Virtualization Strategy
Changing the Economics of Data Center

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29 January 2016
Virtualization Strategy Topics

A. Overview
B. What are the Drivers?
C. What are the Considerations?
D. What are the Strategies for deployment?
E. SDN-NFV deployment Examples
F. Cisco’s solution offering
(A) Overview
NFV-SDN Timeline

POCs
- Operators, vendors learn in lab
- Few field trials

Field Trials
- Vendors productize NFV/SDN software in operator lab trials
- A few more field trials
- ~10 Commercial deployments

Early Commercial Deployments
- Many operators deploy 1 or 2 use cases
- ~40 more commercial deployments

Wider-spread Commercial Deployments
- Mainstream Adoption
- Operators deploy several NFV/SDN use cases, then more each year

Source: SDN and NFV Vendor Leadership/Global Service Provider Survey, Infonetics, Aug. 2015
NFV/SDN Telecom Market Landscape, Technical Business Research, Oct. 2015
Cisco Service Providers Survey, Nov 2015
Total SDN-NFV Spend by Region

TOTAL NFV/SDN SPEND BY REGION

(Values in $Billions)

- North America
- EMEA
- CALA
- APAC

SOURCE: TBR DATA  Sept 15

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Telco NFV Adoption of Applications & Spend

- SP Routers / Carrier Ethernet
- Carrier IP Telephony
- Evolved Packet Core
Evolving Network Function Trend

1. **VNF – Functions and Applications**
   - **Native**: Applications run on dedicated appliances.
   - **Virtualized**: Functions decomposed for increased granularity.
   - **Centralized & Distributed**: Functions run across mixed environments.
   - **Cloud Enabled**: Applications run in cloud infrastructure.

2. **NFVI – Hardware Infrastructure**
   - **Dedicated Appliances**: Networks based on systems running software on dedicated hardware.
   - **COTS Equipment**: Selected software functions moved from network systems to IT infrastructures.
   - **Carrier Grade Open Source**: Hardware, software, and operations optimized to deliver services to carrier specifications.
   - **Distributed & Cloud**: Applications run in a distributed and/or cloud infrastructure.

3. **MANO – Services and Operations Management**
   - **OSS BSS**: Complex interfaces between multiple business and operations systems.
   - **Orchestration VNF Manager VIM**: Components manage hardware and software and integrate with existing networks.
   - **Integration Interoperability Open Source**: Open interfaces and standards in a multi-vendor environment, existing networks and systems integration.
   - **Analytics Automation**: NFV platform integrated with networks, systems, and analytics for complete automation.

Source: Dell Oro April 2015
(B) What are the Drivers for SDN-NFV Adoption?
Key SDN-NFV Benefits

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automation</td>
<td>OpEx Reduction, Network Simplicity and Service Velocity</td>
</tr>
<tr>
<td>Hardware &amp; Support</td>
<td>Reduced HW CapEx and OpEx</td>
</tr>
<tr>
<td>Web Portal &amp; Self Serve</td>
<td>Customer Friendly</td>
</tr>
<tr>
<td>Real Time &amp; Elastic Services</td>
<td>Optimize Resources</td>
</tr>
</tbody>
</table>
VMS Cash Flow and ROI

Cloud VPN Services
NPV: $286M
IRR: 214%

Cloud Security Services
NPV: $534M
IRR: 220%

Source: ACG Research
TCO Comparison for Cloud VPN Services

76% Reduction in TCO Delivering Cloud VPN

Source: ACG Research
Business Customers Want the Benefits
NFV-SDN Can Deliver
Nearly 9 out of 10 Found at Least One Desirable

