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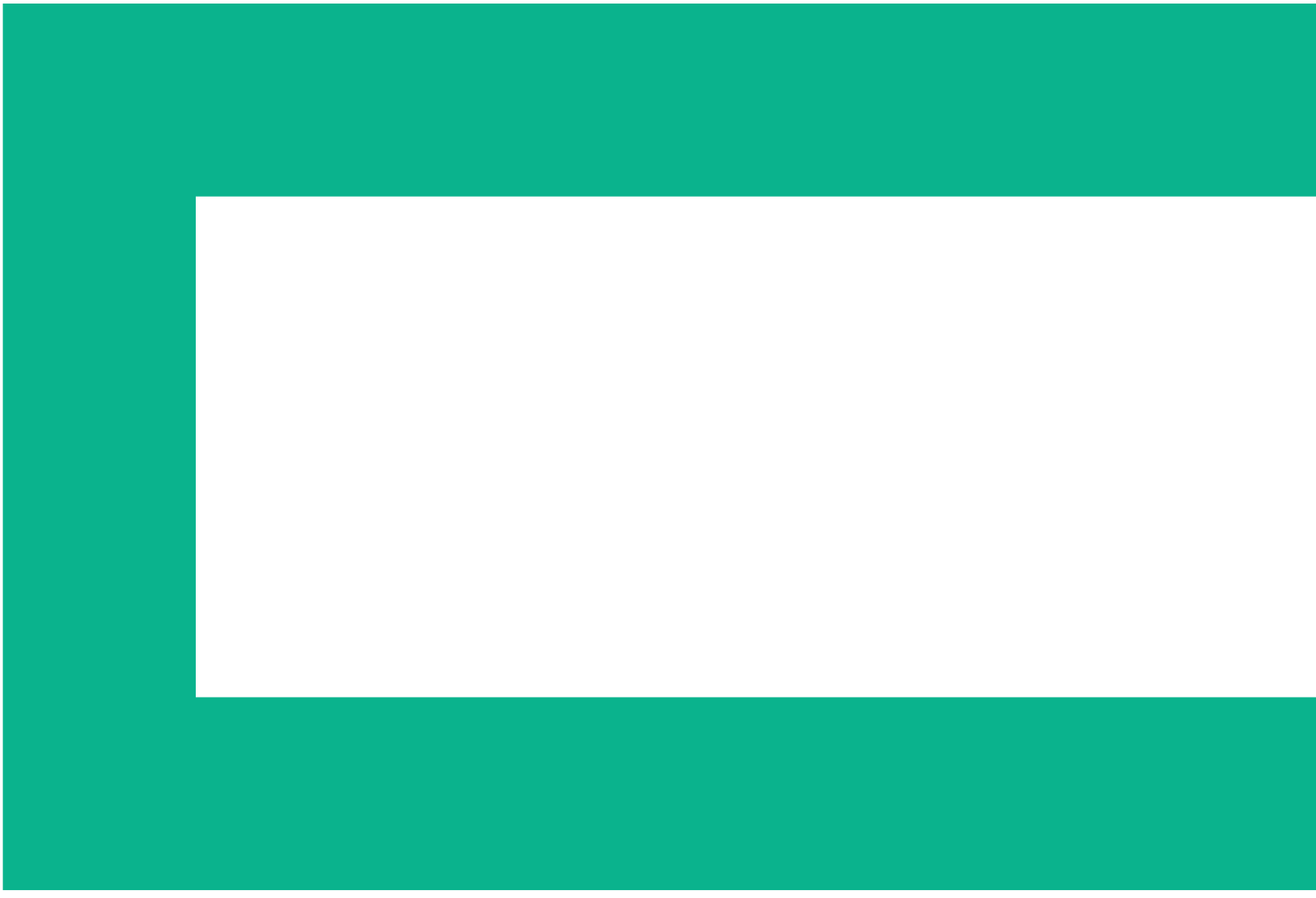
# Your Telco Cloud eZine

Your network. Your customers. Your journey to the Telco Cloud



# In your eZine



# Foreword

Telecommunications and computing were once worlds apart. Today, enabled by the Telco Cloud they work as one.

The Telco Cloud provides a flexible, scalable, highly-available service delivery platform built to enable personalized, on-demand customer engagement. Hewlett Packard Enterprise (HPE) accelerates the Telco Cloud transformation with a complete portfolio of solutions for the communications service providers' (CSP) network infrastructure, service orchestration, and service delivery.

- Accelerate time to value – by moving from proprietary, purpose-built networks to more agile and open cloud networks.
- Accelerate protection – by integrating security on every layer.
- Accelerate Innovation – by empowering real-time actionable customer intelligence through usage patterns, preferences and interest.

- Accelerate productivity – by enabling solutions for CSP that make digital services available and a smarter mobile workplace manageable.

Hewlett Packard Enterprise accelerates the journey to a more agile, efficient, innovative, revenue-generating network. This eZine is just one tool HPE has created to support the industry in this transformation. Your journey to the Telco Cloud is unique, and so should be your eZine. We welcome you to visit often as new articles will always be available.

Learn more about Hewlett Packard Enterprise communication solutions – hpe.com/csp/solutions
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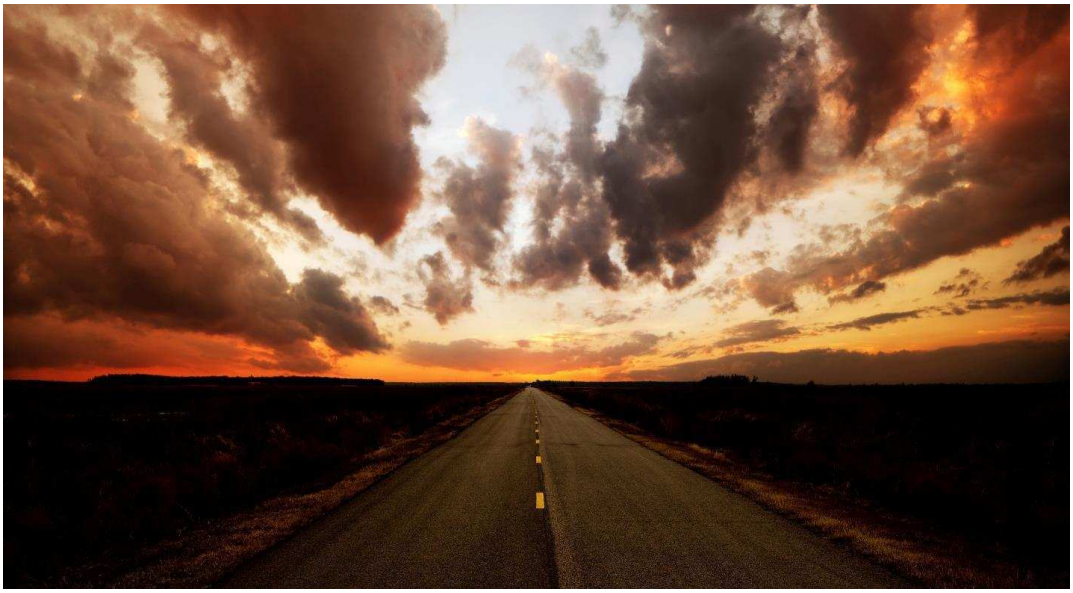
# The Transformation to Telco Cloud



**Part I – Not just any cloud, a *Telco* Cloud**

It's not news that over time OTT competitors and increased infrastructure costs have squeezed Communications Service Provider profits. But since CSPs are who we all rely upon to provide the core connectivity that link us as consumers to providers of network-based services, they are not going extinct any time soon. In fact, when you take a closer look it's clear that CSPs are actually very well-positioned in this competitive landscape to thrive and not just survive.

Why? CSPs have unique strengths – strengths that set them apart from would-be market competitors. They have pervasive presence – serious infrastructure investments in central offices (COs) and point-of-presence (PoPs). Because they have infrastructure-level control of the connectivity that makes the world go they can play a critical role in ensuring that customers get the service they need, especially for stuff like video.

But most importantly, CSPs have customer intimacy – they know customers, and customers know them. Practically-speaking, that means financial and transactional relationships with millions of individuals with whom they transaction billions of dollars of commerce. Any way you slice it, that's an incredibly valuable resource.

So where could CSPs leverage those strengths? There are no shortage of opportunities to expand business with existing customers – both individual consumers and enterprises – and create service offers to go after new specialized market verticals or creatively partner with other market players (like those OTTs) to drive 'win/win' business growth and better customer outcomes.

So what's stopping CSPs from using their incumbent market position to go after these opportunities? The truth is CSPs will not get there with the wonderfully useful networks and operations models they built over the last 20 years. To thrive in the new market reality they will have to be much more agile, efficient, and innovative. They need to do this not only to make going after those opportunities practical, but also to make doing so financially attractive to internal stakeholders and shareholders.

What CSPs need to evolve to be – how they need to transform to get them the agility, efficiency, and innovation they need to compete - is what can be called a **Telco Cloud**. To understand what Telco Cloud means for this transformation we have to talk about where CSPs need to go without losing sight of who they are and what they do.

The wellspring idea of Telco Cloud is that CSPs need to embrace and use all the wonderful technologies that have emerged in Enterprise IT – standardization virtualization, standardization – ultimately manifest in cloud as a transformative service delivery and consumption model. These core technologies will be the catalyst to help CSPs compete. But that's only half the story; the kind of cloud model we are talking about here is not just taking enterprise technology and dropping into Telco networks. Though the technology underpinnings are shared, building and running a Telco network is not at all similar to operating an Enterprise IT environment. *Telco* Cloud means starting with that great Enterprise technology, adapting it, and implementing it in ways that meet the unique requirements of a Telco network environment.

**Part II – the anatomy of a Telco Cloud**

Now that we've reviewed what Telco Cloud is, at the very highest level – namely the adaptation and deployment of Enterprise IT/Cloud technology to help CSPs transform their existing networks – now we'll drill down on exactly what makes up a Telco Cloud.

At the infrastructure level, Telco Cloud means transforming the resources to make them programmable – enabling E2E control and management of resources, exposing those capabilities in the form of accessible APIs, and being able to instantiate new network functions on demand. NFV, SDN, and cloud-based service deliver & consumption are key initiatives that can propel this transformation.

While infrastructure transformation is an important part of what CSPs need to do, it's only half the story; to make meaningful improvements in agility and efficiency CSPs have to focus on operations. This means transforming current operations frameworks to be more automated – tying together orchestration of physical and virtual environments, having a common data model, and exploiting all that to enable real-time and long-term analytics. End-to-end service orchestration, analytics & closed-loop automation, and customer experience management are key initiatives to focus on here.

With the combination of a programmable infrastructure and automated operations as a platform, CSPs have the tools to deliver personalized and on-demand services that are built on an infrastructure and operations 'engine' that is scalable and always available.

