IMAGINE THE POSSIBILITIES...
Reducing the Tradeoff between Performance and Management Using Container and Cloud-Native Approaches

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Market Dynamics – Cable has Evolved

MORE USERS, MORE DEVICES AND MORE BANDWIDTH DEMANDS

- 1.7 Billion Internet Users in 2017, 2.6 Billion in 2022
- 8.6 Billion Devices & Connections in 2017, 13.1 Billion in 2022
- 48.2 Mbps Average Broadband Speeds in 2017, 98.8 Mbps in 2022
- 74% Traffic in 2017, 84% in 2022

Source: Cisco VNI Global IP Traffic Forecast, 2017-2022

EXPERIMENTAL GROWTH IN IP TRAFFIC AND IN WIRELESS

Global IP Traffic by Local Access Technology

By 2022, 71% of total IP traffic will be wireless*

Source: Cisco VNI Global IP Traffic Forecast, 2017-2022

MSOs need to adapt swiftly to the changing market dynamics
Cable Networks – Challenges for Network Transformation

Complex Architecture

Siloed Operations

Limited Scalability and Agility
Cable Networks – What Options Do MSOs Have?

Status Quo
Legacy Appliance-based

Continue expansion with standard appliance-based solution by disaggregation

Scale challenge, operational cost and complexity, siloed approach, impacted TTM

Virtualize
Evolved on Bare-metal

Utilize benefits of virtualization including performance and resource utilization

Operational challenges remain including manageability, high availability, portability and isolation

Next-Gen Cloud
Native on Hypervisor

Utilize true benefits of virtualization including scale and manageability; is future proof

Enables unified converged architecture with benefits of higher availability, densification, and multi-tenancy
Next-Gen Cloud Benefits

**Operationalize**
- Common platform enable deploy and manage multiple K8s clusters along with VMs; provide a consistent experience with simplified LCM

**Scalability**
- Orchestration enables elastic scaling of xNF
- Consistent dimensioning and improved HW utilization reduces space and power required in Headend/Hub

**Faster Time to Market**
- Multi-vendor vast partner ecosystem
- Integrated service blueprinting, deployment, monitoring and management

**Reduced Truck Rolls**
- Remote deployment and self-healing capabilities with leading reliability, high availability reduce truck rolls and need for on-site service technicians

**Reduced Cost**
- Reduced CAPEX by increased throughput and performance
- Reduced OPEX by Intent-based NFVI Assurance

**Easy Convergence**
- Open & Consistent infrastructure, automation and operations enable easy convergence
- Hybrid VM and Container-based applications with advanced networking and security
Next-Gen Cloud Capabilities

**Agility**
- Connect a new bare-metal servers to the container domain in minutes
- SW/HW Decoupling & Abstraction
- Elastic Scaling
- Oversubscription

**Performance**
- Provide equivalent or better workload performance for containers
- High Throughput Capacity
- Low Latency
- SmartNIC offloading

**Networking**
- Implement a single end-to-end underlay network for consistent and simple management
- Centralized Policy
- Advanced Security
- Optimized Data Plane

**Security**
- Run applications securely and efficiently in production
- Strong Isolation
- Proven, Cost Effective, Low Risk
- Micro-segmentation

**Manageability**
- Deploy and manage multiple K8s clusters along with VMs
- Common Platform
- High-Availability
- Multi-tenancy
Next-Gen Cloud Performance – Two Data Plane Acceleration Approaches

1. Offloading with Standard NIC

   • Virtual switch running on the hypervisor
   • Fast Path Acceleration on NIC
   • Standard x86 server

2. Offload to SmartNIC

   • Virtual switch offload on SmartNIC
   • Leverage embedded NIC cores
   • Standard x86 server
Approach 1: Achieve high packet performance in Software

1. NIC Choice
   - NIC Speed to match Cable 10G requirements
   - Simple offloading capabilities (TSO, CSUM…)
   - Overlay support

2. CPU Choice
   - High number of CPU cores for workloads
   - Right balance between GHz/Core Count and Wattage requirements

3. Server Architecture
   - NUMA balance
   - PCIe generation and architecture

4. vSwitch Acceleration
   - Free network from hardware (work on any server, and any modern NIC)
   - Modern, DPDK-based packet processing
   - Dedicated CPU cycles for networking
   - Faster switching with flow cache
   - Lockless Datapath
   - Faster packet processing (SSE)

5. Workload Acceleration
   - Accelerated vNIC (VIRTIO or VMXNET3)
   - Dedicated (pinned and isolated) vCPUs
   - Topology awareness
   - Huge pages support

