FOCUS Solution Profile:
NEC SDN Brings Increased Agility & QoS to Hyper-V and SQL Server

Abstract

Many IT organizations want to expand their successes in virtualization to include business-critical applications such as SQL Server, to gain increased availability and agility but without sacrificing performance. To address these needs, NEC has developed a solution that combines their highly available Enterprise Servers with the advantages of software defined networking (SDN).

Building on their leadership in the development of the SDN OpenFlow specification, NEC has delivered an OpenFlow-based SDN suite which brings the benefits of virtualization to the networking layer. This suite, in conjunction with NEC Enterprise Servers running Microsoft Windows Server 2012 R2 Hyper-V, offers an enterprise-class solution for optimally virtualizing SQL Server, with network mobility, manageable and predictable quality of service (QoS) and other benefits of network virtualization as discussed in this paper.

State of the Industry:

Server virtualization has become a mainstay in data centers today, with more workloads running in virtual environments than physical. Virtualization technology has evolved to the point where the hypervisor overhead is no longer an issue, and the benefits offered by virtualization far outweigh the overhead. Microsoft Windows Server 2012 R2 Hyper-V and System Center 2012 R2 now offer an enterprise-class platform for IT organizations to run their business, and offer an especially strong platform for Microsoft application stacks such as SQL Server 2012, SharePoint and others.

IT organizations have been extremely successful in virtualizing the compute portion of the data center. As those organizations move towards fully virtualized environments and include mission-critical applications, common pain points emerge around networking and storage. These pain points are driving IT and the vendors building solutions beyond virtualizing compute only and into greater virtualization of network and storage resources to gain greater control and increased ease-of-use. New solutions have emerged enabling network virtualization and SDN to bring the same benefits to networking that server virtualization has brought to servers.

Business and Technical Drivers

The move beyond virtualizing only web servers, print servers, etc., to virtualizing multi-tier applications, databases (with higher I/O requirements), and business-and mission-critical applications brings new challenges. Fully embracing virtualization and building and managing private clouds, requires a set of additional enterprise-class features including:

- high-end servers and large multi-host clusters with high reliability, availability and serviceability (RAS)

- increased cores, memory, I/O operations per second (IOPS) and advanced networking capabilities

- resiliency across the platform and management infrastructure

- load balancing capabilities

- application-aware guest clustering

- live virtual machine (VM) and storage migration across hosts and sites with the requisite networking flexibility and automation, and quality of service (QoS) management to allocate the appropriate resources to the most critical applications

Many IT organizations will run the less critical part of the data center on low-end commodity servers with the minimum number of cores and minimal memory necessary. However, for business-critical applications, many organizations are implementing high-end servers with enterprise-class features, enterprise-class RAS, redundancy, fault tolerance, advanced networking such as NIC

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teaming, single root I/O virtualization (SR-IOV), Multi-path IO (MPIO), remote management and reconfiguration and more.

In addition, to handle the high memory and processing requirements of these applications, including databases such as SQL Server, servers need as much horsepower as possible, in terms of cores, processing power, memory, and I/O bandwidth. These high-powered servers and new features in Windows Server 2012 R2 and Hyper-V have allowed many companies to successfully virtualize SQL Server on Hyper-V, and manage everything with System Center.

The ability to move workloads around between hosts through the seamless live migration of running workloads has been a great benefit of virtualization, minimizing or even eliminating server downtime for many situations. The new shared-nothing live migration features of Windows Server 2012 R2 Hyper-V now extend that mobility across geographic locations, with no shared storage required.

The Need for Network Virtualization

As virtual environments expand and increase in complexity (along with the networks they run over), the bottlenecks and the increased need for flexibility and management shifts from the server to the network. While Microsoft Hyper-V live migration allows an administrator to seamlessly live-migrate a virtual machine (VM) workload from one host to another, if the VM moves to a server on a different network segment, the process is not so seamless. Until the network intelligence catches up with the move, users may not be able to access that VM workload for some period of time, effectively resulting in an application outage.

To overcome this limitation, the environment needs to seamlessly handle live migration at the network layer. Additionally, the need for common management, control and visibility, greater security, and consistent QoS across both virtual and physical networks has driven the

> **"By virtualizing SQL Server on Windows Server 2012 Hyper-V, customers are assured of a reliable and manageable data platform for mission-critical enterprise workloads. NEC's high-end servers with NEC's PF products for network virtualization give customers additional agility and control."**
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> *Luis Daniel Soto Maldonado*
> *Director, Product Marketing SQL Server*
> *Microsoft*

overall need for advanced software-based management and configuration of the entire network. This concept, called programmable networks, offers big benefits in agility and availability, as well as simplified management and reduced operational costs.