<table>
<thead>
<tr>
<th>Simple and easy service ordering and self-provisioning</th>
<th>Highly Desirable</th>
<th>Somewhat Desirable</th>
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</thead>
<tbody>
<tr>
<td>NA</td>
<td>32%</td>
<td>35%</td>
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<tr>
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<tr>
<td>MEA</td>
<td>39%</td>
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<tr>
<td>APJ</td>
<td>52%</td>
<td>34%</td>
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<td>WE</td>
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<tr>
<td>CEE</td>
<td>27%</td>
<td>27%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Automated service and network provisioning, account management and configuration</th>
<th>Highly Desirable</th>
<th>Somewhat Desirable</th>
</tr>
</thead>
<tbody>
<tr>
<td>NA</td>
<td>28%</td>
<td>25%</td>
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<td>APJ</td>
<td>48%</td>
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<td>CEE</td>
<td>20%</td>
<td>18%</td>
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<table>
<thead>
<tr>
<th>Ongoing service capacity scale up or down as needed</th>
<th>Highly Desirable</th>
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<tbody>
<tr>
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<td>MEA</td>
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<td>22%</td>
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<tr>
<td>APJ</td>
<td>36%</td>
<td>47%</td>
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<td>CEE</td>
<td>29%</td>
<td>24%</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Consumption/usage based billing (flexibility to be billed for what you use)</th>
<th>Highly Desirable</th>
<th>Somewhat Desirable</th>
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<tbody>
<tr>
<td>NA</td>
<td>18%</td>
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<td>CEE</td>
<td>33%</td>
<td>10%</td>
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<table>
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<tr>
<th>Turn service on/off on demand</th>
<th>Highly Desirable</th>
<th>Somewhat Desirable</th>
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<td>NA</td>
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<td>36%</td>
<td>31%</td>
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<tr>
<td>APJ</td>
<td>45%</td>
<td>40%</td>
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<tr>
<td>WE</td>
<td>43%</td>
<td>22%</td>
</tr>
<tr>
<td>CEE</td>
<td>31%</td>
<td>27%</td>
</tr>
</tbody>
</table>

Source: AMI-Partners
Service Providers Preferences to Get Access to NFV-SDN Benefits

Switch from current providers to specific service providers that offer such benefits:

- NA: 47%
- LATAM: 47%
- MEA: 34%
- APJ: 68%
- WE: 31%
- CEE: 44%

Source: AMI-Partners
Infrastructure & Support Benefits

Traditional Network

- Hardware Maintenance
- Hardware Test and Certification
- Rack Space and Power Management
- Upgrade Line Cards for New Features
- New Software = New Appliance

Complex and expensive: Each device is unique

Physical and Virtual Network

Modern Data Center

- Standard Servers
- Standard Switches
- Standard Data Center Software
- Standard Data Center Processes

Simple: Common equipment, software and processes

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NFV Use Case Results

TCO Savings: 52%  CAPEX Savings: 49%  IRR: 136%

CAGR
PMO 14%  FMO 8%

CAGR
PMO 13%  FMO -5%
Savings (CAPEX)

Q. What capital equipment (capex) cost saving has your organization derived from implementing SDN?

- Under 10%: 18.1%
- 10-20%: 42.7%
- 21-30%: 29.6%
- More than 30%: 6.5%
- Don’t know: 3.1%

n = 260

Base = respondents indicated that their organization has implemented SDN

Source: IDC’s SDN Survey, September 2015
Innovation and Agility – DevOps, Open Source

Open Source drives faster creation, collaboration & innovation than closed models.
(C) What are the SDN-NFV Considerations
## SDN-NFV Considerations and Requirements

1. Carrier Class Performance, High Availability, Secure, Scalable
2. Host Multiple VNF Physical and Virtual from Multiple vendors
3. Multi Hypervisor, Open, ETSI Compliant, Modular, Elastic and future ready
4. Management & Work Flow Automation on Single Pane of Glass
5. Integration between multiple NFV domains: Single Point of Ownership
6. Operational Skillsets: Software skillsets, Programmability, Interop

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### Optimize Cost, Operational Simplicity, Open Architecture
1: Automation and Orchestration Accelerates Service Velocity

Traditional Physical Network

- Help Desk
- Hardware Maintenance
- Provisioning

Labor intensive:
Low service velocity

Physical and Virtual Network

- Web Portal
- Modern Data Center
- Automated Orchestration

Automated:
High service velocity
2: Workload Distribution Deployment Options for NFV

