

Can Virtual CPE Be Cost-Effective for Enterprise Customers?

Charlie Ashton, Wind River



Topics

- **Introduction to Wind River in telecom**
- **Business drivers for virtual CPE**
- **Four key challenges for cost-effective vCPE**
 - Service reliability
 - Service agility
 - Virtualization overhead
 - Server footprint
- **Summary**



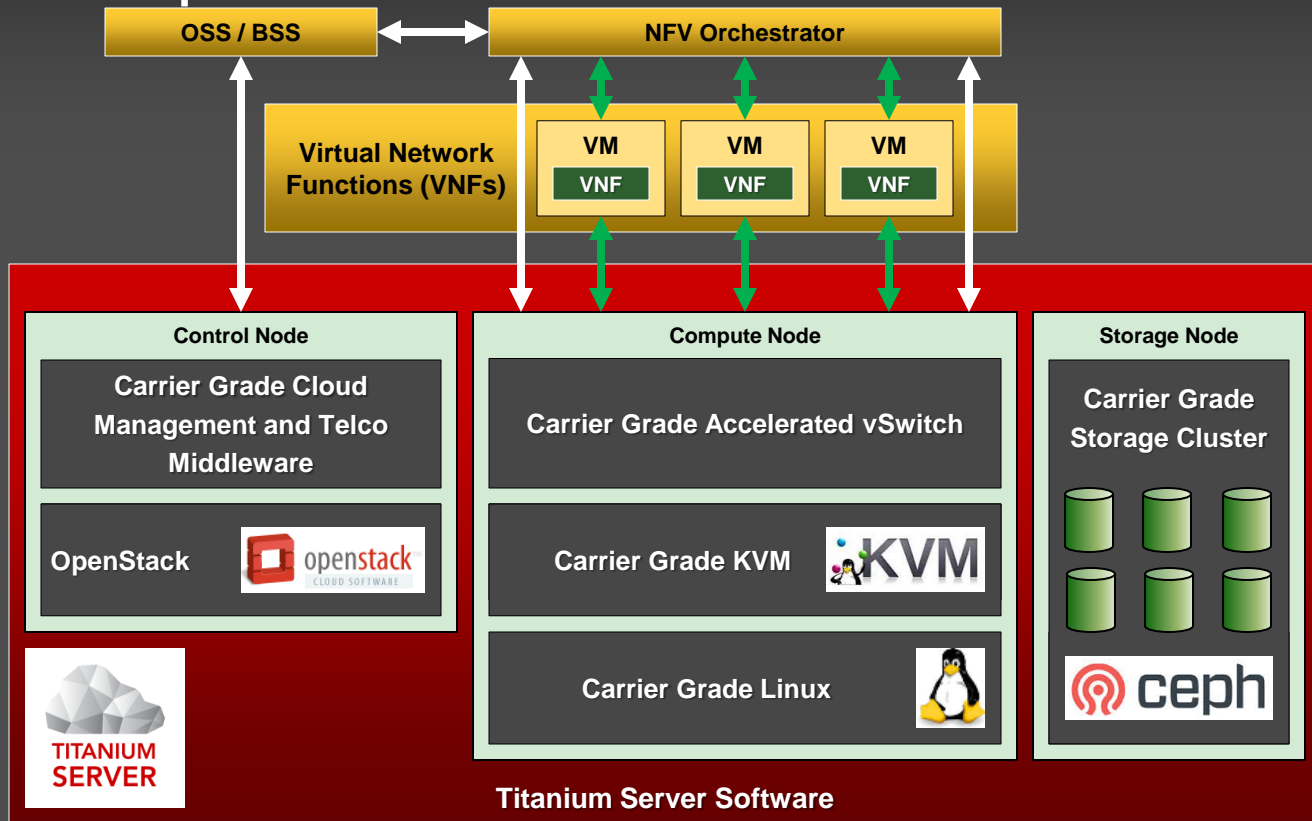
Introduction to Wind River in NFV

- Founded in 1981 as embedded tools and Operating System company
 - Acquired by Intel in 2009
- Our software has been deployed in over two billion devices
 - Where failure is not an option
- Telecom customers include all the top 20 TEMs worldwide

- Solving critical challenges for network virtualization
 - **Titanium Server**: only commercial NFV cloud that delivers the Carrier Grade reliability required for telecom networks
 - Supported by **Titanium Cloud** ecosystem of industry-leading partners



