



Transforming Networks with NFV & SDN

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**“A strategic inflection point is an event that changes the way we think and act.”
Andrew Grove**

Transformation





Transformation



Capital Expense

Operational Expense

Service Revenue

What Problems Do
NFV & SDN Solve?



**A NEW BASELINE
FOR EFFICIENCY**

10¢

PER VM HOUR

*Average Infrastructure
as a Service Cost*

The Tip of The Iceberg

Datacenter SDN

Server, Router, Switch
Network Appliance



The Tip of The Iceberg

Datacenter SDN

Server, Router, Switch
Network Appliance



Service Provider SDN + NFV

Access:
LTE Base Station,
Cloud RAN



Edge:
Border Network Gateway,
Media Gateway



Core:
Evolved Packet Core



NFV & SDN are Driving Architectural Transformation

From This...

Firewall



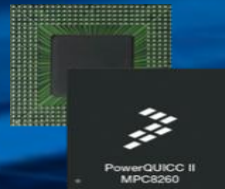
VPN



Intrusion
Detection
System



TEM/OEM Proprietary OS



ASIC, DSP, FPGA, ASSP

NFV & SDN are Driving Architectural Transformation

From This...

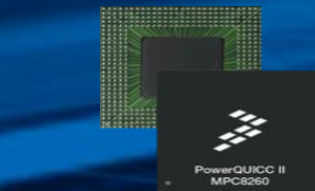
Firewall

VPN

Intrusion
Detection
System



TEM/OEM Proprietary OS



ASIC, DSP, FPGA, ASSP



x86 CPU



NIC
Silicon



Chipset
Acceleration



Switch
Silicon



Linux



To This...

