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White Paper

Network Virtualization:
The New Building Blocks of Network Design

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Abstract

Business and IT leaders have been demanding an IT infrastructure which is more dynamic and responsive to the quick pace of business while being less costly. By dynamic they mean the ability to deliver new applications at the speed in which to be responsive to market dynamics while creating competitive differentiation. For many, IT expenditures as a percentage of revenue are to be managed down. To address these industry requirements IT suppliers have offered virtualization technology and services. Network virtualization represents a new IT paradigm, which challenges existing assumptions and IT deployment models. In this paper we explore network virtualization as a strategy to make corporations more agile and IT expenditure efficient. Network virtualization is presented as a new approach to network design and IT service delivery. Its main four building blocks are presented along with guiding deployment principals.

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A New IT Management Model Emerges

All IT leaders balance expense reduction with business growth initiatives as part of their annual plans. New business growth initiatives usually bring with them funded IT programs designed to seize opportunities. Expense reduction is a business reality independent of the financial condition of the concern, albeit expense reduction projects are ramped up during financially challenging times. This give and take of growth and expense reduction was born out of the fact that IT has been procured as a fixed asset, meaning that most IT leaders were forced to design IT resources for peak traffic/consumption utilization. This design requirement led IT to over design their infrastructures, which remain idle during off-peak periods. Over the past five years business and IT leaders have explored a new model for IT service delivery, which is more agile or flexible and strives to scale resources up and down based upon demand. In short, business and IT leaders have been seeking a more responsive IT infrastructure to business initiatives and one that will remove inefficiencies. This would change the current management mantra of balance expense reduction with business growth initiatives to provision services when needed. The technology to deliver this new dynamic IT infrastructure is called *virtualization*.

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Data center design has been the focus of most virtualization projects as data centers consume the bulk of IT budget spend and exhibit wide utilization swings. Virtualization delivers two main benefits: expand single IT assets available to many or to manage/pool many IT assets as a single resource. For example, a rack of blade servers can be managed as a single server. An application can be virtualized so that its image is available as a logical entity on many servers, increasing its availability. Storage area networks are virtualized in an attempt to more efficiently allocate compute storage making storage available to many servers. Certain aspects of networking have been virtualized for nearly ten years, such as Virtual Local Area Networks (VLANs) which divide broadcast domains to service many applications, thus increasing performance.

Virtualization is being extended well beyond the data center to the entire enterprise now that virtualization projects have proven their value. In particular a new generation of network virtualization technologies is available which are becoming the new building blocks of network design. Local Area Networking (LAN) -based physical networking will remain constant, that being the typical three-tier network structure of edge, distribution and core. Wide area networking (WAN)'s physical structure will too remain constant where a router interfaces to a WAN service such as frame relay, MPLS, broadband connection, private line, etc. What is becoming virtualized are network services such as network security, management, routing, switching, broadcast domains, application intelligence, et al.

With many network virtualization technologies available deployment scenarios are as varied as business needs. For example, network virtualization is delivering unique network attributes to each application to the point where each application believes it has a dedicated network to service its needs, thus increasing application performance. Another important attribute to network virtualization is auto provisioning, which is the auto configuration of network devices based upon application demand. Consider a set of telepresence sessions initiated. Network virtualization will detect the application initiation and configure VLANs, quality of service and other network attributes to support the application by scaling network assets both up and down without operator intervention. The benefits of network virtualization are many, ranging from revenue generation, expense reduction and increased customer satisfaction to name a few. For those who have deployed network virtualization the returns have been large and the experiences mostly positive. This has prompted many business and IT leaders to demand that virtualization be included in annual IT plans.

Network Virtualization Defined

This white paper provides a framework on how to think about network virtualization and its associated value to your organization. Network virtualization delivers increased application performance by dynamically maximizing network asset utilization while reducing operational requirements. There are many aspects of network virtualization such as virtualized dual backbones, virtualized networks, network service virtualization, virtual service orchestration, network I/O virtualization, network hosted storage virtualization, etc. All of these network virtualization technologies can be thought of as building blocks as network virtualization represents a new way to design corporate networks and allocate resources within them. These building blocks can be deployed one at a time or layered to add value based upon business need. In fact each building block satisfies specific business needs; this will be discussed below. Network virtualization bridges the gap between networks as a hardware-based connectivity service to a business platform delivering a wide range of IT services and corporate value. The following section details four building blocks and highlights the business value delivered to business and IT management.

