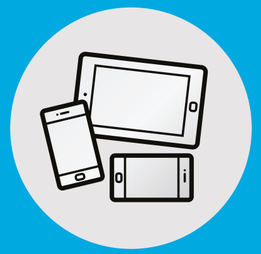
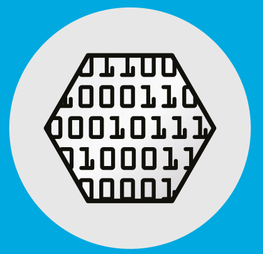
RED HAT'S NFV PARTNER ECOSYSTEM

DELIVERING A COMPLETE NFV INFRASTRUCTURE THROUGH COLLABORATION, INTEGRATION, AND CERTIFICATION





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"Through our long-term and continued collaboration with Red Hat, we are working to build an open industry standard which has enormous potential for expanding awareness and adoption of NFV."

– **ATSUO KAWAMURA**
SENIOR VICE PRESIDENT,
NEC CORPORATION

INTRODUCTION

With a proven development model built upon community-led innovation, Red Hat understands the importance of partner collaboration. Open source communities rely on the power of cooperation, peer review, and widespread participation. While Red Hat provides the core software infrastructure needed for network functions virtualization (NFV), the company aligns with key partners to deliver complete NFV solutions. Each of these partners adds to the value of the Red Hat® infrastructure with innovative components including:

- Management and orchestration (MANO)
- Virtual network functions (VNFs)
- Software-defined networking (SDN) products
- Infrastructure add-ons
- Commercial off-the-shelf (COTS) hardware

The coordinated solutions that Red Hat and its partners provide are tested and validated to simplify customer installation and deployment and ensure that support and maintenance are seamlessly integrated. This ebook provides an in-depth look at Red Hat's NFV partner ecosystem and the solutions you can build with its trusted, interoperable components.

"Working with Red Hat, the major contributor to OpenStack, gives us both the visibility and ability to provide input to OpenStack upstream projects, in order to highlight specific stringent requirements networks demand.

— **DOR SKULER**
VICE PRESIDENT AND GENERAL MANAGER,
CLOUDBAND BUSINESS UNIT,
ALCATEL-LUCENT

OPEN SOURCE POWERS NFV

In today's intensely competitive information and communications technologies (ICT) industry, communications service providers (CSPs) must transform their operations to take advantage of shifting market dynamics. Whether this is achieved by adapting business models to capture new revenue, scaling to meet explosive growth and unpredictable peaks in bandwidth demand, or adding new services to stay ahead of competition, CSPs need IT architectures that provide flexibility, agility, and the ability to innovate quickly. NFV can deliver these capabilities, but full solutions must be developed for CSPs to adopt NFV with confidence.

The ICT industry relies on open communities to provide many of the components needed for NFV. Drawing on more than 20 years of leadership in the open source community, Red Hat delivers technologies that are trusted for their stability, security, and interoperability in critical IT environments and are used by 100% of CSPs in the Fortune Global 500.[1] Red Hat integrates key technologies, like OpenStack® and Linux®, from open source communities into its robust, commercially hardened products. Additionally, the company continues to encourage innovation through ongoing contributions to communities developing technologies for production-grade NFV environments—including Open Platform for NFV (OPNFV), Open Daylight, and OpenStack.

OpenStack has emerged as the preferred open source platform for NFV. Safe, secure, and readily deployable, Red Hat OpenStack Platform serves as the foundation of Red Hat's NFV solutions.

1 *Red Hat client data and Fortune Global 500 list, 2014.*

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"We have cooperated with Red Hat since 2004, and are excited about [our] expanded relationship, as it strongly supports our strategy to smoothly transition proven carrier-grade core software applications to NFV OpenStack cloud environments."

— **MICHAEL CLEVER**
SENIOR VICE PRESIDENT OF CORE,
NOKIA NETWORKS

A TRUSTED NFV ECOSYSTEM

There is no single-vendor NFV solution. To provide CSPs with optimized performance, availability, and support, you need a robust and trusted ecosystem of technologies with close collaboration between vendors.

Red Hat has a proven record in developing commercial ecosystems around open source infrastructure platforms, fostering a strong network of technology providers that deliver the production-grade features needed for critical deployments. Building on its trusted OpenStack ecosystem, Red Hat brings the same approach to vertical solutions for the ICT industry.

In addition to validation of generalized OpenStack infrastructure and applications, Red Hat now offers testing and certification services for partners with products targeted at NFV deployments. This gives CSPs assurance that the components of Red Hat NFV solutions:

- Have been tested and validated by Red Hat and its partners.
- Are fully supported by Red Hat and its partners.
- Meet current industry best practices for deployment and configuration.

Through partnership with key partners, Red Hat's NFV ecosystem lets you build complete, innovative NFV environments based on industry-leading technologies. These solutions are interoperable, agile, and cost-effective, allowing you to more easily transform your business and prepare for the future.

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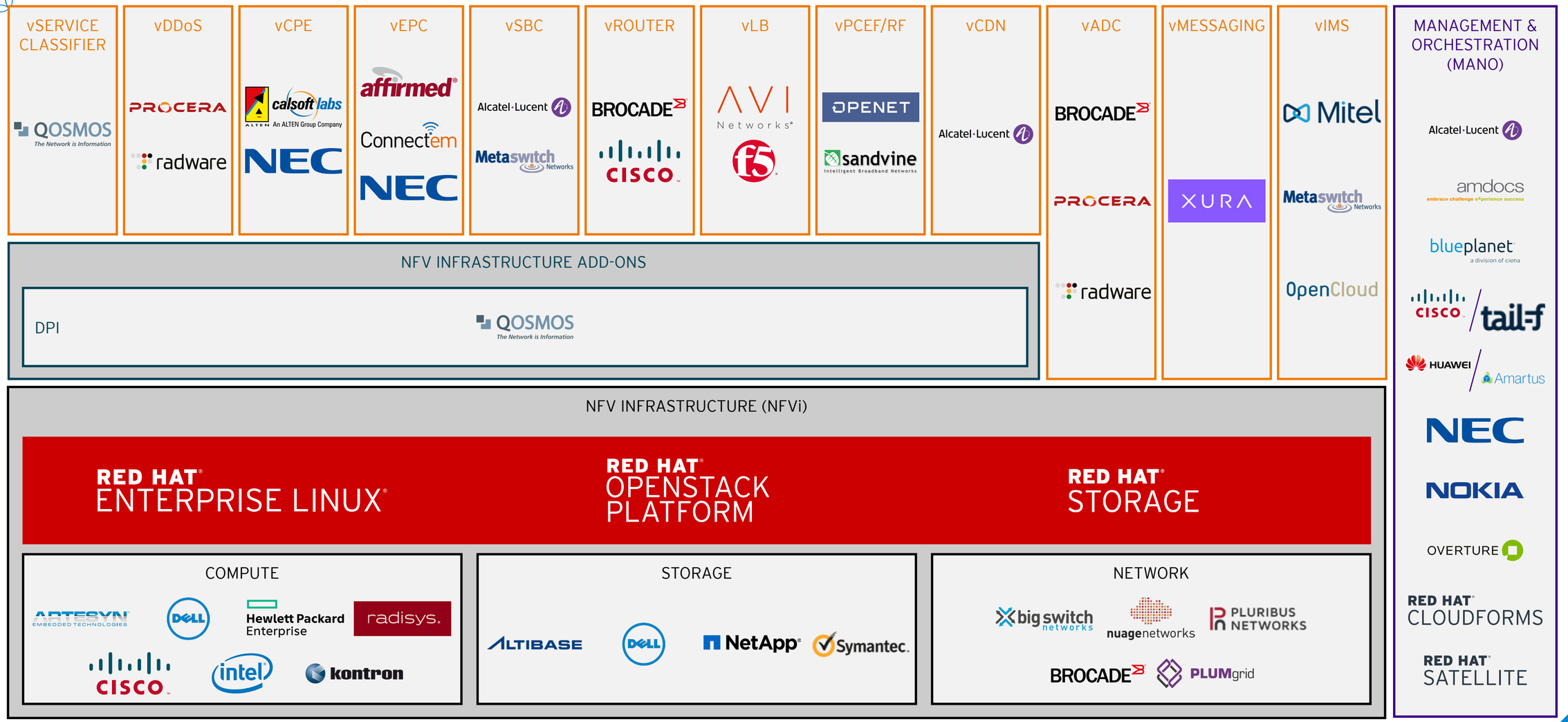

CLICK ON A PARTNER LOGO TO LEARN MORE INFORMATION.

NFV INFRASTRUCTURE PARTNERS

COMPUTE, STORAGE, NETWORK, AND INFRASTRUCTURE ADD-ON TECHNOLOGIES

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DEPLOY A PROVEN, ADAPTABLE NFV FOUNDATION WITH RED HAT AND DELL

SOLUTION BRIEF

Mobile data traffic will grow by

10x

and the number of mobile subscriptions will reach

9.2 billion

by 2019.[1]

Network functions virtualization can help communications service providers take advantage of new market opportunities faster and more efficiently while cutting costs and preparing their infrastructure for the future.

Based on industry-leading components and open standards, Red Hat and Dell deliver a proven, integrated foundation for your NFV environment. With this consistent, uniform building block and a large ecosystem of certified partner technologies, you can create a flexible NFV infrastructure that helps you keep pace with the evolving communications market.

NETWORK FUNCTIONS VIRTUALIZATION TRANSFORMS COMMUNICATIONS

By 2019, mobile data traffic is expected to increase by tenfold.[1] This presents a challenge for communications service providers, as the cost to support data traffic is increasing rapidly but the revenue from data services is growing much slower. Rigid, costly, and limited legacy communications infrastructures can't keep up with today's business demands and impede your ability to innovate and compete in a crowded market.

Network functions virtualization (NFV) virtualizes network functions on a general-purpose, cloud-based infrastructure to give you more flexibility, efficiency, and scalability than legacy infrastructures—while also reducing costs and lowering innovation risks. Using open technologies in your NFV environment further enhances these benefits. Open source technologies promote better interoperability and faster innovation, so you can take advantage of the latest advances quickly and easily. In fact, 83% of communications operators demand or prefer to use open systems within their networks and 95% see open technologies as a positive attribute of any NFV solution.[2]

Red Hat and Dell provide a proven, adaptable infrastructure for NFV environments. Based on open standards and engineering collaboration, the Red Hat® and Dell NFV foundation delivers exceptional scalability and flexibility in an integrated, optimized, and cost-effective package.

BUILD YOUR NFV INFRASTRUCTURE ON OPEN INDUSTRY LEADERSHIP

Red Hat and Dell aim to advance innovation in the communications industry. Through co-engineering and open community leadership, Red Hat and Dell are helping the communications industry move from proprietary infrastructures that are vertically oriented to flexible, scalable, and open infrastructures that are horizontally oriented. Based on Red Hat's open, integrated software stack and Dell's world-class converged infrastructure offerings, this solution provides a consistent foundation that helps communications providers make the transition smoothly and successfully.

Red Hat, the expert in making open technologies safe, secure, and consumable for commercial use, delivers the entire core software stack needed for NFV. Red Hat's open, integrated software stack delivers better interoperability, stability, and security than fragmented solutions. Outstanding scalability, performance, and security combines with simplified deployment and high availability to form an ideal software framework for NFV.

As a key contributor in the enterprise computing shift from mainframe to client-server, Dell brings deep experience in datacenter transformation to the communications industry. Dell's converged infrastructure offering for NFV includes Dell PowerEdge servers, high-performance storage, open networking, and low-level software. Built on open industry standards, the Dell NFV Platform gives you increased interoperability, flexibility, and choice.

1 *Ericsson, "Ericsson Mobility Report," June 2014.*

2 *Doyle Research, "Open Networking Drives NFV Innovation for the Telecom Industry," December 2014.*

ABOUT RED HAT

Red Hat is the world's leading provider of open source software solutions, using a community-powered approach to reliable and high-performing cloud, Linux, middleware, storage, and virtualization technologies. Red Hat also offers award-winning support, training, and consulting services. As a connective hub in a global network of enterprises, partners, and open source communities, Red Hat helps create relevant, innovative technologies that liberate resources for growth and prepare customers for the future of IT.

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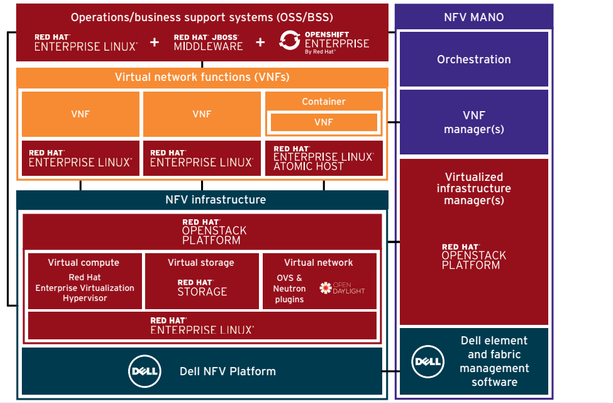

Figure 1. Red Hat and Dell deliver a proven, open, integrated foundation for NFV environments. Both companies foster large certified partner ecosystems that allow you to easily customize your NFV environment.

Together, Red Hat and Dell are committed to providing proven, adaptable solutions to the communications industry. Both companies foster broad certified partner ecosystems that help you customize your NFV environment with the top virtual network functions (VNFs) and orchestration and management tools available. Additionally, professional services based on industry best practices can help you build a stable, secure NFV environment faster and operate it more efficiently.