VM:
Firewall

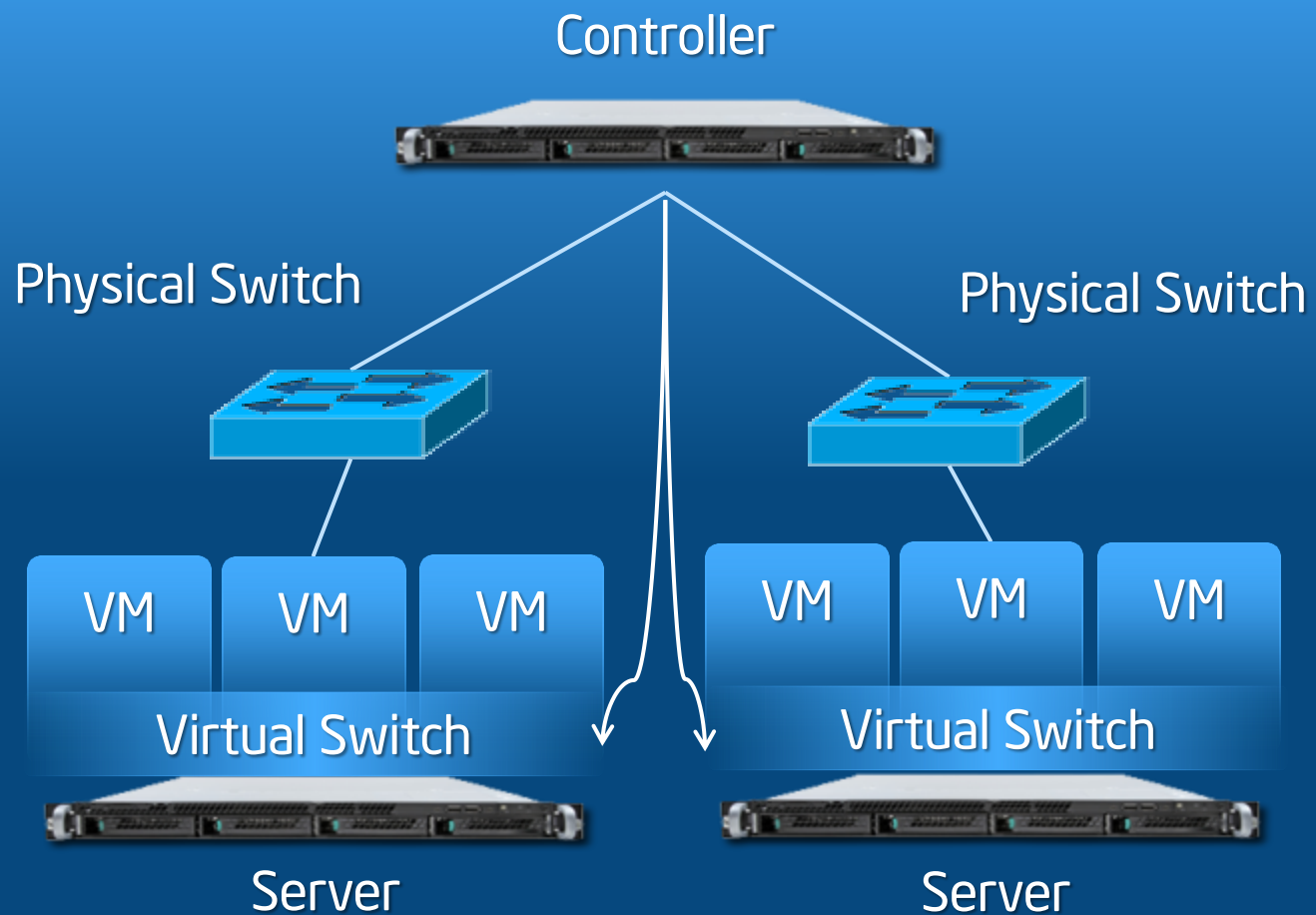
VM:
VPN

VM:
Intrusion
Detection
System

SDN



Architecting the Node... What's Needed?