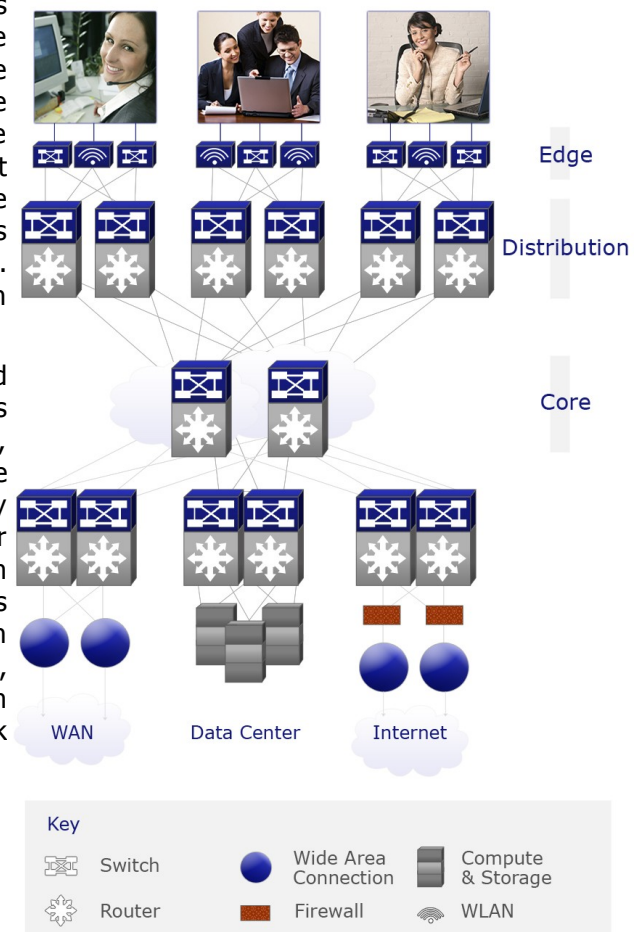### Network Virtualization Building Blocks
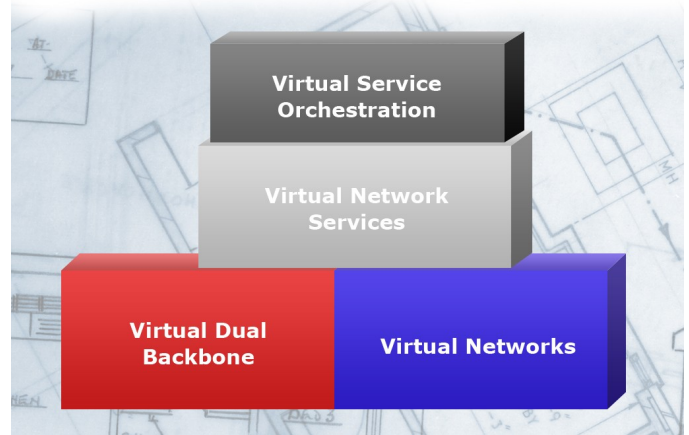
Virtualized Dual Backbone