What will the evolution from what CSP networks look like today to what they will become as they move to Telco Cloud? The answer is that existing CSP deployments – Telco central offices and points-of-presence built on silo'ed, monolithic systems - will look more and more like cloud data

centers deployed by enterprises. Those cloud data centers will be built on open platforms that let CSPs leverage a wide range of enterprise technologies – virtualization, cloud/resource provisioning, and scale-out capacity expansion – and let CSPs move away from fragmented operations to a much more horizontally-integrated approach.

This transformation will not be easy and it won't be without challenges. However, there are a few simple principals that CSPs can keep in mind to increase chances for success. First of which is to focus on implementing open solutions to take full advantage of industry innovation. Only open solutions will let CSPs pick-and-choose from the best enterprise technologies the industry has to offer. Secondly, they should focus on transforming operations in a way that aligns new & existing resource provisioning frameworks to truly realize enhanced agility & real cost savings. And lastly, but most importantly, they must understand that beyond the technology transformation Telco Cloud represents, this is about transforming how CSPs work, collaborate, and operate. Organization change, done is lock-step with the technology transformation that frame Telco Cloud, is the only way CSPs will 'operationalize' innovation. In the end analysis Telco Cloud is a powerful tool, but only a tool. For CSPs to be successful their people need to learn how to put it to work effectively.

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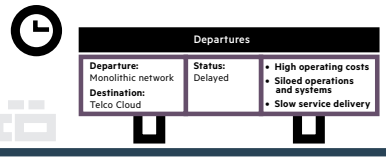
## The journey to automated operations

1

Enter destination coordinates: **the Telco Cloud** – increase agility, efficiency, and innovation.



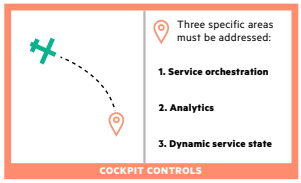

2

### Load the cargo

Essential for any journey to the Telco Cloud, be sure to leverage a common information and data model that bridges physical and virtual infrastructure.

3

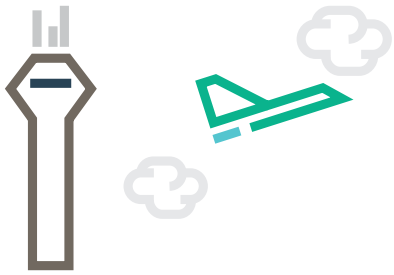
### Plan your route




4

### Take off

Dynamic management of the state of a service keeps workflows simple and lets you launch your service operations into full swing.



### Turn on service orchestration autopilot

Automate processes and orchestrate services across a hybrid infrastructure with the agility of cloud delivery models.

5

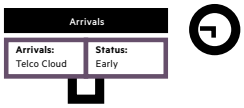
6

### Queue tailored onboard services

Intelligent analytics and closing the loop between assurance and fulfilment can transform data into valuable, monetizable, and actionable service offers.

### Welcome to the Telco Cloud

You arrive at your destination – an agile network that can manage old and new hardware with the ability to launch new services and automate resource management, to realize new revenue streams and reduce costs – in days, not months, and with minimal risk.

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# The journey to programmable infrastructure

Enter destination coordinates: **the Telco Cloud** – increase agility, efficiency, and innovation.

## Pack your trunk

Essential for any journey to the Telco Cloud, be sure to plan for a rich partner ecosystem supported by open, carrier-grade solutions.

1

Start

Now leaving monolithic network

proprietary hardware

truck roll

vendor lock-in

2

## Plan your route

3

Three specific areas must be addressed:

1. NFV
2. Carrier SDN
3. Cloud

GPS – MANO

## The open road

NFV platform based on open standards lets CSPs deploy a network that best suits their needs.

ETSI – Communication Technology

ONF – SDN

TM Forum – Management

OpenDaylight – SDN

OPNFV – NFV

OpenStack – Cloud Computing

4

5

## Travel in a well-oiled NFV machine

Leverage a partner with IT/cloud experience and telco expertise to move to a virtualization model that deploys new services quickly and easily while providing a vast ecosystem of pretested, proven solutions.

OIL

## Accelerate through service deployment pit stop with SDN

A carrier SDN fabric is the foundation for a programmable network that accelerates tailored service deployments and optimizes resource utilization.

6

7

## Cloudy with a chance of carrier-grade

Count on always-on availability, reliability, and performance enabled by a highly scalable environment and streamlined delivery leveraging cloud technologies.

Capacity Peak

## Welcome to the Telco Cloud

You arrive at your destination – an agile network that integrates old and new hardware, with the ability to launch new services, respond to customer needs, and realize new revenue streams – in days, not months, and with minimal risk.

Finish

Welcome to Telco Cloud

8

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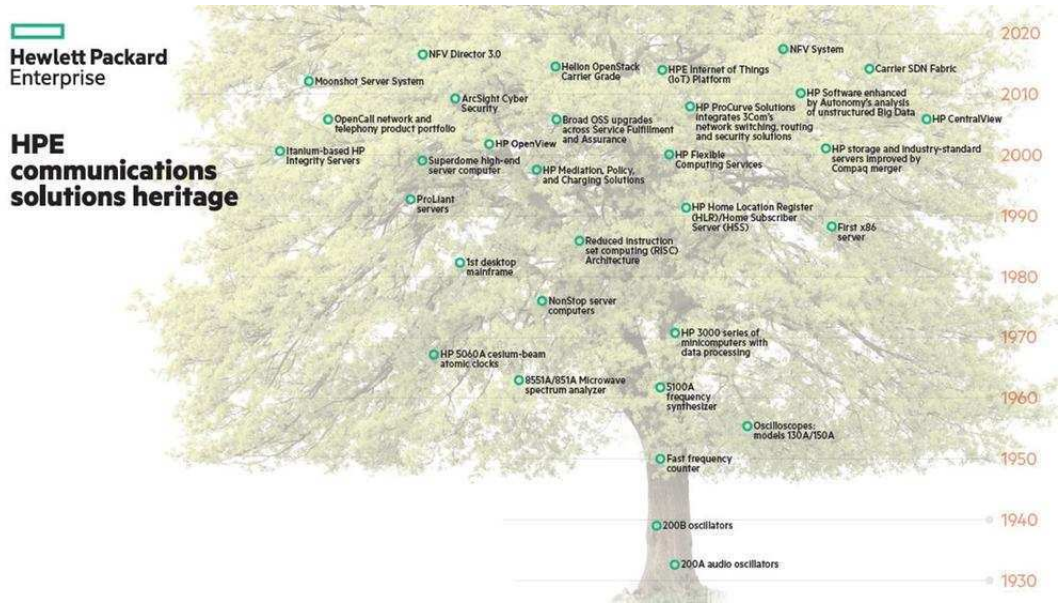
# Our HPE Communications Solutions Heritage




**Author: Jeff Edlund, Chief Technologist, CMS, Communication Solutions Business**

Have you wondered to yourself how HP seemingly burst onto the scene of Telecommunications in September of 2012 with the emergence and advent of Network Functions Virtualization? Have you additionally wondered how an IT giant would think it could be the upstart and disrupter in the next generation of solutions for the Communications Service Provider (CSP)? Well rest assured it is no accident and it didn't happen overnight. HPE and the companies that have been merged or acquired into our capability matrix have a rich, 80+ year history of not only shaping communications with point products but building the communications infrastructure of the world with our CSP solutions for the network.

Bill & Dave started the dalliance in communications back in the 30's by creating the world's first low cost, accurate and configurable audio oscillator. What were audio oscillators used for you might ask? Well HP oscillators were used to design, produce and maintain telephones, stereos, radios and other audio equipment. Audio Oscillator equipment of the time were very expensive, $200 - $300 and most were designed for a fixed set of frequencies. The HP 200A retailed for $54.40, was configurable and was the foundation that Hewlett Packard Enterprise was built on. Fast forward through the next 30-40 years and HP continued is influence and dominance in the communications industry with frequency counters, spectrum analyzers, microwave equipment, atomic clocks for syncing signals and finally the innovation of some of the first mini-computers in the HP 3000 series of data processing systems.

Other IT processing companies were not sitting still and several of the companies that were destined to become part of the HPE family and story were bringing their own innovations to the communications industry.

Digital equipment was doing its own work and making its mark on the IT world with it's PDP and VAX technologies for data processing. What many won't know however is that Digital equipment recognized early on that general purpose computers such as the MicroVax could be used to disrupt the digital signal processing and voice platforms of the day that were very specialized with standard IT technology. Using a combinations of powerful 32bit processing technology, DSP cards from partner vendors and new software written by Digital Equipment and partners the category of general purpose voice response units for telecommunications was created.

Tandem computers at the same time was using its NonStop technology to completely revolutionize Service Control Points and Home Location Register technology for the CSP network. Early in mobile communications the database that held the subscribers entitlements of use on the network were held co-resident with the telephony switch. Tandem recognized an opportunity to disrupt the market and technology by applying its NonStop compute and database technology to centralize the entitlement and service control databases and remove them from the switch. This had the impact of radically reducing the cost for an individual switch as well as vastly improving the overall management and operations of the call entitlement and control environment.

HP was using its own technology in its recently formed OpenCall business unit to start providing next generation CSP network solutions on general purpose computers using standard programming languages allowing significant innovation to start to occur when the closed network appliances used in the network started to become programmable IT like computers. Fast forward again and the innovation just continues. Imagine yourself, in September of 2012, with 3 of your HPE colleagues at the conference facilities of Orange Telecommunications in San Francisco, preparing to present this crazy idea how IT processing technologies and Commercial Off the Shelf Systems have matured enough that you believe they can be applied to solving today's, as well as future problems in the CSP network. The term LCN or Light Core Networking is used to describe along with SDN (Software Defined Networking) how these technologies will transform the economics and agility of the CSP Network. It was an interesting and exciting time as the 13 CSP's present, led by David Clarke from BT, stopped our meeting, went to a side conference room, and wrote a paper that would be presented one month later in Darmstadt Germany initiating the NFV (Network Functions Virtualization) ISG (Industry Specifications Group) within ETSI (European Telecommunications Standards Institute).
HPE CMS not only was at the forefront of creating this new technology wave, we were also busy driving the standards within ETSI for this new technology. Marie-Paule Odini, Chief Technologist CMS was elected the Vice Chair of the ISG Technical Steering Committee. At the same time Marc Flauw, Chief Technologist CMS was recognized as being the top contributor to IFA013 & IFA015 in ETSI NFV (Interfaces & Architecture).

Did HPE stop to assess the situation and wait to see what unfolded? By no means! HPE tapped into its innovative DNA creating the NFV business BU to help address the infrastructure requirements of this new method of network delivery in the carrier environment. This was soon followed by the acquisition of ConteXtream to give HPE a carrier class SDN capability for our overall CSP portfolio of solutions.

This is an exciting era and new chapter for HPE. Never would I thought I would see the dominant Enterprise IT company in the world, find a way to put together the voice processing knowledge and capabilities from Digital Equipment, with the Subscriber Data Management expertise from Tandem, couple it with the signaling and processing expertise from the Hewlett Packard Enterprise OpenCall business unit. Then disrupt and transform the enablement

infrastructure for these solutions with Network Functions Virtualization, modernize with Software Defined Networking capability from ConteXtream and design a new business specifically for the needs of the Carrier, Operator and Service Provider.

