# ALCATEL-LUCENT ENTERPRISE OPTIMIZING NETWORK INFRASTRUCTURE FOR Citrix XenDesktop

APPLICATION NOTE

AT THE SPEED OF IDEAS™

Alcatel·Lucent
Enterprise

# ABSTRACT

Desktop virtualization can increase the productivity of information technology (IT) teams by transforming how they configure and deploy endpoint devices, manage desktops, and support end user applications. Alcatel-Lucent has partnered with Citrix® to deliver a new, improved, end-to-end desktop virtualization solution that will make it easier and more cost-effective for businesses to deploy high-definition virtual desktops and applications to all users across an entire enterprise. This document provides a detailed explanation of how to implement the Alcatel-Lucent Enterprise Virtual Desktop Solution in a typical enterprise network environment to deliver secure and reliable virtual desktops to end users.

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# DESKTOP VIRTUALIZATION IN TOMORROW'S ENTERPRISE

The way enterprises design, build, and deploy desktop workstations is changing rapidly. Traditionally, standard configuration images were copied to personal computers (PCs) at a central location from where all PCs were shipped to the workplace. Once received, users would tailor their PCs to suit individual preferences. But with the increase in the number mobile users on enterprise networks, more PCs are being shipped to more user locations, thereby making the deployment process more difficult to manage. This has led to processing problems, increased security risks and created user access control challenges.

Desktop virtualization can optimize the delivery of desktops, applications and data to users. It can address the new PC configuration and deployment challenges and increase the productivity of information technology (IT) teams by transforming how they configure and deploy endpoint devices, manage desktops, and support end user applications.

Traditionally a user's desktop operating system, applications, and user data were constrained to the user's local device. The loss of the desktop meant a loss of work until the device was repaired or restored. Virtualization improves how IT teams manage desktops by transforming PC images into virtual machines and consolidating end user applications in a virtual environment. The operating system, applications and data are decoupled from the underlying PC hardware and moved to a data center where they can be centrally managed and secured. As a result, rather than juggling thousands of static desktop images, IT teams can manage and update the operating system and applications once from one location, then deliver desktops and applications that are customized to meet the performance, security and mobility requirements of each individual user. This makes it easier to deploy and manage end user devices.

In addition, virtualization increases end user productivity by virtually eliminating downtime. It enables enterprise end users to work securely and productively from any device, anywhere, and at any time by making Windows desktops and traditional applications available on-demand as a service to authorized users on a variety of devices and from any location that offers secure network access.

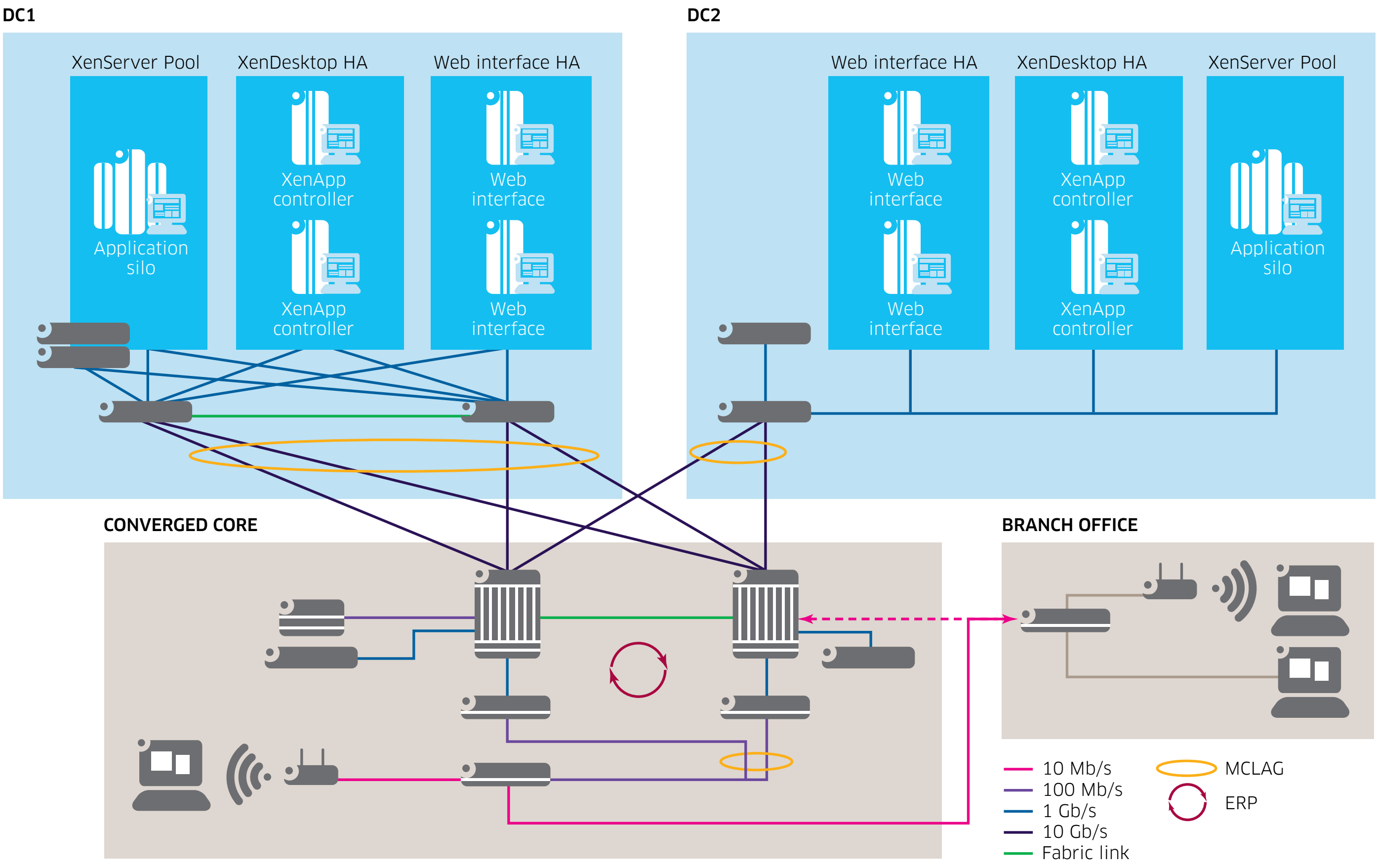
Given this potential, Gartner predicts that the worldwide hosted virtual desktop market will increase through 2013 to reach 49 million units.[1] Revenue is predicted to grow from approximately 1.5 billion United States dollars in 2009 to 65.7 billion in 2013, a number that is equal to more than 40 percent of the worldwide professional PC market.

Alcatel-Lucent is a leading provider of enterprise communications and networking solutions. Its comprehensive product and solution portfolio includes the Alcatel-Lucent OmniSwitch™ family of Local Area Network (LAN) switches, all of which run a common operating system that far exceeds the security levels required for enterprise networks. As part of its complete solution approach, Alcatel-Lucent has partnered with Citrix® to extend its offerings for enterprise network load balancing, desktop and server virtualization, Application Fluent Networks, and Wide Area Network (WAN) optimization. All offerings are engineered to work in data centers, the converged core, and in enterprise branch offices. Now Alcatel-Lucent is leading the next wave of enterprise desktop virtualization and integration.

[1] Gartner March 26, 2009 Press Release: http://www.gartner.com/it/page.jsp?id=920814

Alcatel-Lucent has collaborated with Citrix to deliver a new, improved, end-to-end desktop virtualization solution that will make it easier and more cost-effective for businesses to deploy high-definition virtual desktops and applications to all users across an entire enterprise. The new Alcatel-Lucent Enterprise Virtual Desktop Solution combines the Alcatel-Lucent approach to application fluent networks with Citrix desktop and server virtualization, and Layer 4-7 technologies. It delivers the most cost-effective, scalable and high-performance solution for hosting, securing and optimizing the delivery of virtual desktops and applications (Figure 1).

**Figure 1. Alcatel-Lucent and Citrix Systems deliver a new, improved, end-to-end desktop virtualization solution**



In addition, because efficient network storage is critical for effective desktop virtualization, the Alcatel-Lucent Enterprise Virtual Desktop Solution is enhanced by a comprehensive storage offering from NetApp®. Alcatel-Lucent has partnered with NetApp to integrate its high-performance, Unified Storage Architecture with the Alcatel-Lucent Enterprise Virtual Desktop Solution. This storage solution gives enterprises an agile and scalable storage platform for any virtual desktop environment.

In a virtual environment, the availability and performance of the shared storage infrastructure is more critical than that of the individual servers running the environment. Therefore, a high level of availability and performance is vital to meet storage requirements. NetApp offers a comprehensive set of software and hardware storage solutions that address the most stringent requirements for availability and performance of large, scalable environments. Whether an enterprise storage network is Fiber Channel (FC) or Ethernet (Network File System (NFS), Internet Small Computer System Interface (iSCSI), and Fiber Channel over Ethernet (FCoE)), these technologies combine with NetApp storage to scale the largest consolidation efforts and virtualize the most demanding applications, without sacrificing or requiring the deployment of separate hardware to meet the needs a specific environment.

This document provides a detailed explanation of how to implement the Alcatel-Lucent Enterprise Virtual Desktop Solution in a typical enterprise network environment to deliver secure and reliable virtual desktops to end users.

# ALCATEL-LUCENT ENTERPRISE VIRTUAL DESKTOP SOLUTION

Desktop virtualization in the Alcatel-Lucent Enterprise Virtual Desktop Solution is provided by the Citrix XenDesktop®. Citrix is the industry leader in desktop virtualization and has built a portfolio of products to simplify desktop virtualization deployment.  The Citrix XenDesktop virtualization solution delivers Microsoft® Windows™ desktops as an on-demand service to any user, anywhere. It uses server virtualization for deployment as opposed to a dedicated physical server. As a result, it can quickly and securely deliver individual applications or complete desktops to all enterprise end users, whether they are task workers, knowledge workers or mobile workers.

The Alcatel Lucent Application Fluent Network operates with the Citrix infrastructure to recognize Layer 4-7 traffic flows and prioritize traffic to improve the user's connections, without compromising other network connectivity.

## Citrix XenDesktop deployment

For ease of configuration and simplified deployment, Citrix offers a quick deployment model for XenDesktop. The quick deployment model is the fasted way to deploy a fully functional XenDesktop solution.

Citrix XenDesktop is hypervisor agnostic. It can operate with Citrix XenServer®, Microsoft Hyper-V™, and VMWare® vSphere™ hypervisors hosting virtual desktop infrastructures. For the enterprise application presented in this paper, Citrix XenDesktop configuration uses server virtualization with the VMWare ESX hypervisor.

The key Citrix XenDesktop server side components required for a quick deployment are:

- Citrix XenDesktop Controllers: The Citrix XenDesktop controllers maintain the required number of idle desktops to allow instant connections. They also monitor the state of online and connected virtual desktops and shut down virtual desktops as needed. The primary controller is configured as the farm master server, and it is able to focus on its role of managing the farm when an additional XenDesktop Controller exists.

- Citrix License Server: The Citrix License Server manages the licenses for all components of the XenDesktop.
- Citrix Desktop Studio: The console used to configure and manage XenDesktop deployment.
- Citrix Desktop Director: The console used by support staff to monitor a XenDesktop deployment and perform day-to-day maintenance tasks.
- A database: Each XenDesktop farm requires a database. Citrix XenDesktop uses the database to centralize configuration information for the farm in one location. The database maintains all the static information about the XenDesktop environment.

