer, homogenous COTS systems

Scalability & Elasticity

3

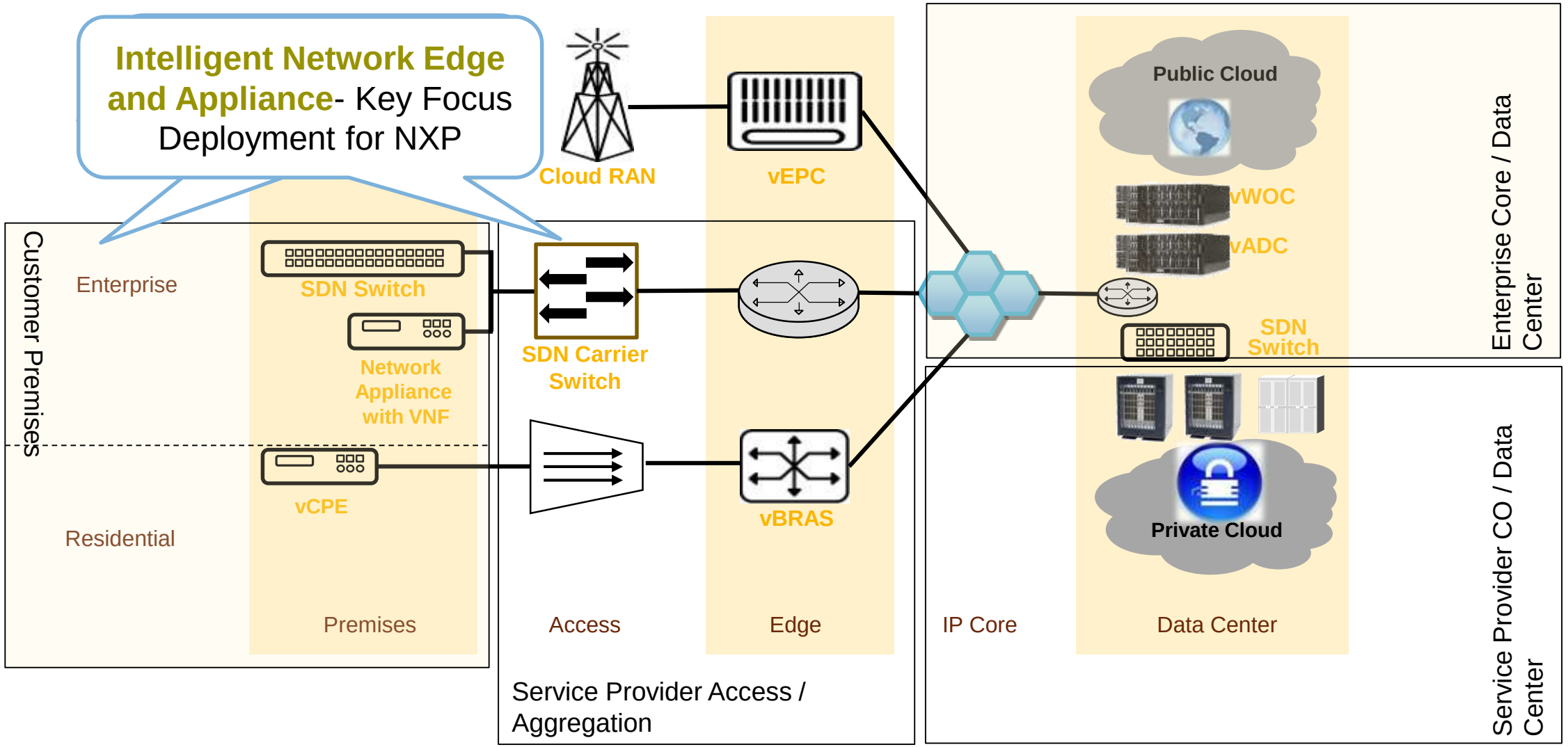


Add Services Nodes

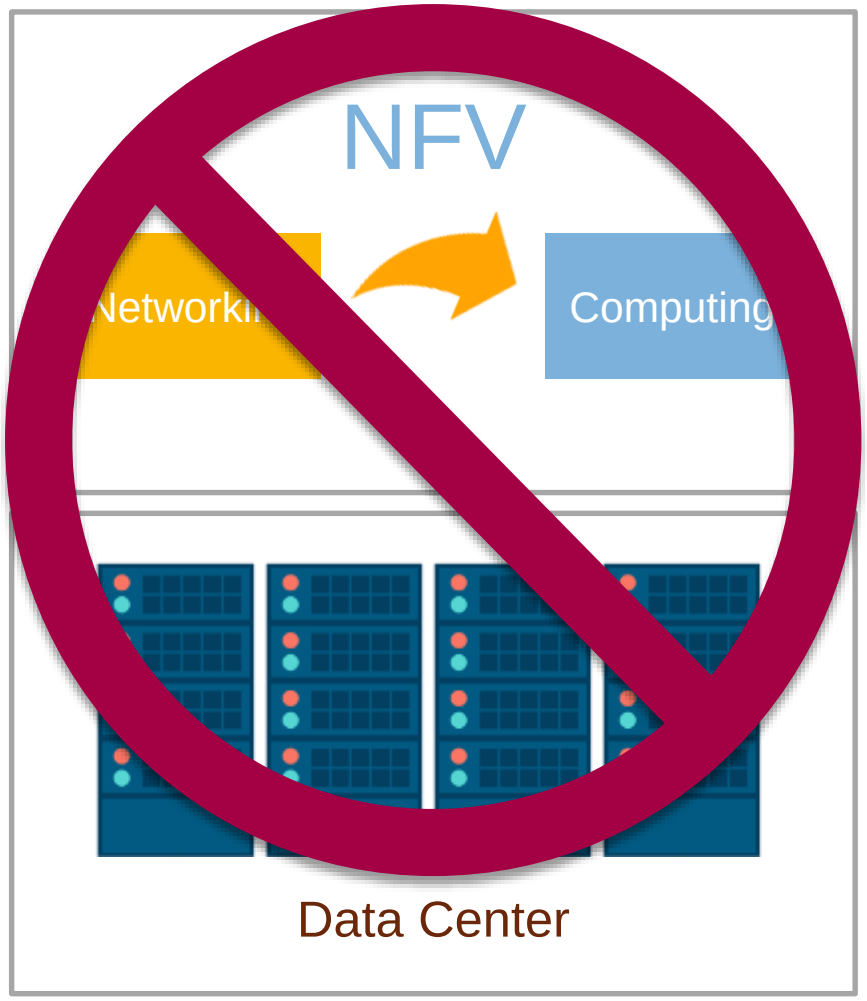
Instantiate More VMs

Scale Back with Demand

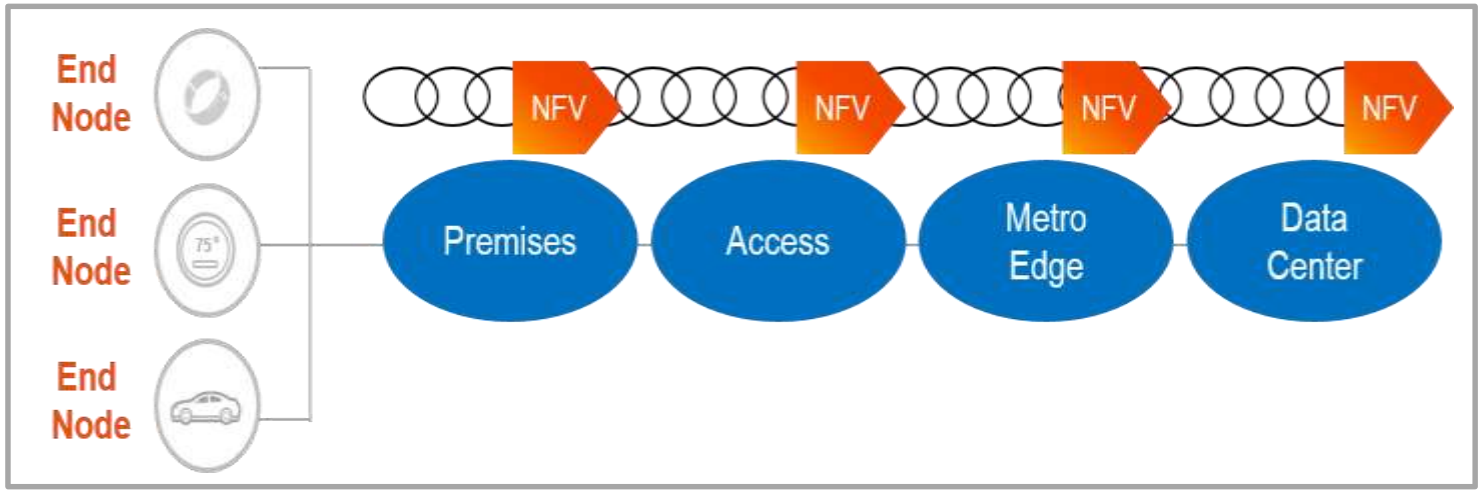
Virtualization Will Be Used Throughout the Network



NFV Does Not Replace Networking With Computing But Blends the Two



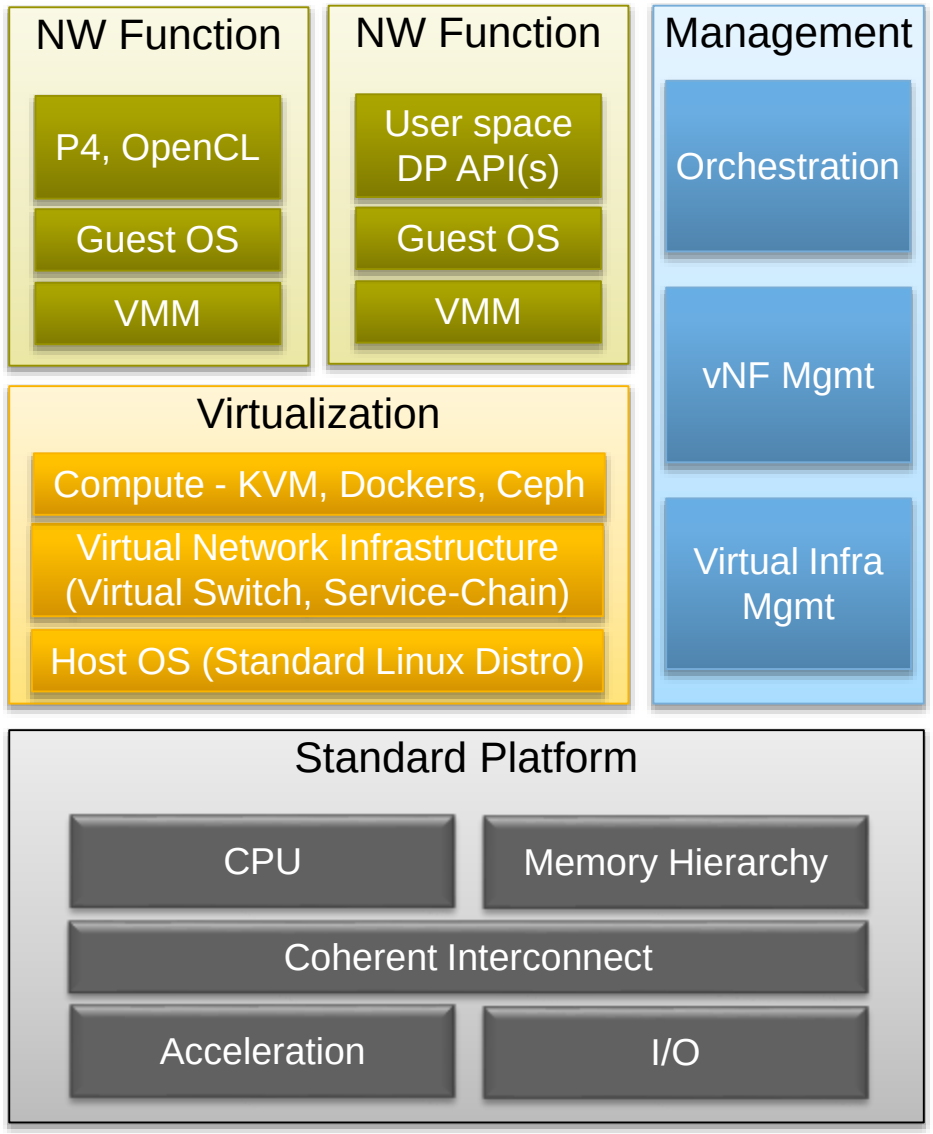
- **Systems in the field provide**
  - I/O, Acceleration
  - Low latency
- **The NFVI must be an intelligent flexible cloud**
  - VNF hosting distributed throughout network
  - Capability, capacity, context determine where VNFs run
- **Services can be chained across domains**