- In mini-DC in CO/POP: 45% (2015-2016), 27% (2017 or later/timing TBD), 27% (Won't deploy/don't know)
- Resident in CPE on customer premises: 41% (2015-2016), 27% (2017 or later/timing TBD), 32% (Won't deploy/don't know)
- Resident on blade in network equipment: 41% (2015-2016), 14% (2017 or later/timing TBD), 45% (Won't deploy/don't know)
- In DC near CO/POP: 36% (2015-2016), 41% (2017 or later/timing TBD), 23% (Won't deploy/don't know)
- In DC not near CO/POP: 27% (2015-2016), 45% (2017 or later/timing TBD), 27% (Won't deploy/don't know)
- Resident on server customer premises: 18% (2015-2016), 18% (2017 or later/timing TBD), 64% (Won't deploy/don't know)
- Resident on/near cell site or base: 50% (2015-2016), 50% (2017 or later/timing TBD), 0% (Won't deploy/don't know)
3: VNF Considerations (ETSI)
4: Security

Figure 1: Where Security Can Be Addressed as Services & Network Functions Virtualize

Source: Heavy Reading
5: Organizational Considerations

SDN Enterprises IT Department Restructuring Plans

Q. As a result of adoption of cloud and SDN, has your organization restructured or does your organization plan to restructure your IT department toward more of a developer operations (DevOps) model?

- Yes. We have restructured: 22.7% (2014) vs 35.2% (2015)
- Yes. We plan to restructure as a result of SDN adoption: 48.9% (2014) vs 46.8% (2015)
- No. We do not plan to restructure the IT department: 18.0% (2014) vs 28.4% (2015)

Source: IDC's SDN Survey, 2014 and September 2015
## 5: Organization Considerations

<table>
<thead>
<tr>
<th>Role</th>
<th>Responsibility and Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIO/CTO</td>
<td>Set capex and opex priorities and assign senior IT staff member to oversee evaluation, selection, and deployment.</td>
</tr>
<tr>
<td>Senior IT director/architect</td>
<td>Lead effort to identify use cases, applications, and business value and assemble multidisciplinary team to ensure alignment across IT department.</td>
</tr>
<tr>
<td>Networking team/NetOps</td>
<td>Participate in architectural assessment and evaluation, qualify architectures and vendors, and ensure that selection provides required performance, reliability, and scalability.</td>
</tr>
<tr>
<td>Developers/DevOps</td>
<td>Participate in requirements process and ensure that SDN architecture and operational model are aligned with developer and application needs.</td>
</tr>
<tr>
<td>Line of business</td>
<td>Provide input where appropriate and establish business context for IT lead.</td>
</tr>
<tr>
<td>Other IT operations</td>
<td>Provide input where appropriate and participate in multidisciplinary team.</td>
</tr>
</tbody>
</table>

Source: IDC, 2015
(D) What are the Strategies for SDN-NFV Deployment?
1: Deployment Strategy Options

Figure 4: Summary of main network virtualisation deployment strategies [Source: Analysys Mason, 2015]

<table>
<thead>
<tr>
<th>Deployment strategy</th>
<th>Description</th>
<th>CSPs considering this strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service-led strategy</td>
<td>Investment for a new service allows the introduction of NFV for the service in a greenfield-like implementation isolated from existing network complexities. One CSP deployment driving this strategy is Korea Telecom’s VoLTE service built on a virtualised IMS, and launched in 2014</td>
<td>80%</td>
</tr>
<tr>
<td>Lifecycle-upgrade strategy</td>
<td>Investing in upgrading end-of-life infrastructure with VNFS to replace physical infrastructure. This approach does not require the CSP to have an explicit business case for network virtualisation if it can get the upgrade done with the same or a lower budget</td>
<td>15%</td>
</tr>
<tr>
<td>Platform-migration strategy</td>
<td>This is an IT-like approach. The CSP defines a scalable virtualisation platform reference architecture and migrates infrastructure (VNFS) and services onto the platform over time. Migration is triggered by a combination of infrastructure and service investments as in the above two strategies, but avoids the past practice of creating deployment silos. Telefónica’s UNICA platform and AT&amp;T’s Universal Services Platform, a convergent digital voice platform, are examples of this strategy</td>
<td>5%</td>
</tr>
</tbody>
</table>
2: NFV Deployment Approach

- **Use Case Led**
  - Service driven
  - Service Agility
  - Business outcome

- **Infrastructure Led**
  - Virtualize, Programmable
  - Cloudify & Automate Infra
  - Leverage Opensource