The key Citrix XenDesktop client side components required for a quick deployment are:

- Citrix client device plug-in: Installed on user devices, the Citrix client device online plug-in enables direct ICA connections from user devices to virtual desktops. The plug-in software is available for a range of different devices, so users can connect to published applications from various devices.
- Domain Controller: The domain controller includes an active directory that provides a common name space and secure method of communication between all the servers and desktops in a virtual environment. It also manages user identities, applies group policy objects and deploys software and updates.
- Virtual Desktop Agent: The Virtual Desktop Agent (VDA) is installed on virtual desktops to enable direct Independent Computing Architecture (ICA) connections between a virtual desktop and user devices with the Citrix online plug-in.
- Virtual machine: The Citrix Hypervisor enables IT teams to create and manage virtual machines. Because XenDesktop is hypervisor agnostic the Citrix Hypervisor can be replaced by either VMWare vSphere or Microsoft Hyper-V hypervisors.
- Citrix XenApp: Citrix XenApp® is an on-demand application delivery solution that enables any Windows application to be virtualized, centralized, and managed in a data center, and instantly delivered as a service to users anywhere on any device. It can be used to deliver both virtual applications and virtual desktops. However, it is typically used for virtual applications.

The additional required components are:

- Domain Name System (DNS) services: DNS services provide IP Host name resolution for the core.
- Dynamic Host Configuration Protocol (DHCP)

Enhancements to the Citrix XenDesktop quick deployment can include:

- Citrix XenServer: A host used for scalable and cost-effective hosting of desktops.
- Profile management: A profile management tool that manages user personalization settings to ensure users get a consistent experience every time they log on.

The Citrix XenDesktop high availability components for desktop delivery include:

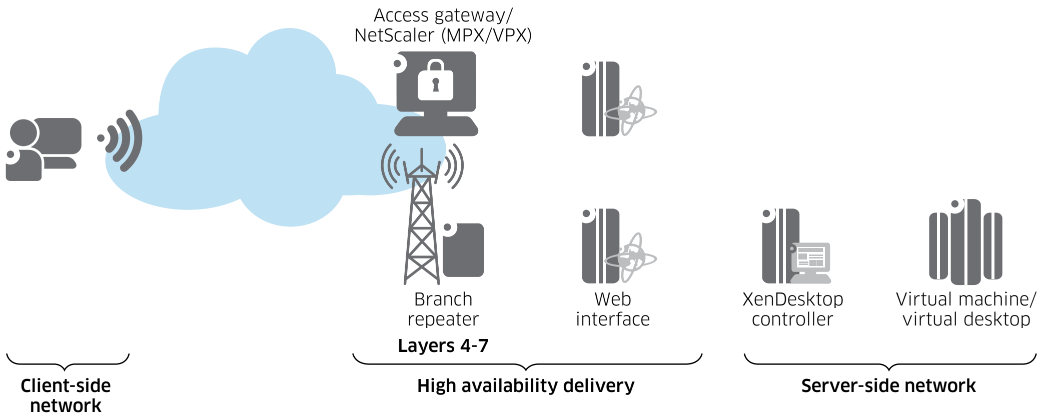
- Citrix Branch Repeater: Citrix Branch Repeater® is a WAN optimization appliance that accelerates, controls and optimizes services — desktops, applications and multimedia — for branch and mobile users. With granular visibility, enhanced prioritization and control of service traffic, it ensures excellent quality of experience (QoE) and availability while reducing bandwidth consumption and simplifying branch IT processes. It uses Citrix HDX IntelliCache and Broadcast technologies to optimize XenDesktop traffic by accelerating time-consuming tasks, such as printing, file downloads and video playback, while speeding up application launch times.
- Citrix NetScaler: Citrix NetScaler® is an advanced cloud networking platform. It enables a data center network to become an end-to-end service delivery fabric that can optimize the delivery of all web applications, cloud-based services, virtual desktops, enterprise business applications and mobile services. It also ensures that the virtual desktop solution always adheres to performance, availability and security service level agreements (SLAs) for any service, to any user, anywhere.
- NetScaler VPX. A virtual appliance delivery of Citrix NetScaler. It provides the functionality of specialized, high-end network devices that can be easily and dynamically deployed on a single server or across entire cloud datacenters. It enables XenDesktop traffic load balancing, acceleration, security, and offloads to become virtualized services that can be easily deployed on-demand in the datacenter or cloud infrastructure. This enables NetScaler to be combined with Alcatel-Lucent virtualized networking solutions to deliver an end-to-end Layer 2-7 virtual networking stack.
- Web Interface: The Citrix Web Interface provides the user interface to the XenDesktop environment. It brokers user authentication, enumerates the available desktops and, upon launch, delivers an .ica file to the Citrix Receiver on the user's local device to initiate a connection.

### Enterprise delivery service: Highly available desktop delivery

In a full XenDesktop infrastructure, the Web Interface servers are responsible for delivering applications and hosted shared desktops to users. Users make a connection to a Web Interface to access available applications and shared desktops (Figure 2).

Ensuring high availability for a Web Interface goes beyond providing an available server. If the sever hosting the Web Interface fails, the Internet Information Services (IIS) fails, or the Web Interface encounters issues, users will be unable to connect to the environment. Intelligent monitoring combined with load balancing allows users to get the fastest application delivery experience.

**Figure 2. High availability delivery with the Citrix XenDesktop**



The NetScaler platform provides intelligent monitoring of Web Interfaces, which is ideal for redundant Web Interface deployment. By launching a connection to the Citrix Web Interface, the monitor determines if the server is available, if the web service is running and if the Web Interface site is functioning and responding. If disruptions in the service are identified, NetScaler generates an alert. The alert is then used as part of the NetScaler load balancing algorithm. If a Web Interface server is not responding correctly, the server is removed from the load balancing pool until the problem is corrected and new user requests are routed only to the available Web Interface servers.

Configuring high availability for a Web Interface allows an administrator to determine the best way of balancing users across servers. For example, one Web Interface server could be the least loaded server, but may be busy with another process. NetScaler can be configured to direct new user requests to Web Interface servers that respond first instead of directing based on user connections.

### Citrix XML service

A critical component of any XenDesktop or XenApp environment is the Extensible Markup Language (XML) Service. It is the critical link between users and the XenDesktop or XenApp infrastructure.

The XML Service brokers user authentication, resource enumeration and resource launching processes. If the brokering process fails, users will not be able to start their virtual desktop. Monitoring the brokering process is not a trivial task because monitoring must go beyond simply identifying if the service is running. The process must also identify if the service is responding correctly. If the service responds incorrectly, the Web Interface server can get stuck in a request/response loop, which will result in users not gaining access to their resources.

NetScaler supports intelligent monitoring of the XML Service through the use of pre-configured monitor templates for the XenDesktop or XenApp. This monitoring determines if the XML Service is running and if the requested information from the broker is provided in a timely manner and with expected information. If the monitoring process returns an unexpected result or a complete failure to respond, NetScaler creates an alert, which is used in the load balancing algorithm. Then NetScaler dynamically adjusts the environment to bypass the failed XenDesktop or XenApp server. When the XML Service functionality is restored, NetScaler automatically detects and incorporates the XenDesktop or XenApp server into the environment.

Providing high-availability to the XML Service requires more than load balancing in the event of failure. In many organizations, a major shift change starts at 8:00 or 9:00 a.m. This results in a huge load on the XenDesktop or XenApp servers providing the XML service. Therefore, NetScaler also load balances connections across multiple XML Services to help spread the load and to provide a better and faster application initialization experience.

### Virtual desktop delivery models

The Citrix XenDesktop can be delivered to virtual desktops using different delivery models:

- Hosted VDI: Hosted VDI desktops offer secure delivery of a virtualized desktop over any network to any device. Users can personalize their desktops as they would a locally hosted desktop. This option is ideal for office workers. It can run on a virtualization layer (XenServer, Hyper-V or ESX) or on bare metal hardware.

- Hosted Shared: Hosted Shared Virtual Desktops offer a locked-down, streamlined and standardized environment with a core set of applications. This model is ideal for task workers in an environment where personalization is not required, such as a call center.
- Streamed Virtual Hard Disk (VHD): Streamed VHDs leverage the local processing power of rich clients, while providing centralized single-image management of the desktop. This option is ideal for government and university labs that use diskless PCs for maximum data security.
- Local Virtual Desktop: Local Virtual Machine desktops provide a desktop that runs entirely on the user's local device. This model extends the benefits of centralized, single-instance management to mobile workers that need to use their laptops offline. When they are able to connect to a suitable network, changes to the OS, applications and user data are automatically synchronized with the data center.
- On-Demand Apps: This model allows any Windows application to be centralized and managed in the data center, hosted either on multi-user terminal servers or virtual machines, and instantly delivered as a service to physical and virtual desktops. Optimized for each user device, network and location, On-Demand Apps can be used with Hosted VDI, Hosted Shared or Streamed VHDs.

Regardless of which model is used, the network will seamlessly support the virtual desktop.

## Network infrastructure for desktop elements

The foundation for all virtual desktop solutions is the network infrastructure. With the unique Alcatel-Lucent framework for application fluent networks, the network that forms the foundation of the Alcatel-Lucent Enterprise Virtual Desktop Solution automatically monitors and adjusts settings to establish the appropriate quality of service (QoS) parameters for all services. In this way, the network enables the environment to function at maximum efficiency to support virtual machine movement and virtual desktops at all times.

### Alcatel-Lucent Converged Network Solution

With the increasing adoption of virtual devices and mobility, it is imperative to have a robust, always-on LAN infrastructure that provides sufficient bandwidth, switching capacity, and dynamic adjustments that support unprecedented traffic patterns. A key component of the Alcatel-Lucent approach to application fluent networks is the Alcatel-Lucent Converged Network Solution. It provides a reliable, high-quality intelligent network that adjusts based on the context of the users, devices, and applications on the network.

### Alcatel-Lucent OmniSwitch 6900 Stackable LAN Switch

Another key component of the network is the Alcatel-Lucent OmniSwitch 6900 Stackable LAN Switch. This switch includes a Virtual Network Profile (vNP) feature that provides network administrators with the ability to define and apply network access control and QoS to specific types of devices by grouping them based on detailed profile criteria. With this ability, network administrators can create vNPs for tagged or untagged traffic with a unified framework of operation and administration. The vNP not only allows network administrators to create profiles for virtual machines, it also allows them to create different methods of authentication coupled with policy enforcement based on any number of rules.

The vNP feature identifies virtual machines based on their Media Access Control (MAC) address and uses a remote or local database lookup (for example, RADIUS) to determine the profile associated with the device. The feature also works when frames from a virtual machine are already tagged with a Virtual Local Area Network (VLAN) ID to associate device presence on the port. A profile name is returned upon successful authentication. Network-wide or switch-wide classification rules are used to classify. In addition, even a VLAN tag classification can be used to create VLAN port associations based on the VLAN ID contained in data traffic.

Because membership to a VLAN is based on vNP profile criteria, devices assigned to the VLAN are not tied to a specific port or switch. This flexibility allows device mobility within the network while maintaining network security. XenServer pools are connected to the ports enabled with OmniSwitch vNP. Upon activation of the vNPs, VLANs are propagated via Multiple VLAN Registration Protocol (MVRP) to the core and other locations of interest.

The Alcatel-Lucent Virtual Machine Manager (VMM), which is part of the Alcatel-Lucent OmniVista™ 2500 Network Management System (NMS), manages vNPs network wide, and listens to XenServer and VCenter events for efficient mobility handling.
With these components, the Alcatel-Lucent network for the Enterprise Virtual Desktop Solution provides a foundation for high availability, low latency, line-rate connectivity, network redundancy, security and QoS for mobile and provisioned devices. It also offers the seamless, redundant connectivity required to support data center-to-data center communications with high availability, and security.

### Alcatel-Lucent Enterprise Data Center Switching Solution

To enhance data center switching for a virtual desktop environment, the Alcatel-Lucent approach to application fluent networks can be configured with the Alcatel-Lucent Enterprise Data Center Switching Solution. This solution helps enterprises address the challenges facing today's data center networks by delivering a high-quality user experience for new real-time applications. It provides greater agility for application deployment, enables seamless integration of public cloud services, and reduces data center costs.

