# CONSUMABLE DATACENTER NETWORKING

Using SDN concepts to create an infrastructure in which network resources are as readily consumable as compute and storage resources

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Your clients and end users want instant access to their chosen applications — anytime, anywhere. To meet this demand, you have undoubtedly investigated cloud services. You know that with cloud services you should be able to turn up applications very quickly. You also expect cloud services will help you simplify operations and control costs. However, for cloud services to meet your expectations, the networks within and across datacenters must evolve to become as virtualized and readily available as the server and storage infrastructure. Today's datacenter networks are not like this. In fact, while application turn-up on virtual compute platforms takes only minutes, network configuration to support those platforms can take weeks or even months to implement!

At Nuage Networks™ we're dedicated to fixing that problem. Our innovative Nuage Networks Virtualized Services Platform (VSP) removes the constraints of the datacenter network so it too can operate at lightning speed. A Software-Defined Networking solution, the Nuage Networks VSP enables you to build a robust and scalable multi-tenant networking infrastructure that delivers secure virtual slices of readily consumable compute, storage and networking instantaneously across thousands of applications and user groups.

"UPMC has been a leader in virtualizing our data centers to provide fast, reliable and flexible services to our clinicians and other customers in a rapidly changing healthcare landscape. With the Nuage Networks SDN solution, we hope to further our strategy of using smart technology to support patient-centered, accountable care."

**William Hanna, Vice President of IT Infrastructure at UPMC**

# CLOUD COMPUTING — A GIANT LEAP FORWARD

With non-cloud-based systems, you have to purchase a large compute system to meet the peak processing needs of a limited set of specific events, such as financial milestones or annual retail events. You are, in effect, forced to make a full year's investment in CAPEX and OPEX for capacity you only need intermittently throughout the year.

You also face a competitive marketplace that is forcing a fundamental shift in the IT domain. Today, applications must be turned over very quickly, and that means traditional IT development cycles must become more agile. You need to be able to implement, modify and decommission applications instantly.

## Application development in the cloud

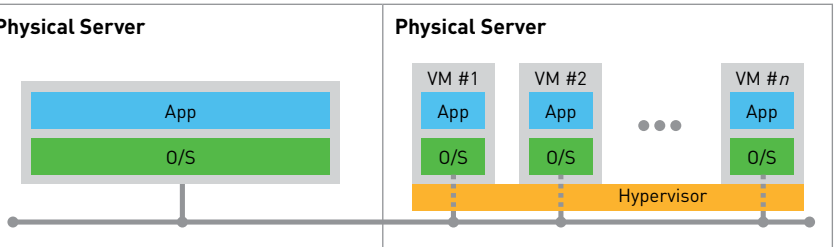
Much of the burden for increasing application agility falls on your IT development-operations team. In the past, dev-ops teams used a dedicated model environment for software development and testing of new application loads. With a move to the cloud and migration to a virtual compute environment, your team can cut costs and reduce wait times. The new virtual development environment has the flexibility to adapt to capacity demands in line with the development lifecycle phase. It also allows the dev-ops team to test the system at peak I/O levels for limited periods of time, rather than having to sustain high capacity when it isn't needed.

### What used to take weeks or months can now be accomplished in hours or even minutes

With a cloud-based infrastructure, you benefit from a nimble development cycle with significantly lower overhead and an improved responsiveness to changing business conditions. What used to take weeks or months of labor-intensive planning meetings, procurement processes, and back-and-forth information exchanges can now be accomplished in hours or even minutes, saving significant overhead and improving IT efficiencies.

However, even with the best virtualization environment, there are underlying delays in the network that hinder the velocity of IT system changes.