RED HAT AND DELL DELIVER A PROVEN, OPTIMIZED NFV FOUNDATION

To promote innovation and interoperability, the European Telecommunications Standards Institute (ETSI) has proposed a next-generation NFV infrastructure based on industry standards. In Figure 1, the Red Hat and Dell NFV foundation integrates all of these components into a flexible, customizable building block. Red Hat and Dell co-engineered this foundation for optimized performance, security, and stability. Plus, the companies continue to work together to incorporate the newest technology and business innovations into the solution so you can confidently keep pace with the evolving communications industry.

CONCLUSION

In the face of growing demands and diminishing returns for data services, NFV allows you to operate flexibly, efficiently, and cost-effectively. Red Hat and Dell deliver a proven, open, and optimized foundation for your NFV environment that lets you meet today's needs while preparing for a fast-changing future. Contact your Red Hat representative to learn more about modernizing your communications infrastructure with a consistent, adaptable NFV foundation.

Learn more about how Red Hat and Dell are working together at redhat.com/dell.

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INCREASE BUSINESS AGILITY WITH NETWORK FUNCTIONS VIRTUALIZATION

Red Hat and Intel's virtual network functions infrastructure for the communications industry

TECHNOLOGY OVERVIEW

COMMUNICATIONS INDUSTRY: NFV INFRASTRUCTURE

80%

of communications service provider technology executives consider accelerating application delivery to be a critical priority.[1]

71%

of communications service provider technology executives are concerned about unpredictable demands and growth in the industry.[1]

Virtualizing network functions gives communications companies unprecedented business agility.

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VIRTUALIZING COMMUNICATIONS INFRASTRUCTURE

As communications companies expand their product offerings to cross traditional service segments, it is essential to stay ahead of the curve with innovative new services. Conventional communications infrastructures rely on dedicated proprietary hardware to implement each network function, which increases cost and complexity. This hardware-centric, siloed infrastructure approach can impede business agility and innovation. Scalability is limited, and deployment is often sluggish, as expensive new servers must be acquired and provisioned. Staffing costs escalate as increased expertise is needed to design, integrate, operate, and maintain the various network function appliances. All of these issues make it difficult to innovate and compete.

Network functions virtualization (NFV) can provide the infrastructure flexibility and agility needed to successfully compete in today's evolving communications landscape. NFV implements network functions in software running on shared commercial off-the-shelf (COTS) servers instead of using dedicated proprietary hardware. This virtualized approach decouples the network hardware from the network functions and results in increased infrastructure flexibility and reduced hardware acquisition and operational costs. Because the infrastructure is simplified and streamlined, new and expanded services can be created quickly and with less expense. Red Hat and Intel collaborate to provide an NFV infrastructure solution that rivals the performance of physical implementations at a fraction of the cost.

VIRTUAL FUNCTIONS WITH PHYSICAL FUNCTION PERFORMANCE

Performance, cost, and high availability are critical to a successful NFV implementation. In order for NFV to be of value, it must be designed to be cost-effective and provide virtual network performance and reliability comparable to that of physical network function implementations. NFV implementations reduce costs by using inexpensive, commonly available hardware, but many fail to provide the required performance due to the added overhead of the virtual infrastructure and virtualized data planes. Simply put, network packets are delayed by unnecessary routing through the operating system, hypervisor, and processor, reducing virtual network function performance. High availability is also a concern, and considerations must be taken into account when building an NFV environment to ensure that it meets enterprise reliability standards.

Unlike other NFV solutions, the Red Hat® and Intel NFV infrastructure eliminates virtual data plane overheads to provide comparable performance to physical network function implementations—in addition to cost savings from widely available commercial hardware. Intel® Xeon® processors and 10 gigabit Intel Ethernet technology deliver extreme processing power and fast, efficient networking for the infrastructure. The Intel Data Plane Development Kit (Intel DPDK) library allows virtual network function software to route network packets around the Linux® operating system kernel, which can improve packet processing performance by up to tenfold. Open vSwitch accelerates virtual switching and network performance throughout the environment. Red Hat Enterprise Linux and the Kernel-based Virtual Machine (KVM) hypervisor provide the secure, reliable operating environment and flexible, high-performance, cost-effective virtualization needed to decouple network functions from the hardware they run on. Red Hat OpenStack® Platform controls the overall NFV infrastructure and provides an open interface for a wide variety of network orchestration tools and virtual network functions software. And, by using Red Hat's best practices for building highly available OpenStack framework, you can be sure your NFV environment meets industry standards for reliability and availability.[2]

1 Gatepoint Research, "Communications Industry Technology Survey," September 2012.

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Virtualizing your network infrastructure can increase business agility, enhance service scalability, and improve subscriber experience.

All of this adds up to unprecedented NFV performance and availability with a cost structure that overcomes the challenges of virtualizing network functions. With the Red Hat and Intel NFV infrastructure, you can dynamically launch, configure, and scale network functions to meet shifting traffic patterns and demands for innovative new services, all while reducing infrastructure costs and improving overall subscriber experience.

VIRTUALIZE YOUR NETWORK WITH AN OPEN FOUNDATION

As shown in Figure 1, each component of the Red Hat and Intel NFV infrastructure provides a key element to help create a high-performance, cost-effective NFV solution.

- **Red Hat Enterprise Linux** lays the open source groundwork for the foundation, allowing secure and reliable operation for virtualized network functions.
- **Open vSwitch and the KVM hypervisor** provide high-performance virtual network switching and virtual machines for network applications.
- **Red Hat OpenStack Platform** controls the foundation infrastructure and provides an interface to network functionality and services.
- **Multi-core Intel processors** provide the advanced performance, workload, and power management needed to contain operating costs without compromising network performance.
- **Intel DPDK** provides high-performance network drivers and an optimized run-time environment that maximizes packet processing performance on Intel Xeon processors. Virtual network functions and NFV infrastructure add-on software can use the Intel DPDK library to route network packets around the Linux kernel, reducing data plane overhead and accelerating performance up to tenfold.
- **10 Gigabit Intel Ethernet controllers and converged network adapters** provide fast network connections throughout the NFV infrastructure.

CUSTOMIZE YOUR NFV INFRASTRUCTURE WITH ADD-ONS

The Red Hat and Intel NFV infrastructure gives you an open foundation for a cost-effective, high-performance NFV environment. You can then choose the infrastructure add-ons and network orchestration tools you need to differentiate your service offerings, knowing that they will be compatible with your NFV foundation.

Accelerated packet processing. Packet processing acceleration add-ons use the Intel DPDK API and libraries to route and administer network packets outside the Linux kernel, further increasing data plane performance for use cases such as virtual evolved packet core (vEPC), Internet Protocol security (IPsec) gateways, and virtualized content delivery networks (CDN).

Deep packet inspection. Deep packet inspection modules bring service awareness to virtual switches to provide detailed, real-time traffic intelligence and application recognition for use cases such as dynamic service chaining and layered service offerings.

2 Red Hat, "Deploying a highly available OpenStack cloud," July 2014.

A smaller, virtualized infrastructure can provide the same service capabilities and performance as a larger hardware-centric infrastructure at a fraction of the cost.

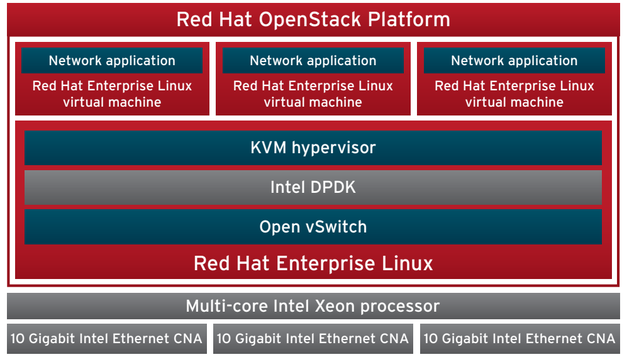

Figure 1. The components of the Red Hat and Intel NFV infrastructure work together to overcome the challenges of virtualizing network functions.

Red Hat OpenStack Platform also provides open standards-based APIs for network orchestration tools and virtual network function software. Below are a few examples of what you can accomplish with a cost-effective, high-performance NFV foundation.

REDUCE YOUR COSTS WITH INFRASTRUCTURE SIMPLICITY

Complex infrastructures are expensive to maintain and operate, and high infrastructure costs detract from the bottom line. The Red Hat and Intel NFV infrastructure simplifies your network environment by converging network functions onto a single, shared architecture. Widely available commercial hardware replaces proprietary appliances, significantly reducing capital expenditures. Decoupling the hardware infrastructure from the software network functions also allows hardware to be replaced less frequently, further increasing hardware return on investment (ROI). Operating expenditures are contained through advanced server power management features and streamlined administration and management. With improved, dynamic scalability, you can easily add and move resources between virtual network functions to meet shifting peaks in network traffic without maintaining fleets of extra dedicated network appliances that remain idle much of the time. A smaller virtualized infrastructure can provide the same service capabilities and performance as a larger hardware-centric infrastructure at a fraction of the cost.

VIRTUAL CUSTOMER-PREMISES EQUIPMENT

Communications subscribers use various CPE devices, such as routers, switches, and set-top boxes, at their sites to connect to services. In many cases, each device controls a single network service such as Internet access or cable service, and one customer will have many devices, each of which must be kept up-to-date. With the Red Hat and Intel NFV infrastructure, multiple CPE devices can be consolidated onto a single virtual setup consisting of a programmable modem, switch, and antenna, reducing costs and complexity. Software updates and service configurations are managed centrally, decreasing operational expenses. New services can be added faster, more easily, and without the need for new CPE devices, significantly improving the customer experience.

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The Red Hat and Intel NFV infrastructure combines fast network performance with cost-effective commodity hardware for increased infrastructure agility and real business value.

BOOST YOUR PROFITS WITH INFRASTRUCTURE AGILITY

Infrastructure flexibility allows you to dynamically modify your service offerings to meet changing market needs. The Red Hat and Intel NFV infrastructure gives you the business agility you need to succeed in an increasingly competitive industry. Dynamic infrastructure scalability allows virtual functions to be automatically migrated across shared resources to accelerate service delivery and ensure growing peak demand levels are met. The risk of innovation is greatly reduced as new revenue-boosting services can be created quickly without the purchase of new hardware, and retired just as fast if market acceptance isn't realized. This allows you to pioneer creative new service offerings that can move you ahead of the competition.

ON-DEMAND SERVICES

In today's on-demand world, communications subscribers expect services to be available whenever and wherever they want to use them. With the Red Hat and Intel NFV infrastructure, shared resources can be dynamically allocated to provide any service at any time, from Internet bandwidth to video-on-demand. With improved access to all services, customers are more likely to take advantage of both existing and new services.

CONCLUSION

Network function virtualization has the potential to revolutionize the way communications providers bring services to their subscribers. Red Hat is the industry leader in making innovative open technologies safe, secure, and consumable for enterprises and communications providers. The Red Hat and Intel NFV infrastructure combines the performance of physical network implementations with the cost benefits of virtualized, commodity-based environments for increased infrastructure agility and real business value. Contact your Red Hat sales representative today to learn more about the Red Hat and Intel NFV infrastructure and take your network profitability to the next level.

ABOUT RED HAT

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SIMPLIFY OPENSTACK NETWORKING

Streamline operations and boost scalability with Red Hat and Big Switch Networks

SOLUTION BRIEF

Red Hat and Big Switch Networks provide a network fabric solution for OpenStack that simplifies your network and streamlines complex setup and management operations for better efficiency, uptime, and scalability while reducing costs.

The Red Hat and Big Switch Networks solution speeds OpenStack networking installation and activation by

16x

and reduces total cost of ownership by

70%,

according to a study by ACG Research.[1]

OPENSTACK ADOPTION IS ACCELERATING

Many organizations are turning to cloud technologies to help improve business, from driving cost efficiencies and enabling workforce mobility to improving customer and partner alignment and gaining better insight from their data.[2] OpenStack® has become the cloud platform of choice, with 84% of U.S. enterprise organizations planning to adopt OpenStack.[3]

However, setting up an OpenStack-based cloud can be a complicated process that may involve custom development. The combination of box-to-box connections and operational workflows that cross physical and virtual networks makes OpenStack networking setup a challenge. Getting the configuration right is critical—errors can lead to poor performance, security issues, inefficient operations, and overall delays.

Red Hat and Big Switch Networks deliver an open, integrated fabric solution for OpenStack that reduces network complexity and streamlines operations. With simplified OpenStack networking, you can improve operational efficiency, increase uptime, reduce costs, and boost scalability.

ELIMINATE NETWORK COMPLEXITY WITH A FULLY INTEGRATED SOLUTION

Combining Red Hat® OpenStack Platform and Big Switch Networks' Big Cloud Fabric™ (BCF), the Red Hat and Big Switch Networks solution simplifies OpenStack network design and operations. The turnkey solution uses software-defined networking (SDN) and hyperscale principles to set up a unified, programmable network fabric for your OpenStack cloud environment. This SDN approach disaggregates networking hardware and software and centralizes network control and management for a drastic decrease in complexity. BCF's SDN controller automates network operations, including policy creation and enforcement, switch installation and provisioning, and network monitoring. Open Ethernet switches provide high-bandwidth layer 2 switching, layer 3 routing, and layer 4-7 service insertion and chaining.