An Open Solution for NFV Infrastructure



- 100% compatible with open standards: no vendor lock-in
- Full Carrier Grade reliability for virtualized services
- Maximum VM density drives OPEX savings

Titanium Cloud Ecosystem Partners



OSS / BSS



NFV Orchestrators



VNFs



Server Platforms

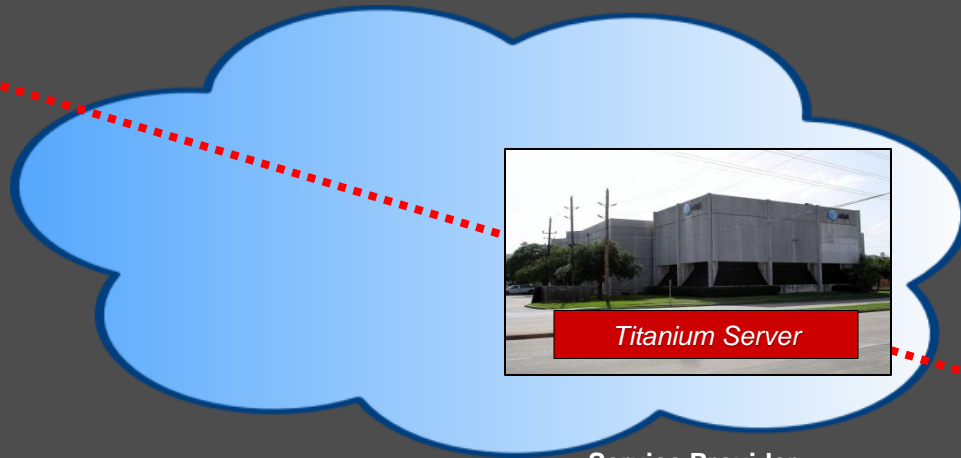


Addressing Multiple Virtual CPE Deployment Options

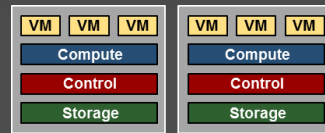
Supporting three deployment models planned by service providers



Service Provider Data Center



Service Provider
Point-of-Presence (PoP)
or
Central Office (CO)



Only two nodes
99.9999% uptime
VNF acceleration
Service agility



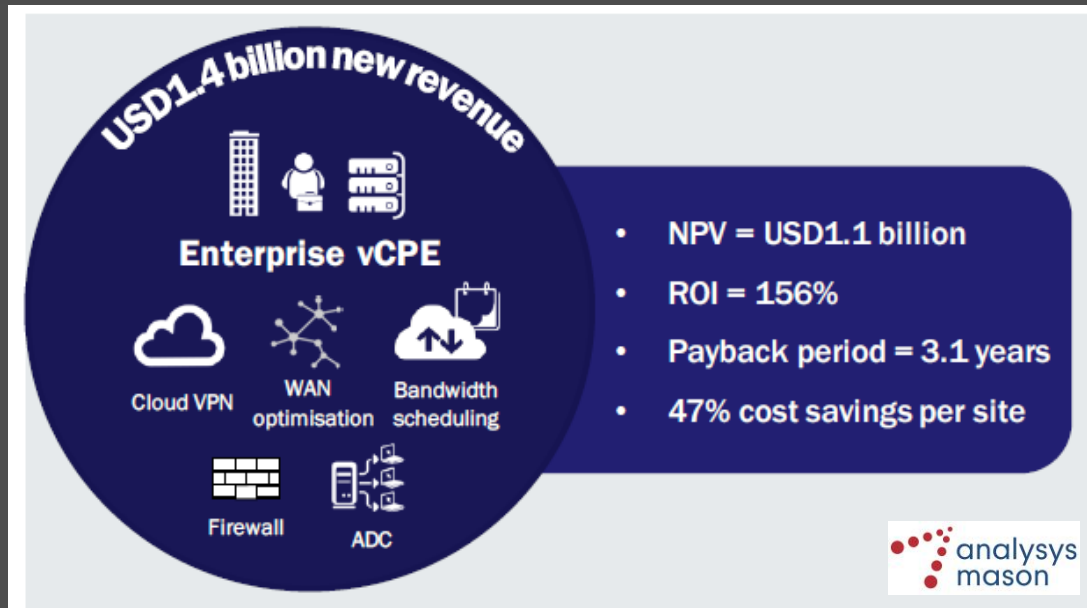
Customer Premise

**VNF partnerships supporting all
three deployment models**



Why Virtual CPE for Enterprises?