**FIGURE 1. Comparing traditional and virtualized datacenter environments**




| | Traditional Server Environment | Virtualized Compute Environment |
|---|---|---|
| **Number of network endpoints** | 1 | 4 – 40+ VMs/Server |
| **Nature of network connections** | Static | Dynamic |
| **Connection longevity** | Months / Years | Hours / Days |
| **Connection longevity** | Simple | Variable |

# NETWORK AGILITY: THE LAST STUMBLING BLOCK

Within IT, the network is a shared infrastructure under a system of strict change controls. These controls are in place to ensure that changes for a single application or group don't affect the performance of other users on the network. Any augmentation or configuration change on the network must follow a defined process to eliminate this risk.

Generally, this process involves the applications project team formally requesting assistance from the network team to adapt the network for the new application. Several different teams within the overall IT structure may be involved and the applications group may have to submit a formal "ticket request" via the help desk. The process requires allocation of the appropriate network personnel including the various technology teams that own IP Addresses, VLAN addresses, switch/router and firewall configurations, and in some cases the physical plant team. A security team must also be involved to ensure that the new application is not exposing information to unauthorized users, in accordance with regulations such as Sarbanes-Oxley.

It's a complex process and involves multiple teams across multiple disciplines. In most cases it results in a project being implemented to action the request. This naturally slows things down, limiting the effectiveness of moving to a virtual compute environment for ad hoc and reactive IT changes.

## Building a flexible, agile network

Nuage Networks™ closes the gap between the network and the cloud-based application model by transforming the way IT groups build and use their networks. Nuage Networks ensures your network elements are as efficient and flexible as your cloud computing. The result is a choreographed datacenter environment where the compute resources and network work seamlessly.

### Imagine the possibilities when network resources are as easily consumable as virtual compute resources

A Nuage Networks datacenter network is as dynamic, automated and virtualized as the server infrastructure and supports the needs of applications with instantaneous network connectivity.

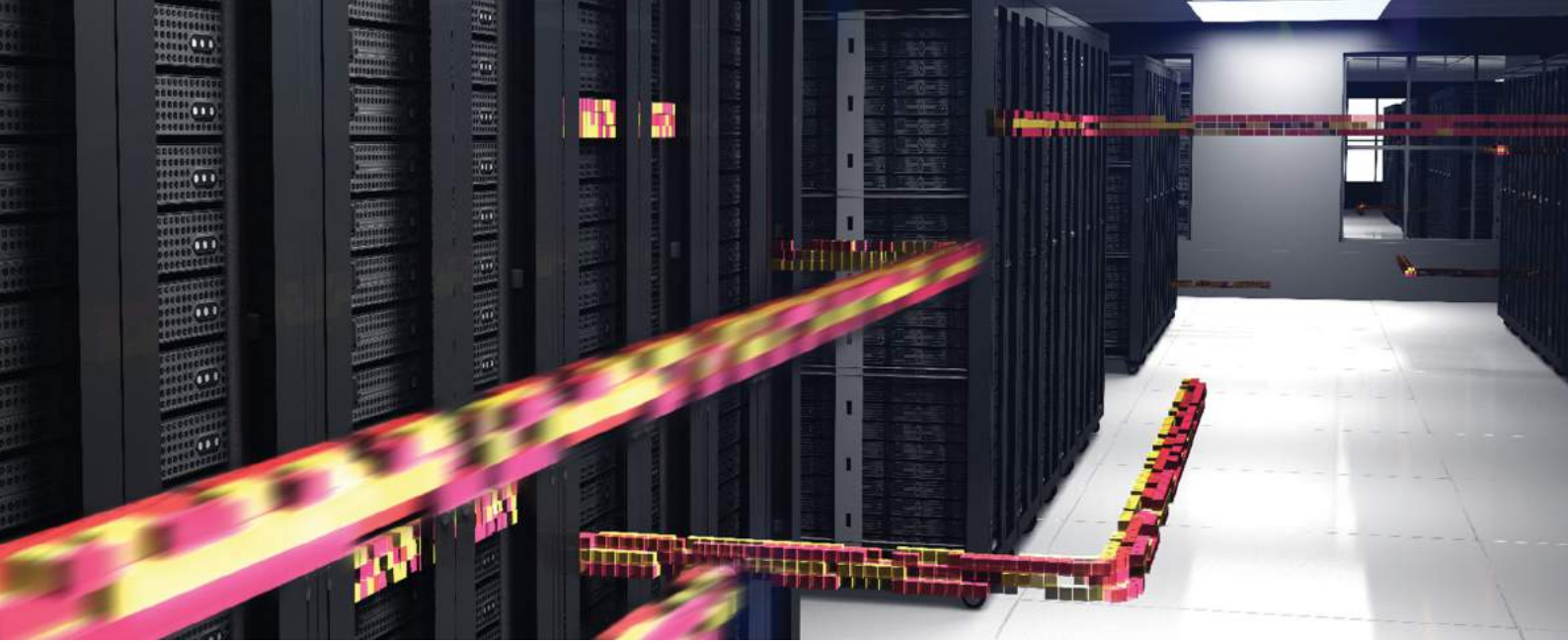
Nuage Networks eliminates the constraints that have been limiting the IT network within the datacenter. With Nuage Networks, you can:

- Define the network service on a per-application basis
- Abstract the application requirements from the network configuration
- Optimize your workload placement across datacenter zones or even across geo-diverse datacenters
- Maximize efficiency of your server and fabric resources

Nuage Networks paves the way for datacenters to be the heartbeat of a powerful cloud infrastructure and provides the foundation for elastic dev-ops and production environments. You can create an environment in which specific user groups within your company can consume their own secure slices of a robust multi-tenant infrastructure, with appropriate operational visibility, auditability and control.

Nuage Networks focuses on two key areas of cloud computing to help you transform your network:

- **Abstracting compute services from the infrastructure.** Cloud computing separates the application from the physical compute infrastructure. This allows workloads to be consistently and remotely configured, and templated for mass deployment. End users don't need to worry about the location and specifications of individual hosts, or the underlying operating system. Virtualization and cloud management tools abstract those details to make the infrastructure more readily consumable.
- **Supporting customer self-fulfillment.** Cloud Management Systems (CMS) and the abstraction layer enabled by server virtualization allow your IT department to minimize the tedious and cumbersome processing of application-to-network transactions. For example, IT can provision end customer access policies in the CMS to govern who is authorized to create compute instances, where they can put them, how much they are allowed to consume, and how much to charge the appropriate department. Users and work groups get instant application deployment, which in turn makes the business more agile and responsive — critical attributes in today's business environment. At the same time, all of the operational expenses associated with the handling of work orders and transactions between organizations are eliminated.

