



EXECUTIVE SUMMARY

The principles of cloud computing are transforming the delivery of information services globally. Every application and industry sector is embracing the model in its own way, and uptake of cloud-based solutions is projected to continue and expand in coming years. Cloud models have also gained the attention of the networking community, with enterprises, service providers and product suppliers globally investing heavily in solutions that leverage the virtualized and automated designs of the cloud. Innovations in SDN and NFV are leading those transformations.

In the past year, one domain that has emerged as especially ripe for transformation is networking for enterprise branch and distributed sites. Solutions using cloud design principles are being developed that promise an order of magnitude improvement in TCO and RoI in branch network services for enterprises and for providers delivering network and IT services to enterprises.

But not every solution providing virtual implementations is capable of bringing the full advantages of the cloud to branch and distributed site networks. They fall short of leveraging the cloud on one or more dimensions. By contrast, Nuage Networks has taken an innovative and visionary approach to enabling branch and wide area network deployments with its Virtualized Network Services (VNS) solution. Fully grounded in the virtual network and automation principles employed in its VSP solution for cloud data center deployments, VNS enables the pervasive agility and innovation that enterprises and service providers expect to obtain from their cloud-based applications and services, and enables them in the branch.

Report Highlights

- Virtual networking innovations are enabling an entirely new approach to designing enterprise network services
- Virtualized services regularly enable 60-80+ % TCO improvements over PMO
- RoI of virtualized solutions is consistently 100+ % better than PMO
- The open architecture of VNS allows for a flexible mix of applications, services and infrastructures to every enterprise deployment
- VNS extends an enterprise's reach to global scale with 'deploy anywhere' agility
- VNS' visionary open policy architecture enables a 'one cloud' experience across branch, WAN and data center sites, with secure access to applications everywhere

The Power of the Cloud

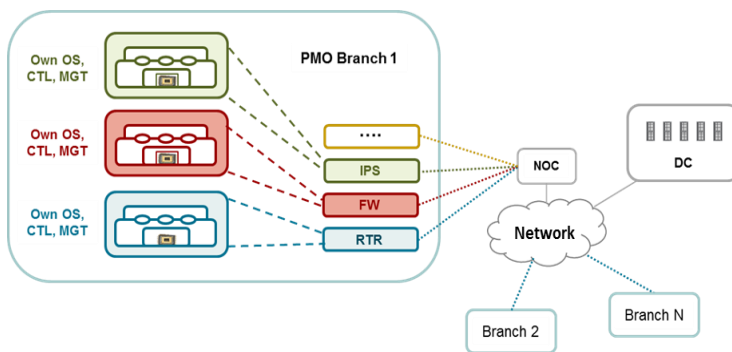
The principles of cloud-based and highly virtualized infrastructures have ushered in a massive transformation in the way information services are delivered and used. Analyses show that over 50% of the world’s application workloads are running in a cloud-based environment of one type or another today (private, hybrid or public), and in five years’ time that number is projected to exceed 75%.¹ The advantages of the cloud model have been demonstrated in many industry sectors and application categories. Use cases will only continue to expand with further maturation of cloud service delivery platforms and the addition of a practically uncountable number of endpoints supported in the internet of things. The positives of the cloud’s highly elastic architectures have been dramatically demonstrated in the data center domain. There is no turning back.

Adoption of Cloud Principles in Virtual Network Infrastructures

The advantages of the virtual infrastructure model have also generated strong interest in the networking community and are stimulating a variety of innovations that embrace it. Two areas of development are receiving the greatest amount of investment. The first is adding versatility to networks via programmable, or software-defined networking (SDN) methods. The second is transitioning a range of value-adding services such as firewall protections and deep packet inspection to a cloud-based model under the umbrella of Network Functions Virtualization (NFV). Via SDN and NFV, enterprise IT and service provider networks extending their reliance on virtualized infrastructure designs, again with no turning back.

Emerging Opportunity in Enterprise Branch and Wide Area Networks

One important area of enterprise networks that has been slow to change over the past five to ten years, and which is emerging as a candidate for improvements based on the cloud and virtual designs, is networking in enterprise branch offices and distributed sites. Like the data center infrastructures that gave rise to the cloud originally, branch office and distributed sites are ripe for the efficiency, flexibility and elasticity the cloud model supports.