Rigid Data Center Centralization

Intelligent Flexible Cloud

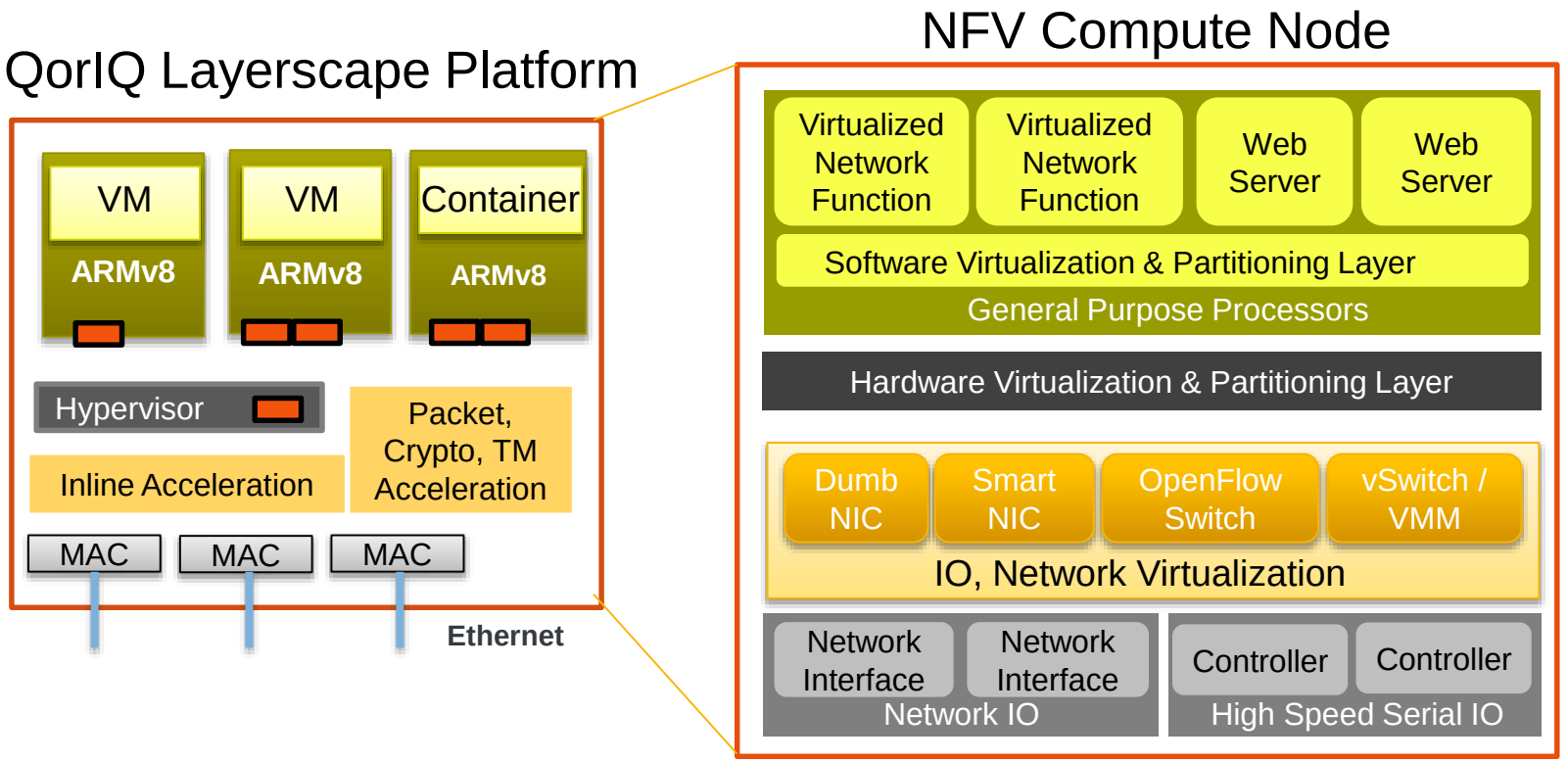
NFV – Driving Open Eco-system Enablement



- **Open Data Plane and Data-Path Development Kit**
  - Standardized, offload-enabled data-path API
  - Supporting Open-source VNFs in user space
  - Vendor-neutral and cross-platform – x86, ARM
- **Virtual Network Infrastructure**
  - Running in user-space today over DPDK, ODP
  - Offload virtual switching, overlay, IPSec to Packet-engine.
  - VNF Service-chaining using DPAA2 virtualized model
- **OPNFV on ARM**
  - Running on QorIQ processors
  - Supporting flexible installation, orchestration environment
- **Standard Platform Enablement**
  - Pre-boot execution environment: UEFI, ONIE installer
  - HAL/Platform standards: ACPI, APD, SBSA
  - OpenStack Management & orchestration

NXP DIFFERENTIATION FOR NFV

Open Platform for NFV – Mapping to Hardware



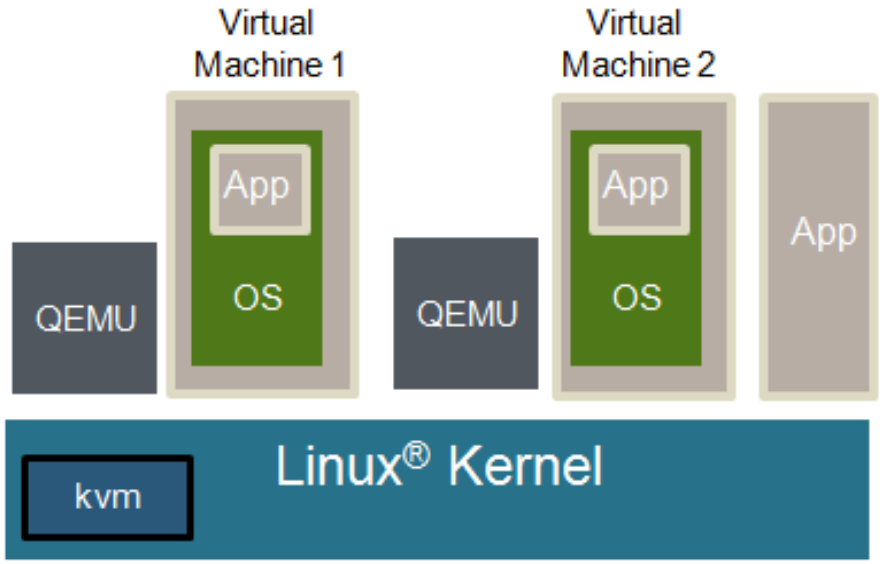
- **Expanded acceleration capability to offload Hypervisor and VMs**
  - VxLAN, OVS, Firewall, Traffic Control, IPSec, Netflow, SDN
- **Driving standardization**
  - Linux, ODP, Virtio, DPDK
- **Driving relevant open standards bodies**
  - ETSI NFV, OPNFV, ONF, LNF
- **Standard SW installation environment**
  - UEFI, ONIE, ACPI, uboot

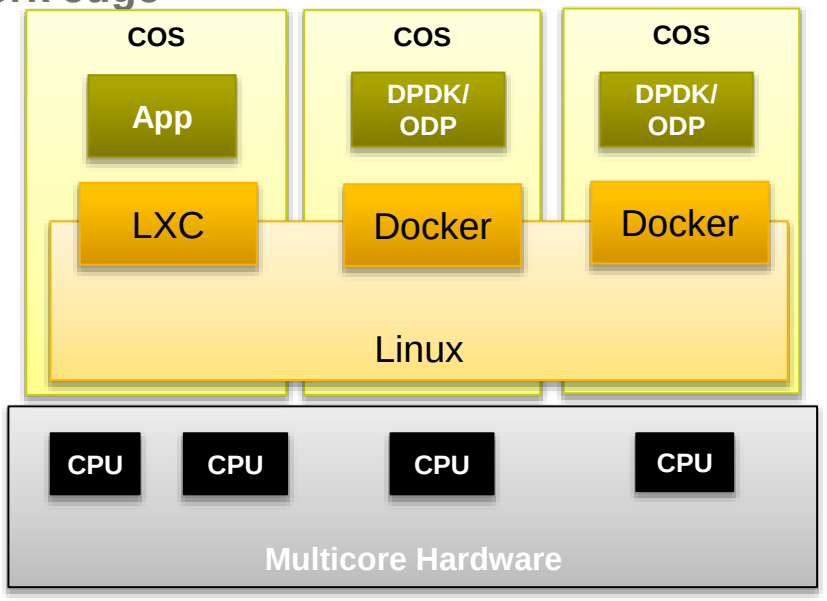
Open, Scalable, Performance / Cost Optimized Solution

Software fully compatible with open standards

Layerscape Compute Virtualization

Scalable virtualization technology for the deeply embedded network edge



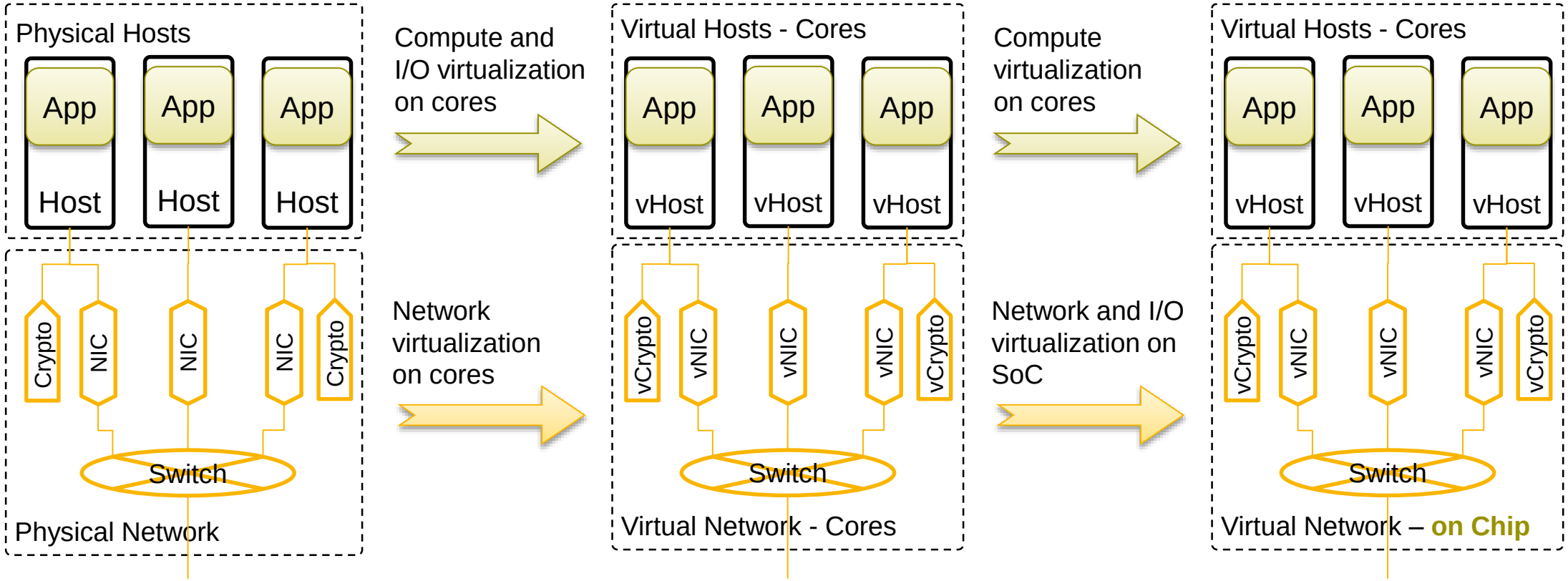


- **KVM** Linux® kernel driver to spin up VMs
- QEMU user space emulator is used in conjunction with KVM
- Solution is open source
- Virtual machines is only limited by particular SoC resources (CPU cycles, memory)