STREAMLINE DEPLOYMENT WITH A TURNKEY INSTALLER

Within the solution, Red Hat OpenStack Platform provides the open, secure, and reliable cloud f oundation, while BCF delivers a scalable, resilient, and unified network fabric. The Red Hat OpenStack Platform director automates installation of cloud components, and supplies system-wide health checks and complete life cycle management. Integration with the BCF networking installer adds seamless, predictable network configuration workflows and ensures cloud stability after system upgrades. The network infrastructure is programmed and automated using Big Switch Network-specific plugins for Neutron, enabling link detection of compute nodes and fabric formation without manual intervention. This lets you dynamically provision isolated tenants and layer 2 networks to meet changing IT and business needs. The resulting network is agile, scalable, easy to administer, and deploys up to 16 times faster than other private cloud technologies.[1]

1 ACG Research, "The Economic Advantages of Open SDN Fabrics," November 2015.

2 KPMG, "2014 Cloud Survey Report: Elevating Business in the Cloud," January 2015.

3 IDG Connect, "OpenStack: The Platform of Choice for Cloud," 2013.

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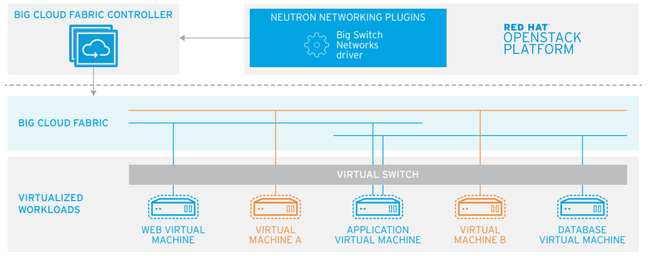

Figure 1. The Red Hat and Big Switch Networks solution automates and simplifies OpenStack networking.

SIMPLIFY NETWORK OPERATIONS AND REDUCE DOWNTIME

Traditional networks are managed on a switch-by-switch basis—a time-consuming, error-prone, and costly process. Conversely, the Red Hat and Big Switch Networks solution streamlines operations and increases network uptime. Automatic fabric configuration reduces setup errors and speeds provisioning. Zero-touch installation and plug-and-play scalability allows you to add more network capacity on demand without configuring each switch manually. Centralized SDN fabric management improves consistency and simplifies operations. Deep network visibility and monitoring with built-in analytics lets you track packets through every level of your network, physically and logically. Built-in redundancy throughout the solution lets you confidently run critical workloads in your OpenStack environment. No-downtime upgrades keep your infrastructure up to date with the latest features and functionality without service interruptions. Finally, a large ecosystem of certified hardware and software technologies lets you easily customize your cloud deployment.

IMPROVE TOTAL COST OF OWNERSHIP

The Red Hat and Big Switch Networks solution can reduce OpenStack total cost of ownership by up to 70%.[4] With an open, software-centric design, the solution lets you use industry-standard hardware for your cloud deployment, reducing capital costs. Simplified, efficient operations decrease operational expenses. With a lower total cost of ownership, you can redirect your budget to strategic projects.

CONCLUSION

OpenStack can provide many business benefits, but building an OpenStack environment is complicated, especially when setting up the underlying network. Red Hat and Big Switch Networks offer an integrated, turnkey fabric solution for OpenStack that simplifies and automates network installation, configuration, and management. With this solution, you can deploy network connectivity faster, streamline operations, reduce costs and downtime, and increase the scalability of your OpenStack environment. Visit bigswitch.com/sdn-products/big-cloud-fabrictm or contact your Red Hat or Big Switch Networks sales representative to learn how you can take advantage of operational simplicity in your OpenStack cloud environment.

4 ACG Research, "The Economic Advantages of Open SDN Fabrics," 2015.

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SIMPLIFY DATACENTER NETWORKING WITH RED HAT AND NUAGE NETWORKS

BROCHURE

COMMUNICATIONS INDUSTRY: NFV INFRASTRUCTURE ADD-ON

76%

of telecommunications financial executives consider the cost-reduction opportunities of the cloud to be strategically important to their business.[1]

Static datacenter networking models require time-consuming manual programming and can delay the availability of network services for cloud applications, limiting the effectiveness of your cloud infrastructure.

The Red Hat and Nuage Networks SDN-based cloud solution makes your network more agile, flexible, and automated so you can launch network services for cloud applications faster, reduce operational costs, and take full advantage of your cloud technologies.

STATIC NETWORKING LIMITS CLOUD APPLICATIONS

Cloud services promise rapid, cost-effective instantiation of applications, which can improve business agility and simplify operations. To deliver on this promise, however, your datacenter networking must be as agile and flexible as your virtualized server and storage infrastructure. Complex, static networking models require tedious, error-prone manual programming, which increases operational costs (OpEx), reduces efficiency, and delays the availability of network services for cloud applications. This restricts cloud operations and prevents you from taking full advantage of your cloud infrastructure.

Moving to a virtualized, software-defined networking (SDN) model can help you enjoy all the benefits the cloud has to offer. Open industry experts Red Hat and Nuage Networks offer an application-centric SDN-based cloud solution that virtualizes and simplifies your datacenter network. With enhanced network flexibility, automated network management, and scalability across multiple tenants and datacenters, Red Hat and Nuage Networks help you reduce costs, launch cloud applications faster, and increase the efficiency of your cloud infrastructure.

IMPROVE AGILITY WITH VIRTUALIZED DATACENTER NETWORKING

Based on a unique, application-centric approach, the Red Hat® and Nuage Networks SDN-based cloud solution abstracts application networking requirements from your physical network topology to streamline management operations and improve agility. Programmable business logic and a powerful policy engine let you define Level 2-4 network requirements once in simplified application terms and ensure compliance with resource policies across your infrastructure on a per-tenant and per-application basis. Event-driven network service instantiation reserves network resources as they are required and without manual intervention, allowing the demands of cloud applications to be quickly met for thousands of users. This frees network administrators to focus on critical issues. Seamless interoperability across multiple administrative domains and datacenters lets you place cloud workloads optimally across your infrastructure, improving server utilization and allowing cloud bursting and hybrid cloud services.

The components of the solution work together to deliver simple, agile network operations.

Red Hat and Intel Network Functions Virtualization (NFV) infrastructure
Red Hat's open software stack and Intel's high-performance processors and network adapters are the foundation of the solution.[2] Red Hat Enterprise Linux®, with the integrated Kernel-based Virtual Machine (KVM) hypervisor, supplies high-performance virtual machines. Red Hat Storage provides flexible, cost-effective, virtualized storage. And Red Hat OpenStack® Platform gives you a fully supported, enterprise-grade cloud platform for next-generation applications.

Nuage Networks Virtualized Services Platform (VSP)
Based on more than a decade of experience building global networks for service providers, Nuage Networks VSP is an open SDN platform for virtualizing datacenter networks using x86 hardware.

1 *KPMG, "2013 Media and Telecommunications Industry Outlook Survey," July 2013.*

2 *Red Hat, "Increase business agility with network functions virtualization," August 2014.*

RED HAT® OPENSTACK PLATFORM

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ABOUT RED HAT

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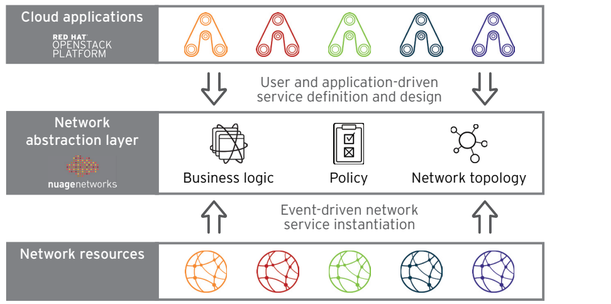

Figure 1. The Red Hat and Nuage Networks SDN-based cloud solution uses an application-centric approach to automatically and dynamically deploy network services across your infrastructure in accordance with pre-defined policies.

Nuage Networks VSP is certified on Red Hat OpenStack Platform and consists of three key components. The Virtualized Services Directory (VSD) is a programmable policy and analytics engine that lets you define and enforce resource policies in a user-friendly manner. Built on multi-protocol Border Gateway Protocol (BGP), the Virtualized Services Controller (VSC) functions as a network control plane and enables federated and highly scalable networks. The Virtual Routing and Switching (VRS) module is an enhanced Open vSwitch (OVS) implementation that makes up the network forwarding plane and applies the Layer 2-4 traffic policies defined in the VSD. It also tracks virtual machine creation, migration, and deletion to dynamically adjust network connectivity.

LAUNCH CLOUD SERVICES FASTER

Cloud services are a significant revenue opportunity for service providers, but if service instantiation is delayed, you risk losing new market share to competitors. With the Red Hat and Nuage Networks SDN-based cloud solution, you can launch cloud services faster. Flexible, automated network configuration delivers instantaneous network connectivity so cloud applications can go live more quickly. And simplified network setup and secure multi-tenant capabilities let you cost-effectively capitalize on new market opportunities for managed cloud services.

CONCLUSION

Service providers are looking to the cloud for their next-generation services, but static networking models can limit your cloud infrastructure. Red Hat and Nuage Networks offer an SDN-based cloud solution that virtualizes and automates your network so you can deliver cloud services faster while simplifying network management and reducing OpEx. Contact your Red Hat sales representative to learn more about the Red Hat and Nuage Networks SDN-based cloud solution and how it can help you get more out of your cloud infrastructure.

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DEPLOY OPENSTACK FASTER WITH RED HAT AND PLUMGRID

SOLUTION BRIEF

COMMUNICATIONS INDUSTRY: NFV INFRASTRUCTURE ADD-ON

82%
of telecommunications financial executives consider cloud technologies to be strategically important to future revenue growth.[1]

30%
are concerned about keeping pace with changing technology.[1]

Combining PLUMgrid ONS for OpenStack with the Red Hat and Intel NFV infrastructure allows you to quickly deploy and configure an agile OpenStack based cloud and deliver secure multi-tenant services for increased revenue.

DEPLOYING OPENSTACK IN THE COMMUNICATIONS INDUSTRY

Cloud technologies like OpenStack® are powerful tools for communications providers that want to gain competitive advantages in a crowded market. However, with complex network setup and configuration, deploying OpenStack for internal and external services can be challenging and time-consuming.

Red Hat and PLUMgrid deliver a flexible, scalable, integrated solution for OpenStack deployment in network functions virtualization (NFV) environments. The combination of the Red Hat® and Intel NFV infrastructure, including Red Hat OpenStack Platform, and PLUMgrid Open Networking Suite (ONS) for OpenStack simplifies and speeds cloud deployment and allows you to cost-effectively deliver secure multi-tenant services to your customers.

BUILD A CLOUD-BASED NFV INFRASTRUCTURE

In many OpenStack implementations, configuring the underlying network is one of the most difficult tasks. The Red Hat and PLUMgrid cloud-based NFV solution streamlines OpenStack network set up and configuration with virtual network overlays and automated workflows. This also allows you to create secure virtual domains within your cloud, eliminating the need for dedicated hardware silos for security-conscious customers. Plus, built-in virtual network functions (VNFs), service chaining capabilities, and open APIs get you up and running quickly and give you the option to add complementary third-party applications as your business needs evolve. As shown in Figure 1, each component of the solution provides key functionality for cloud-based NFV environments.

- **Red Hat and Intel NFV infrastructure.** Based on Red Hat's open technologies and high performance Intel processors and network adapters, the Red Hat and Intel NFV infrastructure provides a secure, scalable, and stable foundation for your cloud-based NFV environment.[2] And, with Red Hat OpenStack Platform, you have a reliable, commercially hardened, and fully supported OpenStack distribution that's ideal for highly available operation.
- **PLUMgrid ONS for OpenStack.** Tightly integrated with the Red Hat and Intel NFV infrastructure, PLUMgrid ONS for OpenStack provides the VXLAN network overlay and Puppet installation modules that let you quickly deploy an OpenStack-based NFV environment. Network functions can be deployed on-demand—without modifying your physical network—so you can quickly and easily deliver rich multi-tenant services to your customers. Highly configurable virtual domains divide your OpenStack cloud into encrypted logical partitions with provable isolation. Identity-based policy enforcement, LDAP authentication, and OpenStack Identity integration ensure the security of each virtual domain. And a large set of built-in VNFs and open APIs let you develop custom service offerings to meet changing customer demands.

A cloud-based NFV environment from Red Hat and PLUMgrid provides many benefits for communications providers. The following are some examples.

1 KPMG, "2013 Media and Telecommunications Industry Outlook Survey," July 2013.

2 Red Hat, "Increase business agility with network functions virtualization," August 2014.

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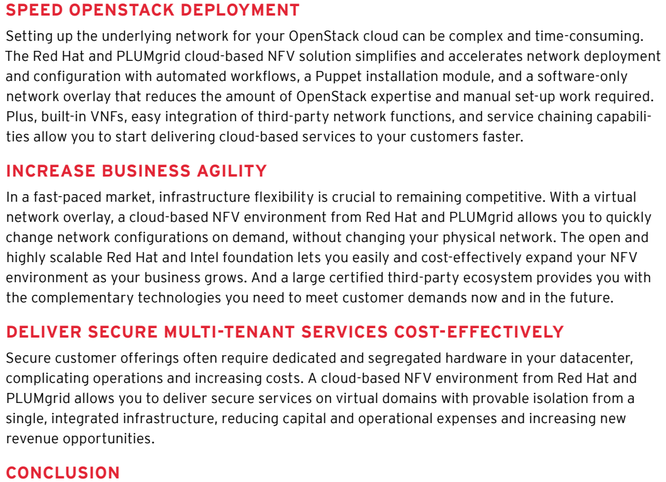

Figure 1. PLUMgrid ONS for OpenStack integrates with the Red Hat and Intel NFV infrastructure to speed OpenStack cloud deployment and streamline network management in cloud-based NFV environments.

SPEED OPENSTACK DEPLOYMENT

Setting up the underlying network for your OpenStack cloud can be complex and time-consuming. The Red Hat and PLUMgrid cloud-based NFV solution simplifies and accelerates network deployment and configuration with automated workflows, a Puppet installation module, and a software-only network overlay that reduces the amount of OpenStack expertise and manual set-up work required. Plus, built-in VNFs, easy integration of third-party network functions, and service chaining capabilities allow you to start delivering cloud-based services to your customers faster.

