Solution Brief
Intel and Brocade
Enabling NFV

Intel and Brocade Network Functions Virtualization (NFV) Solution Helps Service Providers Gain a Competitive Advantage

Enabling virtual environments that can deliver services at utility prices to reduce operational expenses and support revenue growth

It's Time for the Network to Break Free

Service providers have been unable to fully monetize their infrastructure because the network has lagged behind the capabilities of compute and storage. The gap has primarily been caused by the adoption of virtualization technologies, which have created a ripple effect that is disrupting IT architectures everywhere.

Compute and storage have been virtualized, and it's time the network that connects and supports them catches up to match their efficiency, agility and scalability. To support a fully virtualized infrastructure, the network needs to learn from the compute and cloud computing forces that have changed everything; it needs to adapt to support multi-core processing, centralized management and shared infrastructures that will enable the simple portability of compute resources and services.

To complete the disruptive transition and ensure service providers can lower their cost structures and confidently support new business models, it's time for the network to break free and enter the server. Only then will service providers be able to create a virtual environment that is truly able to deliver the services customers want in a way that contains costs and helps drive profitable revenue streams.

Benefits of the High-Performance NFV Solution from Brocade and Intel

- **Lower the TCO of the Infrastructure** the virtualization of network functions delivers the compounded benefits of reducing hardware investments and all the associated operational costs (management, space, power, and cooling requirements).
- **Support Agility and Efficiency** best-of-breed capabilities and innovative implementation models ensure service providers can meet the ever-changing needs of their customers and business.
- **Accelerate Solution Design** explosively fast cycle times enable service providers to quickly and easily deploy and scale network services.
- **Grow Revenue** increase product and service portfolio to capitalize on new market opportunities and jump ahead of competitors.

The Promise of SDN and NFV

Software-Defined Networking (SDN) and Network Function Virtualization (NFV) hold the promise of enabling the disruptive transition of the network. Both decouple the "intelligence" of the network from the hardware that delivers it – SDN solutions support the orchestration and automation of the network, while NFV solutions deliver network functions, as virtual machines, that are elastic and agile.

Using standard IT virtualization technologies that run on common off the shelf (COTS) hardware, NFV solutions make it easier to deploy network services to meet changing needs, as well as reduce the total cost of ownership of the infrastructure. But for service providers to reap the full benefits of fully virtualized infrastructure, they need solutions they can rely on to deliver the performance and scale their customers have come to expect from them as they extend and roll out new services.