The Alcatel-Lucent Enterprise Data Center Switching Solution is built on a unique blueprint for application fluent data center switching. This blueprint brings together three core innovations that, together, enable an extremely scalable, high-performance and resilient data center fabric:

- The Alcatel-Lucent vNP: The Alcatel-Lucent vNP enables applications to be managed as services. It allows the network to fluently understand and dynamically control what is needed for quality application delivery, including automation of virtual machine movement. In this way, the vNP:
  - Eases the IT effort for server virtualization, letting organizations reap greater virtualization benefits
  - Understands the unique requirements of each application (application prioritization, switching provisioning, QoS, security)
  - Automatically adapts the network to optimize performance
- The Alcatel-Lucent Pod: The Pod ensures low latency and high performance by providing server-to-server connectivity through a unique direct-connect architecture, without relying on a core switch to carry traffic. With this architecture, server-to-server traffic can easily be delivered with low 2µs latency.

- The Alcatel-Lucent Mesh: The Alcatel-Lucent Mesh is created by connecting Pods to each other and to core switches, which can scale to more than 14,000 server facing ports with aggregate end-to-end latency of less than five microseconds. With this mesh network, end users across an enterprise benefit from a high performance experience thanks to a direct-connect architecture.

In addition, The Alcatel-Lucent Enterprise Data Center Switching Solution includes the Alcatel-Lucent market-leading OmniSwitch 10K Modular LAN Chassis, the OmniSwitch 6900 and the OmniSwitch 6850E to deliver:

- Low-latency, any-to-any, 10 GigE connectivity that allows enterprises to meet the growing and evolving needs of the data center
- Network virtualization, using the IEEE Multi-Chassis Link Aggregation (MC-LAG) specification and Virtual Chassis
- Applications managed as services with vNP, and with automated virtual machine mobility that is uniquely agnostic to the server virtualization platform in use.

The Alcatel-Lucent OmniSwitch 6900 supports up to 1.28 terabits per second (Tb/s) of wire-rate traffic with sub-microsecond latency for high-performance servers and network connectivity. This is a performance requirement for real-time voice, data, and video applications over converged scalable networks. The OmniSwitch 6900 also provides a comprehensive and flexible fabric architecture designed to automate and simplify the end-to-end deployment of campus, data center, cloud-based services. It is engineered to prevent host address explosion and flooding with built-in SLA service support at low capital and operating costs and based on interoperable proven standards. It extends the lossless capability beyond FCoE to any traffic type in any class of service (CoS) queue and for many queues simultaneously in the same port.

Finally, rounding out the data center portion of the solution is the network management stack, which includes:

- The Alcatel-Lucent VitalSuite™ Performance Management Software for end-to-end application performance visibility
- The OmniVista 2500 Virtual Machine Manager (VMM) for switch fabric management
- The OmniVista 2500 NMS, which unifies physical and virtual infrastructures to provide network operators with a comprehensive end-to-end network view of virtual machine inventory, and enable location tracking, event and log auditing and provisioning operations.

## Storage

### NetApp

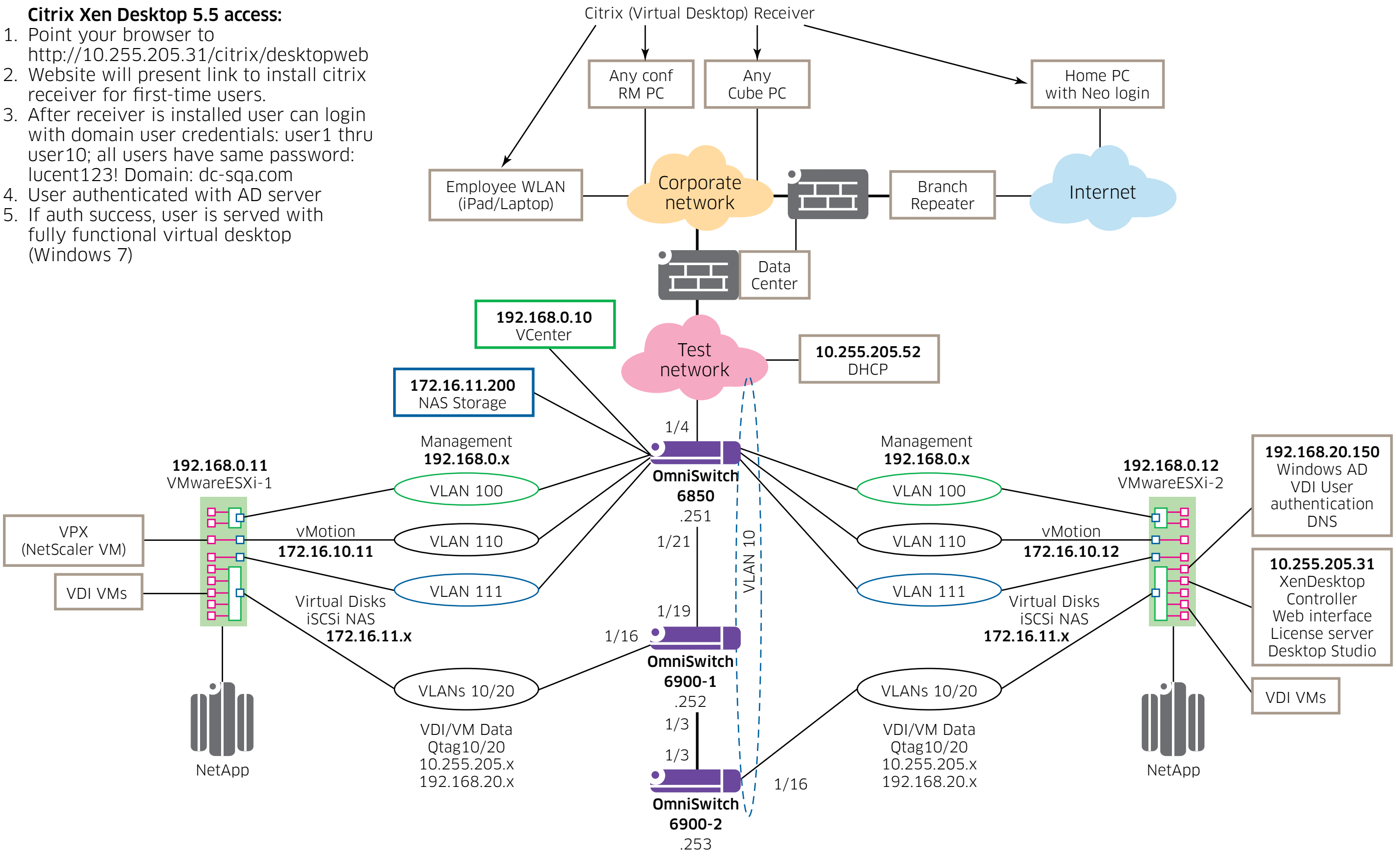
Scalable storage for the Alcatel-Lucent Enterprise Virtual Desktop Solution is provided by the NetApp unified storage architecture. The architecture provides storage efficiency and an increased level of data redundancy for the data center in highly available infrastructures. The NetApp system simultaneously supports FC or Ethernet network attached storage (NAS) protocols.

The network application outlined in this document uses NetApp Open Solution for Hadoop (NOSH), which was designed to improve its software technology to make fully distributed computing possible. Traditional enterprise platforms often rely on the benefits of shared infrastructure. However, the Hadoop Distributed File System (HDFS) improves the operation of the distributed file system by providing data protection, fault tolerance, and the ability to balance workloads. The built-in redundancy and resiliency is required for the dynamic virtual desktop environment.

# NETWORK DESIGN

Figure 3 presents the configuration of an Alcatel-Lucent application network for the Alcatel-Lucent Enterprise Data Center Switching Solution. This configuration shows a simple data center test bed with a simple campus network, which includes a quick deployment of Citrix XenDesktop with Citrix Networking technologies. The test bed was used to demonstrate a virtualized desktop environment working seamlessly on an Alcatel-Lucent networking infrastructure.

**Figure 3. Configuration of an Alcatel-Lucent network for the Alcatel-Lucent Enterprise Data Center Switching Solution**



**Citrix Xen Desktop 5.5 access:**

1. Point your browser to http://10.255.205.31/citrix/desktopweb
2. Website will present link to install citrix receiver for first-time users.
3. After receiver is installed user can login with domain user credentials: user1 thru user10; all users have same password: lucent123! Domain: dc-sqa.com
4. User authenticated with AD server
5. If auth success, user is served with fully functional virtual desktop (Windows 7)

In Figure 3, the OS6850, OS6900 -1, and OS6900 -2  are operating as top of rack with virtualized networks depicted by VLAN 100, 110, 111, 10/20 to VMWare vSphere hypervisor (ESXi). On the 192.168.0.12 server, a Citrix bundle of quick deployment XenDesktop is installed. Citrix bundles XenDesktop, Web Interface, License Server, Data Store, and Desktop Studio for simple deployments. A Quick Start Guide for XenDesktop 5 is available from Citrix (http://support.citrix.com/article/CTX127594). It contains step-by-step instructions for installing the quick deployment of the Citrix XenDesktop.

The 192.168.20.150 server is running Windows AD, VDI User Authentication, and DNS. The Virtual desktops are distributed on the other servers depicted in the diagram.

Once the XenDesktop is installed, a golden image of a virtual machine must be created. Then the administrator can copy the golden image into other virtual machine images and tailor them to user needs.

The VPX in this configuration is Citrix Netscaler. It is running in a virtual machine that provides an all-in-one web application delivery controller that makes applications run five times better, reduces web application ownership costs, optimizes the user experience, and makes sure that applications are always available. This is achieved by using:

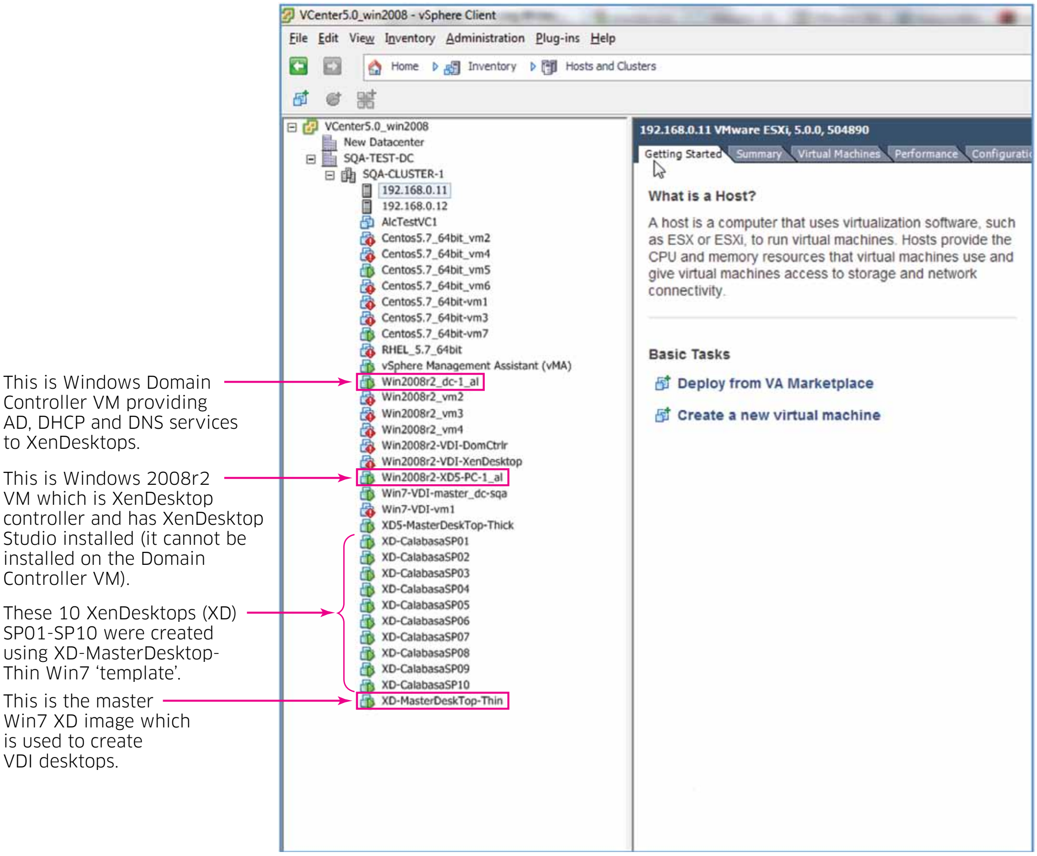
- Proven application acceleration, such as Hypertext Transfer Protocol (HTTP) compression and caching
- High application availability through an advanced L4-7 load balancer
- Application security with an integrated application firewall
- Server offloading to significantly reduce costs and consolidate servers

Active Directory (AD) and DNS services are required to resolve fully qualified domain names (FQDN) for web interface and XML communications, and authenticate user access to the resources delivered by XenDesktop or XenApp. Because AD and DNS services are critical components of an enterprise IT architecture, they are usually designed with high availability in mind. The AD has built-in availability features, such as multi-master replication and AD integrated DNS. Generally, using these features will address availability needs for AD and DNS.