Revenue growth plus cost savings for service providers



Revenue Growth from Agile, On-Demand Services

- **Managed network services for enterprises is already a lucrative market for service providers**
 - ~\$135B worldwide in 2016 
 - MPLS, Ethernet, VPN, WAN Optimization, Security
- **vCPE presents significant growth opportunity for first movers**
 - Scalable, automated deployment of existing and new services
 - Self-provisioning by customers accelerates adoption cycle
 - ~5% annual revenue growth per site



New Revenue from Upsell and Cross-Sell of Services

- **Managed network services enabled by virtualization**

- Dynamic VPN configuration
- Dynamic WAN configuration
- Self-service bandwidth-on-demand
- Data center interconnect services
- Security as a service (firewall, DDoS etc.)
- WAN optimization
- Web acceleration

- **On-demand provisioning is key**

- Expectations set by portals from cloud service providers (Amazon, Google etc.)
- Automated, scalable platforms
- User-friendly dashboards
- On-demand instantiation of CPE VNFs

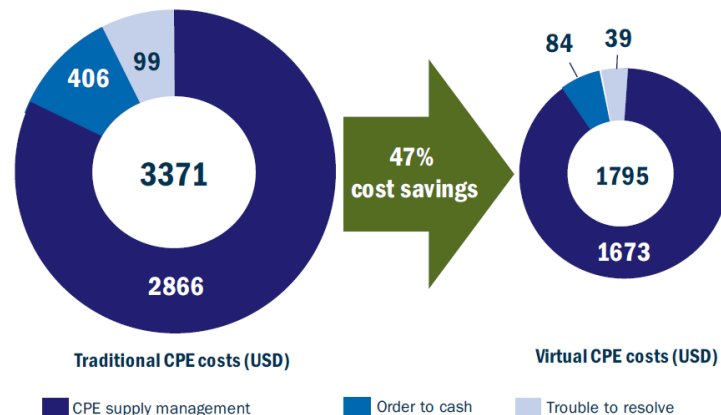


40-50% Cost Savings from Migration to vCPE



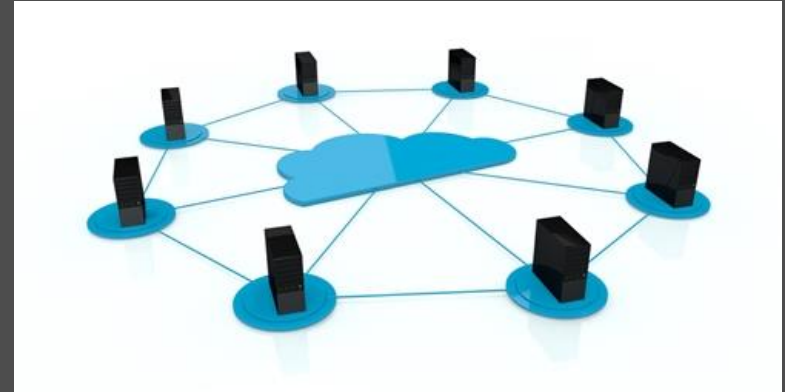
- **Replace expensive, dedicated physical appliances with standard servers**
 - 42% savings in equipment CAPEX and OPEX
- **Remove inefficiencies in manual equipment installation and service provisioning**
 - 72% savings in “Order to Cash” (O2C)
- **Eliminate most truck rolls and accelerate remote resolution of failures**
 - 61% reduction in “Trouble to Resolve” (T2R) costs

Figure 2.1: Summary of key CSP enterprise CPE-related cost splits per site per year before and after 100% vCPE site migration [Source: Analysys Mason, 2015]