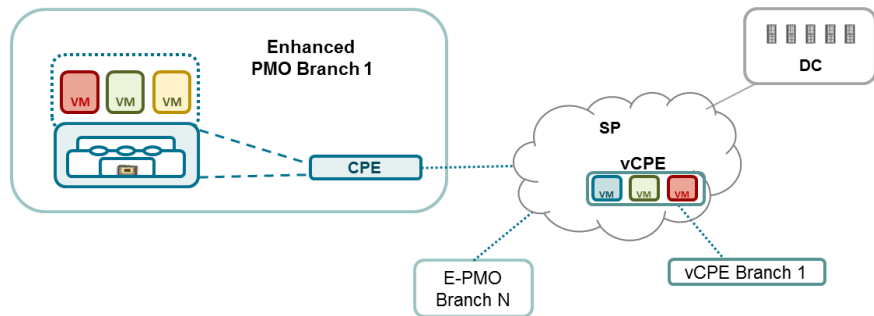
In their present mode of operation (PMO) enterprise branch networks are comprised of one or more purpose-built, closed, relatively costly devices that support their basic operating needs (VPN access, Internet access, additional network or application services). Deployments in the PMO are generally performed on a ‘box per function’

¹ Aggregation of ACG and additional industry research.

model. Each ‘box’ (router, firewall, WLAN controller, etc.) is self-contained, run on proprietary hardware and software, and requires its own management system and technique (command line interface, scripting, element management system, etc.). Over time network managers have found the PMO to be cumbersome, slow and expensive to evolve, and incapable of adapting rapidly to the demands of users and the business for new applications, devices, communication patterns, and efficiency in support. Like the data centers that incubated the cloud model before them, branches are ripe for a new design. Evidence to date shows there is ample upside to motivate it. Research we and others have done on a number of cases shows the total cost of ownership (TCO) of a virtualized branch to range from 50 to 80% lower than the TCO of comparable PMO, and the RoI of virtualized offerings to be an order of magnitude better than PMO (regularly 100% better or more).²

Profile of a New Operating Model

Several approaches to implementing a virtual branch have emerged in recent industry work. In the ETSI NFV Industry Specifications Group, for example, virtual enterprise CPE deployments have been identified as among the more attractive near term use cases to address. Most approaches developed to date employ software-based functions running in virtual machines allocated to the branch in one way or another. Variations on the model include VMs running as strictly local embellishments to an otherwise purpose-built networking device installed at the enterprise site (representing a modest enhancement to PMO), and branch services running in a service provider’s infrastructure in a pool of VMs located there.



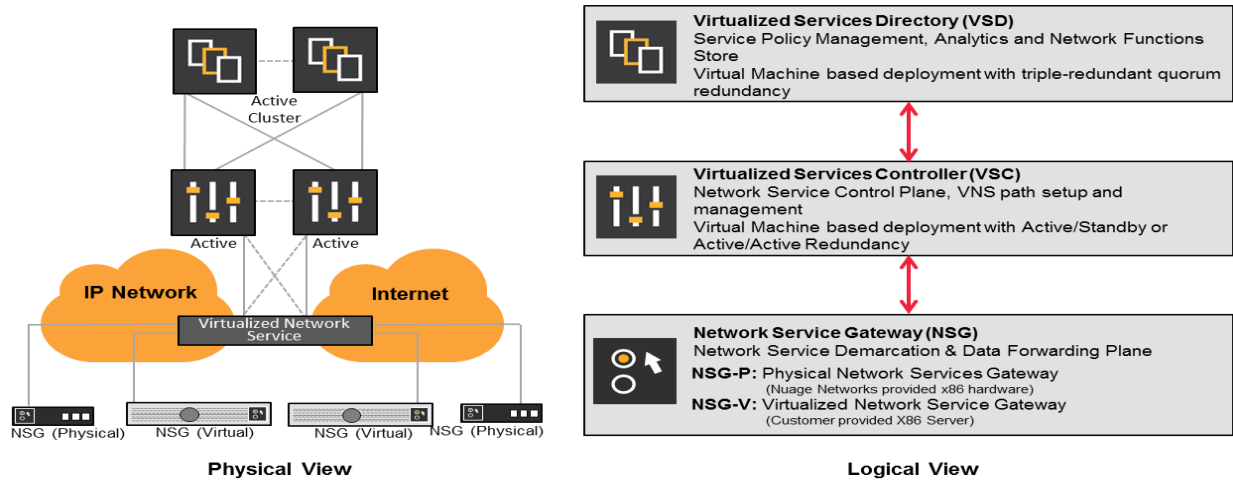
While each of these improves to some extent on the PMO of closed and cumbersome deployments, they fall short of the capturing the full benefits of a cloud-based solution that provides even more flexibility, and is fully integrated with the broader cloud IT environment. In our opinion, Nuage Networks’ Virtualized Network Services (VNS) is an early-to-market, leading example of such a cloud-enabled solution.