- **Linux® Containers,** OS level virtualization – Docker, LXC
- Secure partitioning of Linux apps into domains
- Lightweight overhead compared to KVM
- Control resource utilization within domains such as CPU, I/O BW

Deployed with Cloud Orchestration

Virtual Networking Models



Traditional Networking – multiple devices

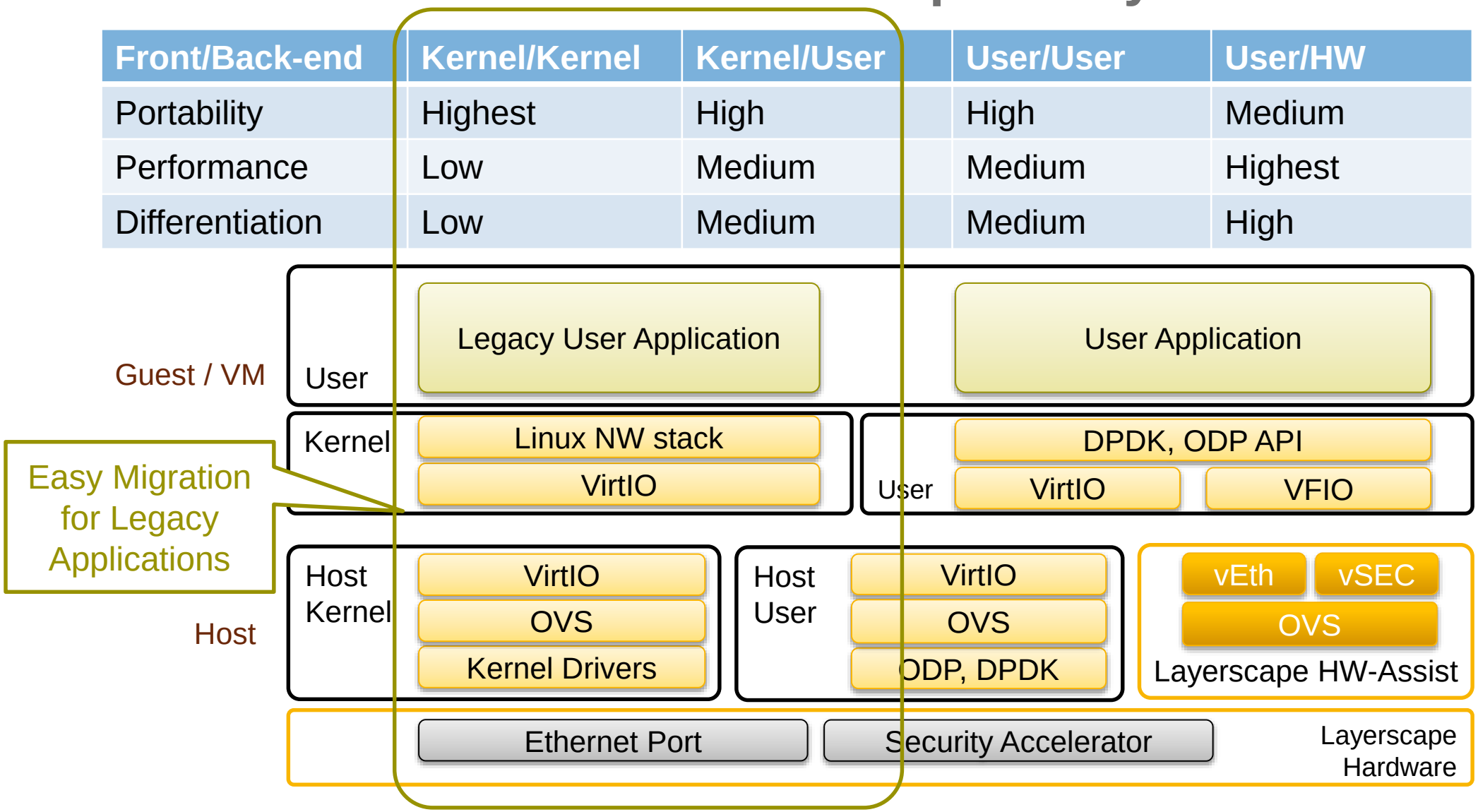
Virtual Networking emulated on cores

Virtual Networking provided by hardware

Layerscape Architecture provides Complete Network Virtualization in Hardware

I/O & Network virtualization – Compatibility

Front/Back-end	Kernel/Kernel	Kernel/User	User/User	User/HW
Portability	Highest	High	High	Medium
Performance	Low	Medium	Medium	Highest
Differentiation	Low	Medium	Medium	High



I/O & Network virtualization – Differentiation

Front/Back-end	Kernel/Kernel	Kernel/User	User/User	User/HW
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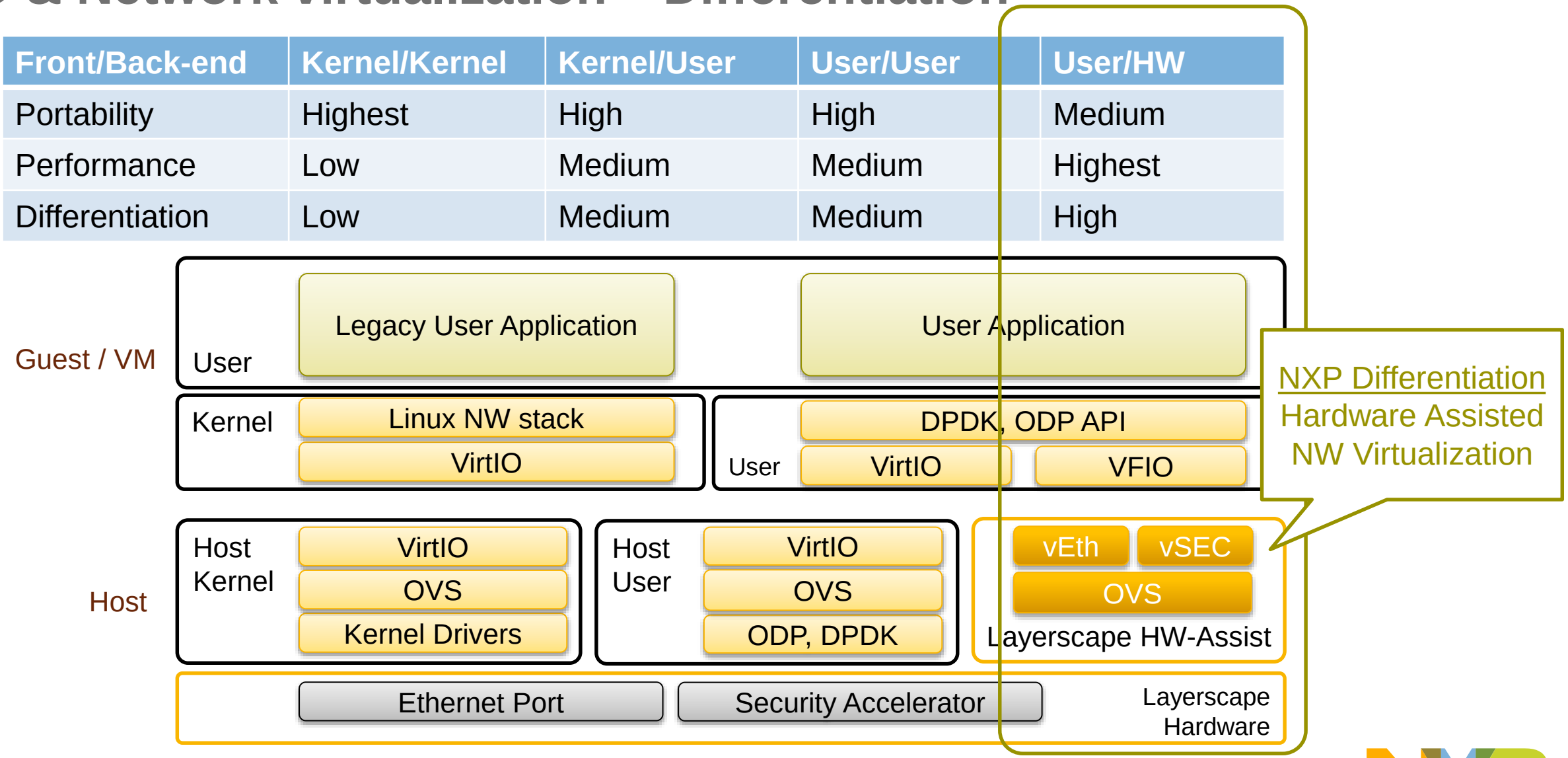

