Deliver the Next Generation Intelligent Datacenter Fabric with the Cisco Nexus 1000V, Citrix NetScaler Application Delivery Controller and Cisco vPath
Executive Summary
Cisco’s Unified Data Center architecture recognizes the importance of layered network services, including robust application delivery capabilities that accelerate application performance for all users while lowering datacenter costs by offloading server functionality. By integrating the Citrix® NetScaler® application delivery controller (ADC) with the Cisco Nexus 1000V Series Switch using Cisco vPath technology, Citrix – in conjunction with Cisco – can now deliver these essential capabilities in a uniquely powerful manner.

With integral support for Cisco vPath, NetScaler delivery services can flexibly be inserted at one or more points in the traffic flow for all applications connected to a Nexus 1000V virtual access switch, independent of NetScaler’s location in the physical network topology. The “deploy anywhere, use anywhere” approach this enables not only lays the foundation for significant cost savings and unparalleled agility, but also results in NetScaler becoming a plug-compatible component of Cisco’s blueprint for the next generation datacenter fabric.

The Next Generation Intelligent Datacenter Fabric
The traditional model for datacenter investment has been to build in silos – often with dedicated resources for lines of business, or even individual applications – and to design for peak usage requirements. However, this approach is not sustainable for modern organizations. It is not practical to scale in response to rapid growth of applications and their traffic and is subject to spiraling costs and complexity. Not only is it impossible to leverage resources across silos, but – because they are constrained by their physical location in the network topology – it’s a challenge even to share them within a given silo.

For example, if the order of components in a network is internet router, enterprise firewall, load balancer and server farm, then application traffic must always flow in that order. Any new applications or requirements that necessitate a different order cannot be accommodated without changing the layout of the network.

Cisco’s vision for addressing this situation is the Unified Data Center, an architecture for the next generation datacenter that combines compute, storage, network and management solutions to enable and automate IT-as-a-Service. A key pillar of this vision, Cisco Unified Fabric is not only responsible for linking all resources within and across datacenters so that they are seamlessly accessible to each other, but also is the home of Cisco Unified Network Services (UNS).

Cisco UNS recognizes the strategic importance of application delivery and other layered network services – such as application-aware security and performance monitoring – to successful datacenter design and operation. It further recognizes, however, that the traditional reliance on intrusive inline deployment, static network topologies and separate policy management platforms is at odds with highly scalable virtual datacenter designs featuring mobile workloads, on-demand virtual machine (VM) provisioning and aggressive service level agreements (SLAs).

This is why a key objective of Cisco UNS is to deliver feature and policy management consistency for all layered network services across all form factors (i.e., appliance, module, integrated, and virtual) and environments (i.e., network, compute, and cloud). Along with the ability to choose and re-use whichever option best fits a given scenario, Cisco UNS also enables automatic, on-
demand provisioning of these services to ensure optimal delivery of all enterprise applications and cloud services.

Realizing the Vision

One way that Citrix has made the NetScaler a plug-compatible component of Cisco’s vision is by linking it to the Cisco 7000 datacenter core switch. This link between the products enables the NetScaler to operate as a virtual service module attached to the Nexus 7000 without the use of custom hardware. A second way, and the focus of this paper, is by adding support for Cisco vPath that enables NetScaler to be part of a highly dynamic virtual services layer coordinated by Nexus 1000V datacenter access switches.

Cisco Nexus 1000V Series Switches

A key component of Cisco’s Unified Fabric, the Nexus 1000V Series Switch is a comprehensive, extensible platform designed to accelerate server virtualization and multi-tenant cloud deployments in a secure and operationally transparent manner. Consisting of a Virtual Ethernet Module (VEM) that runs in the hypervisor kernel as a replacement for native vSwitch capabilities and a separately hosted Virtual Supervisor Module (VSM), the Nexus 1000V brings the network edge directly to the virtual machine environment, providing:

**Advanced virtual machine networking.** Port profiles are used to define and assign network policies for different types or classes of VMs. The result is not only a scalable, policy-based mechanism for configuring networks with large numbers of VMs, but also one that fully accounts for advanced capabilities such as dynamic workload provisioning and VM migration. Because these switches use NX-OS, the same operating system as the rest of the Nexus family, organizations also benefit from having a rich, consistent networking feature set all the way from the virtual machine access layer to the core of their datacenter infrastructure.