Implementing programmable networks so that all network changes to both virtual and physical switches can be done through a single management software interface is called software defined networking (SDN). One of the approaches to SDN that has emerged is based on a new specification known as OpenFlow. OpenFlow is an open source protocol which allows granular software management across multiple vendors' network devices, making networks as flexible as the rest of the virtual data center. OpenFlow allows network control to be centrally managed through SDN software, eliminating the need for traditional protocols such as spanning tree, and greatly reducing complexity and administrative challenges.

OpenFlow is gaining traction — the Open Networking Foundation (ONF), whose mission is to advance the use of SDN and OpenFlow, now has more than 100 members. ONF members include chip companies, system vendors, computer companies, software companies, testing companies, training companies, telecom operators, enterprises, and leading datacenter

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operators like Google, Yahoo, Verizon, and Deutsche Telekom. Adoption is growing, and the past two years have had a significant increase in OpenFlow based switches, controllers, applications, and real-world deployments of the technology.

Vendor and Solution Overview

In addition to its long history of innovation and building enterprise-class servers such as the NEC Express5800, with strong RAS and high-end computing capabilities, NEC has been one of the leaders in SDN, and in the creation of the OpenFlow specification, in partnership with other vendors and the Open Networking Foundation. NEC has invested in creating the first enterprise-class, industry-standard SDN fabric for Windows Server 2012 Hyper-V, based on OpenFlow, known as the NEC ProgrammableFlow (PF) fabric.

NEC's ProgrammableFlow fabric enables a flattened, open topology that delivers greater performance, simplified management (including QoS and increased security), high availability, and expanded scalability to virtualized and cloud environments. Combining the PF fabric with NEC's enterprise class servers running Microsoft Hyper-V, provides a powerful, reliable, highly available, agile, and well-managed platform for delivering SQL Server services.

NEC SDN Architecture/Features

The NEC ProgrammableFlow fabric is made up of three components:
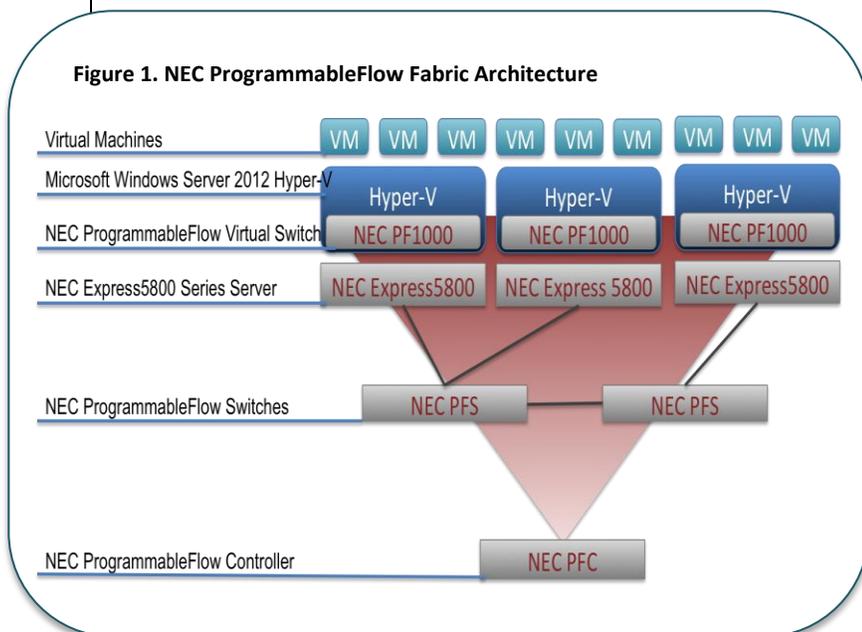
- NEC ProgrammableFlow Controller (PFC)
- NEC ProgrammableFlow Switches (PFS)
- NEC ProgrammableFlow Virtual Switches (PFvS)

All three of these components have the control information and the data path separated to enable SDN using the OpenFlow specification (see Figure 1). NEC ProgrammableFlow solutions are completely compatible with traditional networks, enabling incremental deployments to existing data center infrastructure.

NEC ProgrammableFlow Controller

The NEC PF6800 Controller is the management and configuration interface for the fabric. All the fabric components and service capabilities are defined within the NEC PFC, including QoS settings and security settings. This allows both the virtual and physical network to be monitored and managed consistently and with the same interface. This allows consistent QoS and security policies for communications between VMs through virtual switches on the same host, or virtual or physical switches on different hosts or different sites. The QoS capabilities ensure that critical applications such as SQL Server VMs get the priority resource allocations they need over less important VMs, and improve performance predictability for critical applications while maximizing resource usage.

Figure 1. NEC ProgrammableFlow Fabric Architecture

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The NEC ProgrammableFlow Controller can control any OpenFlow-compliant network devices, either physical or virtual. This saves time and operational costs enabling IT networking experts to set up the network once and have policy applied across the fabric. The advanced network automation and control allows VM mobility across the network, with no additional steps, making the network more responsive to changing business needs while reducing management costs.

