

Meeting 21st Century Network Traffic Demands



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**Hewlett Packard
Enterprise**

Executive Summary

The upward-spiraling growth of customer data traffic demands that today's service providers run much of their traffic through virtual machines (VMs). This transition to virtualized data centers has changed the structure of the traffic and communication paradigms, but traditional data center networks weren't designed to handle the new traffic flow. Further, if additional services such as routing, firewalling, or virtual-private network (VPN) tunneling are required, additional paths must inject into the network. To solve the problem, service providers are turning software-defined networking (SDN) and network function virtualization (NFV) technologies to more quickly roll out end-to-end provisioning of network services that support customer demands and increase revenue.

The combination of Brocade* solutions, the HPE Helion Platform, and virtual cluster-switching (VCS) fabrics enables intra-data center traffic to travel directly from a source to its destination. Thus, traffic avoids the expensive higher layers of the network in situations where routing, firewalling, and VPN connectivity are required. Migrating from static hardware networking to dynamic SDN networking, service providers free up

capital and equipment, avoid vendor lock-in, and provide faster and more secure services to customers.

Purpose-Built Hardware and Traffic Blockage

Managing locations in multiple geographies around the world, service providers live and breathe complexity. Customer data traffic from increasingly sophisticated applications is non-stop and growing exponentially.

Data centers today run much of their traffic through virtual machines (VMs). This transition to virtualized data centers has changed the structure of the traffic and communication paradigms, fulfilling Gartner's prediction that nearly 80 percent of data center traffic will soon become server-to-server communications versus server-to-user.

Therein lies the problem. Traditional data center networks weren't designed to handle the new traffic flow. Further, if additional services such as routing, firewalling, or virtual-private network (VPN) tunneling are required, additional paths must be injected into the network. This forces processes on the same hypervisor to seek services from higher levels in the network. As a result, single-purpose network devices such as routers and VPN appliances must



Telefónica* Benefits from DPDK and Brocade* 5600 vRouter

Telefónica* partnered with Brocade*, Intel®, and Red Hat* to demonstrate that a virtualized environment can deliver the performance a telecom provider demands—without requiring significant customization, commitment to an inflexible proprietary solution, or long deployment cycles. Performed in the Telefónica NFV Reference Lab Framework, the test included the Brocade* 5600 vRouter and Data Plane Development Kit. This was deployed on Intel® Xeon® processor-based servers in a Red Hat environment with a kernel-based virtual machine (KVM) hypervisor and Open Flow-enabled switching equipment.

Completed in just two hours, the test solution achieved 80 Gbps on the system and supported all the server's available ports at line rate. These test results allow Telefónica, as a network operator, to aggressively change their perspective regarding what's possible with software-driven networking and accelerate the adoption and deployment for revolutionary virtualization technologies.

be continually replaced or enhanced to support those workloads—an expensive proposition.

To solve the traffic issue, service providers are turning to software-defined networking (SDN) and network function virtualization (NFV) technologies to more quickly roll out end-to-end provisioning of network services that support customer demands and increase revenue. This paper describes the best-in-class NFV solutions developed collaboratively by Brocade* and HPE with Intel Inside®.

Streamlining Traffic Flow and Storage

Using the globally-applicable European Telecommunications Standards Institute (ETSI) reference architecture as a starting point, Brocade*, HPE, and Intel developed industry-leading NFV solutions for service providers and enterprises that want to build agility and automation into their networks. Implemented as Virtual Network Functions (VNFs) in Virtual Customer Premise Equipment (vCPE) and Virtual Cloud Equipment (vCE) environments, the solution components include:

- **Brocade* 5600 vRouter** is a software-based solution that enables the functionality from hardware-based routers to be deployed directly on hypervisors. Two communicating VMs on a single hypervisor can use routing, firewalling, and VPN tunneling services without having their traffic leave the node. This results in significant savings for enterprises because they don't need to replace or upgrade routers.
- **Brocade* vRouters use the Data Plane Development Kit (DPDK)** so that each forwarding plane can be allocated to multiple Intel® Xeon® processor or Intel® Atom™ processor cores. Isolating forwarding planes on individual processor cores lets the plane deliver over 10 Gbps performance while eliminating resource contention.