**The foundation for hybrid cloud and other advanced architectures.** Support for a wealth of QoS, security, and advanced networking capabilities – such as VXLAN – enables numerous next-generation use cases. For example, with the Nexus 1000V datacenter architects can easily partition infrastructure into multiple, logically isolated networks to establish a secure multi-tenant environment,
or seamlessly extend their layer 2 network into the cloud to enable dynamic workload scaling. With a rich set of APIs at their disposal, CIOs also obtain the programmability needed to embrace the over-arching strategy of having a software-defined network (SDN).

**Advanced service insertion and routing technology.** Cisco vPath technology provides a powerful framework for optimized integration of virtual network services and their transparent, on-demand insertion (or removal) from the network fabric.

**Citrix NetScaler ADC**
Ideal for helping fulfill Cisco’s vision for Unified Network Services, Citrix NetScaler enables IT transformation and helps customers build next-generation networks.

Deployed in thousands of enterprise, service provider and public cloud infrastructures globally, NetScaler ADCs combine L4-7 load balancing, high-speed data compression, content caching, SSL acceleration, application flow visibility and a powerful application firewall into a single, easy-to-use platform. Available as a high-performance single-tenant network appliance, multi-tenant network appliance, and software-based virtual appliance, NetScaler delivers choice of platform while ensuring a consistent feature set and uniform, cross-platform policy management.

Revolutionary Citrix TriScale™ Technology adds to the strengths of NetScaler by providing cloud-like elasticity and scalability for all NetScaler application delivery services. With Citrix TriScale, organizations of all types, sizes and levels of cloud maturity can easily:

- **Scale Up** – elastically increasing performance by 5x on-demand using NetScaler Pay-As-You-Grow
- **Scale In** – significantly simplifying the datacenter and reducing costs by consolidating up to 40 appliances into a single, multi-tenant NetScaler platform
- **Scale Out** – dramatically expanding capacity by 32x with powerful Citrix TriScale clustering

**Cisco vPath – Bringing Nexus 1000V and NetScaler ADC Together**
Independent of each other, Cisco Nexus 1000V virtual switches and Citrix NetScaler ADCs provide a rich set of capabilities that significantly contribute to today’s organizations realizing Cisco’s vision for the next generation datacenter fabric. However, support for Cisco vPath technology within NetScaler VPX virtual appliances delivers even greater benefits. By enabling this pair of best-in-class solutions to seamlessly work together, vPath overcomes the limitations of rigid network topologies and streamlines insertion of essential delivery services into the network fabric, wherever and whenever they’re needed.

Cisco vPath is innovative technology that optimizes use of layered network services in virtual machine and cloud environments. Fundamentally, vPath provides a forwarding-plane abstraction and programmable framework for inserting network services such as firewalls and load balancers at the virtual access layer. The result is that these services, although physically separate, become tightly coupled logical
extensions of the organization’s access layer infrastructure.

Architecturally, this “logical extension” model is enabled by vPath embedded intelligence within the 1000V data plane (i.e., VEM) coordinating service delivery with virtual service nodes that have incorporated the necessary vPath support – such as NetScaler VPX and the Cisco ASA 1000V edge firewall.

Key capabilities and benefits of Cisco vPath that convey to an integrated deployment of Nexus 1000V switches and NetScaler ADCs include:

**Intelligent traffic steering.** Located in the switch data path, vPath intercepts inbound, outbound and VM-to-VM traffic and redirects it for network service processing, before allowing it to proceed to its ultimate destination. The result is a quick and easy mechanism for leveraging application delivery and other layered network services in a virtual environment. How this works internally is that the port profile for a given VM is extended to also include a network service profile that captures the policies configured to specify which traffic should be redirected to which virtual service nodes. With this approach, NetScaler application delivery services become part of the policy-based VM connectivity discussed earlier, meaning they too follow the lifecycle of a VM – whether it is being migrated from one server to another, restarted or dynamically provisioned.