One of the first building blocks is the virtualized dual backbone. This is a new concept, which will be deployed rapidly over the next business cycle. The virtualized dual backbone increases performance and reduces administration. A dual backbone is a completely redundant backbone network design. Building and campus networks utilize a dual backbone design to ensure that paths between end-points, data centers, plus wide area and internet connections are always available. The dual backbone design is a near total redundant backbone based upon redundancy at the edge, distribution and core tiers of a network. See Figure 1. At the network edge both wireless LANs as well as dual wired LAN connections provide alternative paths between end-points and network access. There are redundant edge, distribution and core LAN switches along with their interconnections, which eliminate a single point of failure.
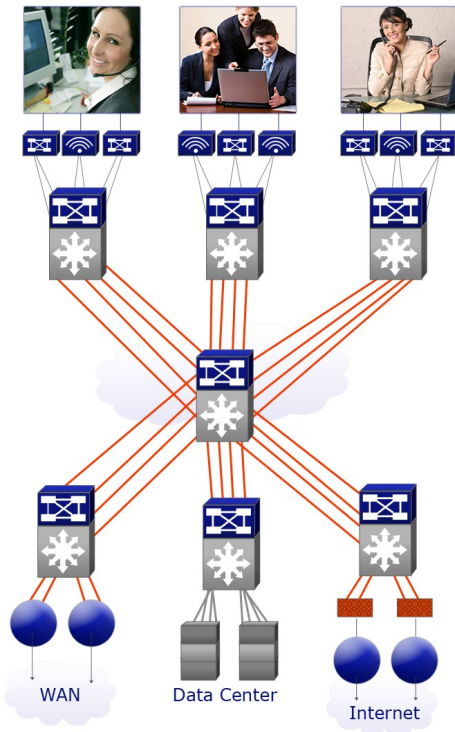
The dual backbone network is common in large corporations and provides high network availability operation. While dual backbones provide high reliability the design can be improved upon. For example, there are multiple devices and control protocols to manage and trouble shoot such as spanning tree and VRRP (Virtual Router Redundancy Protocol). To recover from a distribution switch or link failure, failover convergence times can be long measured in the second range, which can interrupt application flow and performance. Further, redundant links between switches, which use spanning tree protocol, are used only in standby mode, which underutilizes these expensive resources. Further, the fact that dual backbones provide redundant switches is both a high availability feature and an operational chore requiring network operations to manage each switch separately.

Typical Dual Backbone Network

Virtualized Dual Backbone Network

Utilize Existing L2/L3 Network Designs

Key

🔲 Switch

❄️ Router

🔵 Wide Area Connection

🟧 Firewall

▦ Compute & Storage

📶 WLAN

WAN

Data Center

Internet

Virtualizing switches and links can optimize the dual backbone network. New switch virtualization modules allow switches to be pooled and managed as one virtual system, simplifying network operations. In short, multiple switches are managed as one. Further, inter-switch links utilizing multi-chassis Etherchannel eliminates spanning tree and/or VRRP, reducing convergence time to below 200ms while preserving network state information. These two virtualization aspects eliminate application distribution in the event of a switch failure, thus increasing performance. In addition to increased network reliability and simplified network operations a virtualized dual backbone fully utilizes network capacity by activating all available bandwidth plus enabling link aggregation for server NIC (Network Interface Card) teaming across redundant datacenter switches. Figure 2 illustrates the virtual dual backbone network.

The value of the virtualized dual backbone to business and IT leaders is three fold. First, network operations are simplified during configuration and ongoing management as network devices are managed as a pooled entity; plus the number of control protocols is reduced. Second, overall network and application uptime is improved by the fact that virtualized switches are connected so that in the event one device fails there will be nearly no down time. Third, network capacity is increased as all inter-switch and server links are utilized and maximized. The best industry example of the Virtual Dual Backbone is Cisco's Virtual Switching Systems 1440 module for its Catalyst 6500 series switches. Expect others to deliver similar functionality over the next business cycle.
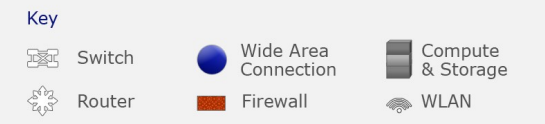
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Network Service Virtualization

Another building block is network service virtualization. While all of the building blocks can be deployed in isolation, network service virtualization is an excellent strategy to consolidate multiple appliances into one, simplifying network operations and acquisition cost. Network Service Virtualization (NSV) virtualizes a network service, for example, a firewall module or IPS software instance, by dividing the software image so that it may be accessed independently among different applications all from a common hardware base.   NSV negates the need to acquire separate devices every time the network service is required by utilizing the software instance off the same physical hardware.   Some NSV implementations such as Cisco's Application Control Engine Module can support nearly 250 separate instances of a network service software image.

NSV is the natural evolution of network service delivery and packaging. Network security provides an excellent example of this trend. To protect networks and systems from attack or to minimize their effects, adaptive threat defense technology is evolving in two complementary directions: vertically and virtualization. Network security products were first brought to market as single purpose appliances. These appliances are now bundled as a set of security functions within one appliance.   For example, firewalls were offered on special purpose hardware as were IPS (Intrusion Protection System), VPN (Virtual Private Network),

NBAD (Network-Based Anomaly Detection) and other security products. The vertical movement toward adaptive threat defense is increasingly integrating firewalls, IPS systems, VPNs (both IPSec and SSL), etc., into one appliance. This integration allows for greater software collaboration between security elements, lowers cost of acquisition and streamlines operations. For example, alarms stemming from the IPS function inspecting VPN flows could cause the firewall software to take action and change its rules to block this VPN flow.   In addition to network security software collaboration, virtualizing network security software extends its reach and an IT organization's defenses.