The DPDK takes a completely flexible software-centric approach to packet processing, enabling extremely high processing performance on industry-standard high-volume servers. The performance advantages delivered by the DPDK transfer seamlessly from conventional physical appliance designs to the virtual appliance designs.

- **The Brocade* SDN Controller (BSC)** is a commercial distribution of the OpenDaylight Project's SDN controller, which controls physical (VNF) and virtual networking devices from all major vendors. While the open core design in the OpenDaylight controller makes it the most promising SDN controller framework on the market, Brocade* brings the needed applications, support, and services to help service providers confidently build more efficient networks.
- **Brocade* vADC (Application Delivery Controller) is designed to make** applications faster, reliable, and secure. It works within cloud environments and easily integrates into an application stack. It is the industry's only complete software-defined Layer 7 ADC with integrated web-content optimization capability, freeing applications from the constraints of traditional monolithic load balancers. The Brocade* vADC product family includes a virtual traffic manager, services director, virtual web-application firewall, and web-content optimization.
- **Brocade VDX* switches and Brocade* VCS Fabric technology for the VNF physical layer** are the foundation for high-performance connectivity in Ethernet fabric, storage, IP network, and IP storage environments. Available in fixed and modular forms, these highly reliable and scalable switches by design serve a wide range of environments, enabling a low total cost of ownership (TCO) and fast return on investment (ROI).

VCS Fabric technology was designed to facilitate and optimize scale-out architectures. It provides automation through zero-touch provisioning, self-forming trunks, and logical chassis so that providers can add, move, and delete capacity automatically. Multi-pathing at Layer 1, 2, and 3 provides resiliency at every network layer.

- The **HPE Helion Platform**, in the network management and orchestration (MANO) layer, supports a variety of cloud apps while meeting the required service-level agreements for security, governance, and privacy. Enterprises and service providers today must often deploy and scale cloud applications across a mix of public and private clouds. Based on industry-leading open source projects in OpenStack* and Cloud Foundry*, HPE Helion (enterprise version) is a combined Infrastructure Service (IaaS) and Platform as a Service (PaaS) offering for cloud-native workloads.

Traffic Flow Management Use Cases

Changing the economics of networking and optimizing the data center, the Brocade* and HPE solutions offer carrier-class performance and reliability that telcos, cloud service providers and enterprises can use for connectivity between hybrid clouds, private clouds and services for in-cloud networks.

vCPE SOLUTION

Brocade's* on-premise Virtual Customer Premise Edge (vCPE) solution for HPE OpenNFV involves replacing legacy CPEs with new commercial off-the-shelf platforms that provide a virtual infrastructure for hosting VNFs (Virtual Network Functions). This solution can blend into hybrid deployments with some network functions running in CO (central office) or POP (point-of-presence) locations. It can also be used in its pure form for situations where existing POP/COs do not have the ability to accommodate servers due to space, power, or cooling issues.

Brocade's* products play a key role in this solution, with the Brocade* vRouter offering Core VNF services such as routing, firewall, NAT and VPN in one package. The vRouter also provides high efficiency in packet handling, allowing for smaller footprint deployment thus lowering CPU and memory requirements, and therefore lowering the cost needed on the CPE COTS platform.

vCE

Brocade's* Virtual Customer Edge (vCE) solution involves replacing legacy CPEs with NIDs (network interface devices) for simpler troubleshooting at branches, and moving the typical functions that CPEs provide into VNFs hosted on infrastructure at the POP or CO. This is an alternative to running virtualized CPEs on-premises and may be an option if the POP/CO has the ability to host servers and accommodate power and cooling needs.

Apart from the Brocade* vRouter offering core VNF services such as routing, firewall, NAT, and VPN in one package, it also provides high efficiency in packet handling, allowing for smaller footprint deployment with higher-densities in vCE instances per server.

