Citrix XenDesktop 7.1 on Microsoft Hyper-V Server 2012 R2 on Nutanix Virtual Computing Platform

Solution Design

Citrix Validated Solutions

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TABLE OF CONTENTS

SECTION 1: EXECUTIVE SUMMARY

Project Overview

Reference Architecture

In order to facilitate rapid and successful deployment of the Citrix XenDesktop FlexCast models, Citrix Consulting APAC have built and tested a solution using the components described in this document. The Citrix Validated Solution ('CVS') provides prescriptive guidance for these components including design, configuration and deployment settings thereby allowing customers to quickly deploy a desktop virtualization solution using Citrix XenDesktop.

Validation was performed by extensive testing using Login VSI to simulate real-world workloads and determine optimal configuration for the integration of components that make up the overall solution.

Audience

This reference architecture document is created as part of a Citrix Validated Solution and is intended to describe the detailed architecture and configuration of the components contained within. Readers of this document should be familiar with Citrix XenDesktop, its related technologies and the foundational components, Nutanix Virtual Computing Platform ('Nutanix'), Arista Networks ('Arista') hardware components and Microsoft Hyper-V Server® 2012 R2.

Purpose

The purpose of this document is to provide design information that describes the architecture for this Citrix Validated Solution which is based on Citrix Hosted Shared Desktop (HSD) and Citrix Hosted Virtual Desktop (HVD) FlexCast models. The solution is built on the Nutanix Virtual Computing Platform, NX-3060 nodes running Microsoft Hyper-V Server® 2012 R2 to support the virtualised environment.

Architecture Overview

This Citrix Validated Solution and its components was designed, built and validated to support two distinct Citrix virtual desktop types. The architecture for each desktop type is described to support up to 1,000 and beyond user desktop sessions:

- **Hosted Shared Desktops**. Shared user sessions running XenDesktop Hosted Shared Desktops on Windows Server 2008 R2 Remote Desktop Session Hosts or
- **Hosted Virtual Desktops**. Individual user sessions running XenDesktop Hosted Virtual Desktops on Windows 7 Enterprise x64.

Each of these desktop types is described in the Citrix FlexCast model operating as virtual machine instances on Microsoft Hyper-V Server® 2012 R2. This architecture is a single, self-supporting modular component identified as a Pod, described to support up to 1,000 users sessions allowing customers to consistently build and deploy scalable environments. Additional pods may be deployed thus scaling out the proposed architecture beyond 1,000 seats.

Citrix Virtual Desktop Types

This Citrix Validated Solution document references Citrix Hosted Shared Desktops and Citrix Hosted Virtual Desktops. Both types of virtual desktops are discussed below for reference. For more information, refer to Citrix FlexCast delivery methods http://flexcast.citrix.com/

- **Hosted Shared Desktop (HSD).** A Windows Remote Desktop Session (RDS) Host using Citrix XenDesktop to deliver Hosted Shared Desktops in a locked down, streamlined and standardised manner with a core set of applications. Using a published desktop on to the Remote Desktop Session Host, users are presented a desktop interface similar to a Windows 7 “look and feel”. Each user runs in a separate session on the RDS server.
- **Hosted Virtual Desktop (HVD) aka Hosted VDI.** A Windows 7 desktop instance running as a virtual machine where a single user connects to the machine remotely. Consider this as 1:1 relationship of one user to one desktop. There are differing types of the hosted virtual desktop model (existing, installed, pooled, dedicated and streamed). This document exclusively refers to both Pooled and Persistent (Dedicated) HVDs.

This document will discuss the delivery of non-persistent or state-less desktop types - Hosted Shared Desktops and Hosted Virtual Desktops (pooled desktops). Throughout this document nomenclature may reference the FlexCast model as; “<FlexCast model>” which should be substituted for either HSD or HVD as appropriate to the design under consideration.

The Pod Concept

The term “pod” is referenced throughout this solution design. In the context of this document a pod is a known entity, an architecture that has been pre-tested and validated. A pod consists of the hardware and software components required to deliver 1,000 virtual desktops using either HSD or HVD FlexCast models.

For clarity this document does not attempt to describe combining both FlexCast models, it specifically discusses each type as s single entity of up to 1,000 desktops.

Justification and Validation

The construct of this Citrix Validated Solution is based on many decisions that were made during validation testing. Testing was carried out using the Login VSI virtual Session Indexer (VSI), an industry standard tool for user / session benchmarking. Login VSI allows comparisons of platforms and technologies under the same repeatable load. The “Medium” VSI workload is expected to approximate the average office worker during normal activities and was the workload used throughout testing.

- http://www.loginvsi.com/

Note. All workloads were tested using the XenDesktop Template Policy “High Server Scalability” running in “Legacy Graphics mode” therefore the Bill of Materials described for each FlexCast model within this document are based on the density of users with these policy settings in place. Using these Citrix Policies allows the greatest host density for each FlexCast model.

In conjunction with Login VSI, further Validation of the end user experience during test load scenarios was validated using Liquidware Labs™ Stratusphere™ UX. Stratusphere™ UX is a comprehensive set of monitoring, performance validation and diagnostics tools.

- http://www.liquidwarelabs.com/products/stratusphere-ux

Citrix Validated Solution Overview

The *Illustration* below depicts the layers of the Citrix XenDesktop Hosted Shared Desktop technology stack utilised in the solution.

