Cisco Desktop as a Service Solution with Desktone

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About Cisco Validated Design (CVD) Program

The CVD program consists of systems and solutions designed, tested, and documented to facilitate faster, more reliable, and more predictable customer deployments. For more information visit http://www.cisco.com/go/designzone.

Cisco Desktop as a Service Solution with Desktone

1 Preface

Introduction

The Cisco Desktop as a Service (DaaS) Solution with Desktone enables service providers to offer desktops as a service to their customers. The Cisco DaaS Solution with Desktone is built to be highly scalable and supports multi-tenancy.

Cisco DaaS Solution with Desktone delivers desktops as a service on a common infrastructure. This common infrastructure is hosted in service provider data centers. Microsoft Windows 7 is the operating system of choice for the virtual desktops and is available in persistent and non- persistent flavors. The Cisco DaaS Solution with Desktone is built by combining data center, network, and security technologies from Cisco and desktop virtualization technologies from our ecosystem partners.

Cisco DaaS Solution with Desktone accomplishes complete separation between customers from desktops in the data center, through the data center network, across the wide area network, and down to the customer network. Customer visibility is restricted to only their virtual desktops. However, service providers have insight into how resources as a whole are utilized by different customers.

The pod-based approach adopted for the Cisco DaaS Solution with Desktone enables flexibility in growth based on business needs without requiring a redesign of the data center. This approach ultimately lowers operational costs for the service provider. The pod as a logical unit supports multiple customers at different scale on a common infrastructure.

Network services deliver exceptional user experience for a large number of users without requiring additional resources to be deployed on the customer end. Security policies are enforced between the customer's network and the virtual desktops in the service provider's data center.

Cisco DaaS Solution with Desktone has been tested end-to-end to confirm that all the different components interoperate. With Cisco DaaS Solution with Desktone, service providers are now able to build a multi-tenant desktop as a service solution faster and at reduced risk than ever before.

Target Audience

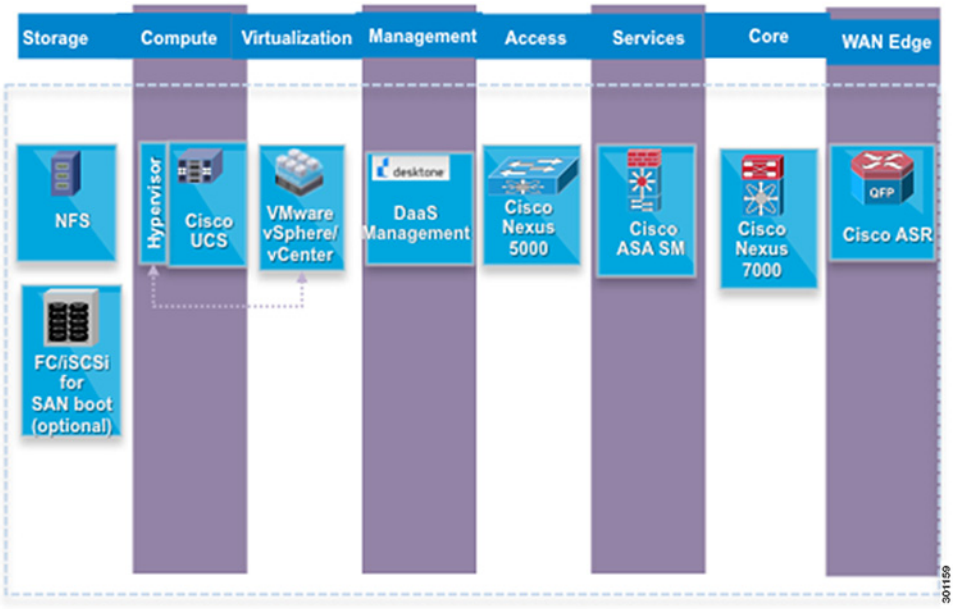
This document is intended for, but not limited to, solution architects and engineers involved in planning and designing Cisco DaaS Solution with Desktone. This document assumes the reader has an understanding of the following:

- Cisco Virtualized Multiservice Data Center
- Cisco Unified Computing System
- Cisco Nexus Switches
- Cisco Catalyst Switches and Service Modules
- Cisco Aggregation Services Router
- Cisco Adaptive Security Appliance
- MPLS VPN
- VMware vSphere
- Desktone
- NFS Storage
- Microsoft Windows 7 Operating System

2 Cisco DaaS Solution with Desktone Overview

This section describes the capabilities of the different products and solutions that are part of the Cisco DaaS Solution with Desktone reference architecture and how these elements are integrated to deliver a scalable, flexible and secure multi-tenant solution for service providers.

Figure 1 System Overview



The building blocks of the Cisco DaaS Solution with Desktone are:

- Virtualized Multiservice Data Center
- Wide Area Network
- Security
- Multi-Tenant Connection Broker

Virtualized Multiservice Data Center

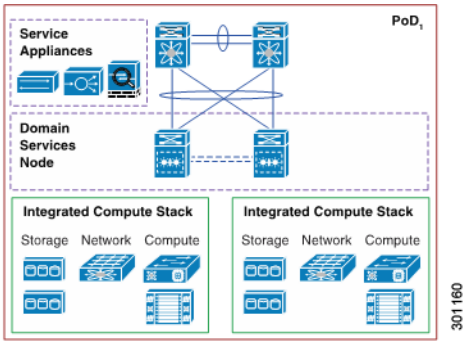
The Cisco Virtualized Multiservice Data Center (VMDC) Version 2.2 is the platform used for Cisco DaaS Solution with Desktone. The platform is ideal for service providers as it is designed for cloud based offerings and provides a multi-tenant infrastructure on which any service can be delivered. The modular architecture is highly scalable and adapts easily to the changing business needs of the service provider. The design has been validated by end-to-end system level testing and offered as part of Cisco Validated Design Program.

The first building block in the Cisco VMDC architecture is an integrated compute stack (ICS) based on Cisco Unified Computing System (UCS).

Compact pod design is the one chosen for Cisco DaaS Solution with Desktone. It uses centralized service node architecture on a collapsed aggregation/core with top-of-rack access.

Multiple ICS blocks are connected through the network infrastructure to form a pod. New pods are built and added to the data center for additional capacity, thereby making the entire solution scalable.

Figure 2 VMDC Pod



VMDC Network is organized into core, aggregation and access layers similar to a campus network design.

The primary function of the core is to provide high performance Layer 3 switching for IP traffic.

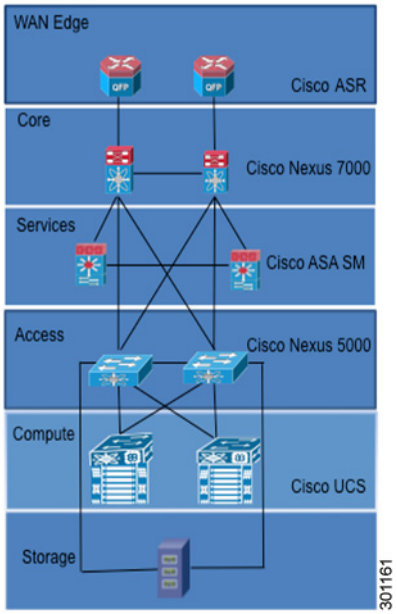
The aggregation layer provides connectivity for the access layer switches in the server farm and aggregates them into a smaller number of interfaces to be connected into the core layer. Services are introduced into data flows at the aggregation layer.

With Cisco DaaS Solution with Desktone using the compact pod design, the core and aggregation layers are collapsed into one.

The access layer provides connectivity for server farm end nodes. Quality of Service (QoS) markings are done on the display protocol traffic at the access layer of the VMDC network and prioritized in the data center network.

The WAN Edge of the service provider's data center provides network traffic isolation between different customers as they come into the data center from the WAN.

Figure 3 Cisco VMDC Network Topology



Wide Area Network

The WAN is the primary method of delivery of virtual desktops to customers. A VPN connection extends the customer network into the data center of the service provider enabling seamless access of virtual desktop for users in the customer premises.

MPLS VPN is one of the VPN technologies supported in Cisco DaaS Solution on Desktone. With MPLS VPN, the traffic separation is built directly into the network without tunneling or encryption. Unique VPN route forwarding (VRFs) at the Provider Edge routers separates the traffic for every customer and allows overlapping IP addresses to exist. A customer's visibility is restricted to their network traffic only.

Based on the Service Level Agreement between the customer and WAN provider, the customer traffic of interest that are marked with appropriate Quality of Service markings is prioritized over the WAN, delivering an enhanced user experience.

Security

Cisco ASA Service Module (SM) is deployed on the Data Service Node, Catalyst 6500 to provide firewall functionality between the customer physical network and the virtual environment hosted by the service provider. The Cisco ASA SM supports multiple contexts, each of which is assigned to a tenant. The context will give every tenant a dedicated firewall to configure specific security policies that they desire.

Multi-Tenant Connection Broker

The Desktone platform supports connections to virtual desktops over multiple display protocols like Microsoft Remote Desktop Protocol (RDP), VMware PC over IP (PCoIP) from different customers. PCoIP was the one used in the study. The platform authenticates and connects users from different customers to the right desktops in the data center. The IT administrator of customers gets to view only their own desktops. The service provider is the only one who has the visibility on how the resources are used by different customers in the data center.

Cisco DaaS Solution with Desktone Components

Table 1 Cisco DaaS Solution on Desktone Components

Function	Product
Compute	Cisco UCS 2.1(1a)
Hypervisor	VMware vSphere 5.1
Storage	NFS Storage iSCSI/FC for SAN boot (optional)
Access Layer	Cisco Nexus 5548UP 5.2(1) N1 (2a)
Core/Aggregation Layer	Cisco Nexus 7009 6.1 (2)
WAN Edge	Cisco ASR 9000 4.2.0
Data Center Service Node	Cisco Catalyst 6506 12.2(33) SXJ1

Function	Product
Compute	Cisco UCS 2.1(1a)
Network Services	Cisco ASA SM 8.5(1)
Connection Broker	Desktone 5.3.2

3 Design Considerations

Cisco DaaS Solution with Desktone has been designed with the following objectives in mind.

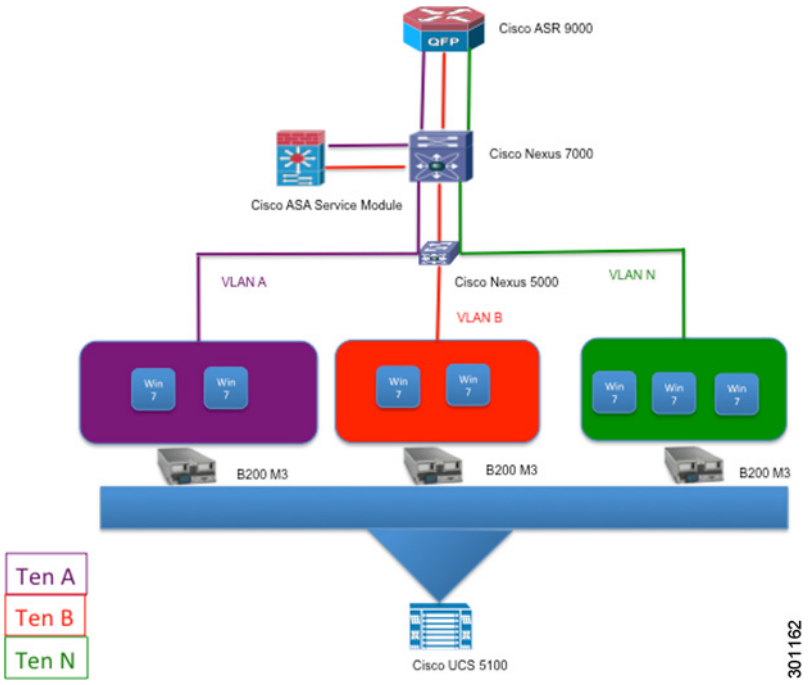
- Tenant Separation
- High Availability

Tenant Separation

Desktops are deployed by enterprises in-house on dedicated infrastructure. To consume desktops on shared infrastructure, customers must be certain that their corporate information is secure and isolated end-to-end. Secure tenant separation is done at the following levels:

- Compute
- Network
- Network Services
- Storage
- Desktop

Figure 4 Tenant Separation



Compute

A separate blade server is assigned for the Desktone Platform management software. This host runs Desktone service provider appliances and tenant appliances for every customer.

Blade servers are dedicated as a whole to every tenant. This is done to comply with Microsoft licensing agreement. Microsoft Virtual Desktop Access license prohibits running Windows 7 virtual desktops for different customers on the same host. This makes sure that there is complete separation of compute between different customers. Dedicated hosts are maintained even in times of hardware crashes when virtual desktops are moved between hosts.

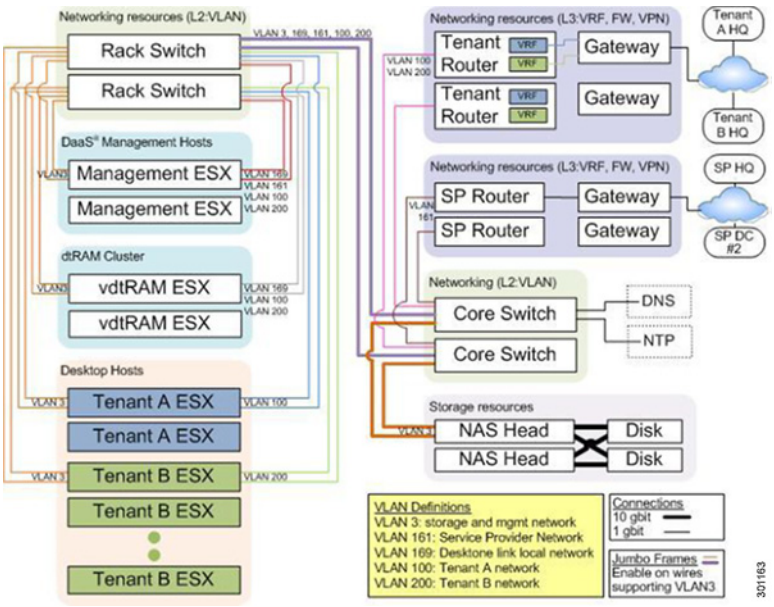
Network

A logically separate network infrastructure is created for every customer. The separation is done at both Layer 2 and Layer 3 using VLAN and VRF respectively.

Layer 3 VPN provides separate links for customers to connect into the service provider data center. VRF at the WAN edge of the data center provides path isolation of customer traffic at Layer 3. A separate routing table is used to make forwarding decisions for every customer's traffic. A separate routing table helps ensure support for overlapping IP address range of customers on a shared network.

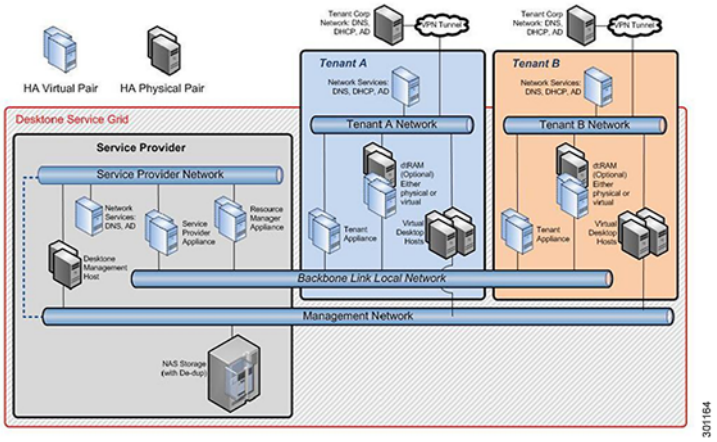
Separation at Layer 2 is done using VLANs. A minimum of one VLAN is assigned to each customer. All virtual desktops and virtual machines that belong to a customer reside on the customer's assigned VLAN. The VLAN ensures that customer's traffic is logically isolated from one another as it traverses different devices in the service provider data center.

Figure 5 Network Separation in Desktone view



The Desktone management appliances are located in different networks depending on the application type. The Service Provider Appliance and Resource Manager Appliances reside on the service provider network. The Tenant Appliances reside in the tenant network and cannot be accessed from any other network. There is a backbone link local network which is used for different Desktone Appliances to talk to each other. The management network is used for the blade servers and storage appliances.

Figure 6 Desktone Service Grid



Network Services

Cisco ASA Service Module deployed on the Data Service Node, Catalyst 6500 is partitioned into multiple virtual firewalls, known as security contexts. The customer's security policies are configured and stored in the tenant configuration file.

Storage

Storage is managed by the VMware vCenter for Desktone. All storage options supported by vCenter are supported storage options for virtual desktops. If NFS is chosen as a storage option, file shares are created for every customer and also one for the Desktone platform. If FC is chosen, one or more Logical Unit Number (LUN) needs to be created for each customer and one for the Desktone platform.

The Desktone platform needs a file share/LUN to host the template used in creation of new tenant appliances on the Desktone platform. This file share/LUN is mounted on the hosts assigned to the Desktone platform.

The virtual desktops for each customer are stored in their corresponding file share/LUN. The file share/LUN of each customer is mounted on the hosts reserved for the customer as VMware datastore. No other host must have access to the datastore of the customer.

Desktop

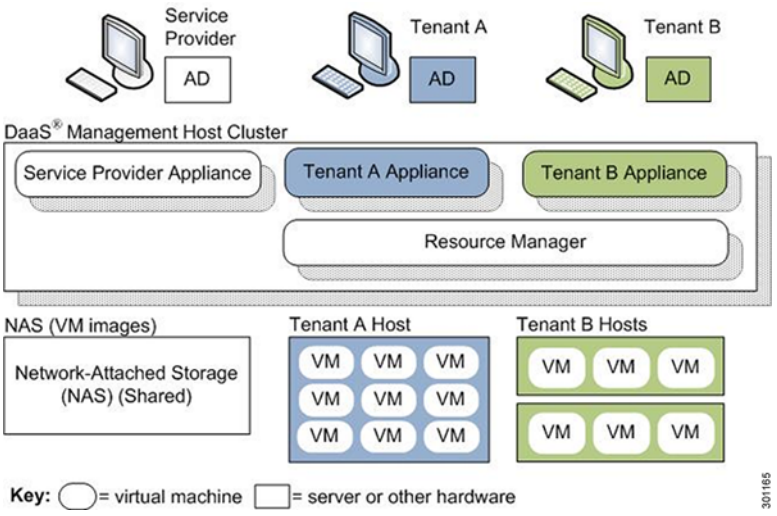
The Desktone Platform manages all incoming connections to the virtual desktops. Based on the user and to which customer the user belongs to, the Desktone Platform connects the user to the right desktop over the preferred display protocol.

The service provider appliance is administered using the Service Center web based Graphical User Interface. The service center portal gives an overview of all the customers sharing the common data center. This portal is also used to manage the system resources for different customers. The service provider appliance should be installed first as it is the foundation for installing rest of the Desktone appliances.

A separate enterprise portal called Enterprise Center is powered by the customer's tenant appliance. The Enterprise Center is only accessible from the corresponding customer's network. This portal restricts visibility to only the desktops the customer owns.

There are two Resource Manager Appliances in a high available environment to manage the resources used for the tenants a whole.

Figure 7 Desktone Components



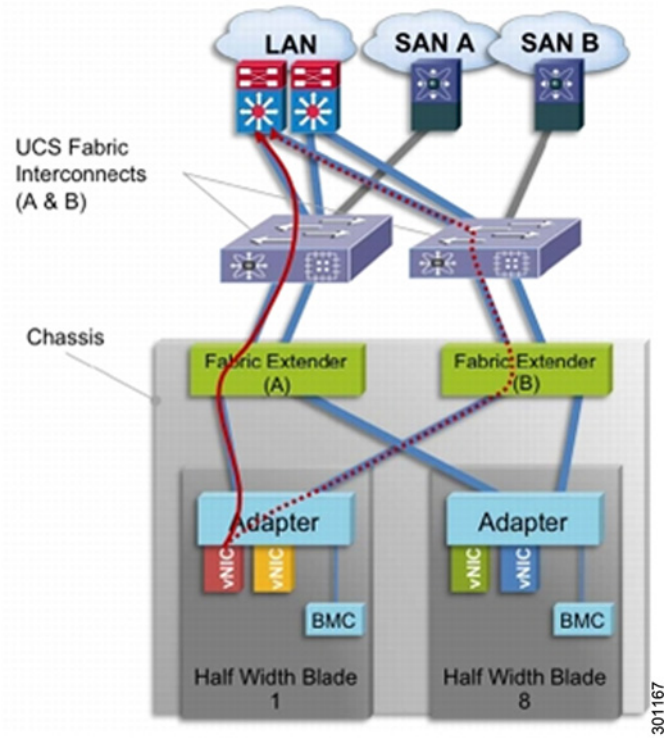
High Availability

High Availability (HA) is a mandatory requirement of any hosted or cloud-based service offerings. For a service to be adopted widely by businesses, service providers need to provide Service Level Assurance (SLA) to their business customers. To meet such SLA, the service provider needs to base their offering on a highly available infrastructure.

VMDC was chosen as platform of choice for Cisco DaaS Solution on Desktone because it can provide redundancy at different levels like Compute, Network and Storage. Redundancy is provided end-to-end all the way from the collapsed core/aggregation, access, compute, and storage layers.

Compute

Figure 8 Redundant paths for Virtual NICs



Cisco Unified Computing System is a fully redundant system. The network adapter is connected to both the fabric planes in active-active node utilizing the full bandwidth. The Fabric Interconnect Uplinks connects to the access layer switches to provide redundant paths for all the virtual machines hosted on the blade server. The Fabric Interconnects should always be deployed in pairs for redundancy and high availability.

As per VMDC recommendation, configure the Cisco UCS Fabric Interconnect uplinks in End Host Mode. In End Host mode, you get the following:

- Uplinks are fully utilized
- Uplinks can be connected to multiple access switches providing redundancy
- Spanning Tree Protocol is not required

Cisco Unified Computing System provides different system class of service to implement quality of service including:

- System classes that specify the global configuration for certain types of traffic across the entire system
- QoS policies that assign system classes for individual vNICs
- Flow control policies that determine how uplink Ethernet ports handle pause frames.

Note Time sensitive applications have to adhere to a strict QOS for optimal performance.

Systems Class is the global operation where entire system interfaces have defined QoS rules.

- By default system has Best Effort Class and FCoE Class.

Note Best effort is equivalent in MQC terminology as “match any”

  - FCoE is special Class define for FCoE traffic. In MQC terminology “match cos 3”
- System class allowed with 4 more users define class with following configurable rules.
  - CoS to Class Map
  - Weight: Bandwidth
  - Per class MTU
  - Property of Class (Drop v/s no drop)
- Max MTU per Class allowed is 9216.
- Through Cisco Unified Computing System, we can map one CoS value to particular class.
- Apart from FCoE class there can be only one more class can be configured as no-drop property.
- Weight can be configured based on 0 to 10 numbers. Internally system will calculate the bandwidth based on following equation (there will be rounding off the number).

➢ $$\%\ \text{b/w shared of given Class} = \frac{(\text{Weight of the given priority} * 100)}{\text{Sum of weights of all priority}}$$

Cisco Unified Computing System defines user class names as follows:

- Platinum
- Gold
- Silver
- Bronze

Table 2 Map between Cisco Unified Computing System and the NXOS

Cisco UCS Names	NXOS Names
Best effort	Class-default
FC	Class-fc
Platinum	Class-Platinum
Gold	Class-Gold
Silver	Class-Silver
Bronze	Class-Bronze

Table 3 Class to CoS Map by default in Cisco Unified Computing System

Cisco UCS Class Names	Cisco UCS Default Class Value
Best effort	Match any
Fc	3
Platinum	5

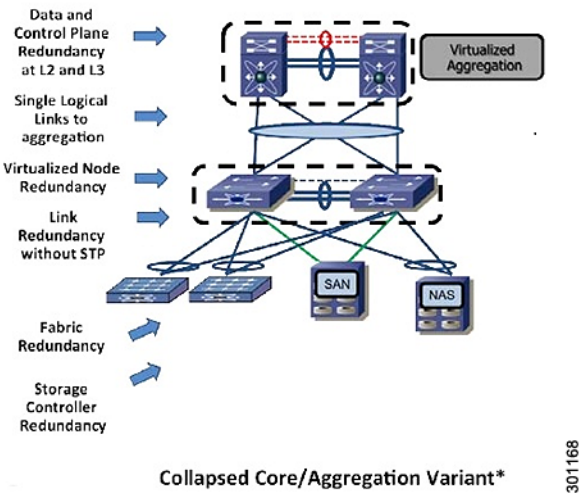
Cisco UCS Class Names	Cisco UCS Default Class Value
Gold	4
Silver	2
Bronze	1

Table 4 Default Weight in Cisco Unified Computing System

Cisco UCS Class Names	Weight
Best effort	5
Fc	5

Network

Figure 9 Redundant Network Layers



Virtual Port Channel (vPC) helps ensure high availability at Layer 2 in the data center. All available paths are utilized to deliver maximum bandwidth to the hosts. Two upstream Nexus switches act as one logical node delivering both hardware redundancy and load balancing.

Host StandBy Router Protocol (HSRP) provides hardware redundancy and high availability at Layer 3 by having two routers act as a single virtual router with shared IP address and MAC address. The shared address enables hosts to always have an active router to forward packets.

Network Services

Cisco ASA Service Module is deployed on the 2 Catalyst 6500 switches for redundancy. It supports high-speed failover between modules in separate chassis. Both Active-Active and Active-Standby failover is supported.

Storage

As per VMDC recommendation, it is required to have hardware redundancy for storage devices.

Desktop

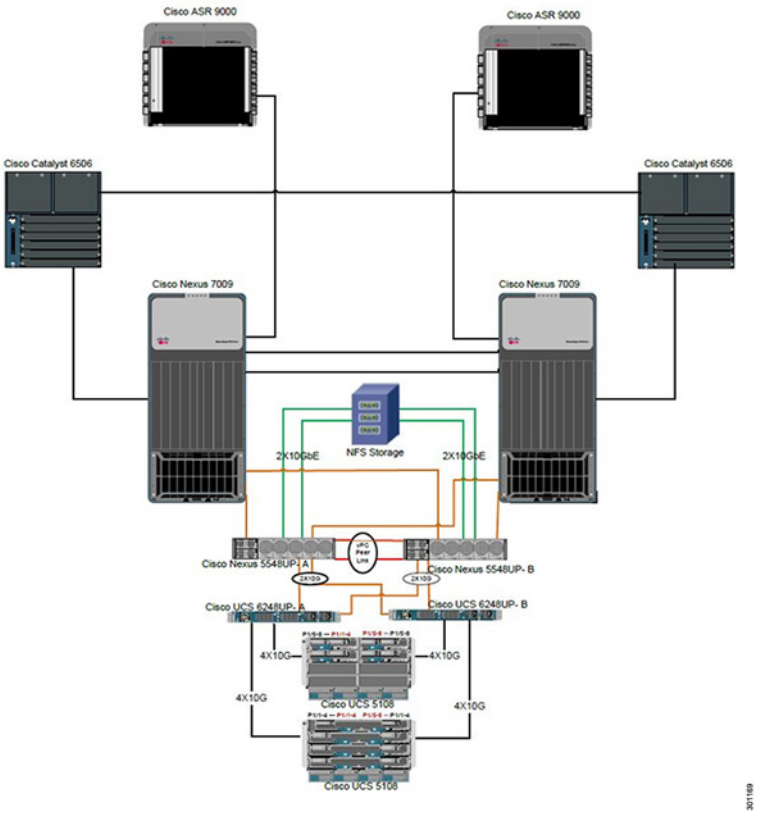
The Desktone platform is installed on two separate blade servers. On each blade server, one instance of Service Provider Appliance, Tenant Appliances and Resource Manager Appliances are installed. One instance is the primary and the other is the secondary. Both primary and secondary instances of the appliances work in active mode. So, either of the appliances can crash with no service interruption. The same holds true if the whole blade server hosting the Desktone appliances were to crash.

When desktop hosts crash, the desktops can be moved over to a new host and the desktops would be available for users. It is recommended to have at least one spare host per tenant to handle blade crashes. This host needs to be on the VLAN assigned to the tenant. It then needs to be assigned to the Tenant Resource Manager to be available for hosting desktops. If and when the crash happens, the desktops need to be migrated to the new host.

4 Solution Validation

This section details the configuration and tuning that was performed on the individual components to produce a complete, validated solution.

Figure 10 Cisco DaaS Solution on Desktone Topology



Configuring the Cisco Unified Computing System

To configure the Cisco Unified Computing System, perform the following steps:

Step 1 Bring up the Cisco 6248UP Fabric Interconnect (FI) and from a serial console connection set the IP address, gateway, and the hostname of the primary FI.

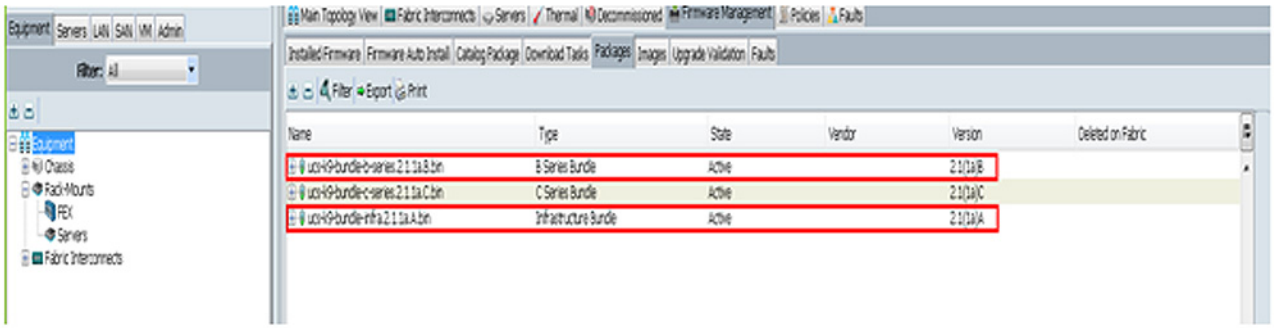
Step 2 Bring up the second fabric interconnect after connecting the dual cables between them. The second FI automatically recognizes the primary and asks if you want to be part of the cluster, answer yes and set the IP address, gateway and the hostname.

Note When Step 2 is completed all access to the FI may be performed remotely. You will also configure the virtual IP address to connect to the FI; you need a total of three IP address to bring it online. You can also wire up the chassis to the FI, using 1, 2, 4 or 8 links per IO Module, depending on your application bandwidth requirement. In this study, four links were connected to each module.

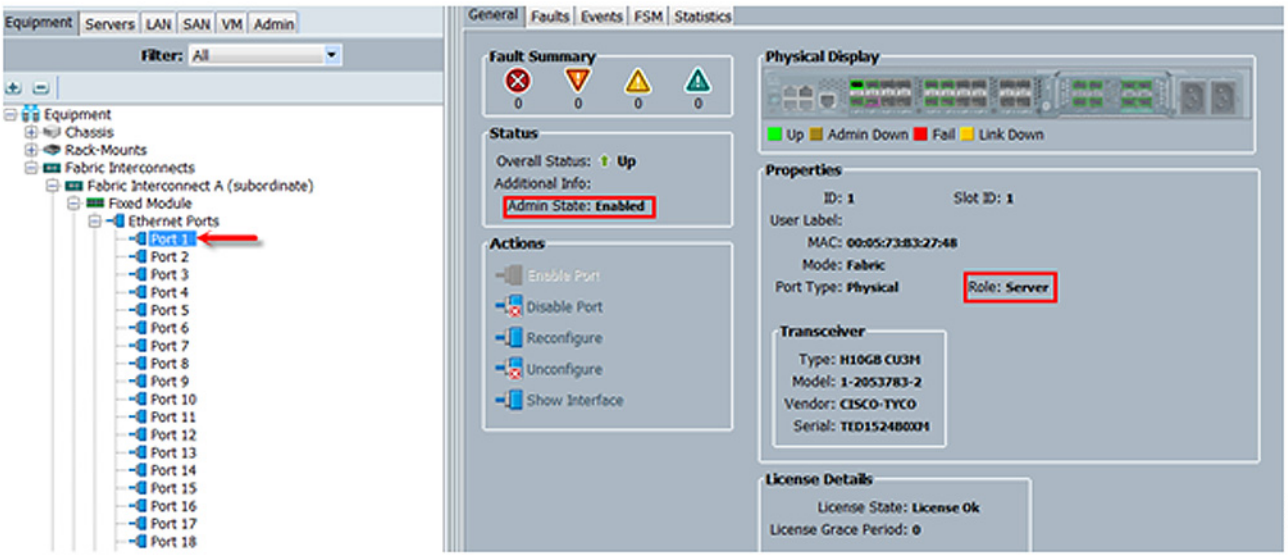
Step 3 Connect using your favorite browser to the Virtual IP address and launch the Cisco UCS Manager. The Java based Cisco UCS Manager enables you to do everything that you could do from the CLI. The GUI methodology is highlighted here.

Step 4 Check the firmware on the system and see if it is current. Visit http://software.cisco.com/download/release.html?mdfid=283612660&softwareid=283655658&release=2.0(4d)&relind=AVAILABLE&rellifecycle=&reltype=latest to download the most current Cisco UCS Infrastructure and Cisco UCS Manager software. Use the UCS Manager Equipment tab in the left pane, then the Firmware Management tab in the right pane and Packages sub-tab to view the packages on the system. Use the Download Tasks tab to download needed software to the FI.

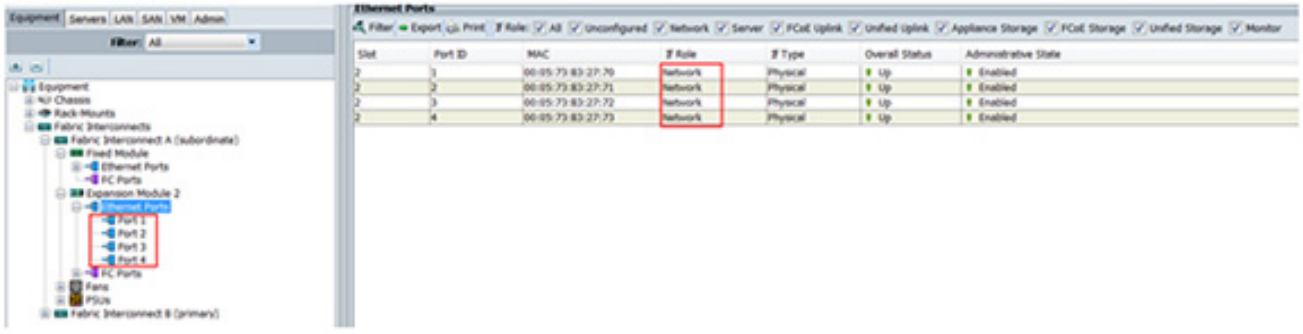
Note The firmware release used in this paper is 2.1(1a).



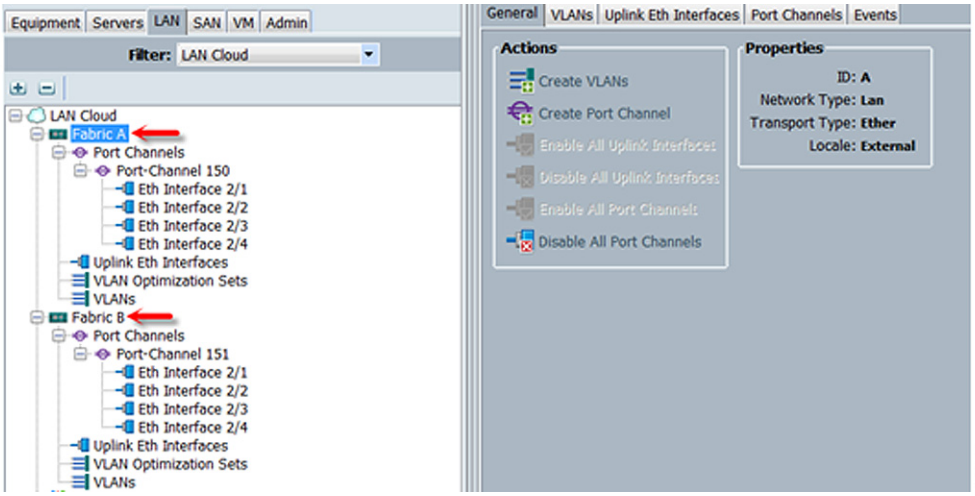
Step 5 Configure and enable the server ports on the FI. These are the ports that will connect the chassis to the FIs.



Step 6 Configure and enable uplink Ethernet ports

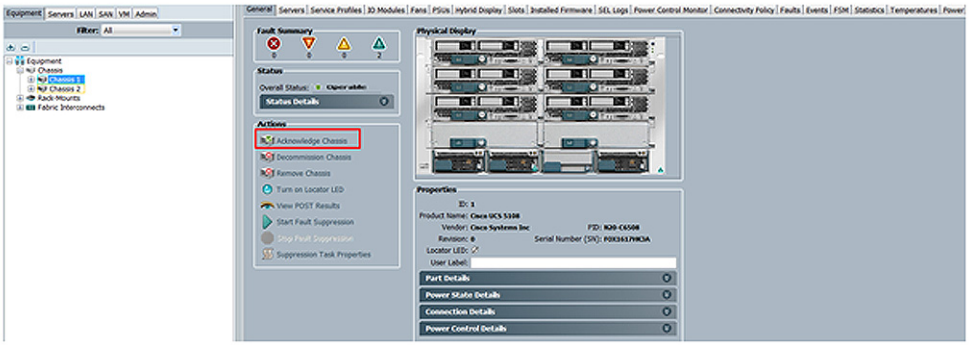


Step 7 On the LAN tab in the Navigator pane, configure the required Port Channels and Uplink Interfaces on both Fabric Interconnects

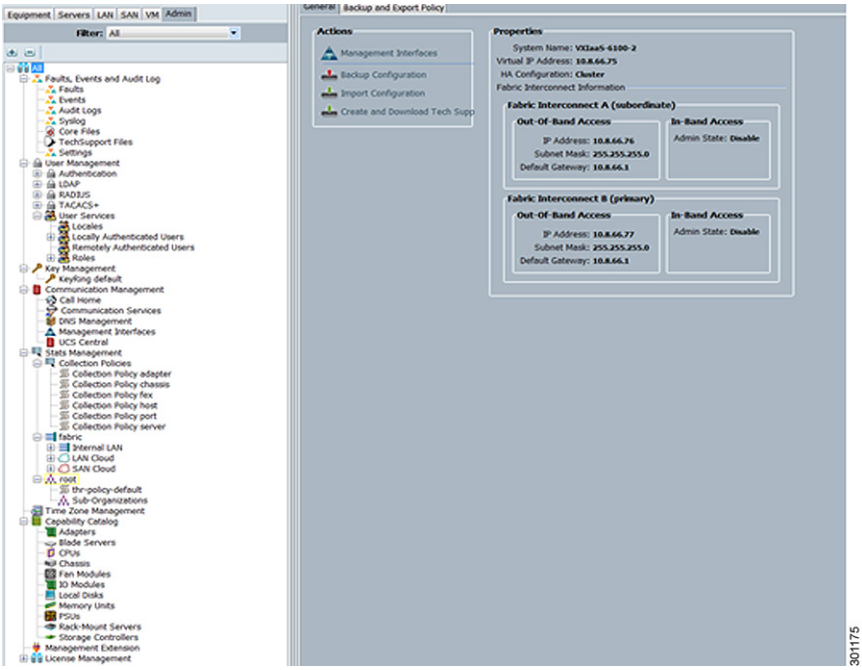


Step 8 Expand the Chassis node in the left pane and click on each chassis in the left pane.

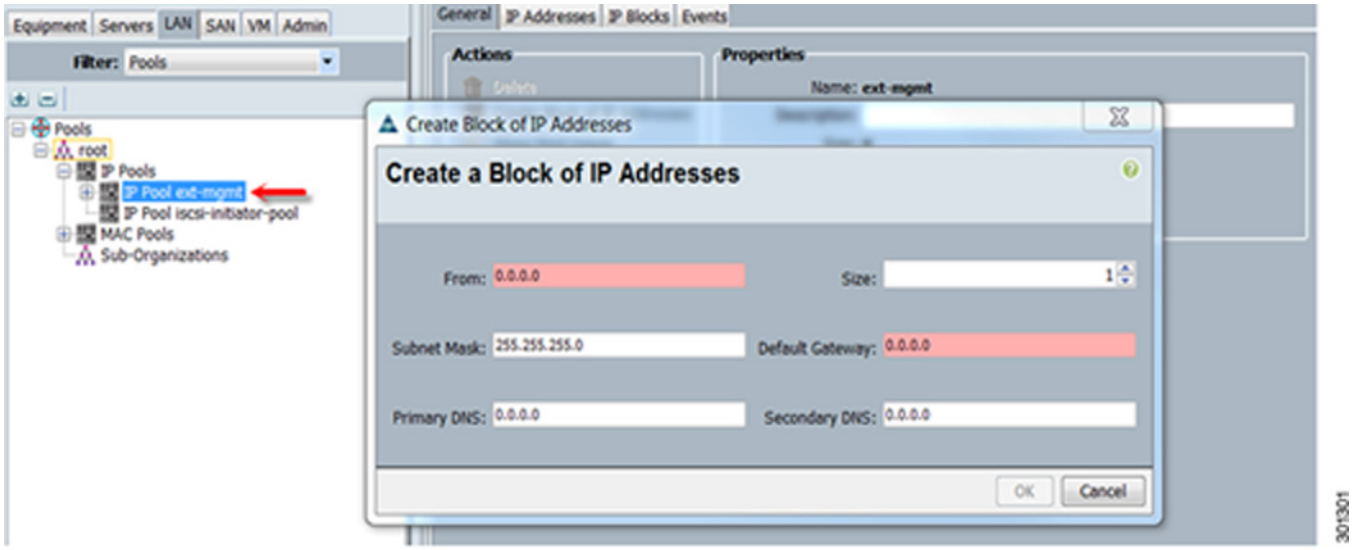
Step 9 Click Acknowledge Chassis in the right pane to bring the chassis online and enable blade discovery.



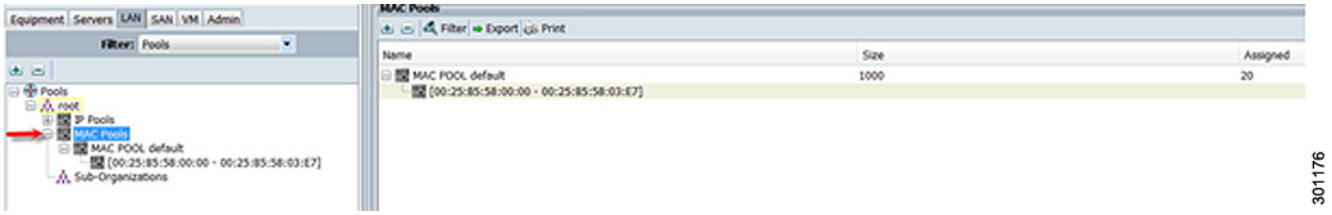
Step 10 From the Admin tab in the left pane, to configure logging, users and authentication, key management, communications, statistics, time zone and NTP services, and licensing. Time zone Management (including NTP time source(s)) and uploading your license files are critical steps in the process.



Step 11 On the LAN tab, expand Pools, IP Pools. Right click on IP Pool ext-mgmt. Configuring your Management IP Pool (which provides IP based access to the KVM of each UCS Blade Server).

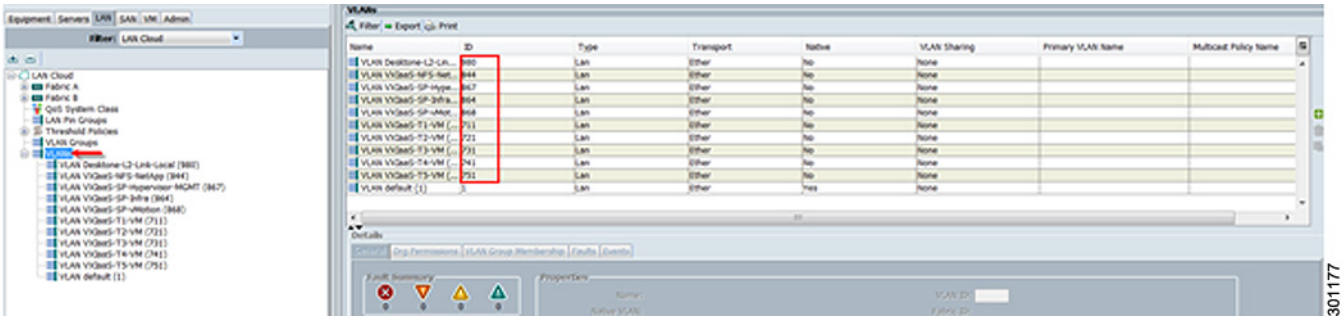


Step 12 From the LAN tab in the navigator, under the Pools node, create a MAC address pool of sufficient size for the environment.

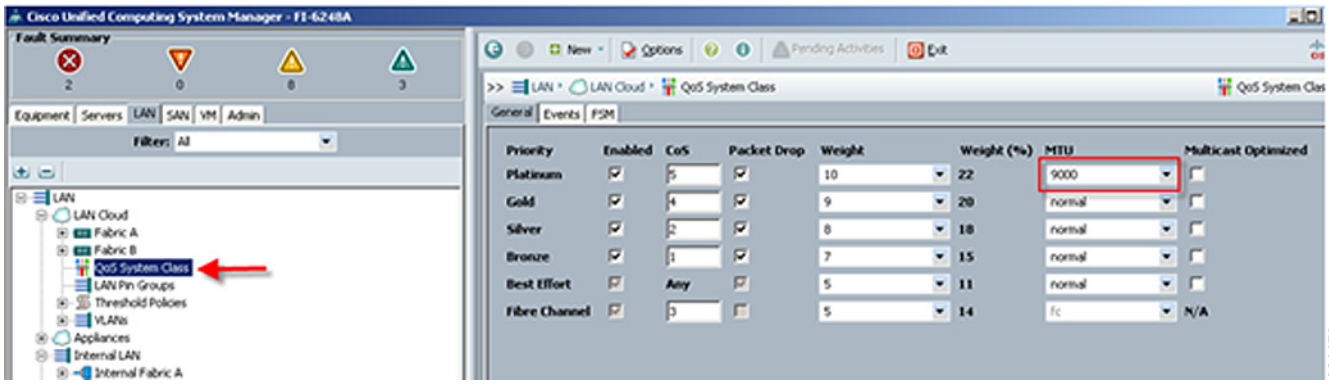


Step 13 From the LAN tab in the navigator pane, configure the VLANs for the environment. You need one VLAN for Service Provider network, one for Link-Local Network and one for each tenant.

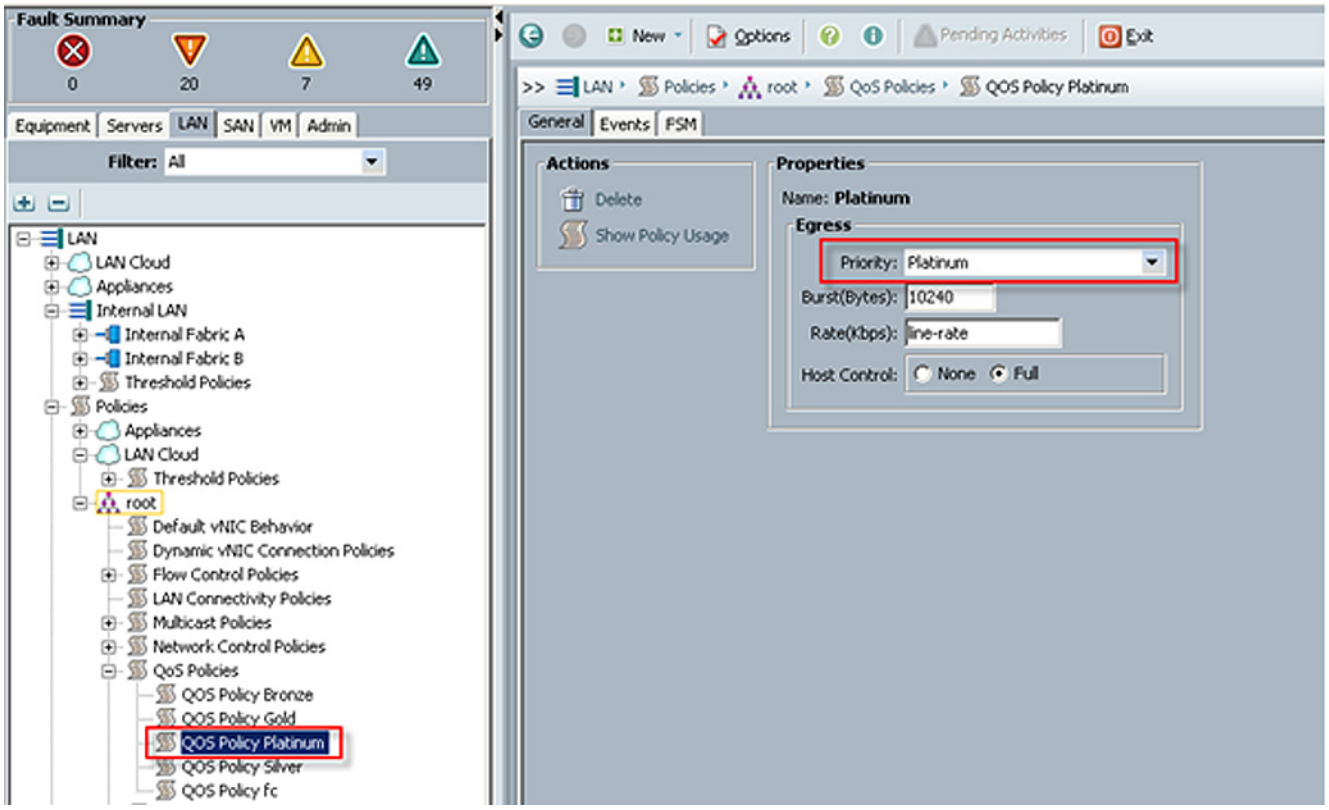
Note In this study, a separate VLAN is used for storage.