Well, it's here! HPE Communications Solutions Business has the combined expertise of over 80 years of innovation in the communications industry that is being brought to bear solving the most vexing problems for the CSP.

What's in store for the future of the next 80 years? Who knows? But I will predict two things: First, in 80 years you will no longer be carrying a smartphone with you. Second, HPE Communications Solutions Business will have shaped that future and will still be providing meaningful solutions to our customers.

# Behind Oz's Curtain: Research on New Revenue from the Telco Cloud

**Author: Bala Thekkedath, Director of Marketing, NFV at Hewlett Packard Enterprise**

For years, the largest communications service providers (CSPs) have relied on wireless service to offset declines in landline voice while still providing modest revenue growth. Those days may finally be coming to an end. With over-the-top players having jumped into the game, the economics of wireless services will never be the same. Connectivity isn't as valuable as it used to be, and as a result, STL Partners estimates global telecoms services revenues will drop from roughly $1 trillion in 2013, to just $700 billion by 2020. CSPs can either change the way they do business, or risk losing over $300 billion in potential revenue. That sort of choice is no choice at all.

## Stormy weather, friendly clouds

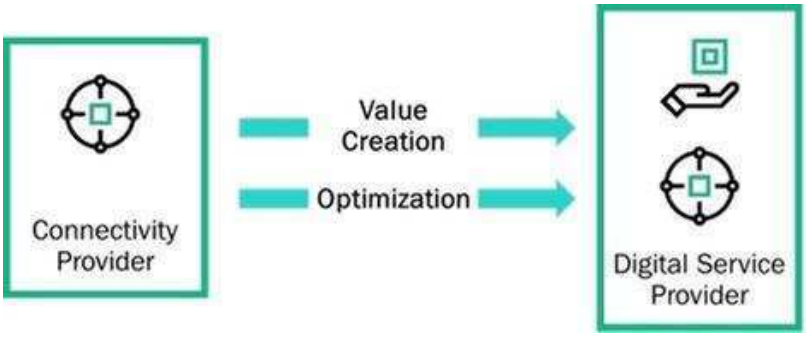
A new approach is needed to turn this grim choice into a ripe opportunity, one that features not only better infrastructure and operations, but which is also software-defined and automated to maximize efficiency and support delivering new ideas quickly to keep pace with customer demand. We call this platform the Telco Cloud.


The shift won't come easily. At their core, CSP networks are collections of proprietary appliances, custom built for specific applications and managed by custom software – and often provided by a single or few dominant vendors. The good news is that many CSPs ARE making the leap. They are gradually virtualizing every element of their existing CSP networks and then bringing in a more modern infrastructure to beef up the capabilities of the aging hardware already in place.

The key to this shift are two technologies: network functions virtualization and software-defined networking. NFV decouples the network functionality from underlying hardware systems that hosts them. SDN separates the control mechanisms for those network functions from the act of forwarding data. Together, NFV and SDN lets CSPs instantiate network functions as and when needed and scaled up/down depending on needs, improving efficiency at a scale CSPs have never before seen.

### 4 emerging revenue opportunities

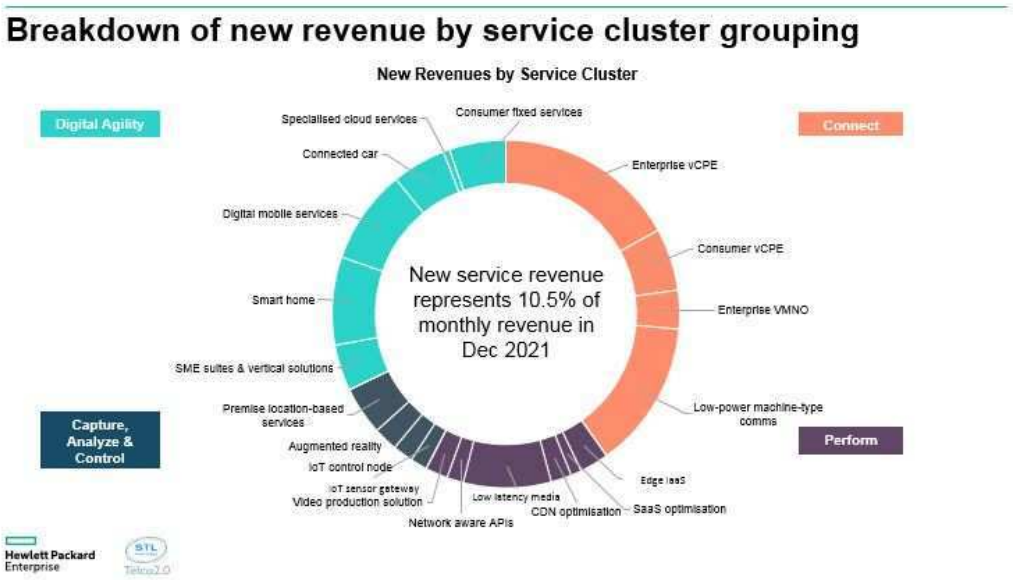
Few businesses are better positioned than major telcos to deliver new services to a greater populace. The Telco Cloud is their catalyst, turning a connectivity-slinging CSP into a value-creating digital service provider.




We see this transformation unleashing new services in four categories:

- **Connect services:** Connect services refer to the optimization of connectivity and networking, similar to existing connectivity and networking services but are delivered and consumed in a more cloud-like way.
- **Perform services:** This category describes services that ensure optimized delivery of content and applications to the consumer; this is particularly important for services that require high bandwidth or low latency.
- **Capture, analyze and control:** These services are less mature and are often dependent on the implementation of more advanced technologies. This category refers to networks that are “two-way,” with the potential for response and action at the edge of the network; this contrasts with existing networks that are more one-way orientated.
- **Digital agility:** Finally, the fully realized Telco Cloud is digital from the ground-up, capable of delivering unique services anywhere. We asked nearly two dozen major telcos to weigh in on their use of the Telco Cloud and the majority said they’re following this path and also see growth

in the transition. Using existing industry data we modeled the likely base revenue for a converged telco operating in a mature European market such as the United Kingdom. Factoring in a combination of voice, data, managed services and consumer digital products results in roughly $1.6 billion in revenue in 2016, declining to about $1.5 billion by the winter of 2021. Adding gross revenues from new services delivered via the Telco Cloud improves the total by 10.5%.




## A software-defined future

Gains will come slowly and steadily, improving as work to implement the Telco Cloud continues. Personalized, high-value services will become easier to deliver with each passing year, reaching its apex when the traditional CSP infrastructure is fully digitized. The future of telco will be governed by platforms that are software-defined and digital native. For the CSPs losing clients and revenue to more agile and responsive competitors, it can't get here fast enough.

Download the entire report at: hpe.com/csp/TelcoCloudReport

# HPE Helps Organizations Increase Agility and Simplify the Network

Cloud-managed, SDN-enabled unified wired and wireless networking portfolio helps IT derive business value from the network

LAS VEGAS — Today at Interop Las Vegas, HP announced new cloud-managed, software-defined networking (SDN)-enabled unified wired and wireless network solutions that help customers to increase the agility of their network while simplifying its management.

The new solutions—including the HP Cloud Managed Network Solution, IEEE 802.11ac wireless access points and SDN applications—expand the industry's most complete unified wired and wireless portfolio.(1) These new solutions are designed to support mobility initiatives for businesses of all sizes by providing improved mobile end-user experiences delivered at triple the speed. Plus, HP's unified wired and wireless network offerings combined with SDN open the door for new business opportunities, thereby enabling IT professionals to derive business value from the network.

"Enterprises need adaptable, robust, easily deployed and secure wireless LAN solutions as more users are accessing the enterprise network via mobile devices while increasingly using these devices for mission-citical applications,: Rohit Mehra, vice president, Network Infrastructure, IDC. (2) SDNbased and cloud managed wireless solutions will provide tools that offer network managers greater flexibility and scalability and, more importantly, programmability of networking resources to support the needs of their businesses.

"Our customers are telling us that their networks are primarily cost centers that are too complex to manage, while they are at the same time facing increasing end-user demand for a better mobile experience," said Bethany Mayer, senior vice president and general manager, Networking Business Unit and Network Functions Virtualization Business, HP. "With HP's cloud-managed and SDN-enabled unified wired and wireless solutions, we are enabling IT organizations to provide an improved mobile user experience, as well as offering simplified management and investment protection."

**Cloud managed wireless network simplifies management and increases agility**

To address the increasing complexity of legacy network infrastructures, the HP Cloud Managed Network provides an easy-to-manage network solution for small and mid-sized businesses (SMBs) and distributed offices. The solution lowers total cost of ownership by reducing the need for onsite IT staff and lowering upfront costs by up to 30 percent(3) with a pay-per-use cloud service model.

**Unified wired and wireless on-premises solutions provide network agility**
With more mobile devices being used in the workplace and congesting the network, IT professionals struggle with providing a high-quality end-user experience. The new HP 560 and 517 IEEE 802.11ac wireless access points offer network agility, enabling organizations to support the growing number of mobile devices, while improving the user experience with speeds three times faster than 802.11n.(3) The HP 560 access points will also be OpenFlow-enabled, empowering customers to leverage SDN applications without having to rip and replace existing infrastructure. To further help IT organizations on their SDN journey, the new HP SDN Roadmap Services create a pragmatic and detailed transition roadmap aligned with business goals.

To bridge the gap between wired and wireless control, new controller appliances deliver consistent policy management across wired and wireless networks, eliminating swivel-chair management. With up to 40 percent(4) higher scalability than competitive solutions, the HP 870 Unified Wired-WLAN Appliance provides reliable application performance for end users, supporting up to 30,000 devices. For midsize to large enterprises, the HP 850 Unified Wired-WLAN Appliance supports up to 10,000 devices.

HP is supporting customers' bring your own device (BYOD) initiatives by partnering with Citrix and MobileIron to offer best-in-class mobile device management (MDM) integration with the HP Intelligent Management Center (IMC) platform. Further, with HP Secure BYOD Services and IP Address Management Services, employees are connected and productive within minutes.

"Omnichannel commerce has driven the need to create a new customer experience, which requires agile and secure IT," said Pascal Trecult, chief technical officer, Monoprix. "HP was able to easily integrate with our partner Wellcoms Technology to deliver streamlined connectivity with a unified wired and wireless management strategy for our network across our 500 plus stores, all while helping us increase sales with targeted advertising."

**SDN-enabled location technology delivers new revenue generation opportunities**
The new HP Location Aware SDN application locates any wireless-enabled device indoors with approximately two meter accuracy—up to five times more accurate than competing alternatives.(5) Powered by technology developed at HP Labs, the company's central research arm, HP Location Aware enables a wide range of new context-aware retail, asset management and security applications. This application will be integrated with the HP Virtual Application Networks (VAN) SDN controller and is designed to help businesses transform wireless LAN infrastructure into revenuegenerating vehicles.