- **Orchestration Led**
  - Service Elasticity
  - Ease of Provisioning
  - Time to Market

- **NFV**
  - Use Case Specific, e.g. vMS, VPC
  - Includes VNF-M and NFV Orchestrator
  - Hardware, VIM (OpenStack) and SDN Controller

- **NFVI**
  - Infrastructure led approach aka NFVI is gaining prominence!
3: IT and NFV

IT Clouds
- Public/Hybrid Cloud Services
  - Bare Metal Services
  - vFirewall
  - Web/Email Security
  - IoT/IIoT
  - Workload Mobility
  - IaaS
  - CCaaS
  - DRaaS
  - HCS
  - DaaS
  - HadoopaaS

Core Apps
- OSS/BSS/Billing/CRM/Customer Care
- Big Data
- Dev Ops
- Mobile/Social Apps
- IT Business Apps

IT Apps
- Mobile/Security
- Web/Email Security
- CCaaS
- DRaaS
- HCS
- DaaS

Telco Cloud
- Telco DC: NFV Workloads
- Broadband
  - Vbranch/vMS
  - Virtual PE Router
  - Virtual BNG
  - vRoute Reflector
- Mobile
  - Virtual EPC
  - Virtual IMS/VoLTE
  - Virtual GilAN
  - Virtual WLC
- Media/Video
  - Cloud DVR
  - vTrancoder
  - Virtual DPI
  - Policy Control, AAA, DHCP, DNS
- Appliances
- OSS/BSS/PaaS/ISVs on Common Virtual Infrastructure
- Converged Network & IT Business Domains
- Centralised and Distributed Common Architectural & Management Components
- Converged Platform
- VNFs
  - OSS
  - IaaS
  - PaaS
  - SaaS

IT & Network DC
- IT & Network DC
- Telco Data Center
- IT Data Center
- Current State
- Current State
- Full Convergence
- Virtualize, Consolidate Network Infra SDN Policy Model
- Self-Service Automated Provisioning
- Service Elasticity (Capacity on Demand)

Separate Specialist IT and Network Domains
- Consolidate and Centralize Core Network Fabric Distributed / Specialist Compute Storage & Management Components
- NFVI
- M & A
- OSS/BSS
- IT VI
- M & A
- OSS/BSS
- VNFs
- Converged Platform
- M & A
- OSS/BSS
- VNFs
- IaaS/PaaS/SaaS
- Converged Network & IT Business Domains
- Centralised and Distributed Common Architectural & Management Components
- vCDN
- Vbranch/vMS
- Dev Ops
- Mobile/Security
- Web/Email Security
- CCaaS
4: Agile Development

MVP (Minimal Viable Product*)

- **MVP1: Concept & Spec**
  - Objective: Market Insight, Early Adopters, Feature Prioritization & Testing Market for GTM Elements

- **MVP2: Prototypes & Early Trials**
  - Objective: Driving faster & more effective development mapping to more customer needs at scale with iterative development & flexible models x-MVP.

- **MVP3: Production Release**
  - Objective: Revenue, Further Customer Validation & Buy-In, Partner & Ecosystem Scale

Critical Customer Feedback Stage: 2 Code Drops to Customers, Iterate features based on feedback; MVP2 Gates for Code Quality from “Beta” to Production Quality

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**Time to Achieve Product-Market Fit**

Commercial Traction for Scalable Development & Deliver Model

- **Trial & Error Mode**
  - Without a Lean/Agile Model (CC, EC, EFT, Beta Release, GA...etc)
  - 12-18 months

- **Agile/Lean Model**
  - Min. Feature, Ship, Iterate, Ship, Iterate, Release
  - 5-6 months

- **~6 Month Cycle Gain**
(E) SDN-NFV Deployment Examples
SDN-NFV Adoption Update

SDN Evaluation and Deployment Timing
n=22

Percent of Respondents

Timeframe

<table>
<thead>
<tr>
<th>Timeframe</th>
<th>Percent of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Already deployed or will in 2015</td>
<td>45%</td>
</tr>
<tr>
<td>Already evaluated or will in 2015</td>
<td>36%</td>
</tr>
<tr>
<td>In 2016</td>
<td>9%</td>
</tr>
<tr>
<td>In 2017</td>
<td>9%</td>
</tr>
<tr>
<td>In 2018 or later</td>
<td>0%</td>
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</tbody>
</table>