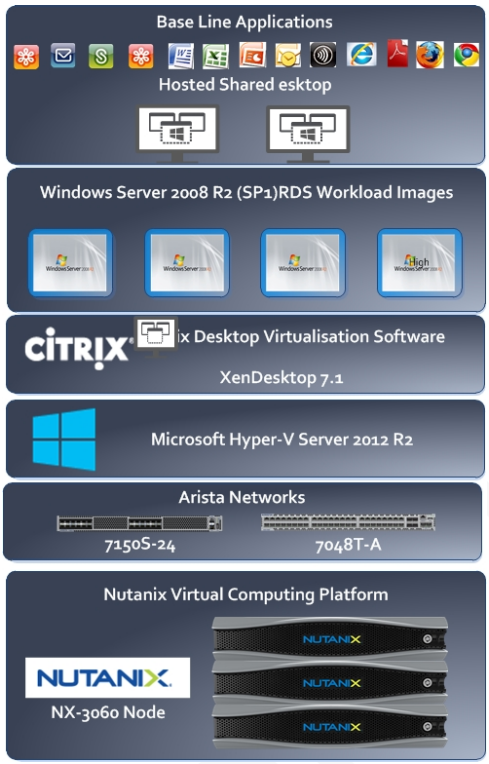

Figure 1. Citrix Validated Solution Stack depicting HSD Workloads

The *Illustration* below depicts the layers of the Citrix XenDesktop Hosted Virtual Desktop technology stack utilised in the solution.

Figure 2. Citrix Validated Solution Stack depicting HVD Workloads

The *Illustrations* below depict the combined physical and logical view of the scale out architecture for both HSD and HVD platforms using the Nutanix Virtual Computing Platform.