## Citrix XenDesktop VDI setup with VMWare vCenter

The test bed network of this application of the Alcatel-Lucent Enterprise Virtual Desktop Solution is running VMWare vCenter for hypervisor deployment. The VDI VMs associated with the test bed are listed in Figure 4.

**Figure 4. VDI VMs associated with the Alcatel-Lucent Enterprise Virtual Desktop Solution application test bed**



```
⊟ VCenter5.0_win2008
    New Datacenter
  ⊟ SQA-TEST-DC
    ⊟ SQA-CLUSTER-1
        192.168.0.11
        192.168.0.12
        AlcTestVC1
        Centos5.7_64bit_vm2
        Centos5.7_64bit_vm4
        Centos5.7_64bit_vm5
        Centos5.7_64bit_vm6
        Centos5.7_64bit-vm1
        Centos5.7_64bit-vm3
        Centos5.7_64bit-vm7
        RHEL_5.7_64bit
        vSphere Management Assistant (vMA)
        Win2008r2_dc-1_al
        Win2008r2_vm2
        Win2008r2_vm3
        Win2008r2_vm4
        Win2008r2-VDI-DomCtrlr
        Win2008r2-VDI-XenDesktop
        Win2008r2-XD5-PC-1_al
        Win7-VDI-master_dc-sqa
        Win7-VDI-vm1
        XD5-MasterDeskTop-Thick
        XD-CalabasaSP01
        XD-CalabasaSP02
        XD-CalabasaSP03
        XD-CalabasaSP04
        XD-CalabasaSP05
        XD-CalabasaSP06
        XD-CalabasaSP07
        XD-CalabasaSP08
        XD-CalabasaSP09
        XD-CalabasaSP10
        XD-MasterDeskTop-Thin
```

**192.168.0.11 VMware ESXi, 5.0.0, 504890**

**What is a Host?**

A host is a computer that uses virtualization software, such as ESX or ESXi, to run virtual machines. Hosts provide the CPU and memory resources that virtual machines use and give virtual machines access to storage and network connectivity.

**Basic Tasks**

This is Windows Domain Controller VM providing AD, DHCP and DNS services to XenDesktops.

This is Windows 2008r2 VM which is XenDesktop controller and has XenDesktop Studio installed (it cannot be installed on the Domain Controller VM).

These 10 XenDesktops (XD) SP01-SP10 were created using XD-MasterDesktop-Thin Win7 ‘template’.

This is the master Win7 XD image which is used to create VDI desktops.

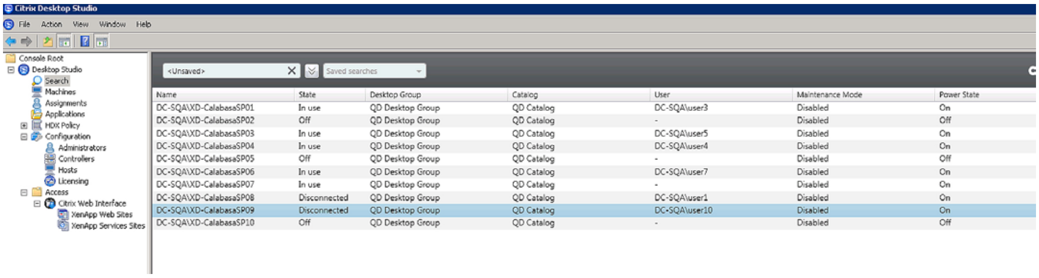
Quick deploy machines are automatically named according to the scheme “*sitename***#”. In this configuration:

- *sitename* is the name specified for deployment on the site page
- ** is two random letters
- # is a number that increases incrementally from 1 to n, where n is the number of desktops to be created.

Leading zeros are added where necessary to ensure that all machine names contain the same number of digits.

Figure 5 presents the display of VDI machines listed on Citrix Desktop screen.

**Figure 5. VDI machines listed on Citrix Desktop screen**



| Name | State | Desktop Group | Catalog | User | Maintenance Mode | Power State |
|---|---|---|---|---|---|---|
| DC-SQA\XD-CalabasaSP01 | In use | QD Desktop Group | QD Catalog | DC-SQA\user3 | Disabled | On |
| DC-SQA\XD-CalabasaSP02 | Off | QD Desktop Group | QD Catalog | - | Disabled | Off |
| DC-SQA\XD-CalabasaSP03 | In use | QD Desktop Group | QD Catalog | DC-SQA\user5 | Disabled | On |
| DC-SQA\XD-CalabasaSP04 | In use | QD Desktop Group | QD Catalog | DC-SQA\user4 | Disabled | On |
| DC-SQA\XD-CalabasaSP05 | Off | QD Desktop Group | QD Catalog | - | Disabled | Off |
| DC-SQA\XD-CalabasaSP06 | In use | QD Desktop Group | QD Catalog | DC-SQA\user7 | Disabled | On |
| DC-SQA\XD-CalabasaSP07 | In use | QD Desktop Group | QD Catalog | - | Disabled | On |
| DC-SQA\XD-CalabasaSP08 | Disconnected | QD Desktop Group | QD Catalog | DC-SQA\user1 | Disabled | On |
| DC-SQA\XD-CalabasaSP09 | Disconnected | QD Desktop Group | QD Catalog | DC-SQA\user10 | Disabled | On |
| DC-SQA\XD-CalabasaSP10 | Off | QD Desktop Group | QD Catalog | - | Disabled | Off |

## OmniVista 2500 Virtual Machine (VM) Manager Configuration

### VM Manager configuration quick steps

The first step in configuring the VM Manager is to configure vCenter network parameters to properly control VM traffic. This must begin by configuring a VLAN Tag for the machine that will enable the VM Manager to monitor the machine and manage traffic. After configuring Virtual Machines and vCenter, OmniVista VM Manager can be configured by following the quick steps outlined below. Generally, VM Manager configuration should conform to the following guidelines:

- Tag Virtual Machines
- Configure one vNP per VM VLAN
- Configure a VLAN Tag Rule for each VM VLAN (additional classification rules vNP can be configured, or the vNP can be associated with a policy list to further shape traffic)

The best way to manage VMs in a data center using VM Manager is to have the VMs communicate using tagged VLAN packets, and by provisioning the network using vNP VLAN Tag Classification rules over vNP Ports. Once all VMs are associated by VLAN tag with VM VLANs, any virtual machine movement will not require further user adjustments to network configuration. This also ensures that OmniVista will notify the user through VM VLAN Notifications when a Virtual Machine and its VM VLAN are mis-configured.

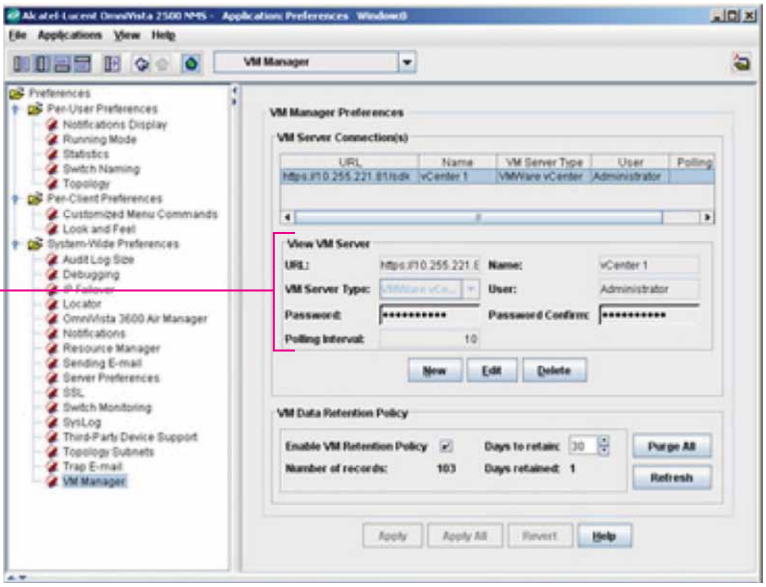
*Step 1*

Configure the VM Manager's connection to a vCenter or XenServer Master Server in the *VM Preferences* window of the OmniVista Preferences application (Figure 6). Click the New button and complete the fields as described below. Click the Apply button to write the configuration to the server. Repeat the steps to configure a second connection.

- URL: The IP address of the vCenter Host Server. Enter the IP address, followed by "/sdk" (e.g., https://10.255.11.1/sdk).
- Name: The user-configured name for the vCenter or XenServer.
- VM Server Type: Select the VM Server Type from the drop-down menu (VMware vCenter or Citrix XenServer).
- User: The administrator's User Name.
- Password: The password needed to access the vCenter or Master XenServer.
- Re-Type Password: Re-type the password needed to access the vCenter or Master XenServer.
- Polling Interval: The interval at which OmniVista will poll the vCenter. The interval set should be determined based on the number of Virtual Machines that must be managed. The more machines, the more resource-intensive the operation will be. The Polling Interval should generally be the same as the interval set for "Regular Updates" in the Setting Frequencies Window in the Discovery Application.

**Figure 6. Configure the VM Manager's connection to a vCenter or XenServer Master Server in the VM Preferences window of the OmniVista Preferences application**

**Connect to vCenter or XenServer**



VM Manager Preferences

VM Server Connection(s)

| URL | Name | VM Server Type | User | Polling |
|---|---|---|---|---|
| https://10.255.221.81/sdk | vCenter 1 | VMWare vCenter | Administrator | |

View VM Server

URL: https://10.255.221.8 Name: vCenter 1

VM Server Type: VMWare vCe... User: Administrator

Password: *********** Password Confirm: ***********

Polling Interval: 10

VM Data Retention Policy

Enable VM Retention Policy ☑ Days to retain: 30

Number of records: 103 Days retained: 1

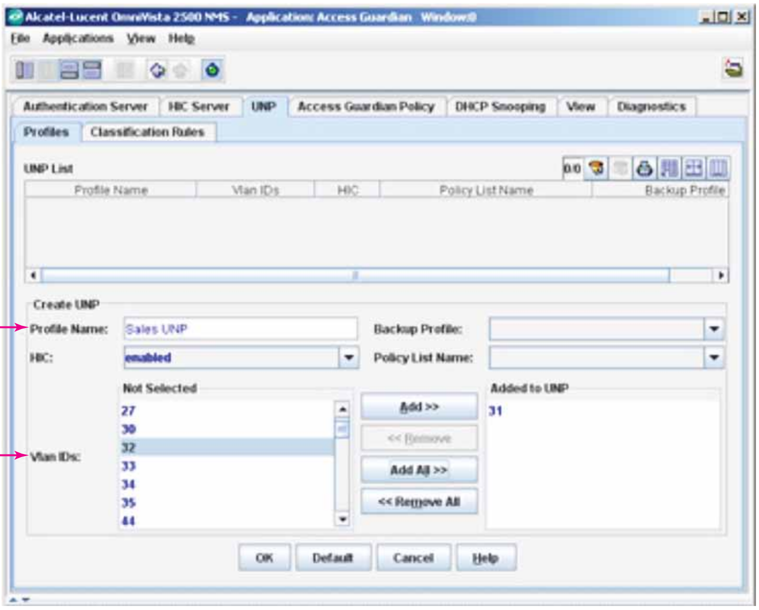
Click **New** and configure the connection. Click **Apply** to write the configuration to the server.