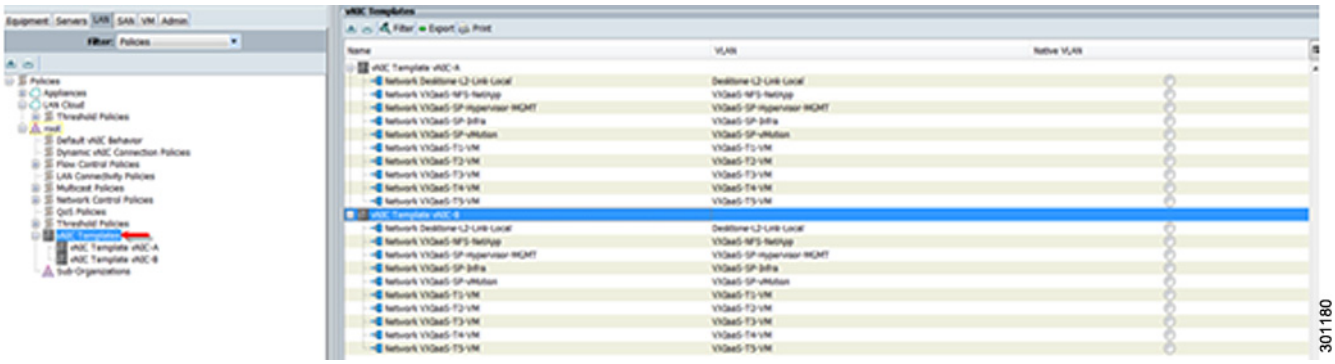
Step 14 Enable the different priorities, Platinum, Gold and Silver for QoS System Class



Step 15 Add the QoS policy with its corresponding priority



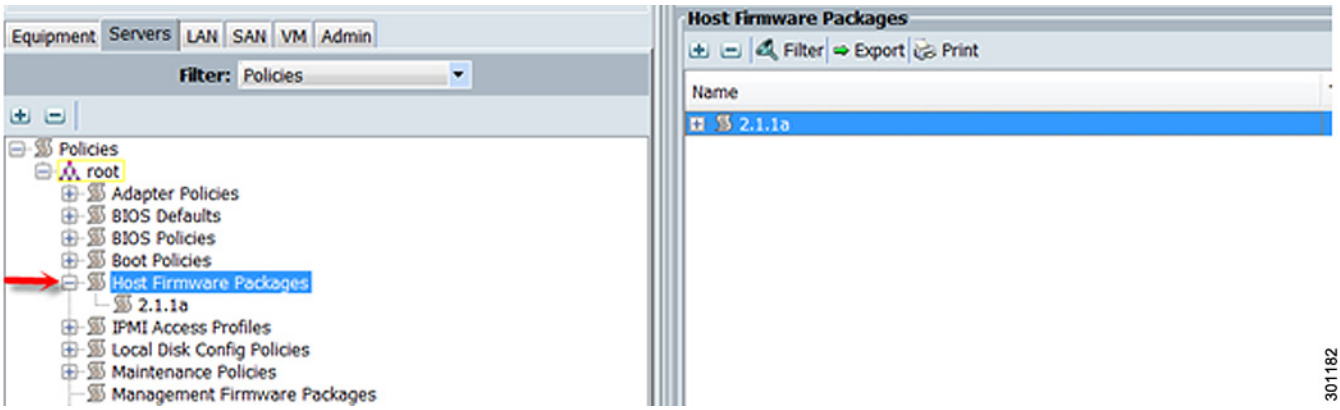
Step 16 From the LAN tab in the navigator pane, under the policies node configure the vNIC templates to be used in the Service Profiles.



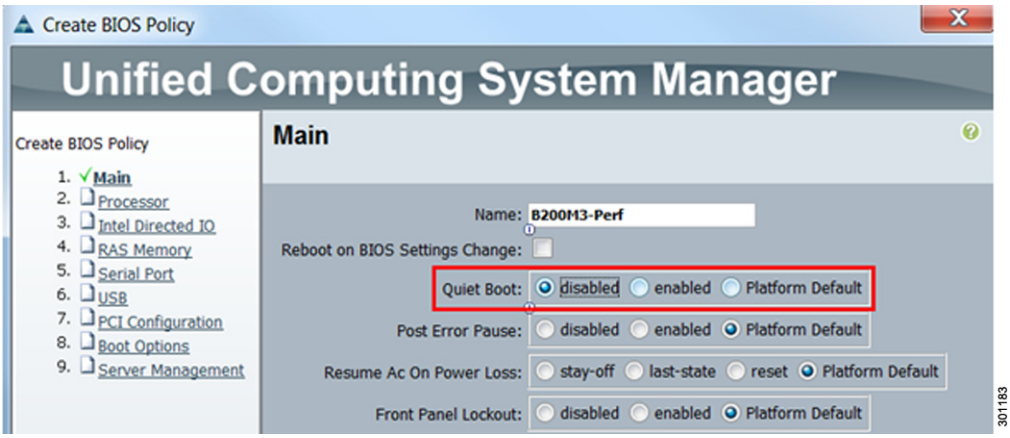
Step 17 Create vNIC templates for both fabrics and select the VLANs to be supported, MTU size and QoS policy.

Step 18 New in Cisco UCS Manager 2.1(1a) is a method to set Host Firmware Package polices that can be set by package version across the Cisco UCS domain rather than by server model.

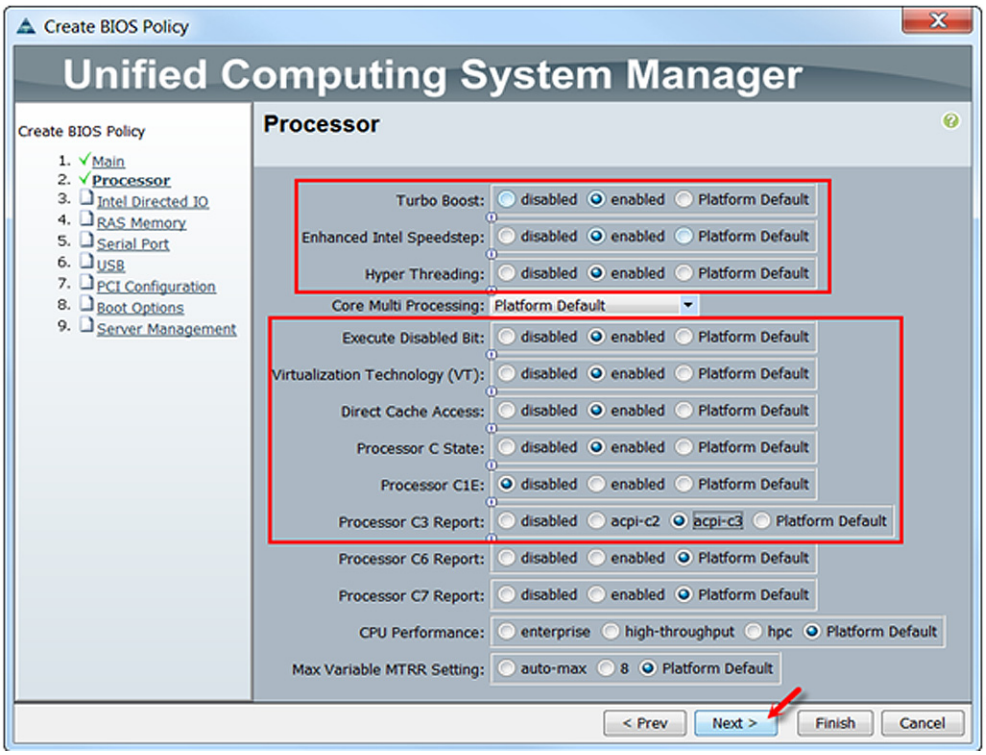
Note You can create specific packages for different models or for specific purposes.



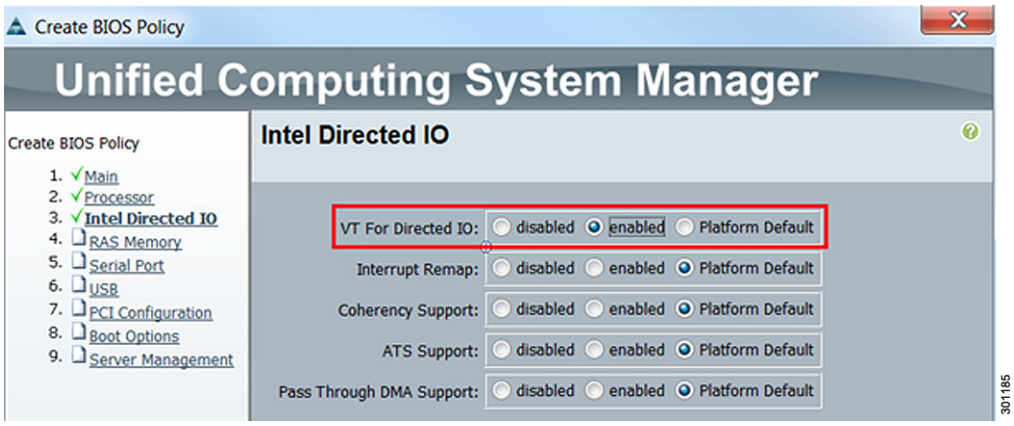
Step 19 Create a BIOS policy under Servers -> Policies -> BIOS Policies for the Cisco UCS B200 M3 blade servers.



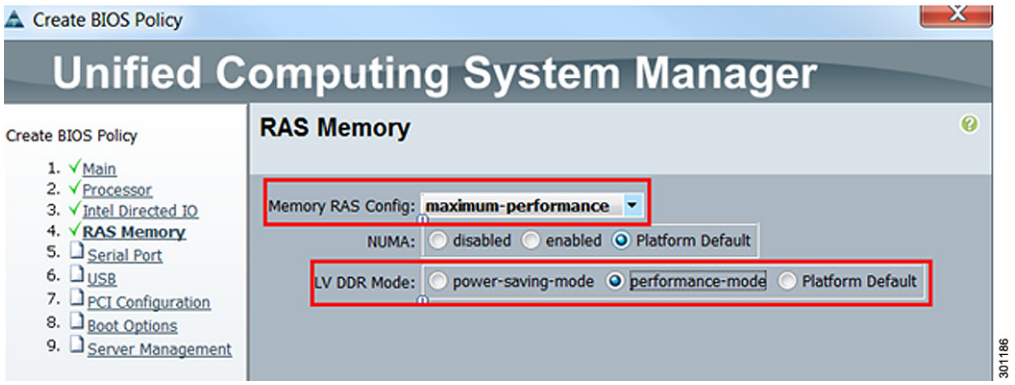
Step 20 Choose the highlighted settings for Processor.



Step 21 Enable VT for Directed IO.

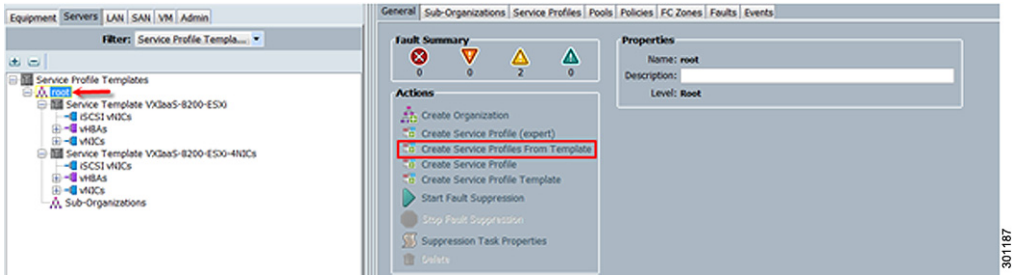


Step 22 Choose the following Memory settings:

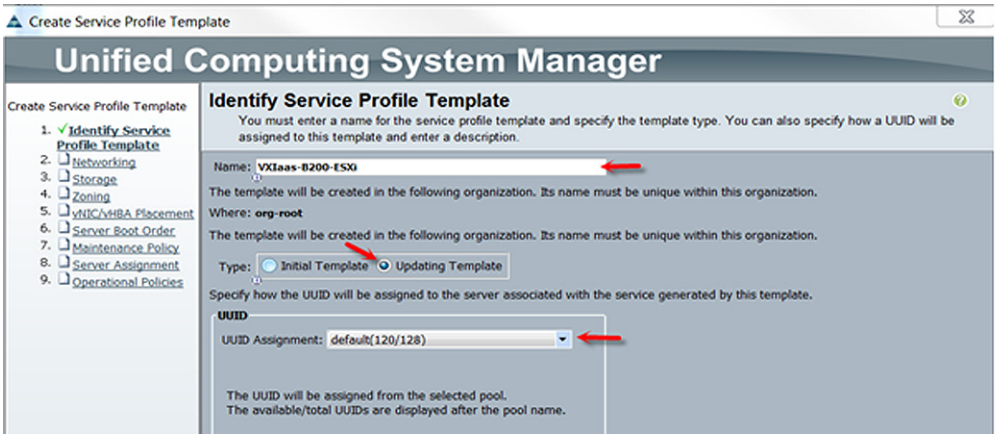


Step 23 Keep the default settings for the other options and click Finish.

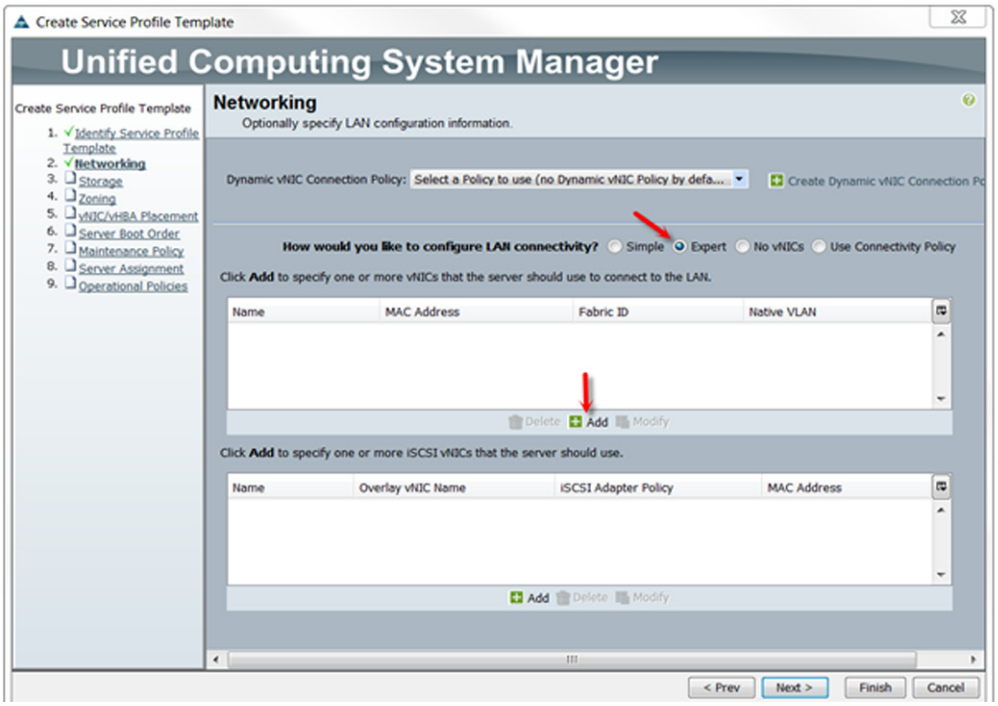
Step 24 Create a service profile template using the pools, templates, and policies configured above.



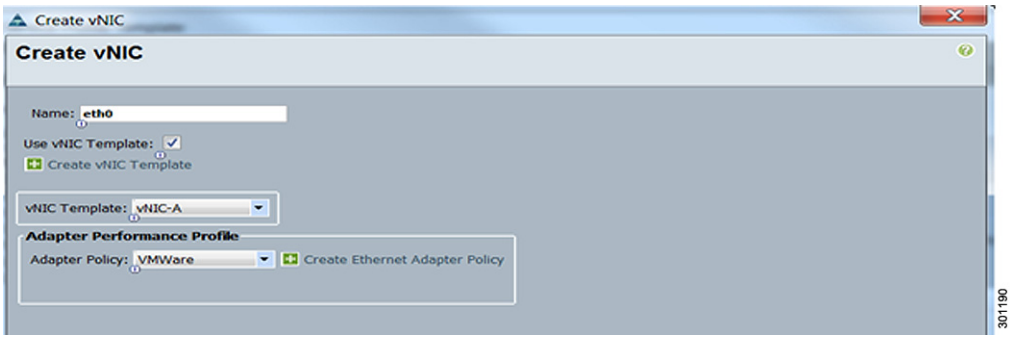
Step 25 For the Identify Service Profile Template, enter a unique name, select the type Updating Template, and click Next.



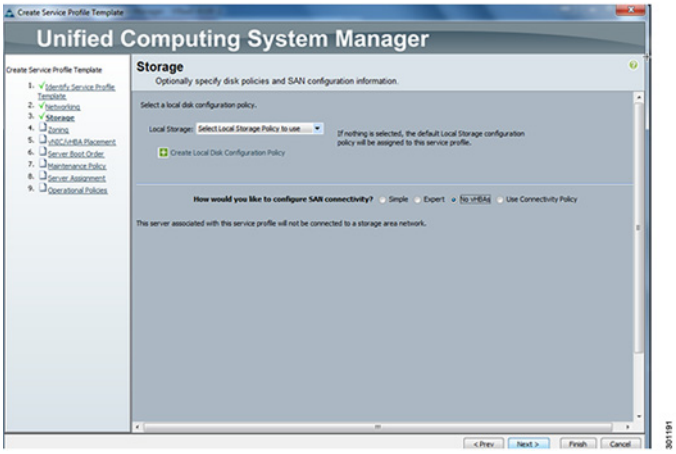
Step 26 For the Networking option, select Expert and click Add in the adapters window.



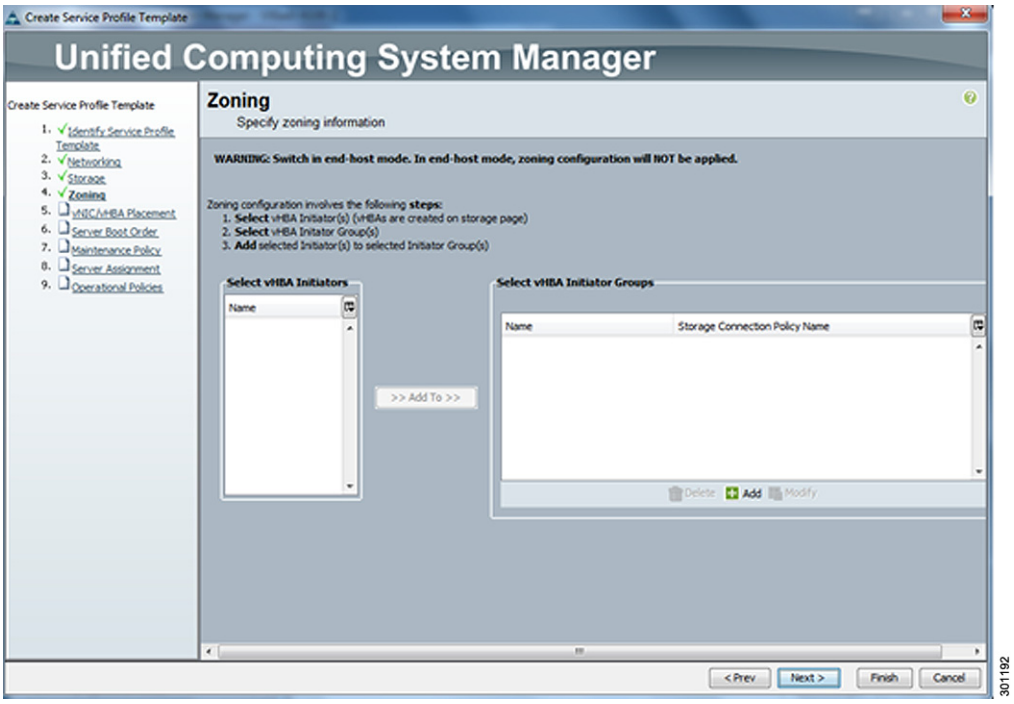
Step 27 Create vNIC and check Use vNIC Template.



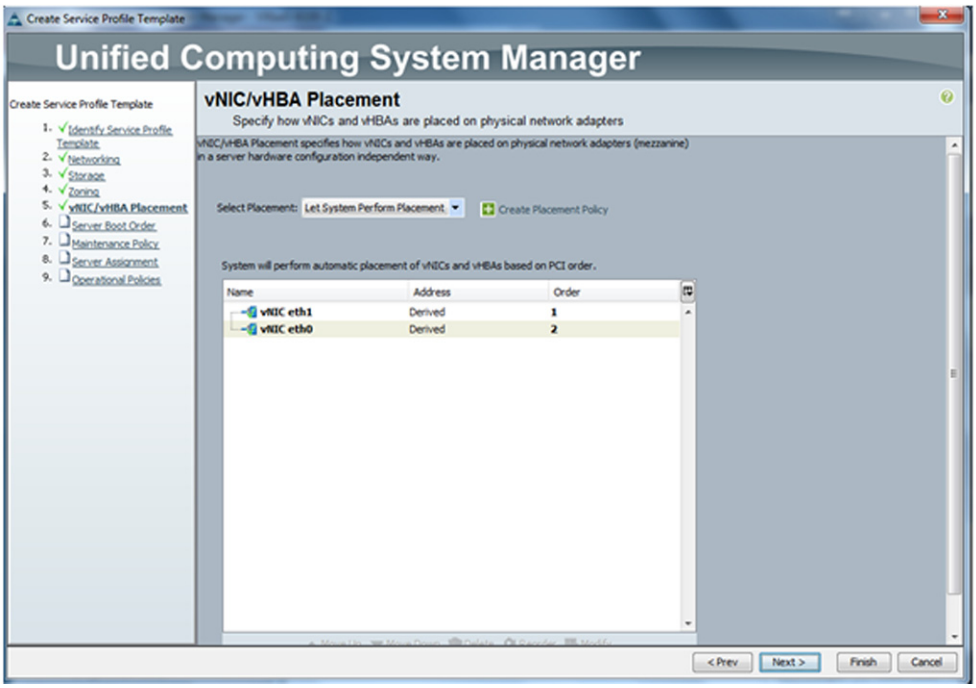
Step 28 Select No vHBAs option since SAN is not used in this study.



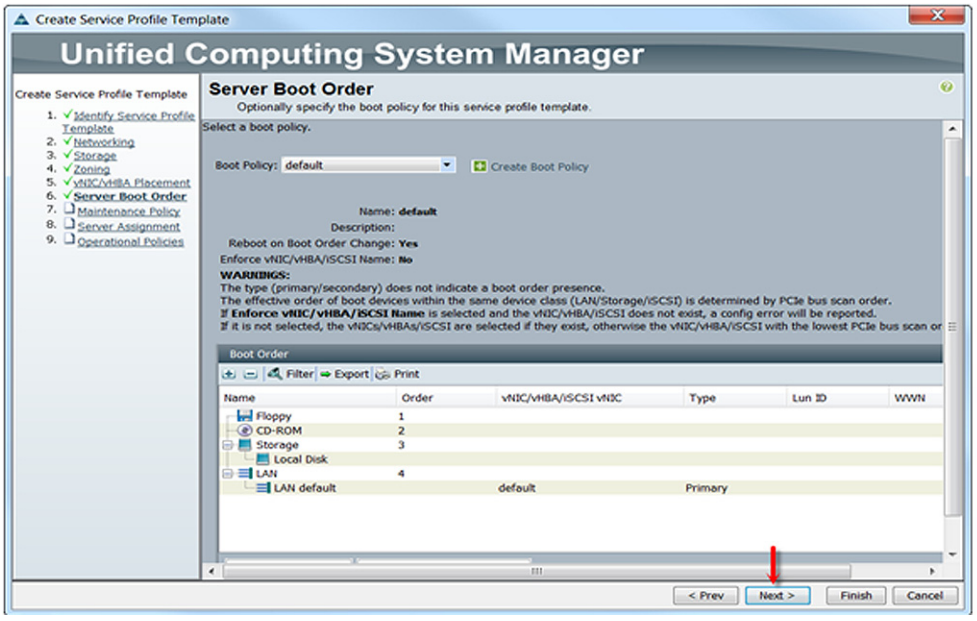
Step 29 Click Next since no Zoning is required.



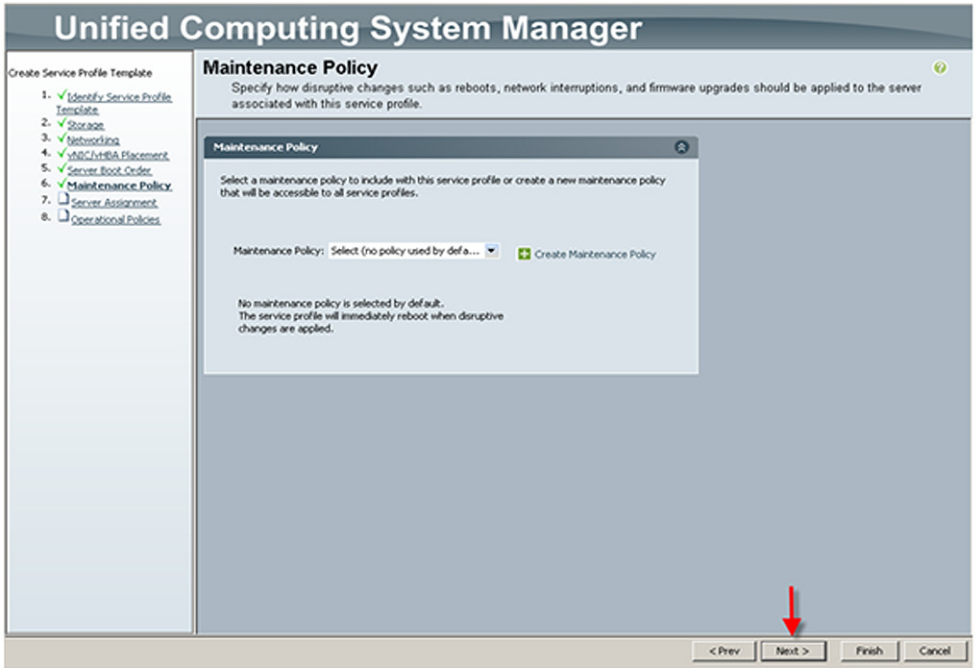
Step 30 Accept Default placement and click Next.



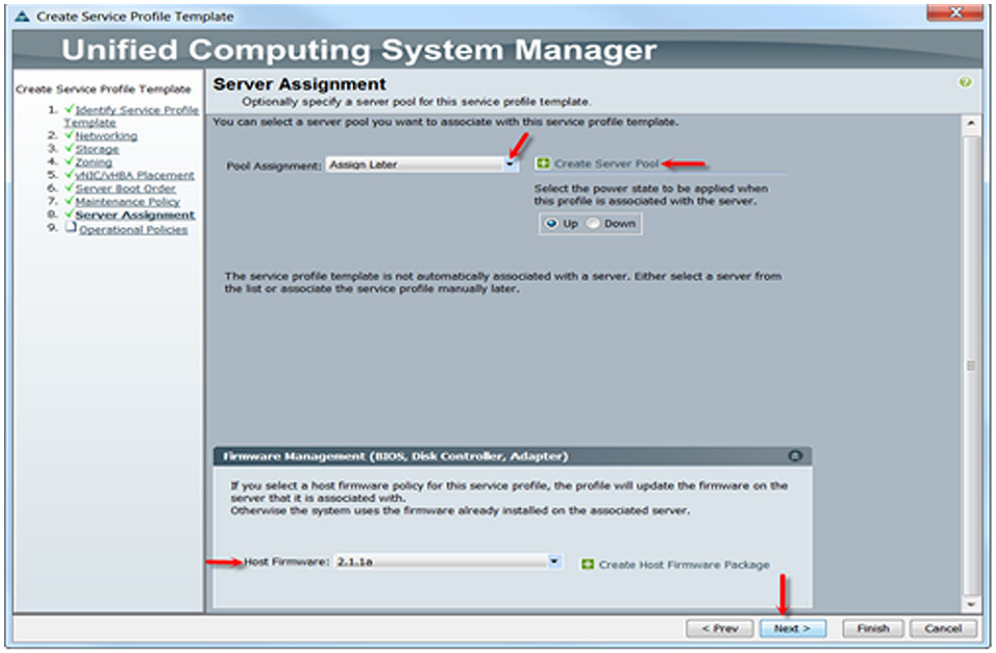
Step 31 Select default boot policy.



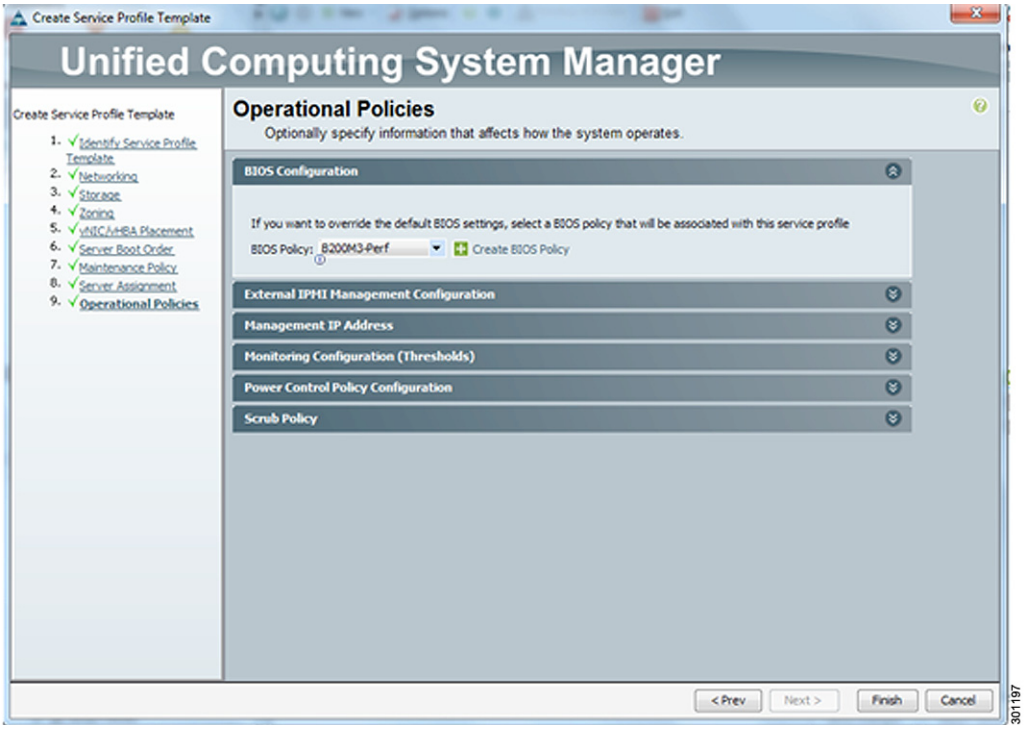
Step 32 A Maintenance policy was not used in this study. Click Next to continue.



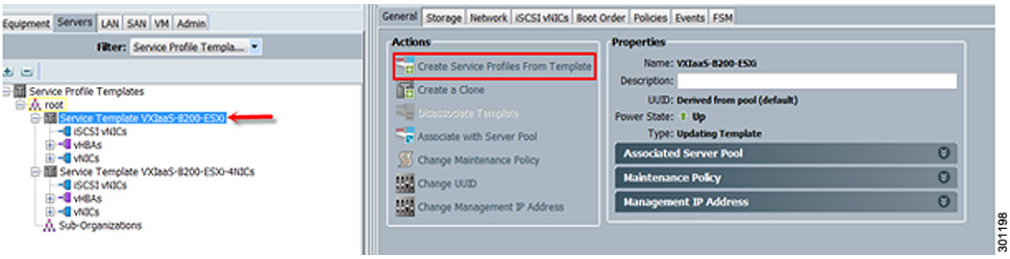
Step 33 For the Server Assignment option select default pool created or create a new server pool. Select Host Firmware package to be applied and click Next.



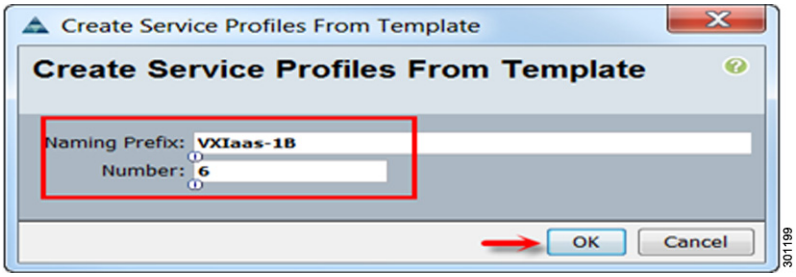
Step 34 Choose the BIOS policy created and click Finish to complete the Service Profile Template.



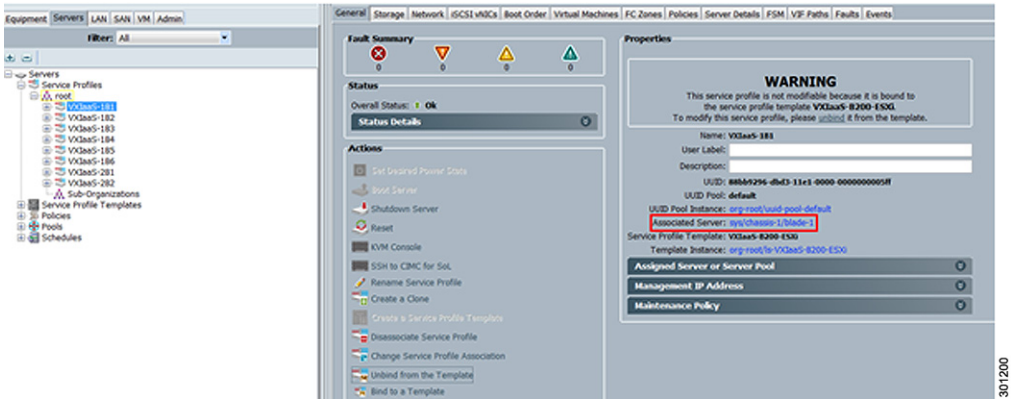
Step 35 Create a Service Profile from Template.



Step 36 Provide a Naming Prefix and the number of service profiles to be created from the template.



Step 37 Service profiles are assigned to the servers.



Installing and Configuring VMware vSphere

Install VMware ESXi

ESXi was installed from the Cisco UCS Manager (UCSM) KVM console using a ESXi 5.1 ISO image downloaded from the VMware site.

The IP address, hostname, and NTP server were configured using Direct Console ESXi Interface accessed from Cisco UCS Manager KVM console.

See the following VMware documentation for details about configuring network settings:

http://pubs.vmware.com/vsphere-50/topic/com.vmware.vsphere.install.doc_50/GUID-26F3BC88-DAD8-43E7-9EA0-160054954506.html.

Install and Configure VMware vCenter

A Cisco UCS B200 M3 blade server was used to host the virtual machines used for SP management including Microsoft Active Directory, DNS, DHCP server, etc., and also for hosting the vCenters used for Desktone environment.

To manage hypervisors and virtual machines on hosts reserved for Desktone Appliances, a dedicated vCenter server instance was installed on a Windows 2008R2 virtual machine.

An identical vCenter server was dedicated for managing the hypervisors and desktops for all tenants.

Table 5 vCenter Server Configuration

VMware vCenter Server			
OS:	Windows 2008 R2	Service Pack:	
CPU:	4vCPUs	RAM:	16GB
Disk:	80GB	Network:	1x10Gbps

To support vCenter instance, one Microsoft SQL Server 2008 R2 was created to host vCenter database.

It is recommended to utilize fault tolerance at the SQL Server level, refer to Microsoft documentation about configuring SQL Server clusters:

http://msdn.microsoft.com/en-us/library/ms189134(v=sql.105).aspx

To install and configure vCenter, perform the following steps:

Step 1 Install the Microsoft® SQL Server® 2008 R2 Native Client for ODBC connections

(http://www.microsoft.com/en-us/download/details.aspx?id=16978 look for Native Client for your architecture)

Step 2 Create a System DSN (control panel, administrative tools, Data Sources ODBC) and connect to your vCenter-SQL server.

Note Make sure to use FQDNs throughout this installation.

Step 3 Install vCenter server package and connect to the database.

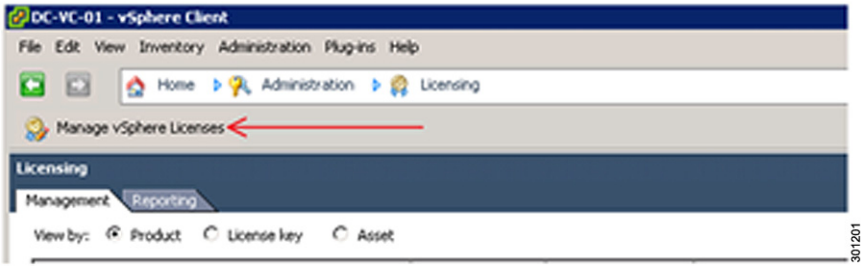
Step 4 Connect your vSphere client to vCenter and create a datacenter.

Step 5 Create a self-signed certificate. (http://kb.vmware.com/selfservice/microsites/search.do?language=en_US&cmd=displayKC&externalId=1021514).

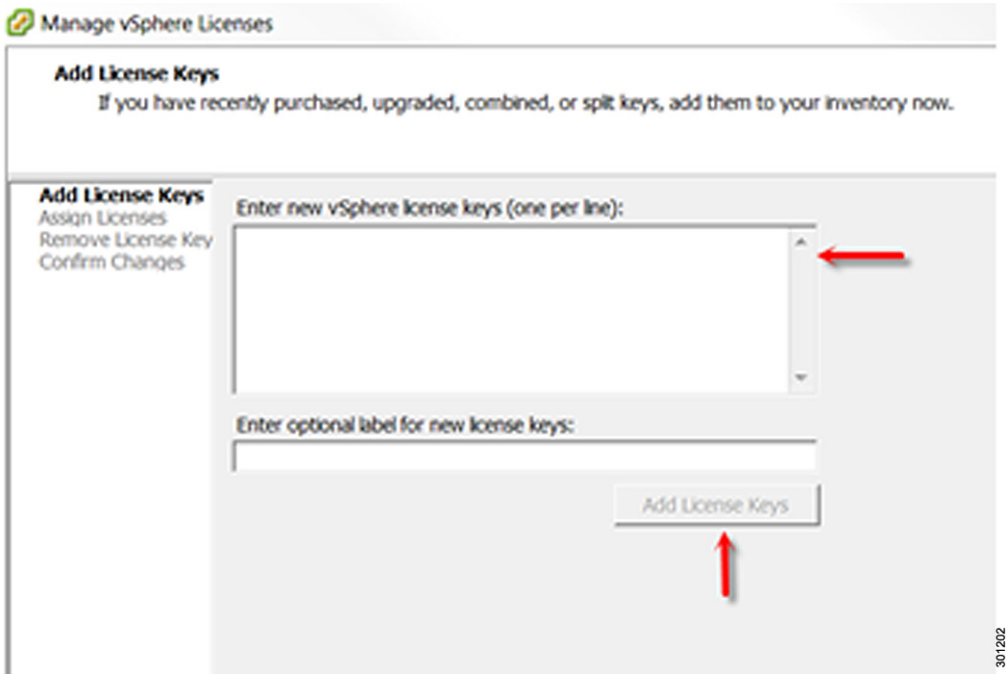
Install Licenses

Step 1 Connect to vCenter using vSphere client.

Step 2 Go to Home --> Administration --> Licensing and click Manage vSphere Licenses.



Step 3 Add License keys for vCenter and Hosts and click Next.



Step 4 Enter the license key and add an optional label.

Step 5 Repeat the above-mentioned procedure to create another instance of vCenter; one for Desktone appliances and another one for tenant desktops.

VMware vSphere Network Configuration for Desktone Appliances

The VLANs for service provider network is added in vSwitch of the vCenter reserved for Desktone appliances.

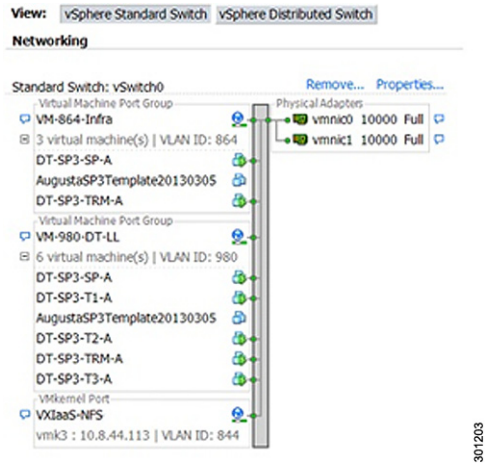
A separate VLAN is used for Desktone Platform management traffic. It is a non-routable subnet with a link-local address. A link-local address is an IP address used only for communications within a link (segment of a local network) or a point-to-point connection to which a host is connected. Routers do not forward packets with link-local addresses. The address block 169.254.1.0 through 169.254.254.255 is reserved for link-local addressing in Internet Protocol Version 4. You cannot choose addresses outside this range.

Note If you have more than one data center, the link-local address space must be unique (non- overlapping) across data centers.

The configured VLANs must be the same across all management hosts.

- VLAN 864 for Service Provider Network
- VLAN 980 for Link Local
- VLAN 844 for Storage

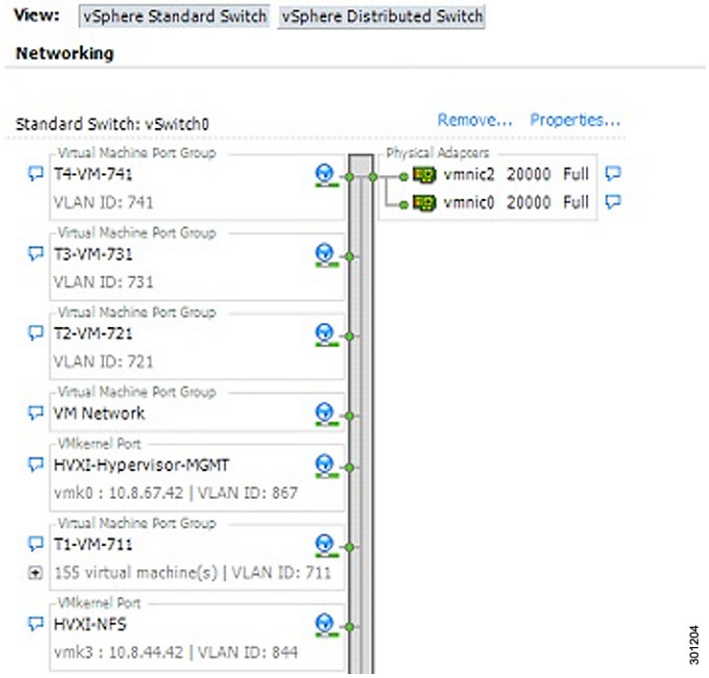
Figure 11 vSwitch for Desktone Appliances



VMware vSphere Network Configuration for Desktone Tenant Appliances

The tenant VLANs and the VLAN for storage are added to the vSwitch of the vCenter reserved for tenant desktops. Tenant 1 was used for this study. The VLAN assigned for Tenant 1 is 711.

Figure 12 vSwitch for Tenant hosts



Creating the Golden Image

Before defining a virtual machine as your gold template you need to create your template. A new OS installation is strongly recommended, which should be customized to VDI best practices.

For details about Windows 7 VDI best practices, see
http://www.vmware.com/files/pdf/VMware-View-OptimizationGuideWindows7-EN.pdf

Note 32bit Windows 7 OS with 1 vCPU, 1.5GB RAM, 24GB HDD, and one 10GB vNIC were used for testing.

Steps to Customize the Golden Image Virtual Machine

Step 1 Install VMware tools on Windows 7 VM.

Step 2 Verify NIC settings. Confirm the adapter type is VMXNET3.

Step 3 Set the power option to High Performance.

Step 4 Enable Administrator account and RDP access.

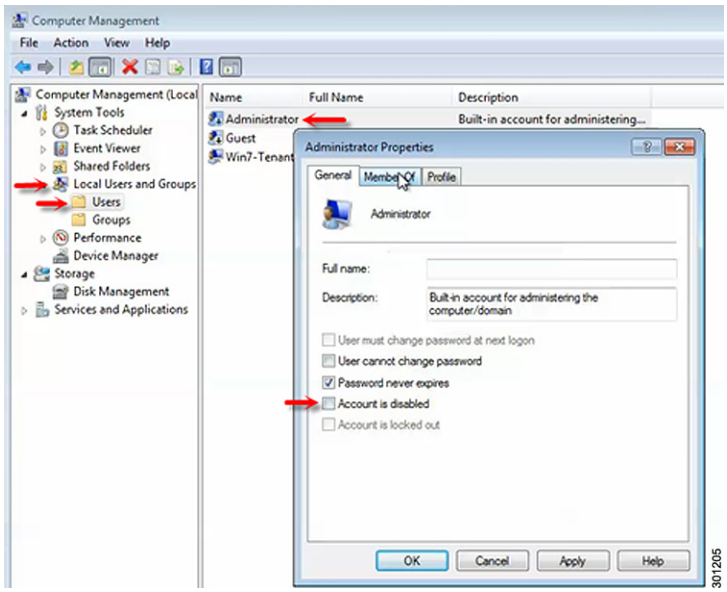
Step 5 Right-click Computer and select Manage.

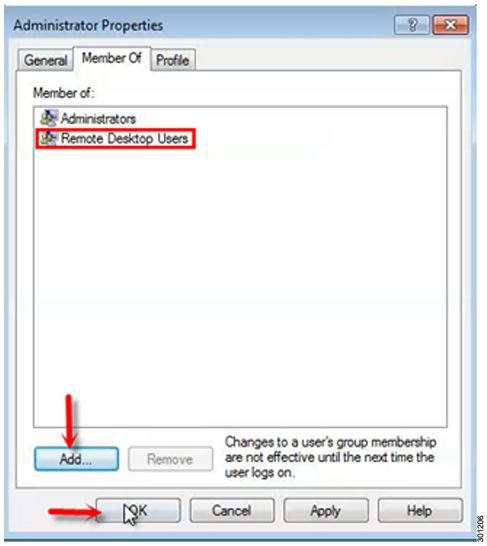
Step 6 Select Local Users and Groups --> Users.

Step 7 Right click the Administrator user and select Properties.

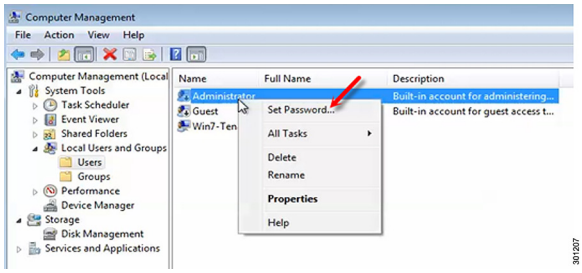
Step 8 From the General tab, uncheck Account is disabled.

Step 9 From the Member Of tab, confirm Administrator is a member of "Remote Desktop Users"





Step 10 Set the Administrator password.



Step 11 Apply PCoIP GPO (.adm file) and configure protocol settings.

Step 12 Confirm the Windows firewall is disabled.

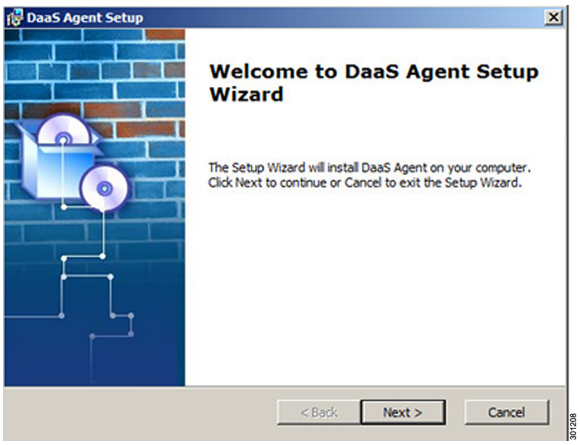
Step 13 Confirm the Windows Updates are current and then disable Windows Updates.

Step 14 Log in as Administrator and remove all other accounts on the virtual machine.

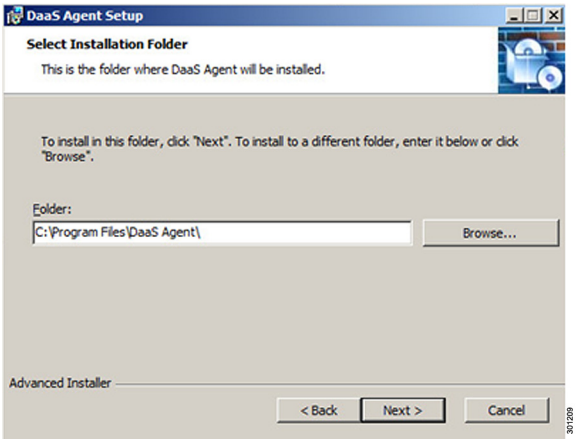
Installing the Desktone DaaS Agent.

Step 1 Copy the DaaSAgent_5.3.1.msi installer file onto the Windows 7 VM and double- click to start the Install.

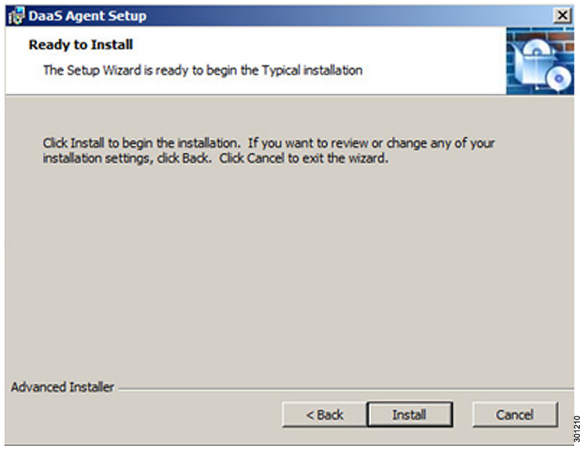
Step 2 Click Next.