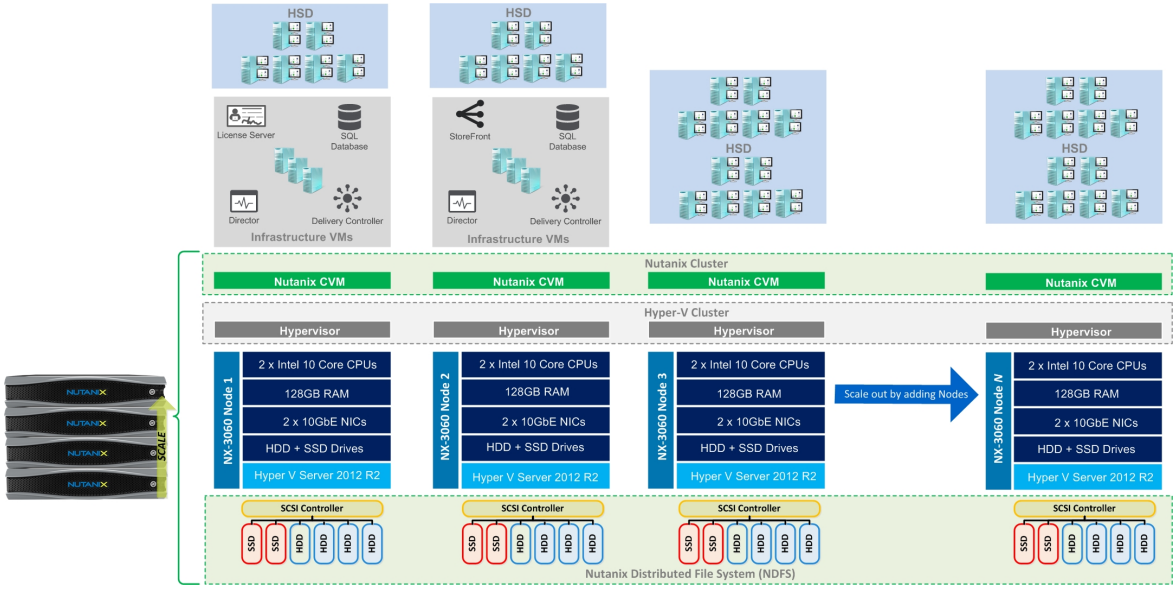

Figure 3. Logical View of the HSD Solution

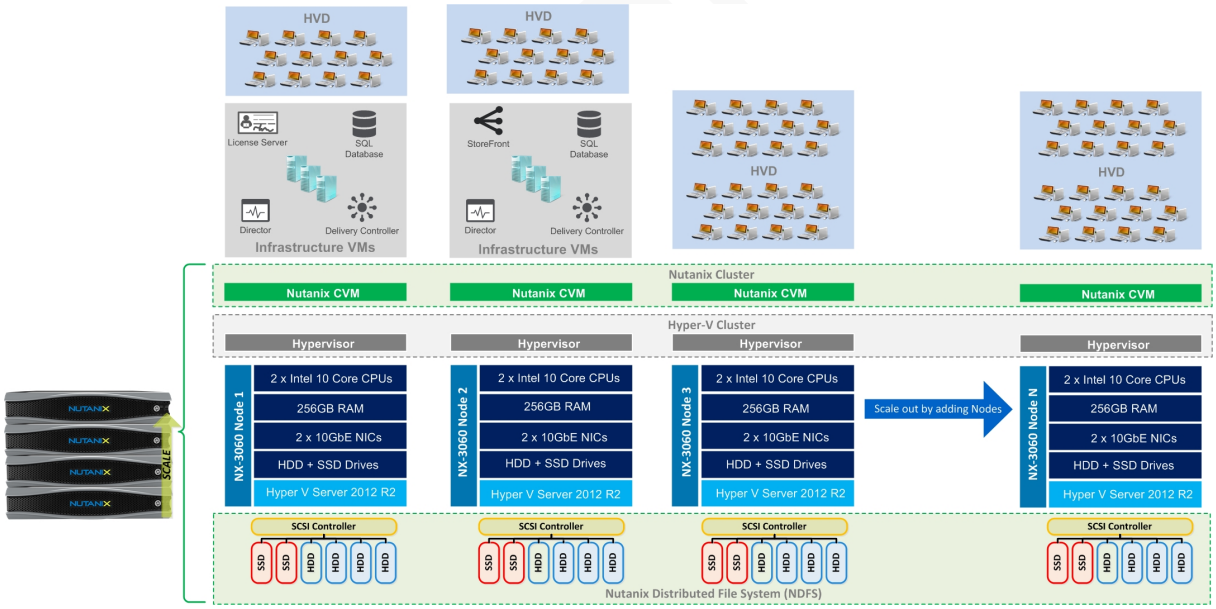

Figure 4. Logical View of the HVD Solution

- **Citrix XenDesktop.** Two virtualised Desktop Delivery Controller servers will be deployed to support the XenDesktop Site. A single XenDesktop Site will be utilised to manage the initial desktop pod.
- **Virtual Desktops.** This solution will focus on the delivery of the two discrete virtual desktops types:

- **Hosted Virtual Desktops** (HVD). Describing the delivery of 1,000 Pooled desktops or Persistent (Dedicated) Windows 7 virtual desktops powered by Citrix XenDesktop 7.1.
- **Hosted Shared Desktops** (HSD). Describing the delivery of 1,000 Shared virtual desktop based on Microsoft Windows Server 2008 R2 Remote Desktop Session host workloads powered by Citrix XenDesktop 7.1.

- **Microsoft Hyper-V Server 2012 R2 (Hyper-V).** The virtualised desktop and server instances are hosted on Microsoft Hyper-V Server 2012® R2 Server Core. Hyper-V was deployed onto the Nutanix nodes through the Nutanix Foundation Deployment Tool and configured into a Fail-Over cluster to support Live Migration, HA and other cluster functions.
- **Nutanix Virtual Computing Platform**. The web-scale Nutanix solution is a converged storage and compute solution, which leverages local hardware components and creates a distributed platform for virtualization. The modular building-block design allows customers to start with small deployments and scale out incrementally into large cluster installations.

  The Nutanix Virtual Computing Platform integrates multiple high-performance compute resources with enterprise-class SSD and HDD storage controlled by the Nutanix Controller VM (CVM) in a cost-effective 2U appliance, removing the need for network-based storage architecture, such as a storage area network (SAN) or network-attached storage (NAS). Nutanix clusters can be scaled without downtime by simply adding additional Nutanix nodes. The additional compute and storage are automatically added to the virtualization and storage pools; no additional configuration or tuning is needed.
- **Nutanix NX-3060 Node.** The underlying compute, network and storage hardware is based on the Nutanix NX-3060 node. Each node is equipped with dual socket 10-core Intel Xeon Ivy Bridge CPU processors, between 128-256GB RAM, a pair of 10GbE network adapters and local storage consisting of SSD and HDD drives. The NX-3000 series solution is a bundled hardware and software appliance which houses virtual computing nodes in a 2U rack unit footprint. Each node runs Microsoft Windows Server 2012 R2 (Server Core and Data Center are supported) with Hyper-V Server 2012 R2 role enabled and the Nutanix Controller VM (CVM).
- **Nutanix Controller Virtual Machine ('CVM').** The Nutanix CVM is what runs on the hypervisor, consolidating and controlling storage across the entire Nutanix cluster. It serves all of the storage I/O operations for the Hyper-V 2012 R2 hypervisor and all virtual machines running on that host over SMB3.
- **Arista Networks Ethernet Switching.** Arista Networks provides the Ethernet switching capability within this platform. The entire Arista portfolio features data centre switches that are inherently suitable to the types of workloads expected by a Citrix XenDesktop deployment. In this solution, the Arista 7150S-24 switch has been chosen to provide top-of-rack connectivity with 24 ports of 10GbE. The out of band connectivity required for Nutanix node management (IPMI), is provided by an Arista 7048T-A switch with 48 ports of 100/1000Mbps Ethernet.
- **Virtual Desktop Provisioning.** This document describes the use of Citrix Machine Creation Services ('MCS') for the provisioning of HSD and HVD guest workloads using a predefined master image containing the optimised operating system and Tier-1 application set.
- **Applications.** Tier-2[1] applications which may include line of business or customer specific applications that are not embedded as part of the master disk image may be delivered using Citrix XenDesktop RDS workloads or Microsoft App-V[2].

1 The solution design for Tier-2 applications delivered by Citrix XenDesktop or Citrix XenApp is out of scope for this document.

2 The solution design of Microsoft App-V components is out of scope for this document.

- **Citrix StoreFront.** Virtualised StoreFront servers will be deployed to provide application and desktop resource enumeration.
- **Citrix Performance Management**. Citrix Director and Citrix EdgeSight will provide monitoring capabilities into the virtual desktops and user sessions.
- **Supporting Infrastructure.** The following components are assumed to exist within the customer environment and are required infrastructure components:
    - Microsoft Active Directory Domain Services.
    - A suitable Microsoft SQL database platform to support the solution database requirements[3].
    - Licensing servers to provide Microsoft licenses are assumed to exist.
    - Public Key Infrastructure (PKI) certification services are assumed to exist.
    - CIFS SMB File sharing is required to support User profile data. This can be provisioned as part of the solution using Windows 2012 R2 File Services.
    - DHCP Services with sufficient IP addresses to support the proposed virtual desktop workloads. This can be provisioned as part of the solution using the Windows Server 2012 R2 DHCP Role.