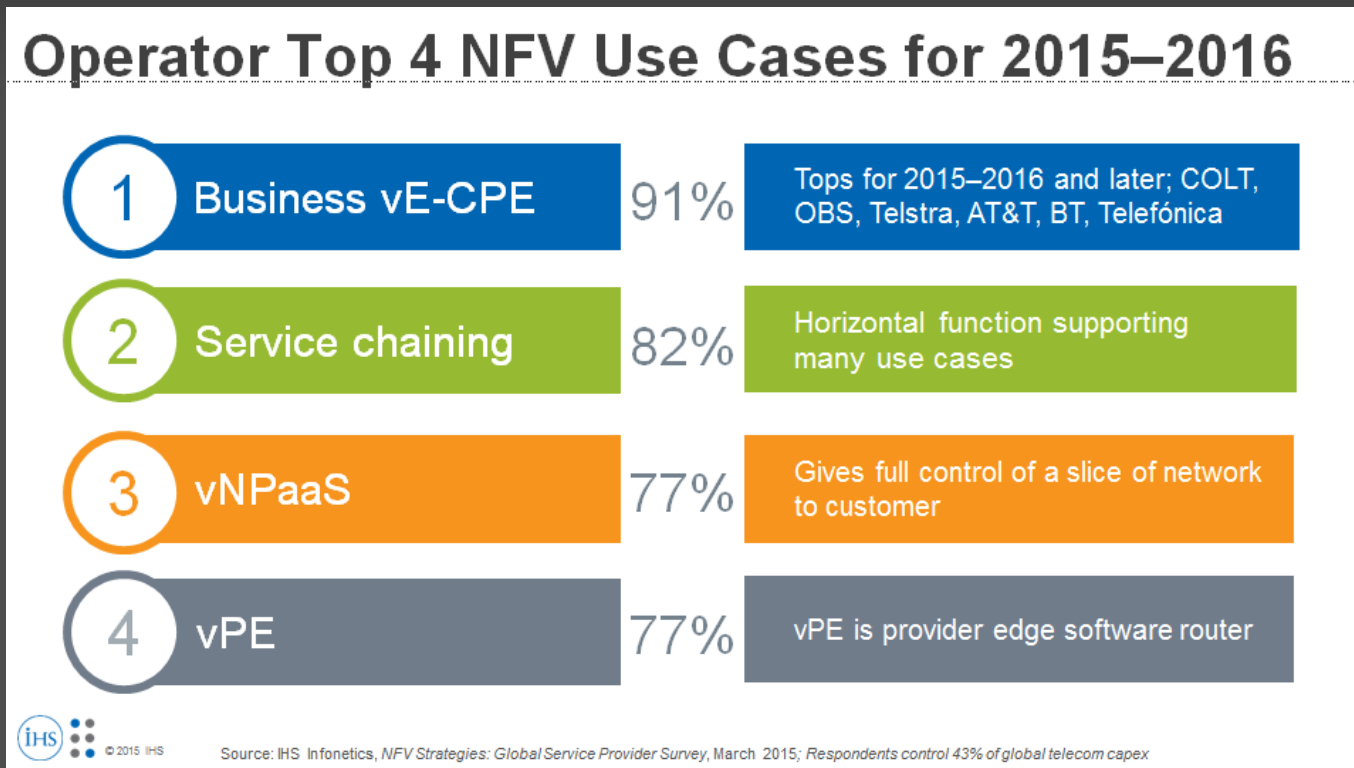


SDN and NFV are Key Enablers for Cost Savings

- **Equipment CAPEX and OPEX savings driven by low-cost standard servers**
 - Efficient resource utilization thanks to virtualization
 - No stranded assets
 - Aggressive VNF pricing driven by competition
- **SDN and NFV drive efficiency in Order-to-Cash**
 - Accelerated, self-service provisioning of new services
- **CPE virtualization minimizes support costs**
 - Customer site repairs mostly eliminated



So.... vCPE is Top NFV Use Case for 2015-2016

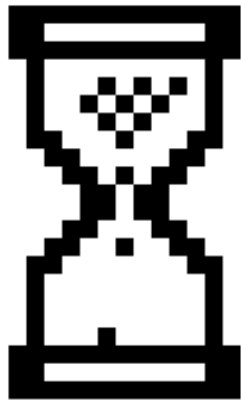


Four Challenges to Cost-Effective Business CPE

- **Service reliability**
- **Service agility**
- **Virtualization overhead**
- **Server footprint**



vBCPE Challenge #1: Service Reliability



- **Enterprise customers expect high reliability from managed services**
 - Whether provided by traditional appliances or delivered by virtual CPE software
 - Typical requirement is five-nines uptime (99.999%)
- **Service downtime impacts service provider revenues**
 - Service Level Agreement (SLA) penalties
 - plus operational expenses
 - plus customer churn