I/O & Network virtualization – NXP Advantage

Front/Back-end	Kernel/Kernel	Kernel/User	User/User	User/HW
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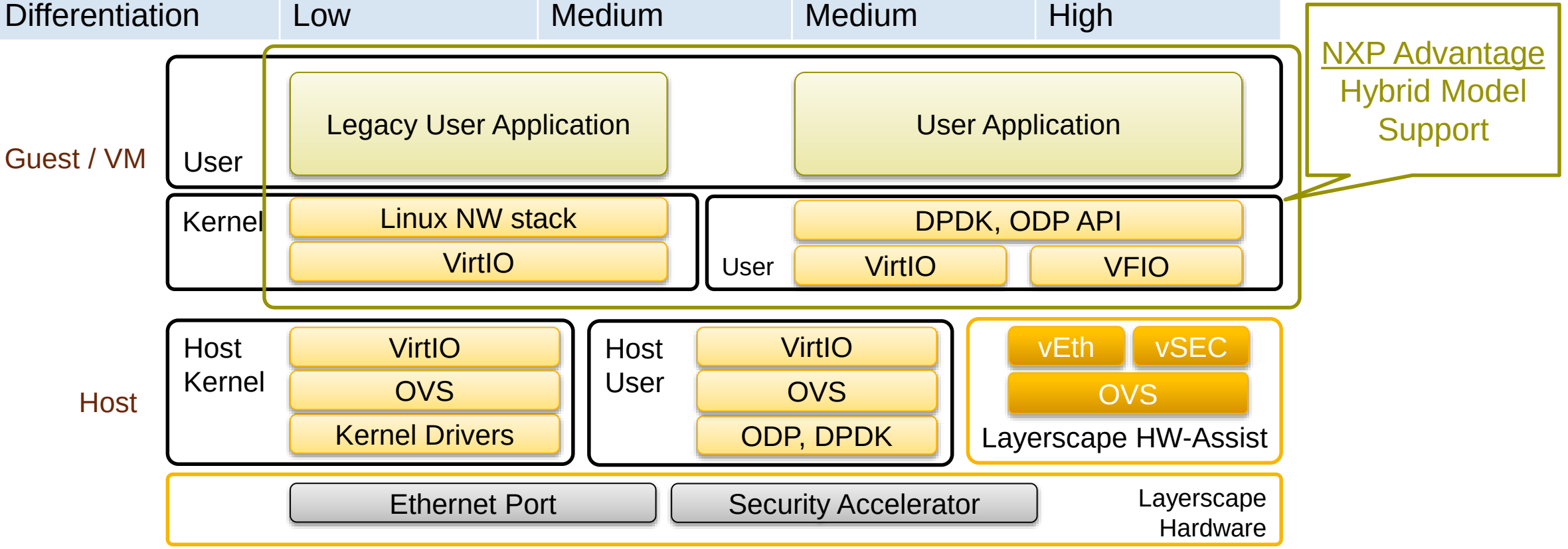
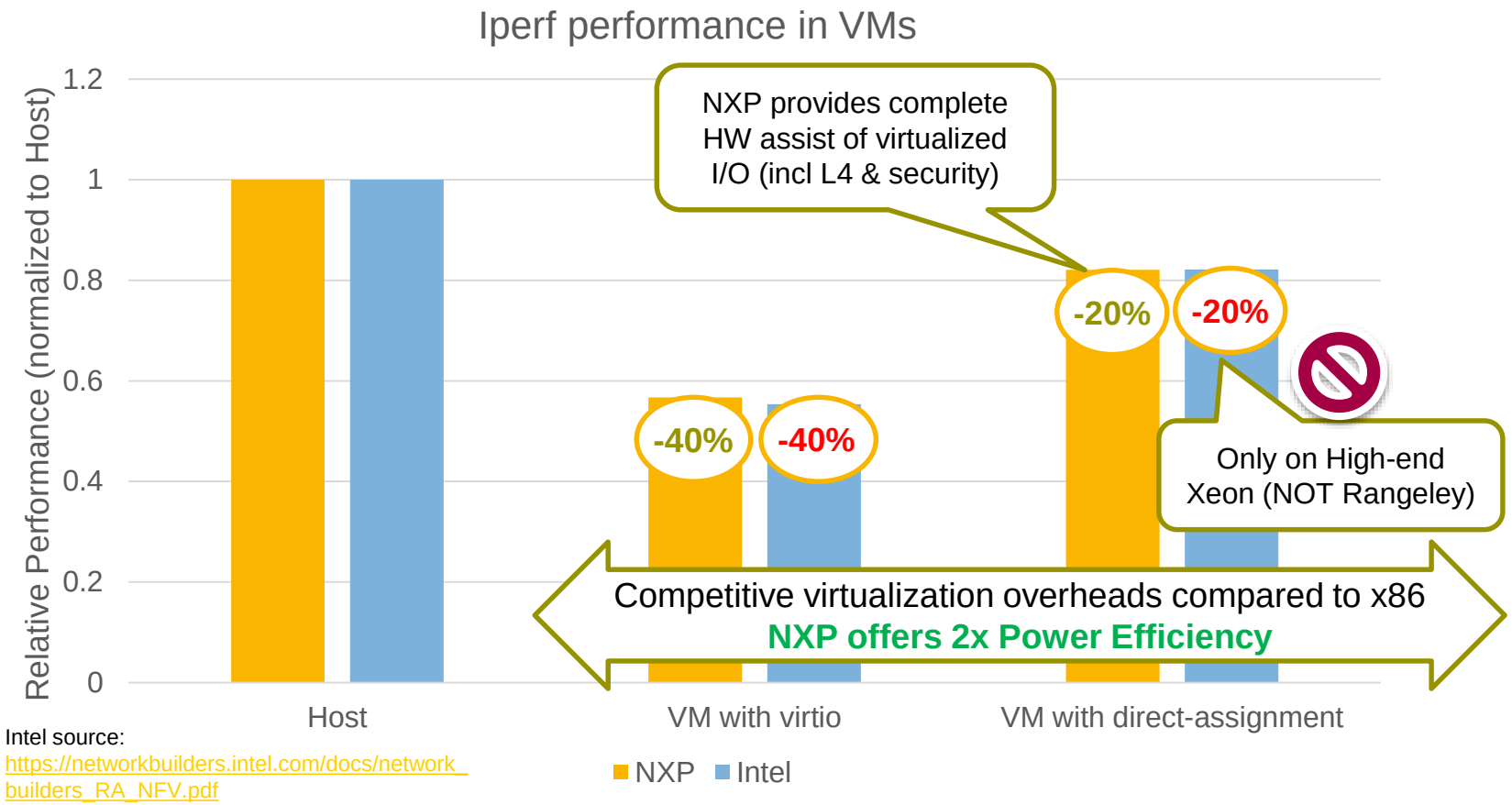


Offering Winning Performance for NFV



Intel source:
https://networkbuilders.intel.com/docs/network_builders_RA_NFV.pdf

Positioning NXP as ***a leader*** in networking and ***virtualization***

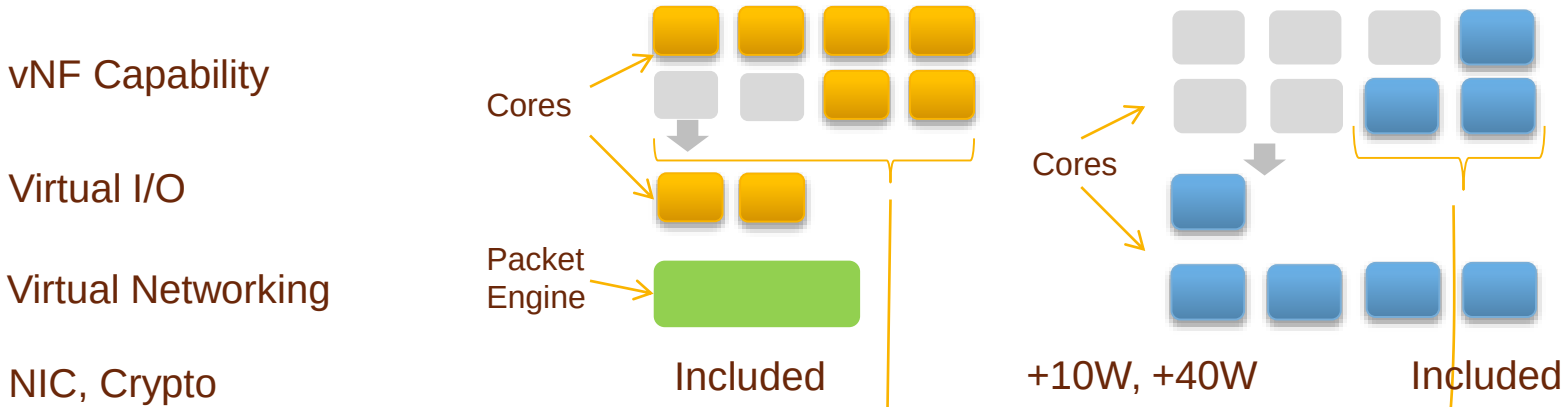
Offering our customers ***competitive and differentiated solution*** ahead of their needs

Demonstrating winning and ***efficient solution for*** the requirements of the ***NFV*** market & applications

Leadership and Groundwork for ARMv8 in the area of Virtualization (QEMU)
Demonstrating excellent scalability under varied (2 or 3) VM configurations

Use Case Example: Power Efficient NFV with LS2088A

	LS2 with AIOP	E5-2618Lv3	Xeon-D 1548
Cores	8 @ 2GHz	8 @ 2.3GHz	8 @ 2 GHz
CoreMark/MHz/Core	5.4	8.2	8.2
Power (TDP)	35W	75W	45W



Cores for Virtual NW, IO	2	4	5
vNF CoreMark	65k	75k	49k
Combined Power	35W	125W	45W
vNF CoreMark/W	**1857**	**600**	**1089**

- VMM network and IO virtualization consumes CPU resources
- Most of it can be assisted by the Layerscape packet engine
- **Therefore**
  - ***More cycles allocated to VM***
  - ***and better integration…***

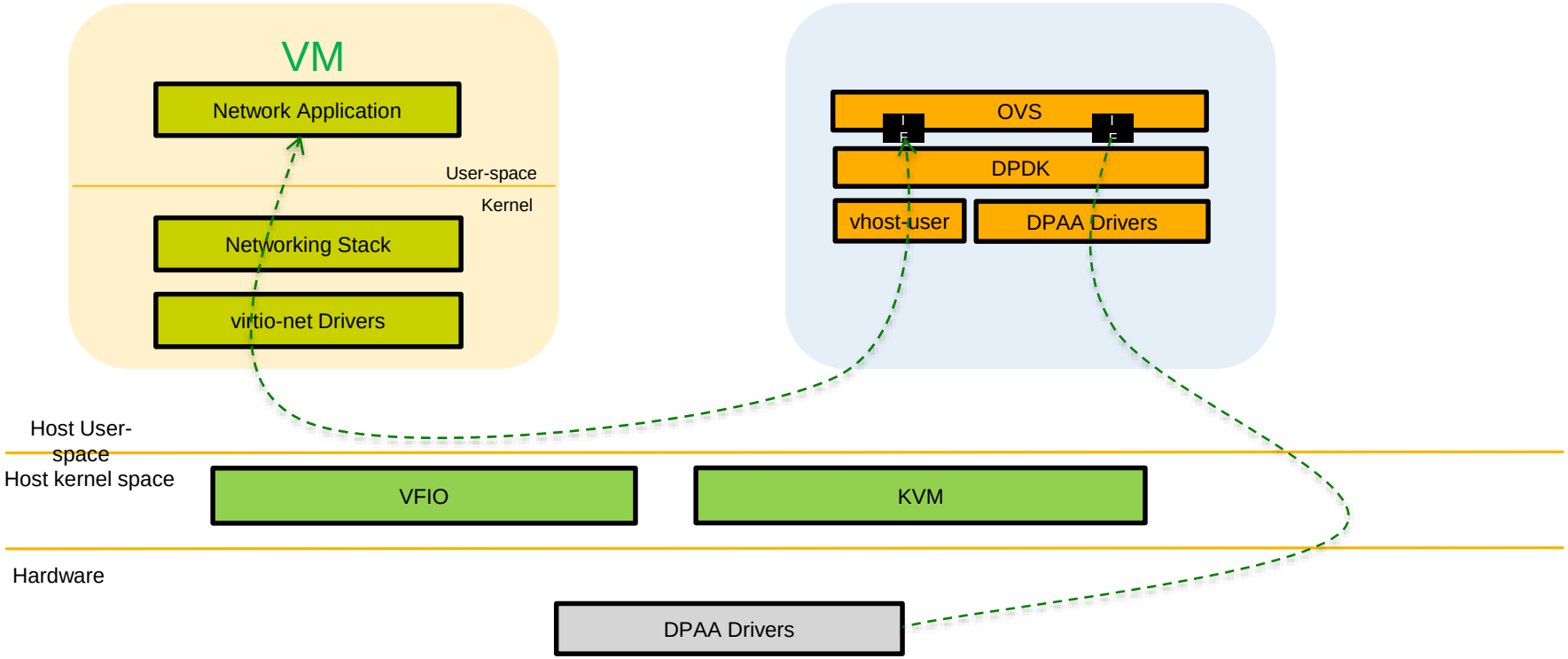
Layerscape Architecture provides a 2x to 3x Performance/Watt advantage

Solutions

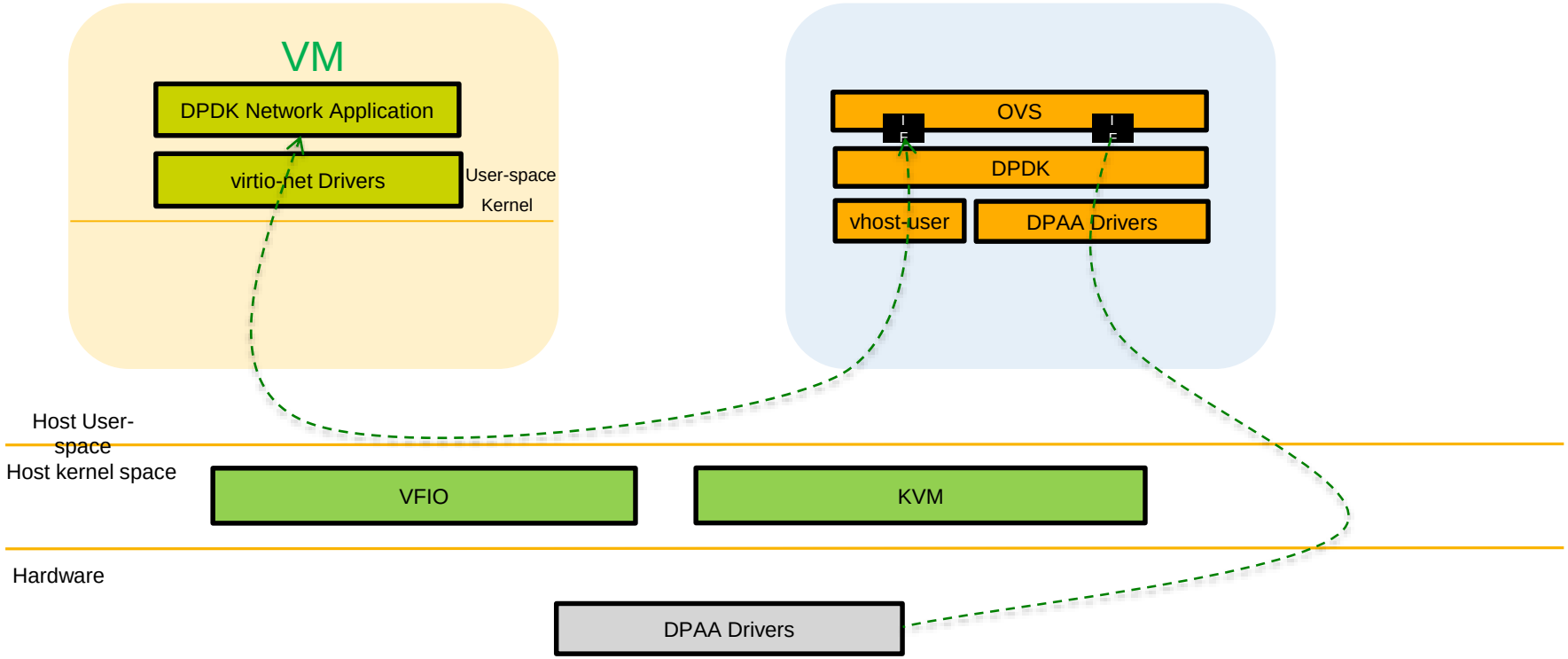
- NFV Solutions
  - ✓GPP solutions
  - ✓AIOP acceleration – Leveraging ADKs
  - ✓vNF Acceleration
  - ✓Intel vs NXP competitor Analysis