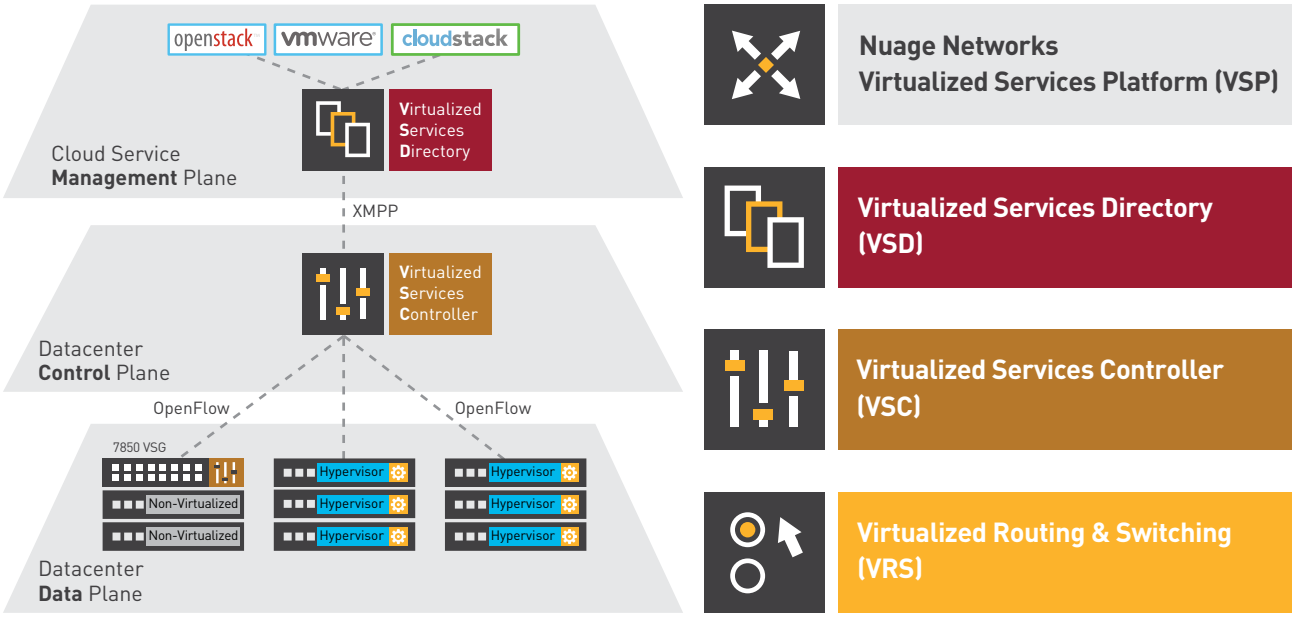


# NUAGE NETWORKS VIRTUALIZED SERVICES PLATFORM

Nuage Networks Virtualized Services Platform (VSP) is the first network virtualization platform to address modern datacenter requirements for multi-tenancy, full-featured routing and security at scale, as well as seamless integration with wide area business VPN services. It is a software solution that transforms the physical network into a simple to manage, rack-once and wire-once, vendor-independent IP backplane. As a result, network resources within and across datacenters can be treated as an elastic resource pool of capacity that can be consumed and repurposed on demand.

Nuage Networks delivers virtualization and automation of the network through the three key elements in the Nuage Networks VSP.

**FIGURE 2. Nuage Networks Virtualized Services Platform**



**Virtualized Services Directory.** Configuration of networks is complex. To eliminate unnecessary complexity while leaving full control and visibility of applications with the IT administrator, the Virtualized Services Directory (VSD) abstracts networking constructs down to basic network building blocks in four categories: Connectivity Domains, Security, Quality of Service, and Analytics. This allows the requirements for network services to be expressed simply, consistently, and in a repeatable manner.

**Virtualized Services Controller.** The Virtualized Services Controller (VSC) is an advanced Software-Defined Networking (SDN) controller that manages the provisioning of virtual network services by programming the edges of the network using OpenFlow™. The VSC ensures that the network follows the application instantaneously. Parting with cumbersome and error-prone device-by-device manual provisioning, Nuage Networks introduces an event-triggered and pull-based configuration model. Once application events such as moves, adds or changes are detected, appropriate policy-based configurations are instantaneously applied.

The VSC runs a full and robust IP routing stack that allows it to communicate and seamlessly integrate into existing networks and to connect with wide area private VPN or public IP networks.

**Virtual Routing and Switching.** Virtual Routing and Switching (VRS) is a true hypervisor for the network. The first of its kind in the industry, the VRS fully virtualizes the network via technologies including Layer 2 and Layer 3 forwarding and Layer 4 security. These virtual network services leverage your existing network infrastructure and are offered in a standards-based manner. You are free to use the servers, hypervisors, and cloud management systems of your choice while the Nuage Networks solution abstracts and automates your cloud-networking infrastructure.

## Bridging the virtualization gap

In many real-world installations, datacenters are a mix of virtualized and non-virtualized assets. To help all datacenters benefit from automation and network virtualization, a new breed of gateway is needed.