NFV Evaluation and Deployment Timing
n=22

Percent of NFV Respondents

Timeframe

<table>
<thead>
<tr>
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</table>
Current Operator Adoption

“It’s not just a choice, it’s a must to go from a hardware-centric to a software infrastructure to handle the challenges we face.” — Krish Prabhu, AT&T CTO

Operator Positioning

Key:
- Early adopter
- Mainstream
- Considering or Early Stage

Challenges:
- Cost-revenue disconnect
- Transport-compute cost disconnect
- Slow proprietary upgrade cycle
- Web-scale competitors

Source: TBR
**Market Deployment Leaders**

**Telefonica**
- Initiative: UNICA
- Telefonica has an aggressive road map for NFV deployment, and the operator is working closely with a range of vendors to build reference platforms and solutions for virtualized domains.

**AT&T**
- Initiative: Domain 2.0
- AT&T is a leading NFV adopter and remains on track to virtualize and control 5% of its network by the end of 2015 and 75% of its network by 2020. The company is developing solutions in-house to customize and deploy NFV.

**Verizon**
- Initiative: N/A
- Verizon is less vocal about its adoption of NFV in comparison to AT&T and Telefonica. However, in April Verizon announced that it is working with Alcatel-Lucent, Cisco, Ericsson, Juniper and Nokia Networks to deploy software-mediated solutions by 2016.
Case Study Cost Reduction: VF Germany

- Telco Cloud Transformation
  - Introduce cloud technologies in VF networks to deliver more efficient, reliable and differentiated networks for the future combining Telco strengths and Cloud benefits
  - First Telco Cloud applications virtualized and introduced in live network in 2013 with strong further expansion during 2014

- Vodafone and Cisco are worldwide pioneers in the field of life Telco Cloud deployments learning together and developing our virtualized network
  - Cisco is prime contractor and e2e-integration partner for several virtualization projects (e.g. vNGN, VoLTE, vEPC)
  - Driving design, testing and network implementation steering further partners

Considered TCO for eight services
- Telco Edge Cloud business case
  - 25 % to 45 % CAPEX savings over the next 5 years
  - 30% to 60% OPEX reductions over the next 3 years
NFV Organization Model

Operation Team
- Physical/Current
- NFV-I Operation
- VNF/Tenants Operation

OSS Team
- Physical/Current OSS
- NGOSS

Service Assurance
- Physical/Current
- NFV Solutions

Service Provider Organization

Planning/Design Team
- NFV/NFV-I Planning/Design
- Current/Physical Design

DevOps
- NFV DevOps Team

Delivery Team
- VNF Tenant
- NFV-I
- Current/Physical

Corporate Team
- Finance
- Biz Unit
- Legal

Organization Readiness
- Skillsets
- Process
- Tools
(G) Cisco’s Solution
Cisco Solution Offering

Unified, Flexible and Agile Platform driving SP Infrastructure Transformation
SDN/NFV is a strategic technology transformation

• It's not about virtualizing a VNF on a bunch of servers
• It's about hosting VNFs on an Open, Programmable, Intelligent Network Infrastructure with flexibility to Manage and Automate Services

Leading to high Operational disruption …
Question 1
What will be the Primary Driver for SDN-NFV

a) Cost Savings
b) Revenue Impact – Reduce Churn, Differentiated Offering, TTM…
c) Investment Protection
d) Not currently planning
Question 2
What if your organization’s Approach to SDN-NFV

a) Driven by Virtual Network Function e.g. Mobile Core, IMS, vCPE…
b) Bottom up – Define a NFV Infrastructure (NFVi) Systems Approach
c) End to End – Define Orchestration, to VNF Management to NFVi
d) Not started SDN-NFV
Question 3
What is the Primary Adoption Plan for SDN-NFV?

a) Best of Breed for each component in the SDN-NFV Architecture
b) In House Development & Engineering
c) Partnership with Vendors/Providers to implement Tested Systems offering
d) Not started SDN-NFV