- ADKs
  - ✓OFSP – OpenFlow Switch Standard at AIOP
  - ✓OFPP – OFSP with L4-L7
  - ✓VMM offload – OFPP with HW virtualization

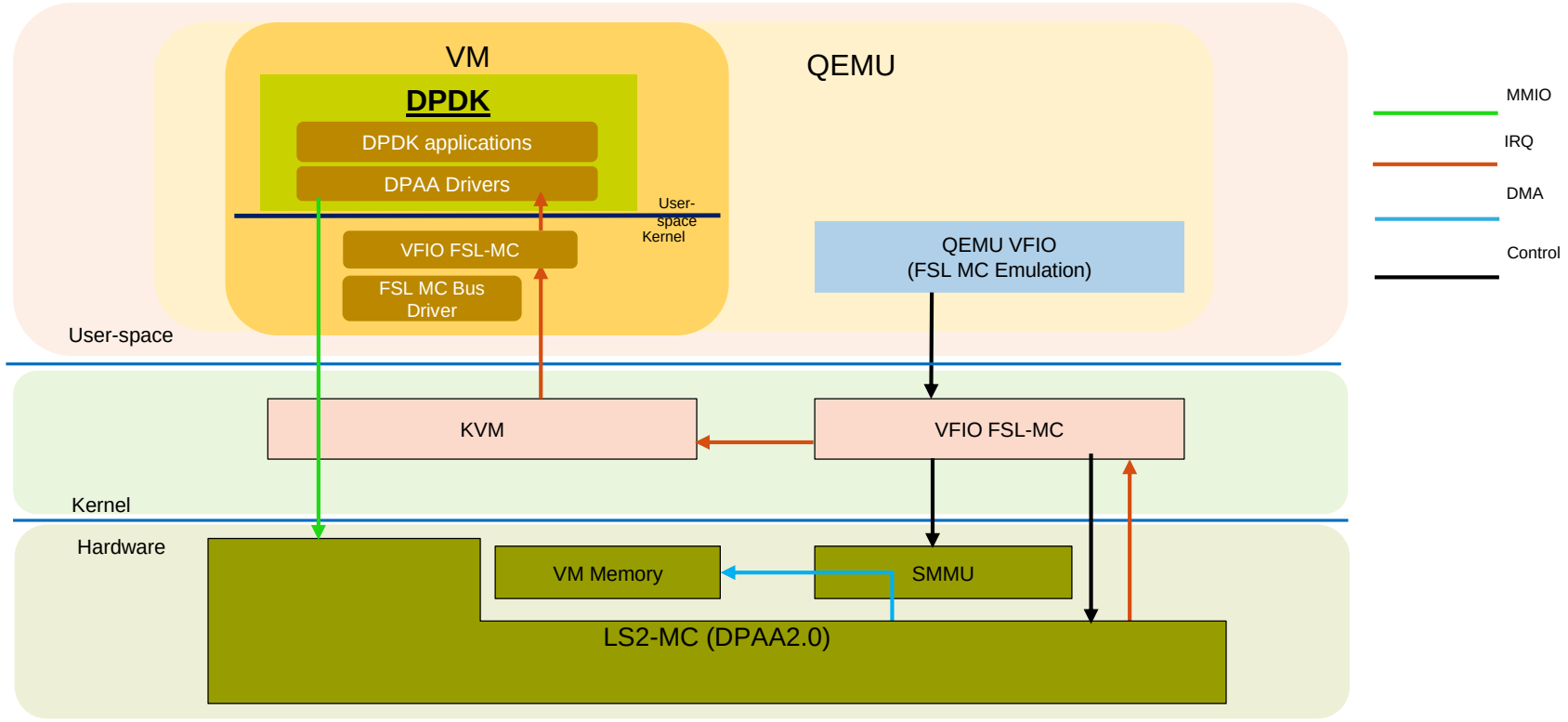
Virtio-net: DPDK-OVS backend



Virtio-net: DPDK in guest using virtio-net



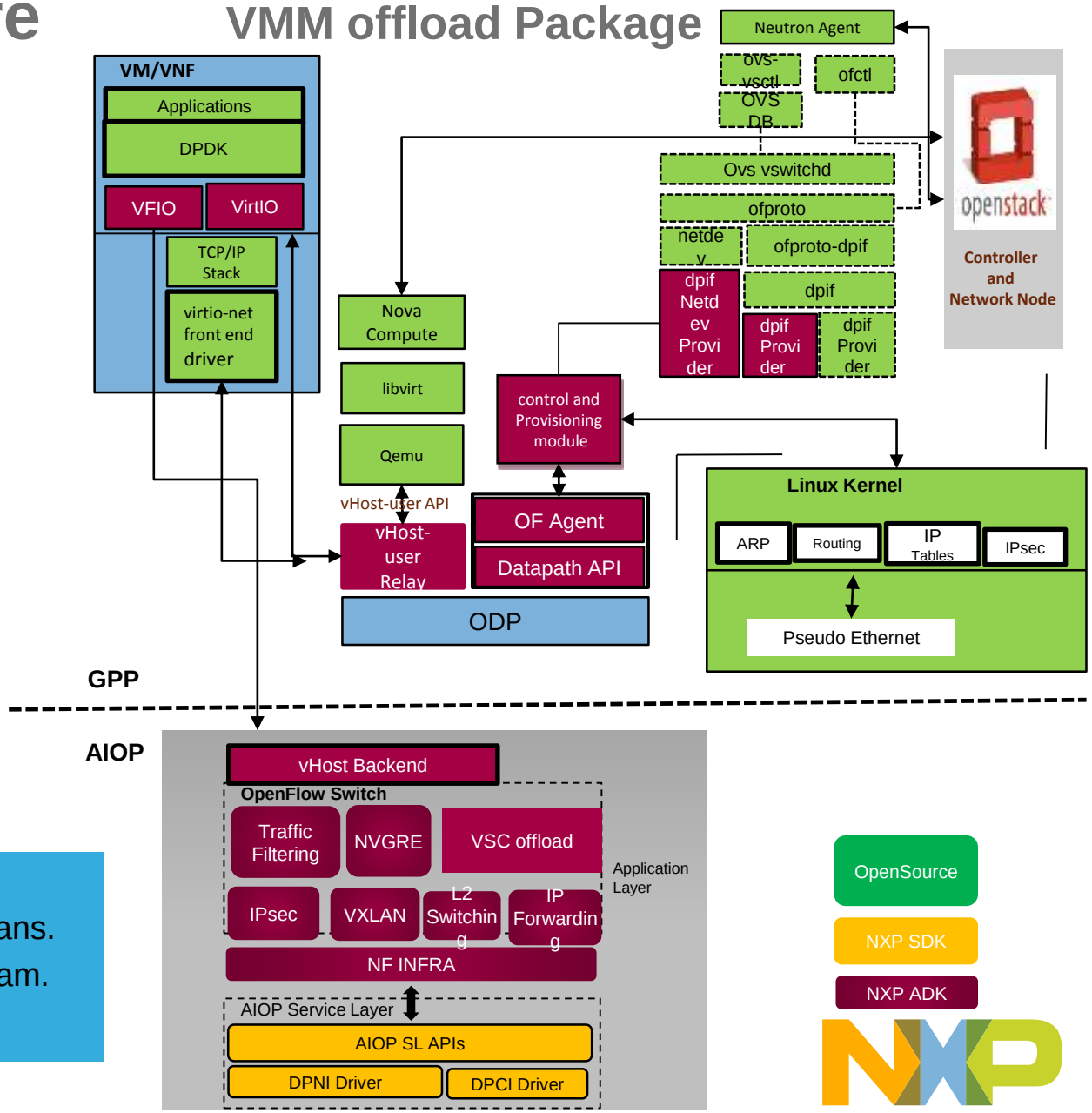
DPAA2 Device Pass-through to DPDK in VM



Layerscape Applications Software

- **Key Features:**
  - NFV Compute Node, vNFs and vSwitch Acceleration at AIOP
- **AIOP:**
  - OpenFlow Switch Specification v1.3 complaint datapaths for
    - L2 Switching, L3 Forwarding
    - IPv4 IPsec
    - IPv4 Firewall/Traffic Filtering
    - VxLAN, VxLAN over IPsec
  - Flow indexing Table (FIT) Fastpath and FIT for multiple datapaths
  - vHost-user/Virtio-net/direct DPNI assignment support
- **GPP:**
  - OpenFlow Agent in GPP
  - Flow API
  - Integrated with OVS utilities & OVS DB.
  - Integrated with embedded FSL controller adapter
  - Enabled OpenStack Orchestration
- **Key Highlights**
  - Reviewed requirements from marketing and provided engineering plans.
  - Accelerated delivery of PoC to meet delivery demands of NFV program.
  - Performance tuning is in progress.