This design document will focus on the desktop virtualisation components which include the desktop workload, desktop delivery mechanism, hypervisor, hardware, network and storage platforms.

[3] This document provides sample sizing guidelines and the licensing requirements for the databases used in this Citrix Validated Solution, however it does not attempt to provide design guidelines for Microsoft SQL Server. The design and implementation for a highly available Microsoft SQL Server platform is required although considered out of scope for this design document.

The Citrix Validated Solution architecture breaks the design into a number of distinct layers, discussed below:

- User Layer[4]. This layer details the user segments defined during the projects "assess phase". Users are grouped based on their network connectivity to the data centre, recommended end point devices, security requirements, data storage needs and virtual workforce needs.
- Access Layer. This layer describes how the user layer will connect to their desktop, which is hosted in the desktop layer of the architecture. Local users will connect directly to StoreFront while remote users connect via a set of firewalls that protect the internal environment. To bridge the firewalls, remote users will connect with an SSL-VPN device (Citrix Access Gateway).
- Desktop Layer. This layer contains the user's virtual desktop, broken down into FlexCast models. It is subdivided into three components, Within each sub-layer, specifics are documented detailing the operating system, assigned policies, profile design and application requirements:
    - User Personalisation
    - Applications
    - Master Image
- Control Layer. This layer is responsible for managing and maintaining all other layers. It provides details on the controller requirements to support the entire solution. The Control layer is broken down into the following sub sections:
    - Infrastructure. The Infrastructure section is responsible for providing the underlying resources to support each component. These resources include Active Directory, database requirements and license servers.
    - Desktop Controllers. The Desktop Controllers section provides details on the components required to support the desktop layer, which include XenDesktop.
    - Access Controllers. The Access Controllers section focuses on the required versions and virtualisation resources.
- Hypervisor Layer. The section described the configuration for Microsoft Hyper-V Server 2012 R2. Hyper-V is a "Type 1" hypervisor that runs directly on the hardware resources described in the Hardware Layer.
- Network. This section defines the physical network switching and logical connectivity requirements to support the solution.
- Hardware Layer. This layer is responsible for the physical devices required to support the entire solution. It includes servers, processors, memory and storage devices. This layer is broken down into the physical and logical components and provides the Bill of Materials (BoM) to deploy the entire solution.

4 User assessment in the context of this document is for reference only. User definition and segmentation for VDI desktop types is out of scope for this document.

The *illustration* below describes the distinct layers of the architecture:

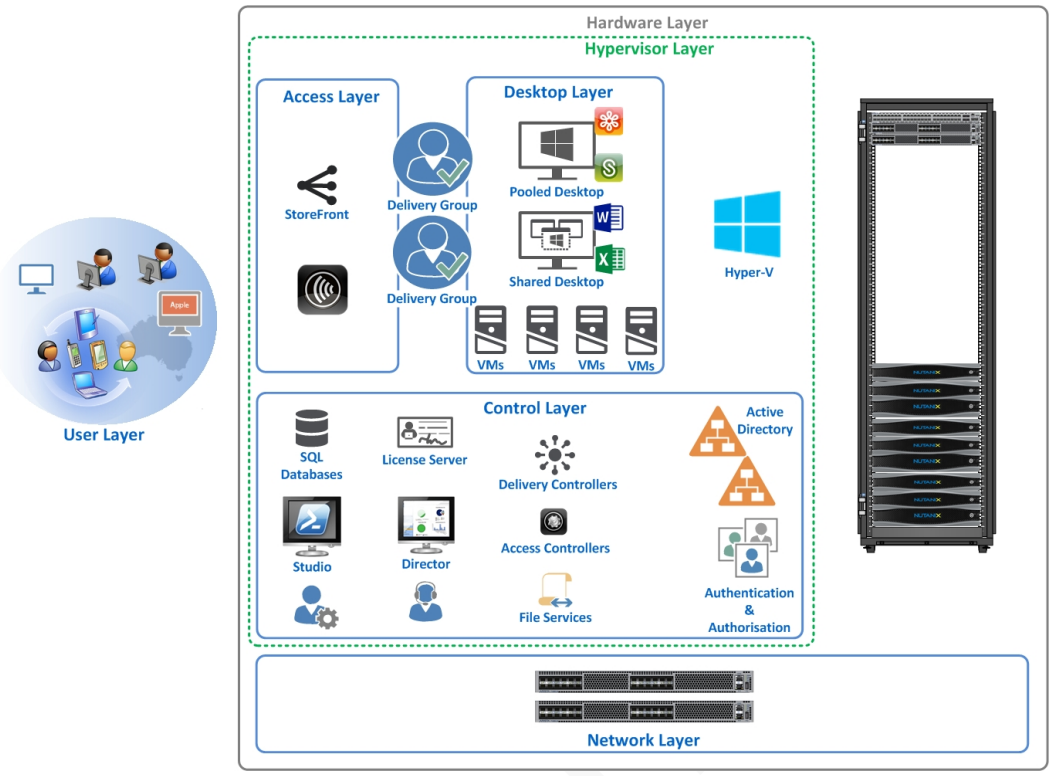

Figure 5. Architecture Layered View

Design Recommendations

Assumptions:

The following assumptions have been made:

- Required Citrix and Microsoft licenses and agreements are available.
- Required power, cooling, rack and data centre space is available.
- No network constraints that would prevent the successful deployment of this design.
- Microsoft Windows Active Directory Domain services are available.
- Microsoft SQL Database platform is available.
- A current and supported version of Citrix Receiver must be deployed to ensure all features and components of the solution are at a supported level, refer to the following link for the latest Citrix Receiver Downloads.
- The User layer in the context of this document is for reference only. User analysis, definition and segmentation for the use of VDI desktop types is out of scope for this document.