INCREASE BUSINESS AGILITY

In a fast-paced market, infrastructure flexibility is crucial to remaining competitive. With a virtual network overlay, a cloud-based NFV environment from Red Hat and PLUMgrid allows you to quickly change network configurations on demand, without changing your physical network. The open and highly scalable Red Hat and Intel foundation lets you easily and cost-effectively expand your NFV environment as your business grows. And a large certified third-party ecosystem provides you with the complementary technologies you need to meet customer demands now and in the future.

DELIVER SECURE MULTI-TENANT SERVICES COST-EFFECTIVELY

Secure customer offerings often require dedicated and segregated hardware in your datacenter, complicating operations and increasing costs. A cloud-based NFV environment from Red Hat and PLUMgrid allows you to deliver secure services on virtual domains with provable isolation from a single, integrated infrastructure, reducing capital and operational expenses and increasing new revenue opportunities.

CONCLUSION

OpenStack brings many benefits to communications providers. The Red Hat and PLUMgrid cloud-based NFV solution allows you to deploy OpenStack faster and provide secure, isolated services from an integrated infrastructure, allowing you to reduce costs and increase revenue. Contact your Red Hat sales representative today to learn how a cloud-based NFV infrastructure can help you gain a competitive advantage.

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IMPROVE NETWORK EFFICIENCY WITH DEEP PACKET INSPECTION

SOLUTION BRIEF

COMMUNICATIONS INDUSTRY: NFV INFRASTRUCTURE ADD-ON

85%

of communications industry IT executives consider improving infrastructure efficiency to be a top priority.[1]

A service-aware NFV infrastructure from Red Hat and Qosmos improves network efficiency and reduces costs through dynamic service chaining and intelligent traffic routing.

EFFICIENT SERVICE CHAINING IN A VIRTUALIZED ENVIRONMENT

In order to remain competitive in an increasingly crowded market, communications providers must operate more efficiently. However, both physical and virtual network infrastructures commonly use an inefficient static chain model that routes all network traffic to every service node, regardless of whether the information is relevant to that node. Then, as overall network traffic grows, all services must be scaled out to handle the increase, even if traffic for a particular service has not grown.

A service-aware NFV infrastructure allows network traffic to be routed intelligently using deep packet inspection (DPI). This dynamic service chaining model directs network flows only to the applicable service nodes. As network traffic for a given service increases, only that service needs to be scaled out, reducing infrastructure costs. Plus, the ability to segregate network flows based on application, protocol, and user allows you develop layered service offerings. Adding the Qosmos Service Aware Module (SAM) DPI module to the Red Hat® and Intel NFV infrastructure[2] allows you to implement dynamic service chaining in an open, enterprise-grade network environment so you can improve operational efficiency, reduce costs, and differentiate with premium services.

IMPROVE EFFICIENCY WITH A SERVICE-AWARE INFRASTRUCTURE

A service-aware NFV environment from Red Hat and Qosmos lets you intelligently route network traffic for more efficient operations and reduced infrastructure costs. Within the NFV environment, the Qosmos SAM DPI module classifies each network flow based on collected metadata and sends this information to the virtual switch, which directs the flow to the appropriate service nodes in the correct order, as shown in Figure 1. The result is reduced network consumption and a streamlined, efficient network infrastructure. Each component of the Red Hat and Qosmos solution plays a key role in delivering a highly available service-aware network infrastructure.

- **Red Hat and Intel NFV infrastructure.** Based on Red Hat Enterprise Linux®, Red Hat OpenStack® Platform, Open vSwitch (OVS), multi-core Intel processors, and Intel Ethernet adapters, the Red Hat and Intel NFV infrastructure provides an innovative, open, and highly available foundation for your network environment.
- **Red Hat OpenStack Platform.** Built on Red Hat Enterprise Linux and the Kernel-based Virtual Machine (KVM) hypervisor, Red Hat OpenStack Platform provides virtual infrastructure management layer for Qosmos SAM.
- **Qosmos SAM DPI module for vSwitch.** The Qosmos SAM DPI module integrates with KVM and OVS to classify network flows and provide Layer 7 visibility and service awareness at the infrastructure level.

The following are examples of what you can accomplish with a service-aware NFV infrastructure from Red Hat and Qosmos.

1 *Gatepoint Research, "Communications Industry Technology Survey," September 2012.*

2 *Red Hat, "Increase business agility with network functions virtualization," August 2014.*

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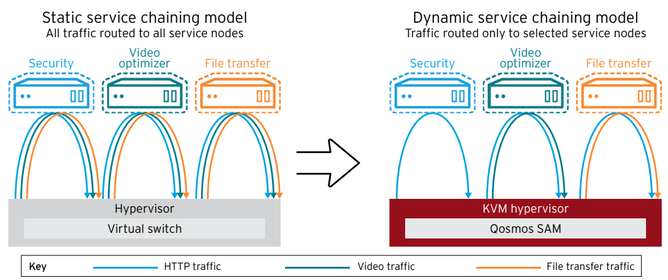

Figure 1. Based on information received from the Qosmos SAM DPI module, KVM routes network traffic only to applicable service nodes, in the appropriate sequence.

REDUCE COSTS WITH STREAMLINED INFRASTRUCTURE

Most IT organizations are facing flat or shrinking budgets. With a service-aware NFV environment from Red Hat and Qosmos, you can streamline your infrastructure and reduce costs. Because network flows are directed only to the relevant service nodes, you can consume significantly less network capacity and maintain a smaller infrastructure. This results in reduced capital expenses from new network capacity and service node acquisition and lower operational costs from infrastructure power and cooling.

INCREASE REVENUE WITH PREMIUM SERVICES

A service-aware NFV infrastructure from Red Hat and Qosmos lets you develop differentiated, layered services. Because network traffic can be segregated by user, you can offer—and demand higher prices for—premium services. For example, video traffic could be directed to an optimizer to deliver higher quality for customers who choose a premium video service. Traffic for customers who don't subscribe to the premium service could be delivered at the basic quality. The result is differentiated service offerings, lower costs, and higher revenues.

ACCELERATE TIME-TO-MARKET FOR SERVICE-AWARE SOLUTIONS

A fast development cycle is critical for independent software vendors (ISVs) and network equipment providers (NEPs) delivering innovative solutions for service providers. Qosmos SAM is delivered in a ready-to-use building block that speeds development of service-aware solutions. Open APIs and partnerships with leading switch vendors ensure compatibility from the start so you can launch new solutions faster.

SUMMARY

Efficient network operations are essential for communications providers to remain competitive in a crowded market. Adding Qosmos SAM to your Red Hat and Intel NFV infrastructure gives you a service-aware NFV environment that streamlines network routing, reduces costs, and allows you to offer layered services that generate more revenue. Contact your Red Hat sales representative to learn more about building a service-aware NFV infrastructure.

ABOUT RED HAT

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VIRTUAL NETWORK FUNCTION PARTNERS

SECURITY, SERVICE CHAINING, LOAD BALANCING, MOBILE SERVICE DELIVERY, APPLICATION DELIVERY, AND BEYOND

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PROTECT YOUR NETWORK WITH RED HAT AND RADWARE

SOLUTION BRIEF

COMMUNICATIONS INDUSTRY: VIRTUAL NETWORK FUNCTION

In 2013, over

50%

of cyber-attack campaigns deployed 5 or more attack vectors.[1]

62%

of those attack vectors were application-based.[1]

Red Hat and Radware allow you to deploy a secure NFV environment that automatically mitigates application and network-based cyber attacks across your entire network.

INTRODUCTION

With more devices than ever connected over a variety of public and private networks, communications providers are facing increasing security challenges. A recent study found that the number of cyber security threats grew by 25% in 2013.[2] And as the complexity of attacks increases, legacy security solutions do not adequately protect networks. Communications providers need comprehensive network protection, but hardware-centric security architectures can be cost-prohibitive and impractical for complete network coverage.

Industry leaders Red Hat and Radware offer a cost-effective, virtualized network security solution that gives you real-time, all-inclusive detection and mitigation of known and emerging application and network-based cyber-attacks, protecting you from availability-based threats. By combining Radware's Virtual DefensePro attack mitigation platform with the Red Hat® and Intel network functions virtualization (NFV) infrastructure, you can protect your entire network infrastructure while reducing security costs.

COMPREHENSIVE, COST-EFFECTIVE NETWORK SECURITY

While early cyber attacks were mainly network-based, current attacks are more often application-based.[1] Legacy security solutions often detect only network-based threats, leaving your network vulnerable. With the Red Hat and Radware virtualized network security solution, you can detect and mitigate both network-based *and* application-based attacks for comprehensive protection against all types of denial-of-service (DoS) and distributed denial-of-service (DDoS) attacks, application vulnerability exploitation, malware spread, network anomalies, information theft, and other emerging cyber attacks. A virtualized framework simplifies deployment and expansion by allowing virtual detection nodes to be placed throughout your network for more complete security coverage. And intelligent, automated threat detection and mitigation identifies threats in real-time and stops them at the most effective and economical location in your network. Each piece of the joint solution delivers key functionality for virtualized network security.

- **Red Hat and Intel NFV infrastructure.** Red Hat Enterprise Linux®, Red Hat OpenStack® Platform, and Intel multi-core processors and Ethernet adapters form a cost-effective, open, and highly available virtualization foundation for the solution.[3]
- **Radware Virtual DefensePro attack mitigation platform.** With real-time, behavioral-based attack mitigation, Radware Virtual DefensePro protects your network from DoS, DDoS, and SSL-based cyber attacks. A complete set of security modules, including Intrusion Protection System (IPS), Network Behavioral Analysis (NBA), anti-DDoS/DoS, and SSL Attack Protection, allows you to maintain business continuity, productivity, and network performance even when under attack.

1 *Radware, "Global Application & Network Security Report 2013," January 2014.*

2 *PricewaterhouseCoopers, "Defending yesterday: Key findings from The Global State of Information Security Survey 2014," September 2013.*

3 *Red Hat, "Increase business agility with network functions virtualization," July 2014.*

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- **Radware DefenseFlow software-defined networking (SDN) application.** In addition to providing communication between Virtual DefensePro nodes, Radware DefenseFlow intelligently and automatically diverts attack-affected network traffic to a scrubbing center for cleansing.
- **Radware APSolute Vision management tool.** Centralized management, monitoring, and reporting for Radware's network security solutions across multiple data centers gives you real-time visibility into network health, performance, and security.
- **Deep packet inspection (DPI) NFV infrastructure add-on.** A DPI module provides detailed network information to Radware's security solutions for intelligent attack mitigation.

SECURE YOUR ENTIRE NETWORK

As cyber criminals launch increasingly sophisticated attacks, legacy security solutions that typically detect only network-based attacks can leave your network exposed. With the Red Hat and Radware virtualized network security solution, you gain protection from both network-based and increasingly common application-based attacks, as well as emerging threats. And the virtualized framework allows you to easily deploy detection nodes throughout your entire network—not just at select points in your datacenter—for more pervasive security.

The ability to deploy detection nodes anywhere in your network also allows you to deliver customized security services to your customers. With hardware-based security solutions, it's often impractical to deploy physical detection nodes near the edge of the network. The virtualized Red Hat and Radware solution allows you to extend enhanced security coverage to your customers' sites for increased revenue opportunities and a better customer experience.

REDUCE YOUR SECURITY COSTS

Hardware-centric network security solutions can be costly to deploy, resulting in gaps in coverage when budgets are limited. The Red Hat and Radware virtualized network security solution allows you to deploy virtual detection nodes, decreasing capital expenses (CapEx) from dedicated hardware acquisition. Automated threat detection and mitigation eliminates the need for manual monitoring and reduces operational expenses (OpEx). Plus, you can integrate your existing physical and virtual scrubbers into the Red Hat and Radware solution to protect your security investments.

CONCLUSION

With cyber attacks increasing in both number and complexity, communications companies must protect their networks to remain in business. Red Hat and Radware deliver a virtualized network security solution that gives you real-time, comprehensive detection and mitigation of cyber attacks across your entire network at a lower cost than legacy and hardware-centric solutions. Contact your Red Hat sales representative to learn more about protecting your network from cyber criminals.

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VIRTUALIZE CUSTOMER PREMISE EQUIPMENT WITH RED HAT AND CALSOFT LABS

SOLUTION BRIEF

COMMUNICATIONS INDUSTRY: VIRTUAL NETWORK FUNCTION

98%

of telecommunications financial executives consider maximizing customer and revenue growth to be a critical or very important strategic challenge to business success.[1]

Implementing a customized vCPE solution from Red Hat and Calsoft Labs lets you reduce operational costs and complexity and offer flexible services for increased revenue and higher customer satisfaction.

PHYSICAL CUSTOMER PREMISE EQUIPMENT IMPEDES AGILITY

Pricing pressures, increasing competition, and growing customer demand are forcing communications providers to adapt to a changing market environment. Traditional network architectures require separate customer premise equipment (CPE) for each service. This approach increases infrastructure complexity, making it difficult to scale and manage, delaying introduction of new services, and increasing capital and operational costs. Consolidating CPE onto virtualized, generic x86 servers reduces costs, simplifies operations, and improves flexibility.

Long-time partners Red Hat and Calsoft Labs offer a customizable virtual CPE (vCPE) solution that combines the high performance of physical CPE environments with the flexibility and cost-effectiveness of virtualized infrastructures. With this agile vCPE environment, you can streamline operations, reduce costs, and quickly and easily offer new, revenue-generating services.