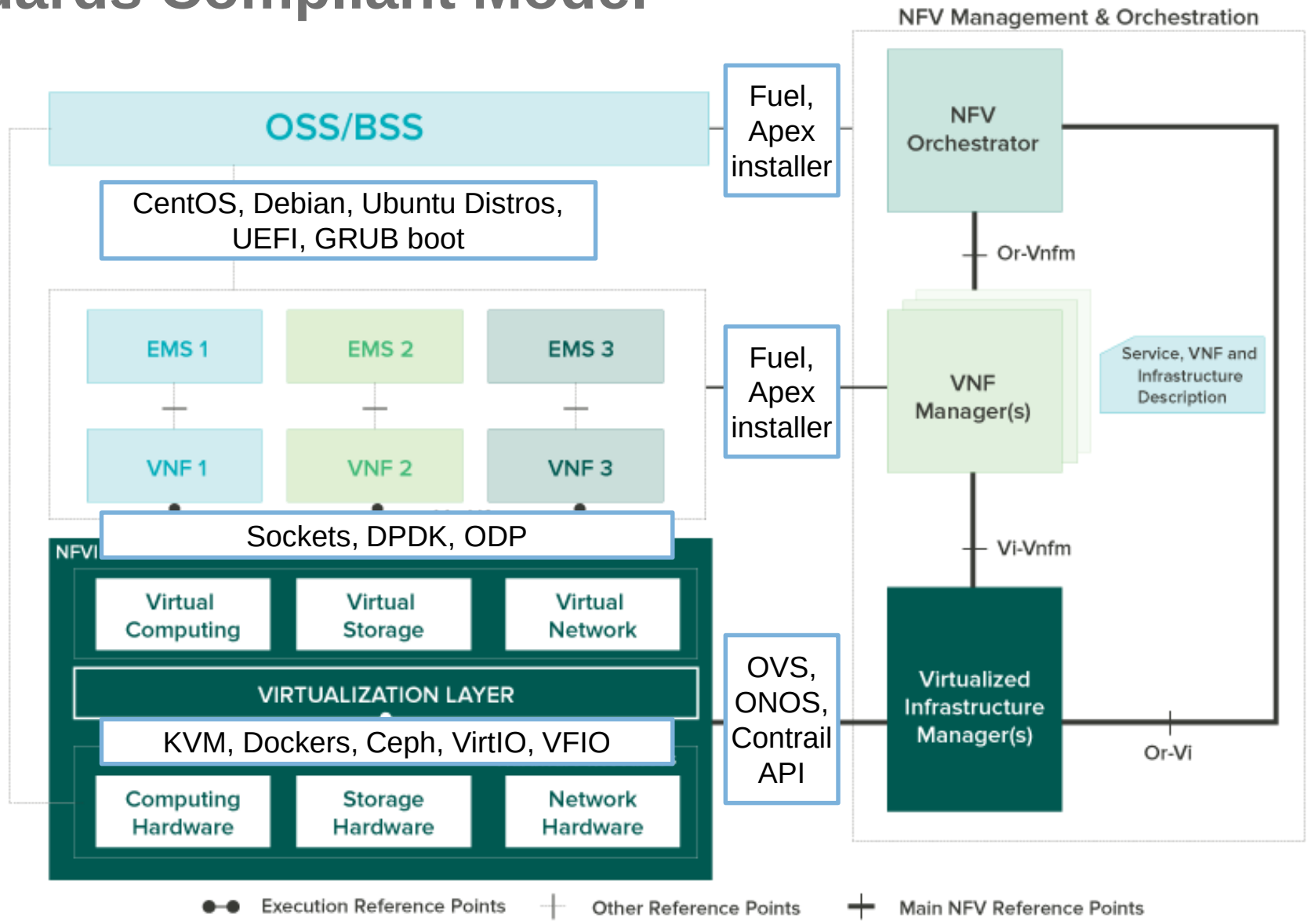
VMM offload Package



OpenSource
NXP SDK
NXP ADK

NFV OFFERING FROM NXP

Standards Compliant Model

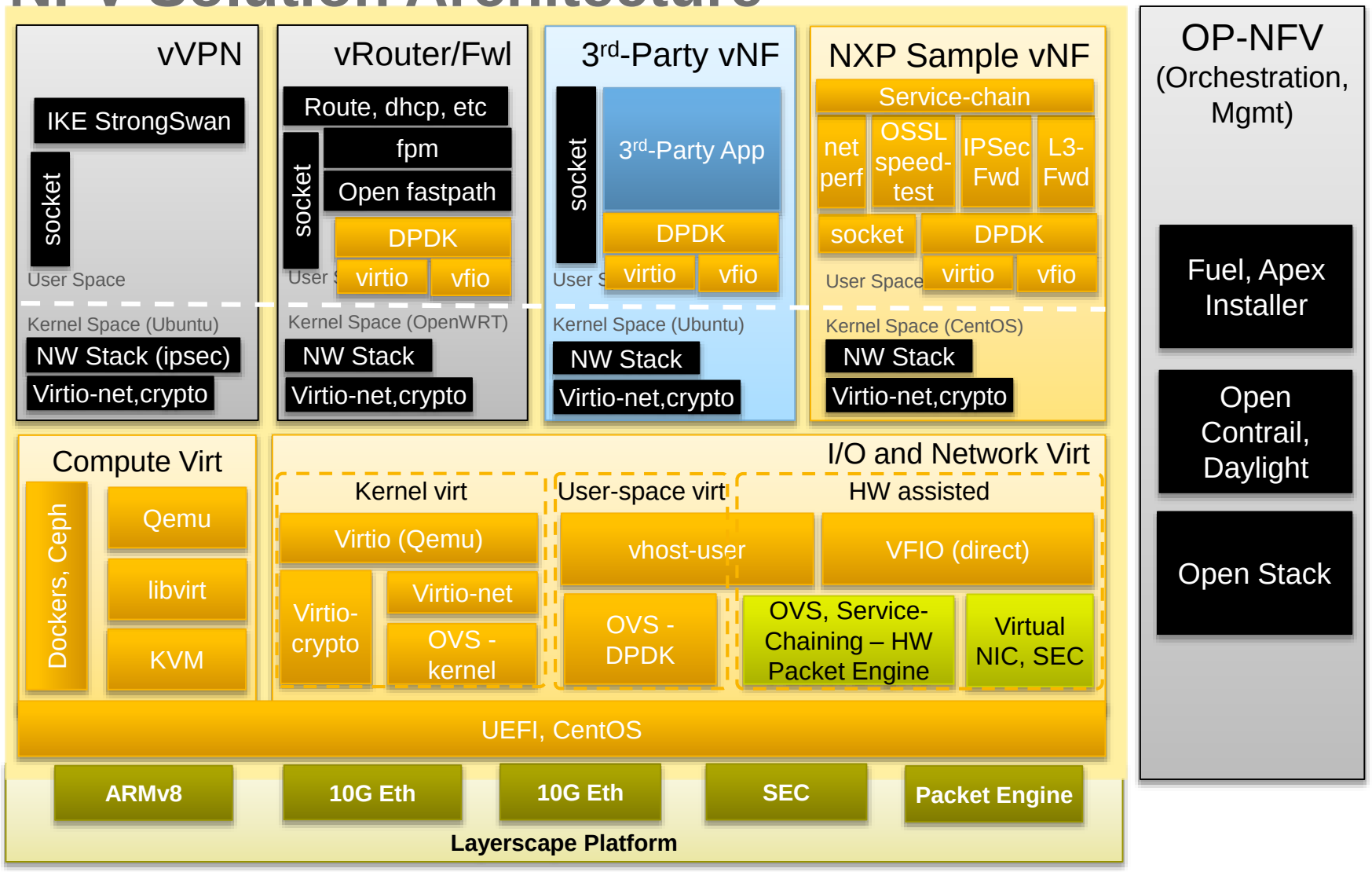


Complies with **standard ETSI NFV model**

NXP NFV Solution offering

Standard Hardware Platforms	• ARMv8: LS2088, LS1088, LS1046, LS1043, LT2088, LT2168
Standard Linux Distro	• CentOS, UEFI, Debian, Ubuntu
Standard Virtualization components	• KVM, QEMU, Dockers, Ceph
Standard Orchestration and Management	• OP-NFV: OpenDayLight, OpenStack
Standard API and libraries	• DPDK, ODP, OVS, Virtio
Reference Virtual Network Functions	• vFirewall, vNAT, vRouter, vVPN
Out-of-the-Box Experience	• Benchmarks, User-guide, Documentation

NFV Solution Architecture



NFV Development Kit	
OP-NFV	• Brahmaputra
DPDK	• v2.2+
OVS	• v2.4/2.5 • OVS DPDK • OVS Packet-Engine
KVM	• v2.2
Qemu	• v2.5
Libvirt	• 1.2.20
Linux	• LTS Kernel 4.1.2
Orchestration	• Open Daylight
Reference vNFs	• Open Source • vRouter, • vFW (iptables), • vVPN (strongSwan)
Distro	• UEFI • CentOS

NXP enablement for NFV – upstreamed to community, competitive performance

Re-use from OP-NFV community and run un-modified

Re-use from 3rd-Party sources and run un-modified

NXP HW assists for extra performance

I/O virtualization

Phase	Front-End	Back-end	Portability	Performance	NXP Value
1	virtio-kernel	virtio-kernel	High	Low	Competitive
3	virtio-kernel	vhost-user	High	Medium	Competitive
3	virtio-user	vhost-user	Medium	High	Competitive
3	vfio-user	NA	Low	Highest	DPAA2 NW Object model

Network virtualization

Phase	Front-End	Back-end	Portability	Performance	NXP Value
1	virtio-kernel	OVS-kernel	High	Low	Competitive
3	virtio-kernel	OVS-user	High	Medium	Competitive
3	virtio-user	OVS-user	Medium	Medium	Competitive
4	virtio-user	OVS-AIOP	Medium	High	AIOP offload
5	vfio-user	OVS-AIOP	Low	Highest	AIOP offload + DPAA2 model

NFV Solutions Roadmap

	NFV Phase-2	NFV Phase-3	NFV Phase-4	NFV Phase-5	NFV Phase-6	NFV Future
Platforms Supported	LS2085, LS1043	LS2085, LS1043	LS2085, LS1043	LS2088, LS1046	LS2088, LS1088, LS1046	LT2, LS2088, LS1088, LS1046

Key New Features	• Base Platform
	  • OP-NFV Brahmaputra
	  • U-boot, Yocto Linux
	• Virtualization
	  • KVM, QEMU, libvirt
	  • Virtio (kernel)
	  • OVS (kernel)
	• VNF
	  • vRouter
	  • vFW
	  • vVPN
	• NXP Test Apps
	  • Netperf
		• Base Platform
		  • U-boot, CentOS
		• Virtualization
		  • Virtio (user-space)
		  • VFIO (DPDK)
		  • OVS (user-space)
		• Offload (PoC)
		  • OVS (packet-engine)
		• NXP Test Apps
		  • L3-Fwd (DPDK)
		  • Pktgen (DPDK)
			• Base Platform
			  • UEFI, CentOS
			  • Docker
			• Virtualization
			  • Virtio-crypto
			  • VFIO-crypto (DPDK)
			• NXP Test Apps
			  • OpenSSL Speed-test
			  • IPSec-Fwd (DPDK)
				• Base Platform
				  • UEFI, PXE, CentOS
				  • Ceph
				• Virtualization
				  • VFIO (offload)
				• Offload
				  • OVS (packet-engine)
					• Base Platform
					  • OP-NFV Cxxx
					  • Debian
					• Offload
					  • Virtual Service Chain
					• NXP Test Apps
					  • Service-chaining
						• Base Platform
						  • Debian, Ubuntu
						• Offload
						  • Protocol offload
						• NXP Optimized VNF
						  • vRouter
						  • vFW
						  • vVPN

Release Date	Target: Mar-2016	Target: May-2016	Target: June-2016	Target: Sep-2016	Target: Q4-2016	Target: 2017