The value of NSV to business and IT leaders is three fold. First, management interfaces are more flexible as network operations has the option to manage many network service instances as one or each instance may have its own and separate management interface. The latter is useful as network operations processes, procedures and management interface familiarity remain the same even though the network service has been virtualized. Second, acquisition cost is reduced as network services delivery is removed from a physical device to a software image extending its access without the need to deploy specialized hardware for every instance the network service is required. Third, alluded to in one and two above, a network service can be extended more easily and effectively as a virtualized entity, thus increasing application performance.

Virtualized Networks

The Virtualized Networks (VN) building block partitions a network into multiple isolated logical networks with unique attributes such as routing, switching, independent polices, quality of service, bandwidth, security, etc. VN is a one-to-many class of virtualization, by dividing a common network into many different logical partitions. These logical network partitions are as varied as the businesses they support.   For example, users may be segmented into corporate employees, contractors/consultants and/or guests. These classes of users are associated further into logical partitions which may be segmented into departments, partners, suppliers, a new merged corporate entity, a department segregated from an organization due to regulatory compliance requirements or even based upon specific applications. VN builds upon network switching and routing features and delivers attributes not attainable previously with the same hardware devices. In short, VN provides secure logical isolation for users, applications and/or departments on an end-to-end basis throughout a corporate network. VN's logical isolation of networks allows business and IT leaders to protect assets, consolidate infrastructure, and adhere to regulatory requirements.

The VN Architecture

The VN architecture is made up of three major components. The first VN component is **controlling network access** and segmenting classes of users. Users are authenticated with authorization, either being allowed or denied into a logical partition.   Users are segmented into employees, contractors/consultants and/or guests with respective access to IT assets. In short, this component identifies users, which are authorized to access the network, then places them into the appropriate logical partition.   The second architectural component is **isolating paths** within the network, which preserves network isolation across the entire enterprise from edge-to-campus-to-WAN-to-back again.   This component maintains traffic partitioned over a routed infrastructure as well as transports traffic over and between isolated partitions. The

Virtual Networks

Merged New Company

Segregated Department
for Regulatory Compliance

Guest

Contractors/Consultants

Employees

Specific Applications

IP Telephony

function of mapping isolated paths to virtual LANs and to virtual services is also performed in component two. The third and last component is called **virtual services** which provides access to shared or dedicated network services such as DHCP, DNS, IP telephony call management, etc., plus applying policy per partition and isolating application environments, if required.

There are multiple business applications for VN, which cross the economy. By consolidating multiple WAN networks into one VN, retail concerns are able to not only significantly reduce their WAN charges but in fact turn them into profit centers. In addition to this change of fortune, retailers are able to experiment with new services and add those most promising quickly, measured in days versus many months.

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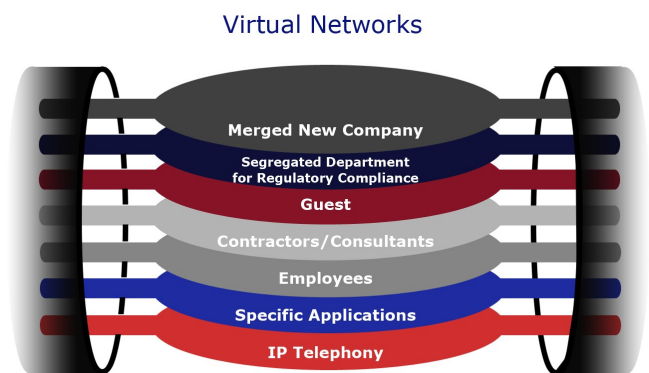
Retail Goes Virtual

A large retail concern has deployed a VN with great success. This company operates membership warehouses that offer a selection of nationally branded and private-label products in a range of merchandise categories in self-service warehouse facilities. The company operates approximately 500 locations across North America.