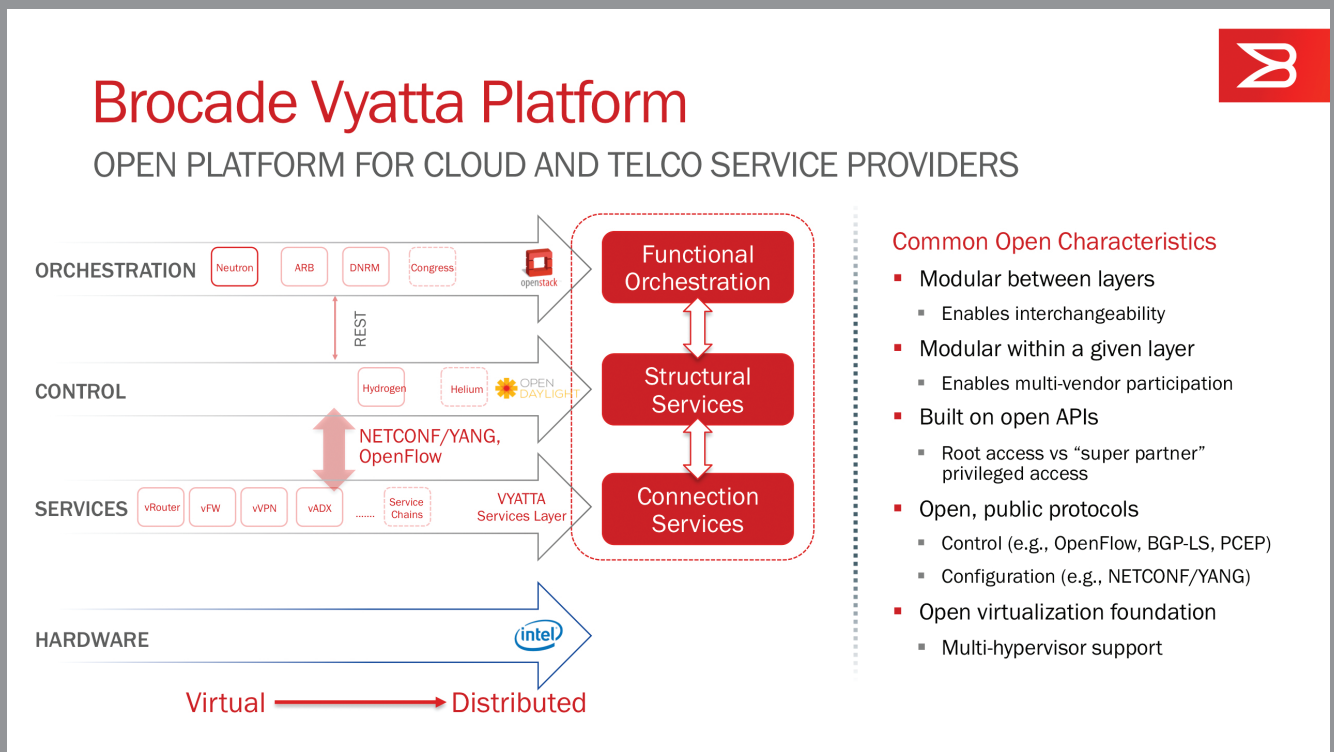


Figure 1. Systems Architecture Decoupling

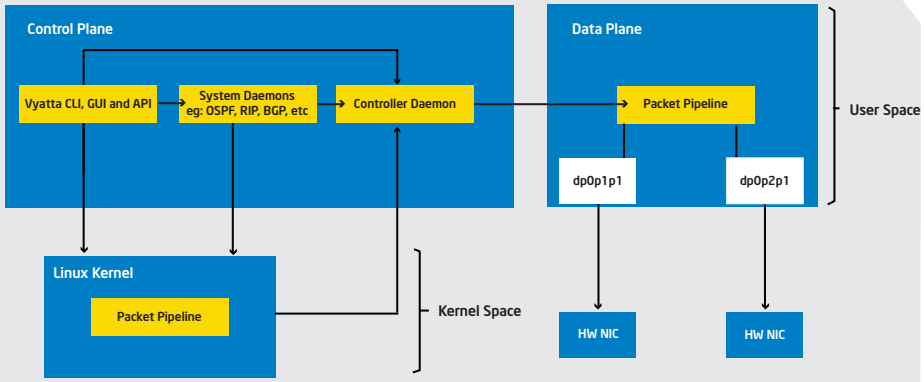


Figure 2. The Brocade Vyatta vRouter vPlane Architecture – Leveraging Intel DPDK to Achieve the Performance and Scalability Service Providers Need