*Step 2*

Configure a vNP using the *vNP* tab in the OmniVista Access Guardian application (Figure 7). Click the *New* Button on the *Profiles* tab to activate the *Create vNP* window. As shown in Figure 7, when a vNP is created, it can be associated with a VLAN. Any traffic matching the rules in the vNP (such as, Classification Rules, Policy List Rules) are forwarded to that VLAN. Associate this vNP (and it's VLAN) with a VM VLAN when creating a VM VLAN in Step 5.

**Figure 7. Configure a vNP using the vNP tab in the OmniVista Access Guardian application**

Create a UNP



Profile Name: Sales UNP

HIC: enabled

Vlan IDs:

Not Selected: 27, 30, 32, 33, 34, 35, 44

Added to UNP: 31

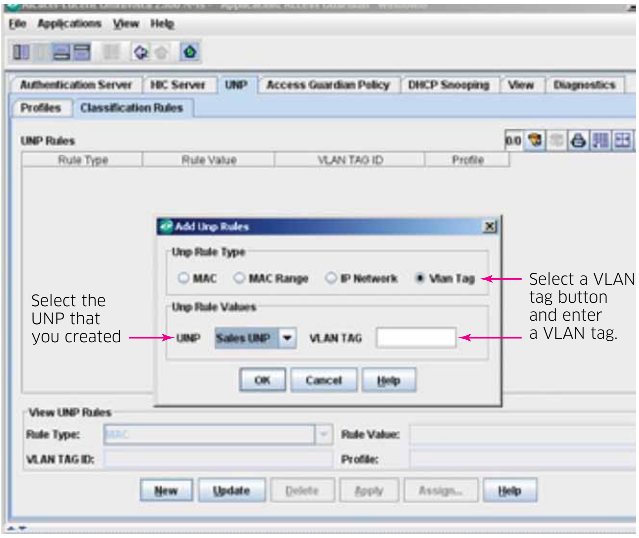
Enter a profile name

Select a VLAN for the profile

*Step 3*

Select the *Classification Rules* tab and click the New button to create a *VLAN Tag* rule for the vNP. Any traffic matching this VLAN tag will be forwarded to the vNP VLAN configured in Step 2 (Figure 8). Additional classification rules for the vNP can be created here.

**Figure 8. Create a VLAN Tag Rule for the vNP**



Unp Rule Type: ○ MAC ○ MAC Range ○ IP Network ● Vlan Tag

UNP: Sales UNP VLAN TAG:

Rule Type: MAC

Select the UNP that you created

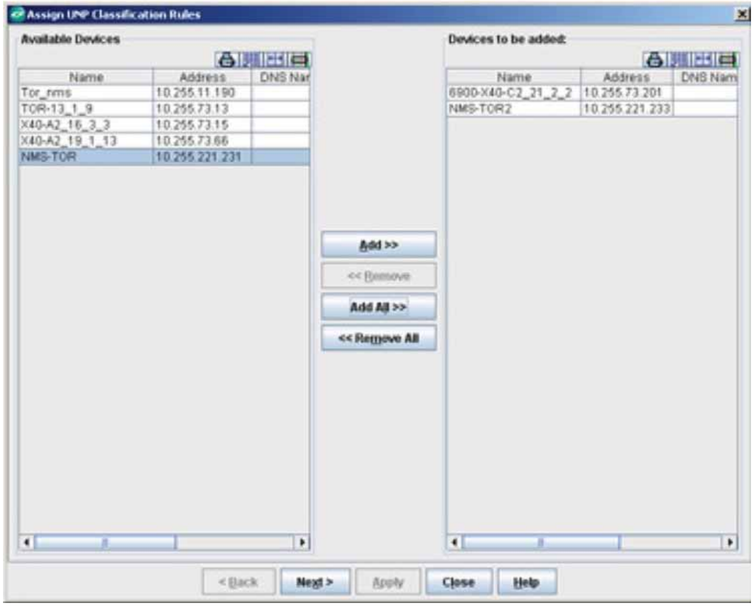
Select a VLAN tag button and enter a VLAN tag.

*Step 4*

After creating the classification rule(s), click on the *Assign* button to launch the *Assign vNP Profiles Wizard* and assign the vNP to all switches on the network (Figure 9).

**Figure 9. Assign the vNP to all switches on the network**

Assign the UNP to Switches



Available Devices

| Name | Address | DNS Nar |
|---|---|---|
| Tor_nms | 10.255.11.190 | |
| TOR-13_1_9 | 10.255.73.13 | |
| X40-A2_16_3_3 | 10.255.73.15 | |
| X40-A2_19_1_13 | 10.255.73.66 | |
| NMS-TOR | 10.255.221.231 | |

Devices to be added:

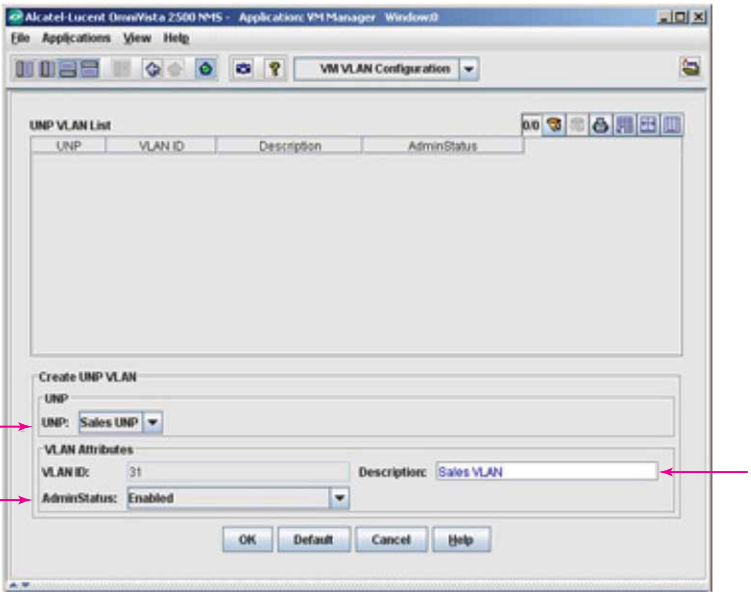
| Name | Address | DNS Nam |
|---|---|---|
| 6900-X40-C2_21_2_2 | 10.255.73.201 | |
| NMS-TOR2 | 10.255.221.233 | |

*Step 5*

Configure a VM VLAN using the *VM VLAN Configuration* window in the VM Manager application and associate the VM VLAN with the vNP created in Steps 2-4 (Figure 10). Click the *New* Button to activate the *Create vNP VLAN* pane, then select the vNP from the drop-down menu. The VLAN ID Field will automatically be completed with the vNP VLAN ID.

**Figure 10. Configure a VM VLAN using the VM VLAN Configuration window**

Create a VM VLAN


Alcatel-Lucent OmniVista 2500 NMS - Application: VM Manager Window0
File
Applications
View
Help
VM VLAN Configuration
0/0
OK
Default
Cancel
Help

UNP VLAN List

| UNP | VLAN ID | Description | AdminStatus |
|---|---|---|---|

Create UNP VLAN

UNP

UNP: Sales UNP

VLAN Attributes

VLAN ID: 31

Description: Sales VLAN

AdminStatus: Enabled

Select the UNP that you want to associate with the VM VLAN

Enable the VM VLAN

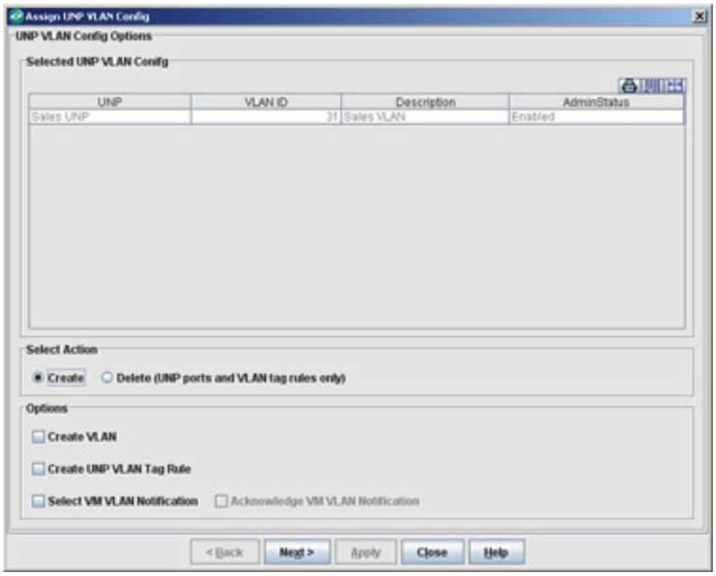
Enter a description

*Step 6*

After creating the VM VLAN, click on the *Assign* button to bring up the *Assign vNP VLAN Config Wizard*. If a VLAN Tag Rule for the vNP has not been created, select the *Create vNP VLAN Tag Rule* checkbox to automatically create a VLAN Tag Rule for the VLAN (Figure 11). Click *Next*.

**Figure 11. Create a VLAN Tag Rule for the VLAN**

**Assign the VLAN to Switches**



Assign UNP VLAN Config

UNP VLAN Config Options

Selected UNP VLAN Config

| UNP | VLAN ID | Description | AdminStatus |
|---|---|---|---|
| Sales UNP | 31 | Sales VLAN | Enabled |

Select Action

● Create ○ Delete (UNP ports and VLAN tag rules only)

Options

□ Create VLAN

□ Create UNP VLAN Tag Rule

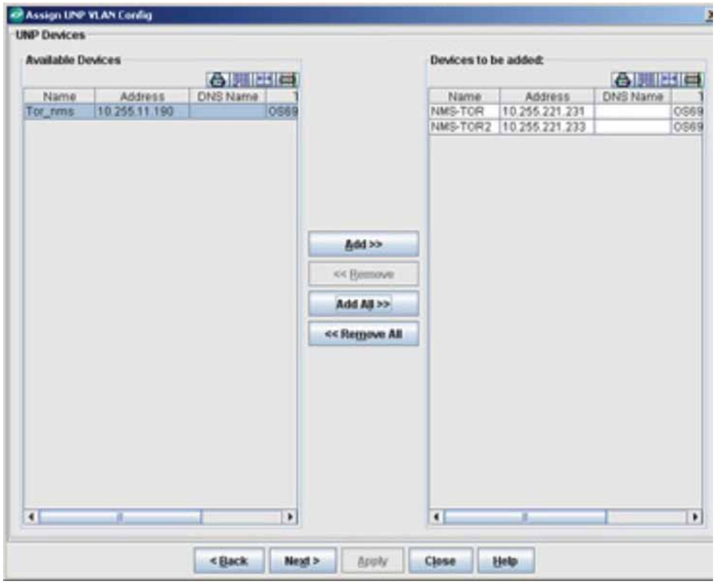
□ Select VM VLAN Notification □ Acknowledge VM VLAN Notification

*Step 7*

Select the switches to which the VLAN will be assigned and click *Next* (Figure 12).