This firm was looking to increase their customer's store experience by offering new in-store services through partners. Before VN the barrier of entry for adding new services was too high, requiring separate WAN connections or opening up security concerns with partners connecting into their network. According to their IT department, with logical partitioning thanks to VN, they were able to lower the barrier of entry for new in-store services to the point where testing, selecting and deploying new services was easy. With a VN the concern was able to experiment with a host of businesses to measure which ones added value to customers and its revenue. During this experimentation stage, the company found five to six new in-store services and used them to justify an overall VN roll-out to their stores. The VN investment allowed it to create an incubator to experiment with new services and business models and then rapidly deploy those which held promise. In-store network-based services were isolated into separate partitions alleviating security and cross-application performance concerns.

Without VN some in-store services would simply not have been possible to deploy. For example, their photo business processes as many as 10,000 prints per day in select stores. The bandwidth load on a private frame relay or ATM network between the store, its headquarters and the partner site would be too large and unable to justify economically. An internet-based VN proved economically viable and secure, allowing them to isolate paths and scale bandwidth up and down based upon demand. In addition to photo processing, the concern added a mobile phone service, a travel agency, in California there is California's Cigarette and Tobacco Products Tax programs which require a dedicated network to support, in Canada the Canadian Pharmacy License requires a separate network to process prescriptions, an in-store kiosk, computer returns, customer returns, concierge service and many more.

The firm's VN economics are by any measure outstanding. The company spent $8 million to deploy their VN and realized $50 million in revenue from sales of its photo processing service alone. Note that the $8 million spend was depreciated over a number of years while revenues are annual which account for an impressive return on investment. As for the other services, the travel and mobile phone services generates some $2.3 million and $200 thousand annually respectively. The kiosk generates between $20-$24 million annually. The California cigarette tax and Canadian Health services are cost avoidance, saving the firm some $1.7 million per year. The total annual revenue generated by the $8 million VN capital expenditure is approximately $75 million, the return on investment was 1.3 months.

In addition to the economic benefits gained by VN, the firm has increased membership returns and memberships due to the increase in services available at its stores. The company can evaluate new applications such as video, music and software services as they have the VN infrastructure to experiment and rapidly deploy.

Nearly all retail concerns can find benefit with VN. Retail banking is embracing VN too as it consolidates many networks into one logically partitioned VN reducing operational expenses. In addition, retail banking is required through regulation to separate new services from existing. Before VN a retail bank would have to deploy two networks, one that ran production applications and one that ran test services. With VN one network can now support both test and production branch applications reducing total cost of ownership and providing a competitive advantage through rapid new service delivery.

Higher education has embraced VN too as a means to segment a common network infrastructure into logical partitions for each department, school and user group (students, facility, administrators, guest, etc.) Rather than dedicate departure and arrival gates to airlines, airports are choosing to deploy virtual gates, which increase the efficiency of their prime resource and increase profitability. For example, the Munich airport has deployed a VN and turned their departure gates into virtual gates. Munich's virtual gates are equipped with a large flat panel screen overhead and a VN connection at the gate desk. Once an airline representative plugs into the VN their airline logo, flight number, destination city, boarding and departure time are displayed for that gate. After the flight has departed another airline representative will plug into the VN and all of their flight information is now displayed on the gate screen as well as throughout the airport on flight monitoring displays. In this case, the user authentication process triggers a series of events, which change the gate information for the appropriate airline, increasing gate utilization.

The value of VN to business and IT leaders is at least four fold. First, VN enables new profitable business models as the retail concern and Munich Airport examples highlight. There is enough evidence to justify that business and IT executives conduct a due diligence exercise to explore how VN can benefit their operations. Second, security is increased through path isolation and user segmentation. Third, total cost of ownership is reduced through network consolidation, especially in wide area networking environments. Fourth, by isolating specific applications and users VN is a regulatory compliance enabler.

Virtual Service Orchestration

As services become virtual with the goal of businesses to scale IT capacity both up and down to meet demand, orchestration of resource provisioning becomes central to this goal. The above three building blocks address network infrastructure virtualization, which improve network behavior and cost to existing applications. Virtual Service Orchestration (VSO) redefines IT service delivery by virtualizing the relationship between computing, storage and networking.

VSO provides an abstraction between the physical infrastructure and the applications running on that infrastructure. VSO will ultimately allow much greater flexibility in the choice, management, and provisioning of resources to better support changing business applications. One of the requirements for end-to-end service orchestration is the creation of virtual service elements. Each service element is an abstraction of the physical element that has the entire relevant configuration for a particular application service. The benefits of this approach are that physical resources can be pooled and used on an as-needed basis. Physical infrastructure need no longer be over-provisioned to meet peak demand or 1:1 High Availability requirements. The same physical resources can be used across all application services, thereby reducing capital expenditures.