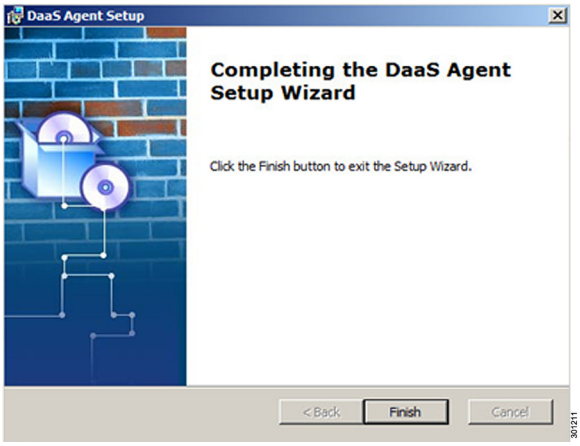
Step 3 Select a specific path for installation or leave it as default. Click Next.



Step 4 Click Next.



Step 5 Click Finish.

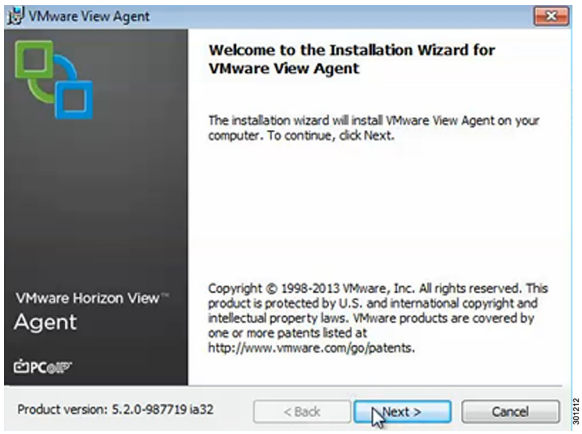


Note The DHCP option code 74 needs to be configured with the tenant appliance IP addresses. This will be utilized by the DaaS Agent to register the virtual desktop to the tenant appliance.

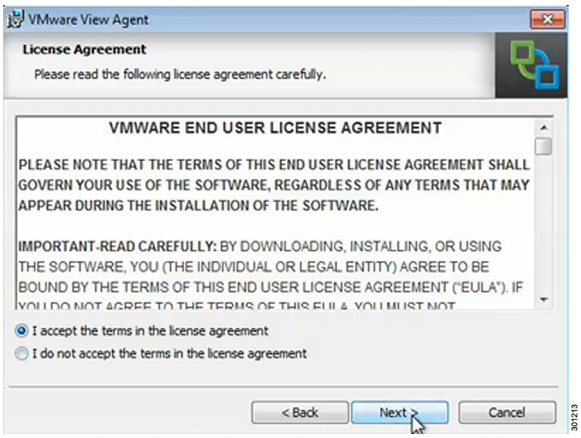
Installing the VMware View Agent

Step 1 Copy the VMware-viewagent-5.2.0-987719.exe file onto the Windows 7 virtual machine.

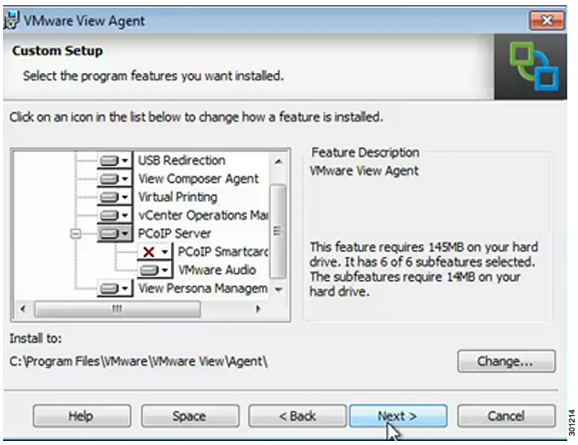
Step 2 Click Next.



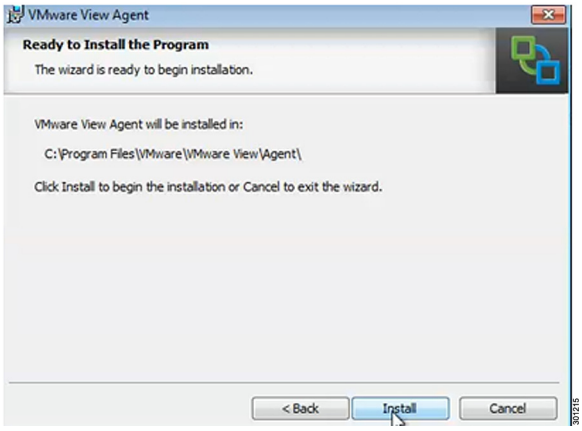
Step 3 Accept the User License Agreement. Click Next.



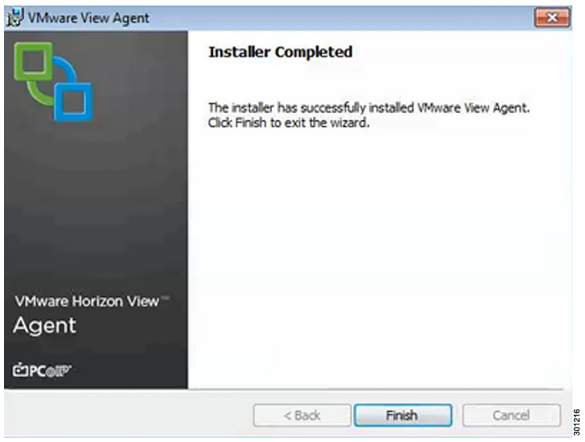
Step 4 Click Next.



Step 5 Click Install.



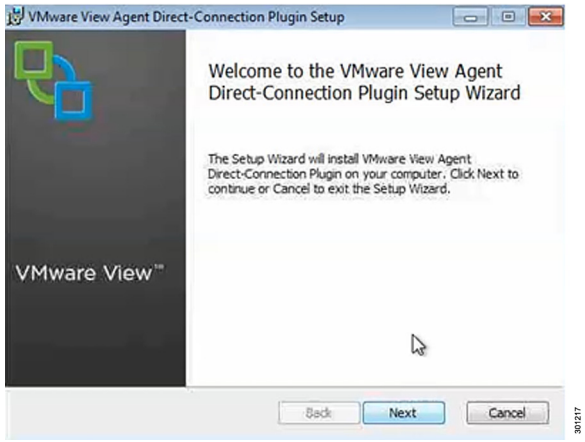
Step 6 Click Finish. A pop-up will then display and prompt a reboot.



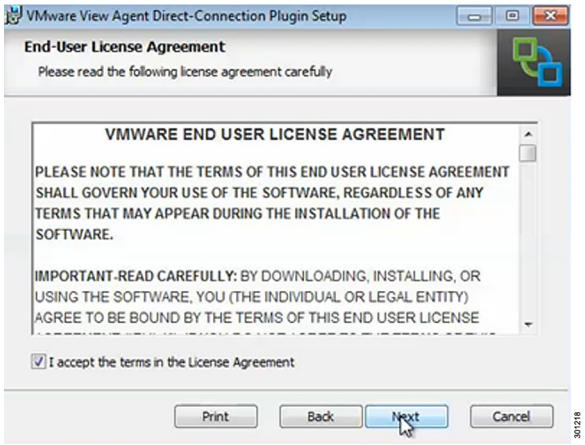
Installing the VMWare View Agent Connect

Step 1 Copy the VMware-viewagent-direct-connection-5.2.0-987719.exe installer file to Windows 7 Golden virtual machine.

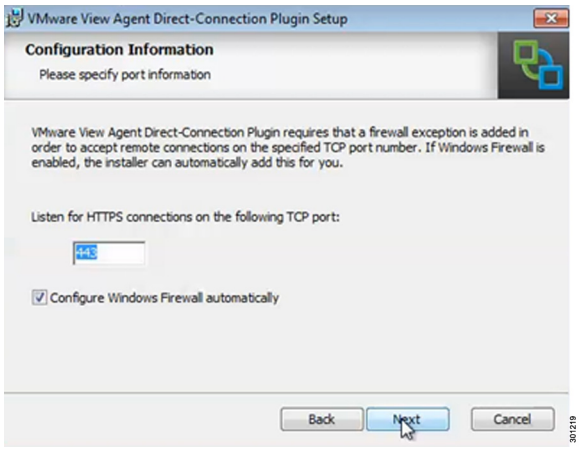
Step 2 Click Next.



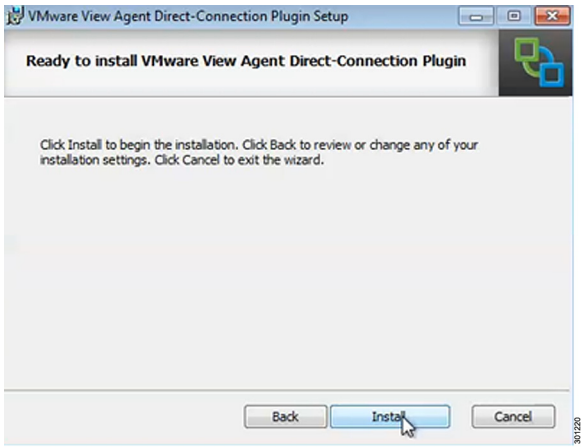
Step 3 Accept the End User License Agreement. Click Next.



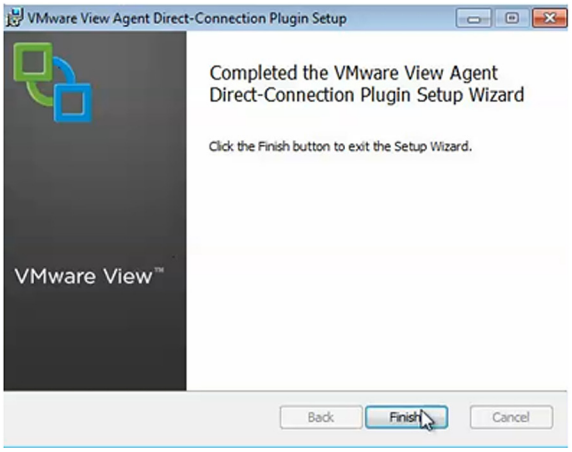
Step 4 Click Next.



Step 5 Click Install.



Step 6 Click Finish.



Note Golden virtual machine must exist on the same datastore and VLAN where the desktops would reside.

Repeat the steps outlined in section Creating the Golden Image for preparing the Windows 7 golden image for other tenants.

Installing and Configuring Desktone

Building a Desktone environment requires the installation of the following components:

- Desktone Service Provider Appliances
- Desktone Resource Manager Appliances
- Desktone Tenant Appliances

Installing Desktone Primary Service Provider Appliance

Download the following required files for installation.

Note Use the worksheets from Desktone to make sure you capture all the required information before you begin the installation.

Table 6

File Contents	File Names
Appliance template	AugustaSP3Template20130305.ova
5.3 debians	dt-platform-5_3_0.deb and dt-aux-1_1_0.deb
Patch	Dt-platform-5_3_0_patch_1.tgz,
Dt-platform-5_3_0_patch_2.tgz	

Note On both management hosts, add the Service Provider datastore. Be sure to use the same name on each host.

Step 1 From the vSphere Client for Service Provider, click on File, Select File and select Deploy OVF Template to deploy the first copy of the ova file.

Note This ova file becomes the first Service Provider appliance.

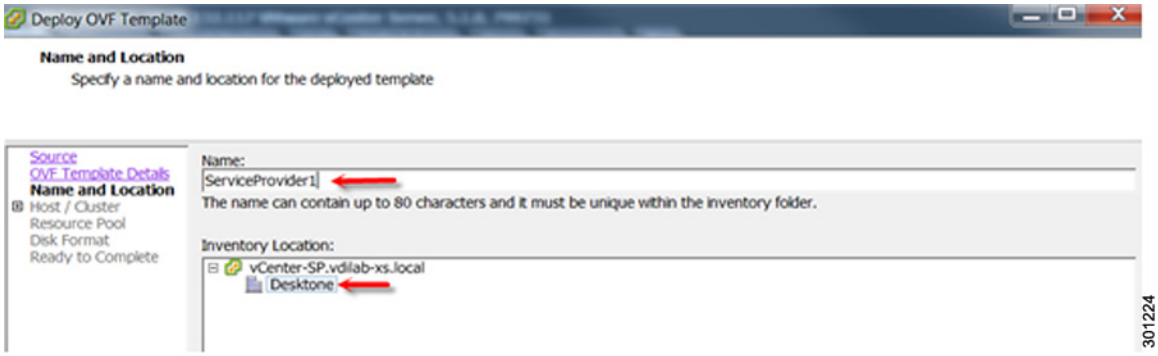
Step 2 Click Browse and select AugustaSP3Template.ova file

Step 3 Click Next.

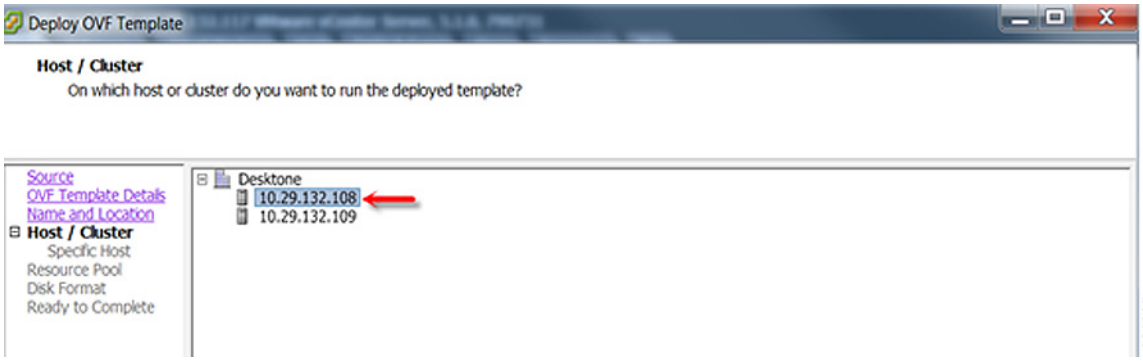
Step 4 Review the OVF template details and click Next.

Step 5 Select a Name and the data center for Service Provider Appliance.

Note Do not use any special characters for the name.



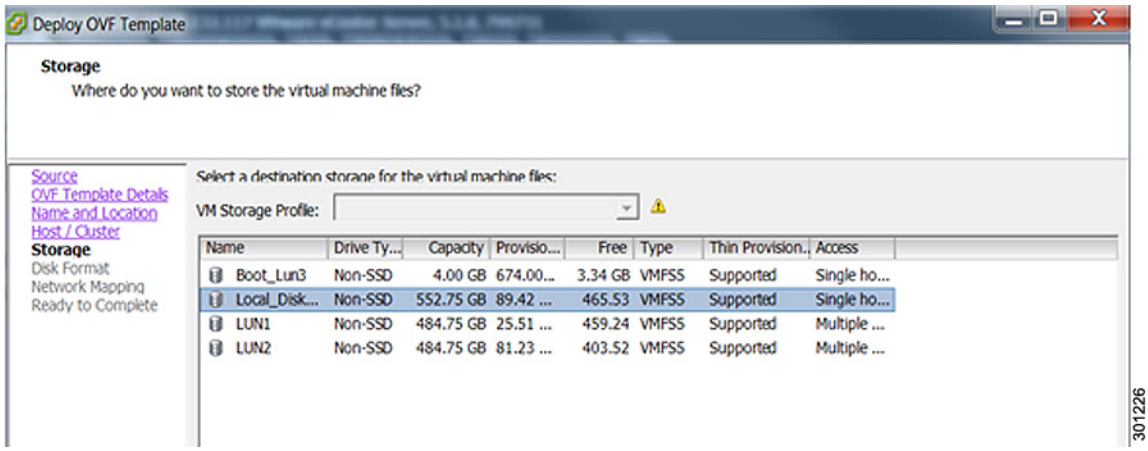
Step 6 Select the host where the virtual machine will reside on and click Next.



Step 7 Deploy the Desktone Service Provider Appliance to local storage on one of the two management hosts.

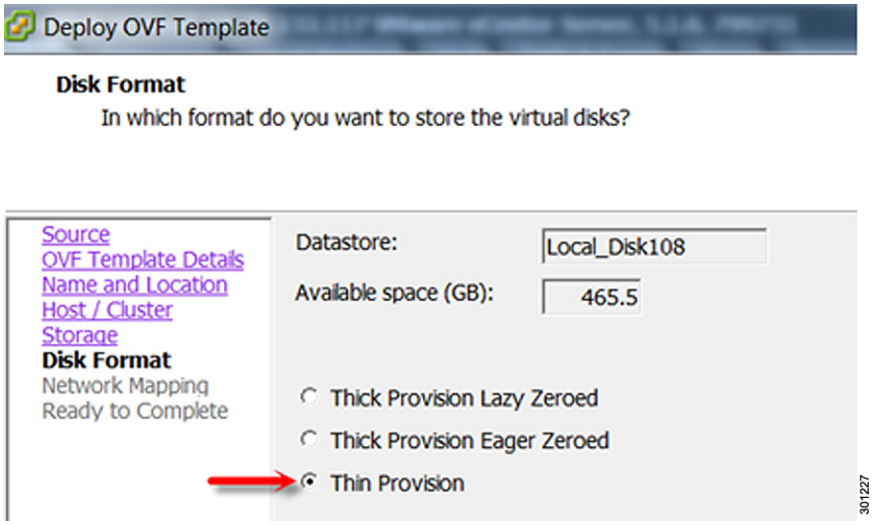
Note

- By default, the Desktone Platform will clone out management appliances on the local disk (through a localdatastore). This is considered a best practice. However, if desired, it is possible to use shared storage for management appliances.
- If using shared storage for management appliances on vCenter, there are a few guidelines:
- Any shared storage (NFS, iSCSI, or FC) can be used.
- Datastores must be manually created on each of the management hosts.The datastore name must be identical (case sensitive) on each management host.

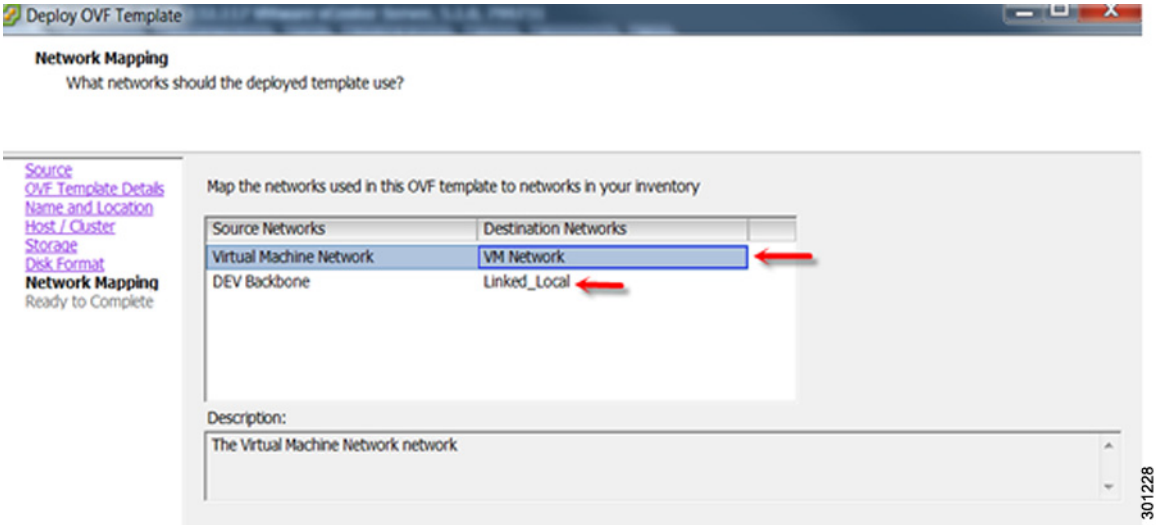


Step 8 Select Thin Provision.

Step 9 Click Next.

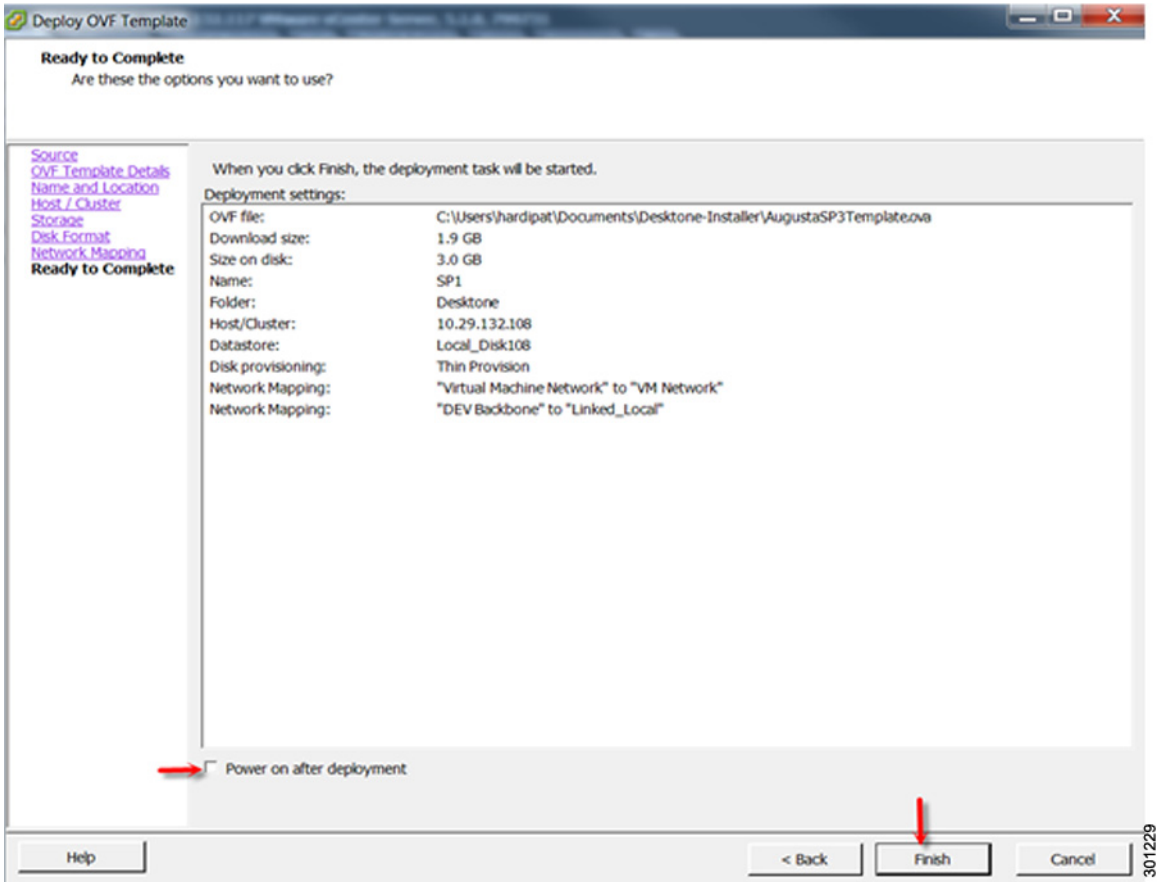


Step 10 Select the service provider network as the destination for the first source network; Virtual Machine Network and Link Local for the second source network, Dev Network.



Step 11 Review the deployment settings and select the check box to power on the virtual machine after deployment

Step 12 Click Finish.



Step 13 Repeat the steps 1-12 to deploy the second copy of the ova file, which becomes the template for all subsequent Desktone management appliances. For the template, do not check the box to power on after deployment.

Note The name of the template must be unique across all datacenters.

Configuring the Network on Desktone Primary Service Provider Appliance

Step 1 From the vSphere Client open a console for Desktone Primary Service Provider Appliance.

Step 2 Logon using the default credentials:

- Username: desktone
- Password: Desktone1

Step 3 Begin the bootstrap process by executing the following command:

```
sudo /usr/local/desktone/scripts/bootstrap.sh
Enter password for Desktone: Desktone1
```

Step 4 The bootstrap script prompts you to enter the network information.

Note The host reboots after entering the network information. Because the node is not configured until the reboot completes, disregard any error messages displayed on the console.

Field	Sample Value	Notes
Existing multi datacenter setup	No	Select “No” to install the first datacenter
Datacenter Name	Desktone	Use Location Name if you have multiple DCs
IP for Eth1 (backbone)	169.254.1.10	For the Backbone network (must be a link-local address)
Enter netmask CIDR format 0-32	24	Use /22 for large number of tenants
Enter Ip for eth0 (SP)	10.29.132.119	For the SP network
Enter netmask CIDR format 0-32	24	For the SP network
Enter Gateway	10.29.132.1	For the SP network
Enter hostname	Sp1.vdilab-xs.local	
Enter nameserver	10.29.132.30	
Enter NTP servers	Ntp.ubuntu.com	
Is this an HA Service Provider appliance setup?	Yes	
Enter the floating IP address	10.29.132.120	
Enter psql password	XYZabc123	This alters the psql passwords for admin, master, slave and slony user.
Appliance password	Password123	The user-defined password for Service Provider appliances in this datacenter. Any Service Provider appliances accessible by ssh requires this custom password.
Does this configuration Look correct?	Yes or No	Review the information applied and select Yes or No.

```
Is this Service Provider appliance part of an existing multi Data Center setup?
If this is the first Data Center, answer no.

Answer yes or no: no
Enter Data Center Name:
Desktone
Enter IP for eth1 (backbone):
169.254.1.10
Enter netmask CIDR format 0-32:
24
Enter IP for eth0 (SP):
10.29.132.119
Enter netmask CIDR format 0-32:
24
Enter Gateway:
10.29.132.1
Enter hostname:
Sp1.vdilab-xs.local
Enter nameserver:
10.29.132.30
Enter NTP servers (if no more NTP servers, press <RETURN>)
If you press enter for the first NTP server, [ntp.ubuntu.com] will be configured
.

Is this an HA Service Provider appliance setup?:
Answer yes or no: yes
Enter the floating IP address:
10.29.132.120
```

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```
After reboot put the latest dt-platform package in the directory: /data/repo/


Does this configuration look correct?

Data Center Name: Desktone
Hostname: Sp1.vdilab-xs.local
eth1 IP: 169.254.1.10
eth1 Netmask: 255.255.255.0
Backbone IP Block: 169.254.1.0/24
eth0 IP: 10.29.132.119
eth0 Netmask: 255.255.255.0
eth0 CIDR: 24
Gateway: 10.29.132.1
HA Transit Server IP: 169.254.1.11
Floating IP: 10.29.132.120
Data Center UID: 256a98db-ed4e-4604-9dfe-b388a5913e31
Nameserver: 10.29.132.30
Data Center Master: True
Multi Data Center: False
NTP Server 1: ntp.ubuntu.com
VMGR UID: 09b83774-cabf-4250-aa01-d55102950da0
Answer yes or no: yes
```

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Step 5 After rebooting, login with the configured username/password: desktone/Password123

Step 6 Copy the following files to the /tmp directory on the service provider appliance.

```
dt-platform-5_3_0.deb
dt-aux-1_1_0.deb
```

Step 7 ssh into the service provider appliance using login credentials. Move the files copied to /tmp directory into the /data/repo directory on the appliance using the commands:

```
sudo mv /tmp/dt-platform-5_3_0.deb /data/repo
sudo mv /tmp/dt-aux-1_1_0.deb /data/repo
```

```
desktone@Sp1:~$ sudo mv /tmp/dt-platform-5_3_0.deb /data/repo/
[sudo] password for desktone:
desktone@Sp1:~$
desktone@Sp1:~$
desktone@Sp1:~$ sudo mv /tmp/dt-aux-1_1_0.deb /data/repo/
```

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Step 8 Run the bootstrap script a second time to install the Desktone software:

```
sudo /usr/local/desktone/scripts/bootstrap.sh
```

Note It might take up to five minutes for the appliance to start after the reboot. Because the node is not configured until the reboot cycle completes, you can disregard any error messages displayed on the console.

```
desktone@Sp1:~$ sudo /usr/local/desktone/scripts/bootstrap.sh
Selecting previously deselected package dt-aux.
(Reading database ... 37442 files and directories currently installed.)
Unpacking dt-aux (from /data/repo/dt-aux-1_1_0.deb) ...
This is Pre Install script
Setting up dt-aux (1.1.0) ...
This is Post Install script

Processing triggers for ureadahead ...
Selecting previously deselected package dt-platform-5-3-0.
(Reading database ... 37480 files and directories currently installed.)
Unpacking dt-platform-5-3-0 (from .../repo/dt-platform-5_3_0.deb) ...
This is Pre Install script
Setting up dt-platform-5-3-0 (5.3.0) ...
This is Post Install script