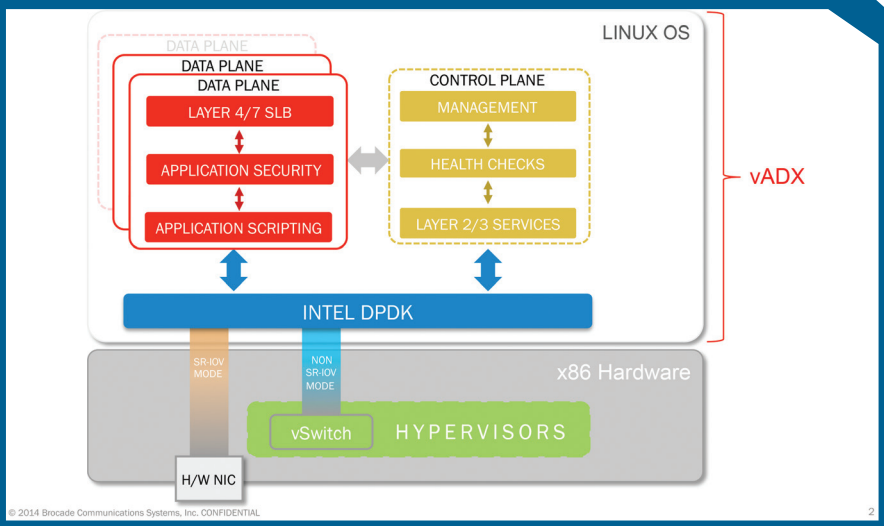


Figure 3. The Brocade vADX – Leveraging Intel DPDK with a Distributed System Architecture to Achieve the Performance and Scalability Service Providers Need

Intel and Brocade: The Perfect Partners to Complete the Network Transition

The partnership of Intel and Brocade is a perfect match of optimized price performance. Together, they are uniquely positioned to deliver the highest performing, feature-rich NFV solution virtualized on common off-the-shelf server hardware in the market. While Brocade has been offering a virtualized network operating system since 2006, Intel has been advancing processing architectures to prove that software networking is not only viable, but also optimal.

Service providers can use the Brocade Vyatta family of products, vRouter and vADX, that leverage the Intel® Data Plane Development Kit (Intel® DPDK), to transform their static hardware-based networks into dynamic software networks that meet the demands of their highly virtualized compute and storage architectures.

The Vyatta family of Products, vRouter and vADX, deliver breakthrough levels of performance. Multiple cores can be dedicated to each interface to achieve line-rate throughput when processing the most demanding workloads, including the smallest packets with a large number of firewall rules. In the vADX, the provisioning of multiple cores for each instance will enable the dynamic scaling of load balancing performance profiles, characterized by throughput, connections, and transactions per seconds, in addition to computationally demanding operations like SSL offload. The Vyatta vRouter and vADX achieve an increase in performance, in orders of magnitude higher compared to non-Intel DPDK-enabled packet forwarding platforms.

The Vyatta vRouter has been included in numerous service provider proofs-of-concept (POCs) for its robust features, dynamic scalability, high performance and ease of use. The most popular deployment scenarios are the following ETSI defined NFV use cases: Use Case #2 VNFaaS, Use Case #4 VNF Forwarding Graphs, and Use Case #5 Virtualization of the Mobile Core and IMS. These POCs have shown how the Vyatta vRouter can be implemented as a VNF (Virtual Network Function) in virtual solutions such as Virtual Customer Premise Equipment (vCPE), Virtual Provider Edge (vPE), and in dynamic service chaining environments.

This powerful combination of virtualization and performance enables services provider to reduce their cost structures to maintain their average revenue per user (ARPU) and drive profitability.

A Quick Look at the NFV Solution for Service Providers from Intel and Brocade

Service Providers can use the Brocade Vyatta family of products, vRouters and vADX, on Intel® processor-based servers to quickly and cost-effectively roll out end-to-end provisioning of network services to support customer demands and new revenue streams. They can:

- **Achieve Unprecedented Performance** – utilizing the Intel DPDK to separate the router's control and forwarding planes to eliminate resource contention.
- **Scale** – leveraging a high-speed packet pipeline architecture for efficient network designs; service providers can virtualize network functions typically deployed in physical appliances to increase per-tenant scalability – simply add VMs as the number of tenants grows.
- **Reduce Operational Complexity and Costs** – simplifying the design, deployment and ongoing management of services; ability to monitor capacity and performance, control updates and migrations and recover unused resources. Cost-effective, "pay-as-you-grow" pricing avoids wasteful overprovisioning.
- **Accelerate the Delivery of Network Services** – Automate and orchestrate support for advanced routing, VPN, firewall, application delivery, NAT and networking-based monitoring services for physical, virtual, and cloud environments.