Open APIs for a unified control plane

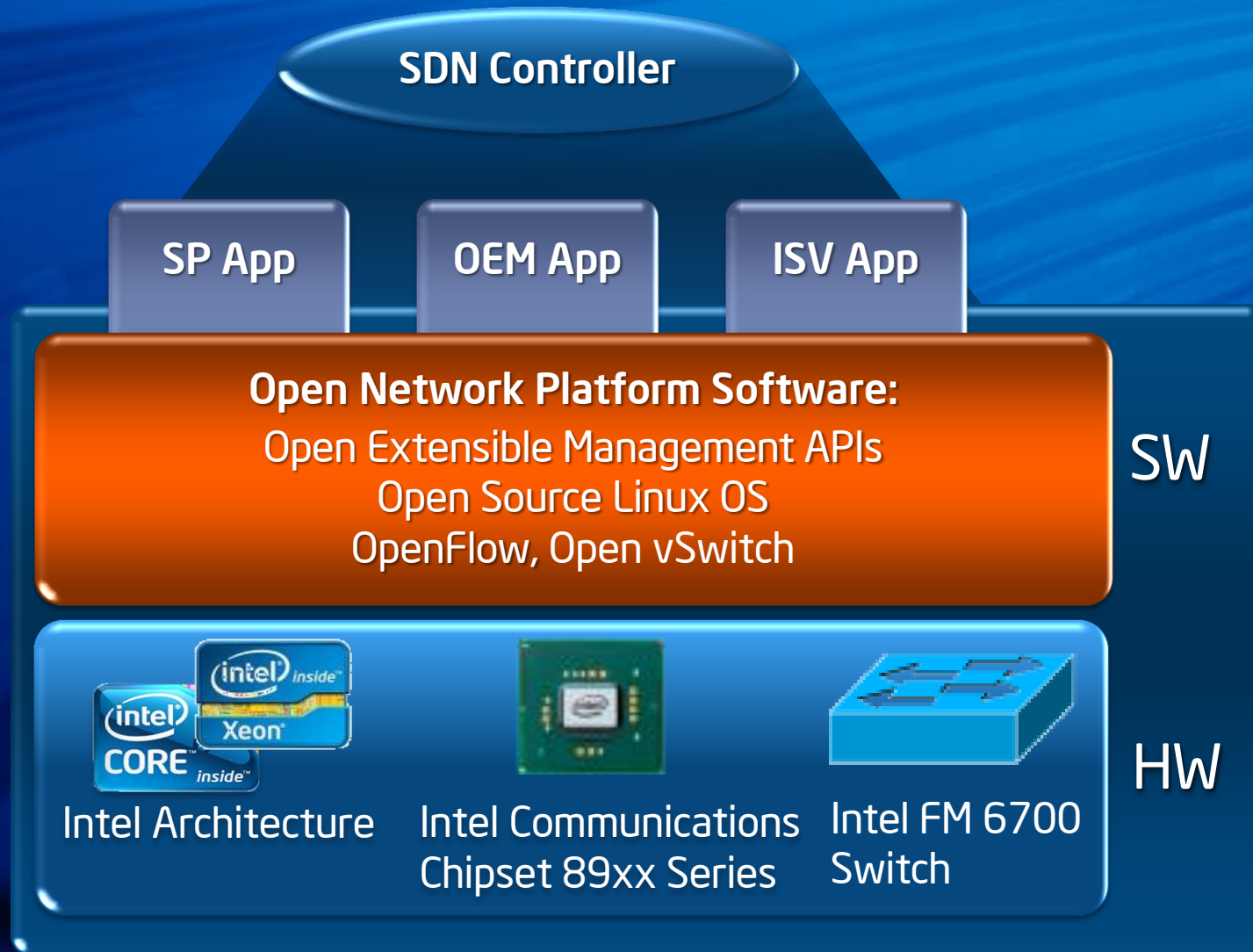
Physical Switching

Virtual Switching

Hybrid Switching

Launching Today

Open Network Platform Switch Reference Design



Intel Product Wind River Product 3rd Party



Launching Today

Open Network Platform Switch Reference Design

Early Development Partners

vmware®

 **VYATTA**
A Brocade® Company

SUPERMICR®

NTT DATA

 **中華電信**
Chunghwa Telecom



AT&T
FOUNDRY™



NEC

big switch
networks



First Production Platform

Quanta™ T3048-IZ1
Optimize Your Datacenter



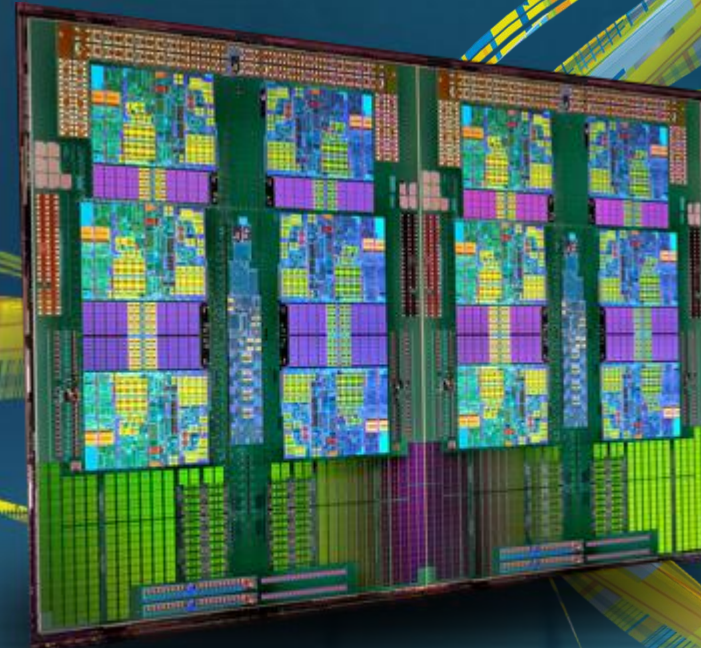