For example, when a physical server fails, VSO is able to detect it and pick another server from a spare server pool and replace the failed server. The storage and network configurations that are required to bring in the new server are done automatically. Since some VSO implementations such as Cisco's VFrame Data Center follows a remote boot model, the OS image of the original server is applied to the new server – this way to the outside world the new server appears exactly identical to the failed server.

A New Approach to IT Service Delivery

So how will IT service delivery design and operations change with VSO? Most applications start off with a set of business requirements or business architecture, which drives application architecture. Application architecture is translated into physical architecture or a blueprint meaning computing, storage, networking, etc. In the traditional method of deploying an application, a set of architects develop a design and partition that blueprint into multiple entities: the network administrator, server administrator, core administrator tasks, etc. Each group deploys their piece and builds the architecture. At the end of deployment there is an infrastructure that's running the application. What VSO does is take that infrastructure and programmatically represent it as an abstracted view of what the application means. Then VSO takes the application architecture and instantiates it on a physical network.

Typically an architect will start with an application architecture, which drives a physical and logical infrastructure such as firewalls, network devices, load balancing, operating system, data base, number of computer and amount of storage required, etc. Now enter VSO. VSO discovers the physical and virtualized devices that represent a data center as part of the application architecture. With discovery and templating features VSO can analyze the application architecture and calculate the number of servers and capacity required which will result in desired performance characteristics, etc.

Consider a web service. Most architects will transition through a design abstraction process to define a web service. VSO contains various templates for application delivery. A template is basically a logical design based upon an existing application infrastructure. For this web service, assume that the data center has a firewall, switch, load balancer, set of servers, and some storage all connected to each other. A service template is the logical definition that has a set of properties associated with it but no direct linkage to the physical infrastructure. To link to the physical architecture VSO needs to discover what is available and its associated capacity.

VSO does discovery on multiple fronts. Its leverage is the presence it has on the network for discovery. VSO discovers servers connected to the network and storage connected to fiber channel as well as IP addressing. Part of the discovery process is the building of an inventory of different devices available and their capabilities, both physical and virtual. A pool of available resources is being built during the discovery process. Once the pool of resources is understood VSO can start on the deployment task.

VSO performs a mapping of the requirements set for design in the above template area to the capabilities that were discovered in the discovery area. VSO then selects appropriate resources from the appropriate pool and configures them. In the end, VSO is dividing the initial provisioning of the different data center resources available in support of an application. So for the web service design above, VSO has a template web service from which an architect can create N number of instances off that web service. For each instance the architect creates, VSO takes the set of discovered resources available, then maps it to the physical and logical network and configures the resources so the new web services application is available.

What if servers are moved or storage is added or reduced? VSO discovery is scheduled by operations. If new storage is added, then that will be discovered during the next discovery run and be added to the pool of resources to be divided accordingly. The same process is true for servers or other assets.

If application performance becomes an issue, one of the typical ways to address this is to add more compute capacity. VSO has an understanding of the relationships among different devices as part of the application design abstraction and discovery. For example, if operations needs to add a server, VSO knows what software image needs to be associated with the server, to what VLANS the server needs to connect, if the service needs to be load balanced, etc. For the web services application VSO would know how to apply load balancing, IP addressing, and what firewall rules/ additions need to be made so that client traffic can reach the new server. A set of automated coordinated actions needs to be orchestrated in support of server addition that can occur thanks to VSO's virtualized infrastructure.

Architects now have insight into the data center's physical and logical resources plus associated capacity. Not only are architects able to perform streamlined initial provisioning, but they're able to automate the run time behavior of the application needs. Life in the data center becomes more automated with VSO thanks to its ability to virtualize IT assets.

VSO implementations are appliance-based and sit in the data center providing control and management services.   VSO is a management feeder and control point designed to improve service orchestration.   The best example of a VSO product and ecosystem is Cisco Systems VFrame Data Center.