Hybrid Cloud Solution

With Brocade's* Hybrid Cloud solution, enterprises can provide high-speed, high-security connectivity between branches, enterprise HQ, private data centers to co-location facilities and virtual public clouds hosted within public IaaS providers.

This solution provides extensive VPN capabilities with strong compatibility that can be used to bridge on-premises assets (physical and virtual) with resources in the public cloud or virtual private clouds. The vRouter's flexibility in deployment—supporting a wide range of hypervisor and cloud platforms—means that the Brocade* solution will run on just about any



Intel Open Network Platform

Intel developed an architecture platform based on the ETSI standards for NFV in an effort to accelerate development of commercial hardware and software platforms. The Intel Open Network Platform (ONP) provides a reference architecture that redefines network architectures by decoupling the network functions from the hardware itself. This provides the Network Function Virtualization Infrastructure (NFVI) necessary to virtualize functions.

With ONP, companies in telecom carrier networks, enterprise environments, and cloud data centers can more easily build solutions using and open source software stack running on commercial, off the shelf servers. With the ONP reference architecture, solution providers can plan, evaluate, and benchmark designs in advance of NFV deployments.

public or private clouds. This allows enterprise workloads to communicate across clouds. The vRouter's flexibility in deployment, supporting a wide range of hypervisor and cloud platforms mean that the Brocade* solution will run on just about any public or private clouds. This flexibility allows enterprise workloads to communicate across clouds.

Cost Savings of Virtual Traffic Control

Since NFV's inception, the industry has seen significant improvements in base technology layers. In this new virtualization environment, the Brocade* and HPE solutions with Intel Xeon processors—and key learnings from Open Network Platform (ONP) reference platforms—are helping to build a new and open ecosystem for VNF providers.

The combination of Brocade* solutions, the HPE Helion platform, and virtual cluster switching (VCS) fabrics enables intra-data center traffic to travel directly from a source to its

destination. Thus, traffic avoids the expensive higher layers of the network in situations where routing, firewalling, and VPN connectivity are required. By changing just these characteristics in the data-center network architecture, service providers can avoid up to 90 percent of the expense to enhance existing routers, firewalls, and VPN concentrators. As a result, they can:

- Align networking topologies with workloads and application demands—without becoming limited to restrictive or obsolete design goals.
- Redeploy the services provided by expensive routers, firewalls, and VPN concentrators to inexpensive virtual machines residing on hypervisors.
- Implement a strategic foundation for high-performance, yet cost-effective NFV. Migrating from static hardware networking to dynamic open-infrastructure networking, service providers free up capital and equipment, avoid vendor lock-in, and provide faster and more secure services to customers.

The NFV Solution Architecture

The infrastructural components of the Brocade* HPE solution are shown in Figure 1 and provide the following features:

- **Automation.** OpenStack* integration, RESTful APIs, NETCONF/YANG support, Linux OS scripting, and DevOps.
- **Robust Firewall Protection.** IPv4/IPv6 stateful packet inspection to intercept and inspect network activity and protect critical data.
- **Secure Connectivity.** Providers can establish secure site-to-site VPN tunnels with a standards-based IPsec VPN between two or more Brocade* vRouters or any IPsec VPN device with support for Dynamic Multipoint VPN (DMVPN). Provides secure network access to remote users with embedded SSL-based OpenVPN functionality.