HP Communications and Media Solutions (CMS), leveraging big data analytics and Location Aware technology, has developed a proof-of-concept application called SmartShopper. Designed for both retailers and service providers, SmartShopper enables enterprises to tighten relationships with their customers and monetize the network delivering real-time, location-based offers to customer's' smartphones.

Using HP's location- and context-aware Telco Big Data and Analytics technology, organizations can increase sales by personalizing the shopping experience and drive revenue through targeted promotion of relevant products.

**Pricing and availability(6)**

- The HP Cloud Managed Network Solution will be available in June.
- The HP 560 802.11ac Access Points are available now for $1,199.
- The HP 517 Unified 802.11ac Wall Jack will be available in May for $499.
- The HP 870 Unified Wired-WLAN Appliance is available now for $35,999; the HP 850 Unified Wired-WLAN Appliance will be available in June.
- Secure BYOD Services and IP Address Management Services are available now globally, and the SDN Roadmap Services will be available in June.
- The HP Intelligent Management Center MDM Integration is available now.

(1) HP internal competitive analysis based on publically available information.
(2) IDC MarketScape: Worldwide Enterprise WLAN 2013-2014 Vendor Analysis, September 2013.
(3) Based on HP internal calculations.
(4) Based on publically available data sheets for Cisco 5760 Series.
(5) 450Mbps vs. 1.3Gbps theoretical.
(6) Estimated U.S. list prices. Actual prices may vary.

# Tracking NFV Progress
NFV as viewed by its adopters

## Introduction

Network function virtualization (NFV) is a recent technology that is deeply affecting the way communication service providers (CSPs) manage their networks. CSPs need to adapt and launch new services at a much faster pace in this century, particularly in response to competition from OTT (Over The Top) services. NFV can solve this.

Within this report, we are sharing some of our findings on what the key users of NFV technology have reported to us. Even just looking at one calendar year, 2015, we tracked a notable progression in attitudes around NFV.

## Quarter 1

### Defining the relationship between NFV and software-defined network (SDN)

In Q1, various IT communities were trying to sort out the differences between two new acronyms—NFV and SDN. The lessons learned were that, while the two are complementary, NFV is likely to arrive sooner, and SDN will build on the benefits of NFV to transform the fabric of a CSP network into a software-controlled layer.

NFV was defined as using virtualization and cloud to deliver CSP network functions more efficiently, cost effectively, and without vendor lock-in. NFV enables:

- Better scalability; more linear, less jagged resource allocation; less wasted capacity
- Off-the-shelf hardware, reduced CAPEX
- Simpler maintenance, greater manageability, and reduced OPEX
- Faster new service launches and better agility, and faster time to revenue
- Open standards as well as diversified vendors ecosystem

If NFV is the notion of running individual functions in software, SDN is the notion of turning the entire CSP network into a software program. Instead of dedicated routes, fixed hardware roles, and set rules, SDN allows the network of NFV equipment to run like an application. SDN will be a key requirement to extract more value from the NFV investment.

### The parts of NFV

In Q1, stakeholders wanted to understand the various parts of NFV better. A complete NFV solution is not just a virtual machine replacing a dedicated box. There is more complexity to a full-blown solution, including:

- Off-the-shelf hardware
- Software running a virtualized network function (VNF)
- An orchestration solution that links and syncs different VNFs to create a consumable service

**The benefits and risks**

As the interest in NFVs grew, people in the telecom space naturally wanted to understand the benefits and risks associated with NFV. But the more we spoke to and polled stakeholders, the more we understood that the driving benefit most sought from NFV was agility. CSPs should quickly offer their own competing services in order to respond, stay relevant, and even get ahead of OTT competition.

The risks from NFV are few. It is possible, or even likely, that a CSP will have new VNFs that fail both in the market and in service uptake. But those failures can be managed by staged rollouts in the usual fashion. What is becoming abundantly clear in this era of competition is that the risk of doing nothing far exceeds the risks of NFV.

## Quarter 2

**What are the first VNFs?**

By the second quarter of 2015, CSPs had essentially acknowledged that NFV was in their future. Now the tone of the conversation had shifted to more tactical questions. Stakeholders and delegates were most interested in knowing what network functions should be among the first to be virtualized.Some of the earlier targets identified in our many discussions were:

- Virtualized mobile core (evolved packet core)
- Voicemail and other simple media servers
- IP Multimedia Subsystem
- Infrastructure as a service
- Customer-premises equipment
- Session border controllers
- Content delivery networks
- Security firewalls

**How many VNFs are needed for a launch?**

Another interesting question considered by delegates was how many VNFs did it make sense to start with? The answers turned out to be more about business than technology.

The majority of our survey and meeting participants indicated that they would prefer to launch NFV with at least five VNFs, the reasoning being one of fixed costs. Put together, the fixed-cost investment makes much better sense when amortized across a handful of useful VNFs.

**What is the impact on operation support systems?**

Our industry partners were also concerned about the impact that NFV would have on operation support systems (OSSs) at the CSPs. As NFV transforms networks, it also decouples functions from infrastructure. This increases complexity in the network. The OSS needs to augment its level of sophistication significantly in order to orchestrate all the moving pieces.

NFV solutions need to have management and orchestration (MANO) software to manage them. The key is that the new complexity caused by software-based machines has to be managed in the software itself.

## Quarter 3

**Who's the MANO?**

As we moved into the second half of 2015, the POC efforts for leading CSPs were bearing fruit. NFV worked essentially as planned (at least, technically), VNFs could replace dedicated hardware appliances, but industry partners were increasingly concerned with how to handle MANO of the various NFV elements.

Fortunately, HPE and other vendors were hard at work developing these MANO solutions. The critical elements of a good orchestration solution are:

- Scalability—ability to deploy across wide networks
- Uses open standards
- Flexible or customizable to the needs of CSP, now and tomorrow

As CSPs look to select solutions to the MANO question, they are starting to realize that this partnership choice is likely to be a very long-term relationship. Therefore, it is critical for CSPs to choose a high-quality, stable partner with strong R&D resources and a commitment to invest in the NFV and SDN industry come and a commitment to providing open platforms.

**Open solutions**

Even though any orchestration layer is likely to be a long-term commitment, the right choice for a partner in the MANO layer is one who embraces open standards to the fullest. The MANO needs to interoperate with all the different VNFs from disparate vendors, those built-in house and legacy systems. Open solutions are essential to unlocking the promised benefits of NFV and SDN. Any stakeholders in NFV should familiarize themselves with at least these bodies:

- OPNFV
- OpenStack®
- OpenDaylight
- TM Forum

## Quarter 4

### POCs bearing fruit

Driven by the agility benefits of NFV and the strategic pressure from OTTs, the CSPs and their vendors launched 38 POCs through European Telecommunications Standards Institute (ETSI) and even more in private engagement between vendors and CSPs. Some of the feedback coming from the POCs is precisely what we might expect—problems. Some of the main POC problems included:

- **Orchestration or MANO**—the task of centrally orchestrating and managing the various VNFs is not complete.
- **Vendor interoperability**—testing always reveals practical difficulties in connecting kit from different vendors, but this is a necessary value proposition of NFV.
- **Service chaining**—chaining VNFs to build a complete market solution will require more interop than standalone VNFs.

The POC method of advancing technology is by far the fastest, and it works even better in the open environment where many minds contribute to shared solutions, rather than being siloed within each company.

### Changing technology is easy, but changing culture is hard

By the end of 2015, the tone of our discussions with stakeholders became much more philosophical. The virtualization transformation will inevitably demand an organizational transformation within the CSPs. This cultural and human hurdle is the hardest one to overcome. And the only solution is one of timing: The answer is not, “so don’t do NFV,” but the opposite, “do it now.” Start slowly and do it steadily. This allows the longest ramp for retraining, and reduces anxiety and resistance among valuable engineering employees.

## What does 2016 hold for NFV?

### Software will eat telecom

Looking forward to 2016, the pace of NFV is only going to accelerate. The market for NFV solutions is predicted to grow over 4x for 2016. IHS forecasts a TAM of $2.3 billion USD in 2015 and whopping $11.6 billion USD in 2016. Meanwhile, Heavy Reading forecasts a CAPEX

spending in NFV rocket from $485 million USD in 2014 to an enormous $12.7 billion USD in 2019. Growth in the sector is as close to a certainty as you can get.

**DevOps**

In 2016, we should also expect another IT trend to cross over into telecom and that's DevOps. This culture shift will be challenging, but it could come with the NFV and SDN revolution. DevOps tears down functional walls within a company, such that CSP product development might work integrally with network operations staff to develop and launch a new service.

**Match OTT coopetition with CSP service agility**

OTT services are increasingly grabbing market opportunity that could have gone to the CSPs if they had been more agile. What the OTTs bring and the telcos can't yet match, is an ability to invent and try new ideas quickly. So, the competitive response must be increased agility at the CSPs. NFV and SDN are the tools for that job. Leveraging an agile platform and diversifying into digital services, CSPs can both compete against and partner with OTT providers:

- Agile network services can be offered directly to customers, built rapidly by the CSP, and deployed as VNFs or service chains.
- CSPs can offer VNFs as a valuable platform that unleashes the best solutions of OTT partners, and participate in the rewards.

In either case, partnership or competition, it is far better for the CSP to be on the field as players, rather than watching the game from the sidelines.

Hewlett Packard Enterprise

PoC fact sheet

# Network functions virtualization use cases

## Proof-of-concept projects


### Commitment to openness and collaboration

The Hewlett Packard Enterprise approach to network functions virtualization (NFV) is built around completeness, openness, standards, and expertise. One of the benefits of this approach is the ability to enable other players to bring in new innovations, and with the HPE OpenNFV Labs, we provide an environment to validate that the pieces work together. To this end, Hewlett Packard Enterprise is actively involved in more than 60 proof-of-concept (PoC) projects around the world.

We've been involved in software-defined networking (SDN) and NFV since day one, before OpenFlow and before the European Telecommunications Standards Institute (ETSI) was working on NFV. Back then, we worked with a large telco company on different use cases such as Internet Protocol Security (IPSec) and virtual content delivery networks (vCDN), proving that telco network functions could run on commodity hardware and sustain performance by properly designing and tuning hardware configurations. We also worked on virtualization use cases, such as virtual customer premises equipment (vCPE), including NFV orchestration more recently.

With another large telco company, the focus started with end-to-end services, combining SDN with NFV, working on service chaining and traffic steering use cases spanning multiple SDN controllers and some virtualized functions. At the time, nobody was talking about service chaining yet, but now it is a popular topic.

### Over 60 active proof-of-concept projects

Today Hewlett Packard Enterprise is involved in more than 60 active NFV use cases covering areas including voice/video, mobile private networks, IP routing and transport, telco cloud, NFV orchestration, virtual evolved packet core (vEPC), multiservice proxy (MSP), vCPE, and IP multimedia subsystem (IMS). Hewlett Packard Enterprise proves with these PoCs that we have the broadest range of capabilities from hardware, networking (including SDN), cloud infrastructure, orchestration, and virtual functions. Multivendor and distributed around the globe, these PoCs are in all three regions: Europe, Americas, and Asia.