**Flexible deployment.** vPath uses overlay tunnels to steer traffic to NetScaler ADCs that are either Layer 2 or Layer 3 adjacent to the corresponding VEM. The tunnels themselves are either L2 or L4, using MAC-in-MAC or MAC-in-UDP encapsulation, respectively. The net result is that vPath effectively decouples the NetScaler ADC from the network topology. In other words, the virtual ADC serving a given VEM and its corresponding VM workloads can physically reside practically anywhere, including the cloud, and can itself be subject to VM mobility. Although the virtual ADC could be deployed on the same physical server as VMs that it is serving, a better option is for it to reside on separate, shared or dedicated hardware – an approach that reduces the processing burden placed on the virtual application infrastructure and enables clearer separation of duties.

**Service chaining.** Application flows often require more than one network service (e.g., firewall and ADC). Also, different application flows may require network services to be applied in a different order (e.g., firewall then ADC, versus ADC then firewall). vPath accommodates both of these scenarios with a capability known as service chaining. With service chaining, administrators can define service paths, or ordered lists of services, which are then attached to VMs as part of the port profile. Service paths are defined from inside to outside – that is, from the perspective of traffic leaving a VM en-route to another VM or external resource – and are automatically reversed by vPath for traffic flowing in the opposite direction. With service chaining, network administrators obtain a single control point that makes deployment of application delivery services in conjunction with multiple, other network services simpler, faster and less error prone. Moreover, there is no need to deploy dedicated silos of application infrastructure to enable network services to be applied in a different order for different applications.

**Network service offloading and acceleration.** With the ability to cache application delivery decisions, vPath can accelerate the data path and effectively offload the NetScaler ADC. Once a packet has been processed by NetScaler, vPath can apply the same decision to all other packets from the same flow

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without having to further involve NetScaler. This enables the NetScaler to handle significantly more aggregate traffic as it no longer needs to participate in connections once a load balancing decision is made.

**Service Chaining Example with Citrix NetScaler and Cisco VSG Intra-tenant Firewall**

**Multi-tenant awareness.** Isolation is maintained between tenants by only steering traffic from a specific tenant’s VMs to NetScaler virtual services nodes assigned to that tenant.

**Non-disruptive operational model.** With the vPath architecture, management responsibilities remain divided along traditional lines: with server/virtualization administrators responsible for VM configuration, network administrators responsible for and able to operate the virtual machine network the same way they do the physical network (e.g., via Cisco CLI and SNMP-based tools), and services administrators still in charge of the virtual services nodes. Although each team works independently and continues to use familiar tools, the Nexus 1000v with embedded vPath technology enforces consistent configuration and policy throughout the server virtualization environment. This “separate yet integrated” approach lowers cost of ownership while supporting various organizational boundaries among server, network, security, and other teams.

**vPath-Enabled Technical Benefits Include:**

- Topology (and location) -agnostic model for deploying NetScaler ADCs
- Efficient, scalable way to implement application delivery services in virtual environments
- Granular enforcement of application delivery policies
- Virtual machine mobility awareness
- Data-path acceleration and NetScaler offload
- Flexible chaining of application delivery services with other network services
- Multi-tenancy awareness
- Non-disruptive operational model
Delivering the Next Generation Datacenter Fabric

Featuring innovative Cisco vPath technology that enables policy-driven, topology-independent insertion of layered network services into the network fabric, Cisco Nexus 1000V Series switches are a key part of Cisco’s vision for the next-generation virtual datacenter. By incorporating support for vPath and effectively integrating with the Nexus 1000V switches, the Citrix NetScaler application delivery controller is now a plug-compatible component of that vision as well. Using the combined Cisco and Citrix solution, IT organizations can leverage virtual NetScaler ADCs deployed practically anywhere, including the public cloud, to optimize, secure and control delivery of enterprise applications running in virtualized environments.

Compelling business benefits of vPath-based integration of NetScaler with Nexus 1000V virtual access layer switches include:

- Accelerated speed of application and cloud services deployment enabled by having a policy driven network fabric that eliminates the need for a silo’ed datacenter design with dedicated, per-application/per-tenant infrastructure
- Reduced total cost of ownership from having a highly efficient and scalable way to implement and optimize the use of crucial application delivery resources in today’s highly dynamic, virtualized datacenters
- Enhanced business agility derived from the ability to more smoothly and quickly make the transition to software-defined networking and next-generation virtual datacenters
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