CUSTOMIZED VIRTUAL CPE SOLUTION

Until recently, most vCPE solutions could not meet the performance standards set by dedicated physical CPE. As shown in Figure 1, Red Hat and Calsoft Labs use a unique architecture built around innovative, open technologies, including OpenStack® and the Data Plane Developer Kit (DPDK), to deliver a vCPE environment that matches physical CPE performance. The virtualized environment increases infrastructure flexibility and scalability, allowing you to quickly adapt your service offerings as market conditions change. With fewer devices to maintain and remote maintenance capabilities, capital and operational costs are significantly reduced. Open APIs and industry-standard components allow you to extend and tailor the solution to fit your business needs. Each component of the solution is customized and delivered by Calsoft Labs' engineering services to help create a high-performance vCPE environment.

Red Hat® and Intel network functions virtualization (NFV) infrastructure
As an economical, industry-standard alternative to dedicated proprietary systems, Red Hat's open technologies and Intel processors and network adapters form an ideal foundation for virtualizing and orchestrating your infrastructure.[2] Red Hat OpenStack Platform is commercially hardened, fully supported, and features an enterprise-grade life cycle so you can take advantage of cloud innovation without risking the reliability and security of your environment.

Red Hat Enterprise Virtualization
Based on the high-performance Kernel-based Virtual Machine (KVM) hypervisor, Red Hat Enterprise Virtualization provides cost-effective, scalable virtual machines and management capabilities to the vCPE environment.

Calsoft Labs Enterprise vCPE framework
Based on Calsoft Labs' deep industry expertise, the Calsoft Labs Enterprise vCPE framework is a customizable architecture for NFV and vCPE. Developed on open standards, the framework is adaptable and expandable with a variety of VNFs and can be managed with any European

1 KPMG, "2013 Media and Telecommunications Industry Outlook Survey," July 2013.

2 Red Hat, "Increase business agility with network functions virtualization," August 2014.

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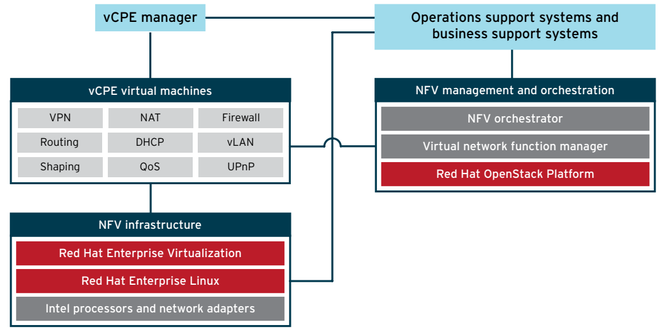

Figure 1. The Red Hat and Calsoft Labs vCPE solution architecture can be customized to meet your specific needs.

Telecommunications Standards Institute (ETSI) NFV Management and Orchestration (MANO) compliant VNF orchestrator through open APIs. The framework also supports a variety of virtualization techniques to address multiple market segments.

REDUCE SERVICE COMPLEXITY AND OPERATIONAL COSTS

80% of communications technical executives consider reducing infrastructure complexity to be a critical priority.[3] A vCPE environment from Red Hat and Calsoft Labs simplifies your infrastructure, streamlines management, and minimizes maintenance activities. This leads to reduced operational costs and allows you to focus your staff – and budget – on strategic, revenue-generating projects.

INCREASE REVENUE WITH FLEXIBLE SERVICE OFFERINGS

Nearly all telecommunications executives are concerned about maximizing customer and revenue growth.[4] The Red Hat and Calsoft Labs vCPE solution allows you to dynamically provision and activate services without setting up new hardware at the customer site, significantly reducing time to market. You can easily offer the on-demand, managed, and pay-as-you-grow services that your customers want. The result is increased revenue opportunities and higher overall customer satisfaction.

CONCLUSION

Facing intense competition, communications companies must be able to quickly adapt to changing market conditions. Red Hat and Calsoft Labs deliver a high-performance, cost-effective vCPE solution that lets you streamline operations, reduce time to market for new services, and quickly accommodate new customer demands. Contact your Red Hat sales representative to learn how the Red Hat and Calsoft Labs vCPE solution can help you boost agility and increase revenue.

3 Gatepoint Research, "Communications Industry Technology Survey," September 2012.

4 KPMG, "2013 Media and Telecommunications Industry Outlook Survey," July 2013.

RED HAT® OPENSTACK PLATFORM

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UNIFY YOUR MOBILE NETWORK WITH RED HAT AND AFFIRMED NETWORKS

SOLUTION BRIEF

COMMUNICATIONS INDUSTRY: VIRTUAL NETWORK FUNCTION

Global mobile data traffic grew by **81%** in 2013.[1]

4G mobile connections represent only **2.9%** of mobile connections but account for **30%** of mobile data traffic.[1]

Unifying your mobile network with a vEPC infrastructure allows you to operate more efficiently, deliver services faster, reduce costs, and prepare for the future.

INTRODUCTION

Demand for mobile data services, and particularly 4G services, is growing at an unprecedented rate. Communication providers need flexible, scalable, efficient, and cost-effective network infrastructures to accommodate increasing mobile traffic. However, traditional wireless networks are often complex to manage, costly to expand, and too inflexible to adapt to changing business needs. Virtualizing your mobile network allows you to operate more efficiently, reduce costs, and deliver new services faster.

Open ecosystem leaders Red Hat and Affirmed Networks offer an innovative virtualized Evolved Packet Core (vEPC) solution that unifies your mobile services onto a single, virtual infrastructure. Combining the Affirmed Mobile Content Cloud™ with the Red Hat® and Intel network functions virtualization (NFV) infrastructure gives you a cost-effective open infrastructure with the flexibility, scalability, and efficiency you need to respond to growing demand for mobile services.

UNIFY YOUR MOBILE SERVICES

Complex traditional mobile network infrastructures can be a business liability. Virtualizing your mobile network with the Red Hat and Affirmed Networks vEPC solution allows you to rapidly deploy mobile services, regardless of vendor, using an economical general purpose infrastructure. A unified management framework simplifies administration. An open, interoperable foundation lets you customize your mobile network infrastructure with a large selection of third-party hardware and software. As your mobile business grows, you can easily scale your virtual infrastructure to support hundreds of millions of subscribers. And the solution can be deployed anywhere in your network – from core to edge – to accommodate your existing architecture and business needs. Each component delivers key functionality to the overall solution.

- **Red Hat and Intel NFV infrastructure.** Based on Red Hat's enterprise-grade, open technologies and Intel's high-performance processors and network adapters, the Red Hat and Intel NFV infrastructure forms the cost-effective, open, scalable foundation of the vEPC solution.[2] Red Hat Enterprise Linux® provides a high-performance operating environment for the Affirmed Mobile Content Cloud. Red Hat OpenStack® Platform orchestrates virtual resources throughout the solution.
- **Affirmed Mobile Content Cloud.** The Affirmed Mobile Content Cloud provides a flexible, virtual architecture for deploying mobile and wireless communications services. The integrated Affirmed Open Workflow™ technology lets you create automated workflows for streamlined operations. Dynamic load balancing across your entire mobile network increases efficiency and reliability. Adding the Acuitas Service Management System allows you to develop, provision, and launch new and premium mobile services quickly. Plus, centralized monitoring of faults, performance, and network statistics gives you deep visibility into your entire mobile network.

1 *Cisco, "Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2013-2018," February 2014.*

2 *Red Hat, "Increase business agility with network functions virtualization," August 2014.*

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ABOUT RED HAT

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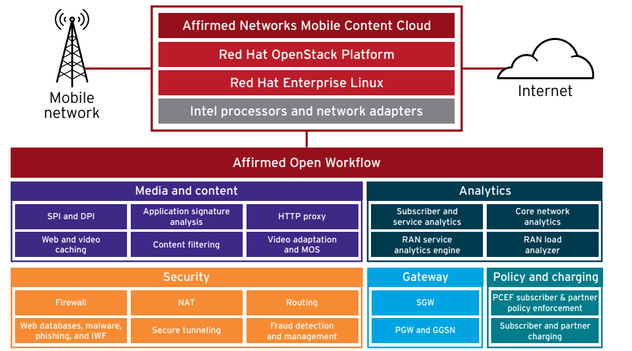

Figure 1. The Red Hat and Affirmed Networks vEPC solution allows you to deploy a multitude of mobile services from an economical virtual infrastructure.

GAIN VISIBILITY INTO YOUR NETWORK

The complexity of legacy mobile network infrastructures often makes it difficult to obtain a holistic view of network operations. With a unified mobile network infrastructure based on the Red Hat and Affirmed Networks vEPC solution, you gain deep visibility into all mobile services across your entire network. Dynamic monitoring of fault, alarms, and network performance lets you identify and mitigate issues before they negatively impact operations. Additionally, a clear, comprehensive view of all mobile services allows you to make well-informed business decisions so you can stay ahead of the competition.

PREPARE FOR THE FUTURE OF MOBILE SERVICES

Adding new services to traditional network infrastructures is often a long and costly process. The Red Hat and Affirmed Networks vEPC solution allows you to develop and launch new services quickly and cost-effectively. As business requirements change, you can easily add additional internally developed and third-party services and scale rapidly to meet growing demand. Plus, with an open, interoperable mobile network infrastructure that seamlessly integrates into your existing infrastructure, you can migrate legacy services at your own pace.

CONCLUSION

Mobile service providers must operate efficiently and cost-effectively to keep up with increasing subscriber demand for data-intensive services. The Red Hat and Affirmed Networks vEPC solution allows you to unify your mobile network onto an economical virtual infrastructure that streamlines management and improves business agility. Contact your Red Hat sales representative today to learn how a unified mobile network infrastructure from Red Hat and Affirmed Networks can help you prepare for the future of mobile network services.

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TRANSFORM YOUR MOBILE NETWORK WITH RED HAT AND CONNECTEM

SOLUTION BRIEF

COMMUNICATIONS INDUSTRY: VIRTUAL NETWORK FUNCTION

76%

of telecommunications financial executives expect sales of applications and content over smartphones, tablets, and other wireless devices to be a top driver of revenue growth over the next 3 years.[1]

The Red Hat and Connectem service-oriented vEPC solution improves the scalability, flexibility, and performance of your mobile network. This means you can meet subscriber demand for next-generation services quickly and cost-effectively and take advantage of new revenue opportunities.

TRADITIONAL EPC NETWORKS CAN'T KEEP UP WITH MOBILE GROWTH

Demand for mobile data services is growing at an unprecedented rate. Faced with an increasing number of new Long-Term Evolution (LTE) applications and mobile devices, traditional Evolved Packet Core (EPC) networks based on dedicated hardware are pushed to capacity. However, expanding traditional network infrastructure can be expensive and slow, preventing service providers from taking advantage of new revenue-generating market opportunities. New network capacity must be provisioned for the highest load expected, which often leaves costly dedicated hardware idle. This forces service providers to make a tough choice: lower margins or lag behind by their competition.

As leaders in open source technologies and software-defined networking, Red Hat and Connectem transform your mobile network so you can cost-effectively meet growing subscriber demand and quickly grow revenue with next-generation services. The Red Hat® and Connectem service-oriented virtual Evolved Packet Core (vEPC) solution gives you the dynamic scalability, simple flexibility, and extreme performance you need to be successful in today's hyper-competitive market.

VIRTUALIZE YOUR MOBILE NETWORK WITH SERVICE-ORIENTED vEPC

The Red Hat and Connectem service-oriented vEPC solution is designed specifically for efficient, virtualized network operation. Instead of mimicking the complex, vertically siloed designs of hardware-based networks, the Red Hat and Connectem solution takes an intelligent, service-oriented software approach to network management, which simplifies your network infrastructure and drastically increases operational efficiency. EPC functionality is abstracted into four key modules. This allows control, data processing, and session management processes to scale independently and automatically. Optimal use of resources and 10GbE line-rate transaction speeds not only improve the performance and efficiency of your network, but also minimize your hardware footprint and reduce the total cost of ownership (TCO). Clustering and built-in load balancing combine with stateless functions for high availability operations with 99.999% uptime. And, open, industry-standard components give you the flexibility to customize your network to best fit your needs at all times.

As shown in Figure 1, the solution's components work together to deliver operational simplicity and integrate with your existing network infrastructure.

Red Hat and Intel Network Functions Virtualization (NFV) infrastructure

Red Hat's open, integrated software stack combines with Intel's high-performance processors and 10GbE network cards to provide an ideal foundation for your virtualized network.[2] With enterprise-grade support, security, and stability, Red Hat Enterprise Linux®, Red Hat Enterprise Virtualization, Red Hat Storage, and Red Hat OpenStack® Platform deliver cost-effective performance and flexibility. Red Hat OpenStack Platform also performs life cycle management and orchestrates the vEPC solution through the Heat orchestration engine.

1 *KPMG, "2014 Media and Telecommunications Industry Outlook Survey," December 2014.*

2 *Red Hat, "Increase business agility with network functions virtualization," August 2014.*

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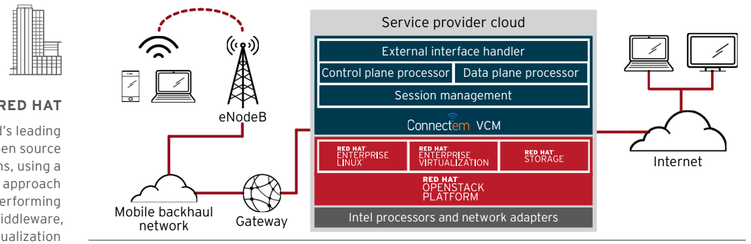

Figure 1. The Red Hat and Connectem service-oriented vEPC solution integrates with your existing infrastructure to deliver operational efficiency.