## PoC fact sheet

**Table 1:** Hewlett Packard Enterprise participation in ETSI-accepted PoCs

| ETSI PoC | Title | Collaborators | HPE contribution | Status |
|---|---|---|---|---|
| **PoC #2** | Service chaining for NW function selection in carrier networks | NTT Communications, Cisco Systems, and Juniper Networks | VSR (HPN virtual router) | Demonstrated at NTT R&D Forum, Feb 2014. Next phase in progress |
| **PoC #6** | Virtualized mobile network with integrated DPI | Telefonica, Intel®, Tieto, Qosmos, and Wind River Systems | HPE hardware in Phase I. For Phase II, HPE and Wind River are contributing carrier grade NFV software platform | Phase I completed. Demonstrated at Mobile World Congress, Feb 2014. Next phase in progress |
| **PoC #13** | SteerFlow: Multi-layered traffic steering for Gi-LAN | Telefonica, Radware, and Mellanox | HPE hardware | Demonstrated at SDN & OpenFlow World Congress, Oct 2014. Next phase in progress |
| **PoC #15** | Subscriber-aware SGi/Gi-LAN virtualization | Telenor Group, Skyfire (an Opera Software company), Guavus, and Red Hat® | HPE hardware | Demonstrated at SDN & OpenFlow World Congress, Oct 2014. Next phase in progress |
| **PoC #22** | Demonstration of high reliability and availability aspects in a multivendor NFV environment | AT&T, KDDI R&D Laboratories, Brocade, and Wind River Systems | HPE hardware | Demonstrated at Intel Developer Forum, Sep 2014 |
| **PoC #23** | E2E orchestration of virtualized LTE core-network functions and SDN-based dynamic service chaining of VNFs using VNF FG | SK Telecom, Samsung, and Telcoware | HPE NFV Director | Demonstrated at SDN & OpenFlow World Congress, Oct 2014 |
| **PoC #27** | VoLTE service based on vEPC and vIMS architecture | ZTE Corporation and China Unicom | HPE NFV Director | Demonstrated at China Unicom R&D Lab, Jan 2015 |
| **POC #37** | Demonstration high availability vEPC and SDN controlled service chain | Huawei, China Telecom, Intel, Trend Micro | COTS servers | To be demonstrated in Network and Terminal Laboratory of China Telecom in Guangzhou, China |
| **POC #38** | Full ISO 7-layer stack fulfilment, activation, and orchestration of VNFs in carrier networks | Alcatel-Lucent, Telstra | HPE NFV Director, NFVI, VIM | To be demonstrated at Telstra Integration Laboratory |

Learn more at
hpe.com/csp/nfv

ETSI NFV Proof of Concept

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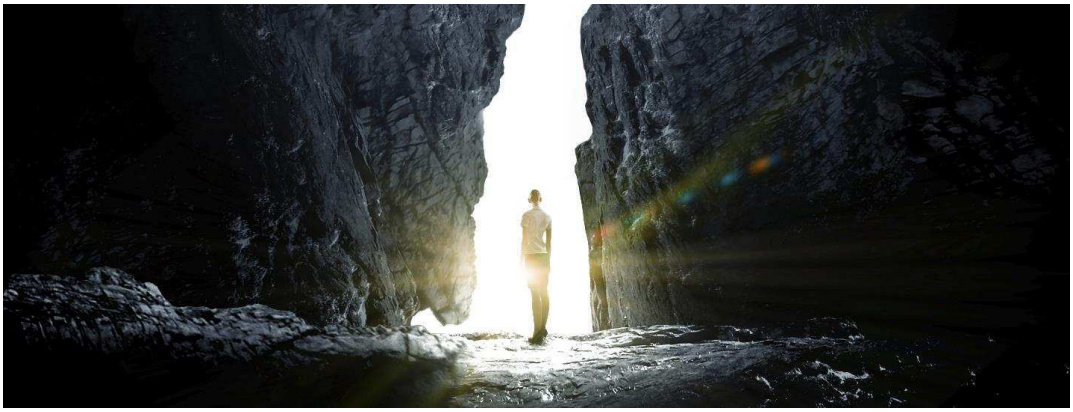
4AA5-5345ENW, November 2015, Rev. 2

# Journey to the cloud

## Offer new services with network functions virtualization



**The promise of NFV**
The traditional CSP network is built on appliances—a cumbersome model with each service requiring its own specialized hardware. NFV will enable CSPs to transition from running network functions on proprietary appliances to a virtualized environment based on commercial-off-the- shelf (COTS) hardware.

By running the same hardware used by enterprise IT and with all services able to run on the same hardware, CSPs will reduce costs by achieving efficiencies of scale and gain the agility to launch cloud services faster.

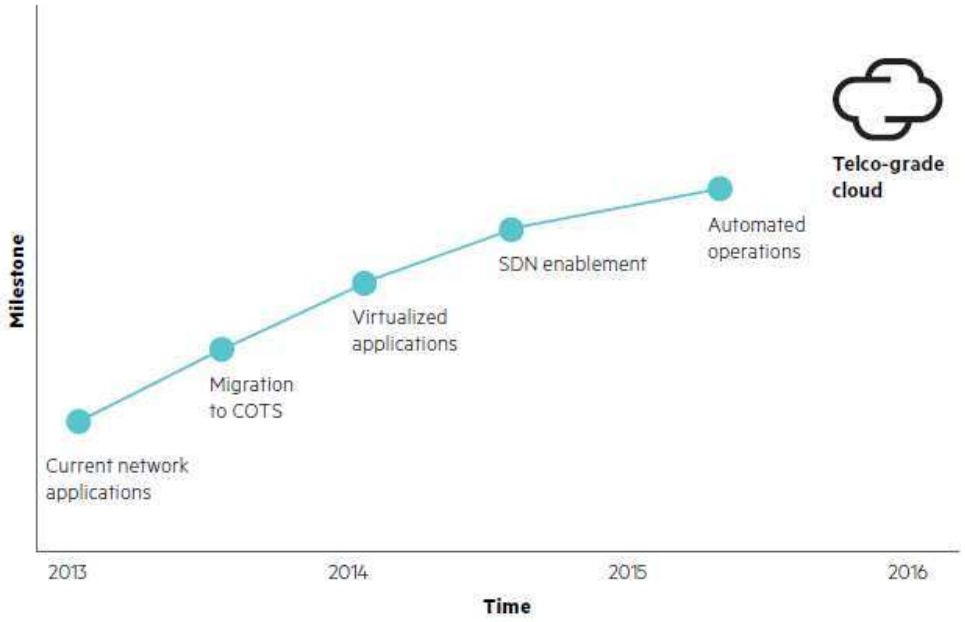
**What the journey will look like**
How will CSPs get there? Back in the 1980s, data centers began a similar journey—one that included consolidation, standardization, and virtualization. We will see similar steps as carriers work to virtualize their networks.

For some, the journey has already begun by taking existing network applications that are trapped on proprietary appliances and liberating them into software, deploying them onto COTS x86 platforms. Next, we'll see the virtualization of some of these applications. Hewlett Packard Enterprise has already started this virtualization process, and not just with our own portfolio. We're helping partners—network equipment providers (NEPs), independent software vendors (ISVs), and original equipment providers (OEMs)—virtualize their network applications and run them on a variety of hypervisors.

As NFV matures, we're going to see software-defined networking (SDN) become an important part of the NFV ecosystem. SDN will let carriers efficiently chain services together through the creation and teardown of flows in the network, resulting in a new, centralized method of software-controlled routing for the entire carrier network.

**NFV and the CSP's journey to the cloud**
To build new revenue streams and compete with the over-the- top (OTT) players, communications service providers (CSPs) are aiming to provide new services to

their customers—especially cloud services such as mobile packet core, virtualized evolved packet core, virtualized IP Multimedia Subsystems (IMS) functions, and virtualized customer premises equipment. Network functions virtualization (NFV) will be key to accelerating the CSPs' journey to the cloud.




Next we'll see the emergence of very robust orchestration and management functions that will allow carriers to automate many operations that they currently have to execute manually within the network. This shift will give carriers visibility into what is happening in the network in real time and will provide the ability for network applications to scale up, down, out, or in based upon time-of-day or traffic patterns. For example, for a voice over IP (VoIP) service, carriers will have the ability to respond not only to current conditions based on call volume, but they will also be able to look back in history and see what happened on a particular date and make predictions on the provisioning that has to be done to scale the application to meet anticipated demand.

Ultimately, we'll arrive at a place we're calling "network cloud," when carriers will fully implement the cloud for solving their most complex network problems.

**Requirements to virtualize the network**

CSPs are already utilizing virtualization and cloud in their data centers. With NFV, we will take what we've learned from virtualizing the data center and apply it to the network. However, there are specific requirements to get the virtualized network to telco-grade (or carrier-grade) capability. These requirements include:

- Availability: In the enterprise cloud, three 9s of availability is often sufficient and four 9s is even better, but for telco, the requirement is five or even six 9s of availability, which is only a few seconds of planned and unplanned downtime per year.
- High performance: The system must handle a huge number of transactions. In the enterprise space, an e-commerce transaction might take a few seconds, while in telco,

transactions—such as a phone system contacting a home location register (HLR) to verify its location—may be sub-seconds in duration. Not only are there a lot of transactions, but with many conversations and messages taking place simultaneously, there are a large number of transactions happening in parallel.

- Serviceability: The network must be serviceable over a long lifetime, perhaps five to 10 years.
- Security: The network must be secure to give consumers the peace of mind that the data they are transmitting is secure.
- Real-time behavior: Carriers are accustomed to having built-in capabilities in the stack that deliver real-time behavior using the host operating system. That capability must be replicated in a virtualized environment.
- Standards-compliant hardware: Carriers want to use standard-compliant x86 hardware and have the same ecosystem or tool chain across the board.

**How Hewlett Packard Enterprise can help**

Hewlett Packard Enterprise has been on this journey for a while now. We made cloud an integral part of the HPE OpenNFV Program to enable CSPs to quickly develop new cloud offerings based on NFV. OpenNFV provides an open, proven and innovative end-to-end environment for NFV. Through its leadership in standards, reference architecture, a partner program, and HPE OpenNFV Labs, Hewlett Packard Enterprise helps CSPs transform in a way that best suits their business and IT.

Hewlett Packard Enterprise has a very rich heritage in cloud and with the telco industry. With a commitment to openness and interoperability, we offer HPE Helion, a portfolio of cloud products and services that enable organizations to build, manage, and consume workloads in hybrid IT environments. We understand that CSPs want to have a robust cloud services offering, and we have what it takes to help them on that journey.

Solution overview brochure

# Gain insight

Use real-time analytics and smart, unified subscriber data management

Hewlett Packard
Enterprise

Ninety-two percent of CSPs recently surveyed stated that customer experience is not adequately addressed. Only an end-to-end process that recognizes and unifies customer assets can deliver a seamless, robust experience.