WIND RIVER

*Other brands and names are the property of their respective owners



Announcing Today... Intel® DPDK Open vSwitch



Memory Management

Queue / Ring Functions

Flow Classification

NIC Poll Mode Drivers

Project Objectives
Improve small packet throughput
User space implementation
Compliment Intel's hardware switching
Use existing OVS infrastructure

OPEN vSWITCH
An Open Virtual Switch

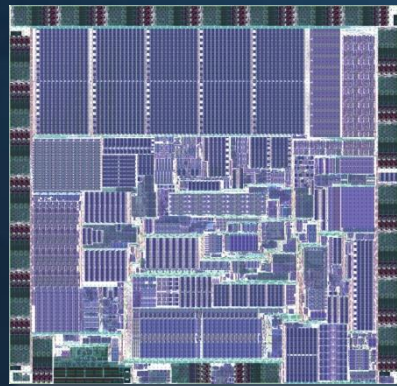


Announcing Today...

Open Network Platform Server Reference Design



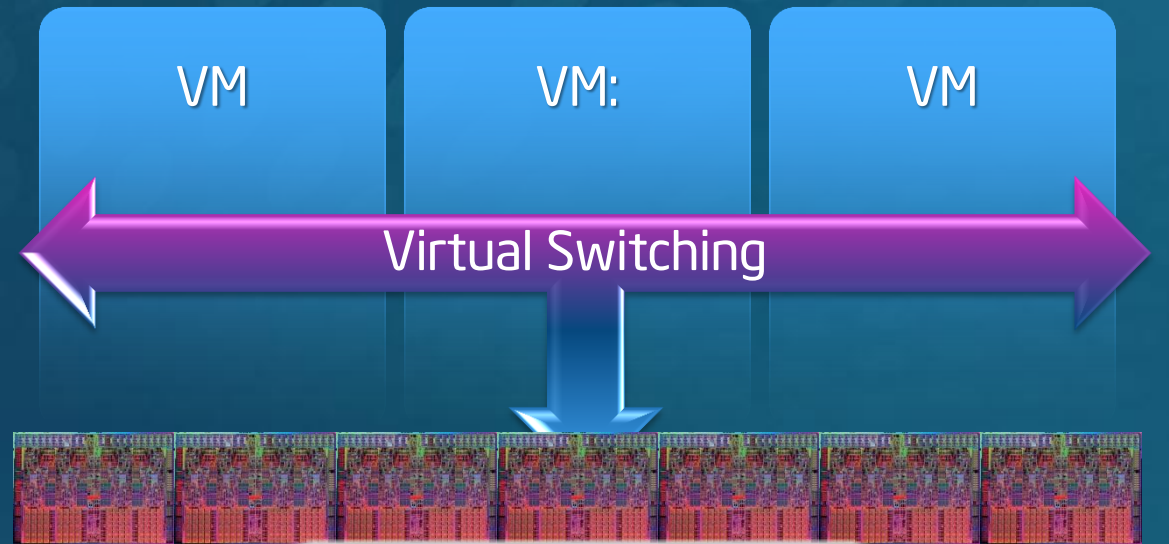
Investing to Lead a New Paradigm in Networking