Shutting down sfcb: done.
```

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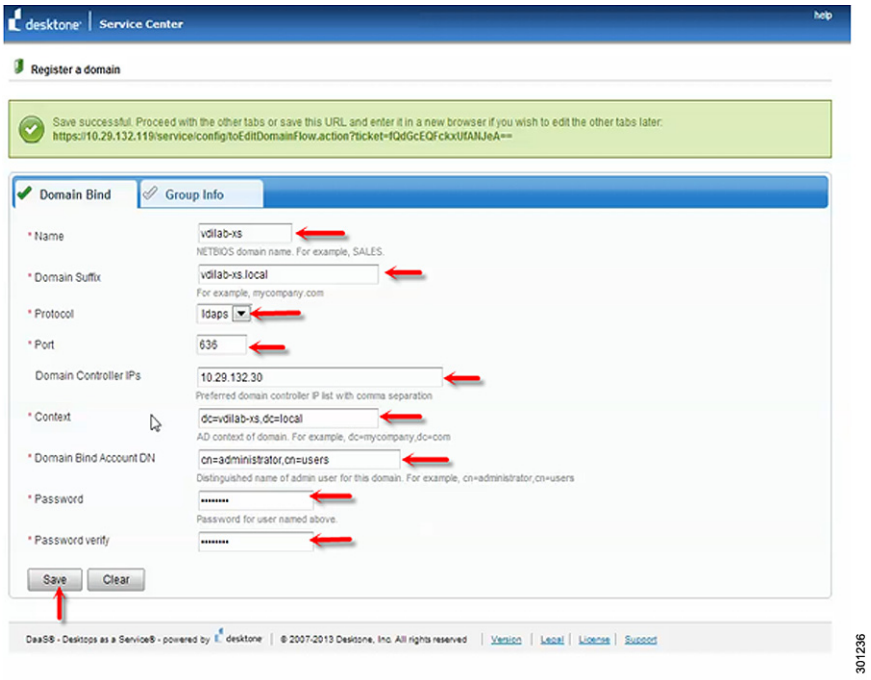
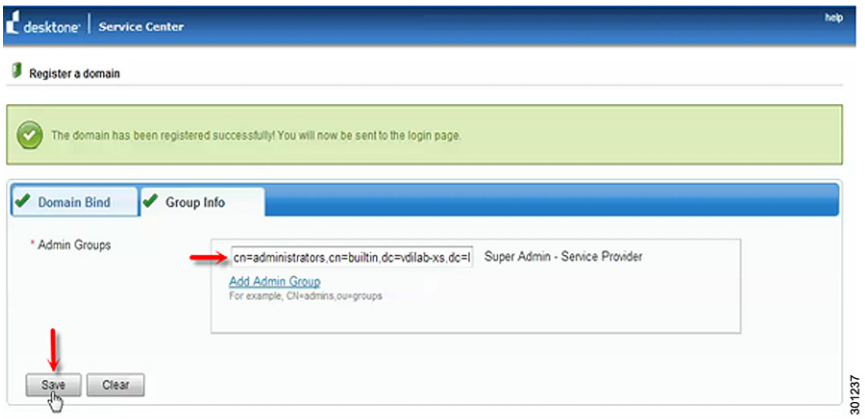
Configuring the Desktone Primary Service Provider Appliance

Step 1 Browse to the Desktone service provider portal by entering the URL or IP address: https://<IP address of service provider appliance>/service

Step 2 Enter the information from the service provider Active Directory and click Save.

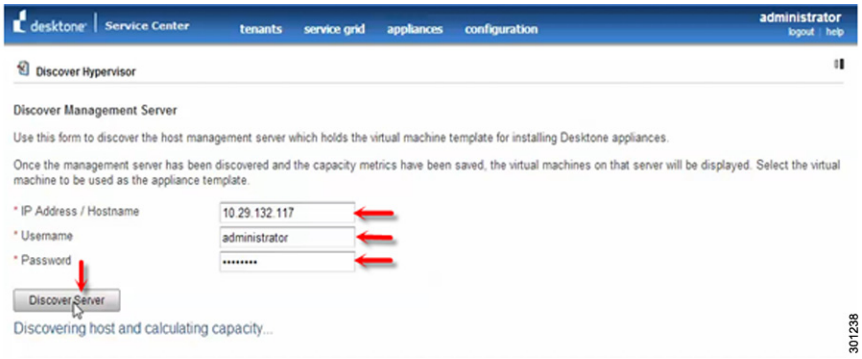
Note The first time, browsing the service center, you will be prompted for Domain Bind and Group Info.





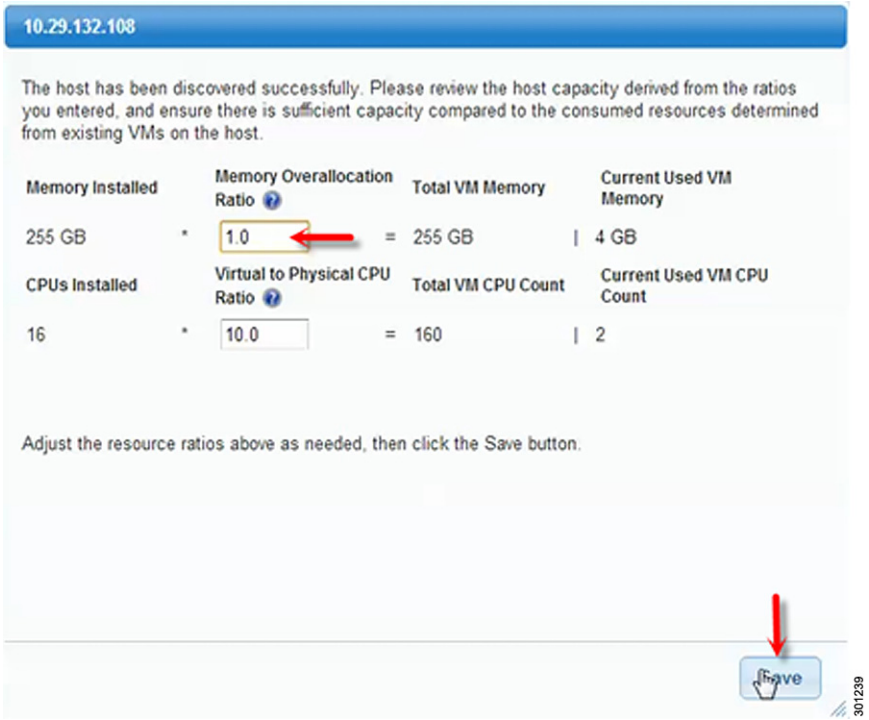
Step 3 Enter a username, password and domain based on the Active Directory information on the service center login page.

Step 4 Enter the IP address or FQDN for vCenter hosting primary Service Provider Appliance, username and password and click Discover Server.



Step 5 Enter the memory over allocation ratio for each discovered host.

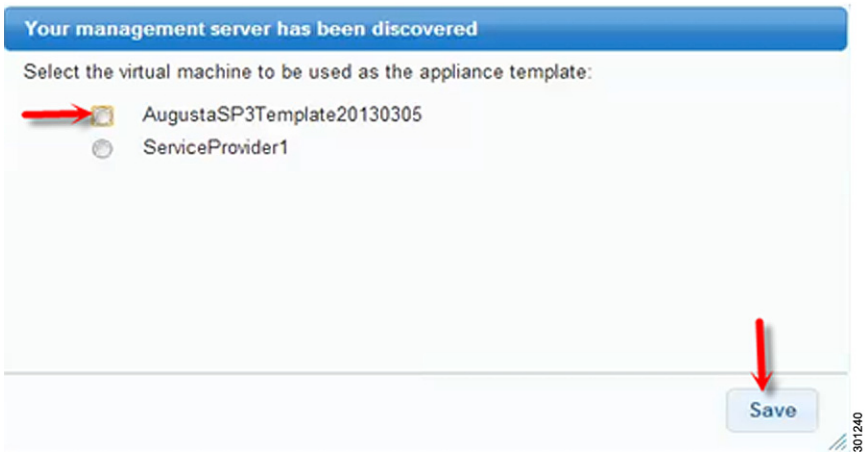
Note If the server is too small to accommodate the ratios, you may be prompted to re-configure them. Click Save to set the ratios.



Step 6 Repeat step 5 for the other ESXi host.

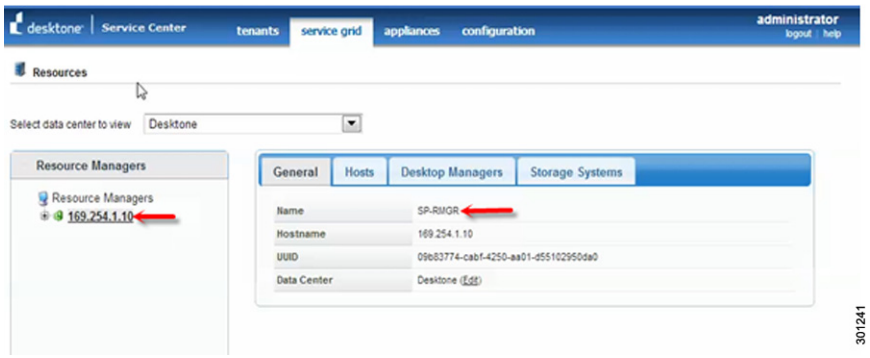
Step 7 After setting the ratios, the Service Center displays a pop-up listing the virtual machines on your host or in your vCenter Data Center.

Step 8 Select the Desktone appliance template to be used for cloning additional management appliances.



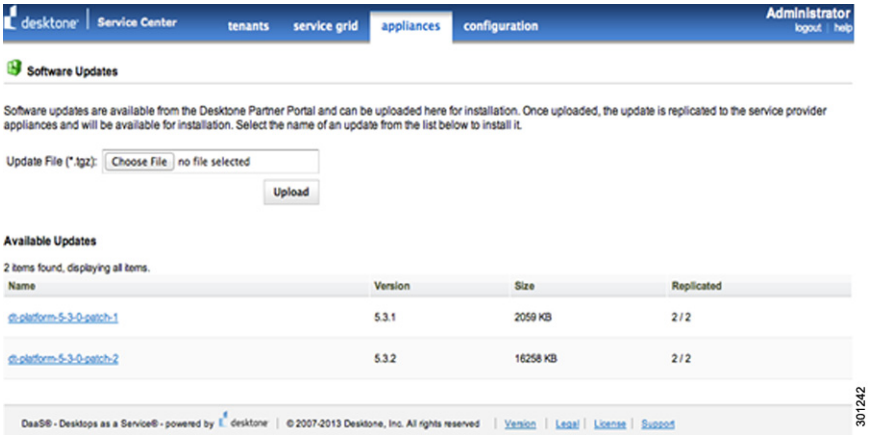
Step 9 Go to service grid --> resources. In the Resource Managers panel on the left, click the IP address of the resource manager.

Step 10 From the General tab, in the Name field, double-click on the IP address of the resource manager. Change the name to a user-friendly name and click OK.



Step 11 Apply the patches for the base image of service provider appliance by clicking appliances --> software update.

Step 12 Browse to the patches to be applied and click on Upload.

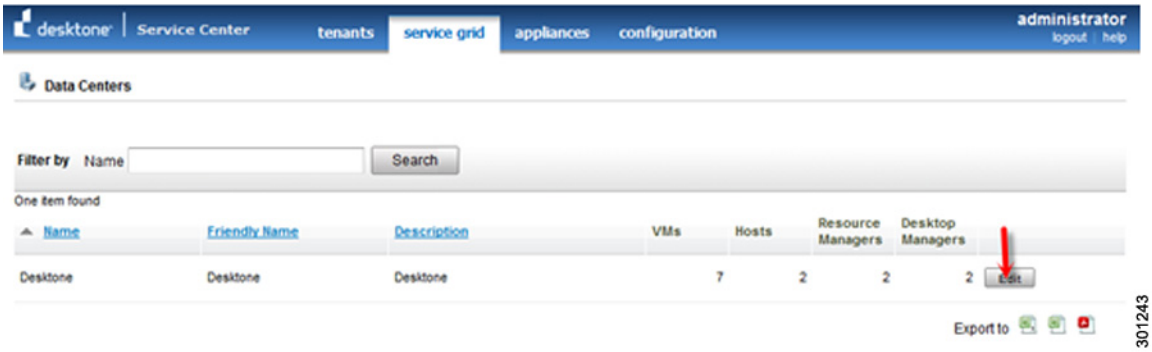


Step 13 SSH into the service provider appliance using login credentials and execute the following commands:

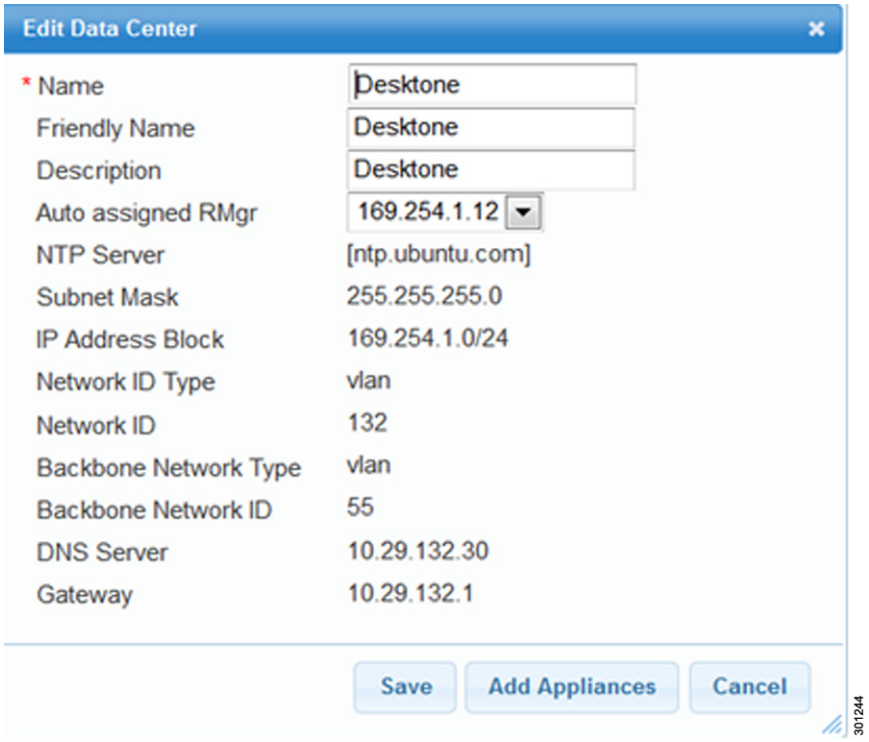
```
cd /data/repo
sudo dpkg -i dt-platform-5_3_0_patch_1.deb
sudo dpkg -i dt-platform-5_3_0_patch_2.deb
sudo service dtService restart
```

Installing the Desktone Secondary Service Provider Appliance

Step 1 Go to Service grid --> data center and click Edit.

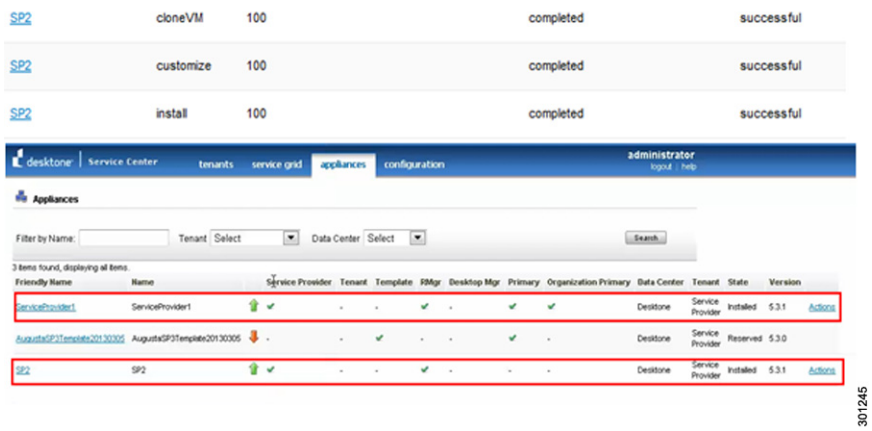


Step 2 Verify the displayed information and click Add Appliances.



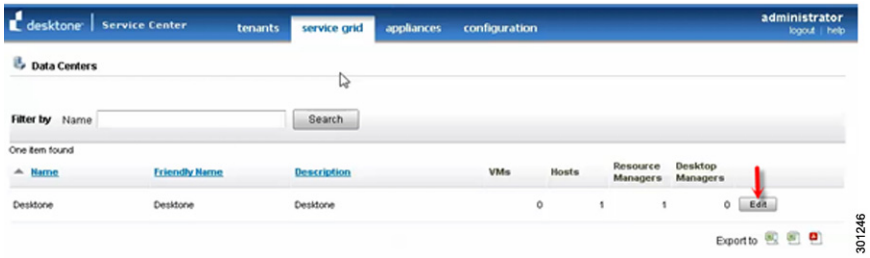
Step 3 Select Service Provider Appliance from the Appliances and enter values for the fields to create the Appliance.

Note Reservation will create a virtual machine for the second service provider appliance for High Availability, customize and install. This screen is accessible by navigating to Appliances --> Reservations and clicking the details on the appropriate reservation. From here, you can check the status of the SP2 appliance.

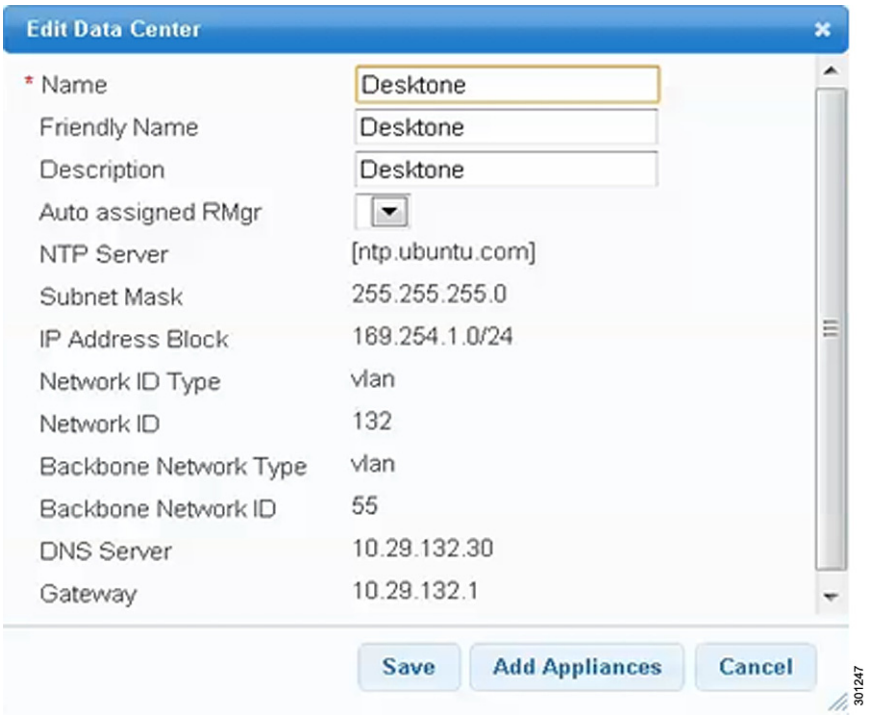


Installing the Desktone Tenant Resource Manager Appliances

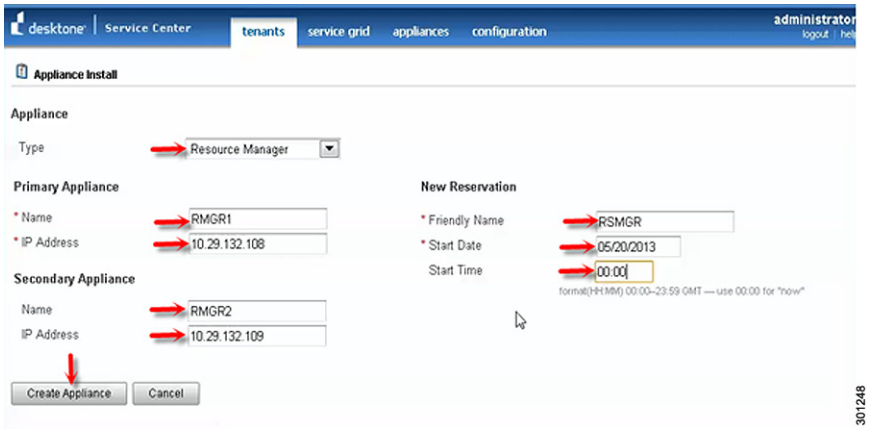
Step 1 In the service center console, select service grid --> data centers.



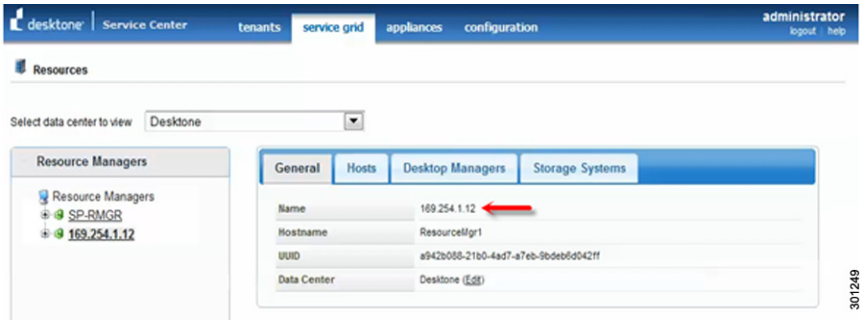
Step 2 Click Add Appliances.



Step 3 Select the Appliance Type as Resource Manager and fill in the appropriate information in the value field for Primary and Secondary appliance and new reservation fields.



Step 4 From the general tab, in the name field double-click on the IP address and change the name for the Resource Manager. For example, TenantRMGR and click OK. You can do this by going to the Service Center console, select Service grid --> resources. In the Resource Managers panel select the IP address for the newly created resource manager.

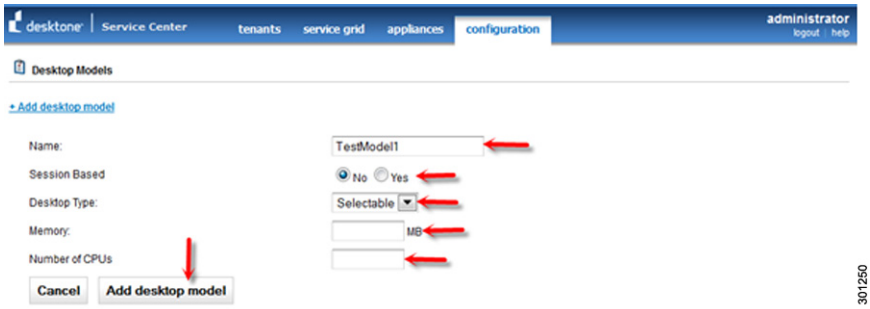


Step 5 Select the Tenant Resource Manager as the default for the Datacenter.

Note It is very important to verify that the default Resource Manager for the Datacenter is the Tenant Resource Manager, not the Service Provider Resource Manager.

Adding Desktop Models

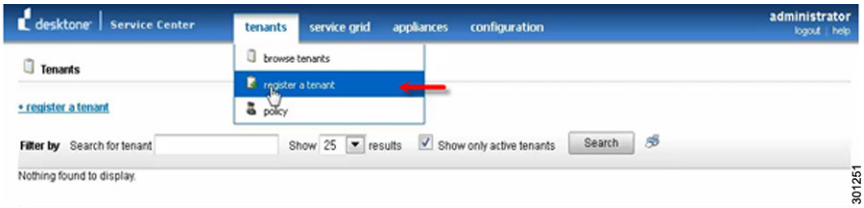
Step 1 Desktop Model is used to create multiple desktops of a certain configuration and priced accordingly. Tenants can then choose from the available desktop models.



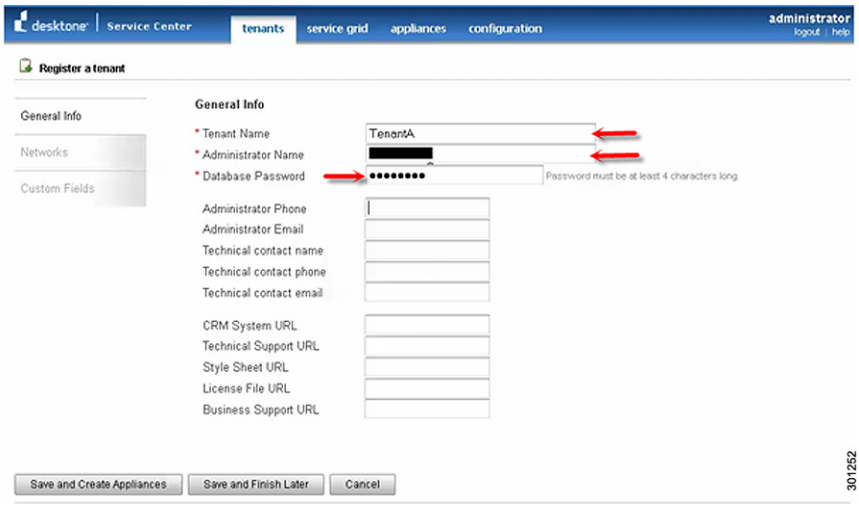
Step 2 Add Desktop Model by going into the Service Center console, Select Configuration --> Desktop Models and click Add Desktop Model.

Installing the Desktone Tenant Appliances

Step 1 In the service center console, select tenants --> register a tenant.

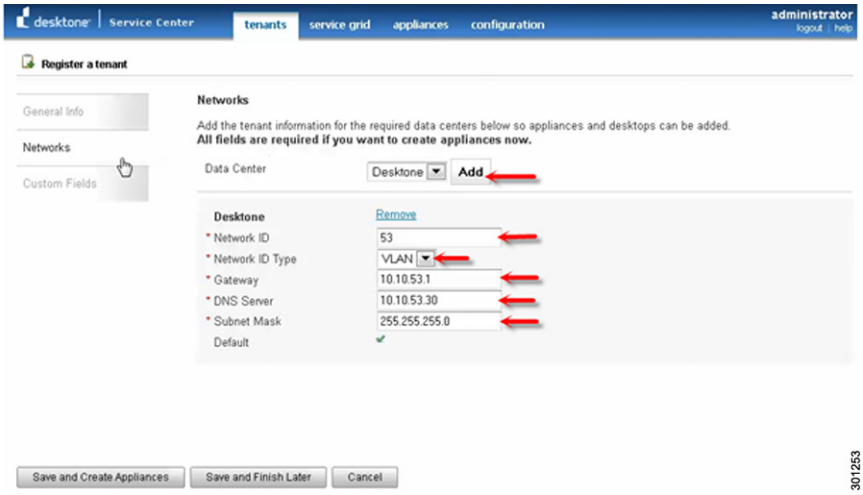


Step 2 From the General Info tab, enter the required fields of Tenant Name, Administrator Name, and Database Password.

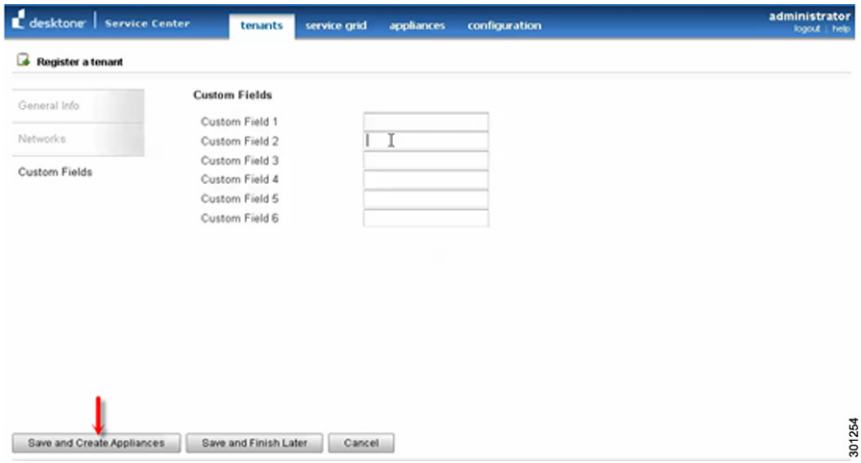


Step 3 Enter the Network Information.

Note Network ID is an install time decision and cannot be changed after the tenant has been installed. Additional networks can be added to a tenant at any time. The first network added would be the default for the tenant and also the network that the tenant appliances will reside on.

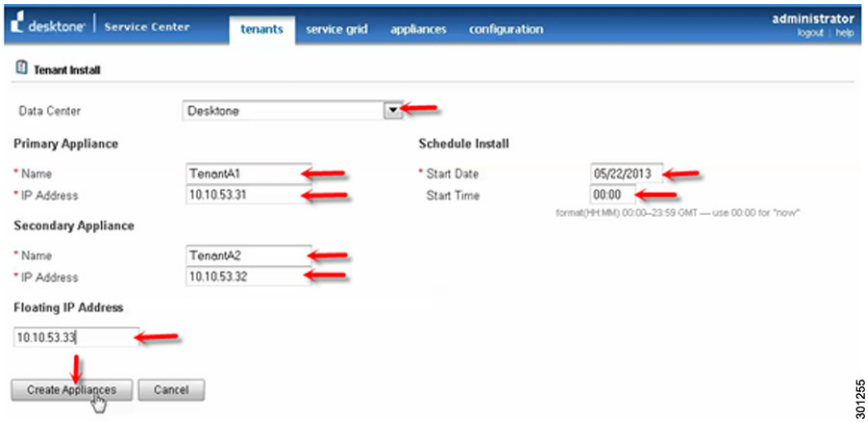


Step 4 From the Custom Fields tab, enter any site-specific information you want to maintain. These are freeform text fields with no data validation; the content is optional.

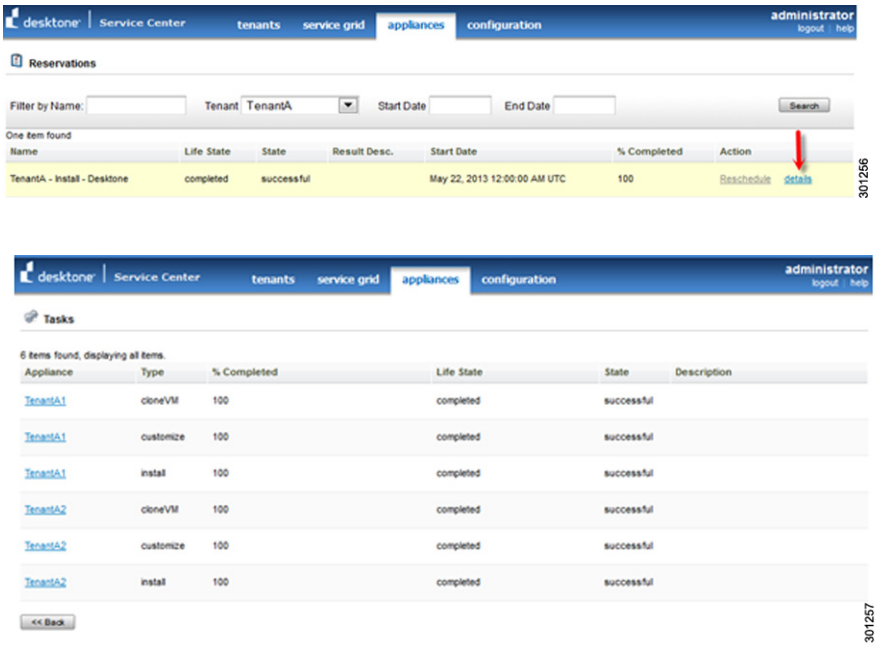


Step 5 Click Save and Create Appliances.

Step 6 From the Tenant Install page, enter the values for the tenant Appliances and click Create Appliances.



Step 7 To monitor the status of the tenant appliances being created, go to the service center console, Select Appliances --> Reservations and click on details to the view the reservation of interest.



Step 8 Repeat the steps 1-7 to create Tenant Appliances for every new tenant.

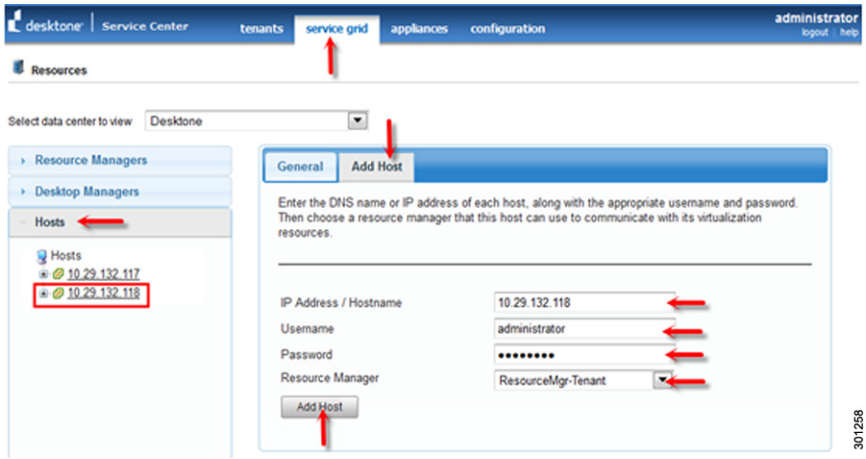
Assigning Hosts to Individual Tenants

Step 1 Assign a host by clicking Add host. Do this by going to the service center console, Select service grid --> resources.

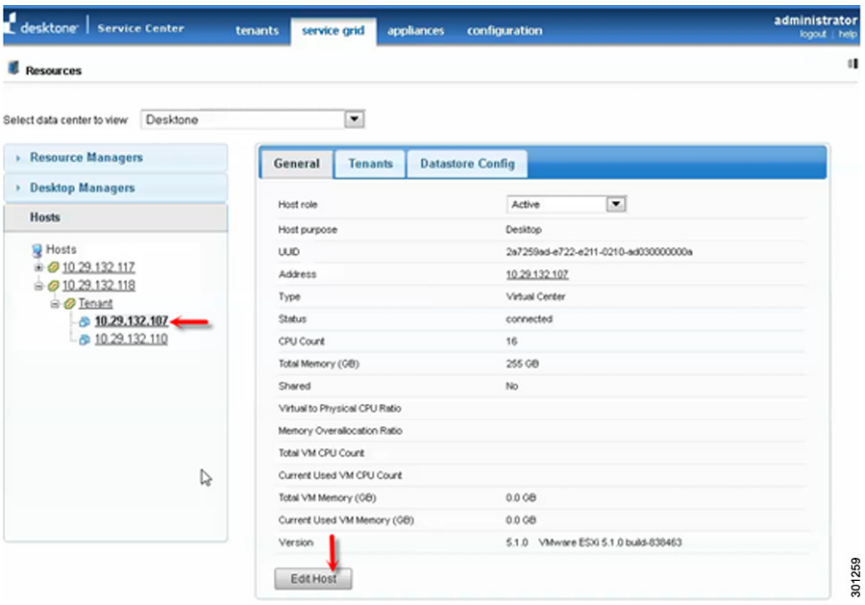
Step 2 From the left side of the screen select Hosts.

Step 3 Click Add Host.

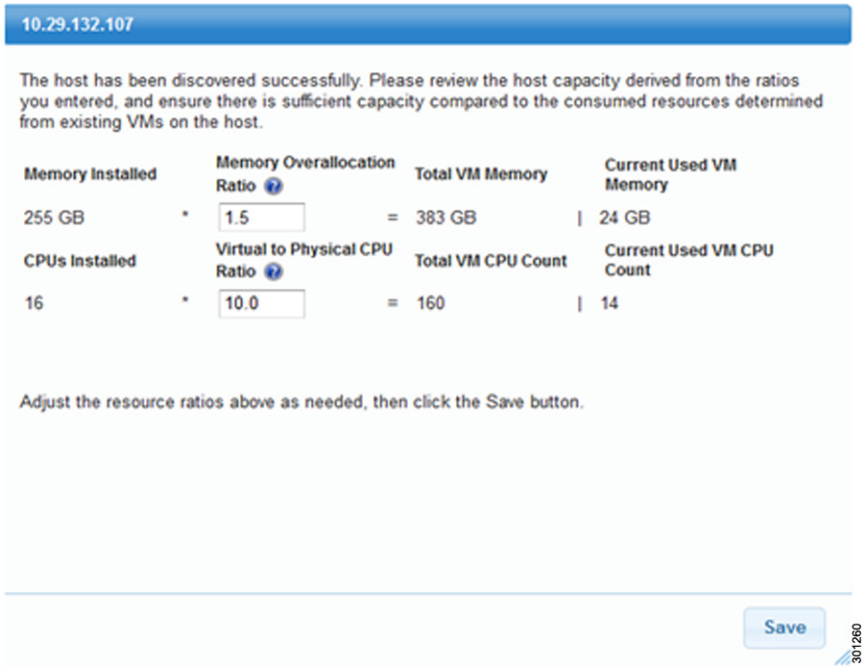
Step 4 Enter the IP address or FQDN for vCenter created for Tenant Desktop Hosts and credentials.



Step 5 Edit the host by selecting the vCenter for Tenant desktop hosts.



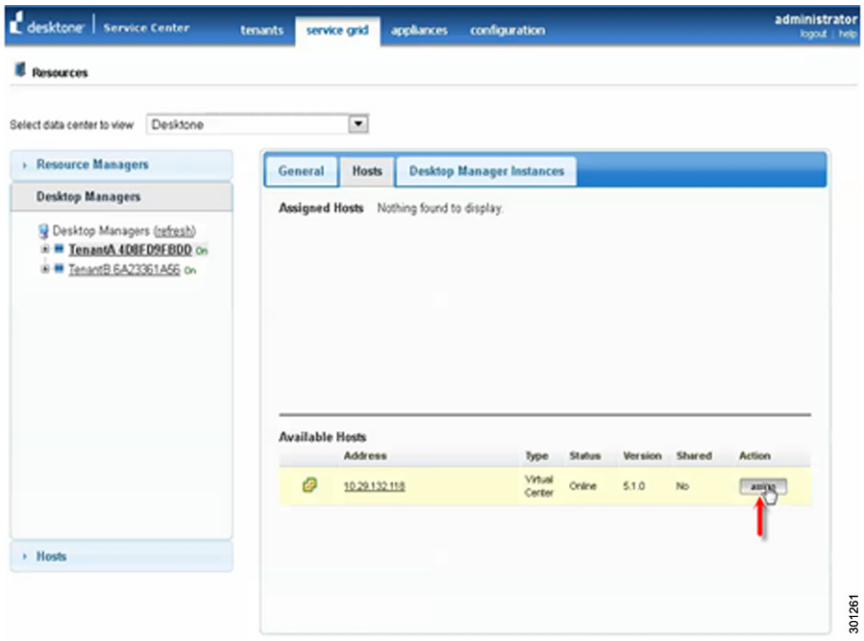
Step 6 Change the memory overallocation ratio if required and click Save.



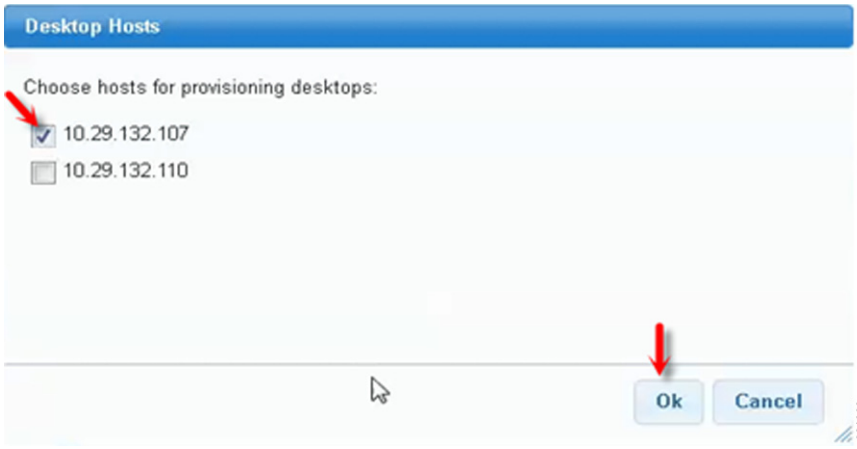
Note This option only allows for ratios to be increased and may not be decreased after the inital setup.

Step 7 Repeat the above steps 1-6 for all ESXi hosts reserved for the tenant.

Step 8 Assign a host to the Desktop Manager by clicking on Assign under Available Hosts from the Desktop Managers tab.



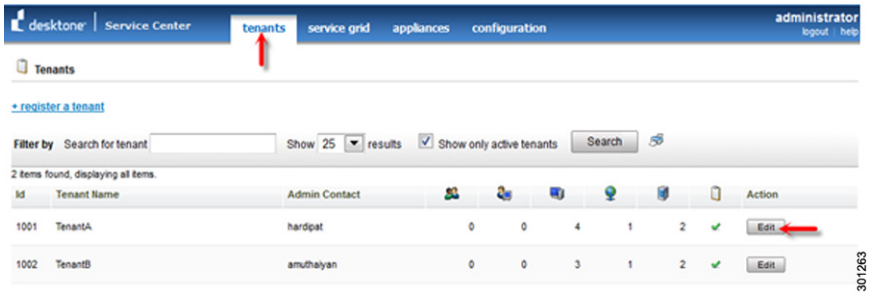
Step 9 Select the hosts in the vCenter for this tenant.



Step 10 Repeat steps 9 and 10 for the other hosts reserved for the tenant.

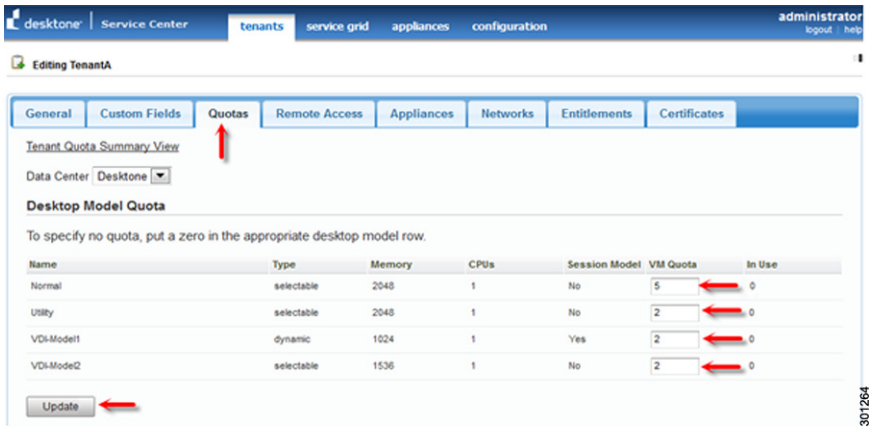
Assigning Quotas for Tenants

Step 1 To assign a quota, go in the Service Center console -> tenants and edit the tenant.

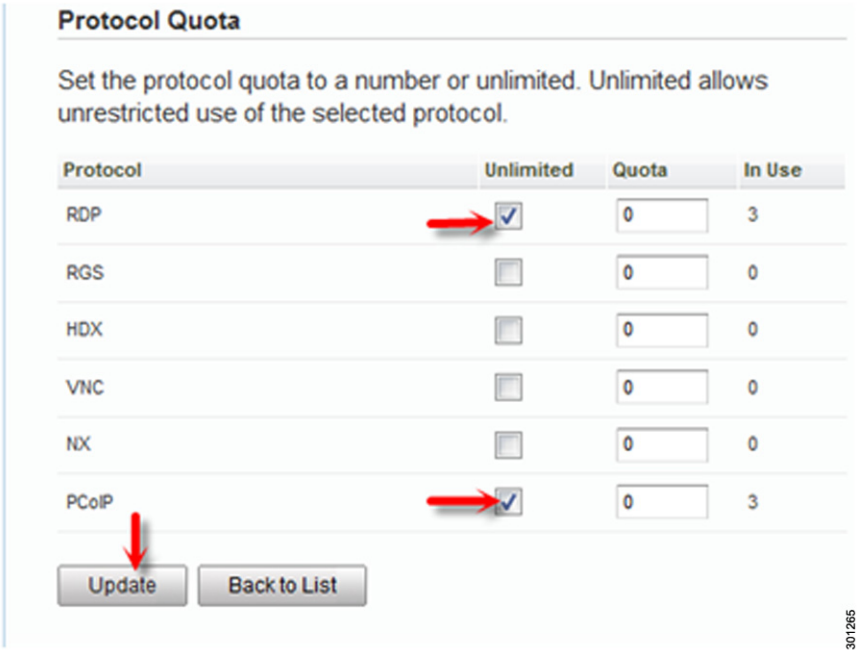


Step 2 Enter the values in the VM Quota column for respective Desktop Models and click Update.

Note If the quota you entered in the VM Quota field is too large, the system will automatically reduce the quota to the largest possible quota.



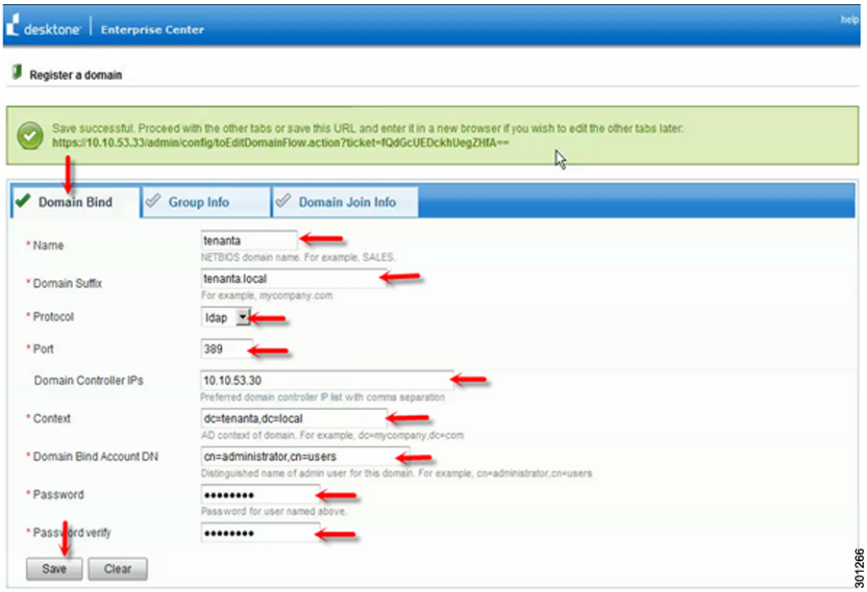
Step 3 Check the desired protocols for the tenant and click Update.



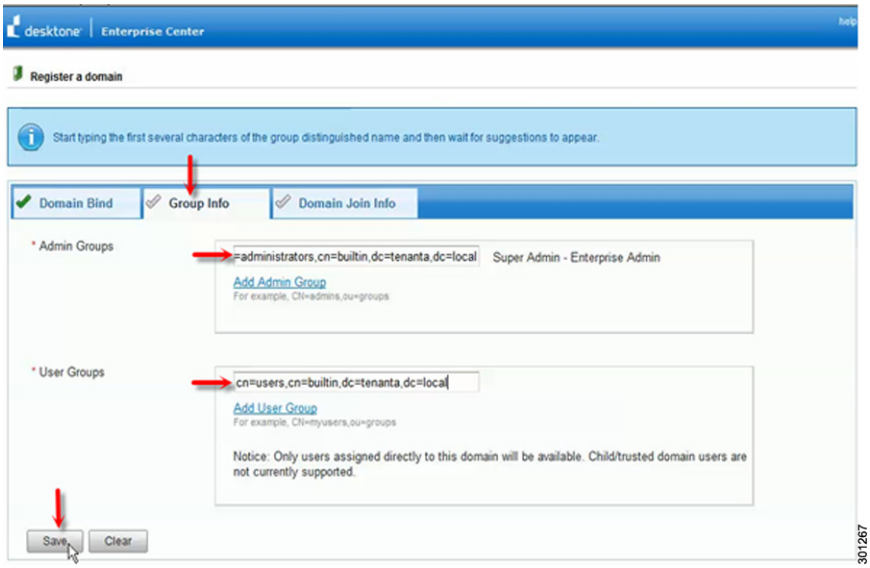
Configuring Tenant Appliance

Step 1 Browse to the Desktone Enterprise Center by entering the URL or IP address in a browser: https://<IP address of Tenant Appliance>/admin

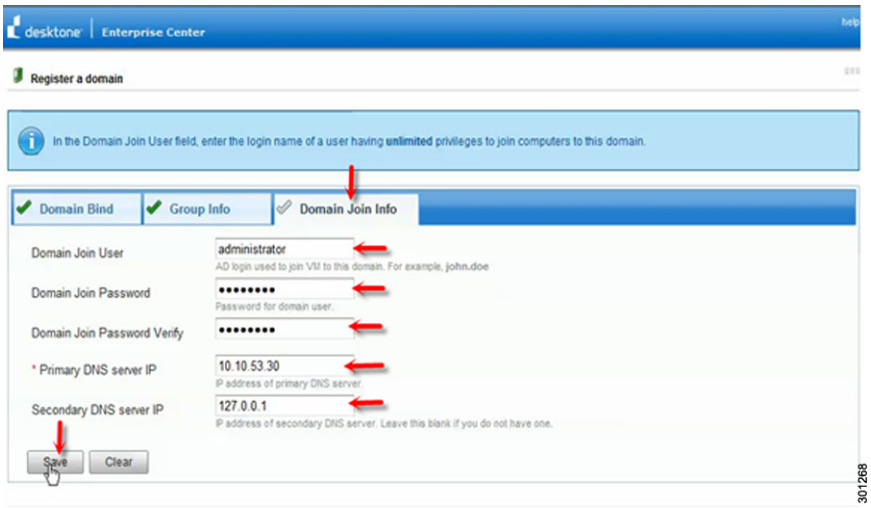
Step 2 Enter the values under Domain Bind, Group Info and Domain Join Info when prompted and click Save.



Step 3 Enter the values under Group Info and click Save.



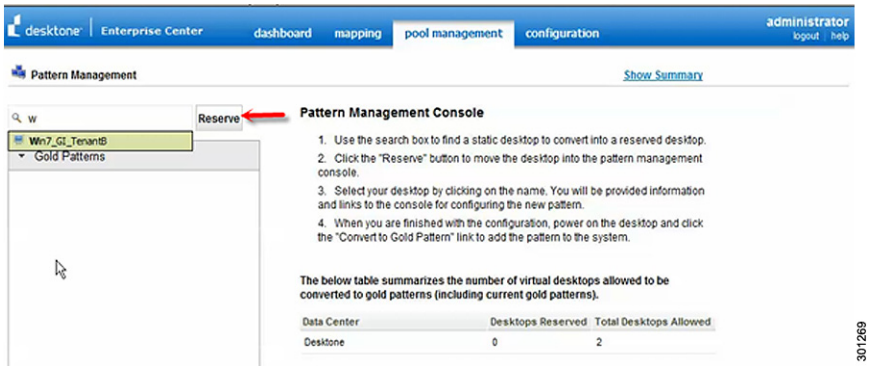
Step 4 Enter the values under Domain Join Info and click Save.



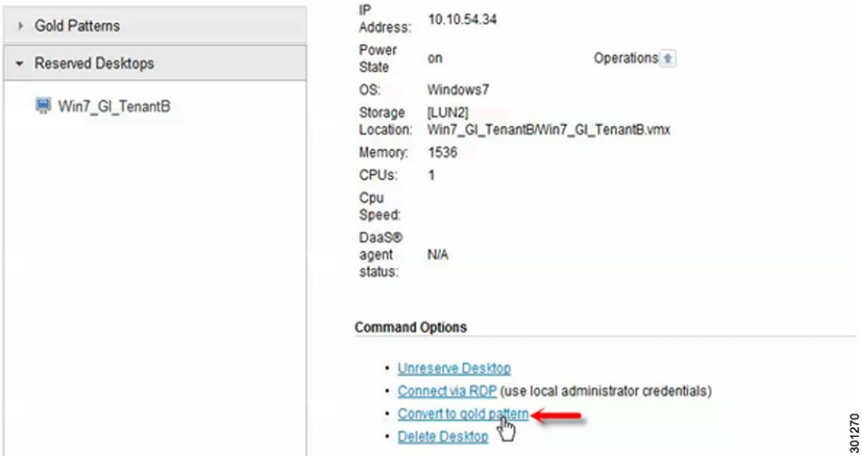
Step 5 Login into the Desktone Enterprise Center login screen again to continue the configuration.

Adding the Golden Template into Desktone Tenant Portal

Step 1 Click on Pool Management -> Pattern Management and type in the Golden Windows 7 VM and click Reserve.

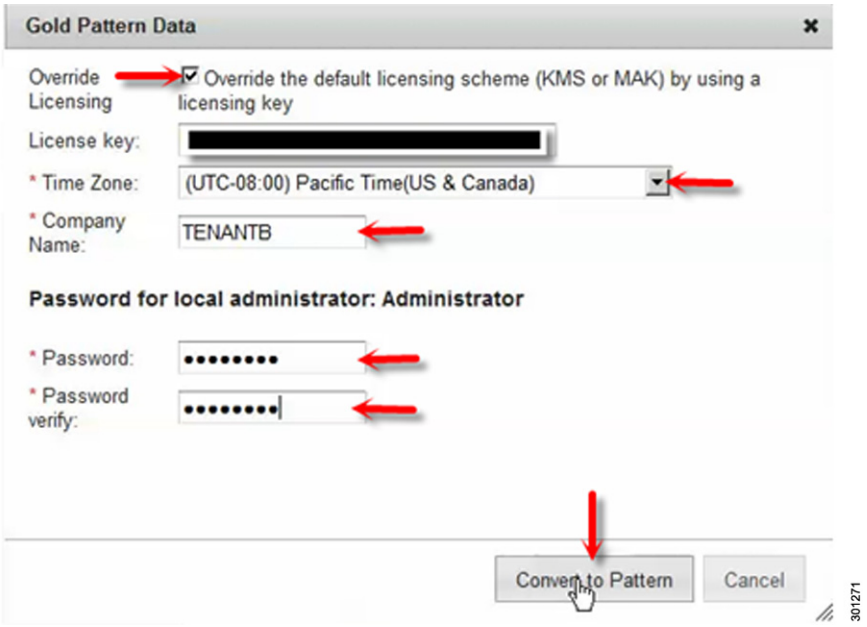


Step 2 Click Convert to Gold Pattern.

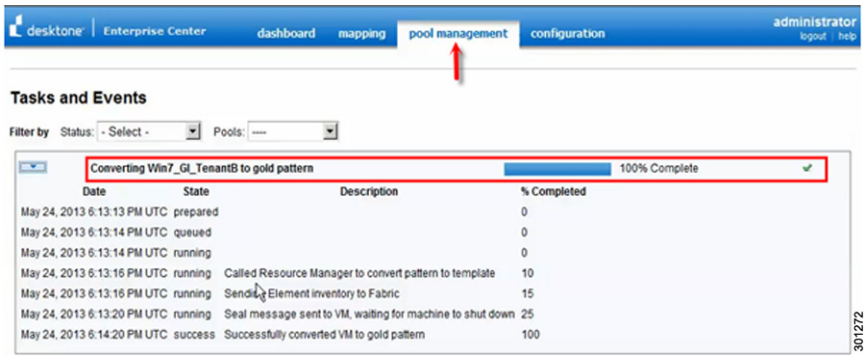


Step 3 Enter the values for the fields shown below and click Convert to Pattern.

Note Do not check the Override Licensing option if you want to use KMS.



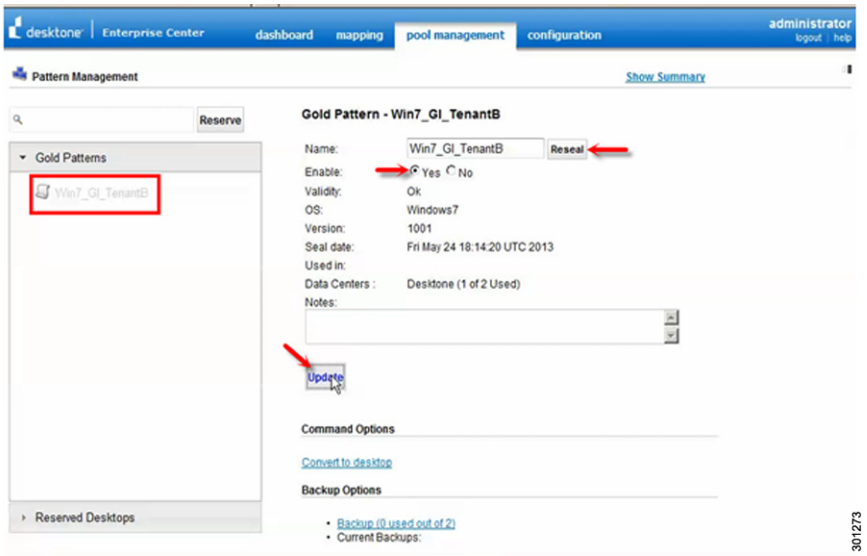
Step 4 Verify the progress under Configuration -> Task and Events.



Step 5 Enable the Gold pattern by clicking Enable.

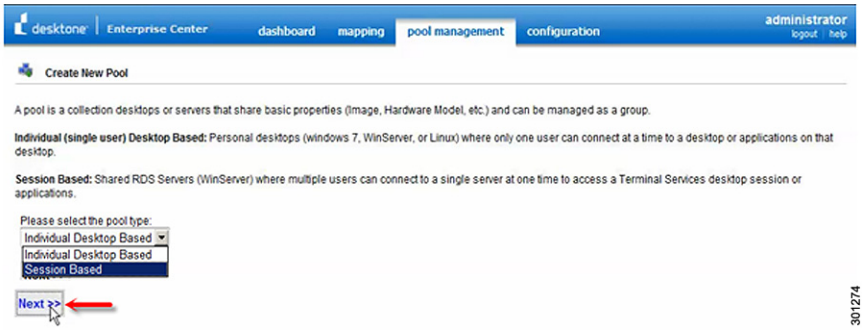
Step 6 Click Update.

Note Reseal option is required only when the Golden Pattern virtual machine is powered on.



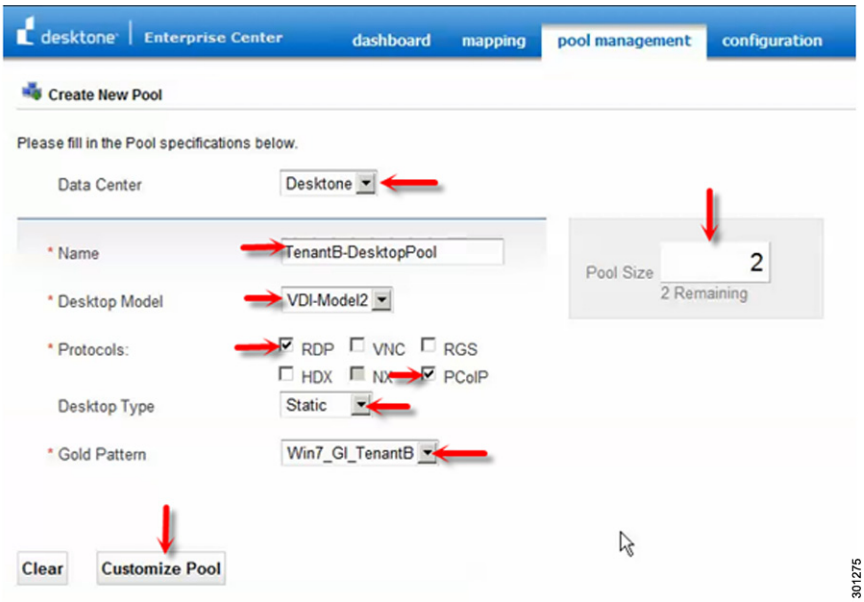
Creating a Pool of Desktops in the Tenant Portal

Step 1 Click Pool Management -> Create Pool and select Individual Desktop Based.

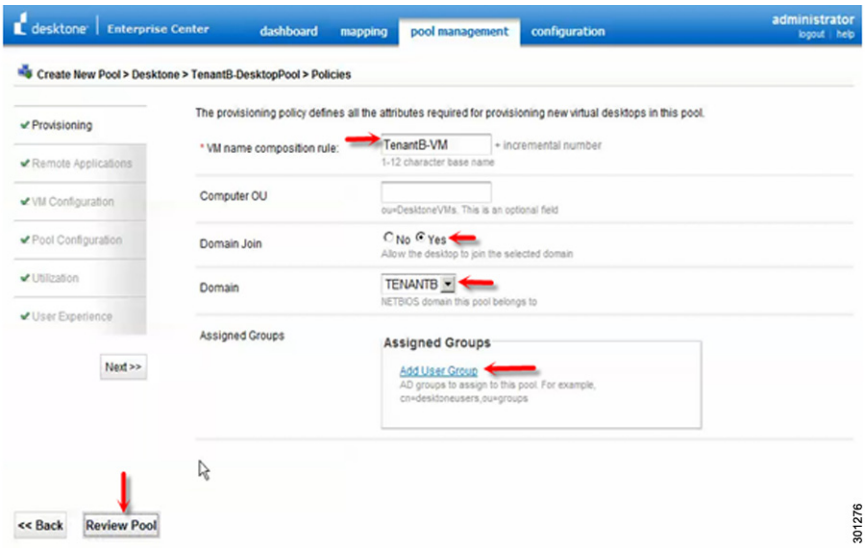


Step 2 Enter the values and click Customize Pool.

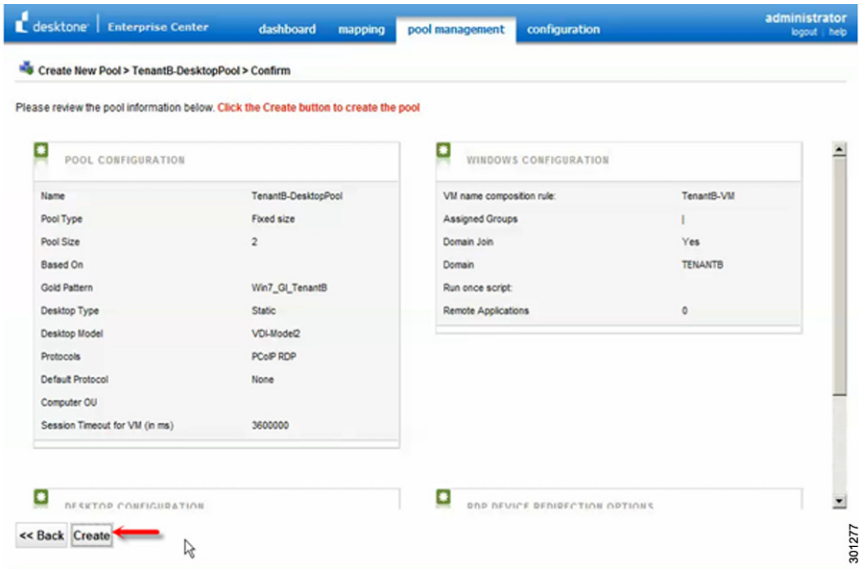
Note There are two desktop types: Static and Dynamic. Static desktops are assigned to individual users and the same desktop is available to users at all times. Dynamic desktops are available to any user for the duration of their session.



Step 3 Enter the values under Policies as applicable for each tenant and click Review Pool.



Step 4 Click Create.



Step 5 You can monitor the task of new desktops being created under Pool Management --> Tasks and Events.

Note

- Desktops will go through restart several times for customization steps like obtaining DHCP IP address, joining Domain, etc.,
- Two virtual displays with 128MB of video memory configuration are used by default when Desktone creates desktops for any desktop pool using PCoIP.

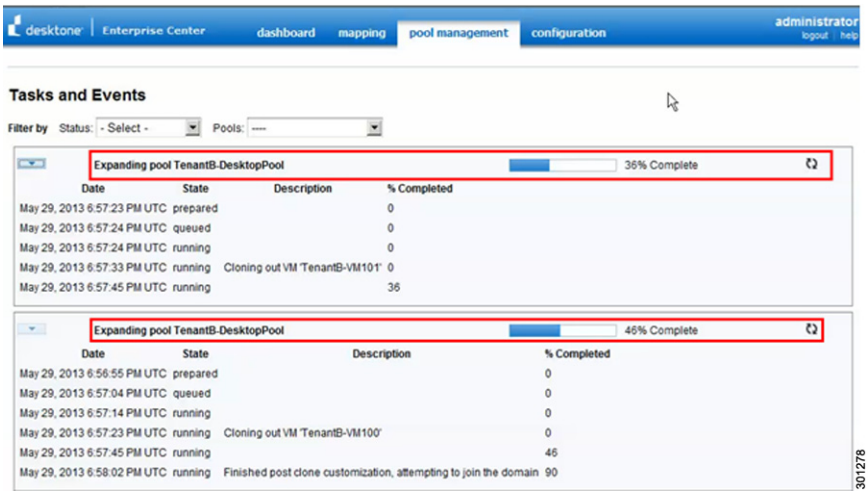
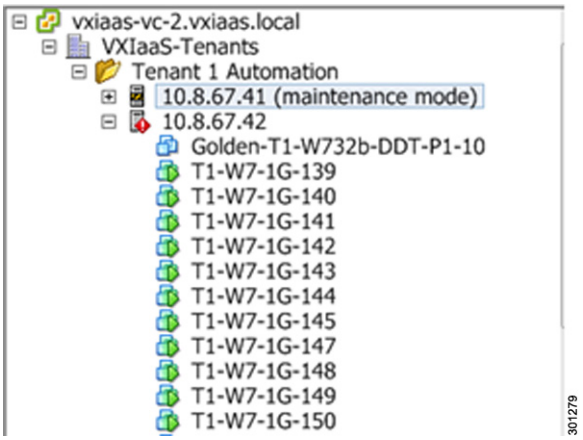


Figure 13 Desktops Created on a Tenant

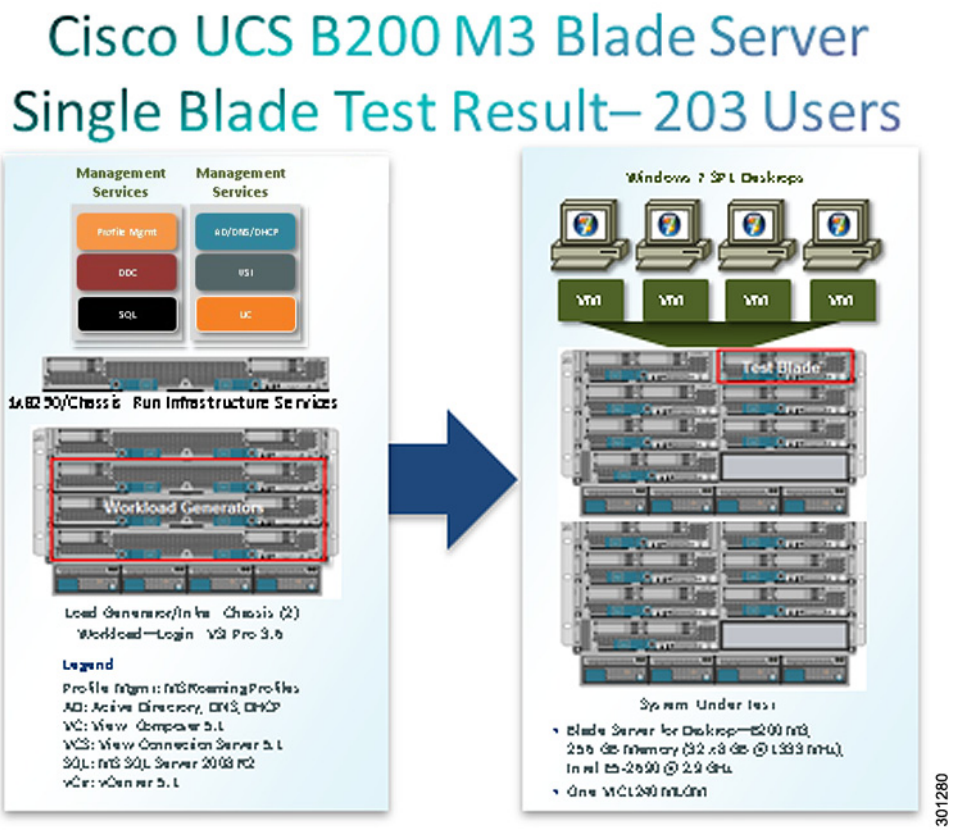


5 Test Setup and Configuration

For this project, a single Cisco UCS B200 M3 blade server in a single chassis for performance was used in testing.

Cisco UCS Test Configuration for Single Blade Scalability

Figure 14 Cisco UCS B200 M3 Blade Server for Single Server Scalability



Hardware Components:

- 2 X Cisco Nexus 7009
- 2 X Cisco Catalyst 6506 with ASA-SM
- 2 X Cisco ASR 9006
- 2 X Cisco Nexus 5548UP Access Switches
- 2 X Cisco UCS Fabric Interconnect 6248UPs
- 1 X Cisco UCS B200-M3 - Virtual Desktop host:
  - 2 x E5-2690 @ 2.9 GHz CPUs
  - 256GB of memory (16 GB X 16 DIMMS @ 1666 MHz)

  - 1 x VIC-1240 Converged Network Adapter/Blade
- 2 X Cisco UCS B series - Desktone Management hosts with minimum of:
  - 2 x Intel Xeon 5680 @ 3.333 GHz CPUs
  - 96 GB of memory
  - 1 X Converged Network Adapter/Blade
- 1 X NFS System storage array:
  - 2 x Service Controllers
  - 2 x 10 GBe Ports per Controller
  - SSD/SAS drives to support atleast 25 IOPS per desktop

    Boot – The ratio of Read/Write is 9:1 (approx)

    Run – The ratio of Read/Write is 4:3 (approx)

Detailed Windows Configuration

- 215 Desktop Configuration: Windows 7 SP1 32 bit, 1vCPU, 1 GB of memory (1GB Reserved), 24 GB/VM, 2 virtual displays with 128MB of Video Memory.
- 155 Desktop Configuration: Windows 7 SP1 32 bit, 1vCPU, 1.5 GB of memory (1GB Reserved), 24 GB/VM, 2 virtual displays with 128MB of Video Memory.

Testing Methodology and Success Criteria

All validation testing was conducted on-site within the Cisco RTP labs with joint support from Desktone. The test results focused on the entire process of the virtual desktop lifecycle by capturing metrics during the desktop boot-up, user logon and virtual desktop acquisition (also referred to as ramp-up,) user workload execution (also referred to as steady state), and user logoff for the Hosted VDI model under test.

Test metrics were gathered from the hypervisor, virtual desktop, storage, and load generation software to assess the overall success of an individual test cycle. Each test cycle was not considered passing unless all of the planned test users completed the ramp-up and steady state phases (described below) and unless all metrics were within the permissible thresholds as noted as success criteria.

Three successfully completed test cycles were conducted for this hardware configuration and the results were found to be relatively consistent from one test to the next.

Load Generation

Within the test environment, load generators were utilized to put demand on the system to simulate multiple users accessing the Desktone 5.3.2 environment and executing a typical end-user workflow. To generate load within the environment, an auxiliary software application was required to generate the end user connection to the Desktone environment, to provide unique user credentials, to initiate the workload, and to evaluate the end user experience.

In the Hosted VDI test environment, session launchers were used to simulate multiple users making a direct connection to the Desktone 5.3.2 connection server through a VMware PCoIP protocol connection.

User Workload Simulation – LoginVSI from Login Consultants

One of the most critical factors of validating a Desktone 5.3.2 deployment is identifying a real-world user workload that is easy for customers to replicate and standardized across platforms to allow customers to realistically test the impact of a variety of worker tasks. To accurately represent a real-world user workload, a third-party tool from Login Consultants was used throughout the Hosted VDI testing.

The tool has the benefit of taking measurements of the in-session response time, providing an objective way to measure the expected user experience for individual desktop throughout large scale testing, including login storms.

The Virtual Session Indexer (Login Consultants' Login VSI 3.6) methodology, designed for benchmarking Server Based Computing (SBC) and Virtual Desktop Infrastructure (VDI) environments is completely platform and protocol independent and hence allows customers to easily replicate the testing results in their environment.

Note In this testing, the tool was used to benchmark in a VDI environment only.

Login VSI calculates an index based on the amount of simultaneous sessions that can be run on a single machine.

Login VSI simulates a medium workload user (also known as knowledge worker) running generic applications such as: Microsoft Office 2007 or 2010, Internet Explorer 8 including a Flash video applet and Adobe Acrobat Reader (Note: For the purposes of this test, applications were installed locally).

Like real users, the scripted Login VSI session will leave multiple applications open at the same time. The medium workload is the default workload in Login VSI and was used for this testing. This workload emulated a medium knowledge working using Office, IE, printing and PDF viewing.

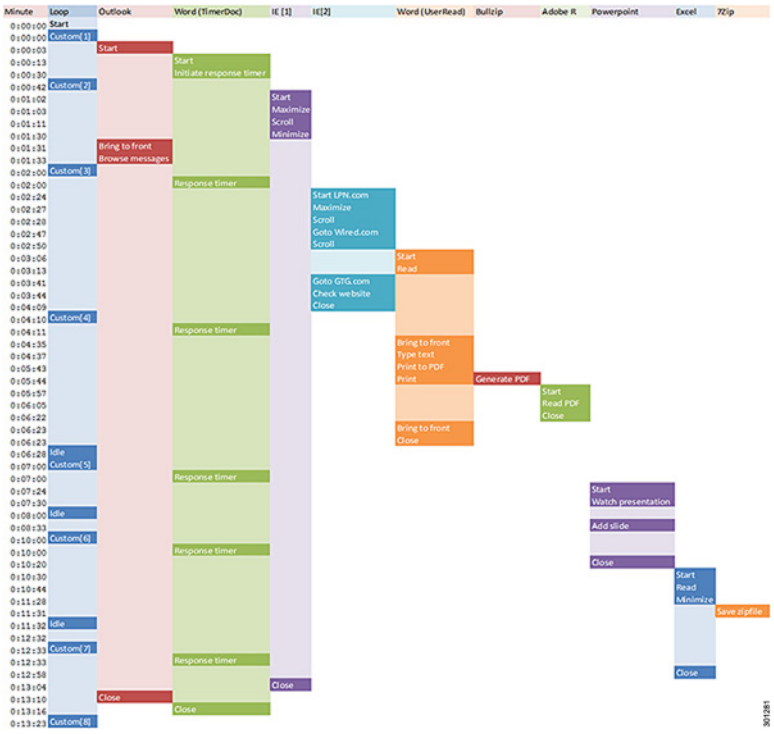
- Once a session has been started the medium workload will repeat every 12 minutes.
- During each loop the response time is measured every 2 minutes.
- The medium workload opens up to 5 apps simultaneously.
- The type rate is 160ms for each character.
- Approximately two minutes of idle time is included to simulate real-world users.

Each loop will open and use:

- Outlook 2007/2010, browse 10 messages.
- Internet Explorer, one instance is left open (BBC.co.uk), one instance is browsed to Wired.com, Lonelyplanet.com and gettheglass.com.
- 480 p Flash application.
- Word 2007/2010, one instance to measure response time, one instance to review and edit document.
- Bullzip PDF Printer & Acrobat Reader, the word document is printed and reviewed to PDF.
- Excel 2007/2010, a very large randomized sheet is opened.
- PowerPoint 2007/2010, a presentation is reviewed and edited.
- 7-zip: using the command line version the output of the session is zipped.

A graphical representation of the medium workload is shown below.

Figure 15 Graphical overview



You can obtain additional information on Login VSI from http://www.loginvsi.com.

Testing Procedure

The following protocol was used for each test cycle in this study to insure consistent results.

Pre-Test Setup for Single and Multi-Blade Testing

All virtual machines were shut down utilizing VMware vCenter. All Launchers for the test were also shut down from VMware vCenter. Then they were started until the required number of launchers was running with the Login VSI Agent at a "waiting for test to start" state.

Test Run Protocol

To simulate severe, real-world environments, Cisco requires the log-on and start-work sequence, known as Ramp Up, to complete in thirty minutes. Additionally, Cisco requires all sessions started to become active within two minutes after the session is launched.

For each of the three consecutive runs on single blade (155 or 215 User) the process detailed below was followed:

1. Time 0:00:00 Start ESXtop Logging on VDI host blade used in test run.
2. Time 0:05 Power-on desktops with the Desktone Tenant Appliance.
3. Time 0:35 All desktops started on a single blade.
4. Time 0:50 Start Login VSI 3.6 Test utilizing 11 Launchers.

5. Time 1:20 Launch desktop sessions.
6. Time 1:22 Desktop sessions become active.
7. Time 1:35 Login VSI Test Ends.
8. Time 1:50 Logoff desktop sessions.
9. Time 2:00 Terminate all logging.

Success Criteria

There were multiple metrics that were captured during each test run, but the success criteria for determining the maximum workload per blade maintaining acceptable end-user experience for a single test run was based on the key metric, VSI Max. The Login VSI Max evaluates the user response time during increasing user load and assesses the point at which end-user experience becomes unacceptable.

Login VSI Max

VSI Max represents the maximum number of users the environment can handle before serious performance degradation occurs. VSI Max is calculated based on the response times of individual users as indicated during the workload execution. The user response time has a threshold of 4000ms and all users response times are expected to be less than 4000ms in order to assume that the user interaction with the virtual desktop is at a functional level. VSI Max is reached when the response times reaches or exceeds 4000ms for 6 consecutive occurrences. If VSI Max is reached, that indicates the point at which the user experience has significantly degraded. The response time is generally an indicator of the host CPU resources, but this specific method of analyzing the user experience provides an objective method of comparison that can be aligned to host CPU performance.

Note In the prior version of Login VSI, the threshold for response time was 2000ms. The workloads and the analysis have been upgraded in Login VSI 3 to make the testing more aligned to real-world use. In the medium workload in Login VSI 3.0, a CPU intensive 480p flash movie is incorporated in each test loop. In general, the redesigned workload would result in an approximate 20% decrease in the number of users passing the test versus Login VSI 2.0 on the same server and storage hardware.

Calculating VSIMax

Typically the desktop workload is scripted in a 12-14 minute loop when a simulated Login VSI user is logged on. After the loop is finished it will restart automatically. Within each loop the response times of seven specific operations is measured in a regular interval: six times in within each loop. The response times if these seven operations are used to establish VSImax. The seven operations from which the response times are measured are:

- Copy new document from the document pool in the home drive
  - This operation will refresh a new document to be used for measuring the response time. This activity is mostly a file-system operation.
- Starting Microsoft Word with a document.
  - This operation will measure the responsiveness of the Operating System and the file system. Microsoft Word is started and loaded into memory; also the new document is automatically loaded into Microsoft Word. When the disk I/O is extensive or even saturated, this will impact the file open dialogue considerably.

- Starting the “File Open” dialogue.
  - This operation is handled for small part by Word and a large part by the operating system. The file open dialogue uses generic subsystems and interface components of the OS. The OS provides the contents of this dialogue.
- Starting Notepad.
  - This operation is handled by the OS (loading and initiating notepad.exe) and by the Notepad.exe itself through execution. This operation seems instant from an end-user’s point of view.
- Starting the “Print” dialogue.
  - This operation is handled for a large part by the OS subsystems, as the print dialogue is provided by the OS. This dialogue loads the print-subsystem and the drivers of the selected printer. As a result, this dialogue is also dependent on disk performance.
- Starting the “Search and Replace” dialogue.
  - This operation is handled within the application completely; the presentation of the dialogue is almost instant. Serious bottlenecks on application level will impact the speed of this dialogue.
- Compress the document into a zip file with 7-zip command line.
  - This operation is handled by the command line version of 7-zip. The compression will very briefly spike CPU and disk I/O.

These measured operations with Login VSI do hit considerably different subsystems such as CPU (user and kernel), Memory, Disk, the OS in general, the application itself, print, GDI, etc. These operations are specifically short by nature. When such operations are consistently long: the system is saturated because of excessive queuing on any kind of resource. As a result, the average response times will then escalate. This effect is clearly visible to end-users. When such operations consistently consume multiple seconds the user will regard the system as slow and unresponsive.

With Login VSI 3.0 and later it is now possible to choose between ‘VSImax Classic’ and 'VSImax Dynamic’ results analysis. For these tests, VSImax Dynamic analysis was utilized.

VSIMax Dynamic

VSImax Dynamic is calculated when the response times are consistently above a certain threshold. However, this threshold is now dynamically calculated on the baseline response time of the test.

Five individual measurements are weighted to better support this approach:

- Copy new doc from the document pool in the home drive: 100%
- Microsoft Word with a document: 33.3%
- Starting the “File Open” dialogue: 100%
- Starting “Notepad”: 300%
- Starting the “Print” dialogue: 200%
- Starting the “Search and Replace” dialogue: 400%
- Compress the document into a zip file with 7-zip command line 200%
- A sample of the VSImax Dynamic response time calculation is displayed below:

Figure 16 VSIMax Dynamic Response Time

Activity (RowName)	Result (ms)	Weight (%)	Weighted Result (ms)
Refresh document (RFS)	160	100%	160
Start Word with new doc (LOAD)	1400	33.3%	467
File Open Dialogue (OPEN)	350	100%	350
Start Notepad (NOTEPAD)	50	300%	150
Print Dialogue (PRINT)	220	200%	440
Replace Dialogue (FIND)	10	400%	40
Zip documents (ZIP)	130	200%	230
	VSImax Dynamic Response Time		**1837**

301282

Then the average VSImax response time is calculated based on the amount of active Login VSI users logged on to the system. For this the average VSImax response times need to consistently higher than a dynamically calculated threshold.

To determine this dynamic threshold, first the average baseline response time is calculated. This is done by averaging the baseline response time of the first 15 Login VSI users on the system.

The formula for the dynamic threshold is: Avg. Baseline Response Time x 125% + 3000. As a result, when the baseline response time is 1800, the VSImax threshold will now be 1800 x 125% + 3000 = 5250ms.

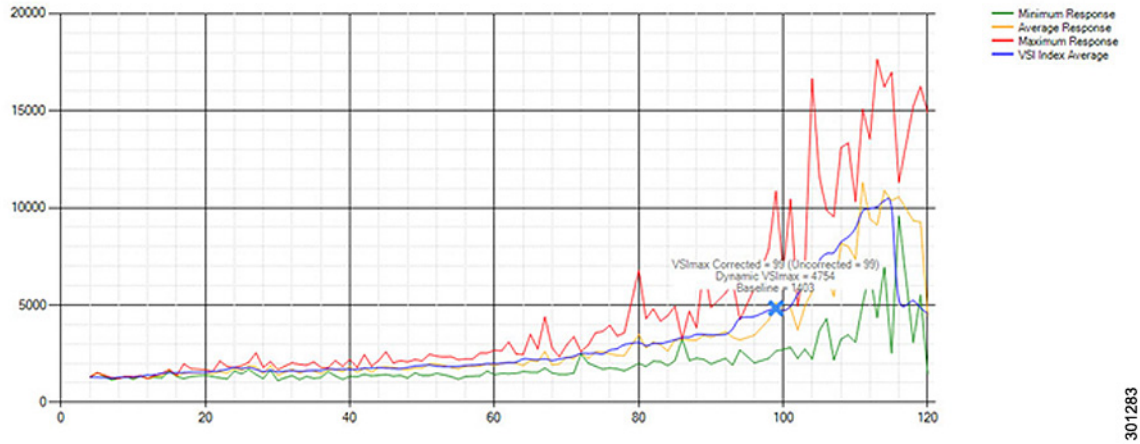
Especially when application virtualization is used, the baseline response time can wildly vary per vendor and streaming strategy. Therefore it is recommend to use VSImax Dynamic when comparisons are made with application virtualization or anti-virus agents. The resulting VSImax Dynamic scores are aligned again with saturation on a CPU, Memory or Disk level, also when the baseline response time are relatively high.

Determining VSIMax

The Login VSI analyzer will automatically identify the VSImax. In the example below the VSImax is 98. The analyzer will automatically determine “stuck sessions” and correct the final VSImax score.

- Vertical axis: Response Time in milliseconds
- Horizontal axis: Total Active Sessions

Figure 17 Sample Login VSI Analyzer Graphic Output



- Red line: Maximum Response (worst response time of an individual measurement within a single session)
- Orange line: Average Response Time within for each level of active sessions
- Blue line: the VSImax average.
- Green line: Minimum Response (best response time of an individual measurement within a single session)

In testing, the total number of users in the test run had to login, become active and run at least one test loop and log out automatically without reaching the VSI Max to be considered a success.

Note A technical issue was discovered with the VSIMax dynamic calculation in testing on Cisco UCS B200 M3 blade servers where the VSIMax Dynamic was not reached during extreme conditions. Working with Login Consultants, a methodology was devised to validate the testing without reaching VSIMax Dynamic until such time as a new calculation is available.

The Login VSI "pass" criteria, accepted by Login Consultants for this testing, is as follows:

- Cisco will run tests at a session count level that effectively utilizes the blade capacity measured by CPU utilization, Memory utilization, Storage utilization and Network utilization.
- Will utilize Login VSI to launch version 3.6 medium workloads, including flash.
- Number of Launched Sessions must equal Active Sessions within two minutes of the last session launched in a test.
- The Desktone Enterprise Center will be monitored throughout the steady state to insure that:
  - All running sessions report in use throughout the steady state
  - No sessions move to unregistered or agent not available state at any time during Steady State
- Within 20 minutes of the end of the test, all sessions on all Launchers must have logged out automatically and the Login VSI Agent must have shut down.
- The Cisco Validated Design will be published with the process recommended above and will note that VSIMax dynamic was not reached during testing due to a technical issue with the analyzer formula that calculates VSIMax.

6 VDI Test Results

The purpose of this testing is to provide the data needed to validate Desktone 5.3.2 infrastructure in an end-to-end Cisco environment.

Server scalability based on desktops supported in a single server is very useful to determine the total number of servers needed for a deployment. Different CPU, memory, storage and network metrics can be used to estimate sizing guidelines for necessary data center components and overall deployment. The information contained in this section provides data points that a customer may reference in designing their own implementations. These validation results are an example of what is possible under the specific environment conditions outlined here, and do not represent the full characterization of Desktone 5.3.2 with VMware vSphere 5.1.

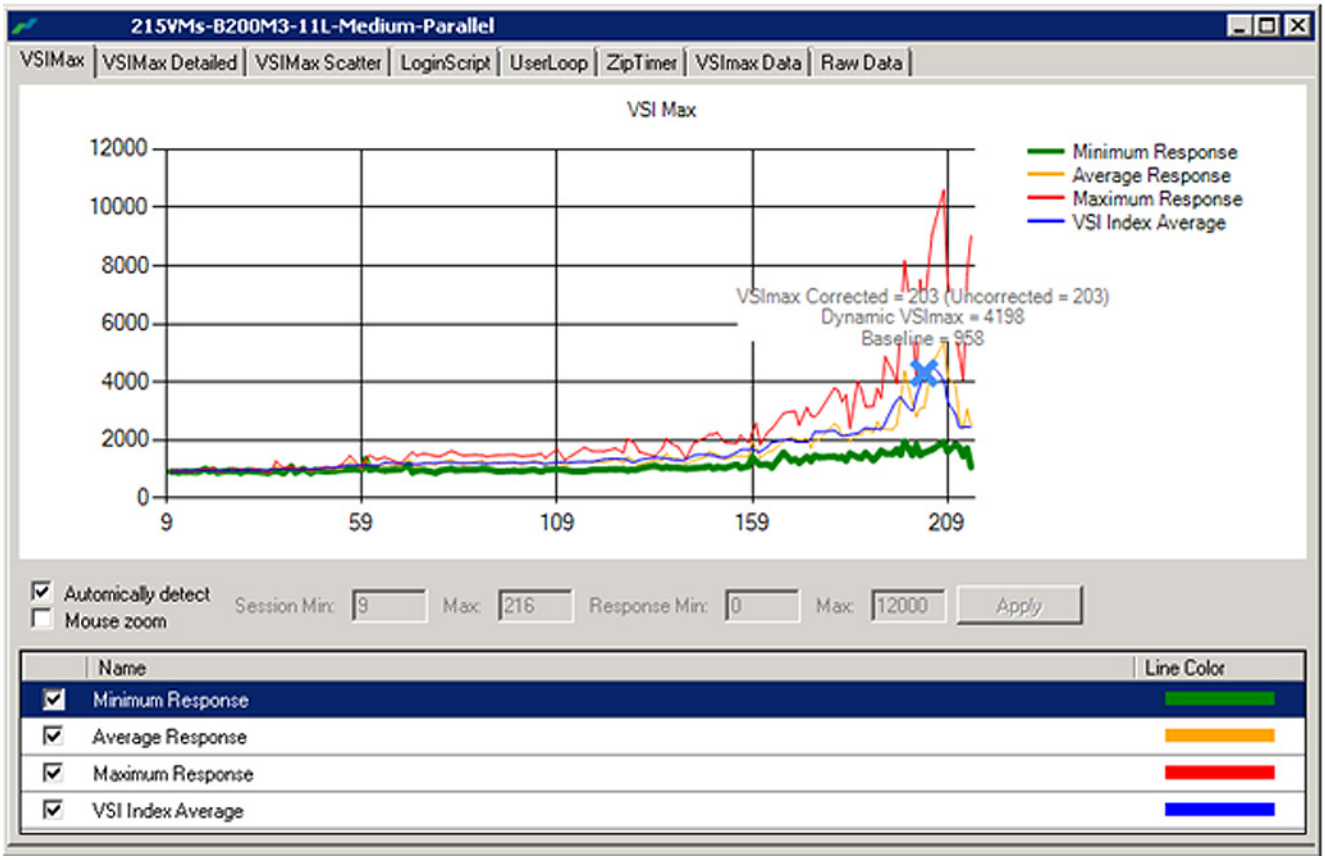
The results provided in this section are based on the testing done on a Cisco UCS B200 M3 blade server running ESXi 5.1 hypervisor managed by vCenter 5.1 to host Desktone automated pools with static assignment and provision Windows 7 SP1 full virtual desktops using a NFS storage system.

Two test sequences, each containing three consecutive test runs generating the same result, were performed to establish single server performance.

Login VSIMax Score

One of the stress tests on a single blade server was conducted to establish the official Login VSI Max Score. Test results show that 215 Medium Workload (with flash) Windows 7 SP1 sessions on a single server achieved a Login VSI Max score of 203. The Login VSI score was achieved on three consecutive runs and is shown in Figure 18 below.

Figure 18 Login VSIMax Reached: 203 Users



Single Blade Maximum Recommended Workload

This section details the results from the Desktone 5.3.2 Hosted VDI single blade server validation testing. The primary success criteria used to validate the overall success of the test cycle is an output chart from Login Consultants' VSI Analyzer Professional Edition, VSIMax Dynamic for the Medium workload (with Flash.)

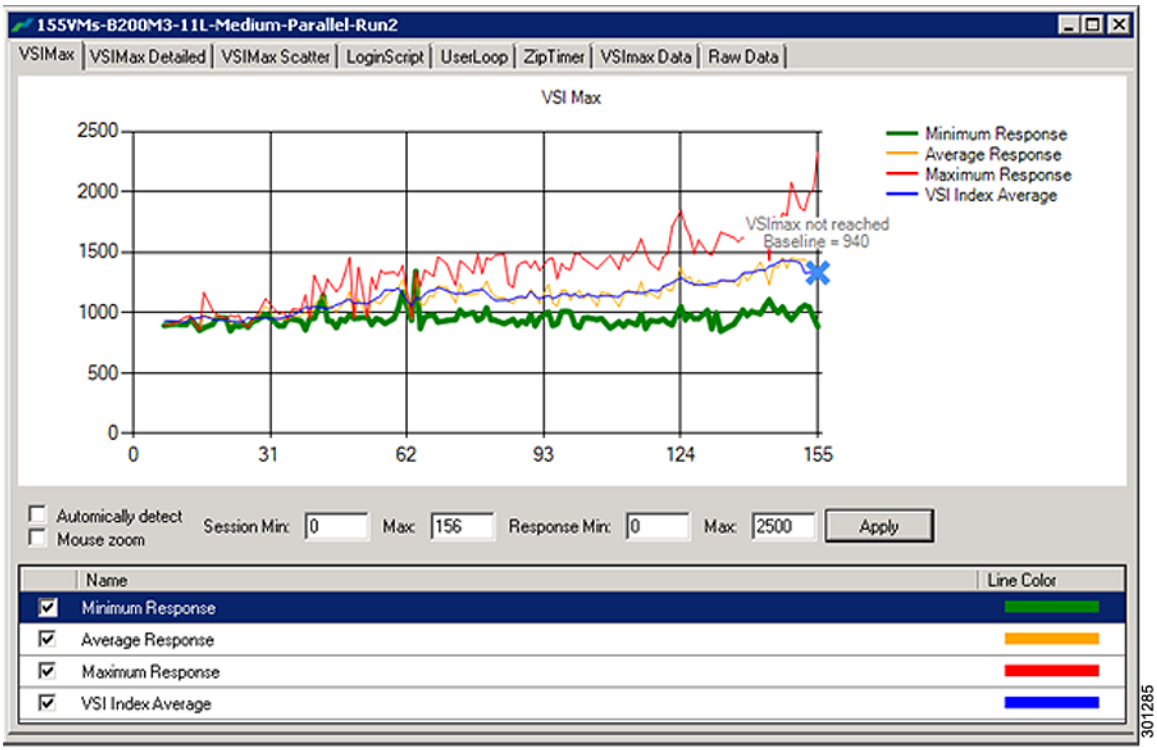
Note VSIMax Dynamic in testing was not reached due to a technical issue with the analyzer formula that calculates VSIMax. See section Determining VSIMax for a discussion of this issue.

A single server test using approximately 24% lower user density than prescribed by the Login VSI Max was executed to achieve a successful pass of the test with server hardware performance in a realistic range. The recommended maximum load for Desktone 5.3.2 Hosted Virtual Desktops on a Cisco UCS B200 M3 blade sever running the Login VSI Medium workload is 155 desktops given adequate storage capability and enough CPU resources. CPU utilization limit of 90% was a consideration to determine the maximum virtual machine density per blade.

Additionally, graphs detailing the CPU, Memory and network utilization during boot phase and peak session loads are also presented.

The charts below present the recommended maximum Login VSI Medium workload loading on a single blade server. The maximum recommended workload for Desktone 5.3.2 Windows 7 32-bit virtual desktops is 155 per B200 M3 blade server. This charts shows that the average and maximum application response times are below 1.5secs and 2.5secs respectively.

Figure 19 155 Desktone 5.3.2 Desktop Sessions on VMware ESXi 5.1 below 2500 ms



Boot Phase Performance Results

The following graphs detail CPU, Memory, Disk and Network performance on a single Cisco UCS B200-M3 blade server during the boot phase collected by esxtop polling data every 10 secs.

The first two charts show the CPU and Core utilizations well below 35% during the boot phase.

The third chart is the memory utilization chart showing the memory allocated to the virtual desktops as they boot up. Because enough memory is available, 1.5GB of RAM was assigned to each VM. A 1GB memory reservation for each VM was configured to minimize or prevent the hypervisor from swapping.

Subsequent charts show the storage performance, in terms of read and write I/O load on the storage system generated by 155 VMs on a single server during the boot phase. The I/O Bandwidth data chart shows the network bandwidth utilization associated with the storage traffic.

Note Some of the charts are in Mbytes/sec instead of Mbits/sec. and can be a starting point for estimating the bandwidth needs in the data center.

Figure 20 155 Users Single Cisco UCS B200 M3 CPU Core Utilization - Boot Phase

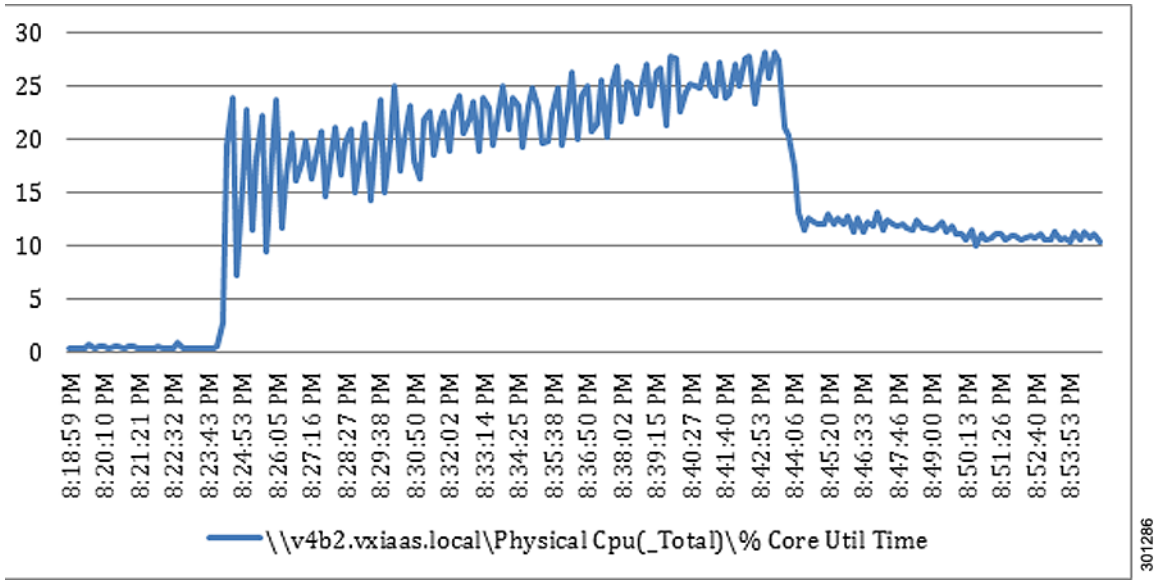


Figure 21 155 Users Single Cisco UCS B200 M3 Processor Time - Boot Phase

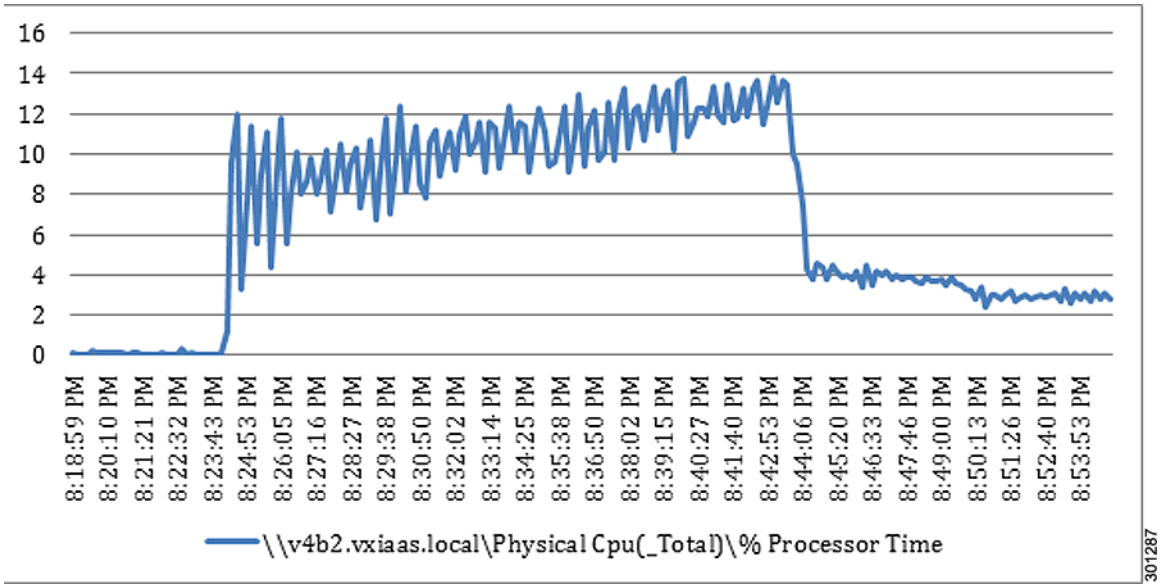


Figure 22 155 Users Single Cisco UCS B200 M3 NonKernel Memory – Boot Phase

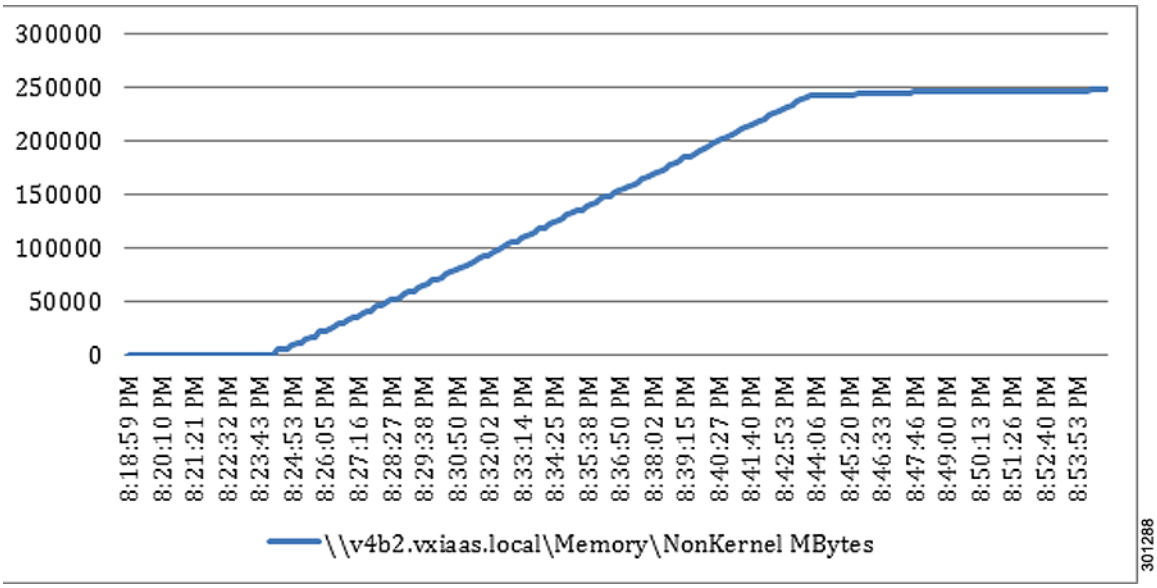


Figure 23 155 Users Single Cisco UCS B200 M3 Cisco VIC1240 MLOM Network Adapter Mbps Receive/Transmit - Boot Phase

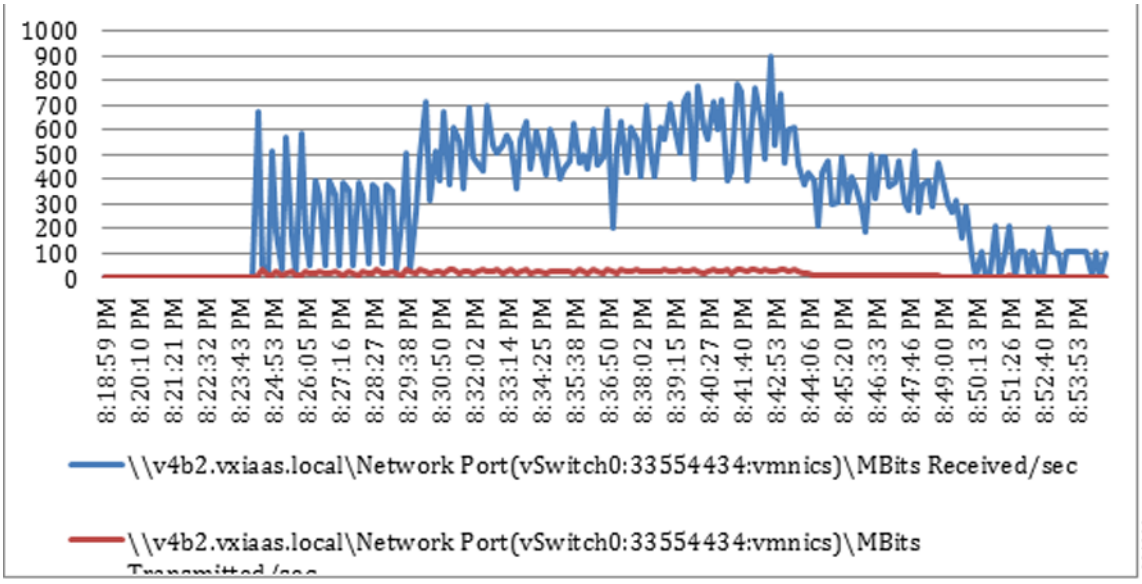


Figure 24 155 Users Single Cisco UCS B200 M3 NFS Read/Write IOPS - Boot Phase

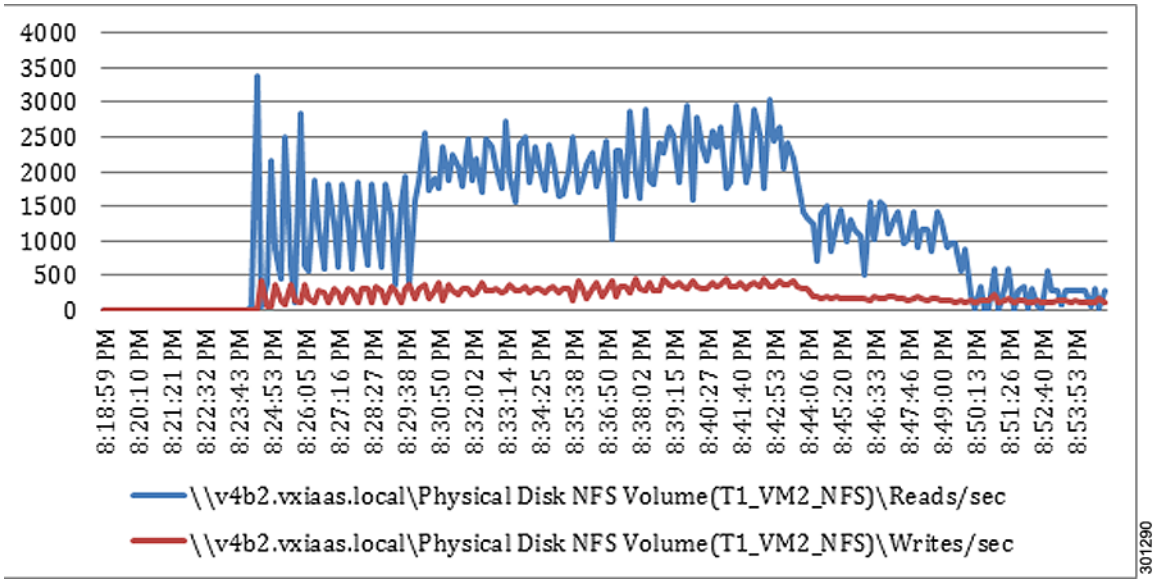


Figure 25 155 Users Single Cisco UCS B200 M3 NFS Read/Write Latency - Boot Phase

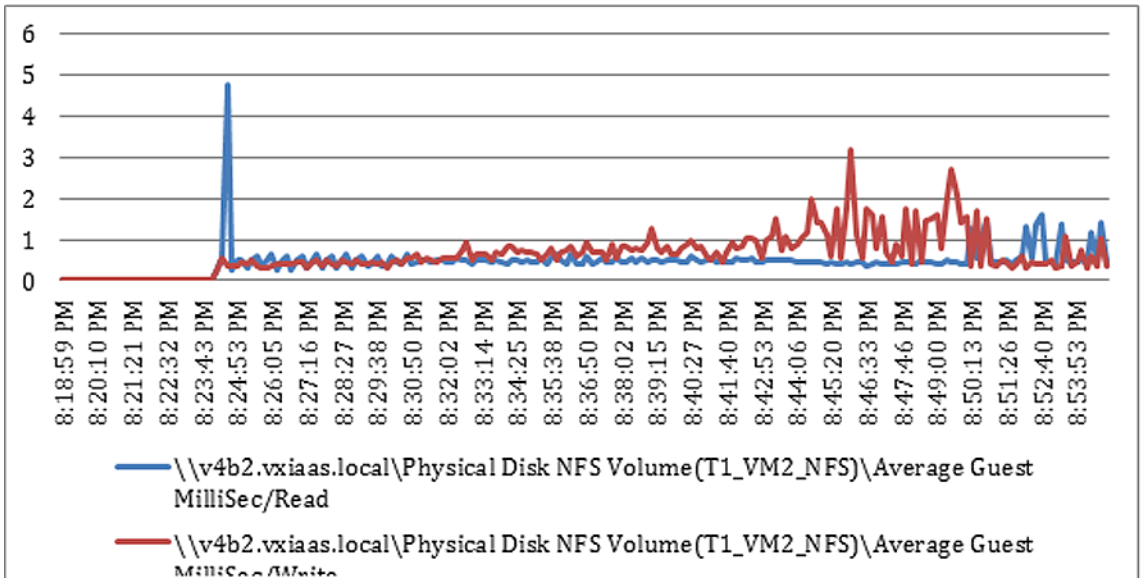
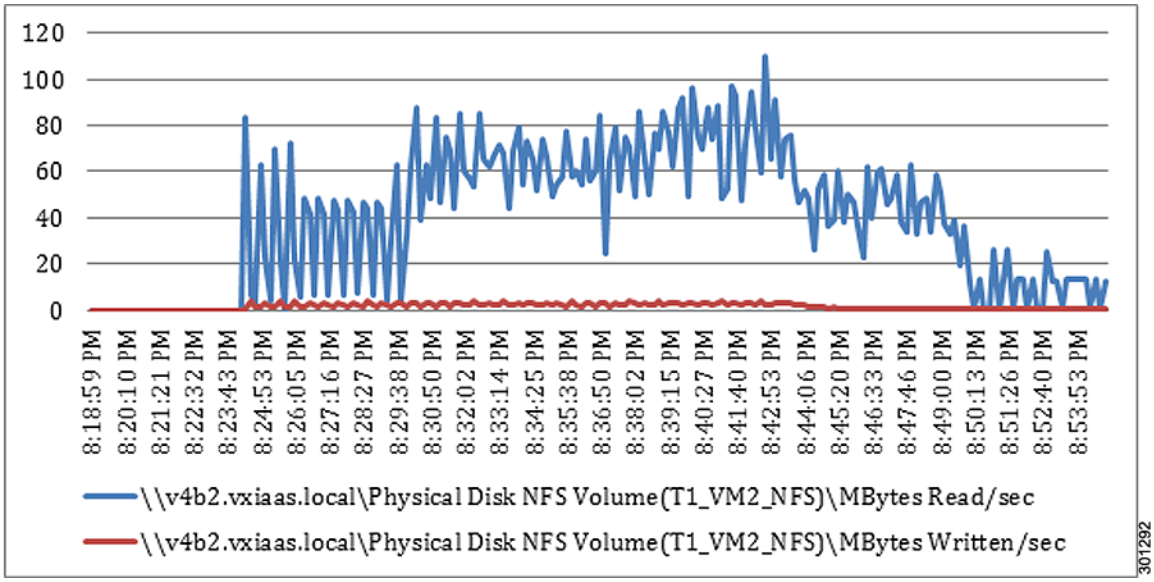


Figure 26 155 Users Single Cisco UCS B200 M3 NFS MBps Read/Write - Boot Phase



Test Phase Performance Results

The following graphs detail CPU, Memory, Disk and Network performance on the Single Cisco UCS B200-M3 blade servers during the test phase collected by esxtop polling data every 10 secs at the recommended maximum load of 155 Windows 7 virtual desktops.

The first charts show the Core utilizations of ~90% during the steady workload phase. The second chart shows the CPU utilization time of ~55% which indicates that the CPU resources were not overcommitted.

The third chart is the memory utilization chart showing the memory allocated to the virtual desktops during the entire workload. Because enough memory is available, 1.5GB of RAM was assigned to each virtual machine. A 1GB memory reservation for each virtual machine was configured to minimize or prevent the hypervisor from swapping.

The next few charts show storage and network performance, in terms of read and write I/O load on the network and the storage system generated 155 VMs on a single server during the entire workload. The I/O Bandwidth data chart shows the network bandwidth utilization associated with the storage traffic.

NOTE: Some of the charts are in Mbytes/sec instead of Mbits/sec. and can be a starting point for estimating the bandwidth needs in the data center.

Figure 27 155 Users Single Cisco UCS B200 M3 CPU Core Utilization - Test Phase

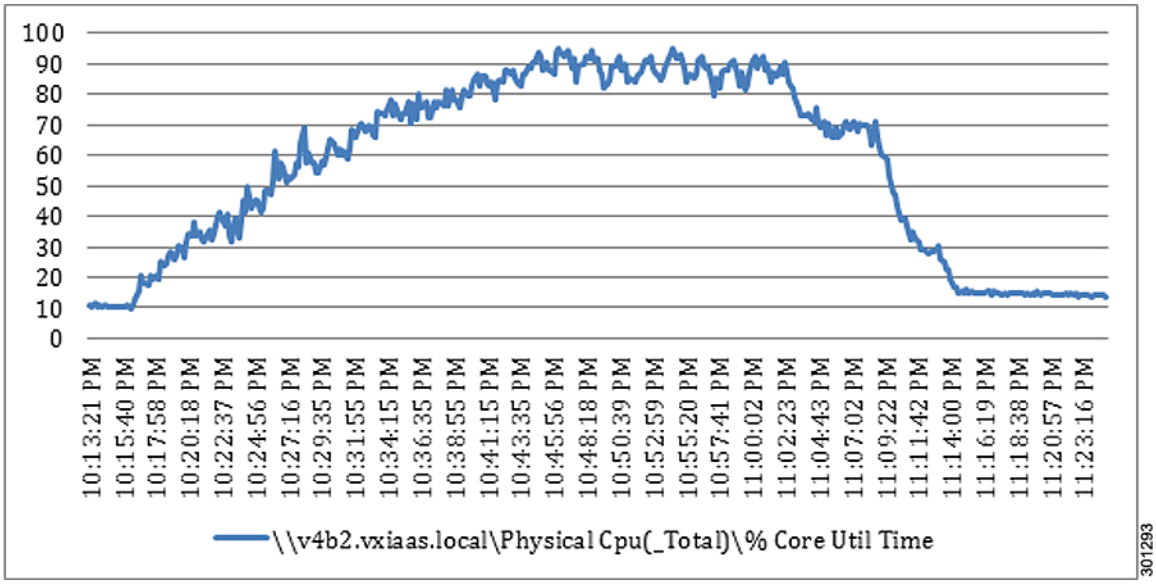


Figure 28 155 Users Single Cisco UCS B200 M3 CPU Processor Time - Test Phase

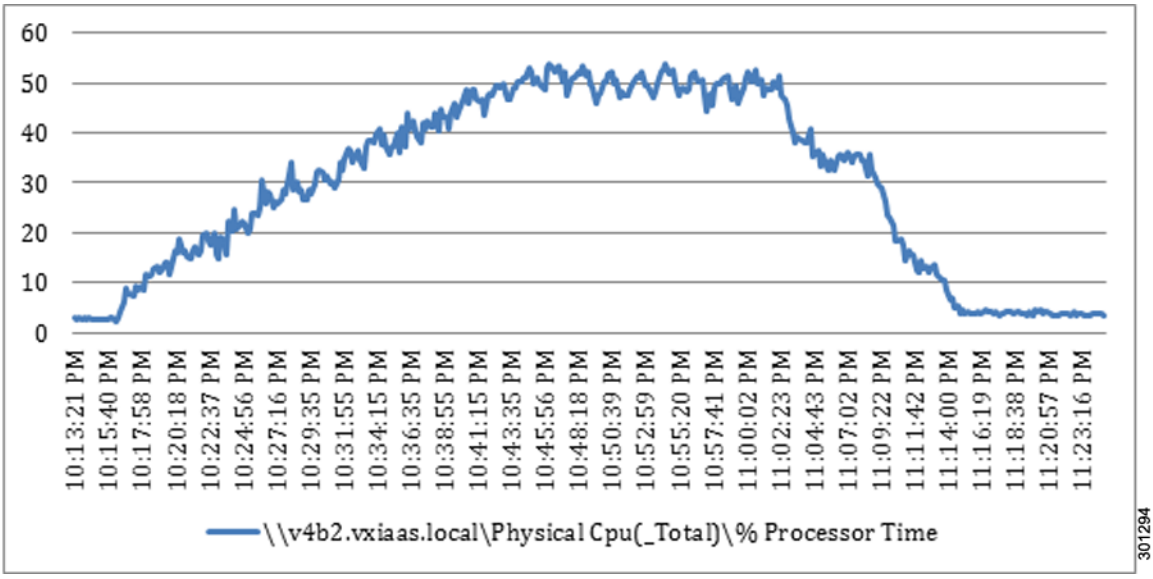


Figure 29 155 Users Single Cisco UCS B200 M3 NonKernel Memory - Test Phase

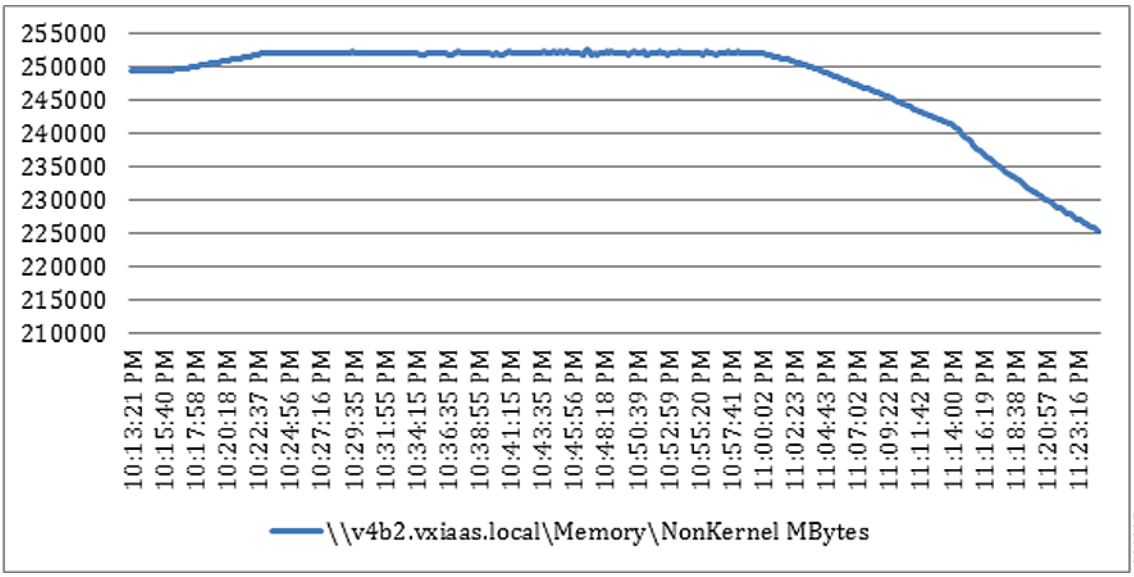


Figure 30 155 Users Single Cisco UCS B200 M3 Cisco VIC1240 MLOM Network Adapter Mbps Receive/Transmit - Test Phase

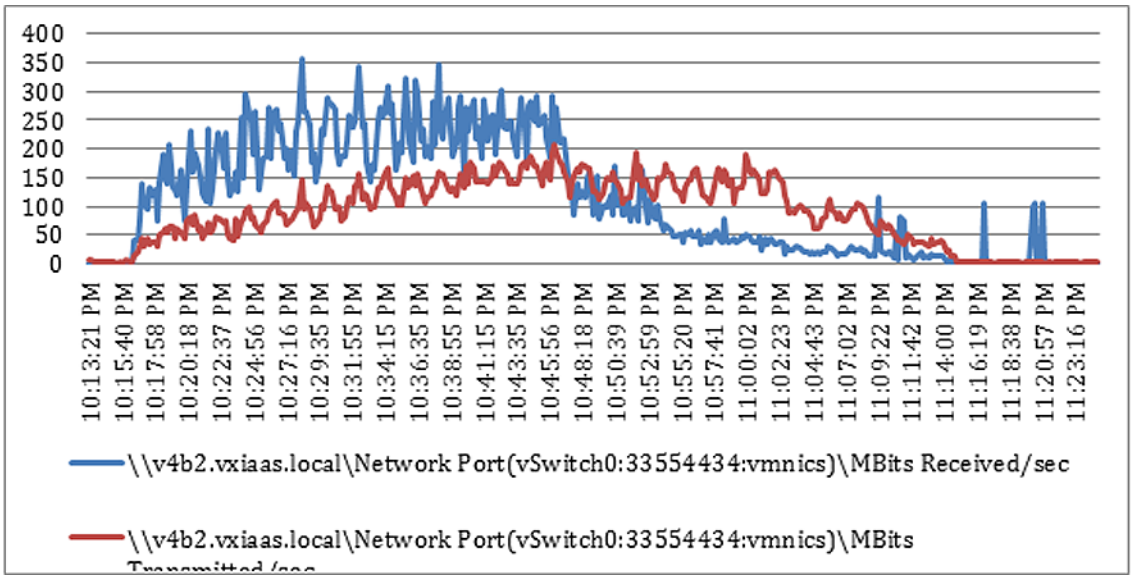


Figure 31 155 Users Single Cisco UCS B200 M3 NFS Read/Write IOPS - Test Phase

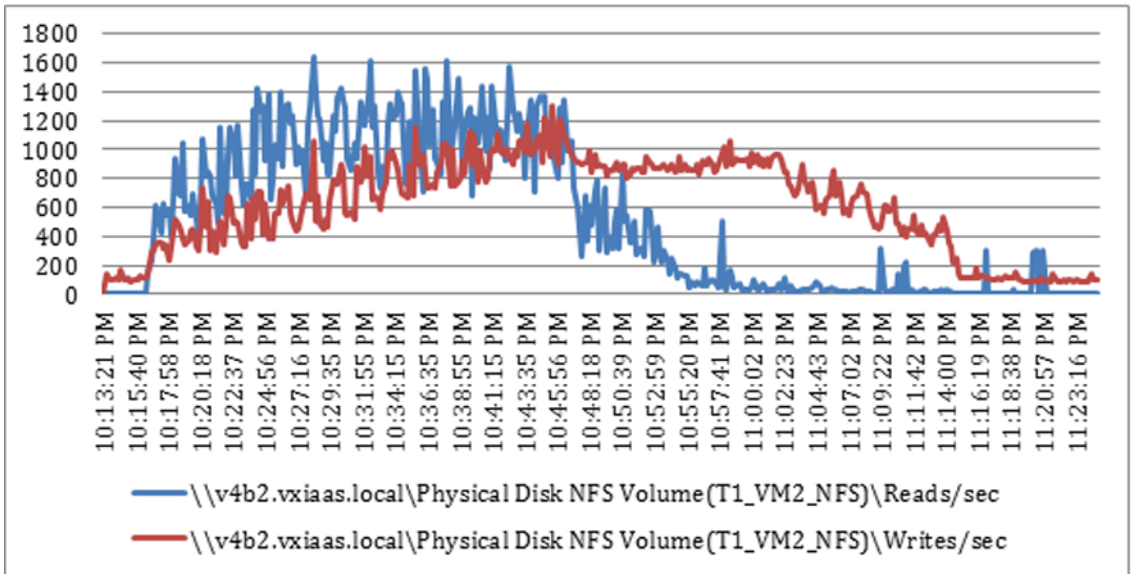


Figure 32 155 Users Single Cisco UCS B200 M3 NFS Read/Write Latency - Test Phase

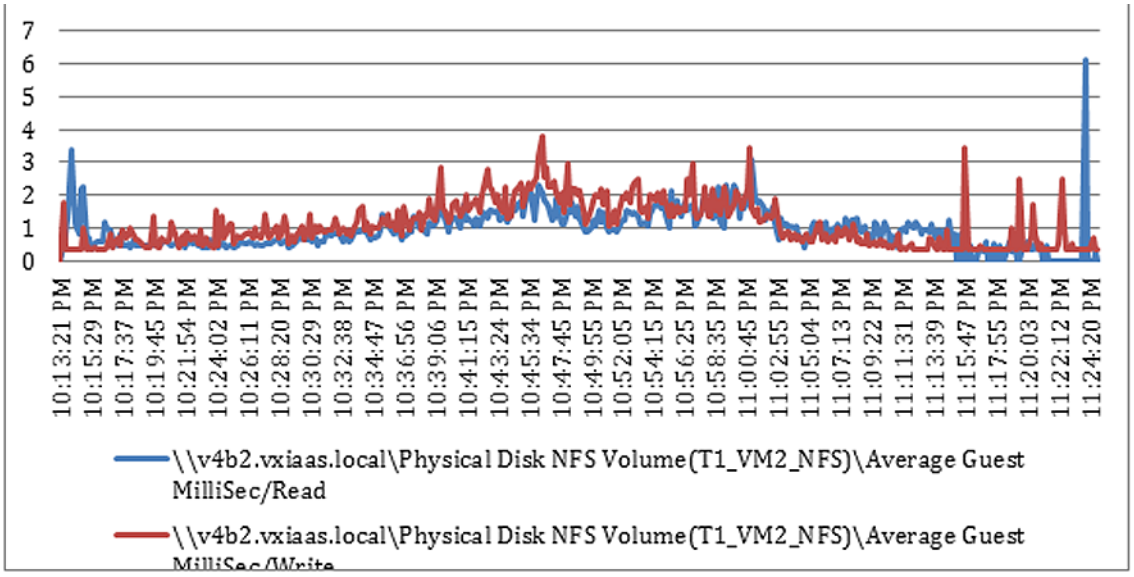
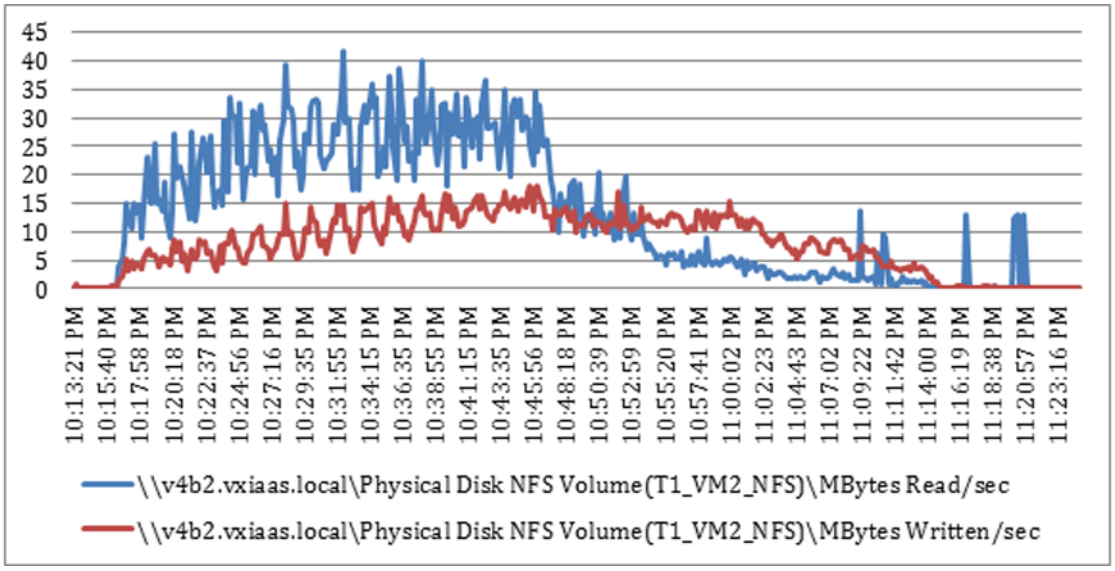


Figure 33 155 Users Single Cisco UCS B200 M3 NFS MBps Read/Write - Test Phase



7 Appendix

Cisco Nexus 5548 configurations