Service Provider Use Cases for Brocade vRouter and vADX s on Intel Processor-Based Servers

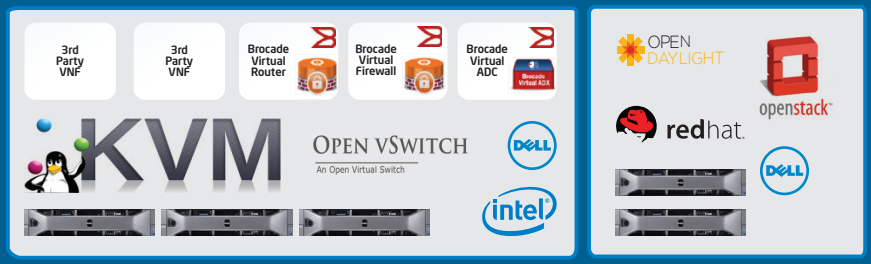
The solution can be used to support a variety of different service provider objectives, including:

- Delivering on service level agreements (SLA)
- Orchestrating virtualized network services with multi-vendor service chaining
- Detecting and mitigating Distributed Denial of Service (DDoS) attacks
- Enabling critical network functions on-demand
- Developing differentiated service offerings to generate new revenue streams.
- Offloading SSL workloads or other computationally intense operations

Use Case – Delivering on service level agreements

Service providers can deploy the Vyatta 5600 virtual router using Intel® Service Assurance Administrator (Intel® SAA) to achieve end-customer-specified Service Level Agreements (SLAs). Running on an Intel processor-based server that leverages Intel DPDK and other accelerators, the Vyatta 5600 achieves a quantum leap in performance over legacy Linux networking. Based on service providers' requirements defined in ETSI NFV Performance working group, Intel and Brocade worked together to integrate Vyatta 5600 with Intel® SAA, OpenStack, and Intel® Open Network Platform Server Reference Design-based Nodes. Now Service Providers can monitor and enforce the performance and service level objectives (SLOs) using Vyatta 5600 in NFV deployment through Intel® SAA.

Service providers can use these capabilities to deploy and orchestrate virtualized network functions (VNFs) to increase the overall agility, automation and efficiency of the network. They can



use the solution to quickly and easily configure affinity rules to maximize performance, and meet SLA requirements. Providers can collect and analyze metrics from the VNFs and other virtual machines to understand what is going on in their network, demo 'what if' scenarios and tweak policies to ensure optimal performance.

Use case – Orchestrating virtualized network services with multi-vendor service chaining

Service providers can simplify integration and management of network service functions across multiple technology domains with an open ecosystem of multi-vendor service chaining. The solution enables service providers to provide end to end visibility of network functions, permit service changes with minimal impact, and automate virtualized network services using best of the breed components.

Under the Intel leadership, the dynamic multi-vendor service chaining embraces the open source and SDN technology to build an agile, flexible and reliable service provider network.

The innovative solution offers:

- Intelligent service functions chaining with OpenStack and OpenDaylight
- OpenStack Neutron plugins for virtualized network functions (VNF)
- Brocade Vyatta virtual router, firewall, and application delivery controller (ADC)

Use case – Providing DDoS Attack Detection and Mitigation

DDoS or SYN attacks are becoming increasingly severe, with attackers launching sophisticated attacks and even building botnets in the cloud. With Vyatta vADX application delivery controller, service providers can leverage its SYN proxy and DDoS attack filters to offer maximum protection against well-known DDoS attacks such as Xmas-tree, SYN fragments, and address sweeps while ensuring the undisrupted flow of legitimate traffic.

Use Case – Enabling critical network functions on-demand

Service providers can use the Vyatta network virtual routers and vADX application delivery controllers to scale network functions to meet the changing demands of customers. These virtual machines can be deployed instantly on a customer's request, via a self-service portal, providing them with full network controls in a shared cloud environment. As a result, service providers can offer their customers highly customized, differentiated services without any additional capital expenditures.