Physical Switching

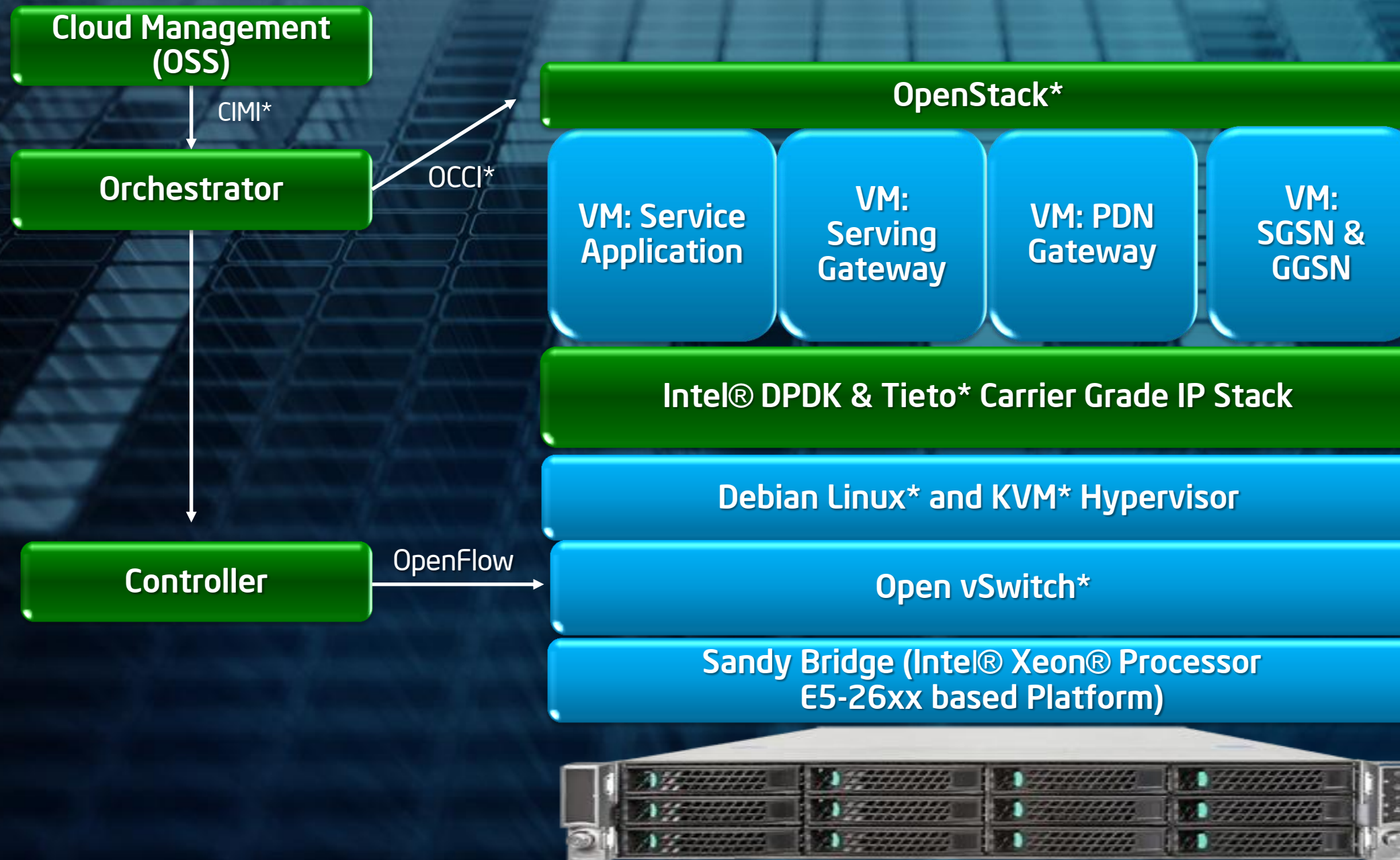


Hybrid Switching



Architecting a Cloud Evolved Packet Core

Intel and Tieto POC



NEC and Telefónica to Collaborate on Network Virtualization

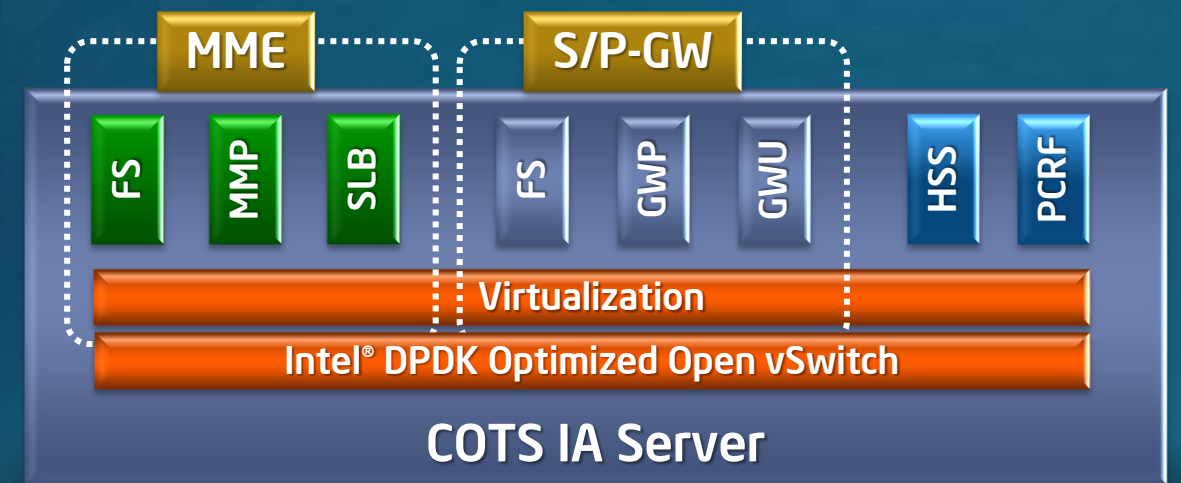
“NEC and Telefónica have produced the first real case study of virtualized EPC (Evolved Packet Core)”