## Face the challenge

Data traffic is exploding—in two days we produce more data than has ever been produced, prior to 2003. However, the revenue generated by deluge of data is not following a similar exponential-increase curve, and that is due to the drastic increase in maintenance costs.

The world of telecommunications is changing so fast that it becomes hard to know "who owns the customer." In reality, nobody owns the customer anymore; instead, customers "own the intersection." Using all of their open ecosystem relationships, customers connect based on their personal preferences, habits, and culture. The question is: How can you strengthen your relationship with your customer to stay successful? And the answer becomes even more complex with always-occurring business, information, and technology disruptions.

- The market is more and more service dominant with intersecting communications service providers (CSPs), over-the-top players, and smart devices offerings.
- Information volume and variety is exploding, with big data containing structured and unstructured content.
- Technology is improving, constantly leading to advances of in-memory, semantics, real-time analytics, and collaboration technologies.

After this decade of mutations, what is the right move for you? How do you stay proactive and close to your users?

## Drive action; deliver value

You have the key elements to succeed—everything necessary to understand and analyze structured and unstructured data from your consumers' points of view. All you need are flexible systems to track their key metrics in real time, multi-networks, and multi-service environments. This is where Hewlett Packard Enterprise (HPE) can help.

The HPE Telecom Analytics solution portfolio can do all of that: Facilitate data collection, along with its analysis, enrichment, unification, and availability, to enable solutions that drive better actionable decisions and deliver greater-value services to your users.

For CSPs, cross-business assets include subscriber data management, policy management, real-time charging, assurance and fulfillment, and real-time analytics. All of these assets are crucial. By establishing and exposing them, you can begin to monetize the true value the industry brings to the world.

## Gain actionable customer intelligence

Your existing customer data is a treasure trove of information to help increase satisfaction, prevent churn, and grow revenue. The ability to see the complete picture of customers in the moment, and over time, can help you better anticipate and respond to future demands. By offering promotions and packages attuned to real usage trends, you increase the likelihood of your customers staying loyal instead of looking to the competition.

Enhance your customers' experience with personalized, enriched services through smarter, actionable insights and unified views of user profiles using HPE Telecom Analytics solutions.

CSPs' customer data is typically scattered over various departments and in different forms. HPE Actionable Customer Intelligence software lets you look at the whole picture.

- We build a single, easily viewed, and secure client profile.
- We analyze information, using trend and predictive analytics to create a smart profile that provides a true understanding of each customer.
- We act to transform single, smart customer profiles into better policy management and targeted promotions to lower churn.

## Achieve monetization momentum

Networks and applications are not the only valuable assets in the operator's domain. Equally valuable is subscriber data, and there is clear momentum for the monetization and leverage of such data. In our interactions with service providers all over the world, four principal themes have emerged out of CSPs communicating their business goals regarding subscriber data:

1. Lower the cost of operations for data management—provisioning, hosting, modifying, synchronizing, and leveraging subscriber data
2. Enrich the subscriber experience, for example, using new targeted applications, increasing features on existing applications, or improving interaction between applications and across business-unit boundaries, especially within triple- and quad-play operators
3. Examine and understand customers' interests and behaviors, with an eye to improving customer relationships and application take rates, and creating alternative sources of revenue, such as advertising and royalties on product sales, royalties from core services and subscriber data by external application developers, and increased subscriber traffic
4. Realign CSPs' business model to web-centered innovations—agility, applications, and new revenue streams are all drivers here; strategic partnerships emerging between CSPs and web powerhouses; and CSPs moving into self-branded new device markets, such as netbooks, smart screen countertop devices, and specialized PDAs

   – The competition for service providers from nontraditional Internet markets and companies continues to increase.

   – Operators who have become triple- or quad-play entities have extreme difficulty in leveraging subscriber experience, data, and context across their business boundaries.

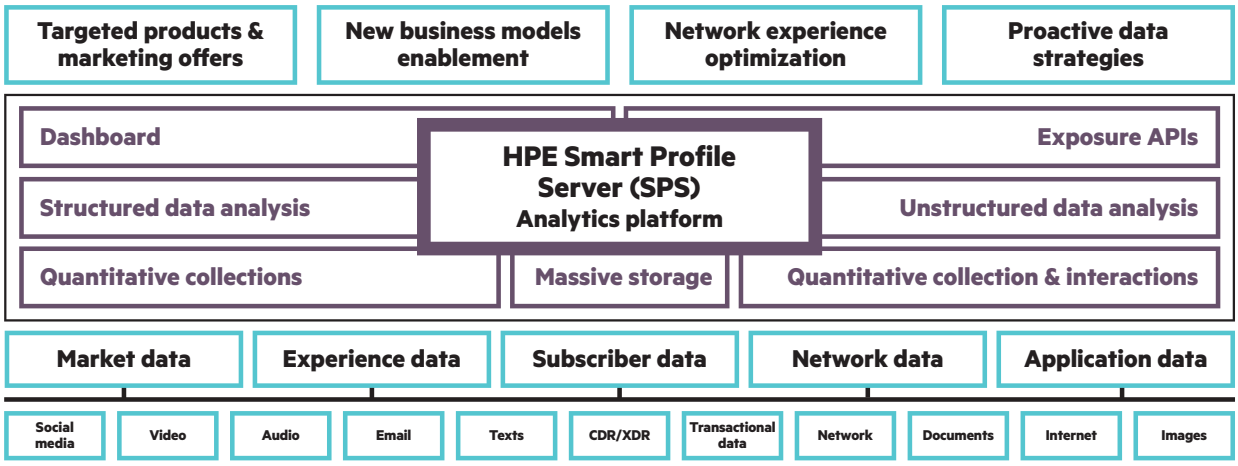



**Figure 1:** Telecom Analytics Platform–Turning data into revenue

**Solution overview brochure**

In a recent survey of CSPs, 92 percent stated that customer experience is not being addressed adequately as their experience frequently spans multiple business and organizational domains. Such a fragmented experience can only be addressed with an end-to-end process that recognizes and addresses unification of client assets across organizational boundaries. Only in this way can CSPs hope to deliver robust and seamless client experience across touch points, and create and maintain a digital relationship as the customer navigates the open Internet.

**Understand our commitment**
At HPE, global citizenship is our commitment to hold ourselves to high standards of integrity, contribution, and accountability in balancing our business goals with our impact on society and the planet. To learn more, visit hpe.com/hpeinfo/globalcitizenship, and for information about HPE environmental programs, go to HPE.com/environment.

## Enrich your subscribers' experiences

The HPE Telecom Analytics framework enables you to implement a variety of use cases for enabling better actionable decisions. These can be grouped in three main categories: service personalization, network intelligence, and service intelligence.

Service personalization use cases:

- Application and content personalization—Managing relationships with third parties and personalizing subscriber content and application offers by better understanding subscriber behavior and interests
- Personalized advertising—Understanding subscriber behavior and usage across applications, social media, and services to better target personalized advertising of services and consumer-relevant offers
- Mobile portal personalization—Providing an interactive mobile portal that takes into account an understanding of subscribers' interests, behavior, and service consumption to personalize self-service, content, and social media feeds
- Consumer profile management—Enabling you to create an enriched subscriber profile that is viewed and managed collectively by the consumer in real time and linked to the broader ecosystem of applications (apps) and third parties through trusted sharing

Network intelligence use cases:

- Active experience management—Actively measuring potential impact on the quality of customer service due to congestion based on real-time application-level understanding and notifying customers of resolution steps
- Data access optimization—Understanding customer behavior, network traffic, and usage patterns to better optimize network resources and quality of service in the "right time"
- Advanced data network analytics—Measuring and understanding mobile data through deep analysis of Internet protocol traffic to establish actionable key performance indicators and data points in the right time

Service intelligence use cases:

- CSP services analytics—Providing plan insights for your services and advice on rate plan offers, discounts, and options based on subscriber usage details and lifestyle—over time and in real time
- Subscriber data usage analysis—Keeping customers informed through granular representation of subscriber mobile data usage based on application understanding—web, email, video, downloads, apps, peer-to-peer services—in real time

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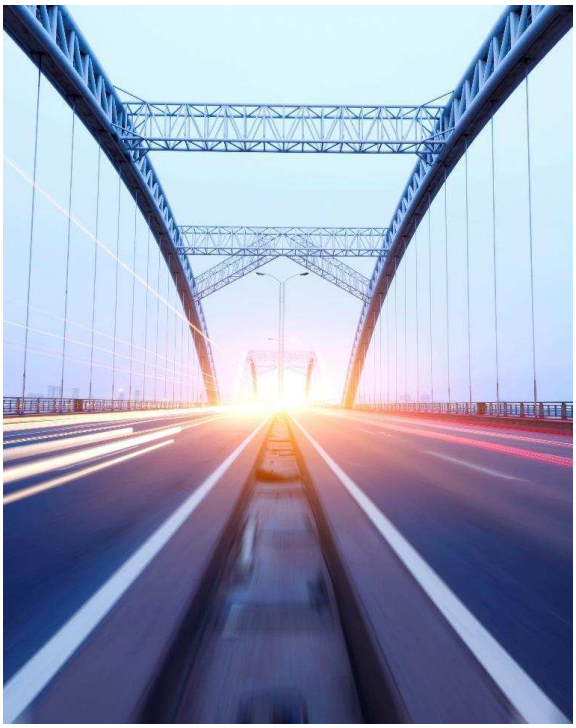
4AA3-6171ENW, November 2015, Rev. 3

# Reimagining OSS for service agility in hybrid networks

**The urgency of OSS transformation**



Today's telecommunications industry is undergoing a radical transformation driven by new technology, new demands on the network (in terms of capacity and performance), and higher expectations from consumers. Communications service providers (CSPs) are focused on enhancing agility to bring new services to the market faster to counter eroding market-, wallet-, and mind-share as applications become more important to the consumer.

At the center of this transformation are three key technologies—software-defined networking (SDN), network functions virtualization (NFV), and cloud. Traditional monolithic telecom infrastructure is being replaced by software entities that run on commercial off-the-shelf hardware—aided by virtualization technologies and cloud-based deployment and delivery models. SDN is driving automation and real-time programmability for the network infrastructure. Together, these three technology initiatives are transforming the CSP infrastructure into a highly programmable entity that has the potential to be personalized in real time and on a massive scale.

The reality for most CSPs, however, is that for the foreseeable future, the infrastructure will remain in a hybrid state, a mix of traditional network infrastructure (physical) and virtualized (NFV-enabled) infrastructure. The same challenges exist for the operations domain as well.

In order for CSPs or their customers to reap the benefit from this investment in infrastructure transformation, this endeavor needs to be synchronized with a corresponding transformation in the way the network is operated and services are created and delivered. OSS provides the link between business outcomes and the NFV innovation.

As NFV proof of concepts (POCs) mature into commercial deployments, it's becoming increasingly urgent to transform the operations support system (OSS) to cover both virtualized and traditional infrastructure. This is particularly challenging because operational processes and OSSs are highly customized for individual CSPs, and transforming this is a challenge for both vendors and CSPs. Today's business process and data model standards neither

take virtualization into account nor are they designed to support the levels of agility and programmability that the transformed infrastructure provides.