The **Nuage Networks 7850 Virtualized Services Gateway (VSG)** extends SDN 2.0 functionality seamlessly between virtualized and non-virtualized assets in the datacenter. It is a high-performance gateway, providing highly scalable (up to a terabit of capacity in a single rack unit), multi-tenant gateway functionality at Layers 2 to 4.

The 7850 VSG works alongside the Nuage Networks VSP to ensure that policies devised for applications automatically extend across virtualized and non-virtualized assets for a fully automated network infrastructure. The 7850 VSG complements the existing VRS-G software gateway from Nuage Networks and the Company's support for third-party VXLAN Tunnel Endpoint (VTEP) "white box" devices from partners.

# INFORMATION SECURITY AND NETWORK CONTROL

The Nuage Networks VSP solution addresses the critical need for mobility. Network services adjust gracefully and instantly as application endpoints and workloads move from virtual machines within or across datacenters. The VSD provides a rich permission-based multi-tenant interface to enable end user provisioning by application owners. Through its role-based hierarchy of permissions, the VSD eliminates operational delays and minimizes transactions between organizations. It does this while providing visibility and control of the network "slices" that each group is assigned to support its application requirements.

Information security is a mandated requirement, so providing a traceable record of any change of application data flow is important for government regulations like Sarbanes-Oxley. The Nuage Networks VSP keeps a complete log of the changes made within the system that can be used for auditing purposes.

Key to any application deployment is the set of specialist network functions that ensure connectivity and security. These functions include network address translations, firewall-based security profiles, traffic load balancing and even distributed denial-of-service protection or intrusion detection. These network functions have historically been based on proprietary hardware platforms, which increased both the complexity and cost of the network.

The industry is moving away from these proprietary solutions with the adoption of Network Function Virtualization (NFV). Using NFV allows applications to build a set of network functions in a chain for all or parts of their traffic flows. This "service-chaining" provides the benefits of the traditional approach but at a fraction of the cost. The choice of which functions are added onto which traffic flows is completely selectable with the Nuage Networks solution.

Network analyzing of application performance has always been a costly and complex operation for the IT and network teams. Proprietary implementations on hardware switches to mirror traffic using tunnels increase costs and limit scalability. With the Nuage Networks solution, a distributed tap feature on the VRS captures performance information for central processing. This allows traffic to be directed at the source and sent directly to the VSD for either processing within the Hadoop-based analytic engine or for forwarding to an external analysis system.

# VIRTUALIZATION SERVES EVERYONE BEST

The Nuage Networks VSP separates the service and security components of network configuration from the physical network devices. This allows IT to easily create network templates that define the rules and permissions (IT and security policy) for the deployment of any given application. These templates are abstracted into network building blocks that can be expanded and move with the application. Nuage Networks eliminates boundaries associated with application deployment, expansion, moves and changes.

### Eliminate boundaries associated with application deployment, expansion, moves and changes

The Nuage Networks approach significantly improves responsiveness and can significantly shorten project timelines: what took weeks or months can be accomplished in minutes. You can get applications up faster and reduce workflow processes. Application owners will have the ability to instantly self-provision. Network engineers can create templates and policies that define a "sandbox" in which application owners can deploy and expand while remaining completely compliant with security, performance and connectivity requirements.

The increased efficiency and independence helps everyone. Customers of your IT department will be happy and your IT team will be able to refocus on more meaningful business tasks. The networking team sheds the load of processing tedious transactions, while the application team gets instant application deployment. The network team is freed from the laborious administrative tasks associated with network change control and configuration, and the application team can focus on software development and testing.

### Expanding virtualization across the network layers

The Nuage Networks VSP supports full network virtualization across Layer 2, Layer 3 or even Layer 4, providing ultimate flexibility compared with partial Layer 2 virtualization realized in early SDN systems. Full Layer 2 to Layer 4 virtualization removes inefficiencies associated with "triangular routing" or "traffic tromboning", and eliminates bottlenecks introduced by the router gateways required by first generation network virtualization solutions.