The value of VN to business and IT leaders is at least four fold. First, VN enables new profitable business models as the retail concern and Munich Airport examples highlight. There is enough evidence to justify that business and IT executives conduct a due diligence exercise to explore how VN can benefit their operations.   Second, security is increased through path isolation and user segmentation.   Third, total cost of ownership is reduced through network consolidation, especially in wide area networking environments. Fourth, by isolating specific applications and users VN is a regulatory compliance enabler.

There are multiple value points of VSO to business and IT leaders. For example, VSO provides template driven provisioning, optimizes storage operations, automates server failover, enables a Service-oriented Architecture SOA-based application development environment, normalizes network connectivity between front- and back-end networking and more. VSO tightly links application deployment and management to networks in ways that it never was before.   VSO is the glue that binds networks, computing and storage together to support dynamic business needs by virtualizing the orchestration of IT service delivery and management. In short, VSO enabled IT resources to scale up and down based upon consumption need.

Network Virtualization Concerns

Some of the above building blocks are relatively new concepts, which create business and IT executive management concern. The concerns usually are focused on network virtualization management. For example, when multiple building blocks are deployed an enterprise may create a large virtual domain, which may be difficult to manage. Having the tools to manage change is important as virtual entities are linked, meaning that one change in the network will impact other entities, potentially triggering a series of changes. Troubleshooting is another concern. As network services are virtualized troubleshooting tools need to provide both physical and logical views and tools to help operational staff quickly identify root source of troubles and fix them.   In short visibility into a virtualized network is required. To mitigate this concern, both vendor selection and pace of deployment are effective. In vendor selection, a full review of network management tools and views will contribute to product selection. The pace of deployment is also an effect strategy with pilots, then measured deployments to both test functionality and train staff on management tools, building trust with the network virtualization vendor's products and support.

Another concern expressed by IT executives is the centralization of software images which virtualization enables being a single point of failure. This centralization is realized by the consolidation of software on fewer hardware devices to service many applications. To mitigate this concern IT executives have reviewed their high availability and disaster recovery strategies to remove single points of failure.   In short, many executives are analyzing resources to determine the correct balance of consolidation with redundancy and back up to deploy for their business.

Complexity, especially in the VSO building block concerns some executives. VSO is a complex building block that touches on all parts of IT infrastructure. For many executives there will be a measured deployment schedule to build trust before pervasive roll-out. All of the above concerns are both valid and to be expected when a new technology becomes available. Some of the same concerns and associated mitigation strategies were utilized when VLAN were first introduced into the market, some ten years ago. The concern was that broadcast domains would look like spaghetti, by creating virtual links across the enterprise. But deployment pace and management tools calmed these concerns to the point where VLANs are an important and systemic

building block of corporate networks. Network virtualization building blocks will traverse the same path.

Guiding Principals: Putting the Building Blocks to Work for Your Organization

There is a new design paradigm in corporate networking that exploits the benefits of virtualization. Network virtualization puts powerful tools in the hands of business and IT leaders to create a dynamic and agile IT infrastructure that responds and scales to business needs. The network virtualization deployment cycle will be deliberate and staged over time regulated by business requirements. The IT industry is at the beginning of a long virtualization cycle with many IT suppliers adding network virtualization building blocks over time. The four building blocks mentioned above can be independently deployed based upon business need and operational staff ability.

Network architecture is the bridge between business strategy and evolution. The best way to think about the new design rules for network virtualization is through the use of guiding principals. The following seven design principals are offered which will transform your network into a network business platform:

Principal One: Re-Think IT Service Delivery

During application development meetings and initiatives, review the service delivery process and explore how VSO and the other building blocks may be applied to the task at hand. IT executives should strive to move away from the laborious process of traditional service delivery which over designs IT infrastructure for peak traffic toward a dynamic IT infrastructure. An infrastructure which is responsive to business needs in near real time. A dynamic IT infrastructure which can bring up applications in days versus months, thanks to network virtualization.

Principal Two: Think Dynamic Auto-Provisioning

Network virtualization delivers auto-provisioning of services via templated solutions and rules, which accelerate application delivery and management. The key here is to think about how all the parts of an application, compute, storage, networking, security, load balancing, etc., can be dynamically provisioned via rules and allocated based upon demand versus the status quo of tweaking, configuring, and optimizing infrastructure.

Principal Three: Question New Appliance Deployments

During times of network service requirement needs, consider virtualized network services first before the deployment of another physical appliance. This will reduce dependence on appliances over time and its associated high total cost of ownership cost while allowing IT to implement NSV on an as needed, event basis.