Connectem Virtual Core for Mobile (VCM)

The industry's first instance of vEPC, Connectem VCM is a robust, self-contained, software-based core network. Its service-oriented approach abstracts EPC functionality into control plane, packet processing, persistence management, and interface handling modules and allows each to operate simply and scale independently and elastically, as shown in Figure 1. Connectem VCM manages unpredictable surges in LTE traffic up to ten times more efficiently than physical EPC networks. With line speed performance and intelligent routing, Connectem VCM can handle tens of thousands of transactions per second on a single server. And support for 3rd Generation Partnership Project (3GPP) and legacy interfaces lets you integrate the vEPC solution into your existing infrastructure.

DYNAMICALLY SCALE WITH GROWING SUBSCRIBER DEMAND

By 2017, it's expected that 841 million end-user and machine-to-machine (M2M) devices will be connected to mobile networks in North America alone.[3] Traditional EPC networks lack the scalability and flexibility to respond quickly to the ever-changing demands presented by the growing number and types of devices. With independently scaling EPC functions, the Red Hat and Connectem vEPC solution automatically adjusts network control, data, and subscriber capacity to meet current demand levels. Integration with your existing network infrastructure and simplified configuration lets you deploy new network capacity in a matter of days instead of months. Plus, the inherent scalability of the solution allows any-size deployment. You can start small and quickly—and cost-effectively—expand to meet growing mobile device connectivity needs and new service requirements.

CONCLUSION

With demand for mobile data services rapidly increasing, service providers need more than traditional EPC networks can provide. Red Hat and Connectem offer an innovative, service-oriented vEPC solution that improves the scalability, flexibility, and performance of your mobile network, all while reducing TCO. With the Red Hat and Connectem solution, you can dynamically adjust your network capacity to respond to quickly changing demand patterns, improve operational efficiency, and take advantage of previously unattainable revenue opportunities. Contact your Red Hat sales representative to learn more about the Red Hat and Connectem vEPC solution and how it can help you stay ahead of the competition.

3 *NetworkWorld, "Mobile data growth accelerating worldwide, led by smartphone users," February 7, 2013.*

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BUILD A FLEXIBLE VIRTUAL NETWORK WITH RED HAT AND BROCADE

SOLUTION BRIEF

COMMUNICATIONS INDUSTRY: VIRTUAL NETWORK FUNCTION

46%

of telecommunications company financial executives consider losing market share to lower-cost producers to be the biggest threat to their business model.[1]

Red Hat and Brocade deliver a high-performance virtual network solution that lets you reduce infrastructure costs while increasing flexibility.

INCREASE NETWORK FLEXIBILITY

Competition in the communications market is more intense than ever. To be successful, communications service providers must cut infrastructure costs and streamline operations while increasing business agility. Traditional hardware-centric infrastructure can't meet these demands and can quickly become a business liability.

Open technology leaders Red Hat and Brocade offer a virtual networking solution that combines the high performance of hardware with the enhanced flexibility of software to speed delivery of on-premise virtual networking services. By adding the Brocade Vyatta 5600 Virtual Router (vRouter) to your Red Hat® and Intel network functions virtualization (NFV) infrastructure, you can increase business agility and reduce capital and operational expenses to gain a competitive advantage.

HIGH-PERFORMANCE VIRTUAL ROUTING

Until recently, virtual and software-based networking solutions often failed to meet hardware-based performance standards. With the Red Hat and Brocade virtual networking solution, you gain the flexibility and cost advantages of software without sacrificing performance. The Red Hat and Brocade virtual networking solution can be deployed in two ways:

1. As the **internal networking framework**, the Brocade Vyatta 5600 vRouter enhances the performance and flexibility of your Red Hat and Intel NFV infrastructure.
2. As a **virtual network function (VNF)**, the Vyatta vRouter can provide a variety of virtual networking services, including firewall, VPN services, and routing, within a service chain.

In either deployment, the solution is capable of up to 10Gb/s throughput per x86 physical core, far surpassing the performance of previous software solutions and allowing you to scale linearly with additional cores. And with a virtualized network infrastructure, you can dynamically respond to evolving needs without making changes to your physical network, reducing the time to deliver on-premise virtual networking services from months to hours. The following components play key roles in delivering a high-performance virtual network infrastructure.

Red Hat and Intel NFV infrastructure

Red Hat's open technologies and Intel's multi-core processors and network adapters provide a high-performance, scalable, and cost-effective foundation for the solution.[2] Red Hat OpenStack® Platform, including the Kernel-based Virtual Machine (KVM) hypervisor, orchestrates the virtual network and automates VNF deployment.

Brocade Vyatta 5600 vRouter

Designed specifically for NFV operations, the Brocade Vyatta 5600 vRouter provides advanced routing in software without sacrificing the reliability and performance of hardware-based networking solutions. By optimizing the Intel Data Plane Development Kit (Intel DPDK), the virtual network operating system provides high-speed packet pipelines and high-end packet service functions, including virtual routing, firewall security protection, Layer 2 and Layer 3 encryption, and virtual private network (VPN) remote access. An OpenStack Networking (codename Neutron) plugin allows integration with Red Hat OpenStack Platform.

1 *KPMG, "2013 Media and Telecommunications Industry Outlook Survey," July 2013.*

2 *Red Hat, "Increase business agility with network functions virtualization," August 2014.*

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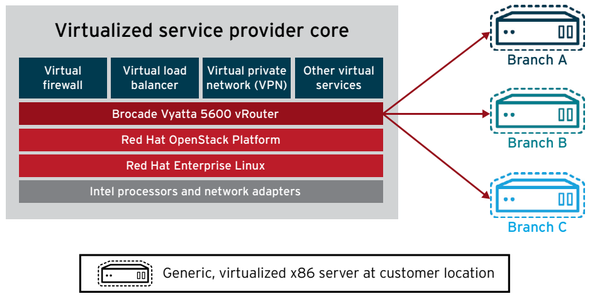

Figure 1. Red Hat and Brocade allow you to virtualize customer premise equipment and remotely manage and deliver services to branch locations, eliminating the need for specialized hardware at the customer site and enabling faster service updates and changes.

INCREASE AGILITY WITH VIRTUAL CUSTOMER PREMISE EQUIPMENT

Hardware-centric customer premise equipment (CPE) can be difficult to update and complex to manage. The Red Hat and Brocade virtual network solution allows you to consolidate and virtualize CPE onto readily available, cost-effective x86 servers. With a virtual infrastructure, you can remotely manage and update current customer services and quickly fulfill orders for new services without setting up new service-specific hardware. The result is streamlined operations, lower infrastructure costs, and greater business agility.

COST-EFFECTIVELY OFFER NEW SERVICES

Recent benchmarks with Telefónica and SDNCentral have validated the high-performance capabilities of the Brocade Vyatta 5600 vRouter across a variety of x86 servers.[3,4] The vRouter's bandwidth can be split across a large number of virtual ports in various ways, allowing you to securely deliver services to many customers from a single router, regardless of the number of physical ports. This adds up to more revenue opportunities and lower per-customer costs.

CONCLUSION

Streamlined operations, cost-effective infrastructure, and enhanced flexibility are essential for communications companies that need to remain competitive in an evolving market. Red Hat and Brocade offer an agile, high-performance virtual networking solution that allows you to quickly respond to changing business needs while reducing capital and operational costs and maintaining the high service levels your customers expect. Contact your Red Hat sales representative to learn more about the advantages of virtualizing your network.

3 *SDNcentral, "Brocade & Telefónica Push Vyatta's Virtual Router to 80G," August 2014.*

4 *SDNCentral, "SDNCentral NFV Performance Test Validates 80-Gbps for Brocade Vyatta on Mid-Range x86 Server," October 2014.*

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MEET APPLICATION SLAs IN THE CLOUD

Deliver enterprise-grade cloud applications reliably with Red Hat and Avi Networks

SOLUTION BRIEF

A recent survey of 950 CIOs, CFOs, and business decision makers found that

70%

fear their business will be uncompetitive unless they embrace cloud technologies to support digital business transformation.[1]

Red Hat and Avi Networks offer an enterprise-grade cloud application delivery solution that accelerates cloud adoption and supports new, agile business processes while guaranteeing SLAs for critical applications and workloads.

With Red Hat and Avi Networks, you can:

- Improve application availability with software-based load balancing and real-time monitoring and visibility.
- Guarantee application service levels with SLA tracking and enforcement.
- Improve developer productivity with self-service portals and automation.

CLOUD TECHNOLOGIES ARE ESSENTIAL FOR BUSINESS SUCCESS

Cloud technologies deliver significant competitive advantages to enterprises. In fact, a recent study found that 70% of CIOs and CFOs fear that they will be uncompetitive by the end of 2015 unless they embrace cloud technologies to support digital transformation within their business.[1] This requires enterprises to move critical applications to the cloud and adopt new, more agile business processes.

To help you gain a competitive advantage, Red Hat and Avi Networks offer an enterprise-grade cloud application delivery solution that guarantees service level agreements (SLAs) for critical applications and workloads and supports digital transformation.

MEET SLAs WITH ENTERPRISE-GRADE APPLICATION DELIVERY

Application delivery and management in cloud environments can be challenging without the right tools. Through SLA tracking and enforcement, the Red Hat® and Avi Networks cloud application delivery solution lets you guarantee cloud application service levels with confidence. The software-only, turnkey solution is designed for cloud environments, simplifying and accelerating application deployment and eliminating the need for expensive hardware overprovisioning. The solution automatically and elastically scales resources to meet demand, increasing reliability and availability for critical applications. Real-time monitoring capabilities give you visibility into cloud application operations so you can ensure compliance and security. Intelligent, closed-loop analytics automatically detect and correct problems, further enhancing availability and performance. Plus, the distributed architecture unifies traditional and cloud application management, so you can manage and load-balance all of your applications using the same application delivery controller (ADC).

As shown in Figure 1, the Red Hat and Avi Networks cloud application delivery solution is based on Red Hat OpenStack® Platform and Avi Networks Cloud Application Delivery Platform (CADP).

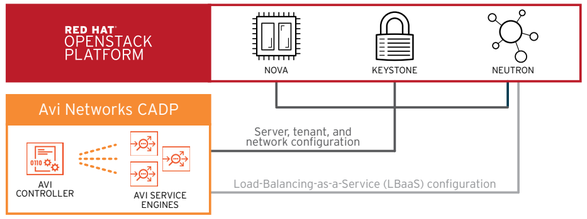

Figure 1. Avi Networks CADP is natively integrated with Red Hat OpenStack to better align with cloud architecture principles like automation and elastic scalability.

1 Computer Weekly, "CIOs fear poor cloud investment is making businesses uncompetitive," October 15, 2014.

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Red Hat OpenStack Platform
Fully supported and commercially hardened to be secure, stable, and reliable, Red Hat OpenStack Platform gives you an enterprise-grade cloud environment for running your critical applications and workloads. Co-engineering with Red Hat Enterprise Linux® enhances performance, availability, and security. A longer life cycle and full support lets you operate your cloud environment with confidence. And access to the largest ecosystem of certified partner software and hardware solutions lets you easily customize your cloud.

Avi Networks Cloud Application Delivery Platform
Built on a hyperscale, distributed architecture, Avi Networks CADP offers elastic application delivery and load balancing services, real-time application and user visibility, and analytics for multitenant cloud environments. Certified on Red Hat OpenStack Platform, the enterprise-grade, software-only ADC integrates with the Nova, Neutron, Keystone, and Glance services to run natively within OpenStack and optimize application delivery. Seamless deployment in both traditional and software-defined networks unify your application delivery environment.

ACCELERATE CLOUD ADOPTION

Red Hat and Avi Networks accelerate cloud adoption with simplified deployment and operations, so you can move critical workloads to the cloud faster and more easily. Automation, real-time monitoring, and SLA tracking and enforcement streamline application management, lower operational expenses (OpEx), and reduce troubleshooting time from hours and days to seconds and minutes. High-value subscription pricing includes enterprise-grade support, eliminates up-front licensing costs, and lowers risk. And, with a unified application delivery environment, you can migrate applications over time in line with your business needs.

MODERNIZE YOUR I.T. ORGANIZATION

To meet the demands placed on them by new business processes, modern IT organizations must take on an internal service provider. Red Hat and Avi Networks help you deploy IT as-a-service (ITaaS) and meet SLAs for internal customers. Self-service portals let users provision resources without manual IT intervention, reducing the burden of day-to-day management. Real-time usage monitoring and chargeback capabilities let you track and organize departmental expenses. The result is streamlined operations, faster response times, and increased IT agility.

IMPROVE DEVELOPER PRODUCTIVITY WITH DEVOPS

DevOps methodologies use collaboration, standardization, and automation to create, deploy, and improve applications faster and more efficiently. The Red Hat and Avi Networks cloud application delivery solution is an ideal foundation for DevOps. Automation and self-service portals allow developers to request and quickly provision resources so they can focus on their work. And integration with popular DevOps tools, including Puppet, Chef, SaltStack, and CFEngine, gives you a choice of development platforms and simplifies the transition to DevOps.

CONCLUSION

Enterprises must adopt cloud technologies to remain competitive. The Red Hat and Avi Networks cloud application delivery solution lets you move critical applications to the cloud with confidence. With this enterprise-grade cloud platform and ADC, you can guarantee SLAs, deploy innovative cloud technologies faster, and support new business practices to gain a competitive advantage. To learn more about this solution, contact your Red Hat sales representative, email sales@avinetworks.com, or visit avinetworks.com.

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CLOUD-BASED APPLICATION DELIVERY WITH RED HAT AND F5 NETWORKS

SOLUTION BRIEF

COMMUNICATIONS INDUSTRY: VIRTUAL NETWORK FUNCTION

82%

of telecommunications financial executives consider cloud technologies to be strategically important to future revenue growth.[1]

An OpenStack-based application delivery environment from Red Hat and F5 Networks allows you to deliver secure multi-tenant services from a highly available, unified infrastructure, reducing costs and improving agility and operational efficiency.