Logical Architecture Overview

This section discusses the logical architecture and concepts for the remainder of this document.

From an architectural perspective Hyper-V will be deployed onto the aforementioned hardware (Hardware Layer) with the infrastructure servers (Control layer) and virtual desktops (Desktop Layer) deployed as Hyper-V virtual machine instances.

From a physical hardware perspective each server node will be configured identically as per the recommended Nutanix NX-3060 Bill of Materials. From a logical perspective the hosts for each desktop can be defined as follows.

- A minimum of three sever nodes is required to establish a Nutanix Cluster. The three nodes running Hyper-V are utilised for hosting both the Citrix Infrastructure Server virtual machines and either HSD or HVD desktop workloads.
- The platform can be scaled-out to support additional desktop and user capacity by simply adding Nutanix nodes to the existing Hyper-V and Nutanix cluster. Scaling out the solution can be achieved by incremental modular scale out by adding a node or by 1,000 user pods, which both allow for granular scale out to precisely meet the capacity demands.

Nutanix Node

The *Illustration* below depicts the logical architecture of a node from Nutanix Virtual Computing Platform, which consists of the Nutanix CVM virtual appliance running on Hyper-V 2012 R2 which in turn leverages high density compute, memory, 10GbE network interface adapters and local solid state drive and hard disk drives.

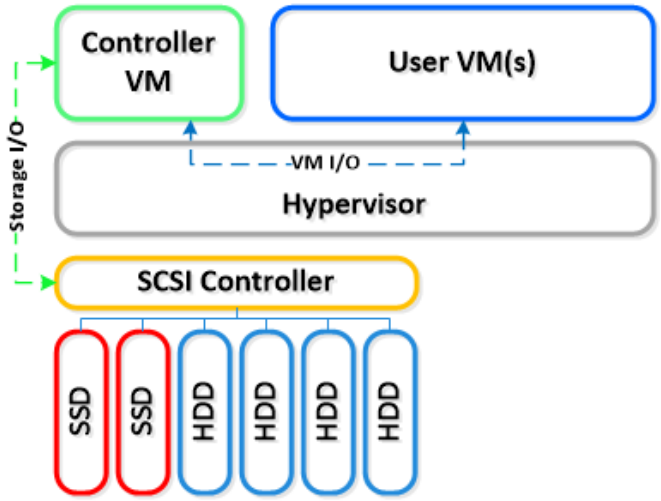

Figure 6. Logical View of a Nutanix Node

Pod of 1,000 HSD Users

The logical and physical components that make up the platform to deliver a 1,000 user Hosted Shared Desktop solution are described below:

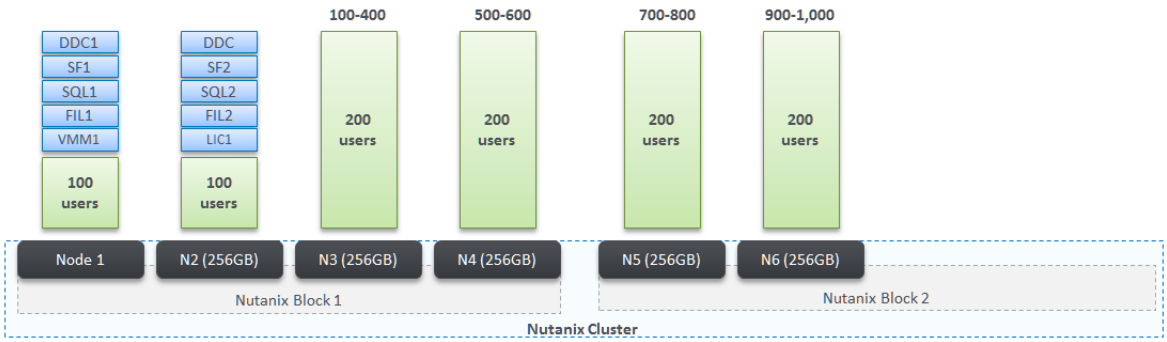

Figure 7. 1,000 HSD Users - Virtual Machine allocation in relation to Nutanix Node