Hardware Choices

Phase One – Today

Software Choices
High Performance Networking in Software Example

Line rate is 40 Gbps

Next-Gen Cloud performance meets the line rate for relevant packet sizes
Networking in Software Latency and Jitter Results

- **Latency contributed by Cloud Infrastructure is ~ 30% of E2E Latency**

- **Jitter contributed by Cloud Infrastructure is ~ 30% of E2E Latency**
Achieve high packet performance - The SmartNIC Story

**Phase Two – Coming**
Scaling to meet 10G requirements

**SmartNIC-Based Architecture**

1. Move Server Management (HV) to SmartNIC Cores
2. Offload entire vSwitch SmartNIC

**Host X86**

1. Dedicated to workloads (increasing efficiency)
2. Can run either a VM/container or a bare-metal

**Technical Benefits**

- Clear cut between infrastructure and application
- Provides air-gap security
- Cost management
- Application acceleration (e.g. Security, load balancers etc.)

**Organizational Benefits**

- Split ownership clearly
- Multi-tenancy

**SmartNIC-Based Architecture Diagram**

- NUMA 0
  - VNF
  - CNF
  - VM/K8s
- NUMA 1
  - VNF
  - CNF
  - VM/K8s

- Host X86
  - Hypervisor
  - SmartNIC
  - vSwitch

**Application Team**
**Infrastructure Management Team**
Benefits of Data Path Acceleration on Next-Gen Cloud

**Performance**
- Consistent and higher performance envelope
- Break the next performance barrier with Smart-NIC/FPGA
- Lower Latency for 10G requirements
- Low convergence to support key use cases
- Leverage hardware assist where available

**Efficient Resource Utilization**
- Self-tuning infrastructure for high performance
- Improved TCO with better utilization of expansive hardware resources
- Dense packing of workloads in the host
- Full availability of X86 with SmartNIC

**Platform**
- Scalable multi-tenanted networks
- High performance Cloud Native networking
- High Availability & Fault tolerance
- Isolate infrastructure from tenant workloads
Next-Gen Cloud Reference Architecture

Highly Flexible and Programmable

- Extensible to emerging solutions and business models
- Centralized control and management, including embedded automation and optimization
- Highly flexible IAC - infrastructure-as-code
- Heterogeneous run-time environment with Network Function and Resource Isolation
- Commodity hardware and storage
- Integrated operations management

> Solutions Tier

| Content | OTT | vCMTS | Video Core | SD-WAN | L2/L3 |

> Cloud Automation Tier

| Service Orchestration | Global SDN Control | OSS / BSS |

> Resource Orchestration Tier

| xNF Management | SDN Controller | Policy | Blueprints |

> Platform Tier

Shared Tenant Slices

| CNF | CNF | VNF |

Tenant Slice 1...N

| CNF | CNF | CNF | VNF | VNF |

Virtualized Infrastructure Management

> Physical Infrastructure Tier

| Compute | Storage | Network |

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Virtualized Cable Network with Next-Gen Cloud

Data Center
- CDN
- Control
- Media
- OSS/BSS
- VIM / KBS
- Cloud Infrastructure
  - HW

Headend
- Local CDN
- OTT
- VOD
- VIM / KBS
- MUX
- VIM / KBS
- Cloud Infrastructure
  - HW

Hub
- Video Core
- STB Control
- Switch
- Controller
- vCMTS
- Cloud Infrastructure
  - HW

Outside Plant
- R-PHY Node
- Coax
- PON Node
- IP

Customer Premise
- CPE

Virtualized Core
Cloud Automation
Cloud Operations
IP
VIM / KBS
Coax
CPE
HSD & QAM Video
Next-Gen Cable Pod
Transaction
Network
Resource
Control
Media
Cloud Infrastructure
HW
HW
HW
Scale and Convergence with Next-Gen Cloud

Data Center
- SD-WAN
- 5G Core
- CDN
- Control
- Media
- OSS/BSS
- VIM / K8S
- Cloud Infrastructure

Headend
- IP
- R-PHY Node
- CPE
- Coax
- PON Node
- e/gNodeB
- MVNO
- 4G/5G Things

Hub
- Cloud Infrastructure
- Virtualized Headend
- Next-Gen Cable Pod
- HSD & QAM Video
- VIM / K8S
- Switch
- Router
- Controller
- vCMTS

Outside Plant
- Customer Premise
- Business
- Small Cells
- Wi-Fi
- CPE
- Coax

Virtualized Core
- Provisioning
- Cloud Automation
- Cloud Operations

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Thank You!

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