CLOUD TECHNOLOGIES INCREASE AGILITY

In today's highly competitive market, communications service providers are looking to cloud technologies to improve operational efficiency, lower costs, and boost agility. As the cloud platform of choice for many enterprises, OpenStack® provides a flexible, open foundation for network functions virtualization (NFV). However, additional functionality is needed to use OpenStack for carrier-grade application delivery.

Red Hat and F5 Networks collaborate to provide an OpenStack-based application delivery environment that meets your needs for availability, security, performance, and flexibility. Combining the Red Hat® and Intel NFV infrastructure with F5 Networks' BIG-IP and BIG-IQ application delivery and management platforms allows you to unify your application delivery infrastructure for increased security, higher resource utilization, and carrier-grade availability.

CLOUD-BASED APPLICATION DELIVERY

Traditional application delivery infrastructures can impede flexibility and scalability and increase capital and operational expenses. With a cloud-based application delivery environment from Red Hat and F5 Networks, you can unify your traditional, virtualized, and cloud infrastructures into a comprehensive, secure, and easy-to-manage environment. Each component provides key functionality to the cloud-based application delivery solution.

- **Red Hat and Intel NFV infrastructure.** Red Hat's open technologies, including Red Hat Enterprise Linux® and Red Hat OpenStack Platform, and Intel's multi-core processors and network adapters build the high-performance, cost-effective foundation of the solution.[2] Red Hat OpenStack Platform combines community innovation with enterprise-grade security, stability, and support, so you operate your cloud with confidence.
- **F5 Networks BIG-IP Local Traffic Manager Virtual Edition (BIG-IP LTM VE).** Featuring high availability, security, and performance, BIG-IP LTM VE is a flexible application delivery for critical business applications. A full proxy architecture and Secure Sockets Layer (SSL) offloading protect your environment from threats. Back-end monitoring capabilities enable load balancing decisions based on real-time server and application status. The F5 OpenStack Load-Balancing-as-a-Service (LBaaS) plugin, which is certified with Red Hat OpenStack Platform, allows OpenStack to communicate with BIG-IP LTM VE. And you can customize your environment with additional complementary BIG-IP modules, including firewall protection, application security, and access control.
- **F5 Networks BIG-IQ Virtual Edition.** With a modular framework and scalable, cluster-based architecture, BIG-IQ is an open, programmable management platform for your cloud-based, virtualized, and traditional application delivery systems.

1 *KPMG, "2013 Media and Telecommunications Industry Outlook Survey," July 2013.*

2 *Red Hat, "Increase business agility with network functions virtualization," August 2014.*

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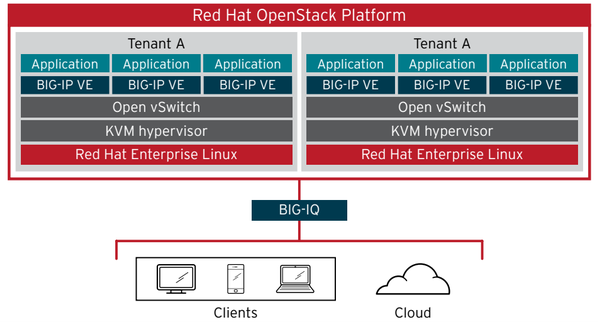

Figure 1. A cloud-based application delivery environment from Red Hat and F5 Networks allows you to administer multi-tenant services from a single infrastructure..

UNIFY YOUR APPLICATION DELIVERY ENVIRONMENT

A cloud-based application delivery environment from Red Hat and F5 Networks allows you to unify your cloud, virtualized, and traditional application delivery systems. Centralized management allows you to provision resources across your infrastructure from a single interface. Multi-tenant support lets you consolidate your infrastructure and streamline customer administration. A full proxy architecture with intelligent traffic management simplifies internal routing and enhances security. Load balancing based on real-time server and application conditions increases reliability and performance. Plus, your existing investments in F5 Networks and other application delivery systems are protected through integration with the BIG-IQ management platform, so you can migrate services to the cloud at the right time for your business. All of this adds up to lower costs, more efficient operations, and better agility.

CONCLUSION

Service providers must operate flexibly to remain competitive in a crowded market. An OpenStack-based application delivery environment from Red Hat and F5 Networks combines the agility of the cloud with the high availability, security, and performance you need for carrier-grade operation. And with a unified application delivery infrastructure, you can reduce costs and streamline operations while protecting your existing infrastructure investments. Contact your Red Hat sales representative to learn how an OpenStack-based application delivery environment can help you increase your operational efficiency.

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ACCELERATE APPLICATION DELIVERY WITH RADWARE ALTEON NG

SOLUTION BRIEF

COMMUNICATIONS INDUSTRY: VIRTUAL NETWORK FUNCTION

80%

of IT executives consider accelerating application delivery to be a critical priority.[1]

Running Radware's Alteon NG vADC software appliance on the Red Hat and Intel NFV infrastructure accelerates application delivery, reduces infrastructure costs, and allows you to always meet customer SLAs.

INTRODUCTION

In today's increasingly crowded market, communications providers must operate efficiently and meet growing service demands to remain competitive. However, they face several challenges. Manual, resource-intensive network management operations associated with hardware-based infrastructures increase costs significantly and slow service delivery. Poor web performance can encourage customers to look to a competitor for better value. And, inflexible, complex infrastructures make it costly to support strict service level agreements (SLAs) and difficult to create and deliver new revenue-generating services.

Industry leaders Red Hat and Radware collaborate to provide a highly available, flexible, and cost-effective application delivery environment that allows communications providers to achieve operational simplicity. By running Radware's Alteon Next-Generation (NG) virtual application delivery controller (vADC) software appliance on top of the Red Hat® and Intel network functions virtualization (NFV) infrastructure, you can guarantee SLAs, reduce costs, and gain a competitive advantage.

EFFICIENT, FLEXIBLE, FAST APPLICATION DELIVERY

With a flexible NFV infrastructure, you can quickly and cost-effectively meet growing demands for services. Adding a vADC appliance with application load balancing gives you the fast, consistent, and predictable performance you need to always meet even the strictest SLAs. Plus, automated workflows streamline application delivery management so you can reduce operational costs and focus on creating new revenue-generating services. Each component of the Red Hat and Radware application delivery environment plays an important role.

- **Red Hat and Intel NFV infrastructure.** Based on Red Hat Enterprise Linux®, Red Hat OpenStack® Platform, and Intel multi-core processors and Ethernet controllers, the Red Hat and Intel NFV infrastructure provides a cost-effective, open, and highly available foundation for the application delivery environment.[2]
- **Radware Alteon NG vADC software appliance.** Alteon NG runs on top of the Red Hat and Intel NFV infrastructure and provides highly available application delivery services and load balancing with a complete advanced ADC feature set. Quick provisioning without hardware modifications and dynamic scaling enables the Alteon NG environment to easily adapt to increases in demand. Additionally, the vDirect plugin allows Alteon NG to integrate with Red Hat OpenStack Platform for unified application and infrastructure management, automation, and orchestration. Alteon NG also incorporates essential functional modules for real-time traffic monitoring, advanced security, and web performance optimization. And, Alteon NG can control OpenDaylight SDN environments through the OpenStack Networking service (codename Neutron).

1 Gatepoint Research, "Communications Industry Technology Survey," September 2012.

2 Red Hat, "Increase business agility with network functions virtualization," July 2014.

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ABOUT RED HAT

Red Hat is the world's leading provider of open source software solutions, using a community-powered approach to reliable and high-performing cloud, Linux, middleware, storage, and virtualization technologies. Red Hat also offers award-winning support, training, and consulting services. As a connective hub in a global network of enterprises, partners, and open source communities, Red Hat helps create relevant, innovative technologies that liberate resources for growth and prepare customers for the future of IT.

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GUARANTEE APPLICATION SLAS WITH RED HAT AND RADWARE

Industry leaders Red Hat and Radware give you an application delivery environment with the high availability, security, scalability, and flexibility you need to guarantee application SLAs. Resources are reserved per application, allowing you to scale up and scale out as needed without impacting performance levels or predictability. Real-time traffic monitoring tracks actual user transactions and response times for better visibility into your environment and faster root cause analysis. Instantaneous error detection and fault isolation identify and mitigate performance issues before they can impact the end user. Integration with Radware's Attack Mitigation Network (AMN) module protects your environment with real-time intrusion detection and denial-of-service (DoS) signaling, so you can be sure your network is secure and available at all times. And, with support for a variety of protocols, including SIP and Diameter, you can load balance and deliver applications across all of your local and global networks. With Red Hat and Radware, you can confidently deliver on even the strictest SLAs.

ACCELERATE WEB CONTENT DELIVERY

For e-commerce sites, slow web performance often results in lost revenue. To accelerate web content delivery, Radware's FastView web performance optimization (WPO) module is integrated into the Alteon NG vADC appliance. FastView automates the lengthy, complex front-end optimization process and applies it in real-time. The result is 40% faster web response times – on any end-user device – which translates to higher e-commerce revenue.

REDUCE INFRASTRUCTURE COSTS

Sixty-six percent of IT executives report reducing infrastructure costs to be a critical priority.[3] The small resource footprint of Alteon NG, combined with commercial off-the-shelf (COTS) hardware pricing, reduces capital expenses significantly. Plus, streamlined and automated application delivery processes and energy-efficient servers lower ongoing operational costs for even more savings.

DELIVER NEW REVENUE-GENERATING SERVICES

Communications providers must continually meet a growing demand for new services to stay ahead of the competition. A virtual application delivery environment from Red Hat and Radware allows you to develop, test, and move new application services to production more quickly and extend cost-effective cloud-hosted application load balancing services to your customers for additional revenue opportunities.

CONCLUSION

In an increasingly crowded market, delivering fast, predictable application performance is essential for communications providers to remain competitive. A virtual application delivery environment based on the Red Hat and Intel NFV infrastructure and the Radware Alteon NG vADC appliance allows you to guarantee application SLAs, accelerate web performance, reduce infrastructure costs, and take advantage of new revenue opportunities. Contact your Red Hat sales representative today to learn more about building a highly available, cost-effective, and flexible virtual application delivery environment with Red Hat and Radware.

3 Gatepoint Research, "Communications Industry Technology Survey," September 2012.

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UNIFY YOUR TELEPHONY INFRASTRUCTURE WITH RED HAT AND METASWITCH NFV

SOLUTION BRIEF

COMMUNICATIONS INDUSTRY: VIRTUAL NETWORK FUNCTION

34%

of media and telecommunications financial executives believe bundled, IP-enabled service offerings will be an important driver of revenue growth over the next 3 years.[1]

The Red Hat and Metaswitch cloud-based IMS solution unifies your telephony infrastructure, allowing you to drastically reduce costs, easily scale to meet growing demand, and grow revenue by offering next-generation, IP-enabled services to your customers.

COST-EFFECTIVE IP MULTIMEDIA SUBSYSTEMS

In an ultra-competitive market with extremely thin margins, communications service providers need to deliver more services than ever before and contain costs to be successful. However, legacy telephony infrastructures rely on multiple hardware silos, each dedicated to a single service. This increases costs and inhibits growth and flexibility. IP multimedia subsystems (IMS) break down hardware silos and streamline operations, but have been cost-prohibitive to implement until now.

Open technology leaders Red Hat and Metaswitch offer a unique, cloud-based IMS solution built entirely on open standards. With this solution, you can unify your telephony infrastructure on a flexible, virtualized foundation to drastically reduce costs, scale faster and more efficiently to meet growing demand, and boost revenue with next-generation, IP-enabled services.

VIRTUALIZE YOUR CORE

An IMS core allows your telephony infrastructure to deliver multivendor multimedia services, including innovative wireline and wireless voice, video, and messaging services, via IP packets rather than physical, switched-circuit paths. The result is a less complex, easier-to-manage, and more flexible environment. A cloud-based IMS solution built on Red Hat's integrated software stack and Metaswitch Clearwater Core adds the benefits of high scalability, open flexibility, and extremely low per-subscriber cost. Based on the open source Project Clearwater, the solution is commercially hardened and fully supported for carrier-grade operation. The open architecture lets you choose complementary components from a wide selection of certified vendors and partners. Plus, you can run circuit-switched and packet-switched telephony systems together, allowing you to migrate your services over time, protect your legacy investments, and ensure service continuity.

The components of the solution work together to deliver a low-cost, carrier-grade IMS infrastructure.

- **Red Hat® and Intel Network Functions Virtualization (NFV) infrastructure.** Red Hat's fully integrated, open technology stack – including Red Hat Enterprise Linux®, Red Hat Enterprise Virtualization, Red Hat Storage, and Red Hat OpenStack® Platform, with Intel-based x86 servers – forms the high-performance, open foundation of the IMS solution.[2]
- **Metaswitch Clearwater Core.** A hardened version of Project Clearwater, Metaswitch Clearwater Core is a highly scalable, full IMS core that includes Interrogating Call Session Control Function (I-CSCF), Serving CSCF (S-CSCF), and Breakout Gateway Control Function (BGCF) capabilities and is supported for carrier-grade use. The web services-oriented design is optimized for cloud-based NFV environments. A single IMS core can be deployed across multiple datacenters for geographic redundancy and failover.