Network virtualization improves bandwidth efficiencies and reduces latency. The best network path for the application is created, rather than a path that requires forwarding intelligence from an external router or gateway. Since Nuage Networks removes the handling of service state from datacenter switches, the vendor lock is broken. Networks can simply use standard Layer 2 forwarding or standards-based Layer 3 routing that has been interoperable for decades.

Your overall network benefits from the addition of the Nuage Networks solution. The open nature of SDN allows you to choose a best of breed solution when you are upgrading equipment, rather than being forced into a proprietary vendor solution. Your procurement department is empowered to run a contestable process on all functions of the datacenter network, which can save you money.

### With Nuage Networks and SDN, you are free to choose best-of-breed solutions

**TABLE 1. Addressing VLAN-based network challenges through virtualization**

| Challenge | What's causing the issue? | How can cloud computing help? |
|---|---|---|
| Cost and time required to deploy new applications | Implementation bottlenecks are created because a new application involves many transactions between numerous specialist teams. Each step requires coordination, and overall IT project management and change control. | The network team can set up controlled, secure templates that application teams use to deploy applications themselves — without any manual transactions or unnecessary project overhead. |
| Cost and time associated with network updates when application requirements change | Current VLAN-based networks restrict application deployments to a single datacenter zone and to the size of a pre-defined subnet assigned to a VLAN. Expansion beyond these limits requires significant network reconfiguration. In real terms, this translates to significant elapsed time, expense, and the possibility of errors. | The network can expand and evolve transparently with the needs of applications, bypassing the datacenter's arbitrary boundaries. |
| Network vendor lock-in | Current VLAN-based datacenter networks use highly proprietary mechanisms to scale and provide resiliency, which in effect ties an enterprise to a single vendor. To overcome shortcomings, these same vendors then upsell proprietary configuration tools to help simplify the complex systems. | The datacenter network is standards-based, and the enterprise is free to work with whichever supplier offers the best solution for the business. |

# THE CLOUD ERA IS HERE

Over the past five years, server virtualization has triggered a revolutionary shift in computing. The ability to turn up applications and move workloads instantaneously has made compute and storage infrastructure readily consumable on demand. Applications can now control the compute infrastructure through open APIs that abstract and expose capabilities, spurring innovative application deployment models.

In the midst of enterprises making a rapid shift to compute-driven cloud consumption models, the networks that form the connectivity between users and their business applications must evolve. An efficient move to the cloud has implications on the network that spans not only the datacenter, but the wide area network as well.

The gap between applications and the networks that serve them must be bridged. The capabilities of networks need to be effectively abstracted and presented to IT and owners of applications in order to ensure that requirements are met efficiently. Furthermore, consumption models for bandwidth need to be better aligned with those of the virtualized computing infrastructure. To date, these consumption models have been misaligned.

Your network must evolve to be more dynamic and responsive to the needs of your users and their applications. In a world where applications can be spun up on virtual machines in seconds, you must be able to establish network connectivity in an equally transparent and expedient manner. And in a compute workload driven world, the consumption model for network resources must match that of your user groups and their applications. Nuage Networks will help you deliver exactly that.

"Even though application workloads are increasingly virtualized, non-virtualized workloads will be with us for a long time. Recognizing the need to support both bare-metal workloads and virtualized workloads, Nuage Networks' approach to network virtualization includes software gateways and white-box gateways as well as high-performance gateways, enabling customers to expand their virtualized workloads while incorporating their non-virtualized assets as they advance toward the full business value that can be derived from the hybrid cloud."

**Brad Casemore, Research Director of Datacenter Networks, IDC**

Visit us on the web

**Learn more about the Nuage Networks Virtualized Services Platform at www.nuagenetworks.net**

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