Virtualized CPE services need to maintain reliability of traditional physical implementations

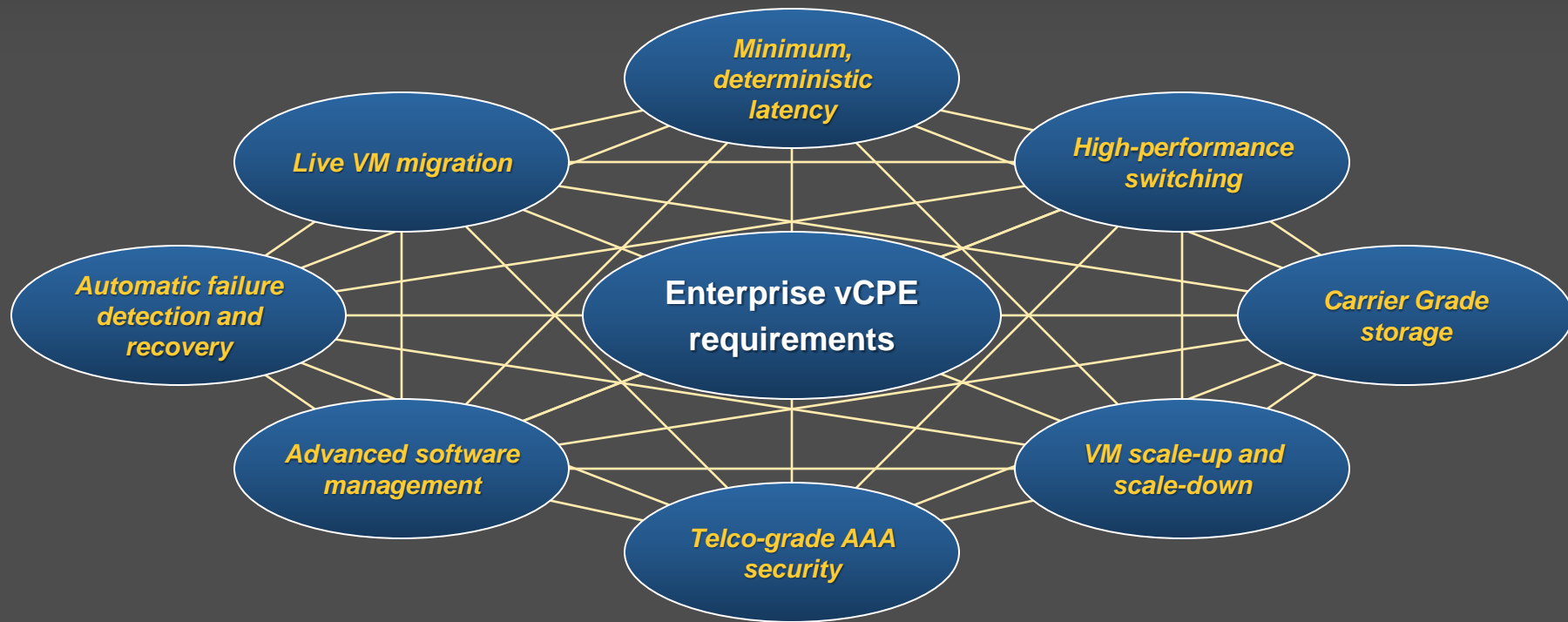
IT Cloud Platforms Don't Deliver Telco Reliability

	IT Platform Capability	Enterprise vCPE Requirements
Detection of failed VM	> 1 minute	< 1s
Detection of failed compute node	> 1 minute	~ 1s
Recovery from control node failure	No support	< 25s
vSwitch performance	1-2 Gbps	Line rate with minimum core utilization
Network link failure detection	Depends on Linux distribution	50ms
Live migration for DPDK-based VMs	No support	Full support