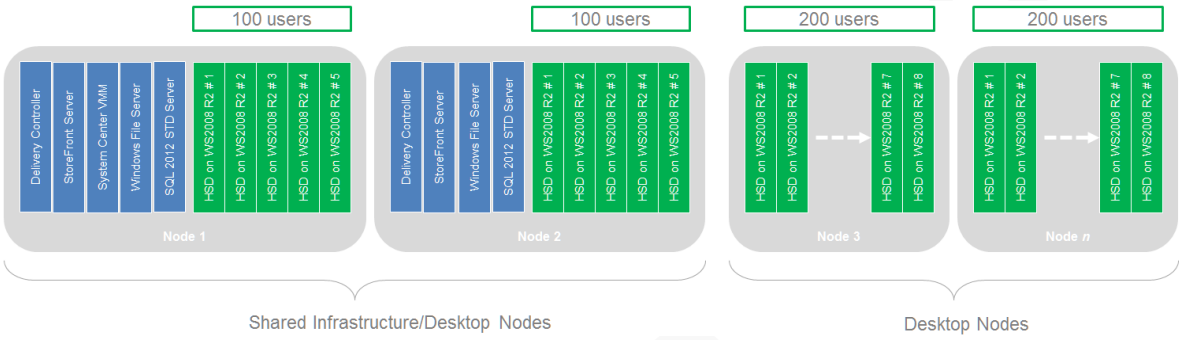

Figure 8. HSD – VM allocation and scale out

Component	Qty
# of Citrix XenDesktop Enterprise Users	Up to 1,000
# of XenDesktop Sites	1
# of XenDesktop Delivery Controllers	2
# of StoreFront Servers	2
# of Citrix/Microsoft License Server[5]	1
# of Microsoft Hyper-V Cluster	1
# of Nutanix Cluster	1
# of MS SCVMM Servers	1
# of Windows File Severs (DFS-R/N in Active/Passive setup)	2
# of SQL 2012 Standard Servers (DB Mirror in Active/Passive)	2
# of NX-3060 Nodes running MS Hyper-V 2012 R2	6
# of XenApp RDS (HSD) Windows Server 2008 R2 Server VMs	40
# of Arista 7150S-24 10GbE ToR Switch	2
# of Arista 7048T-A 100/1000 Mbps Switch	1

Table 1. 1,000 User HSD Pod Detail

[5] Optional. License services can be optionally deployed onto existing servers to conserve on server resources.

Pod of 1,000 HVD Users

The logical and physical components that make up the platform to deliver a 1,000 user Hosted Virtual Desktop solution are described below:

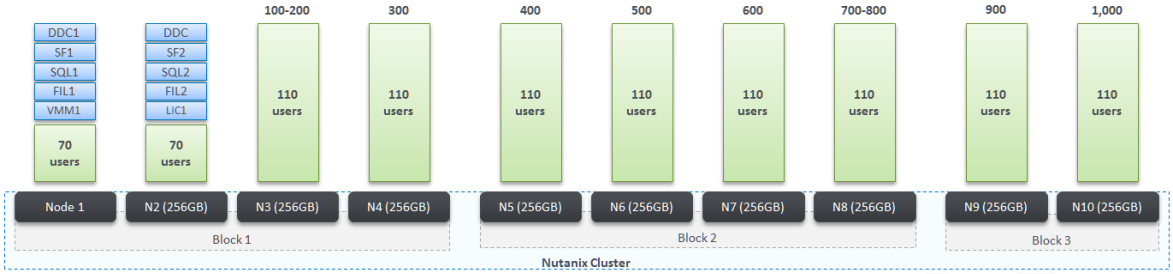

Figure 9. 1,000 HVD users - Virtual Machine allocation in relation to Nutanix Node

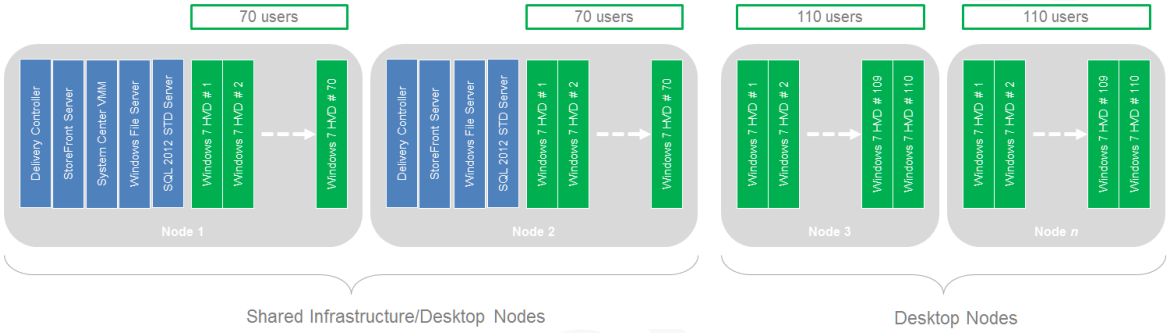

Figure 10. HVD – VM allocation and scale out

Component	Qty
# of Citrix XenDesktop Enterprise Users	Up to 1,020
# of XenDesktop Sites	1
# of XenDesktop Delivery Controllers	2
# of StoreFront Servers	2
# of Citrix/Microsoft License Server[6]	1
# of Microsoft Hyper-V Cluster	1
# of Nutanix Cluster	1
# of MS SCVMM Servers	1
# of Windows File Severs (DFS-R/N in Active/Passive setup)	2
# of SQL 2012 Standard Servers (DB Mirror in Active/Passive)	2
# of NX-3060 Nodes running MS Hyper-V 2012 R2	10
# of Windows 7 Enterprise HVD (virtual desktops)	1,020
# of Arista 7150S-24 10GbE ToR Switch	2
# of Arista 7048T-A 100/1000 Mbps Switch	1

Table 2. 1,000 User HVD Pod Detail

[6] Optional. License services can be optionally deployed onto existing servers to conserve on server resources.

Scale Out Guidance for HSD

This section outlines the sizing metrics applicable to the Nutanix NX-3060 nodes, network switch ports, Hyper-V hosts, Infrastructure server VMs and the required Citrix and Microsoft licenses[7] to stand up the HSD solution based on the suggested scale-out increment.