```
!Time: Sat Jun  1 11:53:31 2013
version 5.2(1)N1(2a)
hostname VXIaaS-N5K-1
no feature telnet
cfs eth distribute
feature udld
feature interface-vlan
feature lacp
feature vpc
feature lldp
feature fex
username admin password 5 $1$yZIj2hxG$uOooTIZcF1u4hbEkhFK1z.  role network-admin
no password strength-check
banner motd #Nexus 5000 Switch
ip domain-lookup
ip access-list BULK-DATA
  10 permit tcp any eq 32111 any
ip access-list CALL-SIGNALING
  10 permit tcp any any eq 2748
  20 permit tcp any any eq 5060
  30 permit tcp any any eq 2000
ip access-list MULTIMEDIA-STREAMING
  10 permit tcp any eq 9427 any
ip access-list TRANSACTIONAL-DATA
  10 permit tcp any eq 3389 any
  20 permit udp any eq 50002 any
  30 permit tcp any eq 50002 any
  40 permit udp any eq 4172 any
  50 permit tcp any eq 4172 any
  60 permit tcp any eq 1494 any
class-map type qos class-fcoe
class-map type qos match-any BULK-DATA
  match access-group name BULK-DATA
class-map type qos match-any CALL-SIGNALING
  match access-group name CALL-SIGNALING
class-map type qos match-any TRANSACTIONAL-DATA
  match access-group name TRANSACTIONAL-DATA
class-map type qos match-any MULTIMEDIA-STREAMING
  match access-group name MULTIMEDIA-STREAMING
class-map type queuing BULK
class-map type queuing BULK-DATA
class-map type queuing class-fcoe
  match qos-group 1
class-map type queuing class-all-flood
  match qos-group 2
class-map type queuing class-ip-multicast
  match qos-group 2
policy-map type qos HVD-ACCESS-PORT
  class CALL-SIGNALING
    set dscp 24
  class MULTIMEDIA-STREAMING
    set dscp 26
  class TRANSACTIONAL-DATA
    set dscp 18
  class BULK-DATA
    set dscp 10
  class class-default
policy-map type queuing UPSTREAM-PORT
  class type queuing class-default
```