**Figure 12. Select the switches for VLAN assignment**

**Select Switches**



Assign UNP VLAN Config

UNP Devices

Available Devices

| Name | Address | DNS Name | T |
|---|---|---|---|
| Tor_nms | 10.255.11.190 | | OS69 |

Devices to be added:

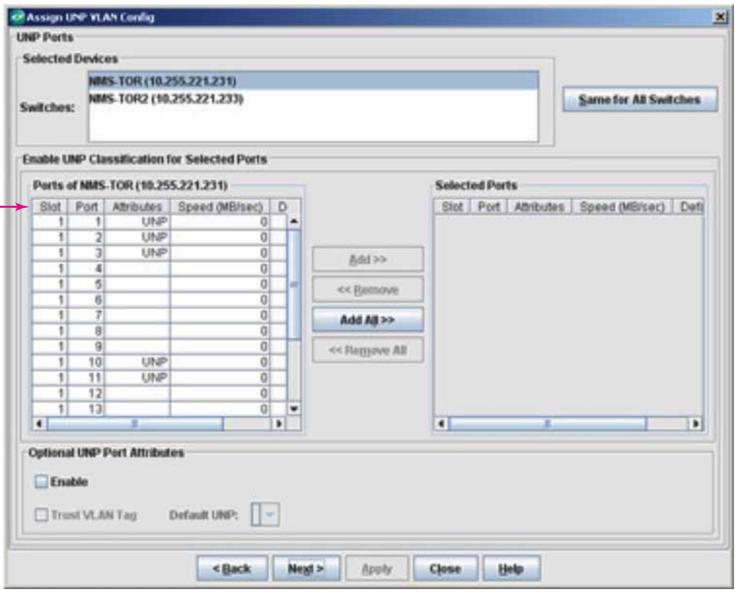
| Name | Address | DNS Name | T |
|---|---|---|---|
| NMS-TOR | 10.255.221.231 | | OS69 |
| NMS-TOR2 | 10.255.221.233 | | OS69 |

*Step 8*

Select and enable vNP ports on the switches (Figure 13). When selecting ports, vNP is automatically enabled on those ports. Optional ports attributes can be configured by selecting the Enable checkbox at the bottom of the screen and selecting an attribute(s). See *Assign vNP Configuration VLAN Wizard* for more information on optional port attributes. Click *Next*.

**Figure 13. Select and enable vNP ports on the switches**

Select and Enable UNP Ports



Select ports

Switches: NMS-TOR (10.255.221.231)
NMS-TOR2 (10.255.221.233)

Ports of NMS-TOR (10.255.221.231)

| Slot | Port | Attributes | Speed (MB/sec) | D |
|---|---|---|---|---|
| 1 | 1 | UNP | 0 | |
| 1 | 2 | UNP | 0 | |
| 1 | 3 | UNP | 0 | |
| 1 | 4 | | 0 | |
| 1 | 5 | | 0 | |
| 1 | 6 | | 0 | |
| 1 | 7 | | 0 | |
| 1 | 8 | | 0 | |
| 1 | 9 | | 0 | |
| 1 | 10 | UNP | 0 | |
| 1 | 11 | UNP | 0 | |
| 1 | 12 | | 0 | |
| 1 | 13 | | 0 | |

Selected Ports

| Slot | Port | Attributes | Speed (MB/sec) | Defi |
|---|---|---|---|---|

□ Enable

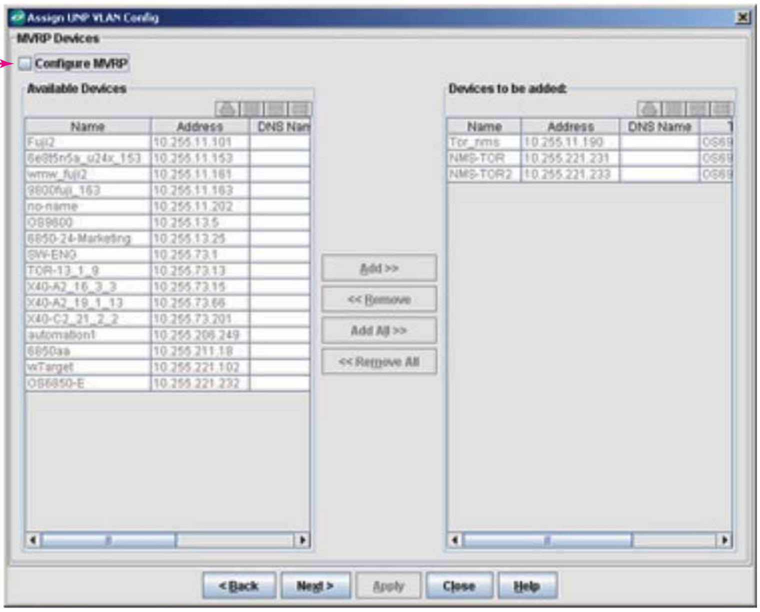
□ Trust VLAN Tag    Default UNP:

*Step 9. (Optional)*

Figure 14 can be used to enable MVRP on selected ports, if necessary. Configure MVRP, if necessary. Otherwise, click *Next* until the *Apply* configuration screen is reached.

**Figure 14. Enable MVRP on selected ports, if necessary**

MVRP Ports Option



Select to configure MVRP ports (optional)

□ Configure MVRP

Available Devices

| Name | Address | DNS Nam |
|---|---|---|
| Fuji2 | 10.255.11.101 | |
| 6e8t5n5a_u24x_153 | 10.255.11.153 | |
| wmw_fuji2 | 10.255.11.161 | |
| 9800fuji_163 | 10.255.11.163 | |
| no-name | 10.255.11.202 | |
| OS9800 | 10.255.13.5 | |
| 6850-24-Marketing | 10.255.13.25 | |
| SW-ENG | 10.255.73.1 | |
| TOR-13_1_9 | 10.255.73.13 | |
| X40-A2_16_3_3 | 10.255.73.15 | |
| X40-A2_19_1_13 | 10.255.73.66 | |
| X40-C2_21_2_2 | 10.255.73.201 | |
| automation1 | 10.255.206.249 | |
| 6850aa | 10.255.211.18 | |
| wTarget | 10.255.221.102 | |
| OS6850-E | 10.255.221.232 | |

Devices to be added:

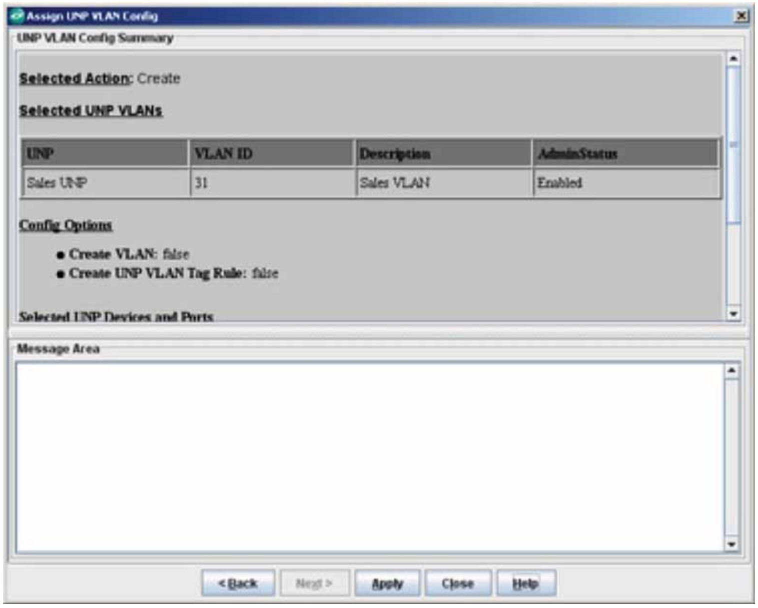
| Name | Address | DNS Name | T |
|---|---|---|---|
| Tor_nms | 10.255.11.190 | | OS69 |
| NMS-TOR | 10.255.221.231 | | OS69 |
| NMS-TOR2 | 10.255.221.233 | | OS69 |

*Step 10*

Click *Apply* to apply the configuration (Figure 15).

**Figure 15. Apply the configuration**

Apply the Configuration



**Selected Action:** Create

**Selected UNP VLANs**

| UNP | VLAN ID | Description | AdminStatus |
|---|---|---|---|
| Sales UNP | 31 | Sales VLAN | Enabled |

**Config Options**

- **Create VLAN:** false
- **Create UNP VLAN Tag Rule:** false

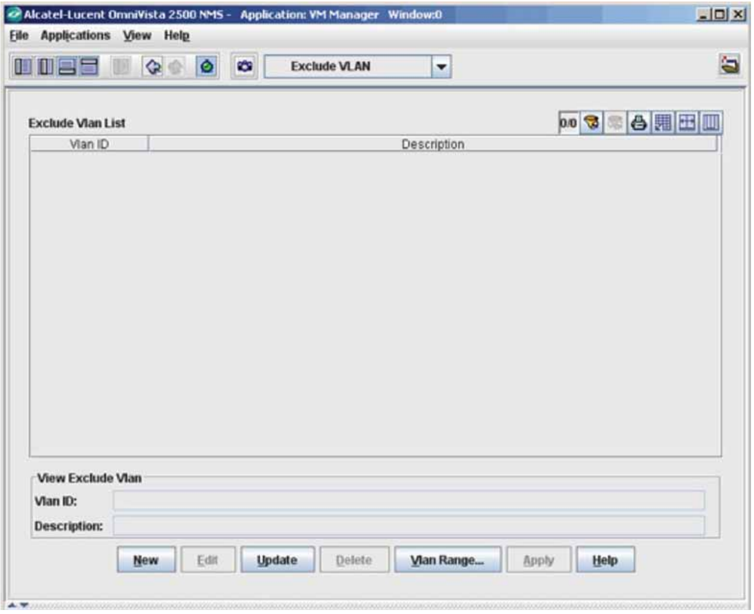
**Selected UNP Devices and Ports**

## Exclude VLAN window

When OmniVista polls the VMware vCenter, it checks Virtual Machine configuration and sends a notification if there is a mis-configuration. The *Exclude VLAN* window is used to define VM VLANs that should be ignored by OmniVista when conducting VM polling (Figure 16).

**Figure 16. Exclude VLAN window**

Exclude VLAN Window

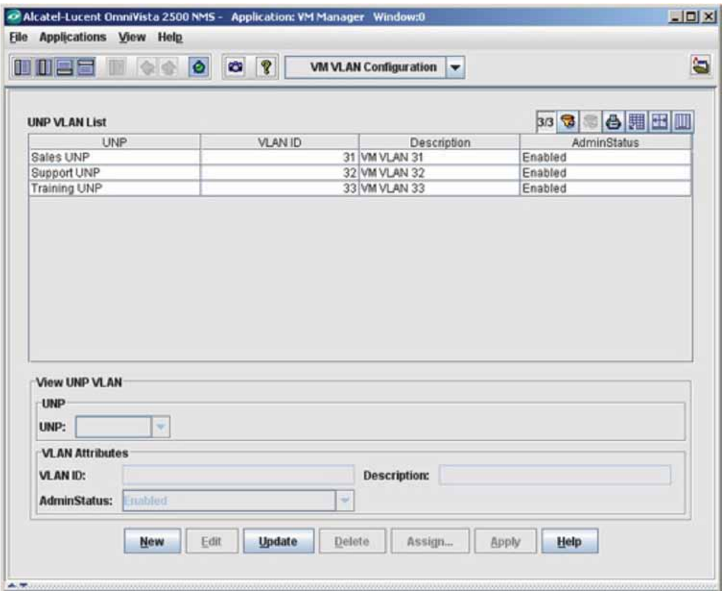


### VM VLAN Configuration Window

The VM VLAN Configuration Window (Figure 17) is used to configure VM VLANs and associate those VLANs with VNPs to manage the virtual machines on the network.