Telefónica
21, 2013

Feb



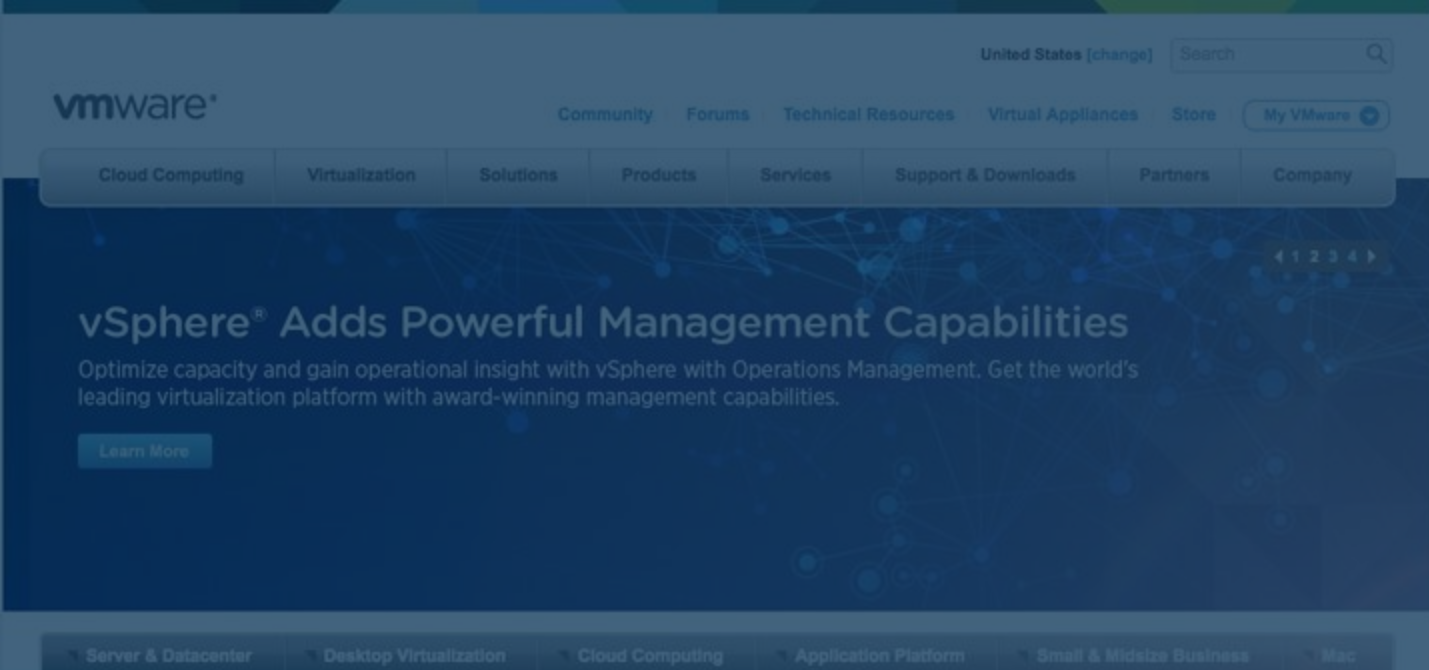
Software-Based EPC Product



NEC

Telefonica

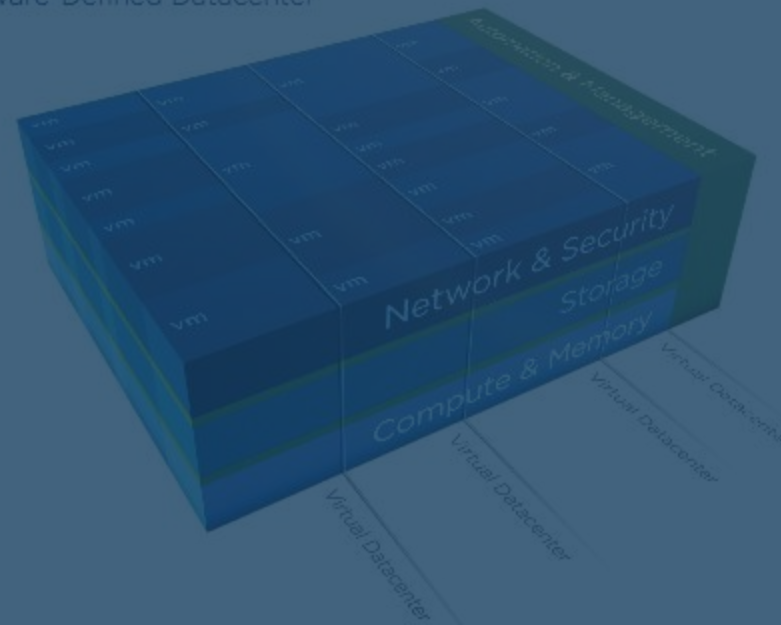




VMware NSX - The Network Virtualization Platform



Software-Defined Datacenter



A screenshot of the VMware NSX management dashboard. The top navigation bar includes 'Dashboard', 'Users & Groups', 'Resources', 'Reporting', and 'Settings', along with a search bar for users, groups, or apps. Below the navigation is a 'Modules' section with several cards. The 'Data' card shows '34,232 files in use' and is 'Enabled'. The 'Web Applications' card shows '128 web applications running' and is 'Enabled'. The 'Mobile Applications' card shows '10 Mobile applications deployed' and is 'Enabled'. There are also 'Alerts' and 'View' buttons. The Intel logo is visible in the bottom right corner.