2016 1Q 2Q 3Q 4Q **2017** 1Q

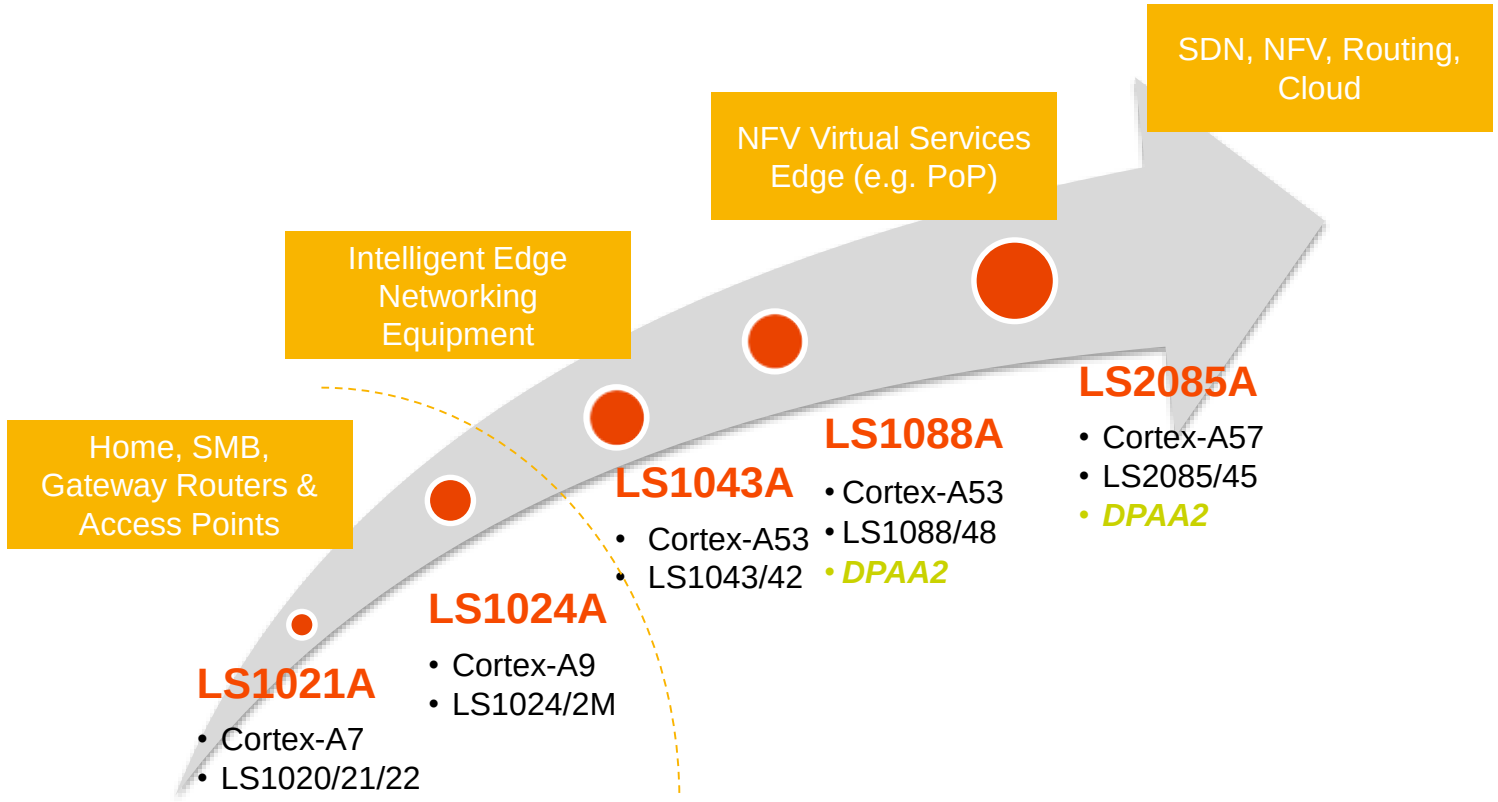
Summary and Takeaways

- Network Function Virtualization will be deployed throughout the network
  - At the Server, Data-center Cloud
  - At the Intelligent Network Edge and Appliance

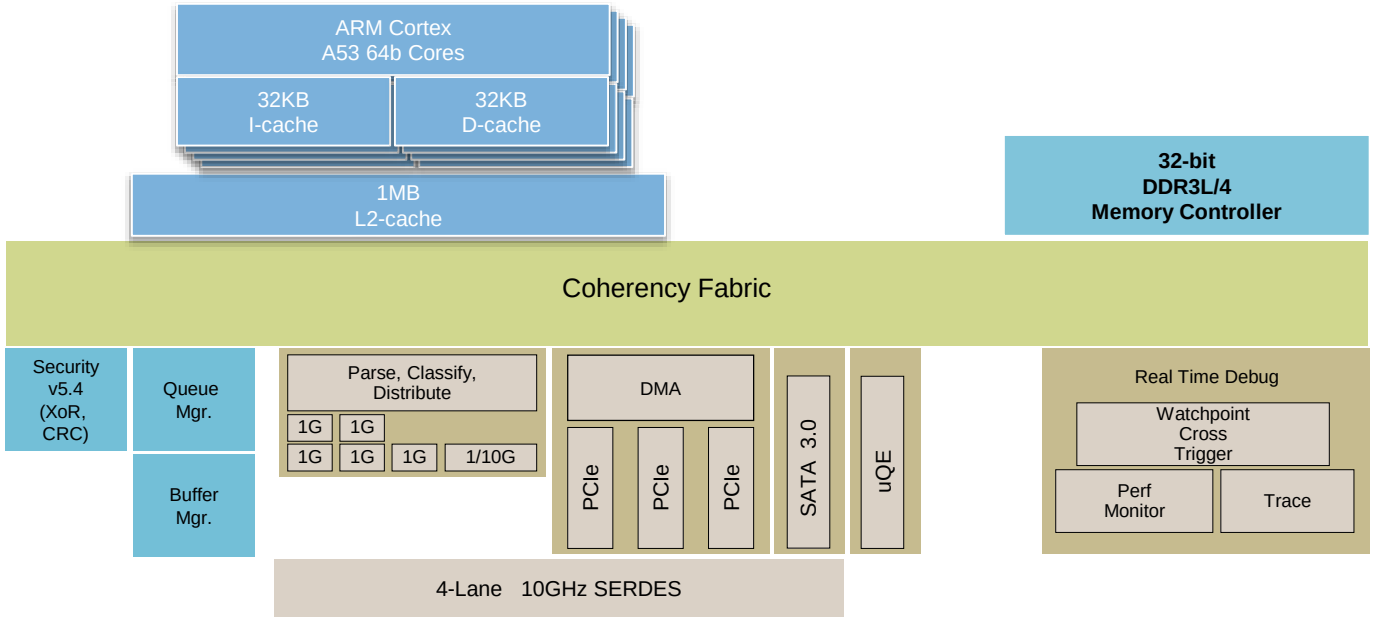
- NXP provides Best-in-class Performance / Watt / Value proposition
  - Hardware Assisted Network and IO virtualization
  - Leadership in ARM virtualization support

- Standards Compliant Solution
  - Standard virtualization components – DPDK, OVS, KVM, Docker, Ceph
  - Seamlessly plug in acceleration
  - Standard OS, install environment

Broad Family of QorIQ LS Series Multicores

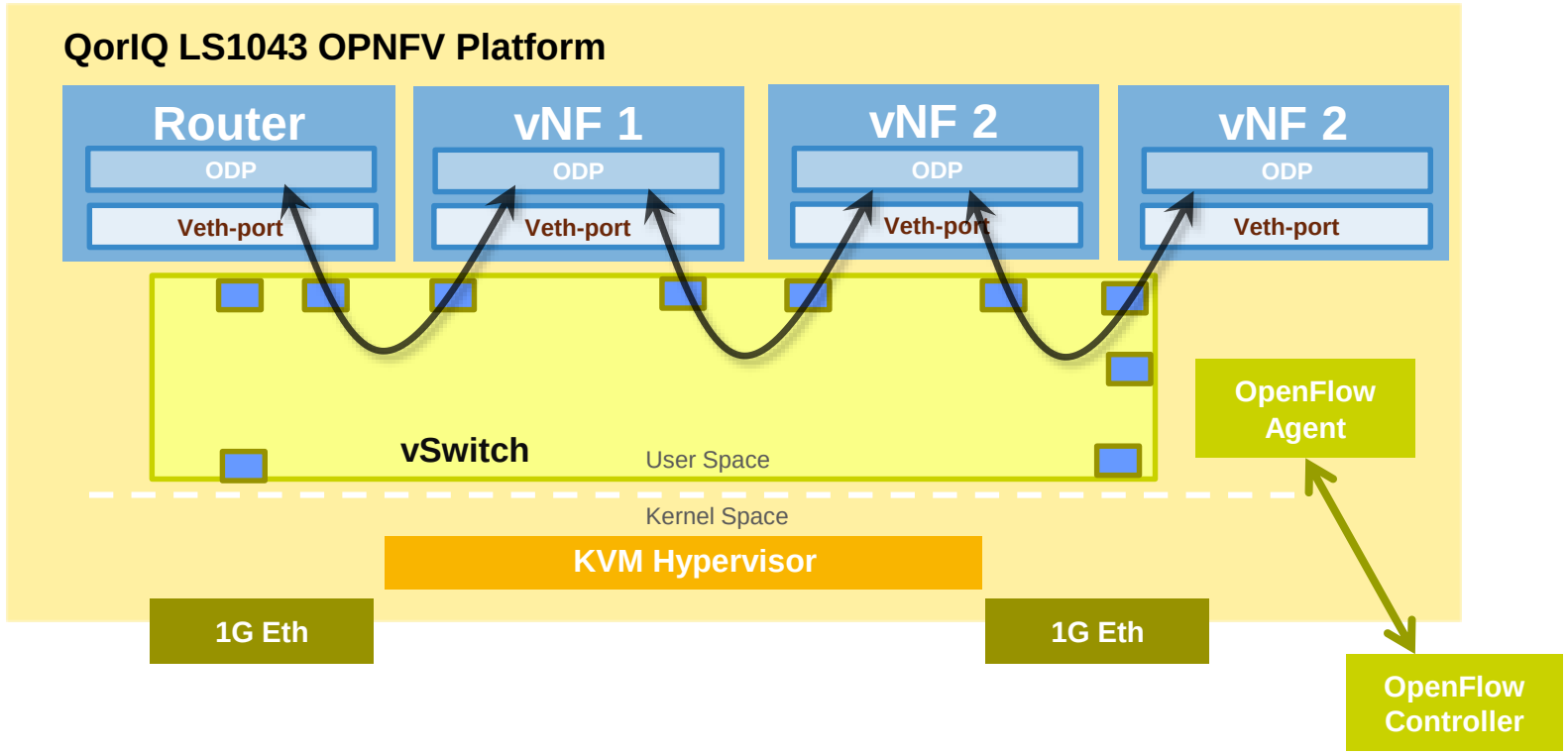


QorIQ LS1043A – Targeted Integration (10G + 5 GE ports)