Principal Four: Look to Pool Network Device Management

IT leaders should consider opportunities where pool network devices can be configured, monitored and troubleshot as one. This will reduce operational cost and workload as well as increase network availability. Principal four strives to reduce the number of physical devices to be managed by virtualizing their image for network operations.

Principal Five: Consolidate Multiple Networks Into a Common Network Separated by Logical Isolation

For scenarios where multiple wide area networks exist, principal five and VN in particular offer an attractive alternative. That alternative is the consolidation of multiple networks and their associated cost into a common network, which logically isolates the collapsed networks. It is not uncommon that in retail scenarios, revenue generation is created while network cost is reduced and service cost avoided.   Principal five recommends logical isolation versus the deployment of a new network.

Principal Six: Utilize all Network Resources

Before upgrading inter-switch links and overall network and backplane capacity consider the deployment of the virtual dual

backbone to capture unused and static network capacity while in the process providing a more flexible and reliable network.

Principal Seven: Think Network Virtualization

As many corporations are in the process of a network refresh, now is the time is consider the various network virtualization building blocks. The value of network virtualization will be realized on many fronts including financial payback accounting, but more importantly from an overall corporate value perspective by enabling an organization to be more responsive to business pressures and opportunities. For every IT project, which includes a network component, network virtualization should be included in the agenda for consideration.

Benefits are always subjective and highly dependent upon pre-existing network and IT conditions. Very few IT organizations architect their networks. Rather they choose vendors, equipment, software and services for each requirement or project with which they are confronted. The result is similar to house construction. Often consumers can choose a builder's package and save a few dollars or do it right and hire an architect to customize a solution for their needs. The architected solutions can cost more and at times take slightly longer but the pay-back is big. You can always tell an architected home. The rooms are pleasing to the eye, the space is planned out and works well, rooms flow into each other and the home sits perfectly on its land. The builder's package often comes with odd-sized rooms, a poor flow, disproportionate windows and doors and the feeling that something is just not right. Often times additional work is done and paid for to fix these anomalies or the buyer lives with dissatisfaction.

In IT an architected solution is business driven and provides an excellent experience for employees, customers, partners and suppliers. The interfaces work well, performance is within human delay tolerances, shifting between applications is painless and work just flows. The IT systems are not frustrating and fatiguing to work with, but support business process as effortlessly as possible.

The time to use the above guiding principals is every time a new project is being evaluated. The IT team should review every major design decision by applying each of the guiding principals and discussing them, one by one, to ensure that the network design supports the principals. Don't move forward until there is agreement that the architecture supports the principal. Over time the network will take on more and more network virtualization attributes, being able to evolve beyond application support to being an integrated component to application delivery creating a dynamic IT infrastructure and competitive business in the process.

As mentioned above, all IT leaders balance expense reduction with business growth initiatives as part of their annual plans. Network virtualization offers the promise to decrease the slope of IT expenditures, which would be favorable when compared to increasing revenue. Network virtualization is a new organizing principal for business and IT leaders that will have material effect on corporate operations.

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About Nick Lippis

Nicholas J. Lippis III is a world-renowned authority on advanced IP networks, communications and their benefits to business objectives. He is the publisher of the Lippis Report, a resource for network and IT business decision leaders to which over 40,000 business and IT executive leaders subscribe. Its Lippis Report podcasts have been downloaded over 30,000 times; i-Tunes reports that listeners also download the Wall Street Journal's Money Matters, Business Week's Climbing the Ladder, The Economist and The Harvard Business Review's IdeaCast. Mr. Lippis is currently working with clients to transform their converged networks into a business platform.

He has advised numerous Global 2000 firms on network architecture, design, implementation, vendor selection and budgeting, with clients including Barclays Bank, Microsoft, Kaiser Permanente, Sprint, Worldcom, Cigitel, Cisco Systems, Nortel Networks, Lucent Technologies, 3Com, Avaya, Eastman Kodak Company, Federal Deposit Insurance Corporation (FDIC), Hughes Aerospace, Liberty Mutual, Schering-Plough, Camp Dresser McKee and many others. He works exclusively with CIOs and their direct reports. Mr. Lippis possesses a unique perspective of market forces and trends occurring within the computer networking industry derived from his experience with both supply and demand side clients.