Use Case – Increasing Services Portfolio

Service Providers can offer customers additional services, such as virtual firewalls, load balancing, VPNs (L2/L3), advanced routing and NAT capabilities to capitalize on market opportunities. They can offer each on a per-tenant basis to increase their service portfolio and add revenue streams.

Use Case – Offloading SSL Workload or Other Computationally Intense Operations

Service Providers can use vADX to offload CPU-intensive Secure Sockets Layer (SSL) negotiation and connection management tasks from application servers, thereby freeing up CPU cycles for application delivery and improving application response time. With the SSL offload service, vADX supports both the 2048-bit and the 1024-bit SSL termination functionality, providing performance gain in processing new SSL sessions per second.

The Intel – Brocade Advantage

The Brocade Vyatta vRouter and vADX running on Intel processor-based servers offer performance to support the varied needs of service providers and their customers. Service Providers can be confident they have the performance, scale and reliability they need to make the transition to a dynamic software networking environment because the solution:

- Is Purpose-Built for NFV
- The most deployed virtual router solution in the world, with more than 1.3 million downloads of the Brocade vRouter, the solution is proven for NFV deployments.

- The Intel DPDK is designed to provide a simple, complete framework for fast packet processing in data plane applications.
- Offers Unmatched Performance
- The highest-performing software router in the industry, achieving 80+ Gbps performance, which is up to 8x times faster than competitive virtual routing products.
- Lowers the Service Provider's Cost Structure
- Frees up capital by minimizing expensive, proprietary hardware investments and ongoing operational costs (space, power, cooling).
- Manual processes are automated to simplify deployment of both on-premise and off-premise cloud services:
- Provides access to ready-to-use patterns and content packs to help speed configuration, provisioning and deployment.
- Delivers services via software to reduce deployment time up to 80%.
- Enable efficient network designs to ensure the solution can integrate within any environment.
- Delivers Advanced Functionality
- Service Providers can deploy advanced routing, stateful firewall, load balancing, NAT and VPN capabilities in software, without sacrificing the reliability and carrier-class performance of hardware networking solutions, to confidently support the needs of enterprise customers.

Brocade Vyatta vRouter and vADX Running on Intel Processor-Based Servers Enable Service Providers to Transform their Network to Reduce Their Cost Structure and Increase Competitiveness

With Intel and Brocade, Service Providers can transform their network to match the agility, efficiency and scale of their virtual compute and storage infrastructures. As a result, they can create a fully virtualized environment that reduces operational expenses to deliver existing and new services at utility prices and support their revenue growth. Vyatta vRouter and vADXs:

- **Lower the TCO of the Infrastructure** –the virtualization of network functions delivers the compounded benefits of reducing hardware investments and all the associated operational costs (management, space, power, and cooling requirements).
- **Support Agility and Efficiency** – best-of-breed capabilities and innovative implementation models ensure service providers can meet the ever-changing needs of their customers and business.
- **Accelerate Solution Design** – explosively fast cycle times enable service providers to quickly and easily deploy and scale network services.
- **Grow Revenue** – increase product and service portfolio to capitalize on new market opportunities and jump ahead of competitors.

About Intel

Intel (NASDAQ: INTC) is a world leader in computing innovation. The company designs and builds the essential technologies that serve as the foundation for the world's computing devices. As a leader in corporate responsibility and sustainability, Intel also manufactures the world's first commercially available "conflict-free" microprocessors. Additional information about Intel is available at newsroom.intel.com and blogs.intel.com and about Intel's conflict-free efforts at conflictfree.intel.com.

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About Brocade

Brocade networking solutions help organizations transition smoothly to a world where applications and information reside anywhere. Innovative Ethernet and storage networking solutions for data center, campus, and service provider networks help reduce complexity and cost while enabling virtualization and cloud computing to increase business agility.

Learn more at **www.brocade.com**

Solution Provided By:

[1] Source: Telefonica test lab results: http://newsroom.brocade.com/press-releases/telefonica-and-brocade-establish-benchmarks-for-nf-nyse-tef-1138649#.U_-uuCzn8y8

[2] Analysis conducted by Brocade customer

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