Allwyn Sequeira
VP, Networking and Security
VMware



VMware / Intel Collaboration

Hypervisor

VT-x

2006

ESX

EPT
QPI/NUMA
VT-d

2008

vSphere

128 pCPU
iSCSI boot
X2APIC

2010

vCloud

TXT
SR-IOV
SMEP

2012

SDDC

Network
Virtualization

TODAY

VMware - The Software-Defined Datacenter

New
architecture
needed:
horizontal SW
building blocks
on x86 HW

Huge
opportunity:
new operating
model will
transform
network
economics

Open standards
critical for
success at
the node

VMware NSX - Transforming the Network for the Cloud Era

Intel IT SDN Proof of Concepts Underway

Intel Intra-Data Center Usage Models



Virtual Switch

Virtual Machine Monitor

Leveraging VMware
Network Virtualization

Tenant A

Tenant B

Virtual Switch

Virtual Machine Monitor

Tenant Based Modeling



Reducing our TCO to deploy VMs

vmware®

Intel DC-Verizon-DC Usage Models

Intel DC

Bandwidth

Cloud DC

Cloud-bursting to increase
bandwidth

Intel DC



Cloud DC

Adding security to Cloud
VMs

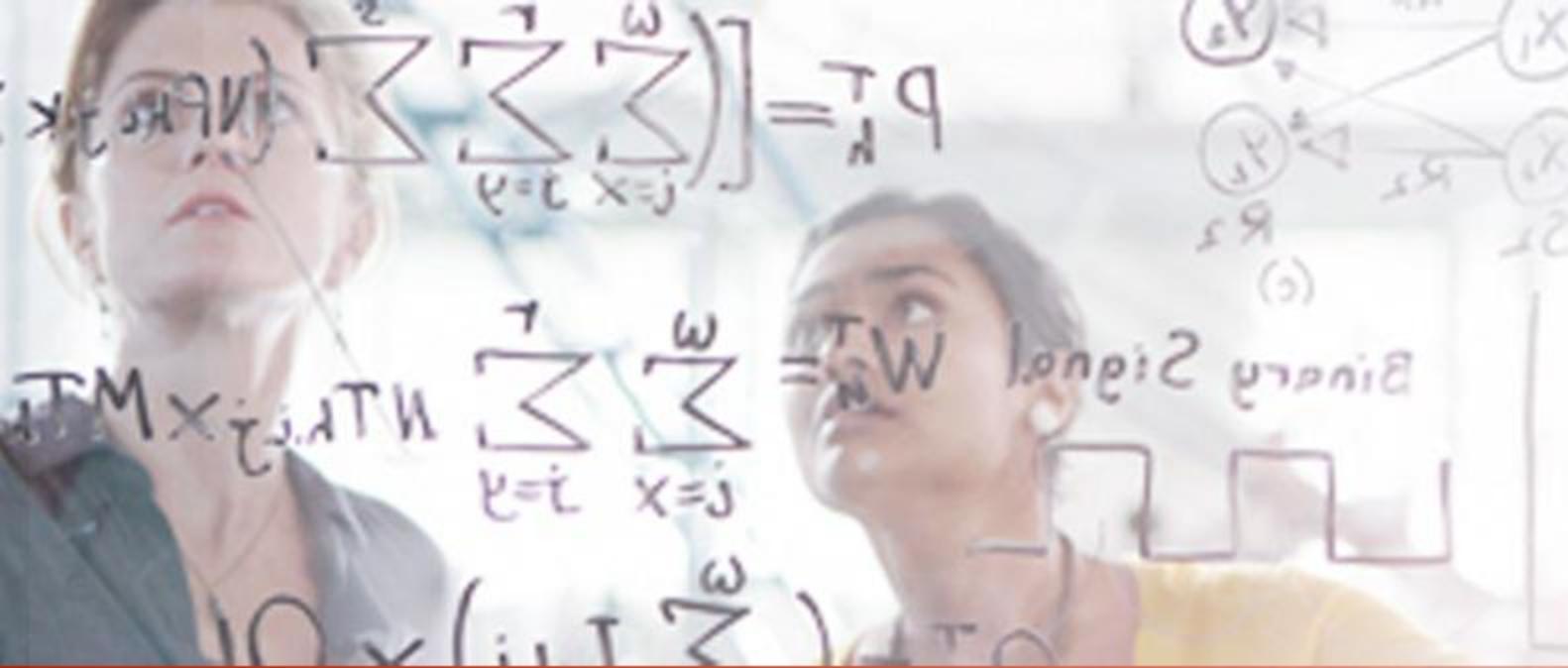
Intel DC



Cloud DC

Network Monitoring

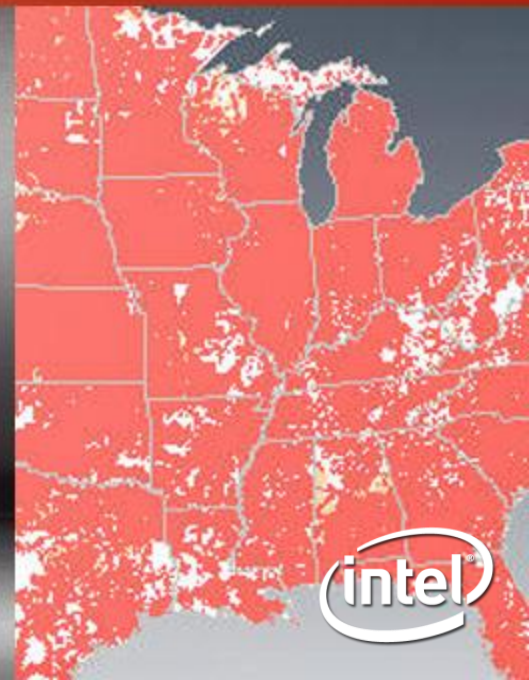




verizon



4G LTE





Prodip Sen
Director of Network Architecture
Verizon Communications