The solution can be scaled out incrementally by adding additional server nodes.

Notes on Microsoft Licensing used as per the below samples[8].

- **# of MS Core Infrastructure Suite (CIS) Standard.** MS CIS includes System Center 2012 R2 Standard and licenses for 2 x Windows Server 2012 Standard VMs or Operating System Environment). Refer to http://www.microsoft.com/licensing/about-licensing/SystemCenter2012-R2.aspx
- **# of MS SQL Server 2012 Standard Server.** Assumes SQL Server is licensed as a 2 VCPU (v-cores) virtual machine with MS Software Assurance. SQL Server license requires minimum of 4 core licenses. Active-Passive SQL Server deployment means no additional licenses are required for secondary passive SQL Server. Refer to http://www.microsoft.com/licensing/about-licensing/sql2014.aspx

Scenario: 3 x Nodes (Minimum Requirement)

Hardware Components	Qty	Infrastructure Components	Qty
# of NX-3060 nodes (128GB)	3[9]	# of SCVMM server	1
# of RU (Nutanix nodes)	2	# of Hyper-V hosts	3
# of 10GbE Ports (Hyper-V)	6	# of Hyper-V Cluster	1
# of 1GbE Ports (IPMI)	3	# of Nutanix Cluster	1
Total # of 10GbE Ports	6	# of XenDesktop Sites	1
Total # of 1GbE Ports	3	# of HSD users	400
# of Arista 7150S-24 10GbE Switch	2	# of HSD Windows Server VMs	16
# of Arista 7048T-A Switch	1		

Table 3. Hardware Component Breakdown - 3 x Nodes

Citrix/Microsoft License Components	Qty
# of Citrix XenDesktop Enterprise User/Device	400
# of MS Remote Desktop Services CALs	400
# of MS Core Infrastructure Suite (CIS) Standard	13
# of MS SQL Server 2012 Standard Server	1

Table 4. Component Breakdown - 3 x Nodes

[7] Each customer will have different Citrix and Microsoft license agreements and as such should be factored into the final configuration.
[8] Actual customer licensing requirements may differ based on their situation, agreements or other factors.
[9] Minimum number of nodes within a Nutanix Cluster running Nutanix NOS 3.5

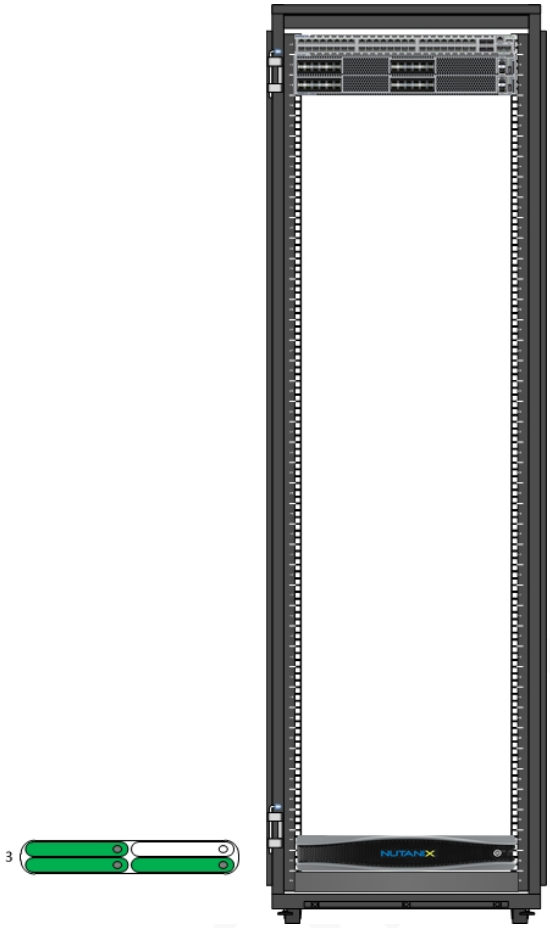

Figure 11. Rack Layout – 3 x Nodes

Scenario: 4 x Nodes (Single Block)

Hardware Components	Qty	Infrastructure Components	Qty
# of NX-3060 nodes (128GB)	4	# of SCVMM server	1
# of RU (Nutanix nodes)	2	# of Hyper-V hosts	4
# of 10GbE Ports (Hyper-V)	8	# of Hyper-V Cluster	1
# of 1GbE Ports (IPMI)	4	# of Nutanix Cluster	1
Total # of 10GbE Ports	8	# of XenDesktop Sites	1
Total # of 1GbE Ports	4	# of HSD users	600
# of Arista 7150S-24 10GbE Switch	2	# of HSD Windows Server VMs	24
# of Arista 7048T-A Switch	1		

Table 5. Hardware Component Breakdown - 4 x Nodes

Citrix/Microsoft License Components	Qty
# of Citrix XenDesktop Enterprise User/Device	600
# of MS Remote Desktop Services CALs	600
# of MS Core Infrastructure Suite (CIS) Standard	17
# of MS SQL Server 2012 Standard Server	1