```
class-map type network-qos class-fcoe
  match qos-group 1
class-map type network-qos class-all-flood
  match qos-group 2
class-map type network-qos class-ip-multicast
  match qos-group 2
policy-map type network-qos jumbo
  class type network-qos class-fcoe
    pause no-drop
    mtu 2158
  class type network-qos class-default
    mtu 9216
    multicast-optimize
system qos
  service-policy type network-qos jumbo
policy-map type control-plane copp-system-policy-customized
  class copp-system-class-default
    police cir 2048 kbps bc 6400000 bytes
hardware profile tcam feature interface-qos limit 50
fex 110
  pinning max-links 1
  description "FEX0110"
  diagnostic bootup level complete
snmp-server user admin network-admin auth md5 0x5b310d304479611ca2ebf839f5c267d7 priv
0x5b310d304479611ca2ebf839f5c267d7 localizedkey
ntp server 10.8.79.254 prefer
vrf context management
  ip route 0.0.0.0/0 10.8.66.1
vlan configuration 731
  service-policy type qos input HVD-ACCESS-PORT
vlan 1
vlan 505
  name VXIaaS-DH-Machines
vlan 711
  name Tenant-1-VM-A
vlan 721
  name Tenant-2-VM-A
vlan 731
  name Tenant-3-VM-A
vlan 741
  name Tenant-4-VM-A
vlan 751
  name Tenant-5-VM-A
vlan 761
  name Tenant-6-VM-A
vlan 844
  name HVXI -NFS

vlan 864
  name VXIaaS-SP-Infra
vlan 865
  name VXIaaS-SP-DH
vlan 867
  name VXIaaS-SP-Hypervisor-MGMT
vlan 868
  name VXIaaS-SP-vMotion
vlan 941
  name Tenant-4-vWAAS
vlan 980
  name Desktone-L2-Link-Local
vpc domain 500
  peer-keepalive destination 10.8.66.9 source 10.8.66.8
port-profile default max-ports 512
interface Vlan1
```

```
interface port-channel1
  description VXIaaS-N5K VPC Peer
  switchport mode trunk
  switchport trunk allowed vlan
505,711,721,731,741,751,761,844,864-865,867-868,941,980
  spanning-tree port type network
  speed 10000
  vpc peer-link
interface port-channel55
  description VXIaaS-N7K Pair
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864-865,867-868,941,980
  spanning-tree port type normal
  speed 10000
  vpc 55
interface port-channel60
  description vxiaas-n1010-a
  switchport mode trunk
  switchport trunk native vlan 867
  switchport trunk allowed vlan 711,867
  spanning-tree port type edge
interface port-channel65
  description vxiaas-n1010-b
  switchport mode trunk
  switchport trunk native vlan 867
  switchport trunk allowed vlan 711,867
  spanning-tree port type edge
interface port-channel100
  description VXIaaS-6100-1-a
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864,867-868,941,980
  spanning-tree port type edge trunk
  spanning-tree bpdufilter enable
  speed 10000
  vpc 100
interface port-channel110
  switchport mode fex-fabric
  fex associate 110
  spanning-tree port type edge trunk
  vpc 110
interface port-channel150
  description VXIaaS-6100-2-a
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864,867-868,980
  spanning-tree port type edge trunk
  spanning-tree bpdufilter enable
  speed 10000
  vpc 150
interface port-channel151
  description VXIaaS-6100-2-b
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864,867-868,980
  spanning-tree port type edge trunk
  spanning-tree bpdufilter enable
  speed 10000
  vpc 151
interface port-channel200
  description VXIaaS-6100-1-b
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864,867-868,941,980
  spanning-tree port type edge trunk
  spanning-tree bpdufilter enable
  speed 10000
  vpc 200
```

```
interface Ethernet1/1
  description VXIaaS-N5K-1
  switchport mode trunk
  switchport trunk allowed vlan
505,711,721,731,741,751,761,844,864-865,867-868,941,980
  channel-group 1 mode active
interface Ethernet1/2
  description VXIaaS-N5K-1
  switchport mode trunk
  switchport trunk allowed vlan
505,711,721,731,741,751,761,844,864-865,867-868,941,980
  channel-group 1 mode active
interface Ethernet1/3
  description VXIaaS-N5K-1
  switchport mode trunk
  switchport trunk allowed vlan
505,711,721,731,741,751,761,844,864-865,867-868,941,980
  channel-group 1 mode active
interface Ethernet1/4
  description VXIaaS-N5K-1
  switchport mode trunk
  switchport trunk allowed vlan
505,711,721,731,741,751,761,844,864-865,867-868,941,980
  channel-group 1 mode active
interface Ethernet1/5
interface Ethernet1/6
interface Ethernet1/7
interface Ethernet1/8
interface Ethernet1/9
interface Ethernet1/10
interface Ethernet1/11
interface Ethernet1/12
interface Ethernet1/13
  description VXIaaS-N7K
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864-865,867-868,941,980
  channel-group 55 mode active
interface Ethernet1/14
  description VXIaaS-N7K
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864-865,867-868,941,980
  channel-group 55 mode active
interface Ethernet1/15
interface Ethernet1/16
interface Ethernet1/17
interface Ethernet1/18
interface Ethernet1/19
interface Ethernet1/20
interface Ethernet1/21
interface Ethernet1/22
interface Ethernet1/23
interface Ethernet1/24
interface Ethernet1/25
  description VXIaaS-6100-2-a
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864,867-868,980
  channel-group 150 mode active
interface Ethernet1/26
  description VXIaaS-6100-2-a
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864,867-868,980
  channel-group 150 mode active
interface Ethernet1/27
  description VXIaaS-6100-2-b
```

```
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864,867-868,980
  channel-group 151 mode active
interface Ethernet1/28
  description VXIaaS-6100-2-b
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864,867-868,980
  channel-group 151 mode active
interface Ethernet1/29
interface Ethernet1/30
interface Ethernet1/31
  description VXIaaS-6100-1-a
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864,867-868,941,980
  channel-group 100 mode active
interface Ethernet1/32
  description VXIaaS-6100-1-b
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864,867-868,941,980
  channel-group 200 mode active
interface Ethernet2/1
interface Ethernet2/2
interface Ethernet2/3
interface Ethernet2/4
interface Ethernet2/5
interface Ethernet2/6
interface Ethernet2/7
interface Ethernet2/8
interface Ethernet2/9
interface Ethernet2/10
interface Ethernet2/11
interface Ethernet2/12
interface Ethernet2/13
interface Ethernet2/14
interface Ethernet2/15
  switchport mode fex-fabric
  fex associate 110
  channel-group 110
interface Ethernet2/16
  switchport mode fex-fabric
  fex associate 110
  channel-group 110
interface mgmt0
  ip address 10.8.66.8/24
interface Ethernet110/1/1
  description vxiaas-n1010-a
  switchport mode trunk
  switchport trunk native vlan 867
  switchport trunk allowed vlan 711,867
  channel-group 60 mode active
interface Ethernet110/1/2
  description vxiaas-n1010-a
  switchport mode trunk
  switchport trunk native vlan 867
  switchport trunk allowed vlan 711,867
  channel-group 60 mode active
interface Ethernet110/1/3
  description vxiaas-n1010-a
  switchport mode trunk
  switchport trunk native vlan 867
  switchport trunk allowed vlan 711,867
  channel-group 60 mode active
interface Ethernet110/1/4
  description vxiaas-n1010-a
```

```
  switchport mode trunk
  switchport trunk native vlan 867
  switchport trunk allowed vlan 711,867
  channel-group 60 mode active
interface Ethernet110/1/5
  description vxiaas-n1010-b
  switchport mode trunk
  switchport trunk native vlan 867
  switchport trunk allowed vlan 711,867
  channel-group 65 mode active
interface Ethernet110/1/6
  description vxiaas-n1010-b
  switchport mode trunk
  switchport trunk native vlan 867
  switchport trunk allowed vlan 711,867
  channel-group 65 mode active
interface Ethernet110/1/7
  description vxiaas-n1010-b
  switchport mode trunk
  switchport trunk native vlan 867
  switchport trunk allowed vlan 711,867
  channel-group 65 mode active
interface Ethernet110/1/8
  description vxiaas-n1010-b
  switchport mode trunk
  switchport trunk native vlan 867
  switchport trunk allowed vlan 711,867
  channel-group 65 mode active
interface Ethernet110/1/9
interface Ethernet110/1/10
interface Ethernet110/1/11
interface Ethernet110/1/12
interface Ethernet110/1/13
interface Ethernet110/1/14
interface Ethernet110/1/15
interface Ethernet110/1/16
interface Ethernet110/1/17
interface Ethernet110/1/18
interface Ethernet110/1/19
interface Ethernet110/1/20
interface Ethernet110/1/21
interface Ethernet110/1/22
interface Ethernet110/1/23
interface Ethernet110/1/24
interface Ethernet110/1/25
interface Ethernet110/1/26
interface Ethernet110/1/27
interface Ethernet110/1/28
interface Ethernet110/1/29
interface Ethernet110/1/30
interface Ethernet110/1/31
interface Ethernet110/1/32
interface Ethernet110/1/33
interface Ethernet110/1/34
interface Ethernet110/1/35
interface Ethernet110/1/36
interface Ethernet110/1/37
interface Ethernet110/1/38
interface Ethernet110/1/39
interface Ethernet110/1/40
interface Ethernet110/1/41
interface Ethernet110/1/42
interface Ethernet110/1/43
interface Ethernet110/1/44
```

```
interface Ethernet110/1/45
interface Ethernet110/1/46
interface Ethernet110/1/47
interface Ethernet110/1/48
clock timezone EST -5 0
clock summer-time EDT 2 Sun Mar 2:00 1 Sun Nov 2:00 60
line console
  exec-timeout 0
line vty
boot kickstart bootflash:/n5000-uk9-kickstart.5.2.1.N1.2a.bin
boot system bootflash:/n5000-uk9.5.2.1.N1.2a.bin



!Time: Sat Jun  1 12:19:44 2013
version 5.2(1)N1(2a)
hostname VXIaaS-N5K-2
no feature telnet
cfs eth distribute
feature udld
feature interface-vlan
feature lacp
feature vpc
feature lldp
feature fex
username admin password 5 $1$vab55EyW$H21ygbp9047zkiTIjFkx60  role network-admin
no password strength-check
banner motd #Nexus 5000 Switch
ssh key rsa 2048
ip domain-lookup
ip access-list BULK-DATA
  10 permit tcp any any eq 2748
ip access-list CALL-SIGNALING
  10 permit tcp any any eq 2748
  20 permit tcp any any eq 5060
  30 permit tcp any any eq 2000
ip access-list MULTIMEDIA-STREAMING
  10 permit tcp any eq 9427 any
ip access-list TRANSACTIONAL-DATA
  10 permit tcp any eq 3389 any
  20 permit udp any eq 50002 any
  30 permit tcp any eq 50002 any
  40 permit udp any eq 4172 any
  50 permit tcp any eq 4172 any
  60 permit tcp any eq 1494 any
class-map type qos class-fcoe
class-map type qos match-any BULK-DATA
  match access-group name BULK-DATA
class-map type qos match-any CALL-SIGNALING
  match access-group name CALL-SIGNALING
class-map type qos match-any TRANSACTIONAL-DATA
  match access-group name TRANSACTIONAL-DATA
class-map type qos match-any MULTIMEDIA-STREAMING
  match access-group name MULTIMEDIA-STREAMING
class-map type queuing class-fcoe
  match qos-group 1
class-map type queuing class-all-flood
  match qos-group 2
class-map type queuing class-ip-multicast
  match qos-group 2
policy-map type qos HVD-ACCESS-PORT
  class CALL-SIGNALING
    set dscp 24
  class MULTIMEDIA-STREAMING
```

```
    set dscp 26
  class TRANSACTIONAL-DATA
    set dscp 18
  class BULK-DATA
    set dscp 10
  class class-default
class-map type network-qos class-fcoe
  match qos-group 1
class-map type network-qos class-all-flood
  match qos-group 2
class-map type network-qos class-ip-multicast
  match qos-group 2
policy-map type network-qos jumbo
  class type network-qos class-fcoe
    pause no-drop
    mtu 2158
  class type network-qos class-default
    mtu 9216
    multicast-optimize
system qos
  service-policy type network-qos jumbo
policy-map type control-plane copp-system-policy-customized
  class copp-system-class-default
    police cir 2048 kbps bc 6400000 bytes
hardware profile tcam feature interface-qos limit 50
fex 110
  pinning max-links 1
  description "FEX0110"
  diagnostic bootup level complete
snmp-server user admin network-admin auth md5 0x5fad43c003bbc5cc41071a4c7ca92e5e priv
0x5fad43c003bbc5cc41071a4c7ca92e5e localizedkey
ntp server 10.8.79.254
vrf context management
  ip route 0.0.0.0/0 10.8.66.1
vlan configuration 731
  service-policy type qos input HVD-ACCESS-PORT
vlan 1
vlan 505
  name VXIaaS-DH-Machines
vlan 711
  name Tenant-1-VM-A
vlan 721
  name Tenant-2-VM-A
vlan 731
  name Tenant-3-VM-A
vlan 741
  name Tenant-4-VM-A
vlan 751
  name Tenant-5-VM-A
vlan 761
  name Tenant-6-VM-A
vlan 844
  name HVXI- NFS
vlan 864
  name VXIaaS-SP-Infra
vlan 865
  name VXIaaS-SP-DH
vlan 867
  name VXIaaS-SP-Hypervisor-MGMT
vlan 868
  name VXIaaS-SP-vMotion
vlan 941
  name Tenant-4-vWAAS
vlan 980
```

```
  name Desktone-L2-Link-Local
vpc domain 500
  peer-keepalive destination 10.8.66.8 source 10.8.66.9
  auto-recovery
port-profile default max-ports 512
interface Vlan1
interface port-channel1
  description VXIaaS-N5K VPC Peer
  switchport mode trunk
  switchport trunk allowed vlan
505,711,721,731,741,751,761,844,864-865,867-868,941,980
  spanning-tree port type network
  speed 10000
  vpc peer-link
interface port-channel55
  description VXiaaS-N7K Pair
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864-865,867-868,941,980
  spanning-tree port type normal
  speed 10000
  vpc 55
interface port-channel60
  description vxiaas-n1010-a
  switchport mode trunk
  switchport trunk native vlan 867
  switchport trunk allowed vlan 711,867
  spanning-tree port type edge
interface port-channel65
  description vxiaas-n1010-b
  switchport mode trunk
  switchport trunk native vlan 867
  switchport trunk allowed vlan 711,867
  spanning-tree port type edge
interface port-channel100
  description VXIaaS-6100-1-a
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864,867-868,941,980
  spanning-tree port type edge trunk
  spanning-tree bpdufilter enable
  speed 10000
  vpc 100
interface port-channel110
  switchport mode fex-fabric
  fex associate 110
  spanning-tree port type edge trunk
  vpc 110
interface port-channel150
  description VXIaaS-6100-2-a
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864,867-868,980
  spanning-tree port type edge trunk
  spanning-tree bpdufilter enable
  speed 10000
  vpc 150
interface port-channel151
  description VXIaaS-6100-2-b
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864,867-868,980
  spanning-tree port type edge trunk
  spanning-tree bpdufilter enable
  speed 10000
  vpc 151
interface port-channel200
  description VXIaaS-6100-1-b
```

```
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864,867-868,941,980
  spanning-tree port type edge trunk
  spanning-tree bpdufilter enable
  speed 10000
  vpc 200
interface Ethernet1/1
  description VXIaaS-N5K-1
  switchport mode trunk
  switchport trunk allowed vlan
505,711,721,731,741,751,761,844,864-865,867-868,941,980
  channel-group 1 mode active
interface Ethernet1/2
  description VXIaaS-N5K-1
  switchport mode trunk
  switchport trunk allowed vlan
505,711,721,731,741,751,761,844,864-865,867-868,941,980
  channel-group 1 mode active
interface Ethernet1/3
  description VXIaaS-N5K-1
  switchport mode trunk
  switchport trunk allowed vlan
505,711,721,731,741,751,761,844,864-865,867-868,941,980
  channel-group 1 mode active
interface Ethernet1/4
  description VXIaaS-N5K-1
  switchport mode trunk
  switchport trunk allowed vlan
505,711,721,731,741,751,761,844,864-865,867-868,941,980
  channel-group 1 mode active
interface Ethernet1/5
interface Ethernet1/6
interface Ethernet1/7
interface Ethernet1/8
interface Ethernet1/9
interface Ethernet1/10
interface Ethernet1/11
interface Ethernet1/12
interface Ethernet1/13
  description VXIaaS-N7K
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864-865,867-868,941,980
  channel-group 55 mode active
interface Ethernet1/14
  description VXIaaS-N7K
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864-865,867-868,941,980
  channel-group 55 mode active
interface Ethernet1/15
interface Ethernet1/16
interface Ethernet1/17
interface Ethernet1/18
interface Ethernet1/19
interface Ethernet1/20
interface Ethernet1/21
interface Ethernet1/22
interface Ethernet1/23
interface Ethernet1/24
interface Ethernet1/25
  description VXIaaS-6100-2-a
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864,867-868,980
  channel-group 150 mode active
interface Ethernet1/26
```

```
  description VXIaaS-6100-2-a
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864,867-868,980
  channel-group 150 mode active
interface Ethernet1/27
  description VXIaaS-6100-2-b
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864,867-868,980
  channel-group 151 mode active
interface Ethernet1/28
  description VXIaaS-6100-2-b
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864,867-868,980
  channel-group 151 mode active
interface Ethernet1/29
interface Ethernet1/30
interface Ethernet1/31
  description VXIaaS-6100-1-a
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864,867-868,941,980
  channel-group 100 mode active
interface Ethernet1/32
  description VXIaaS-6100-1-b
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864,867-868,941,980
  channel-group 200 mode active
interface Ethernet2/1
interface Ethernet2/2
interface Ethernet2/3
interface Ethernet2/4
interface Ethernet2/5
interface Ethernet2/6
interface Ethernet2/7
interface Ethernet2/8
interface Ethernet2/9
interface Ethernet2/10
interface Ethernet2/11
interface Ethernet2/12
interface Ethernet2/13
interface Ethernet2/14
interface Ethernet2/15
  switchport mode fex-fabric
  fex associate 110
  channel-group 110
interface Ethernet2/16
  switchport mode fex-fabric
  fex associate 110
  channel-group 110
interface mgmt0
  ip address 10.8.66.9/24
interface Ethernet110/1/1
  description vxiaas-n1010-a
  switchport mode trunk
  switchport trunk native vlan 867
  switchport trunk allowed vlan 711,867
  channel-group 60 mode active
interface Ethernet110/1/2
  description vxiaas-n1010-a
  switchport mode trunk
  switchport trunk native vlan 867
  switchport trunk allowed vlan 711,867
  channel-group 60 mode active
interface Ethernet110/1/3
  description vxiaas-n1010-a
```

```
  switchport mode trunk
  switchport trunk native vlan 867
  switchport trunk allowed vlan 711,867
  channel-group 60 mode active
interface Ethernet110/1/4
  description vxiaas-n1010-a
  switchport mode trunk
  switchport trunk native vlan 867
  switchport trunk allowed vlan 711,867
  channel-group 60 mode active
interface Ethernet110/1/5
  description vxiaas-n1010-b
  switchport mode trunk
  switchport trunk native vlan 867
  switchport trunk allowed vlan 711,867
  channel-group 65 mode active
interface Ethernet110/1/6
  description vxiaas-n1010-b
  switchport mode trunk
  switchport trunk native vlan 867
  switchport trunk allowed vlan 711,867
  channel-group 65 mode active
interface Ethernet110/1/7
  description vxiaas-n1010-b
  switchport mode trunk
  switchport trunk native vlan 867
  switchport trunk allowed vlan 711,867
  channel-group 65 mode active
interface Ethernet110/1/8
  description vxiaas-n1010-b
  switchport mode trunk
  switchport trunk native vlan 867
  switchport trunk allowed vlan 711,867
  channel-group 65 mode active
interface Ethernet110/1/9
interface Ethernet110/1/10
interface Ethernet110/1/11
interface Ethernet110/1/12
interface Ethernet110/1/13
interface Ethernet110/1/14
interface Ethernet110/1/15
interface Ethernet110/1/16
interface Ethernet110/1/17
interface Ethernet110/1/18
interface Ethernet110/1/19
interface Ethernet110/1/20
interface Ethernet110/1/21
interface Ethernet110/1/22
interface Ethernet110/1/23
interface Ethernet110/1/24
interface Ethernet110/1/25
interface Ethernet110/1/26
interface Ethernet110/1/27
interface Ethernet110/1/28
interface Ethernet110/1/29
interface Ethernet110/1/30
interface Ethernet110/1/31
interface Ethernet110/1/32
interface Ethernet110/1/33
interface Ethernet110/1/34
interface Ethernet110/1/35
interface Ethernet110/1/36
interface Ethernet110/1/37
interface Ethernet110/1/38
```

```
interface Ethernet110/1/39
interface Ethernet110/1/40
interface Ethernet110/1/41
interface Ethernet110/1/42
interface Ethernet110/1/43
interface Ethernet110/1/44
interface Ethernet110/1/45
interface Ethernet110/1/46
interface Ethernet110/1/47
interface Ethernet110/1/48
clock timezone EST -5 0
clock summer-time EDT 2 Sun Mar 2:00 1 Sun Nov 2:00 60
line console
  exec-timeout 0
line vty
boot kickstart bootflash:/n5000-uk9-kickstart.5.2.1.N1.2a.bin
boot system bootflash:/n5000-uk9.5.2.1.N1.2a.bin

Cisco Nexus 7009 configurations:

!Time: Sat Jun  1 12:22:38 2013
version 6.1(2)
hostname VXIaaS-DC-N7K-1
vdc VXIaaS-DC-N7K-1 id 1
  limit-resource module-type f2
  allocate interface Ethernet4/1-48
  allocate interface Ethernet5/1-48
  limit-resource vlan minimum 16 maximum 4094
  limit-resource monitor-session minimum 0 maximum 2
  limit-resource monitor-session-erspan-dst minimum 0 maximum 23
  limit-resource vrf minimum 2 maximum 4096
  limit-resource port-channel minimum 0 maximum 768
  limit-resource u4route-mem minimum 96 maximum 96
  limit-resource u6route-mem minimum 24 maximum 24
  limit-resource m4route-mem minimum 58 maximum 58
  limit-resource m6route-mem minimum 8 maximum 8
  limit-resource monitor-session-inband-src minimum 0 maximum 1
feature telnet
cfs eth distribute
feature ospf
feature bgp
feature eigrp
feature interface-vlan
feature dot1x
feature hsrp
feature lacp
feature dhcp
feature vpc
feature wccp
logging level pixm 2
username admin password 5 $1$QAUkrln2$EgIAciPkN0CLqHbf7SmQf/  role network-admin
no password strength-check
ip domain-lookup
ip domain-name vxiaas.local
ip domain-list cisco.com
ip domain-list vxiaas.local
ip name-server 10.8.64.100
class-map type qos match-any VOICE
  match dscp 46
class-map type qos match-all BULK-DATA
  match dscp 10,12,14
class-map type qos match-any SCAVENGER
  match dscp 8
class-map type qos match-any CALL-SIGNALING
```

```
  match dscp 24
class-map type qos match-any NETWORK-CONTROL
  match dscp 48
class-map type qos match-any TRANSACTIONAL-DATA
  match dscp 18,20,22
class-map type qos match-any MULTIMEDIA-STREAMING
  match dscp 26,28,30
class-map type qos match-any MULTIMEDIA-CONFERENCING
  match dscp 34,36,38
class-map type queuing match-any BROADCAST-VIDEO
policy-map type queuing VPN-EDGE
copp profile strict
snmp-server user admin network-admin auth md5 0xde4b54725e78b89933e0602c1a882917 priv
0xde4b54725e78b89933e0602c1a882917 localizedkey
rmon event 1 log trap public description FATAL(1) owner PMON@FATAL
rmon event 2 log trap public description CRITICAL(2) owner PMON@CRITICAL
rmon event 3 log trap public description ERROR(3) owner PMON@ERROR
rmon event 4 log trap public description WARNING(4) owner PMON@WARNING
rmon event 5 log trap public description INFORMATION(5) owner PMON@INFO
ntp server 10.8.79.254
vlan 1,711,721,731,741,751,761,844,864-868,941,980
vrf context GT-Out
vrf context T1-In
vrf context T1-Out
vrf context T2-In
vrf context T2-Out
vrf context T3-In
vrf context T3-Out
vrf context T4-In
vrf context T4-Out
  ip wccp 61
  ip wccp 62
vrf context T5-In
vrf context T5-Out
vrf context management
  ip route 0.0.0.0/0 10.8.66.1
vlan 711
  name Tenant-1-VM-A
vlan 721
  name Tenant-2-VM-A
vlan 731
  name Tenant-3-VM-A
vlan 741
  name Tenant-4-VM-A
vlan 751
  name Tenant-5-VM-A
vlan 761
  name Tenant-6-VM-A
vlan 844
  name HVXI-NFS
vlan 864
  name VXIaaS-SP-Infra
vlan 865
  name VXIaaS-SP-DH
vlan 866
  name VXIaaS-OOB-MGMT
vlan 867
  name VXIaaS-SP-Hypervisor-MGMT
vlan 868
  name VXIaaS-SP-vMotion
vlan 941
  name Tenant-4-vWAAS
vlan 980
  name Desktone-L2-Link-Local
```

```
spanning-tree vlan 711,721,731,741,751,761,864-868,980 priority 4096
ip prefix-list BGP-DIRECT seq 5 permit 10.8.0.0/16 le 30

ip prefix-list COMMON-SUM seq 5 permit 10.10.0.0/17
ip prefix-list EIGRP-BGP seq 5 permit 10.10.0.0/17
route-map BGP-DIRECT permit 10
  match ip address prefix-list BGP-DIRECT
route-map COMMON-SUM permit 10
  match ip address prefix-list COMMON-SUM
route-map EIGRP-BGP permit 10
  match ip address prefix-list EIGRP-BGP
service dhcp
ip dhcp relay
vpc domain 42
  peer-switch
  role priority 100
  peer-keepalive destination 10.8.66.22 source 10.8.66.21
  peer-gateway
  auto-recovery
  ip arp synchronize
interface Vlan1
interface Vlan711
  vrf member T1-In
  no ip redirects
  ip address 10.9.104.2/21
  ip ospf passive-interface
  ip router ospf VXIaaS area 0.0.0.20
  hsrp version 2
  hsrp 711
    priority 110
    ip 10.9.104.1
  ip dhcp relay address 10.9.10.150
  ip dhcp relay address 10.9.10.151
  description Tenant 1 VMs
  no shutdown
  mtu 9216
interface Vlan721
  vrf member T2-In
  no ip redirects
  ip address 10.9.112.2/21
  ip ospf passive-interface
  ip router ospf VXIaaS area 0.0.0.20
  hsrp version 2
  hsrp 721
    preempt
    priority 110
    ip 10.9.112.1
  ip dhcp relay address 10.9.20.150
  ip dhcp relay address 10.9.20.151
  description Tenant 2 VMs
  no shutdown
  mtu 9216
interface Vlan731
  vrf member T3-In
  no ip redirects
  ip address 10.9.120.2/21
  ip ospf passive-interface
  ip router ospf VXIaaS area 0.0.0.20
  hsrp version 2
  hsrp 731
    preempt
    priority 110
    ip 10.9.120.1
  ip dhcp relay address 10.9.30.150
```

```
  ip dhcp relay address 10.9.30.151
  description Tenant 3 VMs
  no shutdown
  mtu 9216
interface Vlan741
  vrf member T4-In
  no ip redirects
  ip address 10.9.128.2/21
  ip ospf passive-interface
  ip router ospf VXIaaS area 0.0.0.20
  hsrp version 2
  hsrp 741
    preempt
    priority 110
    ip 10.9.128.1
  ip dhcp relay address 10.9.40.150
  ip dhcp relay address 10.9.40.151
  description Tenant 4 VMs
  no shutdown
  mtu 9216
interface Vlan751
  vrf member T5-In
  no ip redirects
  ip address 10.9.136.2/21
  ip ospf passive-interface
  ip router ospf VXIaaS area 0.0.0.20
  hsrp version 2
  hsrp 751
    preempt
    priority 110
    ip 10.9.136.1
  ip dhcp relay address 10.9.50.150
  ip dhcp relay address 10.9.50.151
  description Tenant 5 VMs
  no shutdown
  mtu 9216
interface Vlan864
  no ip redirects
  ip address 10.8.64.2/24
  ip router eigrp 42
  ip passive-interface eigrp 42
  hsrp version 2
  hsrp 864
    priority 110
    ip 10.8.64.1
  description VXIaaS-SP-Infra
  no shutdown
  mtu 9216
interface Vlan865
  no ip redirects
  ip address 10.8.65.2/24
  ip router eigrp 42
  ip passive-interface eigrp 42
  hsrp version 2
  hsrp 865
    priority 110
    ip 10.8.65.1
  description VXIaaS-SP-DH
  no shutdown
  mtu 9216
interface Vlan866
  no ip redirects
  ip address 10.8.66.2/24
  ip router eigrp 42
```

```
  ip passive-interface eigrp 42
  hsrp version 2
  hsrp 866
    priority 110
    ip 10.8.66.1
  description VXIaaS-OOB-MGMT
  no shutdown
  mtu 9216
interface Vlan867
  no ip redirects
  ip address 10.8.67.2/24
  ip router eigrp 42
  ip passive-interface eigrp 42
  hsrp version 2
  hsrp 867
    priority 110
    ip 10.8.67.1
  description VXIaaS-SP-Hypervisor-MGMT
  no shutdown
  mtu 9216
interface Vlan868
  no ip redirects
  ip address 10.8.68.2/24
  ip router eigrp 42
  ip passive-interface eigrp 42
  hsrp version 2
  hsrp 868
    priority 110
    ip 10.8.68.1
  description VXIaaS-SP-vMotion
  no shutdown
  mtu 9216
interface Vlan941
  vrf member T4-Out
  no ip redirects
  ip address 10.9.192.26/29
  ip ospf passive-interface
  ip router ospf VXIaaS area 0.0.0.10
  hsrp version 2
  hsrp 941
    preempt
    priority 110
    ip 10.9.192.25
  ip dhcp relay address 10.9.40.150
  ip dhcp relay address 10.9.40.151
  description Tenant 4 vWAAS
  no shutdown
  mtu 9216
interface port-channel1
  description vPC Peer Link Between N7Ks
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 711,714-715,721,724-725,731,734-735
  switchport trunk allowed vlan add 741,744-745,751,754-755,761,844
  switchport trunk allowed vlan add 864-868,941,980
  spanning-tree port type network
  mtu 9216
  vpc peer-link
interface port-channel2
  description NON-vPC Peer Link Between N7Ks
  mtu 9216
interface port-channel2.718
  description Tenant 1 N7K-N7K Outside
  mtu 9216
```

```
  encapsulation dot1q 718
  vrf member T1-Out
  no ip redirects
  ip address 10.8.78.25/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.10
  no shutdown
interface port-channel2.719
  description Tenant 1 N7K-N7K Inside
  mtu 9216
  encapsulation dot1q 719
  vrf member T1-In
  no ip redirects
  ip address 10.8.78.29/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.20
  no shutdown
interface port-channel2.728
  description Tenant 2 N7K-N7K Outside
  mtu 9216
  encapsulation dot1q 728
  vrf member T2-Out
  no ip redirects
  ip address 10.8.78.57/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.10
  no shutdown
interface port-channel2.729
  description Tenant 1 N7K-N7K Inside
  mtu 9216
  encapsulation dot1q 729
  vrf member T2-In
  no ip redirects
  ip address 10.8.78.61/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.20
  no shutdown
interface port-channel2.738
  description Tenant 3 N7K-N7K Outside
  mtu 9216
  encapsulation dot1q 738
  vrf member T3-Out
  no ip redirects
  ip address 10.8.78.89/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.10
  no shutdown
interface port-channel2.739
  description Tenant 1 N7K-N7K Inside
  mtu 9216
  encapsulation dot1q 739
  vrf member T3-In
  no ip redirects
  ip address 10.8.78.93/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.20
  no shutdown
interface port-channel2.748
  description Tenant 4 N7K-N7K Outside
  mtu 9216
  encapsulation dot1q 748
  vrf member T4-Out
  no ip redirects
  ip address 10.8.78.121/30
```

```
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.10
  no shutdown
interface port-channel2.749
  description Tenant 1 N7K-N7K Inside
  mtu 9216
  encapsulation dot1q 749
  vrf member T4-In
  no ip redirects
  ip address 10.8.78.125/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.20
  no shutdown
interface port-channel2.758
  description Tenant 5 N7K-N7K Outside
  mtu 9216
  encapsulation dot1q 758
  vrf member T5-Out
  no ip redirects
  ip address 10.8.78.153/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.10
  no shutdown
interface port-channel2.759
  description Tenant 1 N7K-N7K Inside
  mtu 9216
  encapsulation dot1q 759
  vrf member T5-In
  no ip redirects
  ip address 10.8.78.157/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.20
  no shutdown
interface port-channel2.788
  description Global Tenant N7K-N7K Outside
  mtu 9216
  encapsulation dot1q 788
  vrf member GT-Out
  no ip redirects
  ip address 10.8.78.249/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.10
  no shutdown
interface port-channel3
  description VXIaaS-OOB-MGMT-SW
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 866
  vpc 3
interface port-channel4
  description VXIaaS-OOB-Tenant-MGMT-SW
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 866
  vpc 4


interface port-channel5
  description Common N5K Pair
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 844,864-865
  spanning-tree port type edge trunk
  mtu 9216
```

```
  vpc 5
interface port-channel6
  description VXIaaS-OOB-SP-MGMT-SW
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 866
  vpc 6
interface port-channel55
  description VXIaaS-SP-5K-Pair
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864-865
  switchport trunk allowed vlan add 867-868,941,980
  spanning-tree port type normal
  mtu 9216
  vpc 55
interface port-channel103
  description L3 Link To Service 6500 VSS
  no lacp graceful-convergence
interface port-channel103.611
  description T1 Outside Service 6500
  encapsulation dot1q 611
  vrf member T1-Out
  no ip redirects
  ip address 10.8.76.1/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.10
  no shutdown
interface port-channel103.613
  description T1 Inside Service 6500
  encapsulation dot1q 613
  vrf member T1-In
  no ip redirects
  ip address 10.8.76.9/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.20
  no shutdown
interface port-channel103.621
  description T2 Outside Service 6500
  encapsulation dot1q 621
  vrf member T2-Out
  no ip redirects
  ip address 10.8.76.65/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.10
  no shutdown
interface port-channel103.623
  description T2 Inside Service 6500
  encapsulation dot1q 623
  vrf member T2-In
  no ip redirects
  ip address 10.8.76.73/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.20
  no shutdown
interface port-channel103.631
  description T3 Outside Service 6500
  encapsulation dot1q 631
  vrf member T3-Out
  no ip redirects
  ip address 10.8.76.129/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.10
  no shutdown
```

```
interface port-channel103.633
  description T3 Inside Service 6500
  encapsulation dot1q 633
  vrf member T3-In
  no ip redirects
  ip address 10.8.76.137/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.20
  no shutdown
interface port-channel103.641
  description T4 Outside Service 6500
  encapsulation dot1q 641
  vrf member T4-Out
  no ip redirects
  ip address 10.8.76.193/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.10
  no shutdown
  ip wccp 61 redirect in
interface port-channel103.643
  description T4 Inside Service 6500
  encapsulation dot1q 643
  vrf member T4-In
  no ip redirects
  ip address 10.8.76.201/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.20
  no shutdown
interface port-channel103.651
  description T5 Outside Service 6500
  encapsulation dot1q 651
  vrf member T5-Out
  no ip redirects
  ip address 10.8.77.1/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.10
  no shutdown
interface port-channel103.653
  description T5 Inside Service 6500
  encapsulation dot1q 653
  vrf member T5-In
  no ip redirects
  ip address 10.8.77.9/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.20
  no shutdown
interface port-channel103.681
  description Global Tenant Outside Service 6500
  encapsulation dot1q 681
  vrf member GT-Out
  no ip redirects
  ip address 10.8.77.193/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.10
  no shutdown
interface Ethernet4/1
  description vPC Peer Link Between N7Ks
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 711,714-715,721,724-725,731,734-735
  switchport trunk allowed vlan add 741,744-745,751,754-755,761,844
  switchport trunk allowed vlan add 864-868,941,980
  mtu 9216
  channel-group 1 mode active
```

```
  no shutdown
interface Ethernet4/2
  description vPC Peer Link Between N7Ks
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 711,714-715,721,724-725,731,734-735
  switchport trunk allowed vlan add 741,744-745,751,754-755,761,844
  switchport trunk allowed vlan add 864-868,941,980
  mtu 9216
  channel-group 1 mode active
  no shutdown
interface Ethernet4/3
interface Ethernet4/4
interface Ethernet4/5
  description NON-vPC Peer Link Between N7Ks
  mtu 9216
  channel-group 2 mode active
  no shutdown
interface Ethernet4/6
  description NON-vPC Peer Link Between N7Ks
  mtu 9216
  channel-group 2 mode active
  no shutdown
interface Ethernet4/7
interface Ethernet4/8
interface Ethernet4/9
interface Ethernet4/10
interface Ethernet4/11
interface Ethernet4/12
interface Ethernet4/13
interface Ethernet4/14
interface Ethernet4/15
interface Ethernet4/16
interface Ethernet4/17
  description Common N5K Pair
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 844,864-865
  spanning-tree port type edge trunk
  mtu 9216
  channel-group 5 mode active
  no shutdown
interface Ethernet4/18
interface Ethernet4/19
interface Ethernet4/20
interface Ethernet4/21
interface Ethernet4/22
interface Ethernet4/23
interface Ethernet4/24
interface Ethernet4/25
interface Ethernet4/26
interface Ethernet4/27
interface Ethernet4/28
interface Ethernet4/29
interface Ethernet4/30
interface Ethernet4/31
interface Ethernet4/32
interface Ethernet4/33
interface Ethernet4/34
interface Ethernet4/35
interface Ethernet4/36
interface Ethernet4/37
interface Ethernet4/38
interface Ethernet4/39
```

```
interface Ethernet4/40
interface Ethernet4/41
interface Ethernet4/42
interface Ethernet4/43
interface Ethernet4/44
interface Ethernet4/45
interface Ethernet4/46
interface Ethernet4/47
interface Ethernet4/48
interface Ethernet5/1
  description vPC Peer Link Between N7Ks
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 711,714-715,721,724-725,731,734-735
  switchport trunk allowed vlan add 741,744-745,751,754-755,761,844
  switchport trunk allowed vlan add 864-868,941,980
  mtu 9216
  channel-group 1 mode active
  no shutdown
interface Ethernet5/2
  description vPC Peer Link Between N7Ks
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 711,714-715,721,724-725,731,734-735
  switchport trunk allowed vlan add 741,744-745,751,754-755,761,844
  switchport trunk allowed vlan add 864-868,941,980
  mtu 9216
  channel-group 1 mode active
  no shutdown
interface Ethernet5/3
  switchport
interface Ethernet5/4
  switchport
interface Ethernet5/5
  description NON-vPC Peer Link Between N7Ks
  mtu 9216
  channel-group 2 mode active
  no shutdown
interface Ethernet5/6
  description NON-vPC Peer Link Between N7Ks
  mtu 9216
  channel-group 2 mode active
  no shutdown
interface Ethernet5/7
interface Ethernet5/8
interface Ethernet5/9
interface Ethernet5/10
interface Ethernet5/11
interface Ethernet5/12
interface Ethernet5/13
interface Ethernet5/14
interface Ethernet5/15
interface Ethernet5/16
interface Ethernet5/17
  description Common N5K Pair
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 844,864-865
  spanning-tree port type edge trunk
  mtu 9216
  channel-group 5 mode active
  no shutdown
interface Ethernet5/18
interface Ethernet5/19
```

```
interface Ethernet5/20
interface Ethernet5/21
interface Ethernet5/22
interface Ethernet5/23
interface Ethernet5/24
interface Ethernet5/25
  description VXIaaS-OOB-MGMT-SW
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 866
  channel-group 3 mode active
  no shutdown
interface Ethernet5/26
  description VXIaaS-OOB-Tenant-MGMT-SW
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 866
  channel-group 4 mode active
  no shutdown
interface Ethernet5/27
  description VXIaaS-GW (10.81 net)
  ip address 10.8.79.242/30
  ip router eigrp 42
  ip summary-address eigrp 42 10.8.0.0/16
  no shutdown

interface Ethernet5/28
  description VXIaaS-OOB-SP-MGMT-SW
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 866
  channel-group 6 mode active
  no shutdown
interface Ethernet5/29
interface Ethernet5/30
interface Ethernet5/31
interface Ethernet5/32
interface Ethernet5/33
  description Common N5K-1 L3
  mtu 9216
  no ip redirects
  ip address 10.10.0.26/30
  ip router eigrp 42
  ip passive-interface eigrp 42
  no shutdown
interface Ethernet5/34
  description Common N5K-2 L3
  mtu 9216
  no ip redirects
  ip address 10.10.0.34/30
  ip router eigrp 42
  ip passive-interface eigrp 42
  no shutdown
interface Ethernet5/35
interface Ethernet5/36
interface Ethernet5/37
  description VXIaaS-DC-ASR9K-1
  no shutdown
interface Ethernet5/37.712
  description T1 Link to ASR9K-1
  encapsulation dot1q 712
  vrf member T1-Out
  no ip redirects
  ip address 10.8.78.1/30
```