Service Reliability Requirements Are Complex

VM lifecycle management, software updates, security and performance



One Solution that Meets All the Requirements

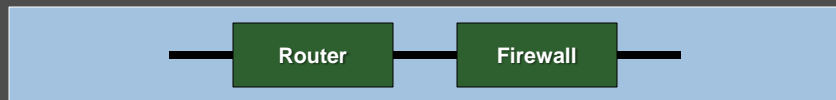
	IT Platforms	Enterprise vCPE Requirements	Titanium Server 
Detection of failed VM	> 1 minute	< 1s	500ms
Detection of failed compute node	> 1 minute	~ 1s	1s
Recovery from control node failure	No support	< 25s	< 25s
vSwitch performance	1-2 Gbps	Line rate with minimum core utilization	40 Gbps with 2 cores (256B packets)
Network link failure detection	Depends on Linux distribution	50ms	50ms
Live migration for DPDK-based VMs	No support	Full support	Full support: 200ms



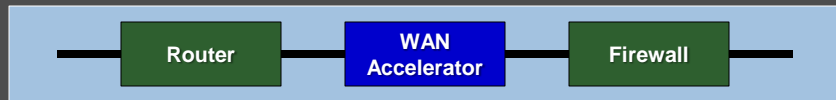
vBCPE Challenge #2: Service Agility

Example

Before:



After:



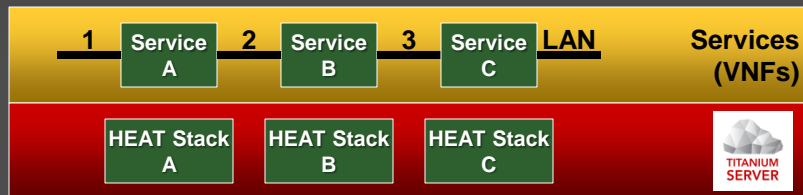
- OpenStack has no primitives to reconnect the firewall interface from the router to the WAN accelerator
- Only options are:
 - Either delete the firewall interface and reconnect, which may lead to ambiguity because firewall rules tied to specific virtual NIC
 - Or provision new service chain from scratch which causes outage of at least five minutes

Need a solution for reconfiguring service chains with minimal service downtime

Two Solutions for Service Chain Reconfiguration

Option 1:

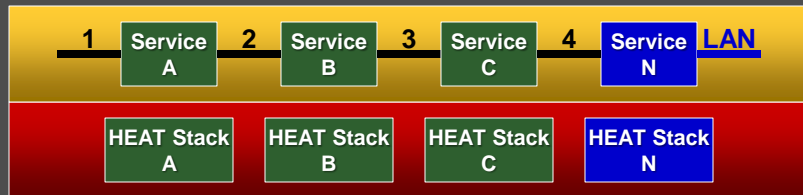
- Orchestrate service chain update using OpenStack
- Accelerated by use of HEAT stack for each service



Initial service chain

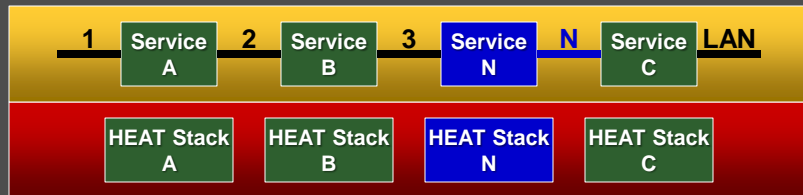
Option 2:

- Reconfigure vSwitch flows using SDN



Add new service at the end:

- *Change Stack C*
- *Create Stack N*



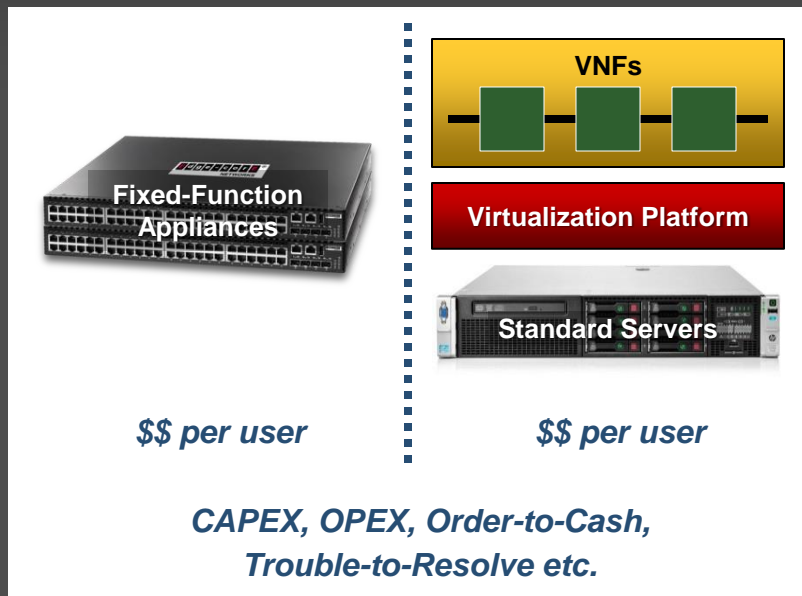
Add new service in the middle:

- *Change Stack C*
- *Create Stack N*

Add a new service in seconds

- vs. weeks or months today

vBCPE Challenge #3: Virtualization Overhead



- **Multiple elements contribute to bottom-line cost-per-user**
 - Needs to be favorable vs. physical appliances
 - Goal is lower costs plus increased revenues
- **Virtualization overhead is a major factor**
 - Off-the-shelf virtual switches have very low performance vs. physical switches
 - Limits VNF performance
 - Causes inefficient resource utilization

Need to ensure that virtualization overhead is minimized

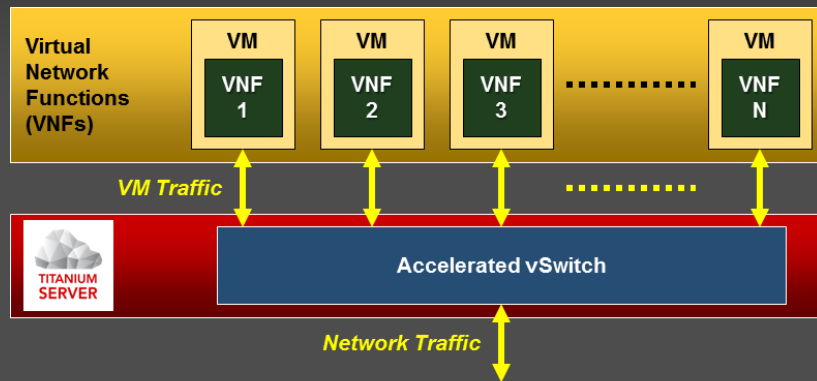
High Performance vSwitching Drives OPEX Savings

- **Example: Accelerated vSwitch integrated in Titanium Server**
 - 40x performance of Open vSwitch (OVS)
 - Fully compatible with Open vSwitch: standard APIs
- **Increased switching performance = greater VM density**
 - Fewer cores required to run vSwitch
 - More cores available for VMs

Greater VM density → reduced OPEX

- More users per server

Virtualization overhead is minimized



Example use case: virtualized media gateway

System configuration:

- 28-core platform (dual socket) with one VM per core
- Bandwidth required: 3.5 Gbps per core (6.8 Mpps per core)

Most efficient implementation using Open vSwitch

- 23 cores required for switching, 1 core running VM, 4 unused

Most efficient implementation using Titanium Server

- 10 cores required for switching, 17 cores running VMs, 1 unused

17x improvement in VM density

vBCPE Challenge #4: Server Footprint

Especially critical issue for customer premise deployments



- **Need to deploy vBCPE on low-cost servers**
 - Customers won't pay more for servers than for physical appliances
 - Solution price has to include VNFs and virtualization platform
- **Must ensure service reliability required by enterprises**
 - Minimum two servers for redundancy on hardware failures
- **Server utilization must be optimized**
 - Only compute nodes run the services that generate revenue
 - Control and storage nodes represent overhead costs

Central Office (CO)



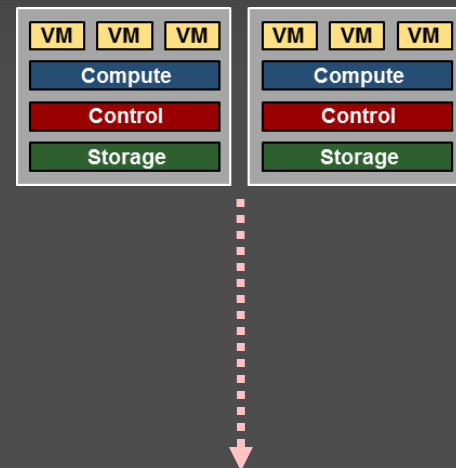
Customer Premise



One Small-Footprint Solution: Titanium Server CPE

Complete, high-reliability vBCPE on just two servers

- **Compute, control and storage nodes instantiated on each server**
 - Only one processor core required for control and one for storage
 - Maximizes cores available for accelerated vSwitch and VMs: revenue
- **Ensures service uptime required by enterprises**
 - Six-nines infrastructure reliability enables five-nines services
- **Accelerated vSwitching maximizes number of users per server**
- **Validated, pre-integrated VNFs for complete vCPE solution**