1 *KPMG, "2014 Media and Telecommunications Industry Outlook Survey," December 2014.*

2 *Red Hat, "Increase business agility with network functions virtualization," August 2014.*

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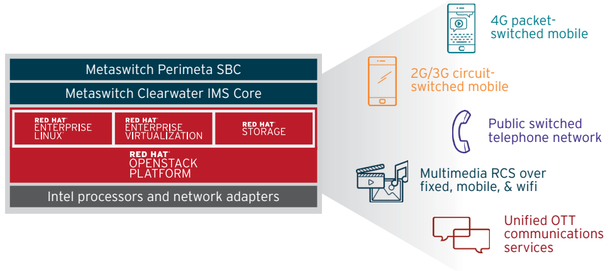


Figure 1. The cloud-based IMS solution from Red Hat and Metaswitch allows you to unify your telephony infrastructure, including wired and wireless voice and multimedia services.

- **Metaswitch Perimeta Session Border Controller (SBC).** A pure software solution, Metaswitch Perimeta SBC provides carrier-grade, virtualized Proxy CSCF (P-CSCF) and perimeter security for the IMS solution. Horizontal, elastic scaling ensures high availability. Optional acceleration via the Data Plane Developer Kit (DPDK) delivers superior performance for processor-intensive multimedia services.

CUT INFRASTRUCTURE COSTS

Until now, implementing an IMS core has been cost-prohibitive for most service providers. With the open source Metaswitch Clearwater Core, however, you can drastically reduce the annual per-subscriber cost of IMS from around US$10 to less than a dollar. Virtualizing your telephony systems onto generic x86 servers also reduces capital expenses. Plus, the unified infrastructure cuts operational costs with streamlined management and protects existing investments in legacy systems.

BOOST REVENUES WITH NEXT-GENERATION SERVICES

Over 50% of communications service providers consider competition from over-the-top (OTT) vendors to be an important challenge over the next 5 years.[3] The Red Hat and Metaswitch cloud-based IMS solution gives you the performance and flexibility needed to deliver revenue-boosting, next-generation services to your customers. The IP-based infrastructure paves the way for Voice over IP (VoIP) services, including Voice over LTE (VoLTE), allowing you to take back market share from OTT vendors. And you gain the ability to deliver your own OTT services, as well as Rich Communications Services (RCS), for additional revenue opportunities.

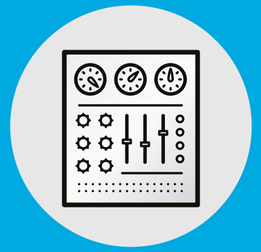
CONCLUSION

Service providers need to deliver next-generation services and contain costs to be successful in a highly competitive market. The Red Hat and Metaswitch cloud-based IMS solution allows you to virtualize your telephony infrastructure so you can boost revenues with new, highly scalable, IP-enabled services without disrupting your legacy offerings. Plus, open flexibility and carrier-grade reliability and support let you operate with confidence. Contact your Red Hat sales representative to learn more about implementing IMS with Red Hat and Metaswitch.

3 *Telecoms.com Intelligence, "Industry Survey 2014," February 2014.*

MANAGEMENT AND ORCHESTRATION PARTNERS

INTEGRATED TOOLS FOR COMPLETE INFRASTRUCTURE AND VNF ADMINISTRATION



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RED HAT OPENSTACK PLATFORM AND CIENA BLUE PLANET

Cost-effective, end-to-end infrastructure orchestration for the communications industry

TECHNOLOGY OVERVIEW

COMMUNICATIONS INDUSTRY: MANAGEMENT AND ORCHESTRATION

80%

of communications service provider technology executives consider reducing the complexity and improving the manageability of their IT infrastructure to be a critical priority.[1]

66%

of communications service provider technology executives are concerned about lowering capital and operational expenses within their IT infrastructure.[1]

Communications companies must contain costs and launch innovative, differentiated services to remain competitive.

NETWORK FUNCTIONS VIRTUALIZATION

With increased demand for bandwidth, on-demand services, and new products—all at lower price-points—communications companies face many challenges in a more competitive market. Delivering services using a traditional IT environment based on proprietary hardware can hold business back. Increased infrastructure complexity raises operational expenses and management resource requirements, limits scalability, and increases expansion costs. Agility and innovation are constrained as IT staff are overwhelmed with day-to-day administrative tasks that leave little to no time for strategic initiatives. Network functions virtualization (NFV) has emerged as a solution that can answer some of these challenges. However, a siloed NFV approach still increases network infrastructure complexity, which in turn requires increased expertise and costs to design, operate, and maintain.

Implementing a single, common network orchestration tool to design and control all network devices lets you take advantage of the cost and flexibility benefits of NFV while simplifying network infrastructure and management. All network devices, regardless of function and location, can be controlled through a single interface, allowing you to gain visibility into overall network performance and operations. Common network management tasks can be automated, freeing IT staff to focus on innovation and strategic business objectives. In addition, users benefit from faster new service development, provisioning, rollout, and management. Running Ciena's Blue Planet network orchestration platform on top of the Red Hat and Intel NFV infrastructure[2] gives you the visibility and control to run your network infrastructure more effectively.

EFFICIENT NETWORK INFRASTRUCTURE ORCHESTRATION

Network functions virtualization changes the way communications services are delivered by increasing infrastructure flexibility and efficiency. However, most communications companies cannot migrate their entire network to an NFV infrastructure at once, and instead begin by virtualizing new services and single network functions. In these environments, virtual network functions operate alongside physical network functions, potentially creating more complexity in the short term. In contrast, combining the Red Hat and Intel NFV infrastructure with Ciena's Blue Planet network orchestration platform allows you to manage your entire virtual *and* physical network infrastructure from a common orchestration controller. Simplified network design and management allows IT staff to respond quickly and efficiently to new and changing business needs, while still maintaining enterprise- and carrier-grade functionality and reliability. Unified network administration and open API-based development tools allow new services to be created, tested, and provisioned quickly for product differentiation and faster time-to-revenue. And because virtualized network functions are implemented on commonly available, inexpensive hardware, significant capital expenditure (CapEx) reductions can be realized.

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1 *Gatepoint Research, "Communications Industry Technology Survey," September 2012.*
2 *Red Hat, "Increase business agility with network functions virtualization," August 2014.*

Manage and control your entire multi-vendor physical and virtual network infrastructure from an integrated platform for more efficient operations and better infrastructure visibility.

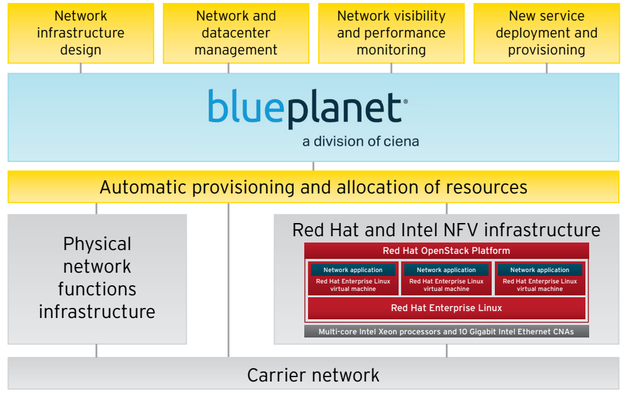

Figure 1. The architecture and functionality of the orchestrated NFV solution from Red Hat and Ciena.

UNIFIED PHYSICAL AND VIRTUAL NETWORK MANAGEMENT

As shown in Figure 1, each component of the orchestrated NFV solution from Red Hat and Ciena helps simplify network infrastructure and increase operational efficiency.

- **Red Hat and Intel NFV infrastructure.** Based on Red Hat Enterprise Linux®, Red Hat Enterprise Virtualization, and Intel processors, the Red Hat and Intel NFV infrastructure provides a high-performance, cost-effective NFV implementation that helps increase infrastructure flexibility.
- **Red Hat OpenStack® Platform.** Red Hat OpenStack Platform connects the Red Hat and Intel NFV infrastructure to Ciena's Blue Planet orchestration platform, facilitating control and management of datacenter resources and virtual network functions. With stability, reliability, security, and support, Red Hat OpenStack Platform is ready for critical carrier-grade operations. Additionally, the massively scalable, open source platform ensures that your infrastructure can easily grow with your business and it gives you the flexibility to choose the right applications for your needs now and in the future.
- **Ciena Blue Planet.** Blue Planet connects to Red Hat OpenStack Platform and aggregates virtual and physical network functions and devices. End-to-end, multi-vendor network infrastructure orchestration makes network infrastructure management simple and fast. Blue Planet's unified interface lets you design, operate, and gain visibility into all aspects of the network and available services. Fine-grained control of all network functions and devices allows you to tune performance and scaling, while new virtual services can be developed, deployed, and provisioned faster.

39%

of communications service provider technology executives think proprietary systems negatively impact IT infrastructure scalability.[3]

Building your network infrastructure with commercial off-the-shelf (COTS) hardware and open software allows you to scale easily with business growth.

The orchestrated NFV solution from Red Hat and Ciena provides an ideal migration path for communications companies that want to virtualize physical network functions for cost savings and increased flexibility while simplifying overall network infrastructure operation. Below are some use cases and examples of what you can accomplish with a high-performance NFV foundation with unified network infrastructure orchestration.

SIMPLIFY YOUR NETWORK INFRASTRUCTURE

Traditional network infrastructure uses dedicated, proprietary hardware to implement each network function. Not only are these systems more expensive, but each is specific to a particular network function, so more systems must be deployed to ensure that peak demand can be met. The result is higher capital expenses and lower system utilization because a large percentage of the systems remain idle most of the time. Implementing the orchestrated NFV solution from Red Hat and Ciena lets you virtualize physical network functions on inexpensive, commonly available servers. This eliminates the need for costly dedicated hardware. And, because different virtualized network functions can share server resources, you don't need to over-provision resources for each network function. The result is drastically reduced CapEx through the use of fewer, less expensive servers.

Using dedicated hardware for each network function also increases the complexity of your network infrastructure. Complex network infrastructures require more time, resources, and expertise to manage and operate, which increases operational expenses. With the orchestrated NFV solution from Red Hat and Ciena, you can consolidate multiple network management tools into a single, common controller for all functions and devices. Because the entire infrastructure is managed through a single tool, common network management functions can be automated. Less time and fewer staff are needed for day-to-day infrastructure design and management tasks, which reduces operational expenses (OpEx) and allows IT departments to focus on business objectives and product differentiation.

GAIN DEEP VISIBILITY INTO NETWORK OPERATIONS

Using multiple tools to manage different network functions and aspects of your network infrastructure gives you a segmented view of your overall network. This makes troubleshooting problems difficult and time-consuming. The orchestrated NFV solution from Red Hat and Ciena gives you a consolidated view of your entire infrastructure, which allows you to quickly identify and fix faults regardless of where in the infrastructure they occur. A single point of infrastructure control also allows automatic failover throughout the infrastructure, which improves network resiliency. Additionally, deep visibility into the interconnects and underpinnings of your infrastructure helps you make more informed business and network planning decisions using real-time and historical analytics.

ACCELERATE NEW SERVICES AND INCREASE BUSINESS AGILITY

In an increasingly competitive market, differentiation is critical to success. The orchestrated NFV solution from Red Hat and Ciena lets you introduce and provision new services faster through automation and integration, which speeds time-to-revenue. Integrated design tools based on open APIs allow you to develop and roll out innovative new applications and services quickly so you can gain competitive advantage while the market is prime.

3 Gatepoint Research, "Communications Industry Technology Survey," September 2012

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Streamline network infrastructure management and operations with the orchestrated NFV solution from Red Hat and Ciena to lower CapEx and OpEx, introduce new services faster, decrease time-to-revenue, and increase business agility.

The orchestrated NFV solution from Red Hat and Ciena also allows you to dynamically scale your infrastructure with business growth and changing requirements. On a day-to-day basis, virtual machines and virtualized network resources can be quickly launched and decommissioned. Infrastructure expansion can be fast, easy, and inexpensive with COTS hardware. Plus, the solution's open source foundation ensures that you can always choose the right complementary applications to meet your needs.

BRING DATACENTER AND NETWORK INFRASTRUCTURES TOGETHER

Many communications companies provide services to their customers' external corporate datacenters. These datacenters are typically managed separately from the network infrastructure, adding a layer of operational complexity. With high-availability, high-performance network protocols connecting communication companies' enterprise locations with external corporate datacenters, the orchestrated NFV solution from Red Hat and Ciena can extend the single management platform concept beyond the network infrastructure. This results in more streamlined operations across vendor platforms, service layers, and infrastructures. Using Blue Planet, you can dynamically provision virtual machines, network and compute capacity, and virtualized network resources in a remote datacenter without human intervention. This on-demand provisioning brings all the cost, visibility, and flexibility benefits of orchestrated NFV to the datacenter.

CONCLUSION

In an increasingly competitive communications market, network infrastructure efficiency is critical to success. Virtualizing network resources with the orchestrated NFV solution from Red Hat and Ciena allows you to manage your entire network infrastructure from a single platform. This simplifies management and streamlines operations for reduced costs. More efficient day-to-day administration gives you the time and resources to focus on strategic objectives and innovation so you can differentiate your products and services. And, increased infrastructure flexibility ensures you can respond to changing business needs quickly and turn your network infrastructure operations into a valuable competitive asset. Contact your Red Hat sales representative today to learn more about the orchestrated NFV solution from Red Hat and Ciena.

ABOUT RED HAT

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SUMMARY

Collaboration between technology vendors is essential to developing production-grade NFV environments that provide the flexibility, agility, and innovation CSPs need to succeed. As an open source expert, Red Hat has experience fostering large, platform-based ecosystems and is uniquely positioned to create an NFV ecosystem that meets the demands of the ICT industry. This ecosystem provides you with a complete set of innovative, interoperable, and industry-leading components, testing and validation services, and business-grade support. With it, you can build a secure, reliable, manageable, and affordable NFV environment to transform your business.

How will you stay ahead of your competition and prepare for an uncertain future? The choice is yours.

Ready to transform your service delivery infrastructure?

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