A Brief History of Intel and Verizon SDN / NFV Collaboration

Demoed packet processing on IA

2009

Form Network Cloud Formations Collaboration

2011

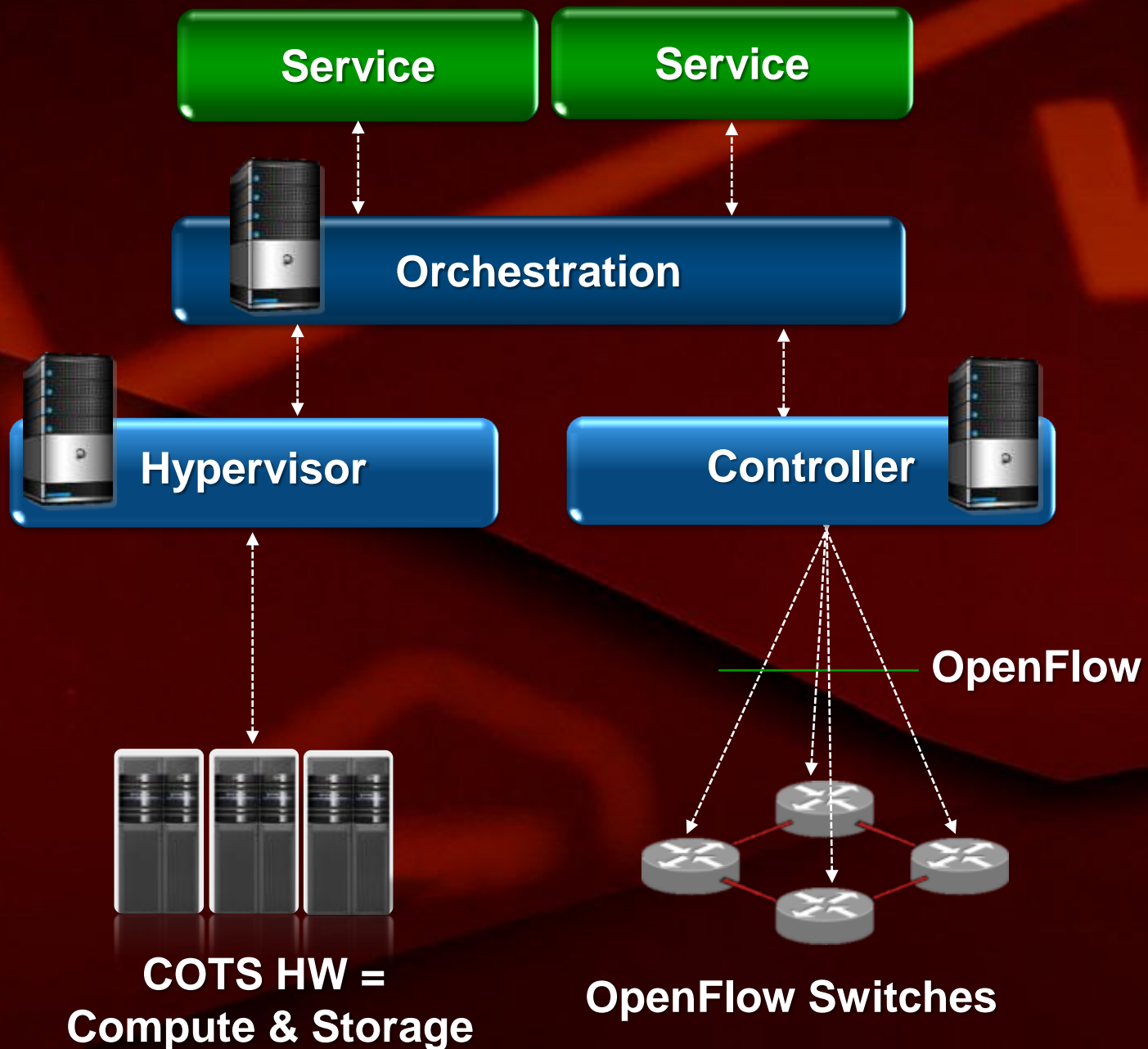
Developed SDN resource pooling demo for ONS

2012

Collaborate on Intel DC to Verizon DC SDN Trials

2013

Verizon SDN and NFV Priorities



Objectives
Better CAPEX ROI
Lower Operating Expenses
Business Agility
New ways to monetize infrastructure

Enablers ("SDN" and "Cloud")
Implement network functions on SHV/COTS hardware
Virtualization of network functions
Application/service aware routing
Orchestration of network and cloud resources

Intel DC to Verizon DC SDN Trial

Cloud-bursting to increase network bandwidth

Adding security to Cloud VMs without physical appliances

Network Monitoring virtualized apps in Verizon's DC



Intel Lab
Private Cloud
Portland, OR



Verizon Lab
Public Cloud
Waltham, MA



HP Lab
SDN SW Development
Plano, TX





Summary

SDN and NFV are Enabling a Network Transformation

Intel and Collaborators are Leading the Transformation across Cloud, Enterprise and Telco

Intel is Investing in Software, Silicon, and Reference Designs to Enable the New Network