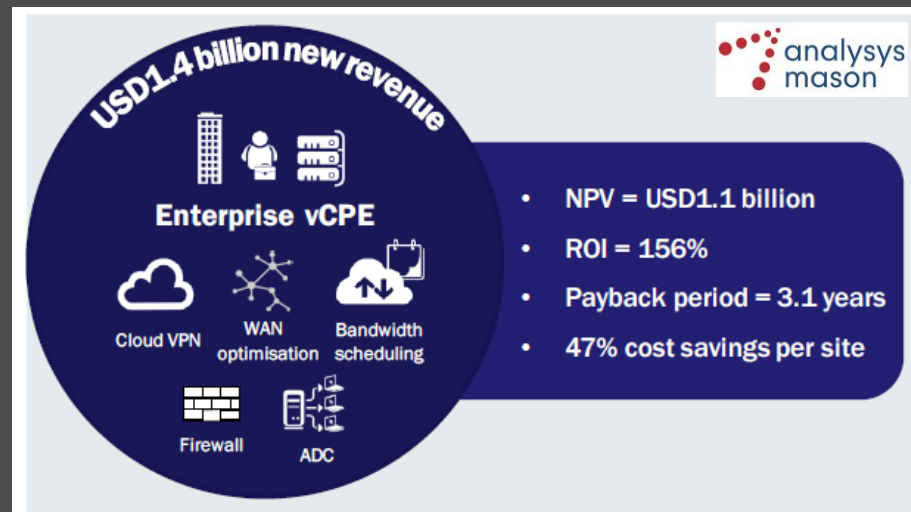


Customer Premise

Summary

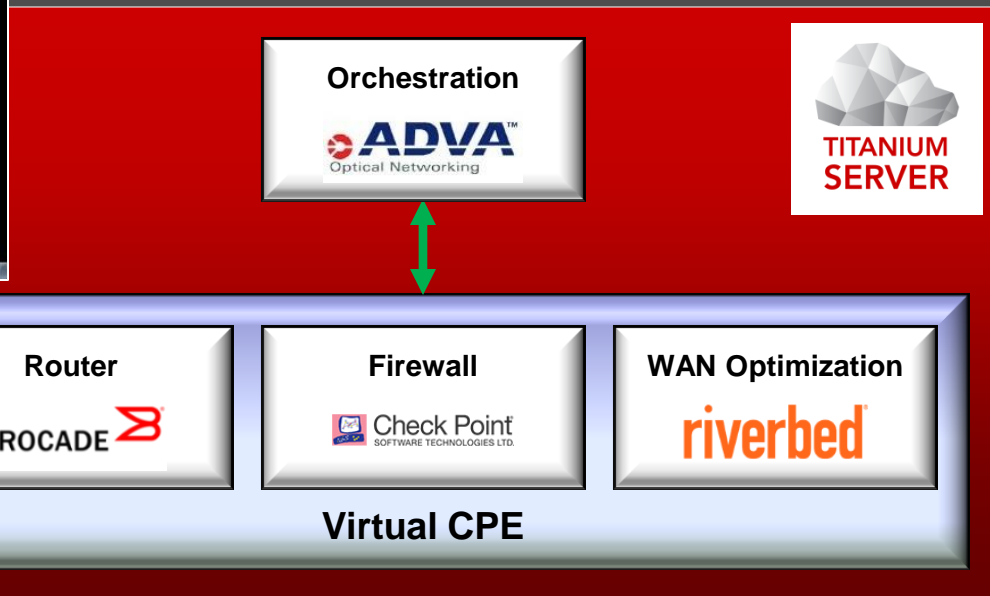
Key challenges to cost-effective enterprise virtual CPE are all solvable

- Service reliability ✓
- Service agility ✓
- Virtualization overhead ✓
- Server footprint ✓



Business upside opportunity for service providers is significant and achievable

Please Come and See Our Complete vCPE Demo



Wind River pod in
the Intel booth