**The issues with the status quo**
Before we talk about the way we transform the OSS, let's first look at how the CSP operations are structured today. Typically, service creation and delivery within a CSP is handled by the following major components of an OSS:

1. Service Fulfillment Functions handle the service design (idea to implement), service activation (order to activate), and resource provisioning (plan to provision) processes
2. Service Assurance Functions cover the assurance processes (trouble to resolve)
3. Analytics Functions include business analytics that can be used to provide data for providing personalized service offers to customers and revenue analytics that can be used for revenue assurance

Today, CSPs' operations typically view fulfillment and assurance business processes individually, as silos. The people, processes, and technology base of service onboarding to activation (or fulfillment) is often a separate silo distinct from service problem event generation to resolution (or assurance). This separation or disconnection of fulfillment and assurance processes makes industrialization difficult—and more so when the introduction of new technologies (such as NFV and SDN) create a hybrid operating environment. The ability to automate and industrialize processes is key to achieving service agility.

One of the key benefits of NFV is it introduces a whole new dimension to product and service lifecycle management—one that is more real-time and on-demand. CSPs are on the path to move away from the era of mass rollouts to a "fast-fail" methodology (popularized by the over-the-tops [OTTs]) of rapid prototyping of "alpha" services, run in "beta" trials with selected customer bases, changed and adapted on the fly, and then (if encouraging) brought into mass production. The classic OSS is not designed for this mode of operation, which is another reason why the status quo is no longer a feasible option for CSPs.

Today, service fulfillment processes depend on a workflow methodology in which instructions are executed in a sequential manner to achieve the desired outcome. This process was well suited to the static nature of the infrastructure in the past. However, as we move to NFV, the infrastructure layer becomes an on-demand, programmable entity with the ability to be distributed geographically. As the type of services that need to be created tend to be increasingly personalized based on multiple parameters—user policies, application, network conditions, and more—the workflow methodology falls short. As services become more personalized and adaptable, the workflows become exponentially complex.

**The key ingredients for a transformed OSS**
The foundation of the OSS transformation is the use of a common model for data, relationships, and behavior of objects across both the physical and virtualized infrastructure. This common model can then be used for both the service fulfillment and service assurance functions.

The Hewlett Packard Enterprise approach to OSS transformation is built on an innovative approach to modeling and designing services developed by our research team. The Concept is called dynamic service descriptors (DSD).

This new "dynamic descriptor" approach **gets rid of the classic workflow-driven** orchestration, in which the service behavior is hard-coded into the workflows. Instead, it uses a declarative language to describe the service, its relationships, and behavior (policies). The engine takes

these service descriptors, looks at the current state or configuration of the service, and will **build a runbook at run-time** to achieve the desired state.

The descriptor is able to model **any** service or resource. Therefore, it can be used to control resources that are not immediately involved in a service as well, such as core infrastructure. The service descriptors are able to describe how the service should behave in an exceptional scenario, for example, a component failure. This opens the door to self-healing—the OSS listens to the network health and reconfigures it to circumvent the problem.

Micro workflows are used as an atomic layer (for example, to create single virtualized network functions [VNFs]), while declaration descriptors are used on a molecular layer to combine other descriptors or workflows.

The impact of this approach is profound; not only is service onboarding much faster, but the service designer is also able to recompose products (while taking complex product behavior into account). This vastly reduces firefighting and drivers down the cost of delivery. Even complex re-engineering processes, like replacing network equipment at runtime, are possible with little effort.

The advantages of this descriptor-based approach are many. For example, a service chain with four VNFs (for example, vServices Router, vWAN Accelerator, vWAN Optimization, and vSecurity Gateway) has 16 possible workflow combinations. A scripted approach would require 16 process scripts. In contrast, only four descriptors are required with the DSD approach, one for each service. Thus, OPEX is reduced.

DSD allows projects to adopt a fast-fail methodology. Agile teams consisting of Product Managers, Service Designers, OSS engineers, and Infrastructure Experts work in sprints to develop the product offerings, the underlying service model, the relationships, and the behavior of each modeled component, as well their integration to the network functions. DSDs object-oriented nature provides the ability to inherit or compose individual service model for rapid reuse.

Continuous Integration/Continuous Development cycles allow for nightly builds of the service orchestration, their immediate testing with the environment and validation of stakeholder expectations.

Based on initial experience from deployments, this new technology will lead to improvements in orders of magnitude.

**The HPE solution for agile service management on a hybrid infrastructure**
A key part of the NFV reference architecture is the Management and Orchestration (MANO) framework. While the ETSI NFV MANO reference architecture does not cover scenarios of service creation and management across a hybrid network, it did provide a model for agile service creation on virtualized infrastructure that could be replicated to cover both virtualized and physical infrastructure. The HPE NFV Director (NFV-D) uses a common inventory model for both fulfillment and assurance business processes. Forming the basis for introducing a closed-loop automation between the two processes and is the foundation for agile service creation in an NFV environment. Additional enhancements through Analytics provide further operational capabilities.

The HPE approach to transforming the OSS is based on the same principle: extending this common data- and analytics-driven automation between fulfillment and assurance processes

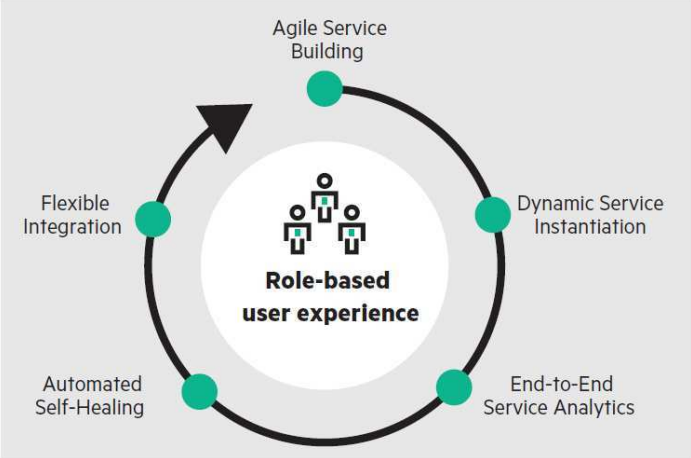
to both the virtualized infrastructure and the traditional physical infrastructure. Today's OSS provides domain-specific operations capabilities for the physical networks. Similarly, the NFV orchestration solution that the NFV transformation introduces is domain specific to the virtualized infrastructure. In order to implement an agile service operations infrastructure, telecommunications network and service operators need a component that pairs the domain OSS of the present with the NFV layer. The HPE Service Director is positioned to be an end-to-end (E2E) service management entity that couples the virtual and the standard production world, providing a homogeneous model toward the BSS layer.

HPE's current NFV offerings include high performance NFV Platforms and Orchestration solutions, a rich ecosystem of VNF partners and solutions that are pre-integrated in the OpenNFV Labs and transformation consulting and services. The HPE Service Director is a natural extension to this portfolio to bring in the capability to provide agile management of services across both NFV enabled and traditional CSP infrastructure.

As opposed to classic commercial-off-the-shelf solutions, HPE Service Director is designed to provide true service agility, automation, and operational flexibility across both virtual and standard telecom infrastructures for end-to-end services. The new HPE OSS portfolio features four elements:

1. **HPE Unified OSS Console**—a single portal to all functions of the end-to-end service operations solution.
2. **HPE NFV Director**—implementing the NFV orchestration and virtual network function manager (VNFM) function in accordance with the ETSI MANO standards. This includes closed-loop NFV assurance and fulfillment.
3. **HPE Service Director**—as the new end-to-end service management entity, providing more
   agility, analytics-based planning and assurance, and the closed loop automation at an E2E level using a dynamic declarations-based service model.
4. **The existing HPE OSS and HPE Software portfolio** for telco and data center management—will be used by Service Director to integrate the non-NFV–specific world for managing physical network functions (PNFs). This includes both OSS fulfillment and assurance solutions. HPE OSS Fulfillment includes HPE Service Activator for configuration and activation, and HPE Service Provisioner for service order management and provisioning, as well as HPE Trueview for inventory. HPE OSS Assurance solutions include HPE Service Manager, HPE Universal SLA Manager (USLAM), Service Quality Manager (SQM), HPE Performance Manager, HPE TeMIP, HPE Network Node Manager i (NNMi), HPE Unified Correlation Analyzer (UCA), and HPE Operations Manager i (OMi). These solutions may also be used in a separate "factory" under the BSS, to keep existing domain management or functionality as is, when desired.

HPE Service Director provides six fundamental capabilities along a single value chain as shown in figure 1. The journey begins with Agile Service Building, a model-based design approach that allows the dynamic construction of service models, its components, and relationships through service descriptors.1 The behavior is expressed as a set of policies that drive the business processes. Dynamic Service Instantiation makes use of the service declarations to rapidly perform service configurations and changes. The same declarations define a variety of service analytics (for example, usage, trending, performance forecasting, and capacity management) of the end-to-end services using fault, performance, and usage or configuration information. Automated Self-Healing uses real-time correlation and analytics to detect and




declare healing procedures to correct errors during operations across the hybrid network and service setups.

Open application program interfaces (APIs) allow the Flexible Integration with the broader OSS ecosystem and legacy business processes. The entire lifecycle is controlled through a role-based user experience across all stakeholders.

**Figure 1:** The six capabilities of HPE Service Director

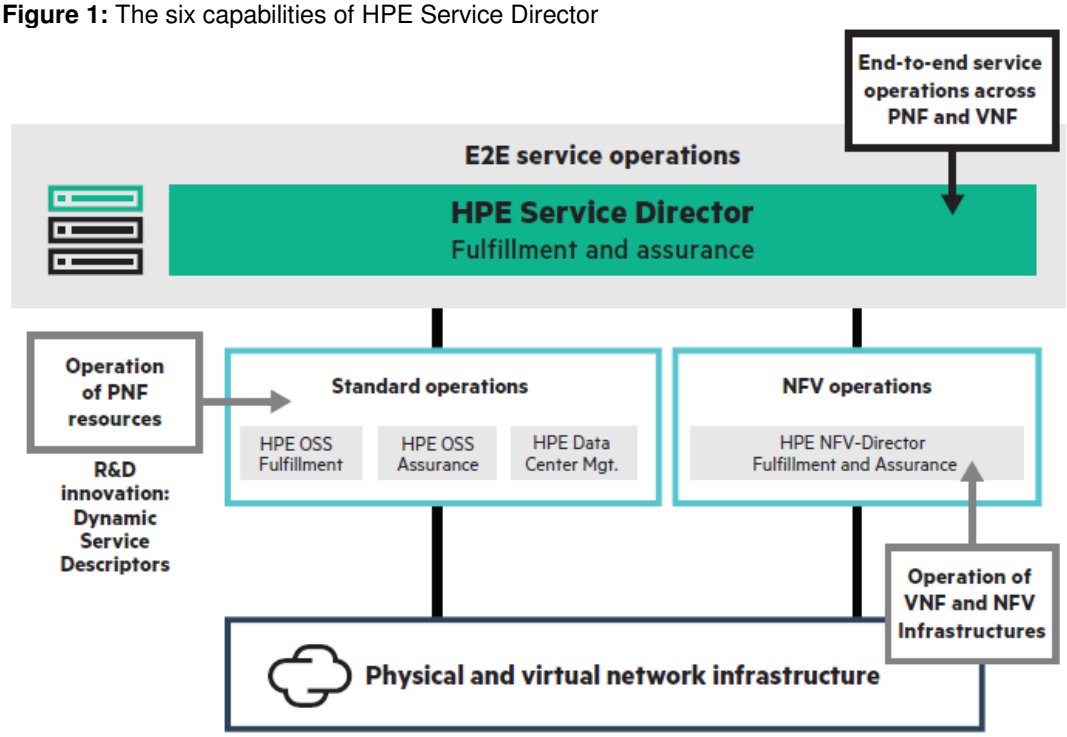



**Figure 2:** HPE OSS portfolio and new HPE Service Director

**Key benefits of the HPE approach**

The biggest benefit that the HPE Service Director brings to CSPs is the ability to create and manage services over a hybrid infrastructure at the speed the new NFV-enabled infrastructure provides. The automation made possible by the use of a common, declarative model for data and behavior is the foundation for the service agility benefits that HPE Service Director offers.