Figure 17. VM VLAN Configuration window

VM VLAN Configuration Window



Alcatel-Lucent OmniVista 2500 NMS - Application: VM Manager Window:0
File Applications View Help
VM VLAN Configuration
3/3
New
Edit
Update
Delete
Assign...
Apply
Help

UNP VLAN List

| UNP | VLAN ID | Description | AdminStatus |
|---|---|---|---|
| Sales UNP | 31 | VM VLAN 31 | Enabled |
| Support UNP | 32 | VM VLAN 32 | Enabled |
| Training UNP | 33 | VM VLAN 33 | Enabled |

View UNP VLAN

UNP

UNP:

VLAN Attributes

VLAN ID:

Description:

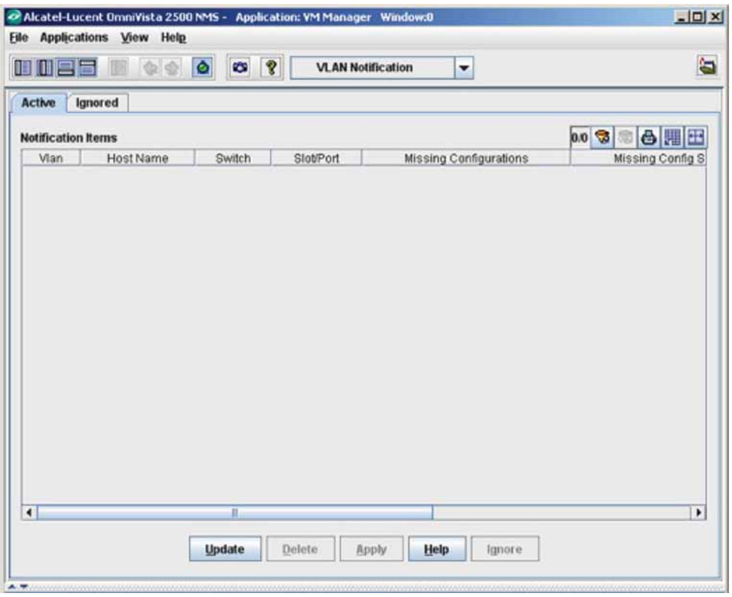
AdminStatus: Enabled

### VM VLAN notification window

The *VM VLAN Notification* window (Figure 18) displays VM VLAN notifications generated by the VMM Service for missing VLAN/vNP configuration on a switch slot/port where VMs are connected. Ideally, there should not be any notifications in this panel. If there are any vNP/VLAN notifications in this panel, the tree Icon for the VLAN Notification node turns red.

Figure 18. VM VLAN Notification window

VM VLAN Notification Window



Alcatel-Lucent OmniVista 2500 NMS - Application: VM Manager Window:0
File Applications View Help
VLAN Notification
Active
Ignored
0/0
Update
Delete
Apply
Help
Ignore

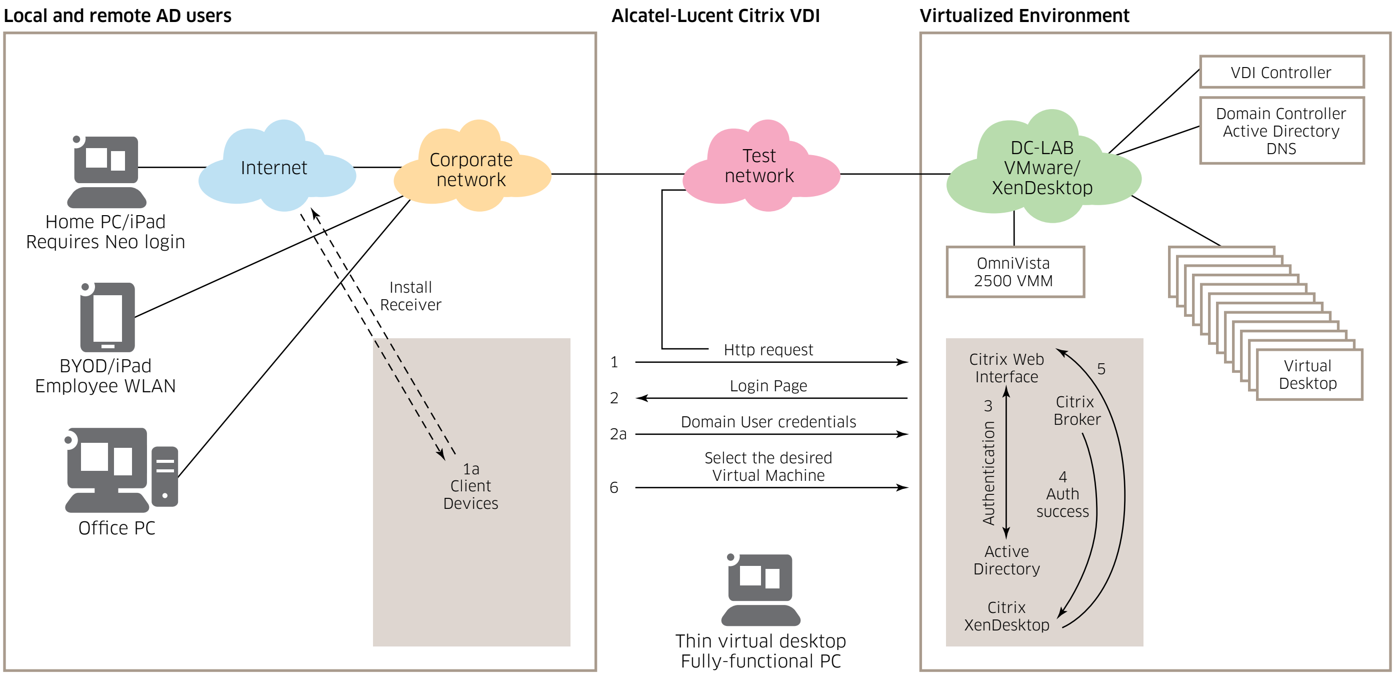
Notification Items

| Vlan | Host Name | Switch | Slot/Port | Missing Configurations | Missing Config S |
|---|---|---|---|---|---|

# OPERATIONAL SEQUENCE

The following operational sequence provides step-by-step instructions for connecting via a Citrix Virtual desktop (Figure 19).

Figure 19. Connecting via a Citrix Virtual desktop



The end user launches an Internet browser to access the Web Interface, and if the receiver needs to be installed it will be installed at this time.

1. The Web Interface prompts the user for Active Directory credentials and passes the credentials to the Desktop Delivery Controller acting as a dedicated XML server.
2. The XML Service running the dedicated XML server (Desktop Delivery Controller) authenticates the user against Active Directory.
3. After the user is successfully authenticated, the XML Service contacts the database to determine which virtual desktops are available for that user.
4. The virtual desktop information is sent back to the Web Interface and the Web Interface renders a web page containing a list of available desktops.
5. The user clicks on the desktop icon and the Web Interface forwards the request to the Desktop Delivery Controller. The Desktop Delivery Controller tells the Virtual Desktop Agent running on the virtual machine to start listening for an incoming session.
6. If the virtual desktop is not powered on, the Desktop Delivery Controller tells the VMWare vSphere to start a new virtual desktop and then notify the Virtual Desktop Agent. In addition, an indication is sent from the Alcatel-Lucent Virtual Machine Manager to the switches indicating a new VM to VLAN association, and the OV determines if a new VLAN must be created.
   a. If a new VLAN must be created a message is sent to the Network Administrator.
7. The OmniSwitch 6900’s vNP detects the virtual machine, and the MAC address gets authenticated via a backend Radius server. Once authenticated, a VLAN is assigned and OmniSwitch applies the QoS rules for the traffic.

8. The virtual desktop connection information is forwarded to the Web Interface. The Web Interface creates a launch file (ICA) for the specific virtual desktop and forwards the launch file to the end user's device.
9. The Virtual Desktop Agent running on the virtual desktop tells the Desktop Delivery Controller that the user has connected. The user's logon information is then sent for validation.
10. The Desktop Delivery Controller validates the login credentials and checks out a license from the Citrix License Server. If the credentials are valid and a license is available, then the credentials, XenDesktop license and policies are sent to the virtual desktop for processing.
11. Once the connection has been approved, the Virtual Desktop Agent uses the transferred credentials to log on against Active Directory and applies profile configurations.

# MONITORING VIRTUAL MACHINES

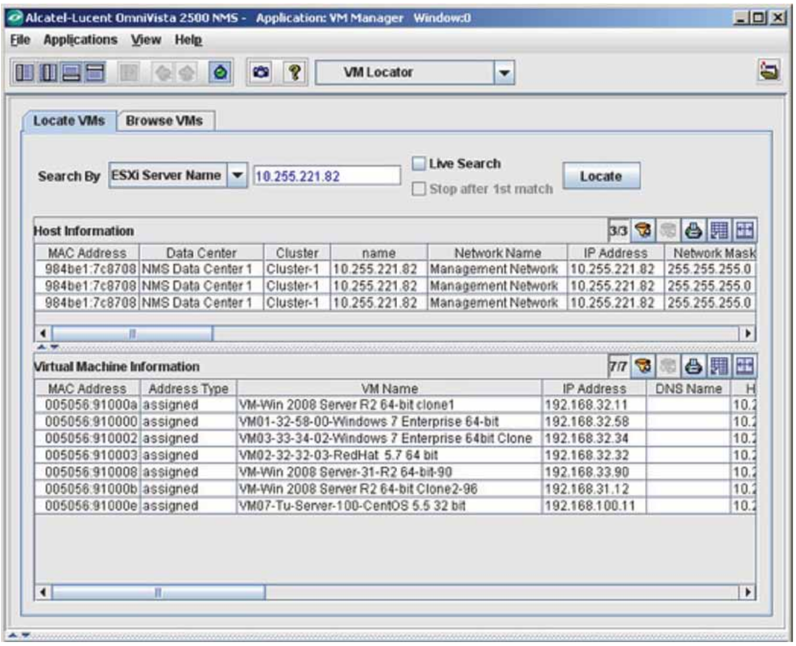
## Locate VM tab

The *Locate VMs* tab (Figure 20) allows IT managers to search for virtual machines on the network. It provides detailed information about the host machine (the ESXi Server on which the virtual machine resides), as well as the virtual machines residing on the host machine. With this screen, managers can search for virtual machines by several search criteria (for example, date center name), and can perform a live search or an historical search.

(Note: For VM Locator to function properly, set 802.1q Port Filtering in the *Locator Preferences* window of the *Preferences* application to *Standard Mode* so that OmniVista can detect virtual machines with tagged frames. In general, if the network has Q-Tagged data packets from IP Phones etc., the user must set *802.1q Port Filtering to Standard Mode*.)

**Figure 20. Locate VMs tab**

Locate VMs Tab


Alcatel-Lucent OmniVista 2500 NMS - Application: VM Manager Window:0
File
Applications
View
Help
VM Locator
Locate VMs
Browse VMs
Locate
3/3
7/7

Search By: ESXi Server Name — 10.255.221.82

□ Live Search

□ Stop after 1st match

Host Information

| MAC Address | Data Center | Cluster | name | Network Name | IP Address | Network Mask |
|---|---|---|---|---|---|---|
| 984be1:7c8708 | NMS Data Center 1 | Cluster-1 | 10.255.221.82 | Management Network | 10.255.221.82 | 255.255.255.0 |
| 984be1:7c8708 | NMS Data Center 1 | Cluster-1 | 10.255.221.82 | Management Network | 10.255.221.82 | 255.255.255.0 |
| 984be1:7c8708 | NMS Data Center 1 | Cluster-1 | 10.255.221.82 | Management Network | 10.255.221.82 | 255.255.255.0 |

Virtual Machine Information

| MAC Address | Address Type | VM Name | IP Address | DNS Name | H |
|---|---|---|---|---|---|
| 005056:91000a | assigned | VM-Win 2008 Server R2 64-bit clone1 | 192.168.32.11 | | 10.2 |
| 005056:910000 | assigned | VM01-32-58-00-Windows 7 Enterprise 64-bit | 192.168.32.58 | | 10.2 |
| 005056:910002 | assigned | VM03-33-34-02-Windows 7 Enterprise 64bit Clone | 192.168.32.34 | | 10.2 |
| 005056:910003 | assigned | VM02-32-32-03-RedHat 5.7 64 bit | 192.168.32.32 | | 10.2 |
| 005056:910008 | assigned | VM-Win 2008 Server-31-R2 64-bit-90 | 192.168.33.90 | | 10.2 |
| 005056:91000b | assigned | VM-Win 2008 Server R2 64-bit Clone2-96 | 192.168.31.12 | | 10.2 |
| 005056:91000e | assigned | VM07-Tu-Server-100-CentOS 5.5 32 bit | 192.168.100.11 | | 10.2 |