As a result of these innovations, NEC's ProgrammableFlow Controller won Best of Interop 2012 for "innovation, insight, and advanced thinking."

NEC ProgrammableFlow Switches

NEC ProgrammableFlow switches are OpenFlow-enabled switches managed by the NEC ProgrammableFlow Controller, separating the switch management from the data path capabilities. This allows IT staff to match the application needs with the appropriate network hardware capabilities without having to change the management environment.

The NEC PF5200 series runs both traditional and OpenFlow protocols and is designed with hardware support for complex network requirements.

- **NEC PF5240 Switch** – high-performance hybrid, non-blocking Ethernet switch with 48 ports of 1-Gbps and four ports of 10-Gbps of connectivity

- **NEC PF5248 Switch** – high-performance hybrid, non-blocking Ethernet switch with 8 ports of 10-Gbps and two ports of 1-Gbps of connectivity.

The **NEC PF5820 Switch** is a non-blocking Ethernet switch with 48 SFP+ ports that operate at 10-Gbps or 1-Gbps and four QSFP+ ports that operate at 40 Gbps (or as 16 additional 10-Gbps ports). It features low latency and 1.3 Terabits per second (Tbps) of throughput in a 1U form factor.

NEC ProgrammableFlow Virtual Switch

The NEC PF1000 Virtual Switch is a virtual switch that integrates with Windows Server 2012 Hyper-V. Like the NEC physical switches, it is OpenFlow-enabled, which allows it to be managed exactly the same way the physical switches are managed, from the NEC ProgrammableFlow Controller. This simplifies network management across the entire environment and enables automation of network management tasks for both virtual and physical switches, thereby reducing operation costs associated with network management in a virtualized data center.

Offering secure multi-tenancy, the NEC PF suite enables VM migration with QoS and security policy moving with the VM, regardless of its physical or virtual connectivity or end location.

Differentiators

The NEC PF Suite delivers the first SDN virtual switch integrated with Windows Server 2012 Hyper-V using OpenFlow. It provides connectivity and control, from the VMs all the way through the fabric. This allows the virtual and physical networks to be managed the same, from a single management software interface, across the entire fabric.

Having consistent policies and procedures for virtual and physical networks brings end-to-end QoS and security control to business-critical applications such as virtualized SQL Server.

Combining the NEC PF suite with NEC enterprise-class servers offers a highly reliable, highly available solution with the compute, IOPS and networking horsepower for applications such as SQL Server, with the network agility that only SDN can bring.

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Strengths/Limitations

Strengths

NEC is the first company to deliver SDN based on the OpenFlow standard, for Windows Server 2012 Hyper-V. The ability to separate control path from data path and increase operational efficiencies is essential in effective data center management today. It is especially important for the deployment of virtual and cloud infrastructures.

The NEC PF solution enables this level of physical abstraction, increasing agility, reducing complexity and maximizing efficiency. In addition, its QoS and security policy capabilities across virtual and physical network are critical to managing business-critical applications such as SQL Server.

Furthermore, at TechEd, Microsoft demonstrated the planned integration of NEC's PF products with System Center Virtual Machine Manager. This will provide greater management capabilities and integration for IT organizations using System Center.

Limitations

From a data center point of view, one of the advantages of SDN based on OpenFlow is the ability to manage any OpenFlow-enabled network infrastructure from a single management console. Because the technology is relatively new, there are currently a limited number of vendors with OpenFlow implementations available, thus restricting the choices in networking infrastructure. As support continues to grow, FOCUS sees this limitation diminishing.

Focus Analysis

With more IT organizations moving to cloud and fully virtualized infrastructures including business and mission-critical applications, it is essential that pain points around networking and storage are removed. New solutions based

on software-defined networking and OpenFlow bring the benefits of reduced complexity, consolidated management, network agility and scalability, and consistent QoS and security across the virtual and physical network infrastructure.

As an industry-leader again, NEC is the first to enhance its enterprise-class servers with an end-to-end SDN OpenFlow-based solution for Windows Server 2012 Hyper-V, with the NEC ProgrammableFlow fabric. Today, companies running business-critical applications like SQL Server can have agility and control over QoS and security, with simplified management through NEC Servers, PF Controllers, Switches, and Virtual Switches.

About Focus

FOCUS, LLC offers independent market research, analysis, and consulting focused on transformational technologies in virtualization, cloud computing, systems, and storage for the enterprise, SMB, and government markets. Focus areas include Cloud Computing; Virtualization – Server, Desktop, Application and Storage; Software Defined Datacenter, Software Defined Networking, Workspace Mobility, Systems, Storage and Enterprise Management (Physical and Virtual); Data Protection, Disaster Recovery, and Backup; Storage Networking and Storage Technologies; Blade Systems; Converged Infrastructure, and Business Benefits of Technology (ROI, TCO).