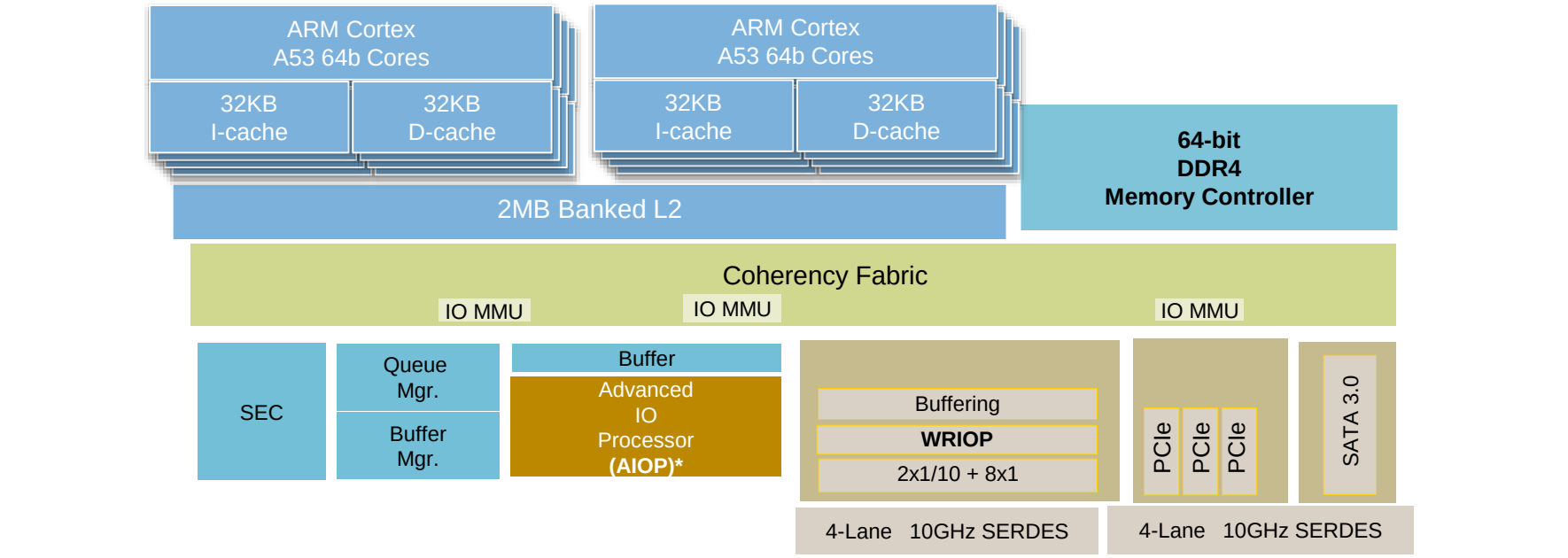


Targeted Integration (10G + 5 GE ports), Low Power, 5 Gb/s IPSec

Virtualizable CPE: ARM® v8 vCPE with QorIQ LS1043A

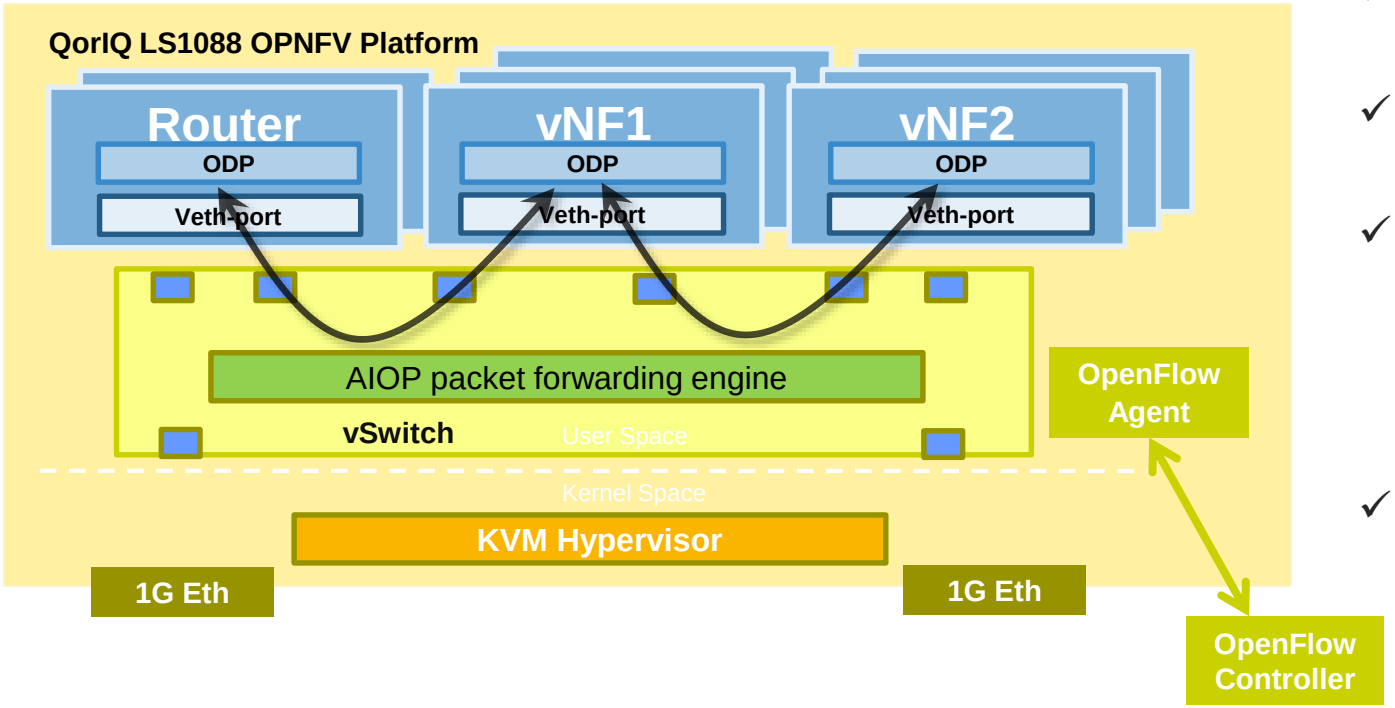


LS1088A – Higher Performance (Dual 10G Support)



2x Core performance and 4x Packet throughput of LS1043A

Higher Capacity vCPE with QorIQ LS1088/LS1048



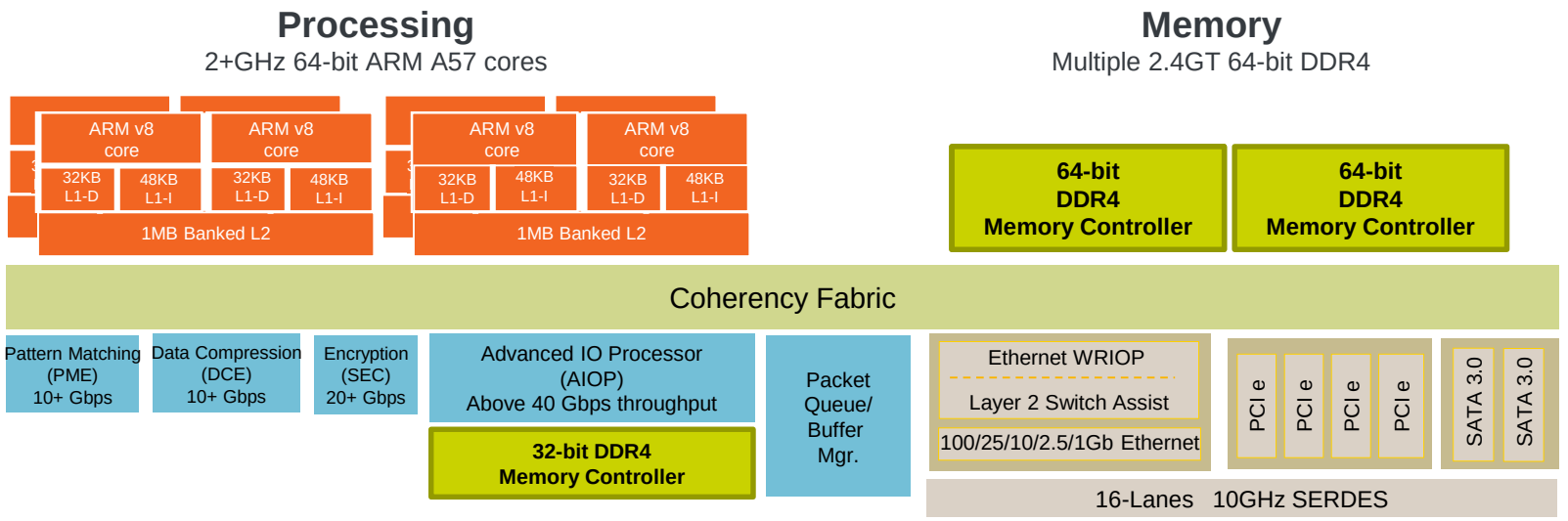
- ✓ Supports fully compliant OPNFV platform
- ✓ vNF 100% source compatible with x86
- ✓ 4+ vNFs with dedicated cores
- ✓ AIOP packet forwarding frees up GPP core(s) AND significantly improves network throughput (>5X vs. single GPP core)
- ✓ Significant cost saving

vCPE Comparisons

	LS1043	LS1088	Intel D1540
Virtual Networking	DPAA 1.0	DPAA 2.0	SRIOV
Switching Offload	4x A53 Cores + h/w acceleration	8x A53 Cores + h/w acceleration+ packet processing	Cores
Security Offload	SEC engine	SEC engine	Cores
Power	5W	10W	45W
ISA	ARM V8 (4x A53)	ARM V8 (8x A53)	x86 quad-core
Cost	$	$$	$$$$

Layerscape achieves vCPE performance, cost, power targets

QorIQ LS2085A Enabling 64-bit ARM® NFV Infrastructure



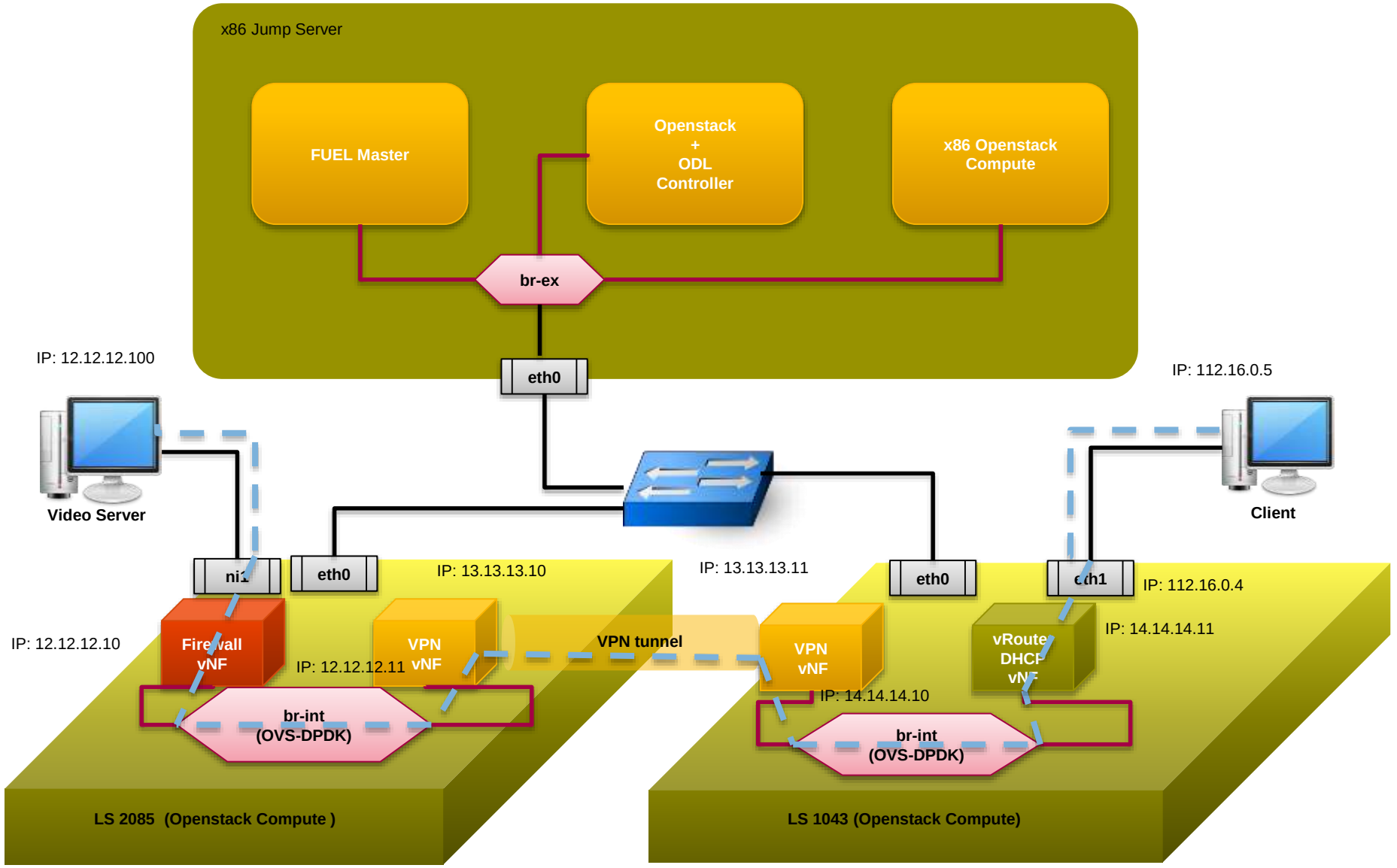
5x Core performance and 10x Packet throughput of LS1043A

NXP OFFERING DEMO

QorIQ NFV Phase 4 Release – Software Components

Software Component	Version
OPNFV	Brahmaputra 3.0
Platforms	LS2085, LS1043
OpenStack	Liberty
OpenDaylight	Beryllium
OVS	Openstack Compute (LS2085): 2.5.0 Openstack Compute (LS1043): 2.5.0 Openstack Controller: 2.4.90
DPDK	16.04 in VM
QEMU	Openstack Compute (LS2085): 2.4.0 Openstack Compute (LS1043): 2.3.0 Openstack Compute (x86): 2.0.0
Libvirt	Openstack Compute (LS2085): 1.2.12 Openstack Compute (LS1043): 1.2.13 Openstack Compute (x86): 1.2.9
Linux	Openstack Compute (LS2085): EAR 6.0 Openstack Compute (LS1043): SDK 2.0 tag fsl-sdk-v2.0- rc1 Openstack Compute (x86): Ubuntu 14.04
Reference vNFs	vFirewall (iptables) vVPN (strongswan) vDHCP vRouter

Demo – vCPE use case



OPNFV members

Platinum

Silver

SECURE CONNECTIONS
FOR A SMARTER WORLD