Let’s look at the elements of the solution and determine why this is the case.

VNS employs the principles of the cloud running on general purpose X86 hardware of varying sizes, allowing installation in small, medium and large enterprise sites as well as in VM pools in an operator’s cloud, if preferred.

² ACG Research, ‘Business Case for Virtual Managed Services’, October, 2014.

Additionally, VNS software is open on a number of dimensions that matter significantly from a future-proofing point of view. Its virtual routing and switching functionality – the functions that provide networking services to each workload expecting to run in the network – is agnostic to the hypervisor employed. This means companies can run VNS in KVM, Xen, or ESXi environments. In addition to VMs, VNS can also run in Linux containers and bare metal servers if desired. This range of platforms provides valuable flexibility in deployment.

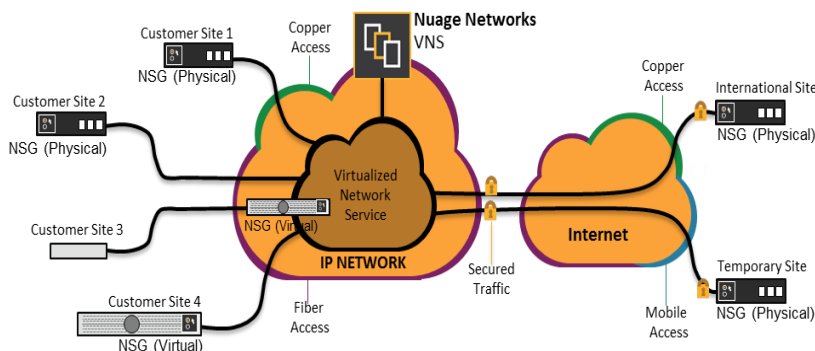


Virtualized Network Services (VNS) Solution Architecture

VNS is also open northbound, allowing policies for applications and services to be imported and applied from OpenStack, CloudStack, and VMware vCloud Suite orchestration systems. Support for this range of orchestrators allows VNS to be used in an array of enterprise environments, and also in different units of a larger enterprise that may employ different cloud orchestration systems.

Pervasive Agility: Realizing the Full Promise of the Cloud

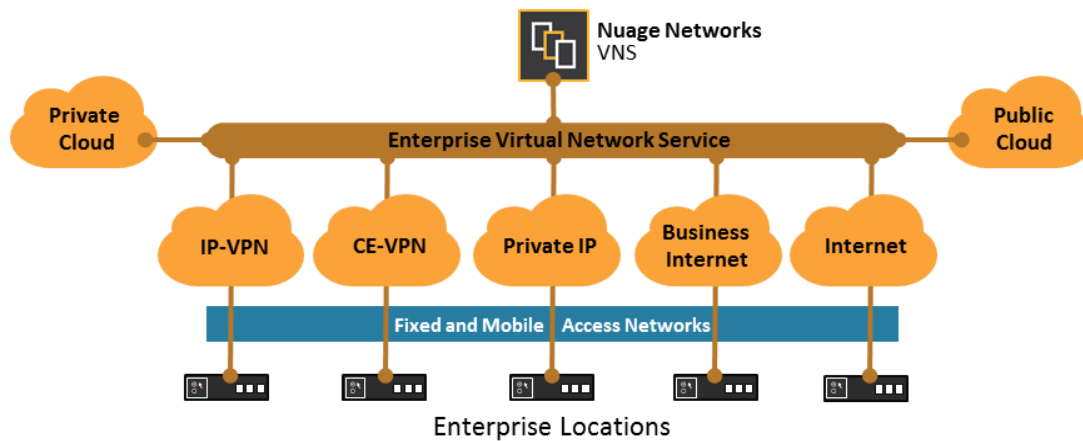
While these capabilities are attractive enough, there are additional elements of the VNS implementation that more fully distinguish it from other solutions.