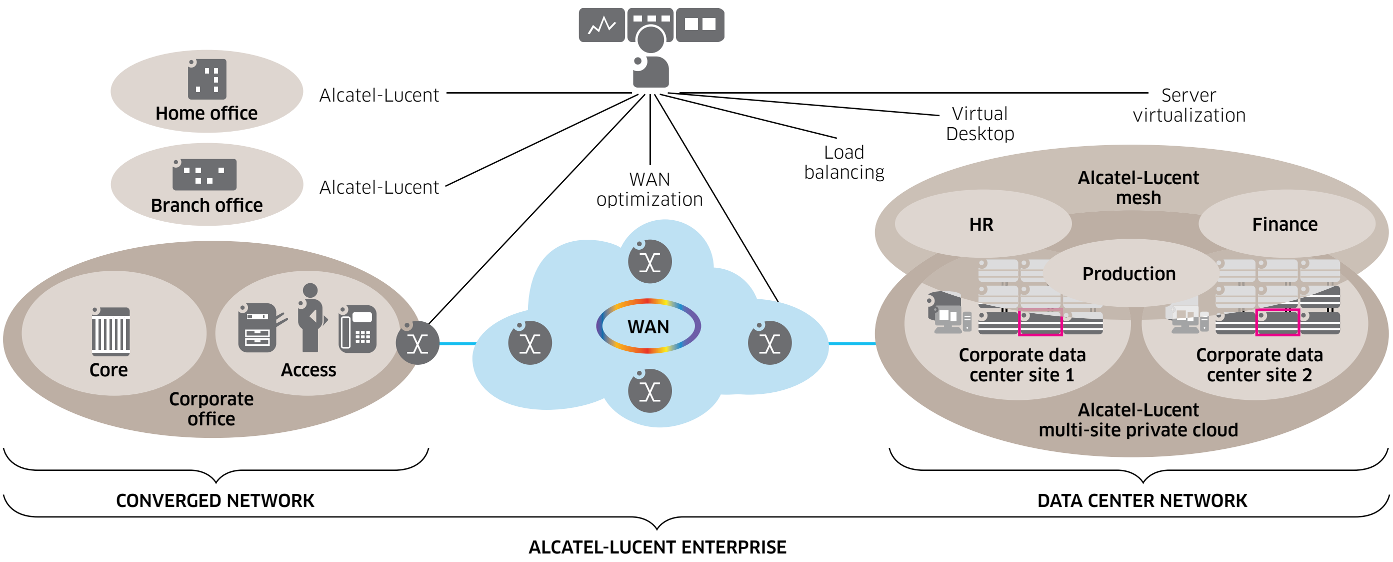
### Performing a search

To perform a search, select the Search By criteria from the drop-down menu and enter the relevant information into the field to the right. By default, OmniVista will conduct an historical search. If a live search is required, select the Live Search checkbox. (Check the Stop after 1st match checkbox to stop the search after finding the first match, if desired.) When ready to perform the search, click the Locate button. The results will appear in the Host Information and Virtual Machine Information tables.

## BENEFITS

The network infrastructure is the key to providing resiliency, redundancy and security for users in a virtual desktop environment, regardless of their access mechanism. Traditionally, users access a virtual environment from the office. However, today they can be working at home, at remote offices, or just about anywhere. No matter where they are, employees want anytime, anywhere access to their data regardless of the device. The Alcatel-Lucent network is always ready to provide a quality user experience based on a simplified provisioning and management process (Figure 21).

**Figure 21. The Alcatel-Lucent network provides a quality user experience with simplified provisioning and management**



In a virtualized desktop environment, the user's operating system, applications and personal settings are abstracted from the core hardware. Essentially, the user is able to jump across the network and to different machines without impacting the usability of the desktop. This provides fault tolerance in the following ways:

- Endpoint Failure: If the user's physical endpoint fails, any new endpoint can be used to gain access to the virtual desktop
- Hosted Virtual Desktop Failure: If the server delivering the hosted virtual desktop fails, the user can immediately initiate a new connection and the XenDesktop connection broker will direct the user to a new virtual desktop with all applications and personalization settings intact.
- Streamed Virtual Desktop Failure: If the endpoint device hosting a streamed virtual desktop fails, the user can use any other device and connect to a new hosted virtual desktop or a streamed virtual desktop of similar hardware specifications.

Citrix XenDesktop and networking technologies coupled with Alcatel-Lucent highly efficient and redundant network solutions provide a huge advantage for fault tolerance. To augment fault tolerance, the following areas must be addressed:

1. A high availability virtualization infrastructure to host a virtual desktop.
2. Reliable operating system delivery.
3. Application and desktop delivery providing user security and Netscaler intelligent monitoring and management.
4. High availability and redundancy from the network infrastructure.
5. High speed Layer 4-7 load balancing and seamless networking integration to provide end-to-end Layer 2-7 cloud networking services.
6. Network virtual machine profiles for quick reaction to desktop movement, as well as high priority for desktop delivery.
7. Low latency on desktop and application delivery.
8. Desktop controllers providing the proper level of idle desktop to allow for instantaneous connections, monitoring state of online and connected virtual desktops, and shutting down virtual desktops as needed.
9. Application controllers for fully redundant application delivery.

## ABOUT ALCATEL-LUCENT

The long-trusted partner of service providers, enterprises and governments around the world, Alcatel-Lucent is a leading innovator in the field of networking and communications technology, products and services. The company is home to Bell Labs, one of the world’s foremost research centers, responsible for breakthroughs that have shaped the networking and communications industry. Alcatel-Lucent was named one of MIT Technology Review’s 2012 Top 50 list of the “World’s Most Innovative Companies” for breakthroughs such as lightRadio™, which cuts power consumption and operating costs on wireless networks while delivering lightning fast Internet access. Through such innovations, Alcatel-Lucent is making communications more sustainable, more affordable and more accessible as we pursue our mission - Realizing the Potential of a Connected World.

## ABOUT CITRIX

Citrix Systems, Inc. (NASDAQ:CTXS) is the company transforming how people, businesses and IT work and collaborate in the cloud era. With market-leading cloud, collaboration, networking and virtualization technologies, Citrix powers mobile workstyles and cloud services, making complex enterprise IT simpler and more accessible for 260,000 enterprises. Citrix touches 75 percent of Internet users each day and partners with more than 10,000 companies in 100 countries. Annual revenue in 2011 was $2.21 billion. Learn more at www.citrix.com.

# ACRONYMS

| Term | Definition |
|---|---|
| AD | Active Directory |
| CoS | class of service |
| DHCP | Dynamic Host Configuration Protocol |
| DNS | Domain Name System |
| FC | Fiber Channel |
| FCoE | Fiber Channel over Ethernet |
| FQDN | fully qualified domain name |
| HDFS | Hadoop Distributed File System |
| HTTP | Hypertext Transfer Protocol |
| ICA | Independent Computing Architecture |
| IIS | Internet Information Services |
| IT | information technology |
| iSCSI | Internet Small Computer System Interface |
| LAN | Local Area Network |
| MAC | Media Access Control |
| MC-LAG | Multi-Chassis Link Aggregation |
| MVRP | Multiple VLAN Registration Protocol |
| NAS | network attached storage |
| NFS | Network File System |
| NMS | Network Management System |
| NOSH | NetApp Open Solution for Hadoop |
| PvS | Provisioning Server |
| Tb/s | terabits per second |
| PC | personal computer |
| QoE | quality of experience |
| QoS | quality of service |
| SLA | service level agreement |
| VDA | Virtual Desktop Agent |
| VHD | Virtual Hard Disk |
| vDisk | virtual disk |
| VLAN | Virtual Local Area Network |
| VM | Virtual Machine |
| VMM | Virtual Machine Manager |
| vNP | Virtual Network Profile |
| WAN | Wide Area Network |
| XML | Extensible Markup Language |

# APPENDIX

## Boot configuration files

Below is the Boot file for the TOR address 172.16.11.252.as a sample bootfile.

```
!= = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
 = !
! File: /flash/vmm/boot.cfg               !
!= = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
 = !
! Chassis:
system name TOR-VMSW-1

! Configuration:

! Capability Manager:
! Multi-Chassis:
! Virtual Flow Control:
! Interface:
! Link Aggregate:
! VLAN:
vlan 1 admin-state enable
vlan 10 admin-state enable
vlan 110-113 admin-state enable

! Spanning Tree:
spantree mode flat
spantree vlan 1 admin-state enable
spantree vlan 10 admin-state enable
spantree vlan 20 admin-state enable
spantree vlan 110 admin-state enable
spantree vlan 111 admin-state enable
spantree vlan 112 admin-state enable
spantree vlan 113 admin-state enable
spantree vlan 333 admin-state enable

! Bridging:
! Port Mirroring:
! Port Mapping:
! IP:
ip service port 21 admin-state enable
ip service port 22 admin-state enable
ip service port 23 admin-state enable
ip service port 80 admin-state enable
ip service port 123 admin-state disable
ip service port 161 admin-state enable
ip service port 443 admin-state enable
ip interface “vlan-110” address 172.16.10.252 mask 255.255.255.0 vlan 110 ifindex 2
ip interface “vlan-111” address 172.16.11.252 mask 255.255.255.0 vlan 111 ifindex 3
ip interface “vlan-112” address 172.16.12.252 mask 255.255.255.0 vlan 112 ifindex 4
ip interface “vlan-113” address 172.16.13.252 mask 255.255.255.0 vlan 113 ifindex 5
ip interface “vlan-20” address 192.168.20.252 mask 255.255.255.0 vlan 20 ifindex 6
```

```
! IPv6:
! IPSec:
! IPMS:
! AAA:
aaa ldap-server “OV-10.255.205.48” host 10.255.205.48 port 5389 dn “cn = DirMgr,
o = alcatel.com” password d2255943b2edf91d2261f32004afd96c base “ou = People,
o = alcatel.com” type generic retransmit 3 timeout 2 no ssl
aaa authentication default “local”
aaa authentication console “local”
aaa authentication snmp “local”

! NTP:
! QOS:
! Policy Manager:
! VLAN Stacking:
! ERP:
! MVRP:
mvrp port 1/3 enable
mvrp enable

! LLDP:
! UDLD:
! Server Load Balance:
! High Availability Vlan:
! Session Manager:
session cli timeout 555555
session prompt default “Tor-vmsw-1- > ”

! Web:
! Trap Manager:
snmp-trap absorption disable

! Health Monitor:
! System Service:
swlog appid capManSig subapp all level error
system timezone PST

! SNMP:
! BFD:
! IP Route Manager:
ip static-route 10.255.205.0/24 gateway 192.168.0.251 metric 1

! VRRP:
! UDP Relay:
ip helper address 10.255.205.52

! RIP:
! OSPF:
ip load ospf
ip ospf area 0.0.0.0
ip ospf interface “vlan-110”
ip ospf interface “vlan-110” area 0.0.0.0
ip ospf interface “vlan-110” admin-state enable
ip ospf interface “vlan-111”
ip ospf interface “vlan-111” area 0.0.0.0
ip ospf interface “vlan-111” admin-state enable
ip ospf interface “vlan-112”
ip ospf interface “vlan-112” area 0.0.0.0
ip ospf interface “vlan-112” admin-state enable
ip ospf interface “vlan-113”
ip ospf interface “vlan-113” area 0.0.0.0
ip ospf interface “vlan-113” admin-state enable
ip ospf interface “vlan-20”
ip ospf interface “vlan-20” area 0.0.0.0
ip ospf interface “vlan-20” admin-state enable
ip ospf admin-state enable

! IP Multicast:
! DVMRP:
! IPMR:
! RIPng:
! OSPF3:
! BGP:
! Netsec:
! Module:
! RDP:
! DA-UNP:

unp dynamic-vlan-configuration enable
unp name vm-10 vlan 10
unp name vm-20 vlan 20
unp name vm-333 vlan 333
unp classification vlan-tag 10 unp-name vm-10
unp classification vlan-tag 20 unp-name vm-20
unp classification vlan-tag 333 unp-name vm-333
unp port 1/16
unp port 1/16 classification enable
unp port 1/16 trust-tag enable

! DHL:
```