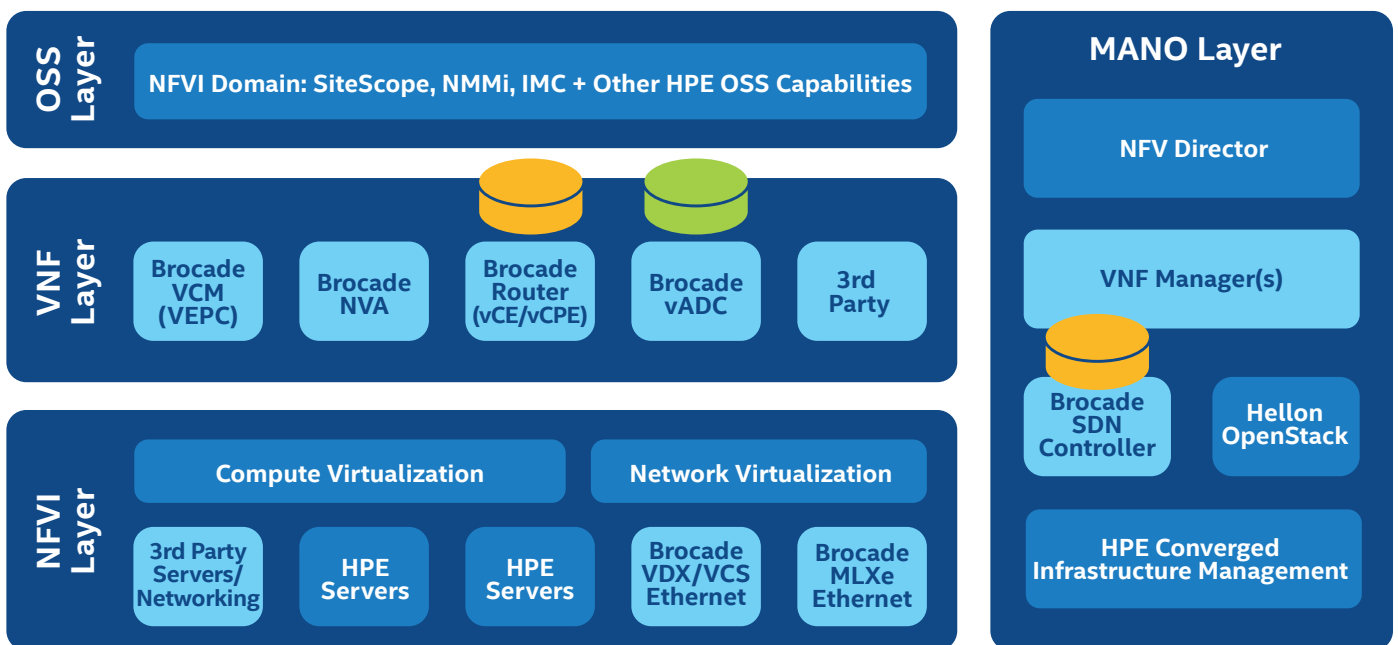


Figure 1. HPE's infrastructure provide faster and more secure services to customers.

- **IPv6 Compatibility.** Powerful routing engine with full support for IPv4 and IPv6 dynamic routing protocols (BGP4/4+, OSPFv2/ v3, RIP), Multicast, Policy-Based Routing (PBR), NAT, and DHCP. Brocade* 5600 vRouter OS also supports a variety of Ethernet NICs like Intel® Ethernet Controller 82599 or XL710 Family.
- **Simplified Administration and Authentication.** Can be managed through a familiar network-centric Command Line Interface (CLI), Web-based GUI, or through external management systems using the Remote Access API. All network management sessions can be securely managed using SSHv2, RADIUS, or TACACS+.
- **Cloud Capability.** Supported in most major Tier 1 public cloud providers with the broadest range of hypervisor support.

Ecosystem Partners Deliver Reliability and Performance

With Hewlett Packard Enterprise as a technology partner, Intel collaborates closely with Intel® Network Builders members such as Brocade*. This collaborative ecosystem enables an open, flexible environment for CoSPs to make the transition to NFV on the HPE NFVI platform, which includes Intel® Xeon® processors, a Data Plane Development Kit (DPDK) and the Intel® ONP reference architecture.

The Intel-HPE-Intel Network Builders ecosystem provides CoSPs with the resources to respond quickly to market demands while accelerating the overall transformation toward NFV. HPE's NFVI platform streamlines the design, proof-of-concept, trial, and deployment of new cloud-enabled network services and innovations, while lowering capital expenditures, operating expenditures, and risk. Intel is a key contributor to the HPE OpenNFV Lab testing, standards work, and the development of the NFVI platform.