First is its ability to ‘deploy anywhere’. This is based on a VNS ‘site’ being a collection of virtual functions that can be deployed in VMs anywhere and securely integrated with the other VNS nodes over IP Sec (or other encapsulations and links). ‘Anywhere’ in this case can be

taken literally: it can be in an enterprise location in a remote region in a different network operator’s area, or in a distant SP’s ‘as a service’ virtual infrastructure on an entirely different continent. VNS extends the reach of IT services significantly on a common, scalable and flexible foundation.

Second is that VNS enables policy continuity across domains. While simple in concept this is not as simple in reality to achieve. It is especially valuable in a distributed, cloud-based service. The benefit of this is that policies that apply to a given user (access rights, for example), or to an application (resource allocations, for example) can be defined and managed in a unified manner between data center and wide area or branch resources - for all intents and purposes, on an end-to-end basis. In some environments an implementation approximating these outcomes can be stitched together from separately cooperating solutions. However in such cases, separately provisioned resources must be brought together ‘in the middle’ via person-to-person coordination, as with a baton handoff in a relay race. With VNS, if a Nuage solution such as VSP is running in the data center, and VNS is running in the branch and WAN, alignment of policies can be automatically achieved, since policies are managed from a single logical policy store (VSD) supporting network operation in each domain.



Finally VNS is able to deploy services at scale, especially valuable for large enterprises who may have multiple operating units and varying private, hybrid, and public cloud implementations. This is enabled by federating the solution’s Virtual Services Controllers (VSC, VNS’ abstracted control plane component). Because VSC employs MP-BGP based on Alcatel-Lucent’s widely deployed SR-OS routing software, a VNS deployment can function as a federated network with scaling beyond the limits of many other SDN solutions.

Deployment Models and Use Cases

With its flexible and scalable architecture, VNS enables a number of deployment models and use cases. Where it makes sense, a VNS gateway can be deployed on general purpose X86 servers at branch and remote site premises. The number of services deployed (FW, NAT, secure-VPN, etc.) is a menu and auto-provisioning choice for each site’s needs. Whether it is a small branch or a larger operating site, capacity can be allocated from VM pools on the appropriate number of servers. VNS gateways can be

deployed with IPSec over a variety of network transports, and can also be deployed natively over carrier Ethernet or MPLS VPNs where an enterprise has procured those transports. And where the enterprise is widely distributed across countries or continents, gateways can be deployed in secure VMs in remote operator sites (for example, where a global company has Latin American sites supported in a local operator's infrastructure, and the company's headquarters DC is located in Canada). All of these models employ the same scalable, synchronized, and unified policy and control solution using VSC and the centralized policy control point of the Virtualized Services Directory (VSD) in a single enterprise service.

Benefits for the Enterprise

Because of its use of cloud design principles, VNS is positioned to bring significant benefits to enterprises of many sizes and in many industry sectors. VNS significantly improves the TCO of network and IT services to branch and remote enterprise sites. This is based on its use of cloud and open system principles throughout its implementation. By leveraging general purpose hardware, open OS and hypervisor agnostic designs, support of virtualized network functions, and flexible integration with orchestration systems, VNS streamlines operations that have been encumbered by closed and slow to evolve platforms in the past. In addition, because of the diversity of networks into which VNS can be deployed, it opens up applications to users that have not been as easily reached in the past – improving productivity for employees and quality of service to customers. And finally, because it is using the same automation and management software as Nuage VSP for data center infrastructures, VNS enables seamless and scalable access for branch office users to resources in private, hybrid and public cloud environments the enterprise has decided to deploy. This makes the entire IT and network infrastructure the enterprise is deploying cloud-ready, accelerating the time to results IT groups can achieve.

Conclusion

By taking the innovative step of applying the design principles of the cloud, where Nuage Networks has already demonstrated its strengths, to the needs of branch and remote site networks, Nuage has created a compelling solution poised to unlock important benefits for enterprise users and the IT groups that support them. With architectural consistency across both branch and cloud, 'deploy anywhere' reach, efficient use of open and general purpose infrastructures, and broad integration into service orchestration systems, VNS is poised to bring unparalleled agility and responsiveness into enterprise network services.