```
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.0
  no shutdown
interface Ethernet5/37.722
  description T2 Link to ASR9K-1
  encapsulation dot1q 722
  vrf member T2-Out
  no ip redirects
  ip address 10.8.78.33/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.0
  no shutdown
interface Ethernet5/37.732
  description T3 Link to ASR9K-1
  encapsulation dot1q 732
  vrf member T3-Out
  no ip redirects
  ip address 10.8.78.65/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.0
  no shutdown
interface Ethernet5/37.742
  description T4 Link to ASR9K-1
  encapsulation dot1q 742
  vrf member T4-Out
  no ip redirects
  ip address 10.8.78.97/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.0
  ip wccp 62 redirect in
  no shutdown
interface Ethernet5/37.752
  description T5 Link to ASR9K-1
  encapsulation dot1q 752
  vrf member T5-Out
  no ip redirects
  ip address 10.8.78.129/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.0
  no shutdown
interface Ethernet5/37.782
  description Global Tenant Link to ASR9K-1
  encapsulation dot1q 782
  vrf member GT-Out
  no ip redirects
  ip address 10.8.78.225/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.0
  no shutdown
interface Ethernet5/38
  description VXIaaS-DC-ASR9K-2
  no shutdown
interface Ethernet5/38.713
  description T1 Link to ASR9K-2
  encapsulation dot1q 713
  vrf member T1-Out
  no ip redirects
  ip address 10.8.78.5/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.0
  no shutdown
interface Ethernet5/38.723
  description T2 Link to ASR9K-2
  encapsulation dot1q 723
```

```
  vrf member T2-Out
  no ip redirects
  ip address 10.8.78.37/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.0
  no shutdown
interface Ethernet5/38.733
  description T3 Link to ASR9K-2
  encapsulation dot1q 733
  vrf member T3-Out
  no ip redirects
  ip address 10.8.78.69/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.0
  no shutdown
interface Ethernet5/38.743
  description T4 Link to ASR9K-2
  encapsulation dot1q 743
  vrf member T4-Out
  no ip redirects
  ip address 10.8.78.101/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.0
  ip wccp 62 redirect in
  no shutdown
interface Ethernet5/38.753
  description T5 Link to ASR9K-2
  encapsulation dot1q 753
  vrf member T5-Out
  no ip redirects
  ip address 10.8.78.133/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.0
  no shutdown
interface Ethernet5/38.783
  description Global Tenant Link to ASR9K-2
  encapsulation dot1q 783
  vrf member GT-Out
  no ip redirects
  ip address 10.8.78.229/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.0
  no shutdown

interface Ethernet5/39
interface Ethernet5/40
interface Ethernet5/41
  description L3 Link To Service 6500 VSS
  channel-group 103 mode active
  no shutdown
interface Ethernet5/42
  description L3 Link To Service 6500 VSS
  channel-group 103 mode active
  no shutdown
interface Ethernet5/43
interface Ethernet5/44
interface Ethernet5/45
  description VXIaaS-SP-5K
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864-865
  switchport trunk allowed vlan add 867-868,941,980
  mtu 9216
  channel-group 55 mode active
```

```
  no shutdown
interface Ethernet5/46
  description VXIaaS-SP-5K
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864-865
  switchport trunk allowed vlan add 867-868,941,980
  mtu 9216
  channel-group 55 mode active
  no shutdown
interface Ethernet5/47
interface Ethernet5/48
interface mgmt0
  vrf member management
  ip address 10.8.66.21/24
interface loopback0
  description MGMT Loopback
  ip address 10.8.79.250/32
  ip router eigrp 42
  ip passive-interface eigrp 42
interface loopback1
  description T1 Outside Loopback
  vrf member T1-Out
  ip address 192.168.10.5/32
  ip router ospf VXIaaS area 0.0.0.0

interface loopback2
  description T2 Outside Loopback
  vrf member T2-Out
  ip address 192.168.20.5/32
  ip router ospf VXIaaS area 0.0.0.0
interface loopback3
  description T3 Outside Loopback
  vrf member T3-Out
  ip address 192.168.30.5/32
  ip router ospf VXIaaS area 0.0.0.0
interface loopback4
  description T4 Outside Loopback
  vrf member T4-Out
  ip address 192.168.40.5/32
  ip router ospf VXIaaS area 0.0.0.0
interface loopback5
  description T5 Outside Loopback
  vrf member T5-Out
  ip address 192.168.50.5/32
  ip router ospf VXIaaS area 0.0.0.0
interface loopback8
  description Global Tenant Outside Loopback
  vrf member GT-Out
  ip address 192.168.80.5/32
  ip router ospf VXIaaS area 0.0.0.0
interface loopback10
  description T1 Inside Loopback
  vrf member T1-In
  ip address 192.168.10.9/32
  ip router ospf VXIaaS area 0.0.0.20
interface loopback20
  description T2 Inside Loopback
  vrf member T2-In
  ip address 192.168.20.9/32
  ip router ospf VXIaaS area 0.0.0.20
interface loopback30
  description T3 Inside Loopback
  vrf member T3-In
```

```
  ip address 192.168.30.9/32
  ip router ospf VXIaaS area 0.0.0.20
interface loopback40
  description T4 Inside Loopback
  vrf member T4-In
  ip address 192.168.40.9/32
  ip router ospf VXIaaS area 0.0.0.20
interface loopback50
  description T5 Inside Loopback
  vrf member T5-In
  ip address 192.168.50.9/32
  ip router ospf VXIaaS area 0.0.0.20
clock timezone EST -5 0
clock summer-time EDT 2 Sun Mar 02:00 1 Sun Nov 02:00 60
line console
  exec-timeout 0
line vty
  exec-timeout 420
boot kickstart bootflash:/n7000-s1-kickstart.6.1.2.bin sup-1
boot system bootflash:/n7000-s1-dk9.6.1.2.bin sup-1
boot kickstart bootflash:/n7000-s1-kickstart.6.1.2.bin sup-2
boot system bootflash:/n7000-s1-dk9.6.1.2.bin sup-2
router eigrp 42
  default-metric 10000 100 255 1 1500
  redistribute bgp 42 route-map EIGRP-BGP
router ospf VXIaaS
  vrf GT-Out
    router-id 8.8.8.15
    area 0.0.0.10 nssa default-information-originate
    log-adjacency-changes detail
    auto-cost reference-bandwidth 100 Gbps
  vrf T1-In
    router-id 1.1.1.15
    area 0.0.0.20 nssa
    log-adjacency-changes detail
    auto-cost reference-bandwidth 100 Gbps
  vrf T1-Out
    router-id 1.1.1.10
    area 0.0.0.10 nssa default-information-originate
    log-adjacency-changes detail
    auto-cost reference-bandwidth 100 Gbps
  vrf T2-In
    router-id 2.2.2.15
    area 0.0.0.20 nssa
    log-adjacency-changes detail
    auto-cost reference-bandwidth 100 Gbps
  vrf T2-Out
    router-id 2.2.2.10
    area 0.0.0.10 nssa default-information-originate
    log-adjacency-changes detail
    auto-cost reference-bandwidth 100 Gbps
  vrf T3-In
    router-id 3.3.3.15
    area 0.0.0.20 nssa
    log-adjacency-changes detail
    auto-cost reference-bandwidth 100 Gbps
  vrf T3-Out
    router-id 3.3.3.10
    area 0.0.0.10 nssa default-information-originate
    log-adjacency-changes detail
    auto-cost reference-bandwidth 100 Gbps
  vrf T4-In
    router-id 4.4.4.15
    area 0.0.0.20 nssa
```

```
    log-adjacency-changes detail
    auto-cost reference-bandwidth 100 Gbps
  vrf T4-Out
    router-id 4.4.4.10
    area 0.0.0.10 nssa default-information-originate
    log-adjacency-changes detail
    auto-cost reference-bandwidth 100 Gbps
  vrf T5-In
    router-id 5.5.5.15
    area 0.0.0.20 nssa
    log-adjacency-changes detail
    auto-cost reference-bandwidth 100 Gbps
  vrf T5-Out
    router-id 5.5.5.10
    area 0.0.0.10 nssa default-information-originate
    log-adjacency-changes detail
    auto-cost reference-bandwidth 100 Gbps
router bgp 42
  address-family ipv4 unicast
    redistribute direct route-map BGP-DIRECT
    aggregate-address 10.8.0.0/16 summary-only
    maximum-paths 4
  neighbor 10.10.0.25 remote-as 1000
    address-family ipv4 unicast
      route-map COMMON-SUM in
  neighbor 10.10.0.33 remote-as 1000
    address-family ipv4 unicast
      route-map COMMON-SUM in


Time: Sat Jun  1 12:21:48 2013
version 6.1(2)
hostname VXIaaS-DC-N7K-2
vdc VXIaaS-DC-N7K-2 id 1
  limit-resource module-type f2
  allocate interface Ethernet4/1-48
  allocate interface Ethernet5/1-48
  limit-resource vlan minimum 16 maximum 4094
  limit-resource monitor-session minimum 0 maximum 2
  limit-resource monitor-session-erspan-dst minimum 0 maximum 23
  limit-resource vrf minimum 2 maximum 4096
  limit-resource port-channel minimum 0 maximum 768
  limit-resource u4route-mem minimum 96 maximum 96
  limit-resource u6route-mem minimum 24 maximum 24
  limit-resource m4route-mem minimum 58 maximum 58
  limit-resource m6route-mem minimum 8 maximum 8
  limit-resource monitor-session-inband-src minimum 0 maximum 1
feature telnet
cfs eth distribute
feature ospf
feature bgp
feature eigrp
feature interface-vlan
feature dot1x
feature hsrp
feature lacp
feature dhcp
feature vpc
feature wccp
logging level pixm 2
username admin password 5 $1$EBvmxlZW$V1JNHlNyrvy6kVcEtaTbI1  role network-admin
no password strength-check
ip domain-lookup
ip domain-name vxiaas.local
```

```
ip domain-list cisco.com
ip domain-list vxiaas.local
ip name-server 10.8.64.100
class-map type qos match-any VOICE
  match dscp 46
class-map type qos match-all BULK-DATA
  match dscp 10,12,14
class-map type qos match-any SCAVENGER
  match dscp 8
class-map type qos match-any CALL-SIGNALING
  match dscp 24
class-map type qos match-any NETWORK-CONTROL
  match dscp 48
class-map type qos match-any TRANSACTIONAL-DATA
  match dscp 18,20,22
class-map type qos match-any MULTIMEDIA-STREAMING
  match dscp 26,28,30
class-map type qos match-any MULTIMEDIA-CONFERENCING
  match dscp 34,36,38
class-map type queuing match-any BROADCAST-VIDEO
policy-map type queuing VPN-EDGE
copp profile strict
snmp-server user admin network-admin auth md5 0x7b83230d09d201df578c1f817cb425da priv
0x7b83230d09d201df578c1f817cb425da localizedkey
rmon event 1 log trap public description FATAL(1) owner PMON@FATAL
rmon event 2 log trap public description CRITICAL(2) owner PMON@CRITICAL
rmon event 3 log trap public description ERROR(3) owner PMON@ERROR
rmon event 4 log trap public description WARNING(4) owner PMON@WARNING
rmon event 5 log trap public description INFORMATION(5) owner PMON@INFO
ntp server 10.8.79.254
vlan 1,711,721,731,741,751,761,844,864-868,941,980
vrf context GT-Out
vrf context T1-In
vrf context T1-Out
vrf context T2-In
vrf context T2-Out
vrf context T3-In
vrf context T3-Out
vrf context T4-In
vrf context T4-Out
  ip wccp 61
  ip wccp 62
vrf context T5-In
vrf context T5-Out
vrf context management
  ip route 0.0.0.0/0 10.8.66.1
vlan 711
  name Tenant-1-VM-A
vlan 721
  name Tenant-2-VM-A
vlan 731
  name Tenant-3-VM-A
vlan 741
  name Tenant-4-VM-A
vlan 751
  name Tenant-5-VM-A
vlan 761
  name Tenant-6-VM-A
vlan 844
  name HVXI-NetApp-NFS
vlan 864
  name VXIaaS-SP-Infra
vlan 865
  name VXIaaS-SP-DH
```

```
vlan 866
  name VXIaaS-OOB-MGMT
vlan 867
  name VXIaaS-SP-Hypervisor-MGMT
vlan 868
  name VXIaaS-SP-vMotion
vlan 941
  name Tenant-4-vWAAS
vlan 980
  name Desktone-L2-Link-Local

spanning-tree vlan 711,721,731,741,751,761,864-868,980 priority 4096
ip prefix-list BGP-DIRECT seq 5 permit 10.8.0.0/16 le 30
ip prefix-list COMMON-SUM seq 5 permit 10.10.0.0/17
ip prefix-list EIGRP-BGP seq 5 permit 10.10.0.0/17
route-map BGP-DIRECT permit 10
  match ip address prefix-list BGP-DIRECT
route-map COMMON-SUM permit 10
  match ip address prefix-list COMMON-SUM
route-map EIGRP-BGP permit 10
  match ip address prefix-list EIGRP-BGP
service dhcp
ip dhcp relay
vpc domain 42
  peer-switch
  peer-keepalive destination 10.8.66.21 source 10.8.66.22
  peer-gateway
  auto-recovery
  ip arp synchronize
interface Vlan1
interface Vlan711
  vrf member T1-In
  no ip redirects
  ip address 10.9.104.3/21
  ip ospf passive-interface
  ip router ospf VXIaaS area 0.0.0.20
  hsrp version 2
  hsrp 711
    ip 10.9.104.1
  ip dhcp relay address 10.9.10.150
  ip dhcp relay address 10.9.10.151
  description Tenant 1 VMs
  no shutdown
  mtu 9216
interface Vlan721
  vrf member T2-In
  no ip redirects
  ip address 10.9.112.3/21
  ip ospf passive-interface
  ip router ospf VXIaaS area 0.0.0.20
  hsrp version 2
  hsrp 721
    ip 10.9.112.1
  ip dhcp relay address 10.9.20.150
  ip dhcp relay address 10.9.20.151
  description Tenant 2 VMs
  no shutdown
  mtu 9216

interface Vlan731
  vrf member T3-In
  no ip redirects
  ip address 10.9.120.3/21
  ip ospf passive-interface
```

```
  ip router ospf VXIaaS area 0.0.0.20
  hsrp version 2
  hsrp 731
    ip 10.9.120.1
  ip dhcp relay address 10.9.30.150
  ip dhcp relay address 10.9.30.151
  description Tenant 3 VMs
  no shutdown
  mtu 9216
interface Vlan741
  vrf member T4-In
  no ip redirects
  ip address 10.9.128.3/21
  ip ospf passive-interface
  ip router ospf VXIaaS area 0.0.0.20
  hsrp version 2
  hsrp 741
    ip 10.9.128.1
  ip dhcp relay address 10.9.40.150
  ip dhcp relay address 10.9.40.151
  description Tenant 4 VMs
  no shutdown
  mtu 9216
interface Vlan751
  vrf member T5-In
  no ip redirects
  ip address 10.9.136.3/21
  ip ospf passive-interface
  ip router ospf VXIaaS area 0.0.0.20
  hsrp version 2
  hsrp 751
    ip 10.9.136.1
  ip dhcp relay address 10.9.50.150
  ip dhcp relay address 10.9.50.151
  description Tenant 5 VMs
  no shutdown
  mtu 9216
interface Vlan864
  no ip redirects
  ip address 10.8.64.3/24
  ip router eigrp 42
  ip passive-interface eigrp 42
  hsrp version 2
  hsrp 864
    ip 10.8.64.1
  description VXIaaS-SP-Infra
  no shutdown
  mtu 9216

interface Vlan865
  no ip redirects
  ip address 10.8.65.3/24
  ip router eigrp 42
  ip passive-interface eigrp 42
  hsrp version 2
  hsrp 865
    ip 10.8.65.1
  description VXIaaS-SP-DH
  no shutdown
  mtu 9216
interface Vlan866
  no ip redirects
  ip address 10.8.66.3/24
  ip router eigrp 42
```

```
  ip passive-interface eigrp 42
  hsrp version 2
  hsrp 866
    ip 10.8.66.1
  description VXIaaS-OOB-MGMT
  no shutdown
  mtu 9216
interface Vlan867
  no ip redirects
  ip address 10.8.67.3/24
  ip router eigrp 42
  ip passive-interface eigrp 42
  hsrp version 2
  hsrp 867
    ip 10.8.67.1
  description VXIaaS-SP-Hypervisor-MGMT
  no shutdown
  mtu 9216
interface Vlan868
  no ip redirects
  ip address 10.8.68.3/24
  ip router eigrp 42
  ip passive-interface eigrp 42
  hsrp version 2
  hsrp 868
    ip 10.8.68.1
  description VXIaaS-SP-vMotion
  no shutdown
  mtu 9216
interface Vlan941
  vrf member T4-Out
  no ip redirects
  ip address 10.9.192.27/29
  ip ospf passive-interface
  ip router ospf VXIaaS area 0.0.0.10
  hsrp version 2
  hsrp 941
    ip 10.9.192.25
  ip dhcp relay address 10.9.40.150
  ip dhcp relay address 10.9.40.151
  description Tenant 4 vWAAS
  no shutdown
  mtu 9216
interface port-channel1
  description vPC Peer Link Between N7Ks
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 711,714-715,721,724-725,731,734-735
  switchport trunk allowed vlan add 741,744-745,751,754-755,761,844
  switchport trunk allowed vlan add 864-868,941,980
  spanning-tree port type network
  mtu 9216
  vpc peer-link
interface port-channel2
  description NON-vPC Peer Link Between N7Ks
  mtu 9216
interface port-channel2.718
  description Tenant 1 N7K-N7K Outside
  mtu 9216
  encapsulation dot1q 718
  vrf member T1-Out
  no ip redirects
  ip address 10.8.78.26/30
  ip ospf network point-to-point
```

```
  ip router ospf VXIaaS area 0.0.0.10
  no shutdown
interface port-channel2.719
  description Tenant 1 N7K-N7K Inside
  mtu 9216
  encapsulation dot1q 719
  vrf member T1-In
  no ip redirects
  ip address 10.8.78.30/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.20
  no shutdown
interface port-channel2.728
  description Tenant 2 N7K-N7K Outside
  mtu 9216
  encapsulation dot1q 728
  vrf member T2-Out
  no ip redirects
  ip address 10.8.78.58/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.10
  no shutdown
interface port-channel2.729
  description Tenant 1 N7K-N7K Inside
  mtu 9216
  encapsulation dot1q 729
  vrf member T2-In
  no ip redirects
  ip address 10.8.78.62/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.20
  no shutdown
interface port-channel2.738
  description Tenant 3 N7K-N7K Outside
  mtu 9216
  encapsulation dot1q 738
  vrf member T3-Out
  no ip redirects
  ip address 10.8.78.90/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.10
  no shutdown
interface port-channel2.739
  description Tenant 1 N7K-N7K Inside
  mtu 9216
  encapsulation dot1q 739
  vrf member T3-In
  no ip redirects
  ip address 10.8.78.94/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.20
  no shutdown
interface port-channel2.748
  description Tenant 4 N7K-N7K Outside
  mtu 9216
  encapsulation dot1q 748
  vrf member T4-Out
  no ip redirects
  ip address 10.8.78.122/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.10
  no shutdown
interface port-channel2.749
  description Tenant 1 N7K-N7K Inside
```

```
  mtu 9216
  encapsulation dot1q 749
  vrf member T4-In
  no ip redirects
  ip address 10.8.78.126/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.20
  no shutdown
interface port-channel2.758
  description Tenant 5 N7K-N7K Outside
  mtu 9216
  encapsulation dot1q 758
  vrf member T5-Out
  no ip redirects
  ip address 10.8.78.154/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.10
  no shutdown
interface port-channel2.759
  description Tenant 1 N7K-N7K Inside
  mtu 9216
  encapsulation dot1q 759
  vrf member T5-In
  no ip redirects
  ip address 10.8.78.158/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.20
  no shutdown
interface port-channel2.788
  description Global Tenant N7K-N7K Outside
  mtu 9216
  encapsulation dot1q 788
  vrf member GT-Out
  no ip redirects
  ip address 10.8.78.250/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.10
  no shutdown
interface port-channel3
  description VXIaaS-OOB-MGMT-SW
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 866
  vpc 3
interface port-channel4
  description VXIaaS-OOB-Tenant-MGMT-SW
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 866
  vpc 4
interface port-channel5
  description Common N5K Pair
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 844,864-865
  spanning-tree port type edge trunk
  mtu 9216
  vpc 5
interface port-channel6
  description VXIaaS-OOB-SP-MGMT-SW
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 866
  vpc 6
```

```
interface port-channel55
  description VXIaaS-SP-5K-Pair
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864-865
  switchport trunk allowed vlan add 867-868,941,980
  spanning-tree port type normal
  mtu 9216
  vpc 55
interface port-channel104
  description L3 Link To Service 6500 VSS
  no lacp graceful-convergence
interface port-channel104.612
  description T1 Outside Service 6500
  encapsulation dot1q 612
  vrf member T1-Out
  no ip redirects
  ip address 10.8.76.5/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.10
  no shutdown
interface port-channel104.614
  description T1 Inside Service 6500
  encapsulation dot1q 614
  vrf member T1-In
  no ip redirects
  ip address 10.8.76.13/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.20
  no shutdown
interface port-channel104.622
  description T2 Outside Service 6500
  encapsulation dot1q 622
  vrf member T2-Out
  no ip redirects
  ip address 10.8.76.69/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.10
  no shutdown
interface port-channel104.624
  description T2 Inside Service 6500
  encapsulation dot1q 624
  vrf member T2-In
  no ip redirects
  ip address 10.8.76.77/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.20
  no shutdown
interface port-channel104.632
  description T3 Outside Service 6500
  encapsulation dot1q 632
  vrf member T3-Out
  no ip redirects
  ip address 10.8.76.133/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.10
  no shutdown
interface port-channel104.634
  description T3 Inside Service 6500
  encapsulation dot1q 634
  vrf member T3-In
  no ip redirects
  ip address 10.8.76.141/30
  ip ospf network point-to-point
```

```
  ip router ospf VXIaaS area 0.0.0.20
  no shutdown
interface port-channel104.642
  description T4 Outside Service 6500
  encapsulation dot1q 642
  vrf member T4-Out
  no ip redirects
  ip address 10.8.76.197/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.10
  no shutdown
  ip wccp 61 redirect in
interface port-channel104.644
  description T4 Inside Service 6500
  encapsulation dot1q 644
  vrf member T4-In
  no ip redirects
  ip address 10.8.76.205/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.20
  no shutdown
interface port-channel104.652
  description T5 Outside Service 6500
  encapsulation dot1q 652
  vrf member T5-Out
  no ip redirects
  ip address 10.8.77.5/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.10
  no shutdown
interface port-channel104.654
  description T5 Inside Service 6500
  encapsulation dot1q 654
  vrf member T5-In
  no ip redirects
  ip address 10.8.77.13/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.20
  no shutdown
interface port-channel104.682
  description Global Tenant Outside Service 6500
  encapsulation dot1q 682
  vrf member GT-Out
  no ip redirects
  ip address 10.8.77.197/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.10
  no shutdown
interface Ethernet4/1
  description vPC Peer Link Between N7Ks
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 711,714-715,721,724-725,731,734-735
  switchport trunk allowed vlan add 741,744-745,751,754-755,761,844
  switchport trunk allowed vlan add 864-868,941,980
  mtu 9216
  channel-group 1 mode active
  no shutdown

interface Ethernet4/2
  description vPC Peer Link Between N7Ks
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 711,714-715,721,724-725,731,734-735
```

```
  switchport trunk allowed vlan add 741,744-745,751,754-755,761,844
  switchport trunk allowed vlan add 864-868,941,980
  mtu 9216
  channel-group 1 mode active
  no shutdown
interface Ethernet4/3
interface Ethernet4/4
interface Ethernet4/5
  description NON-vPC Peer Link Between N7Ks
  mtu 9216
  channel-group 2 mode active
  no shutdown
interface Ethernet4/6
  description NON-vPC Peer Link Between N7Ks
  mtu 9216
  channel-group 2 mode active
  no shutdown
interface Ethernet4/7
interface Ethernet4/8
interface Ethernet4/9
interface Ethernet4/10
interface Ethernet4/11
interface Ethernet4/12
interface Ethernet4/13
interface Ethernet4/14
interface Ethernet4/15
interface Ethernet4/16
interface Ethernet4/17
  description Common N5K Pair
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 844,864-865
  spanning-tree port type edge trunk
  mtu 9216
  channel-group 5 mode active
  no shutdown
interface Ethernet4/18
interface Ethernet4/19
interface Ethernet4/20
interface Ethernet4/21
interface Ethernet4/22
interface Ethernet4/23
interface Ethernet4/24
interface Ethernet4/25
interface Ethernet4/26
interface Ethernet4/27
interface Ethernet4/28
interface Ethernet4/29
interface Ethernet4/30
interface Ethernet4/31
interface Ethernet4/32
interface Ethernet4/33
interface Ethernet4/34
interface Ethernet4/35
interface Ethernet4/36
interface Ethernet4/37
interface Ethernet4/38
interface Ethernet4/39
interface Ethernet4/40
interface Ethernet4/41
interface Ethernet4/42
interface Ethernet4/43
interface Ethernet4/44
interface Ethernet4/45
```

```
interface Ethernet4/46
interface Ethernet4/47
interface Ethernet4/48
interface Ethernet5/1
  description vPC Peer Link Between N7Ks
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 711,714-715,721,724-725,731,734-735
  switchport trunk allowed vlan add 741,744-745,751,754-755,761,844
  switchport trunk allowed vlan add 864-868,941,980
  mtu 9216
  channel-group 1 mode active
  no shutdown
interface Ethernet5/2
  description vPC Peer Link Between N7Ks
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 711,714-715,721,724-725,731,734-735
  switchport trunk allowed vlan add 741,744-745,751,754-755,761,844
  switchport trunk allowed vlan add 864-868,941,980
  mtu 9216
  channel-group 1 mode active
  no shutdown
interface Ethernet5/3
interface Ethernet5/4
interface Ethernet5/5
  description NON-vPC Peer Link Between N7Ks
  mtu 9216
  channel-group 2 mode active
  no shutdown
interface Ethernet5/6
  description NON-vPC Peer Link Between N7Ks
  mtu 9216
  channel-group 2 mode active
  no shutdown
interface Ethernet5/7
interface Ethernet5/8
interface Ethernet5/9
interface Ethernet5/10
interface Ethernet5/11
interface Ethernet5/12
interface Ethernet5/13
interface Ethernet5/14
interface Ethernet5/15
interface Ethernet5/16
interface Ethernet5/17
  description Common N5K Pair
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 844,864-865
  spanning-tree port type edge trunk
  mtu 9216
  channel-group 5 mode active
  no shutdown
interface Ethernet5/18
interface Ethernet5/19
interface Ethernet5/20
interface Ethernet5/21
interface Ethernet5/22
interface Ethernet5/23
interface Ethernet5/24
interface Ethernet5/25
  description VXIaaS-OOB-MGMT-SW
  switchport
```

```
  switchport mode trunk
  switchport trunk allowed vlan 866
  channel-group 3 mode active
  no shutdown
interface Ethernet5/26
  description VXIaaS-OOB-Tenant-MGMT-SW
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 866
  channel-group 4 mode active
  no shutdown
interface Ethernet5/27
  description VXIaaS-GW (10.81 net)
  ip address 10.8.79.246/30
  ip router eigrp 42
  ip summary-address eigrp 42 10.8.0.0/16
  no shutdown
interface Ethernet5/28
  description VXIaaS-OOB-SP-MGMT-SW
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 866
  channel-group 6 mode active
  no shutdown
interface Ethernet5/29
interface Ethernet5/30
interface Ethernet5/31
interface Ethernet5/32
interface Ethernet5/33
  description Common N5K-1 L3
  mtu 9216
  no ip redirects
  ip address 10.10.0.30/30
  ip router eigrp 42
  ip passive-interface eigrp 42
  no shutdown
interface Ethernet5/34
  description Common N5K-2 L3
  mtu 9216
  no ip redirects
  ip address 10.10.0.38/30
  ip router eigrp 42
  ip passive-interface eigrp 42
  no shutdown
interface Ethernet5/35
interface Ethernet5/36
interface Ethernet5/37
  description desc VXIaaS-DC-ASR9K-1
  no shutdown
interface Ethernet5/37.714
  description T1 Link to ASR9K-1
  encapsulation dot1q 714
  vrf member T1-Out
  no ip redirects
  ip address 10.8.78.9/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.0
  no shutdown

interface Ethernet5/37.724
  description T2 Link to ASR9K-1
  encapsulation dot1q 724
  vrf member T2-Out
  no ip redirects
```

```
  ip address 10.8.78.41/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.0
  no shutdown
interface Ethernet5/37.734
  description T3 Link to ASR9K-1
  encapsulation dot1q 734
  vrf member T3-Out
  no ip redirects
  ip address 10.8.78.73/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.0
  no shutdown
interface Ethernet5/37.744
  description T4 Link to ASR9K-1
  encapsulation dot1q 744
  vrf member T4-Out
  no ip redirects
  ip address 10.8.78.105/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.0
  ip wccp 62 redirect in
  no shutdown
interface Ethernet5/37.754
  description T5 Link to ASR9K-1
  encapsulation dot1q 754
  vrf member T5-Out
  no ip redirects
  ip address 10.8.78.137/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.0
  no shutdown
interface Ethernet5/37.784
  description Global Tenant Link to ASR9K-1
  encapsulation dot1q 784
  vrf member GT-Out
  no ip redirects
  ip address 10.8.78.233/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.0
  no shutdown

interface Ethernet5/38
  description VXIaaS-DC-ASR9K-2
  no shutdown
interface Ethernet5/38.715
  description T1 Link to ASR9K-2
  encapsulation dot1q 715
  vrf member T1-Out
  no ip redirects
  ip address 10.8.78.13/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.0
  no shutdown
interface Ethernet5/38.725
  description T2 Link to ASR9K-2
  encapsulation dot1q 725
  vrf member T2-Out
  no ip redirects
  ip address 10.8.78.45/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.0
  no shutdown
interface Ethernet5/38.735
```

```
  description T3 Link to ASR9K-2
  encapsulation dot1q 735
  vrf member T3-Out
  no ip redirects
  ip address 10.8.78.77/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.0
  no shutdown
interface Ethernet5/38.745
  description T4 Link to ASR9K-2
  encapsulation dot1q 745
  vrf member T4-Out
  no ip redirects
  ip address 10.8.78.109/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.0
  ip wccp 62 redirect in
  no shutdown
interface Ethernet5/38.755
  description T5 Link to ASR9K-2
  encapsulation dot1q 755
  vrf member T5-Out
  no ip redirects
  ip address 10.8.78.141/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.0
  no shutdown
interface Ethernet5/38.785
  description Global Tenant Link to ASR9K-2
  encapsulation dot1q 785
  vrf member GT-Out
  no ip redirects
  ip address 10.8.78.237/30
  ip ospf network point-to-point
  ip router ospf VXIaaS area 0.0.0.0
  no shutdown
interface Ethernet5/39
interface Ethernet5/40
interface Ethernet5/41
  description L3 Link To Service 6500 VSS
  channel-group 104 mode active
  no shutdown
interface Ethernet5/42
  description L3 Link To Service 6500 VSS
  channel-group 104 mode active
  no shutdown
interface Ethernet5/43
interface Ethernet5/44
interface Ethernet5/45
  description VXIaaS-SP-5K
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864-865
  switchport trunk allowed vlan add 867-868,941,980
  mtu 9216
  channel-group 55 mode active
  no shutdown
interface Ethernet5/46
  description VXIaaS-SP-5K
  switchport
  switchport mode trunk
  switchport trunk allowed vlan 711,721,731,741,751,761,844,864-865
  switchport trunk allowed vlan add 867-868,941,980
  mtu 9216
```

```
  channel-group 55 mode active
  no shutdown
interface Ethernet5/47
interface Ethernet5/48
interface mgmt0
  vrf member management
  ip address 10.8.66.22/24
interface loopback0
  description MGMT Loopback
  ip address 10.8.79.251/32
  ip router eigrp 42
  ip passive-interface eigrp 42
interface loopback1
  description T1 Outside Loopback
  vrf member T1-Out
  ip address 192.168.10.6/32
  ip router ospf VXIaaS area 0.0.0.0
interface loopback2
  description T2 Outside Loopback
  vrf member T2-Out
  ip address 192.168.20.6/32
  ip router ospf VXIaaS area 0.0.0.0
interface loopback3
  description T3 Outside Loopback
  vrf member T3-Out
  ip address 192.168.30.6/32
  ip router ospf VXIaaS area 0.0.0.0
interface loopback4
  description T4 Outside Loopback
  vrf member T4-Out
  ip address 192.168.40.6/32
  ip router ospf VXIaaS area 0.0.0.0
interface loopback5
  description T5 Outside Loopback
  vrf member T5-Out
  ip address 192.168.50.6/32
  ip router ospf VXIaaS area 0.0.0.0
interface loopback8
  description Global Tenant Outside Loopback
  vrf member GT-Out
  ip address 192.168.80.6/32
  ip router ospf VXIaaS area 0.0.0.0
interface loopback10
  description T1 Inside Loopback
  vrf member T1-In
  ip address 192.168.10.10/32
  ip router ospf VXIaaS area 0.0.0.20
interface loopback20
  description T2 Inside Loopback
  vrf member T2-In
  ip address 192.168.20.10/32
  ip router ospf VXIaaS area 0.0.0.20
interface loopback30
  description T3 Inside Loopback
  vrf member T3-In
  ip address 192.168.30.10/32
  ip router ospf VXIaaS area 0.0.0.20

interface loopback40
  description T4 Inside Loopback
  vrf member T4-In
  ip address 192.168.40.10/32
  ip router ospf VXIaaS area 0.0.0.20
interface loopback50
```

```
  description T5 Inside Loopback
  vrf member T5-In
  ip address 192.168.50.10/32
  ip router ospf VXIaaS area 0.0.0.20
clock timezone EST -5 0
clock summer-time EDT 2 Sun Mar 02:00 1 Sun Nov 02:00 60
line console
  exec-timeout 0
line vty
  exec-timeout 420
boot kickstart bootflash:/n7000-s1-kickstart.6.1.2.bin sup-1
boot system bootflash:/n7000-s1-dk9.6.1.2.bin sup-1
boot kickstart bootflash:/n7000-s1-kickstart.6.1.2.bin sup-2
boot system bootflash:/n7000-s1-dk9.6.1.2.bin sup-2
router eigrp 42
  default-metric 10000 100 255 1 1500
  redistribute bgp 42 route-map EIGRP-BGP
router ospf VXIaaS
  vrf GT-Out
    router-id 8.8.8.11
    area 0.0.0.10 nssa default-information-originate
    log-adjacency-changes detail
    auto-cost reference-bandwidth 100 Gbps
  vrf T1-In
    router-id 1.1.1.16
    area 0.0.0.20 nssa
    log-adjacency-changes detail
    auto-cost reference-bandwidth 100 Gbps
  vrf T1-Out
    router-id 1.1.1.11
    area 0.0.0.10 nssa default-information-originate
    log-adjacency-changes detail
    auto-cost reference-bandwidth 100 Gbps
  vrf T2-In
    router-id 2.2.2.16
    area 0.0.0.20 nssa
    log-adjacency-changes detail
    auto-cost reference-bandwidth 100 Gbps
  vrf T2-Out
    router-id 2.2.2.11
    area 0.0.0.10 nssa default-information-originate
    log-adjacency-changes detail
    auto-cost reference-bandwidth 100 Gbps
  vrf T3-In
    router-id 3.3.3.16
    area 0.0.0.20 nssa
    log-adjacency-changes detail
    auto-cost reference-bandwidth 100 Gbps
  vrf T3-Out
    router-id 3.3.3.11
    area 0.0.0.10 nssa default-information-originate
    log-adjacency-changes detail
    auto-cost reference-bandwidth 100 Gbps
  vrf T4-In
    router-id 4.4.4.16
    area 0.0.0.20 nssa
    log-adjacency-changes detail
    auto-cost reference-bandwidth 100 Gbps
  vrf T4-Out
    router-id 4.4.4.11
    area 0.0.0.10 nssa default-information-originate
    log-adjacency-changes detail
    auto-cost reference-bandwidth 100 Gbps
  vrf T5-In
```

```
    router-id 5.5.5.16
    area 0.0.0.20 nssa
    log-adjacency-changes detail
    auto-cost reference-bandwidth 100 Gbps
  vrf T5-Out
    router-id 5.5.5.11
    area 0.0.0.10 nssa default-information-originate
    log-adjacency-changes detail
    auto-cost reference-bandwidth 100 Gbps
router bgp 42
  address-family ipv4 unicast
    redistribute direct route-map BGP-DIRECT
    aggregate-address 10.8.0.0/16 summary-only
    maximum-paths 4
  neighbor 10.10.0.29 remote-as 1000
    address-family ipv4 unicast
      route-map COMMON-SUM in
  neighbor 10.10.0.37 remote-as 1000
    address-family ipv4 unicast
      route-map COMMON-SUM in
```

Cisco Catalyst 6506 configuration:

```
!
version 12.2
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
service counters max age 5
hostname VXIaaS-DC-SVC-6500
boot-start-marker
boot system flash bootflash:s72033-ipservicesk9_wan-mz.122-33.SXJ1.bin
boot-end-marker
security passwords min-length 1
no logging console
enable password cisco_123
username admin password 0 cisco_123
aaa new-model
aaa authentication login default local
aaa session-id common
clock timezone EST -5
clock summer-time EDT recurring
firewall autostate
firewall multiple-vlan-interfaces
firewall switch 1 module 3 vlan-group 1,3
firewall switch 2 module 3 vlan-group 1,3
firewall vlan-group 1  910,915
firewall vlan-group 3  616,617,626,627,636,637,646,647,656,657
ip vrf GT-In
ip vrf GT-Out
ip vrf T1-In
ip vrf T1-Out
ip vrf T2-In
ip vrf T2-Out
ip vrf T3-In
ip vrf T3-Out
ip vrf T4-In
ip vrf T4-Out
ip vrf T5-In
ip vrf T5-Out
ip vrf T6-In
ip vrf T6-Out
ip vrf T7-In
ip vrf T7-Out
```

```
ip ssh source-interface Vlan866
no ip domain-lookup
ip domain-name vxiaas.local
vtp mode transparent
switch virtual domain 42
 switch mode virtual
mls netflow interface
spanning-tree mode rapid-pvst
spanning-tree extend system-id
diagnostic bootup level complete
redundancy
 main-cpu
  auto-sync running-config
 mode sso
vlan internal allocation policy ascending
vlan access-log ratelimit 2000
vlan 616
 name T1-ASA-Out
vlan 617
 name T1-ASA-In
vlan 626
 name T2-ASA-Out
vlan 627
 name T2-ASA-In
vlan 636
 name T3-ASA-Out
vlan 637
 name T3-ASA-In
vlan 646
 name T4-ASA-Out
vlan 647
 name T4-ASA-In
vlan 656
 name T5-ASA-Out
vlan 657
 name T5-ASA-In
vlan 686
 name GT-ASA-Out
vlan 687
 name GT-ASA-In
vlan 866
 name VXIaaS-OOB-MGMT
vlan 910
 name ASA-FW-LAN-FO
vlan 915
 name ASA-FW-STATE-FO
nterface Loopback1
 description T1 Outside Loopback
 ip vrf forwarding T1-Out
 ip address 192.168.10.7 255.255.255.255
interface Loopback2
 description T2 Outside Loopback
 ip vrf forwarding T2-Out
 ip address 192.168.20.7 255.255.255.255
interface Loopback3
 description T3 Outside Loopback
 ip vrf forwarding T3-Out
 ip address 192.168.30.7 255.255.255.255
interface Loopback4
 description T4 Outside Loopback
 ip vrf forwarding T4-Out
 ip address 192.168.40.7 255.255.255.255
interface Loopback5
 description T5 Outside Loopback
```

```
 ip vrf forwarding T5-Out
 ip address 192.168.50.7 255.255.255.255
interface Loopback8
 description GT Outside Loopback
 ip vrf forwarding GT-Out
 ip address 192.168.80.7 255.255.255.255
interface Loopback10
 description T1 Inside Loopback
 ip vrf forwarding T1-In
 ip address 192.168.10.8 255.255.255.255
interface Loopback20
 description T2 Inside Loopback
 ip vrf forwarding T2-In
 ip address 192.168.20.8 255.255.255.255
interface Loopback30
 description T3 Inside Loopback
 ip vrf forwarding T3-In
 ip address 192.168.30.8 255.255.255.255
interface Loopback40
 description T4 Inside Loopback
 ip vrf forwarding T4-In
 ip address 192.168.40.8 255.255.255.255
interface Loopback50
 description T5 Inside Loopback
 ip vrf forwarding T5-In
 ip address 192.168.50.8 255.255.255.255
interface Loopback80
 description GT Inside Loopback
 ip vrf forwarding GT-In
 ip address 192.168.80.8 255.255.255.255
interface Port-channel10
 no switchport
 no ip address
 switch virtual link 1
 mls qos trust cos
 no mls qos channel-consistency
interface Port-channel15
 description VPN ASA Outside
 no switchport
 ip vrf forwarding GT-Out
 ip address 10.8.77.209 255.255.255.248
 no ip redirects
 no ip unreachables
 no ip proxy-arp
 ip ospf network point-to-point
interface Port-channel16
 description VPN ASA Inside
 no switchport
 no ip address
 no ip redirects
 no ip unreachables
 no ip proxy-arp
interface Port-channel16.635
 encapsulation dot1Q 635
 ip vrf forwarding T3-Out
 ip address 10.8.76.153 255.255.255.248
 no ip redirects
 no ip unreachables
 no ip proxy-arp
 ip ospf network point-to-point
interface Port-channel20
 no switchport
 no ip address
 switch virtual link 2
```

```
 mls qos trust cos
 no mls qos channel-consistency
interface Port-channel103
 description N7K-1 Uplink
 no switchport
 no ip address
interface Port-channel103.611
 description T1 Outside N7K-1
 encapsulation dot1Q 611
 ip vrf forwarding T1-Out
 ip address 10.8.76.2 255.255.255.252
 no ip redirects
 no ip unreachables
 no ip proxy-arp
 ip ospf network point-to-point
interface Port-channel103.613
 description T1 Inside N7K-1
 encapsulation dot1Q 613
 ip vrf forwarding T1-In
 ip address 10.8.76.10 255.255.255.252
 no ip redirects
 no ip unreachables
 no ip proxy-arp
 ip ospf network point-to-point
interface Port-channel103.621
 description T2 Outside N7K-1
 encapsulation dot1Q 621
 ip vrf forwarding T2-Out
 ip address 10.8.76.66 255.255.255.252
 no ip redirects
 no ip unreachables
 no ip proxy-arp
 ip ospf network point-to-point
interface Port-channel103.623
 description T2 Inside N7K-1
 encapsulation dot1Q 623
 ip vrf forwarding T2-In
 ip address 10.8.76.74 255.255.255.252
 no ip redirects
 no ip unreachables
 no ip proxy-arp
 ip ospf network point-to-point
interface Port-channel103.631
 description T3 Outside N7K-1
 encapsulation dot1Q 631
 ip vrf forwarding T3-Out
 ip address 10.8.76.130 255.255.255.252
 no ip redirects
 no ip unreachables
 no ip proxy-arp
 ip ospf network point-to-point
 shutdown
interface Port-channel103.633
 description T3 Inside N7K-1
 encapsulation dot1Q 633
 ip vrf forwarding T3-In
 ip address 10.8.76.138 255.255.255.252
 no ip redirects
 no ip unreachables
 no ip proxy-arp
 ip ospf network point-to-point
interface Port-channel103.641
 description T4 Outside N7K-1
 encapsulation dot1Q 641
```

```
 ip vrf forwarding T4-Out
 ip address 10.8.76.194 255.255.255.252
 no ip redirects
 no ip unreachables
 no ip proxy-arp
 ip ospf network point-to-point
interface Port-channel103.643
 description T4 Inside N7K-1
 encapsulation dot1Q 643
 ip vrf forwarding T4-In
 ip address 10.8.76.202 255.255.255.252
 no ip redirects
 no ip unreachables
 no ip proxy-arp
 ip ospf network point-to-point
interface Port-channel103.651
 description T5 Outside N7K-1
 encapsulation dot1Q 651
 ip vrf forwarding T5-Out
 ip address 10.8.77.2 255.255.255.252
 no ip redirects
 no ip unreachables
 no ip proxy-arp
 ip ospf network point-to-point
interface Port-channel103.653
 description T5 Inside N7K-1
 encapsulation dot1Q 653
 ip vrf forwarding T5-In
 ip address 10.8.77.10 255.255.255.252
 no ip redirects
 no ip unreachables
 no ip proxy-arp
 ip ospf network point-to-point
interface Port-channel103.681
 description GT Outside N7K-1
 encapsulation dot1Q 681
 ip vrf forwarding GT-Out
 ip address 10.8.77.194 255.255.255.252
 no ip redirects
 no ip unreachables
 no ip proxy-arp
 ip ospf network point-to-point
interface Port-channel104
 description N7K-2 Uplink
 no switchport
 no ip address
interface Port-channel104.612
 description T1 Outside N7K-2
 encapsulation dot1Q 612
 ip vrf forwarding T1-Out
 ip address 10.8.76.6 255.255.255.252
 no ip redirects
 no ip unreachables
 no ip proxy-arp
 ip ospf network point-to-point
interface Port-channel104.614
 description T1 Inside N7K-2
 encapsulation dot1Q 614
 ip vrf forwarding T1-In
 ip address 10.8.76.14 255.255.255.252
 no ip redirects
 no ip unreachables
 no ip proxy-arp
 ip ospf network point-to-point
```

```
interface Port-channel104.622
 description T2 Outside N7K-2
 encapsulation dot1Q 622
 ip vrf forwarding T2-Out
 ip address 10.8.76.70 255.255.255.252
 no ip redirects
 no ip unreachables
 no ip proxy-arp
 ip ospf network point-to-point
interface Port-channel104.624
 description T2 Inside N7K-2
 encapsulation dot1Q 624
 ip vrf forwarding T2-In
 ip address 10.8.76.78 255.255.255.252
 no ip redirects
 no ip unreachables
 no ip proxy-arp
 ip ospf network point-to-point
interface Port-channel104.632
 description T3 Outside N7K-2
 encapsulation dot1Q 632
 ip vrf forwarding T3-Out
 ip address 10.8.76.134 255.255.255.252
 no ip redirects
 no ip unreachables
 no ip proxy-arp
 ip ospf network point-to-point
 shutdown
interface Port-channel104.634
 description T3 Inside N7K-2
 encapsulation dot1Q 634
 ip vrf forwarding T3-In
 ip address 10.8.76.142 255.255.255.252
 no ip redirects
 no ip unreachables
 no ip proxy-arp
 ip ospf network point-to-point
interface Port-channel104.642
 description T4 Outside N7K-2
 encapsulation dot1Q 642
 ip vrf forwarding T4-Out
 ip address 10.8.76.198 255.255.255.252
 no ip redirects
 no ip unreachables
 no ip proxy-arp
 ip ospf network point-to-point
interface Port-channel104.644
 description T4 Inside N7K-2
 encapsulation dot1Q 644
 ip vrf forwarding T4-In
 ip address 10.8.76.206 255.255.255.252
 no ip redirects
 no ip unreachables
 no ip proxy-arp
 ip ospf network point-to-point
interface Port-channel104.652
 description T5 Outside N7K-2
 encapsulation dot1Q 652
 ip vrf forwarding T5-Out
 ip address 10.8.77.6 255.255.255.252
 no ip redirects
 no ip unreachables
 no ip proxy-arp
 ip ospf network point-to-point
```

```
interface Port-channel104.654
 description T5 Inside N7K-2
 encapsulation dot1Q 654
 ip vrf forwarding T5-In
 ip address 10.8.77.14 255.255.255.252
 no ip redirects
 no ip unreachables
 no ip proxy-arp
 ip ospf network point-to-point
interface Port-channel104.682
 description GT Outside N7K-2
 encapsulation dot1Q 682
 ip vrf forwarding GT-Out
 ip address 10.8.77.198 255.255.255.252
 no ip redirects
 no ip unreachables
 no ip proxy-arp
 ip ospf network point-to-point
interface TenGigabitEthernet1/1/1
 description N7K-1 Uplink
 no switchport
 no ip address
 channel-group 103 mode active
interface TenGigabitEthernet1/1/2
 description N7K-2 Uplink
 no switchport
 no ip address
 channel-group 104 mode active
interface TenGigabitEthernet1/1/3
 description VPN ASA Outside
 no switchport
 no ip address
 channel-group 15 mode active
interface TenGigabitEthernet1/1/4
 description VPN ASA Inside
 no switchport
 no ip address
 channel-group 16 mode active
interface GigabitEthernet1/5/1
 no switchport
 no ip address
 shutdown
interface GigabitEthernet1/5/2
 no switchport
 no ip address
 shutdown
interface GigabitEthernet1/5/3
 description VXIaaS-OOB-MGMT SW1
 switchport
 switchport access vlan 866
 switchport mode access
 arp timeout 1500
interface TenGigabitEthernet1/5/4
 no switchport
 no ip address
 mls qos trust cos
 channel-group 10 mode on
interface TenGigabitEthernet1/5/5
 no switchport
 no ip address
 mls qos trust cos
 channel-group 10 mode on
interface TenGigabitEthernet2/1/1
 description N7K-1 Uplink
```