Hewlett Packard Enterprise OpenNFV Labs

Once a titan in the world of proprietary hardware, Hewlett Packard Enterprise now champions x86 standardization and open platform development with equal fervor. Recognizing the benefits of NFV for telecoms and other enterprise markets, HPE launched its OpenNFV Partner Program for network equipment providers, independent software vendors, and system integrators. Within the OpenNFV and its global array of HPE-operated labs, partners can accelerate their design, proof-of-concept, trial, and deployment operations for cloud-enabled network services. This creates a supportive atmosphere in which all participants can ultimately present buyers with lower CapEx, OpEx, and risk.

The OpenNFV platform provides NFV infrastructure running on HPE's converged servers, which also happen to be consolidated under HPE Helion Virtual Infrastructure Manager (VIM) and HPE NFV Director for MANO, as defined within ETSI NFV documentation. This solution provides a simple pathway for VNF images such as Brocade's* router, SDN controller, vADC, and VDX switches to test within a fully scalable, managed space and assess any potential issues long before reaching live production environments.

OpenNFV assists CoSPs in selecting their own VNF partners. HPE's OpenNFV Labs (located in the USA, France, Israel, and South Korea) then help these partners to validate their component interoperability under high, variable loads within complex NFVI environments. In effect, the Labs are incubation tanks and trial by fire forges. They also showcase HPE's ample commitment to open industry standards, some of which include the Alliance for Telecommunications Industry Solutions (ATIS), Open Networking Foundation (ONF), Open Data Center Alliance (ODCA), Internet Engineering Task Force (IETF), OPNFV, and open source initiatives such as OpenStack and Open Daylight.

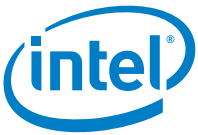
Wind River®, an Intel company, is also working with HPE to help CoSPs deliver commercial solutions targeting ETSI Network Function Virtualization use cases on the HPE Helion OpenStack® Carrier Grade platform. Further integrations will take place with Intel and open source communities such as OPNFV when those integrations meet the CoSPs' performance requirements.

Intel

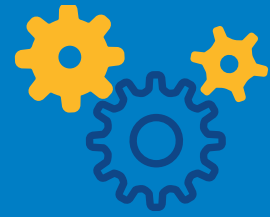
Intel is leading network transformation through open-source, open-standard technologies that form the building blocks of SDN and NFV. They contribute solutions for the four layers of SDN architecture and support workgroups implementing NFV concepts. Intel nurtures and supports an "open" ecosystem of partners and customers with reference designs, developer programs, and public collaboration. Their standards-based approach has enabled proofs of concept and public trials of innovative solutions, including telecom applications, such as Cloud RAN, virtual Evolved Packet Core, virtual CDN, and virtual CPE. Intel collaborates closely with Brocade as a member of Intel Network Builders in concert as a part of their technology partnership with HPE. Together they're able to offer their CoSP customers VNF solutions on HPE NFVI infrastructure that have integrated key learnings and technologies from Intel—such as Intel Xeon processors—taking advantage of their collaboration with DPDK and ONP reference platform.

Conclusion

For connectivity between hybrid clouds, private clouds, and services for in-cloud networks, the Brocade and HPE solutions offer carrier-class performance and reliability for telcos, cloud service providers, and enterprises. By enabling intra-data center traffic to travel directly from a source to its destination, traffic avoids the expensive higher layers of the network in situations where routing, firewalling, and VPN connectivity are required. By transitioning from hardware networking to SDN networking, service providers free up capital and equipment, avoid vendor lock-in, and provide better customer service.



Learn More, visit <http://hpe.com/go/nfv> or <https://networkbuilders.intel.com> or <http://www.brocade.com/nfv>



Brocade* Communications Systems

Originally known for its leadership in fiber channel storage networks, Brocade* has expanded its focus to include a wide range of products for New IP and third platform technologies. These products include routers and switches, NFV and SDN solutions, and network management software that spans physical and virtual devices.

¹ Gartner, "Your Data Center Network is Heading for Traffic Chaos," Bjarne Munch, Gartner ID: G00210674, April 27, 2011.

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