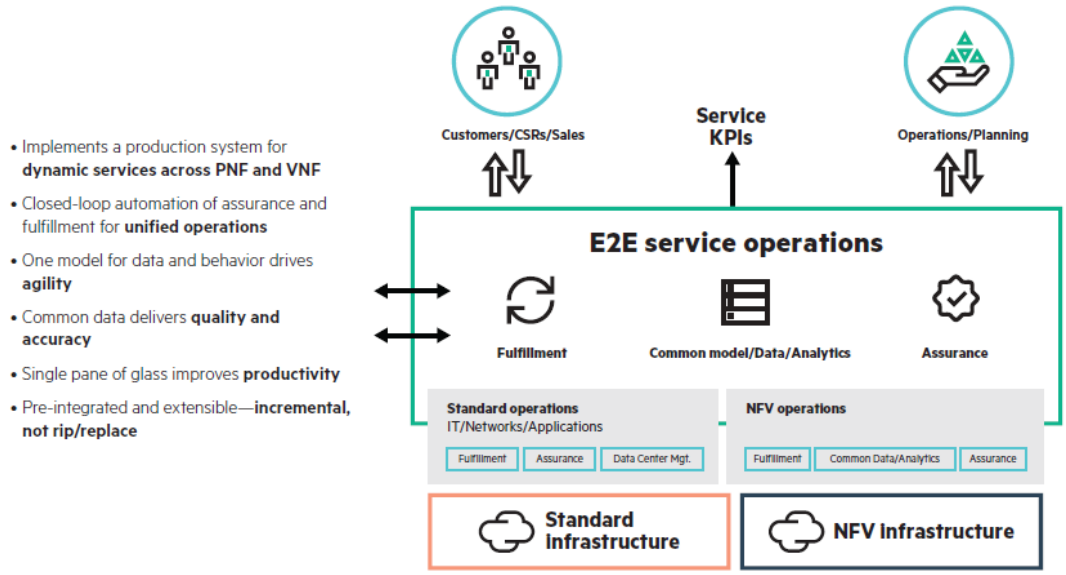



**Figure 3:** HPE OSS Strategy—Agile Service Operations approach

The closed-loop, analytics-enhanced automation of assurance and fulfillment processes enables common operations. This, combined with the "single-pane-of-glass" mode of management is key to reducing OPEX. The use of common data delivers accuracy and high fidelity processes, thus contributing again to lower OPEX and an improved customer experience, which almost always eventually leads to increased revenue opportunities.

Initial pilot deployments with HPE Service Director show a drastic reduction in the time required for foundational processes like VNF onboarding and network service graph creation—from months to hours. Improving time-to-market by even a few weeks has a net positive impact on revenues. In addition, faster time-to-market also results in higher market share (gaining subscribers from competitors by coming to market first with an innovative offer). Using the HPE Service Director, the ease and the faster pace at which new services can be composed and offered to the market enables a CSP to constantly churn out innovative services and outperform the competition, resulting in a positive cycle of subscriber and revenue growth.

The HPE OSS transformation strategy enables CSPs to choose an incremental approach to incorporating the new mode of operation. In the true spirit of openness that all Hewlett Packard Enterprise products embody, all the core software components of the HPE Service Director provide interfaces to third-party products and components through REST, SOAP, or classic JMS interfaces (or also CLI).

# NFV PoCs Offer Examples and Insights as They Move Into Trials and Deployments

Guest Author: Vinay Saxena, HPE Fellow, Network Functions Virtualization

As a growing number of NFV proof of concepts (PoCs) successfully conclude, and the focus begins to turn towards trials and full deployments, evidence mounts that the powerful, flexible next-generation architecture is ready for the real world. These PoCs illustrate how NFV enables service providers, data center operators and enterprises to address a wide range of critical operational and business challenges.

HPE currently has 20 design-phase PoCs in the US and 28 active PoCs worldwide, and expects many deployments in multiple areas in the next 8 to 12 months. While PoCs can be found in all key areas, the majority of use cases are focused on NFV infrastructure and Virtualization Technologies (26 PoCs) and Mobile Core-IMS/EPC (17 PoCs).

**Important Examples**

Although there isn't enough space to provide a complete summary of every significant NFV PoC, here's a look at three particularly important use cases:

- Nokia Telco Cloud. A joint telco-cloud solution, compliant with ETSI NFV principles, this PoC is designed to provide operators an open source-based cloud that meets their reliability and availability requirements. The PoC, which aims to accelerate the transition to an NFV deployment, is based on Helion Carrier Grade on NFV Systems, Nokia MME on Helion Carrier Grade with RT Linux, and the DPDK Enabled vSwitch with full affinity/auto-affinity deployment models.
- ETSI PoC #34: SDN-Enabled Virtual EPC Gateway. This PoC is designed to demonstrate how an SDN-enabled virtual EPC gateway can split the control and user plane of the Serving and Packet Gateway elements, allowing them to scale EPC components independently and enable a range of deployment options. This use case is particularly significant since it involves working with multiple partners. Service level orchestration is provided by NFV-D, Helion OpenStack as the Virtual Infrastructure Management (VIM) layer, and SiteScope offers agentless monitoring and NNMi supplies Fault Management
- Virtual Content Delivery Network (vCDN) with Orange Communications. This PoC shows validation of the Akamai CDN solution on an NFV architecture using KVM extended into the OpenStack environment. The specific use cases are Automation, Scale In and Out and Release Upgrade Automation. Service level orchestration is accomplished using NFV-D, and Helion OpenStack as the VIM layer. SiteScope supplies agentless monitoring and NNMi provides Fault Management.

**Key Insights**

The various PoCs to date have provided several key insights and revealed many important operational issues. HPE has learned, for instance, that VNF Manager and VIM integration is still vendor specific.  It is also apparent that the NFV tool chain is still maturing and VM applications continue to require post-installation configuration, a process that is hard to automate. Meanwhile, progress must still be made on licensing support for VNFs.

It's also important to note that not all VNFs are validated on OpenStack. There are no clear boundaries between VNFs and network services. Interaction between SDN/NFV controllers remains a work in progress. And perhaps one of the most important lessons learned to date is the fact that even simple things take time.

**HP: Your Partner for PoCs**

As carriers continue exploring NFV PoCs, live trials and deployments, HP is helping advance NFV by supporting the major features customers want. HP has offerings in every layer and provides a set of modular functions according to the ETSI reference architecture. This allows HP to execute any kind of PoC a customer may need.

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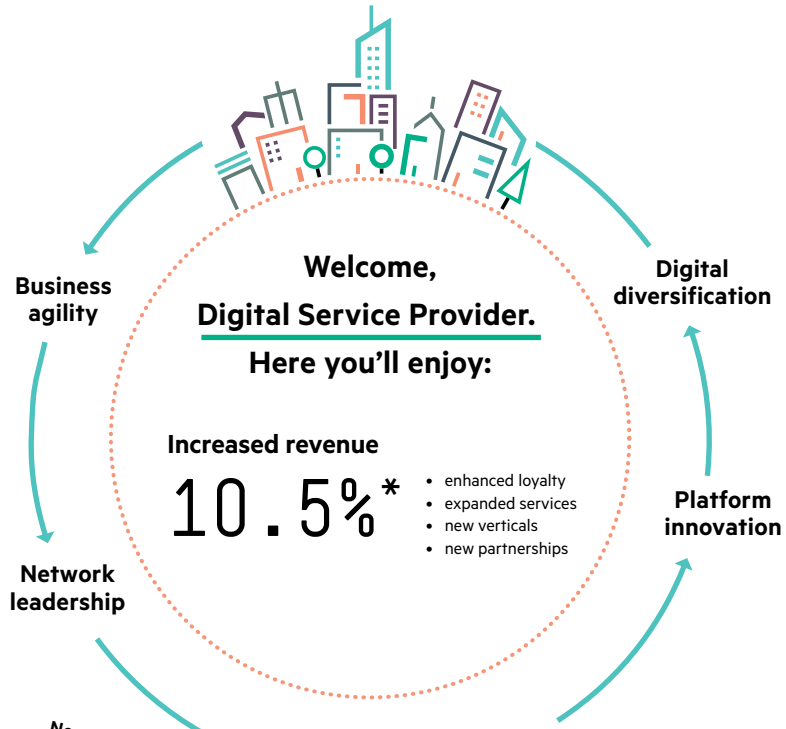


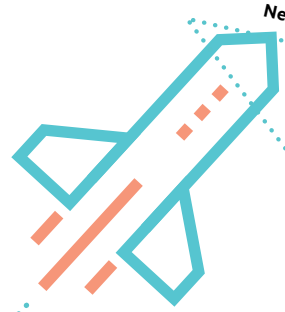

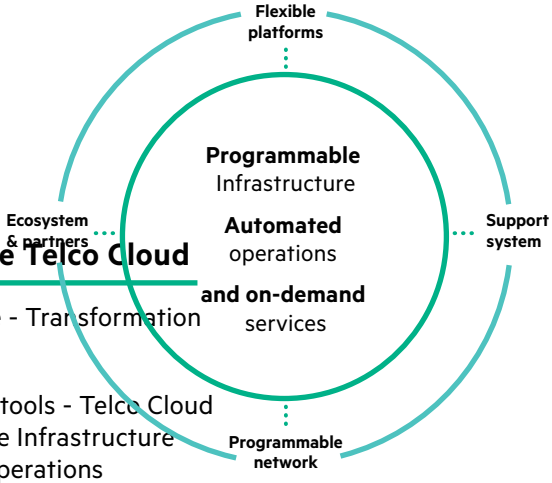


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