```
 no switchport
 no ip address
 channel-group 103 mode active
interface TenGigabitEthernet2/1/2
 description N7K-2 Uplink
 no switchport
 no ip address
 channel-group 104 mode active
interface TenGigabitEthernet2/1/3
 description VPN ASA Inside
 no switchport
 no ip address
 channel-group 16 mode active
interface TenGigabitEthernet2/1/4
 description VPN ASA Outside
 no switchport
 no ip address
 channel-group 15 mode active
interface GigabitEthernet2/5/1
 no switchport
 no ip address
 shutdown
interface GigabitEthernet2/5/2
 no switchport
 no ip address
 shutdown
interface GigabitEthernet2/5/3
 description VXIaaS-OOB-MGMT SW2
 switchport
 switchport access vlan 866
 switchport mode access
 arp timeout 1500
interface TenGigabitEthernet2/5/4
 no switchport
 no ip address
 mls qos trust cos
 channel-group 20 mode on
interface TenGigabitEthernet2/5/5
 no switchport
 no ip address
 mls qos trust cos
 channel-group 20 mode on
interface Vlan1
 no ip address
 shutdown
interface Vlan616
 description T1 ASA Outside
 ip vrf forwarding T1-Out
 ip address 10.8.76.33 255.255.255.248
interface Vlan617
 description T1 ASA Inside
 ip vrf forwarding T1-In
 ip address 10.8.76.41 255.255.255.248
interface Vlan626
 description T2 ASA Outside
 ip vrf forwarding T2-Out
 ip address 10.8.76.97 255.255.255.248
interface Vlan627
 description T2 ASA Inside
 ip vrf forwarding T2-In
 ip address 10.8.76.105 255.255.255.248
interface Vlan636
 description T3 ASA Outside
 ip vrf forwarding T3-Out
```

```
 ip address 10.8.76.161 255.255.255.248
interface Vlan637
 description T3 ASA Inside
 ip vrf forwarding T3-In
 ip address 10.8.76.169 255.255.255.248
interface Vlan646
 description T4 ASA Outside
 ip vrf forwarding T4-Out
 ip address 10.8.76.225 255.255.255.248
interface Vlan647
 description T4 ASA Inside
 ip vrf forwarding T4-In
 ip address 10.8.76.233 255.255.255.248
interface Vlan656
 description T5 ASA Outside
 ip vrf forwarding T5-Out
 ip address 10.8.77.33 255.255.255.248
interface Vlan657
 description T5 ASA Inside
 ip vrf forwarding T5-In
 ip address 10.8.77.41 255.255.255.248
interface Vlan866
 description VXIaaS-OOB-MGMT
 ip address 10.8.66.13 255.255.255.0
 no ip redirects
 no ip unreachables
 no ip proxy-arp
 arp timeout 1500
router ospf 10 vrf T1-Out
 router-id 1.1.1.12
 log-adjacency-changes detail
 auto-cost reference-bandwidth 100000
 nsf ietf
 capability vrf-lite
 area 10 nssa
 redistribute static subnets
 passive-interface Loopback1
 passive-interface Vlan616
 network 10.8.76.2 0.0.0.0 area 10
 network 10.8.76.6 0.0.0.0 area 10
 network 10.8.76.33 0.0.0.0 area 10
 network 192.168.10.7 0.0.0.0 area 10
router ospf 20 vrf T2-Out
 router-id 2.2.2.12
 log-adjacency-changes detail
 auto-cost reference-bandwidth 100000
 nsf ietf
 capability vrf-lite
 area 10 nssa
 redistribute static subnets
 passive-interface Loopback2
 passive-interface Vlan626
 network 10.8.76.66 0.0.0.0 area 10
 network 10.8.76.70 0.0.0.0 area 10
 network 10.8.76.97 0.0.0.0 area 10
 network 192.168.20.7 0.0.0.0 area 10
router ospf 30 vrf T3-Out
 router-id 3.3.3.12
 log-adjacency-changes detail
 auto-cost reference-bandwidth 100000
 nsf ietf
 capability vrf-lite
 area 10 nssa
 redistribute static subnets
```

```
 passive-interface Loopback3
 passive-interface Vlan636
 network 10.8.76.130 0.0.0.0 area 10
 network 10.8.76.134 0.0.0.0 area 10
 network 10.8.76.153 0.0.0.0 area 10
 network 10.8.76.161 0.0.0.0 area 10
 network 192.168.30.7 0.0.0.0 area 10
router ospf 40 vrf T4-Out
 router-id 4.4.4.12
 log-adjacency-changes detail
 auto-cost reference-bandwidth 100000
 nsf ietf
 capability vrf-lite
 area 10 nssa
 redistribute static subnets
 passive-interface Loopback4
 passive-interface Vlan646
 network 10.8.76.194 0.0.0.0 area 10
 network 10.8.76.198 0.0.0.0 area 10
 network 10.8.76.225 0.0.0.0 area 10
 network 192.168.40.7 0.0.0.0 area 10
router ospf 50 vrf T5-Out
 router-id 5.5.5.12
 log-adjacency-changes detail
 auto-cost reference-bandwidth 100000
 nsf ietf
 capability vrf-lite
 area 10 nssa
 redistribute static subnets
 passive-interface Loopback5
 passive-interface Vlan656
 network 10.8.77.2 0.0.0.0 area 10
 network 10.8.77.6 0.0.0.0 area 10
 network 10.8.77.33 0.0.0.0 area 10
 network 192.168.50.7 0.0.0.0 area 10
router ospf 15 vrf T1-In
 router-id 1.1.1.13
 log-adjacency-changes detail
 auto-cost reference-bandwidth 100000
 nsf ietf
 capability vrf-lite
 area 20 nssa default-information-originate
 passive-interface Loopback10
 passive-interface Vlan617
 network 10.8.76.10 0.0.0.0 area 20
 network 10.8.76.14 0.0.0.0 area 20
 network 10.8.76.41 0.0.0.0 area 20
 network 192.168.10.8 0.0.0.0 area 20
router ospf 25 vrf T2-In
 router-id 2.2.2.13
 log-adjacency-changes detail
 auto-cost reference-bandwidth 100000
 nsf ietf
 capability vrf-lite
 area 20 nssa default-information-originate
 passive-interface Vlan627
 network 10.8.76.74 0.0.0.0 area 20
 network 10.8.76.78 0.0.0.0 area 20
 network 10.8.76.105 0.0.0.0 area 20
 network 192.168.20.8 0.0.0.0 area 20
router ospf 35 vrf T3-In
 router-id 3.3.3.13
 log-adjacency-changes detail
 auto-cost reference-bandwidth 100000
```

```
 nsf ietf
 capability vrf-lite
 area 20 nssa default-information-originate
 passive-interface Loopback30
 passive-interface Vlan637
 network 10.8.76.138 0.0.0.0 area 20
 network 10.8.76.142 0.0.0.0 area 20
 network 10.8.76.169 0.0.0.0 area 20
 network 192.168.30.8 0.0.0.0 area 20
router ospf 45 vrf T4-In
 router-id 4.4.4.13
 log-adjacency-changes detail
 auto-cost reference-bandwidth 100000
 nsf ietf
 capability vrf-lite
 area 20 nssa default-information-originate
 passive-interface Loopback40
 passive-interface Vlan647
 network 10.8.76.202 0.0.0.0 area 20
 network 10.8.76.206 0.0.0.0 area 20
 network 10.8.76.233 0.0.0.0 area 20
 network 192.168.40.8 0.0.0.0 area 20
router ospf 55 vrf T5-In
 router-id 5.5.5.13
 log-adjacency-changes detail
 auto-cost reference-bandwidth 100000
 nsf ietf
 capability vrf-lite
 area 20 nssa default-information-originate
 passive-interface Loopback50
 passive-interface Vlan657
 network 10.8.77.10 0.0.0.0 area 20
 network 10.8.77.14 0.0.0.0 area 20
 network 10.8.77.41 0.0.0.0 area 20
 network 192.168.50.8 0.0.0.0 area 20
router ospf 80 vrf GT-Out
 router-id 8.8.8.12
 log-adjacency-changes detail
 auto-cost reference-bandwidth 100000
 nsf ietf
 capability vrf-lite
 area 10 nssa
 redistribute static subnets
 passive-interface Loopback8
 network 10.8.77.194 0.0.0.0 area 10
 network 10.8.77.198 0.0.0.0 area 10
 network 10.8.77.209 0.0.0.0 area 10
 network 192.168.80.7 0.0.0.0 area 10
ip classless
ip forward-protocol nd
ip route 0.0.0.0 0.0.0.0 10.8.66.1
ip route vrf T1-In 0.0.0.0 0.0.0.0 10.8.76.43
ip route vrf T1-Out 10.9.104.0 255.255.248.0 10.8.76.35
ip route vrf T2-In 0.0.0.0 0.0.0.0 10.8.76.107
ip route vrf T2-Out 10.9.112.0 255.255.248.0 10.8.76.99
ip route vrf T3-In 0.0.0.0 0.0.0.0 10.8.76.171
ip route vrf T3-Out 10.9.120.0 255.255.248.0 10.8.76.163
ip route vrf T4-In 0.0.0.0 0.0.0.0 10.8.76.235
ip route vrf T4-Out 10.9.128.0 255.255.248.0 10.8.76.227
ip route vrf T5-In 0.0.0.0 0.0.0.0 10.8.77.43
ip route vrf T5-Out 10.9.136.0 255.255.248.0 10.8.77.35
no ip http server
no ip http secure-server
control-plane
```

```
dial-peer cor custom
line con 0
 exec-timeout 0 0
 logging synchronous
line vty 0 4
 exec-timeout 300 0
 password cisco_123
 logging synchronous
 transport input telnet ssh
mac-address-table aging-time 1800
module provision switch 1
 slot 1 slot-type 148 port-type 60 number 4  virtual-slot 17
 slot 2 slot-type 207 port-type 106 number 1  virtual-slot 18
 slot 3 slot-type 330 port-type 111 number 3  virtual-slot 19
 slot 5 slot-type 254 port-type 31 number 2 port-type 61 number 1 port-type 60 number
2  virtual-slot 21
module provision switch 2
 slot 1 slot-type 148 port-type 60 number 4  virtual-slot 33
 slot 2 slot-type 207 port-type 106 number 1  virtual-slot 34
 slot 3 slot-type 330 port-type 111 number 3  virtual-slot 35
 slot 5 slot-type 254 port-type 31 number 2 port-type 61 number 1 port-type 60 number
2  virtual-slot 37
end
```

Cisco ASA Service Module Tenant 1 configuration:

```
ASA Version 8.5(1) <context>
hostname T1
enable password MkHB0dBXOzv6EXRs encrypted
passwd 2KFQnbNIdI.2KYOU encrypted
names
interface Vlan616
 nameif outside
 security-level 10
 ip address 10.8.76.35 255.255.255.248 standby 10.8.76.36
interface Vlan617
 nameif inside
 security-level 100
 ip address 10.8.76.43 255.255.255.248 standby 10.8.76.44
access-list inside-acl extended permit ip any any
access-list inside-acl extended permit udp any any
access-list inside-acl extended permit tcp any any
access-list inside-acl extended permit icmp any any
access-list outside-acl extended permit ip any any
access-list outside-acl extended permit udp any any
access-list outside-acl extended permit tcp any any
access-list outside-acl extended permit icmp any any
access-list mgmt-acl extended permit icmp any any
access-list mgmt-acl extended permit tcp any any
access-list mgmt-acl extended permit udp any any
access-list mgmt-acl extended permit ip any any
pager lines 24
logging buffered debugging
mtu outside 1500
mtu inside 1500
icmp unreachable rate-limit 1 burst-size 1
icmp permit any outside
icmp permit any inside
no asdm history enable
arp timeout 1500
access-group outside-acl in interface outside per-user-override
access-group inside-acl in interface inside per-user-override
route outside 0.0.0.0 0.0.0.0 10.8.76.33 1
route inside 10.9.104.0 255.255.248.0 10.8.76.41 1
```

```
timeout xlate 3:00:00
timeout conn 1:00:00 half-closed 0:10:00 udp 0:02:00 icmp 0:00:02
timeout sunrpc 0:10:00 h323 0:05:00 h225 1:00:00 mgcp 0:05:00 mgcp-pat 0:05:00
timeout sip 0:30:00 sip_media 0:02:00 sip-invite 0:03:00 sip-disconnect 0:02:00
timeout sip-provisional-media 0:02:00 uauth 0:05:00 absolute
timeout tcp-proxy-reassembly 0:01:00
timeout floating-conn 0:00:00
no snmp-server location
no snmp-server contact
telnet timeout 5
ssh timeout 5
no threat-detection statistics tcp-intercept
class-map inspection_default
 match default-inspection-traffic
policy-map type inspect dns preset_dns_map
 parameters
  message-length maximum client auto
  message-length maximum 512
policy-map global_policy
 class inspection_default
  inspect dns preset_dns_map
  inspect ftp
  inspect h323 h225
  inspect h323 ras
  inspect ip-options
  inspect netbios
  inspect rsh
  inspect rtsp
  inspect skinny
  inspect esmtp
  inspect sqlnet
  inspect sunrpc
  inspect tftp
  inspect sip
  inspect xdmcp
service-policy global_policy global
Cryptochecksum:bc9bd98b298c334af9d76007204a043b
: end
```

Cisco ASR 9006 configurations:

```
!! IOS XR Configuration 4.2.0
!! Last configuration change at Mon Jan 14 18:43:43 2013 by admin
hostname VXIaaS-DC-9K-1
logging disable
domain name vxiaas.local
cdp
vrf GT
vrf T1
vrf T2
vrf T3
vrf T4
vrf T5
vrf management
line console
 exec-timeout 0 0
 length 32
interface Loopback1
 description Tenant 1 VRF Loopback
 vrf T1
 ipv4 address 192.168.10.1 255.255.255.255
interface Loopback2
 description Tenant 2 VRF Loopback
 vrf T2
```

```
 ipv4 address 192.168.20.1 255.255.255.255
interface Loopback3
 description Tenant 3 VRF Loopback
 vrf T3
 ipv4 address 192.168.30.1 255.255.255.255
interface Loopback4
 description Tenant 4 VRF Loopback
 vrf T4
 ipv4 address 192.168.40.1 255.255.255.255
interface Loopback5
 description Tenant 5 VRF Loopback
 vrf T5
 ipv4 address 192.168.50.1 255.255.255.255
interface Loopback8
 description Global Tenant VRF Loopback
 vrf GT
 ipv4 address 192.168.80.1 255.255.255.255
interface MgmtEth0/RSP0/CPU0/0
 description MGMT Interface
 vrf management
 ipv4 address 10.8.66.15 255.255.255.0
interface MgmtEth0/RSP0/CPU0/1
 shutdown
interface GigabitEthernet0/1/0/0
 description Global Tenant Internet
 vrf GT
 ipv4 point-to-point
 ipv4 address 192.168.200.2 255.255.255.252
interface GigabitEthernet0/1/0/1
 shutdown
interface GigabitEthernet0/1/0/2
 shutdown
interface GigabitEthernet0/1/0/3
 shutdown
interface GigabitEthernet0/1/0/4
 shutdown
interface GigabitEthernet0/1/0/5
 shutdown
interface GigabitEthernet0/1/0/6
 shutdown
interface GigabitEthernet0/1/0/7
 shutdown
interface GigabitEthernet0/1/0/8
 shutdown
interface GigabitEthernet0/1/0/9
 shutdown
interface GigabitEthernet0/1/0/10
 shutdown
interface GigabitEthernet0/1/0/11
 shutdown
interface GigabitEthernet0/1/0/12
 shutdown
interface GigabitEthernet0/1/0/13
 shutdown
interface GigabitEthernet0/1/0/14
 shutdown
interface GigabitEthernet0/1/0/15
 shutdown
interface GigabitEthernet0/1/0/16
 shutdown
interface GigabitEthernet0/1/0/17
 shutdown
interface GigabitEthernet0/1/0/18
 shutdown
```

```
interface GigabitEthernet0/1/0/19
 shutdown
interface GigabitEthernet0/1/0/20
 shutdown
interface GigabitEthernet0/1/0/21
 shutdown
interface GigabitEthernet0/1/0/22
 shutdown
interface GigabitEthernet0/1/0/23
 shutdown
interface GigabitEthernet0/1/0/24
 shutdown
interface GigabitEthernet0/1/0/25
 shutdown
interface GigabitEthernet0/1/0/26
 shutdown
interface GigabitEthernet0/1/0/27
 shutdown
interface GigabitEthernet0/1/0/28
 shutdown
interface GigabitEthernet0/1/0/29
 shutdown
interface GigabitEthernet0/1/0/30
 shutdown
interface GigabitEthernet0/1/0/31
 shutdown
interface GigabitEthernet0/1/0/32
 shutdown
interface GigabitEthernet0/1/0/33
 shutdown
interface GigabitEthernet0/1/0/34
 shutdown
interface GigabitEthernet0/1/0/35
 shutdown
interface GigabitEthernet0/1/0/36
 shutdown
interface GigabitEthernet0/1/0/37
 shutdown
interface GigabitEthernet0/1/0/38
 shutdown
interface GigabitEthernet0/1/0/39
 shutdown
interface TenGigE0/0/0/0
 description VXIaaS-N7K-1
 cdp
interface TenGigE0/0/0/0.712
 description T1 N7K-1
 vrf T1
 ipv4 point-to-point
 ipv4 address 10.8.78.2 255.255.255.252
 encapsulation dot1q 712
interface TenGigE0/0/0/0.722
 description T2 N7K-1
 vrf T2
 ipv4 point-to-point
 ipv4 address 10.8.78.34 255.255.255.252
 encapsulation dot1q 722
interface TenGigE0/0/0/0.732
 description T3 N7K-1
 vrf T3
 ipv4 point-to-point
 ipv4 address 10.8.78.66 255.255.255.252
 encapsulation dot1q 732
interface TenGigE0/0/0/0.742
```

```
 description T4 N7K-1
 vrf T4
 ipv4 point-to-point
 ipv4 address 10.8.78.98 255.255.255.252
 encapsulation dot1q 742
interface TenGigE0/0/0/0.752
 description T5 N7K-1
 vrf T5
 ipv4 point-to-point
 ipv4 address 10.8.78.130 255.255.255.252
 encapsulation dot1q 752
interface TenGigE0/0/0/0.782
 description Global Tenant N7K-1
 vrf GT
 ipv4 point-to-point
 ipv4 address 10.8.78.226 255.255.255.252
 encapsulation dot1q 782
interface TenGigE0/0/0/1
 description VXIaaS-N1K-2
 cdp
interface TenGigE0/0/0/1.714
 description T1-N7K-2
 vrf T1
 ipv4 point-to-point
 ipv4 address 10.8.78.10 255.255.255.252
 encapsulation dot1q 714
interface TenGigE0/0/0/1.724
 description T2-N7K-2
 vrf T2
 ipv4 point-to-point
 ipv4 address 10.8.78.42 255.255.255.252
 encapsulation dot1q 724
interface TenGigE0/0/0/1.734
 description T3-N7K-2
 vrf T3
 ipv4 point-to-point
 ipv4 address 10.8.78.74 255.255.255.252
 encapsulation dot1q 734
interface TenGigE0/0/0/1.744
 description T4-N7K-2
 vrf T4
 ipv4 point-to-point
 ipv4 address 10.8.78.106 255.255.255.252
 encapsulation dot1q 744
interface TenGigE0/0/0/1.754
 description T5-N7K-2
 vrf T5
 ipv4 point-to-point
 ipv4 address 10.8.78.138 255.255.255.252
 encapsulation dot1q 754
interface TenGigE0/0/0/1.784
 description GT-N7K-2
 vrf GT
 ipv4 point-to-point
 ipv4 address 10.8.78.234 255.255.255.252
 encapsulation dot1q 784
interface TenGigE0/0/0/2
 cdp
 shutdown
interface TenGigE0/0/0/3
 cdp
 shutdown
interface TenGigE0/0/0/4
 description SP-ASR9K-1
```

```
 cdp
interface TenGigE0/0/0/4.511
 vrf T1
 ipv4 point-to-point
 ipv4 address 10.8.2.2 255.255.255.252
 encapsulation dot1q 511
interface TenGigE0/0/0/4.521
 vrf T2
 ipv4 point-to-point
 ipv4 address 10.8.2.10 255.255.255.252
 encapsulation dot1q 521
interface TenGigE0/0/0/4.531
 vrf T3
 ipv4 point-to-point
 ipv4 address 10.8.2.18 255.255.255.252
 encapsulation dot1q 531
interface TenGigE0/0/0/4.541
 vrf T4
 ipv4 point-to-point
 ipv4 address 10.8.2.26 255.255.255.252
 encapsulation dot1q 541
interface TenGigE0/0/0/4.551
 vrf T5
 ipv4 point-to-point
 ipv4 address 10.8.2.34 255.255.255.252
 encapsulation dot1q 551
interface TenGigE0/0/0/5
 description SP-ASR9K-2
 cdp
interface TenGigE0/0/0/5.513
 vrf T1
 ipv4 point-to-point
 ipv4 address 10.8.2.66 255.255.255.252
 encapsulation dot1q 513
interface TenGigE0/0/0/5.523
 vrf T2
 ipv4 point-to-point
 ipv4 address 10.8.2.74 255.255.255.252
 encapsulation dot1q 523
interface TenGigE0/0/0/5.533
 vrf T3
 ipv4 point-to-point
 ipv4 address 10.8.2.82 255.255.255.252
 encapsulation dot1q 533
interface TenGigE0/0/0/5.543
 vrf T4
 ipv4 point-to-point
 ipv4 address 10.8.2.90 255.255.255.252
 encapsulation dot1q 543
interface TenGigE0/0/0/5.553
 vrf T5
 ipv4 point-to-point
 ipv4 address 10.8.2.98 255.255.255.252
 encapsulation dot1q 553
interface TenGigE0/0/0/6
 description VXIaaS-ASR9K-2
 cdp
interface TenGigE0/0/0/6.716
 description T1 ASR9K-2
 vrf T1
 ipv4 point-to-point
 ipv4 address 10.8.78.17 255.255.255.252
 encapsulation dot1q 716
interface TenGigE0/0/0/6.726
```

```
 description T2 ASR9K-2
 vrf T2
 ipv4 point-to-point
 ipv4 address 10.8.78.49 255.255.255.252
 encapsulation dot1q 726
interface TenGigE0/0/0/6.736
 description T3 ASR9K-2
 vrf T3
 ipv4 point-to-point
 ipv4 address 10.8.78.81 255.255.255.252
 encapsulation dot1q 736
interface TenGigE0/0/0/6.746
 description T4 ASR9K-2
 vrf T4
 ipv4 point-to-point
 ipv4 address 10.8.78.113 255.255.255.252
 encapsulation dot1q 746
interface TenGigE0/0/0/6.756
 description T5 ASR9K-2
 vrf T5
 ipv4 point-to-point
 ipv4 address 10.8.78.145 255.255.255.252
 encapsulation dot1q 756
interface TenGigE0/0/0/6.786
 description GT ASR9K-2
 vrf GT
 ipv4 point-to-point
 ipv4 address 10.8.78.241 255.255.255.252
 encapsulation dot1q 786
interface TenGigE0/0/0/7
 description VXIaaS-ASR9K-2
 cdp
interface TenGigE0/0/0/7.717
 description T1 ASR9K-2
 vrf T1
 ipv4 point-to-point
 ipv4 address 10.8.78.21 255.255.255.252
 encapsulation dot1q 716
interface TenGigE0/0/0/7.727
 description T2 ASR9K-2
 vrf T2
 ipv4 point-to-point
 ipv4 address 10.8.78.53 255.255.255.252
 encapsulation dot1q 726
interface TenGigE0/0/0/7.737
 description T3 ASR9K-2
 vrf T3
 ipv4 point-to-point
 ipv4 address 10.8.78.85 255.255.255.252
 encapsulation dot1q 736
interface TenGigE0/0/0/7.747
 description T4 ASR9K-2
 vrf T4
 ipv4 point-to-point
 ipv4 address 10.8.78.117 255.255.255.252
 encapsulation dot1q 746
interface TenGigE0/0/0/7.757
 description T5 ASR9K-2
 vrf T5
 ipv4 point-to-point
 ipv4 address 10.8.78.149 255.255.255.252
 encapsulation dot1q 756
interface TenGigE0/0/0/7.787
 description GT ASR9K-2
```

```
 vrf GT
 ipv4 point-to-point
 ipv4 address 10.8.78.245 255.255.255.252
 encapsulation dot1q 786
rd-set 100:110
  end-set
rd-set 200:220
  end-set
rd-set 300:330
  end-set
rd-set 400:440
  end-set
rd-set 500:550
  end-set
rd-set 800:880
  end-set
route-policy all
  pass
  end-policy
route-policy GT-BGP
  pass
  end-policy
route-policy T1-BGP
  pass
  end-policy
route-policy T2-BGP
  pass
  end-policy
route-policy T3-BGP
  pass
  end-policy
route-policy T4-BGP
  pass
  end-policy
route-policy T5-BGP
  pass
  end-policy
route-policy GT-OSPF
  pass
  end-policy
route-policy T1-OSPF
  pass
  end-policy
route-policy T2-OSPF
  pass
  end-policy
route-policy T3-OSPF
  pass
  end-policy
route-policy T4-OSPF
  pass
  end-policy
route-policy T5-OSPF
  pass
  end-policy
router static
 vrf management
  address-family ipv4 unicast
   0.0.0.0/0 10.8.66.1
router ospf VXIaaS
 vrf GT
  router-id 8.8.8.1
  auto-cost reference-bandwidth 100000
  default-information originate
```

```
  redistribute bgp 42 route-policy GT-BGP
  area 0
   interface Loopback8
    network point-to-point
    passive enable
   interface TenGigE0/0/0/0.782
    network point-to-point
    neighbor 10.8.78.225
   interface TenGigE0/0/0/1.784
    network point-to-point

  neighbor 10.8.78.233
   interface TenGigE0/0/0/6.786
    network point-to-point
    neighbor 10.8.78.242
   interface TenGigE0/0/0/7.787
    network point-to-point
    neighbor 10.8.78.246
vrf T1
  router-id 1.1.1.1
  auto-cost reference-bandwidth 100000
  default-information originate
  redistribute bgp 42 route-policy T1-BGP
  area 0
   interface Loopback1
    network point-to-point
    passive enable
interface TenGigE0/0/0/0.712
    network point-to-point
    neighbor 10.8.78.1
interface TenGigE0/0/0/1.714
    network point-to-point
    neighbor 10.8.78.9
interface TenGigE0/0/0/6.716
    network point-to-point
    neighbor 10.8.78.18
   interface TenGigE0/0/0/7.717
    network point-to-point
    neighbor 10.8.78.22
vrf T2
  router-id 2.2.2.1
  auto-cost reference-bandwidth 100000
  default-information originate
  area 0
   interface Loopback2
    network point-to-point
    passive enable
interface TenGigE0/0/0/0.722
    network point-to-point
    neighbor 10.8.78.33
interface TenGigE0/0/0/1.724
    network point-to-point
    neighbor 10.8.78.41
interface TenGigE0/0/0/6.726
    network point-to-point
    neighbor 10.8.78.50
interface TenGigE0/0/0/7.727
    network point-to-point
    neighbor 10.8.78.54
vrf T3
  router-id 3.3.3.1
  auto-cost reference-bandwidth 100000
  default-information originate
  area 0
```

```
   interface Loopback3
    network point-to-point
    passive enable
interface TenGigE0/0/0/0.732
    network point-to-point
    neighbor 10.8.78.65
interface TenGigE0/0/0/1.734
    network point-to-point
    neighbor 10.8.78.73
interface TenGigE0/0/0/6.736
    network point-to-point
    neighbor 10.8.78.82
interface TenGigE0/0/0/7.737
    network point-to-point
    neighbor 10.8.78.86
vrf T4
  router-id 4.4.4.1
  auto-cost reference-bandwidth 100000
  default-information originate
  area 0
   interface Loopback4
    network point-to-point
    passive enable
interface TenGigE0/0/0/0.742
    network point-to-point
    neighbor 10.8.78.97
interface TenGigE0/0/0/1.744
    network point-to-point
    neighbor 10.8.78.105
interface TenGigE0/0/0/6.746
    network point-to-point
    neighbor 10.8.78.114
interface TenGigE0/0/0/7.747
    network point-to-point
    neighbor 10.8.78.118
vrf T5
  router-id 5.5.5.1
  auto-cost reference-bandwidth 100000
  default-information originate
  area 0
   interface Loopback5
    network point-to-point
    passive enable
interface TenGigE0/0/0/0.752
    network point-to-point
    neighbor 10.8.78.129
interface TenGigE0/0/0/1.754
    network point-to-point
    neighbor 10.8.78.137
interface TenGigE0/0/0/6.756
    network point-to-point
    neighbor 10.8.78.146
interface TenGigE0/0/0/7.757
    network point-to-point
    neighbor 10.8.78.150
router bgp 42
 address-family ipv4 unicast
address-family vpnv4 unicast
vrf GT
  rd 800:880
  bgp router-id 8.8.8.1
  address-family ipv4 unicast
   redistribute ospf VXIaaS route-policy GT-OSPF
neighbor 192.168.200.1
```

```
   remote-as 40
   address-family ipv4 unicast
    route-policy all in
    route-policy all out
vrf T1
  rd 100:110
  bgp router-id 1.1.1.1
  address-family ipv4 unicast
   redistribute ospf VXIaaS route-policy T1-OSPF
neighbor 10.8.2.1
   remote-as 20
   address-family ipv4 unicast
    route-policy all in
    route-policy all out
neighbor 10.8.2.65
   remote-as 20
   address-family ipv4 unicast
    route-policy all in
    route-policy all out
vrf T2
  rd 200:220
  bgp router-id 2.2.2.1
  address-family ipv4 unicast
   redistribute ospf VXIaaS route-policy T2-OSPF
neighbor 10.8.2.9
   remote-as 20
   address-family ipv4 unicast
    route-policy all in
    route-policy all out
neighbor 10.8.2.73
   remote-as 20
   address-family ipv4 unicast
    route-policy all in
    route-policy all out
vrf T3
  rd 300:330
  bgp router-id 3.3.3.1
  address-family ipv4 unicast
   redistribute ospf VXIaaS route-policy T3-OSPF
neighbor 10.8.2.17
   remote-as 20
   address-family ipv4 unicast
    route-policy all in
    route-policy all out
neighbor 10.8.2.81
   remote-as 20
   address-family ipv4 unicast
    route-policy all in
    route-policy all out
vrf T4
  rd 400:440
  bgp router-id 4.4.4.1
  address-family ipv4 unicast
   redistribute ospf VXIaaS route-policy T4-OSPF
neighbor 10.8.2.25
   remote-as 20
   address-family ipv4 unicast
    route-policy all in
    route-policy all out
neighbor 10.8.2.89
   remote-as 20
   address-family ipv4 unicast
    route-policy all in
    route-policy all out
```

```
vrf T5
  rd 500:550
  bgp router-id 5.5.5.1
  address-family ipv4 unicast
   redistribute ospf VXIaaS route-policy T5-OSPF
neighbor 10.8.2.33
   remote-as 20
   address-family ipv4 unicast
    route-policy all in
    route-policy all out
neighbor 10.8.2.97
   remote-as 20
   address-family ipv4 unicast
    route-policy all in
    route-policy all out
ssh server vrf management
end

!! IOS XR Configuration 4.2.0
!! Last configuration change at Mon Jan 14 18:48:08 2013 by admin
hostname VXIaaS-DC-9K-2
logging disable
domain name vxiaas.local
cdp
vrf GT
vrf T1
vrf T2
vrf T3
vrf T4
vrf T5
vrf management
line console
 exec-timeout 0 0
 length 23
interface Loopback1
 description Tenant 1 VRF Loopback
 vrf T1
 ipv4 address 192.168.10.2 255.255.255.255
interface Loopback2
 description Tenant 2 VRF Loopback
 vrf T2
 ipv4 address 192.168.20.2 255.255.255.255
interface Loopback3
 description Tenant 3 VRF Loopback
 vrf T3
 ipv4 address 192.168.30.2 255.255.255.255
interface Loopback4
 description Tenant 4 VRF Loopback
 vrf T4
 ipv4 address 192.168.40.2 255.255.255.255
interface Loopback5
 description Tenant 5 VRF Loopback
 vrf T5
 ipv4 address 192.168.50.2 255.255.255.255
interface Loopback8
 description Global Tenant VRF Loopback
 vrf GT
 ipv4 address 192.168.80.2 255.255.255.255
interface MgmtEth0/RSP0/CPU0/0
 description MGMT Interface
 vrf management
 ipv4 address 10.8.66.16 255.255.255.0
interface MgmtEth0/RSP0/CPU0/1
 shutdown
```

```
interface GigabitEthernet0/1/0/0
 description Global Tenant Internet
 vrf GT
 ipv4 point-to-point
 ipv4 address 192.168.200.6 255.255.255.252
interface GigabitEthernet0/1/0/1
 shutdown
interface GigabitEthernet0/1/0/2
 shutdown
interface GigabitEthernet0/1/0/3
 shutdown
interface GigabitEthernet0/1/0/4
 shutdown
interface GigabitEthernet0/1/0/5
 shutdown
interface GigabitEthernet0/1/0/6
 shutdown
interface GigabitEthernet0/1/0/7
 shutdown
interface GigabitEthernet0/1/0/8
 shutdown
interface GigabitEthernet0/1/0/9
 shutdown
interface GigabitEthernet0/1/0/10
 shutdown
interface GigabitEthernet0/1/0/11
 shutdown
interface GigabitEthernet0/1/0/12
 shutdown
interface GigabitEthernet0/1/0/13
 shutdown
interface GigabitEthernet0/1/0/14
 shutdown
interface GigabitEthernet0/1/0/15
 shutdown
interface GigabitEthernet0/1/0/16
 shutdown
interface GigabitEthernet0/1/0/17
 shutdown
interface GigabitEthernet0/1/0/18
 shutdown
interface GigabitEthernet0/1/0/19
 shutdown
interface GigabitEthernet0/1/0/20
 shutdown
interface GigabitEthernet0/1/0/21
 shutdown
interface GigabitEthernet0/1/0/22
 shutdown
interface GigabitEthernet0/1/0/23
 shutdown
interface GigabitEthernet0/1/0/24
 shutdown
interface GigabitEthernet0/1/0/25
 shutdown
interface GigabitEthernet0/1/0/26
 shutdown
interface GigabitEthernet0/1/0/27
 shutdown
interface GigabitEthernet0/1/0/28
 shutdown
interface GigabitEthernet0/1/0/29
 shutdown
interface GigabitEthernet0/1/0/30
```

```
 shutdown
interface GigabitEthernet0/1/0/31
 shutdown
interface GigabitEthernet0/1/0/32
 shutdown
interface GigabitEthernet0/1/0/33
 shutdown
interface GigabitEthernet0/1/0/34
 shutdown
interface GigabitEthernet0/1/0/35
 shutdown
interface GigabitEthernet0/1/0/36
 shutdown
interface GigabitEthernet0/1/0/37
 shutdown
interface GigabitEthernet0/1/0/38
 shutdown
interface GigabitEthernet0/1/0/39
 shutdown
interface TenGigE0/0/0/0
 description VXIaaS-N1K-1
 cdp
interface TenGigE0/0/0/0.713
 description T1 N7K-1
 vrf T1
 ipv4 point-to-point
 ipv4 address 10.8.78.6 255.255.255.252
 encapsulation dot1q 713
interface TenGigE0/0/0/0.723
 description T2 N7K-1
 vrf T2
 ipv4 point-to-point
 ipv4 address 10.8.78.38 255.255.255.252
 encapsulation dot1q 723
interface TenGigE0/0/0/0.733
 description T3 N7K-1
 vrf T3
 ipv4 point-to-point
 ipv4 address 10.8.78.70 255.255.255.252
 encapsulation dot1q 733
interface TenGigE0/0/0/0.743
 description T4 N7K-1
 vrf T4
 ipv4 point-to-point
 ipv4 address 10.8.78.102 255.255.255.252
 encapsulation dot1q 743
interface TenGigE0/0/0/0.753
 description T5 N7K-1
 vrf T5
 ipv4 point-to-point
 ipv4 address 10.8.78.134 255.255.255.252
 encapsulation dot1q 753
interface TenGigE0/0/0/0.783
 description Global Tenant N7K-1
 vrf GT
 ipv4 point-to-point
 ipv4 address 10.8.78.230 255.255.255.252
 encapsulation dot1q 783
interface TenGigE0/0/0/1
 description VXIaaS-N1K-2
 cdp
interface TenGigE0/0/0/1.715
 description T1 N7K-2
 vrf T1
```

```
 ipv4 point-to-point
 ipv4 address 10.8.78.14 255.255.255.252
 encapsulation dot1q 715
interface TenGigE0/0/0/1.725
 description T2 N7K-2
 vrf T2
 ipv4 point-to-point
 ipv4 address 10.8.78.46 255.255.255.252
 encapsulation dot1q 725
interface TenGigE0/0/0/1.735
 description T3 N7K-2
 vrf T3
 ipv4 point-to-point
 ipv4 address 10.8.78.78 255.255.255.252
 encapsulation dot1q 735
interface TenGigE0/0/0/1.745
 description T4 N7K-2
 vrf T4
 ipv4 point-to-point
 ipv4 address 10.8.78.110 255.255.255.252
 encapsulation dot1q 745
interface TenGigE0/0/0/1.755
 description T5 N7K-2
 vrf T5
 ipv4 point-to-point
 ipv4 address 10.8.78.142 255.255.255.252
 encapsulation dot1q 755
interface TenGigE0/0/0/1.785
 description GT-N7K-2
 vrf GT
 ipv4 point-to-point
 ipv4 address 10.8.78.238 255.255.255.252
 encapsulation dot1q 785
interface TenGigE0/0/0/2
 cdp
 shutdown
interface TenGigE0/0/0/3
 cdp
 shutdown
interface TenGigE0/0/0/4
 description SP-ASR9K-1
 cdp
interface TenGigE0/0/0/4.512
 vrf T1
 ipv4 point-to-point
 ipv4 address 10.8.2.6 255.255.255.252
 encapsulation dot1q 512
interface TenGigE0/0/0/4.522
 vrf T2
 ipv4 point-to-point
 ipv4 address 10.8.2.14 255.255.255.252
 encapsulation dot1q 522
interface TenGigE0/0/0/4.532
 vrf T3
 ipv4 point-to-point
 ipv4 address 10.8.2.22 255.255.255.252
 encapsulation dot1q 532
interface TenGigE0/0/0/4.542
 vrf T4
 ipv4 point-to-point
 ipv4 address 10.8.2.30 255.255.255.252
 encapsulation dot1q 542
interface TenGigE0/0/0/4.552
 vrf T5
```

```
 ipv4 point-to-point
 ipv4 address 10.8.2.38 255.255.255.252
 encapsulation dot1q 552
interface TenGigE0/0/0/5
 description SP-ASR9K-2
 cdp
interface TenGigE0/0/0/5.514
 vrf T1
 ipv4 point-to-point
 ipv4 address 10.8.2.70 255.255.255.252
 encapsulation dot1q 514
interface TenGigE0/0/0/5.524
 vrf T2
 ipv4 point-to-point
 ipv4 address 10.8.2.78 255.255.255.252
 encapsulation dot1q 524
interface TenGigE0/0/0/5.534
 vrf T3
 ipv4 point-to-point
 ipv4 address 10.8.2.86 255.255.255.252
 encapsulation dot1q 534
interface TenGigE0/0/0/5.544
 vrf T4
 ipv4 point-to-point
 ipv4 address 10.8.2.94 255.255.255.252
 encapsulation dot1q 544
interface TenGigE0/0/0/5.554
 vrf T5
 ipv4 point-to-point
 ipv4 address 10.8.2.102 255.255.255.252
 encapsulation dot1q 554
interface TenGigE0/0/0/6
 description VXIaaS-ASR9K-1
 cdp
interface TenGigE0/0/0/6.716
 description T1 ASR9K-1
 vrf T1
 ipv4 point-to-point
 ipv4 address 10.8.78.18 255.255.255.252
 encapsulation dot1q 716
interface TenGigE0/0/0/6.726
 description T2 ASR9K-1
 vrf T2
 ipv4 point-to-point
 ipv4 address 10.8.78.50 255.255.255.252
 encapsulation dot1q 726
interface TenGigE0/0/0/6.736
 description T3 ASR9K-1
 vrf T3
 ipv4 point-to-point
 ipv4 address 10.8.78.82 255.255.255.252
 encapsulation dot1q 736
interface TenGigE0/0/0/6.746
 description T4 ASR9K-1
 vrf T4
 ipv4 point-to-point
 ipv4 address 10.8.78.114 255.255.255.252
 encapsulation dot1q 746
interface TenGigE0/0/0/6.756
 description T5 ASR9K-1
 vrf T5
 ipv4 point-to-point
 ipv4 address 10.8.78.146 255.255.255.252
 encapsulation dot1q 756
```

```
interface TenGigE0/0/0/6.786
 description GT ASR9K-1
 vrf GT
 ipv4 point-to-point
 ipv4 address 10.8.78.242 255.255.255.252
 encapsulation dot1q 786
interface TenGigE0/0/0/7
 description VXIaaS-ASR9K-1
 cdp
interface TenGigE0/0/0/7.717
 description T1 ASR9K-1
 vrf T1
 ipv4 point-to-point
 ipv4 address 10.8.78.22 255.255.255.252
 encapsulation dot1q 716
interface TenGigE0/0/0/7.727
 description T2 ASR9K-1
 vrf T2
 ipv4 point-to-point
 ipv4 address 10.8.78.54 255.255.255.252
 encapsulation dot1q 726
interface TenGigE0/0/0/7.737
 description T3 ASR9K-1
 vrf T3
 ipv4 point-to-point
 ipv4 address 10.8.78.86 255.255.255.252
 encapsulation dot1q 736
interface TenGigE0/0/0/7.747
 description T4 ASR9K-1
 vrf T4
 ipv4 point-to-point
 ipv4 address 10.8.78.118 255.255.255.252
 encapsulation dot1q 746
interface TenGigE0/0/0/7.757
 description T5 ASR9K-1
 vrf T5
 ipv4 point-to-point
 ipv4 address 10.8.78.150 255.255.255.252
 encapsulation dot1q 756
interface TenGigE0/0/0/7.787
 description GT ASR9K-1
 vrf GT
 ipv4 point-to-point
 ipv4 address 10.8.78.246 255.255.255.252
 encapsulation dot1q 786
rd-set 100:110
  end-set
rd-set 200:220
  end-set
rd-set 300:330
  end-set
rd-set 400:440
  end-set
rd-set 500:550
  end-set
rd-set 800:880
  end-set
route-policy all
  pass
  end-policy
route-policy GT-BGP
  pass
  end-policy
route-policy T1-BGP
```

```
  pass
  end-policy
route-policy T2-BGP
  pass
  end-policy
route-policy T3-BGP
  pass
  end-policy
route-policy T4-BGP
  pass
  end-policy
route-policy T5-BGP
  pass
  end-policy
route-policy GT-OSPF
  pass
  end-policy
route-policy T1-OSPF
  pass
  end-policy
route-policy T2-OSPF
  pass
  end-policy
route-policy T3-OSPF
  pass
  end-policy
route-policy T4-OSPF
  pass
  end-policy
route-policy T5-OSPF
  pass
  end-policy
router static
 vrf management
  address-family ipv4 unicast
   0.0.0.0/0 10.8.66.1
router ospf VXIaaS
 redistribute bgp 42 route-policy GT-BGP
 vrf GT
  router-id 8.8.8.2
  auto-cost reference-bandwidth 100000
  default-information originate
  area 0
   interface Loopback8
    network point-to-point
    passive enable
   interface TenGigE0/0/0/0.783
    network point-to-point
    neighbor 10.8.78.229
   interface TenGigE0/0/0/1.785
    network point-to-point
    neighbor 10.8.78.237
   interface TenGigE0/0/0/6.786
    network point-to-point
    neighbor 10.8.78.241
   interface TenGigE0/0/0/7.787
    network point-to-point
    neighbor 10.8.78.245
 vrf T1
  router-id 1.1.1.2
  auto-cost reference-bandwidth 100000
  default-information originate
  redistribute bgp 42 route-policy T1-BGP
  area 0
```

```
  interface Loopback1
   network point-to-point
   passive enable
  interface TenGigE0/0/0/0.713
   network point-to-point
   neighbor 10.8.78.5
  interface TenGigE0/0/0/1.715
   network point-to-point
   neighbor 10.8.78.13
  interface TenGigE0/0/0/6.716
   network point-to-point
   neighbor 10.8.78.17
  interface TenGigE0/0/0/7.717
   network point-to-point
   neighbor 10.8.78.21
vrf T2
 router-id 2.2.2.2
 auto-cost reference-bandwidth 100000
 default-information originate
 area 0
  interface Loopback2
   network point-to-point
   passive enable
  interface TenGigE0/0/0/0.723
   network point-to-point
  interface TenGigE0/0/0/1.725
   network point-to-point
   neighbor 10.8.78.45
  interface TenGigE0/0/0/6.726
   network point-to-point
   neighbor 10.8.78.49
  interface TenGigE0/0/0/7.727
   network point-to-point
   neighbor 10.8.78.53
vrf T3
 router-id 3.3.3.2
 auto-cost reference-bandwidth 100000
 default-information originate
 area 0
  interface Loopback3
   network point-to-point
   passive enable
  interface TenGigE0/0/0/0.733
   network point-to-point
   neighbor 10.8.78.69
  interface TenGigE0/0/0/1.735
   network point-to-point
   neighbor 10.8.78.77
  interface TenGigE0/0/0/6.736
   network point-to-point
   neighbor 10.8.78.81
  interface TenGigE0/0/0/7.737
   network point-to-point
   neighbor 10.8.78.85
vrf T4
 router-id 4.4.4.2
 auto-cost reference-bandwidth 100000
 default-information originate
 area 0
  interface Loopback4
   network point-to-point
   passive enable
  interface TenGigE0/0/0/0.743
   network point-to-point
```

```
    neighbor 10.8.78.101
   interface TenGigE0/0/0/1.745
    network point-to-point
    neighbor 10.8.78.109
   interface TenGigE0/0/0/6.746
    network point-to-point
    neighbor 10.8.78.113
   interface TenGigE0/0/0/7.747
    network point-to-point
    neighbor 10.8.78.117
 vrf T5
  router-id 5.5.5.2
  auto-cost reference-bandwidth 100000
  default-information originate
  area 0
   interface Loopback5
    network point-to-point
    passive enable
   interface TenGigE0/0/0/0.753
    network point-to-point
    neighbor 10.8.78.133
   interface TenGigE0/0/0/1.755
    network point-to-point
    neighbor 10.8.78.141
   interface TenGigE0/0/0/6.756
    network point-to-point
    neighbor 10.8.78.145
   interface TenGigE0/0/0/7.757
    network point-to-point
    neighbor 10.8.78.149
router bgp 42
 address-family ipv4 unicast
 address-family vpnv4 unicast
 vrf GT
  rd 800:880
  bgp router-id 8.8.8.2
  address-family ipv4 unicast
   redistribute ospf VXIaaS route-policy GT-OSPF
  neighbor 192.168.200.5
   remote-as 40
   address-family ipv4 unicast
    route-policy all in
    route-policy all out
 vrf T1
  rd 100:110
  bgp router-id 1.1.1.2
  address-family ipv4 unicast
   redistribute ospf VXIaaS route-policy T1-OSPF
  neighbor 10.8.2.5
   remote-as 20
   address-family ipv4 unicast
    route-policy all in
    route-policy all out
  neighbor 10.8.2.69
   remote-as 20
   address-family ipv4 unicast
    route-policy all in
    route-policy all out
 vrf T2
  rd 200:220
  bgp router-id 2.2.2.2
  address-family ipv4 unicast
   redistribute ospf VXIaaS route-policy T2-OSPF
  neighbor 10.8.2.13
```

```
  remote-as 20
  address-family ipv4 unicast
   route-policy all in
   route-policy all out
 neighbor 10.8.2.77
  remote-as 20
  address-family ipv4 unicast
   route-policy all in
   route-policy all out
vrf T3
 rd 300:330
 bgp router-id 3.3.3.2
 address-family ipv4 unicast
  redistribute ospf VXIaaS route-policy T3-OSPF
 neighbor 10.8.2.21
  remote-as 20
  address-family ipv4 unicast
   route-policy all in
   route-policy all out
 neighbor 10.8.2.85
  remote-as 20
  address-family ipv4 unicast
   route-policy all in
   route-policy all out
vrf T4
 rd 400:440
 bgp router-id 4.4.4.2
 address-family ipv4 unicast
  redistribute ospf VXIaaS route-policy T4-OSPF
 neighbor 10.8.2.29
  remote-as 20
  address-family ipv4 unicast
   route-policy all in
   route-policy all out
 neighbor 10.8.2.93
  remote-as 20
  address-family ipv4 unicast
   route-policy all in
   route-policy all out
vrf T5
 rd 500:550
 bgp router-id 5.5.5.2
 address-family ipv4 unicast
  redistribute ospf VXIaaS route-policy T5-OSPF
 neighbor 10.8.2.37
  remote-as 20
  address-family ipv4 unicast
   route-policy all in
   route-policy all out
 neighbor 10.8.2.101
  remote-as 20
  address-family ipv4 unicast
   route-policy all in
   route-policy all out
ssh server vrf management
end
```

8 Related Documents

The following links provide more detailed information regarding:

- Cisco VMDC
- Cisco UCS
- Cisco Nexus Switch
- Cisco Catalyst 6500 Switch
- Cisco ASR
- Cisco ASA
- Desktone