Table 6. Component Breakdown - 4 x Nodes

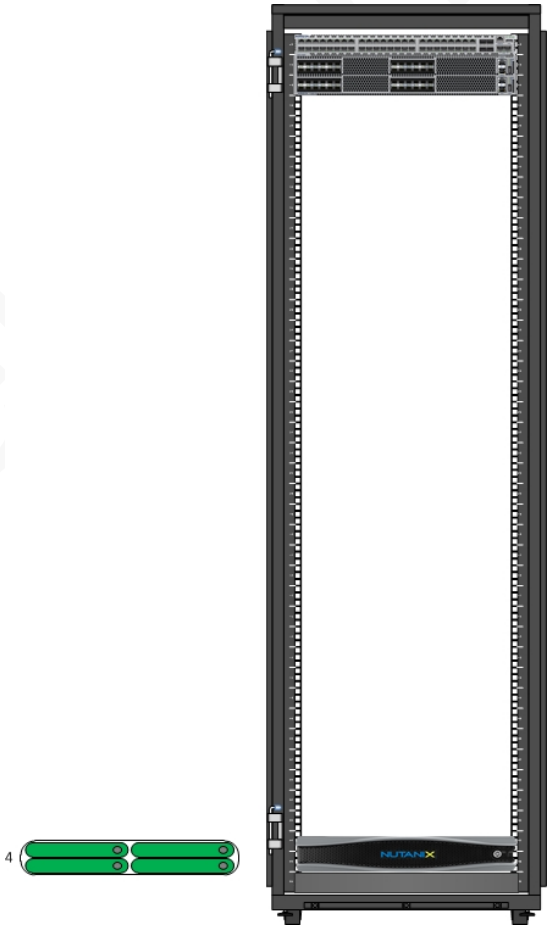

Figure 12. Rack Layout – 4 x Nodes

Scenario: 6 x Nodes (1½ Block)

Hardware Components	Qty	Infrastructure Components	Qty
# of NX-3060 nodes (128GB)	6	# of SCVMM server	1
# of RU (Nutanix nodes)	4	# of Hyper-V hosts	6
# of 10GbE Ports (Hyper-V)	12	# of Hyper-V Cluster	1
# of 1GbE Ports (IPMI)	6	# of Nutanix Cluster	1
Total # of 10GbE Ports	12	# of XenDesktop Sites	1
Total # of 1GbE Ports	6	# of HSD users	1,000
# of Arista 7150S-24 10GbE Switch	2	# of HSD Windows Server VMs	40
# of Arista 7048T-A Switch	1		

Table 7. Hardware Component Breakdown - 6 x Nodes

Citrix/Microsoft License Components	Qty
# of Citrix XenDesktop Enterprise User/Device	1,000
# of MS Remote Desktop Services CALs	1,000
# of MS Core Infrastructure Suite (CIS) Standard	25
# of MS SQL Server 2012 Standard Server	1

Table 8. Component Breakdown - 6 x Nodes

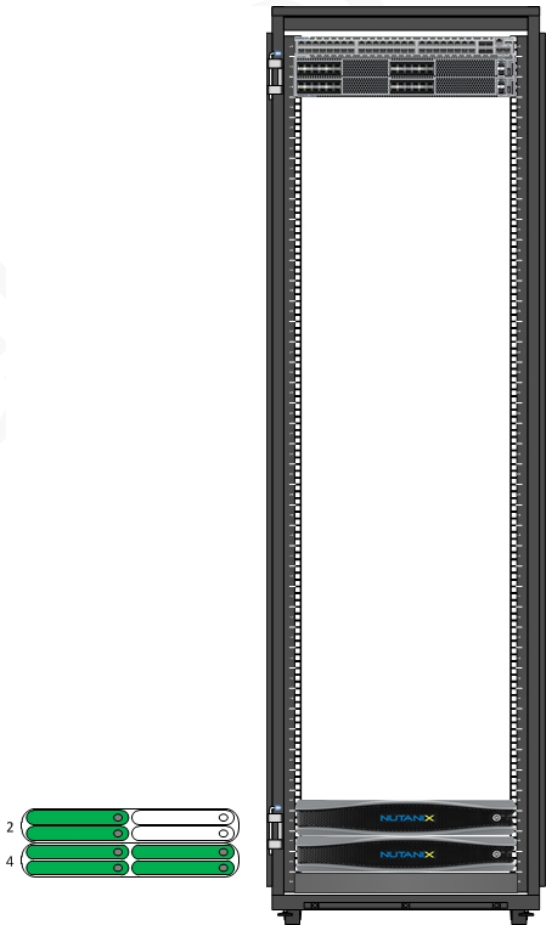

Figure 13. Rack Layout – 6 x Nodes

Scenario: 8 x Nodes (Two Full Blocks)

Hardware Components	Qty	Infrastructure Components	Qty
# of NX-3060 nodes (128GB)	8	# of SCVMM server	1
# of RU (Nutanix nodes)	4	# of Hyper-V hosts	8
# of 10GbE Ports (Hyper-V)	16	# of Hyper-V Cluster	1
# of 1GbE Ports (IPMI)	8	# of Nutanix Cluster	1
Total # of 10GbE Ports	16	# of XenDesktop Sites	1
Total # of 1GbE Ports	8	# of HSD users	1,400
# of Arista 7150S-24 10GbE Switch	2	# of HSD Windows Server VMs	56
# of Arista 7048T-A Switch	1		

Table 9. Hardware Component Breakdown - 8 x Nodes

Citrix/Microsoft License Components	Qty
# of Citrix XenDesktop Enterprise User/Device	1,400
# of MS Remote Desktop Services CALs	1,4,00
# of MS Core Infrastructure Suite (CIS) Standard	33
# of MS SQL Server 2012 Standard Server	1

Table 10. Component Breakdown - 8 x Nodes

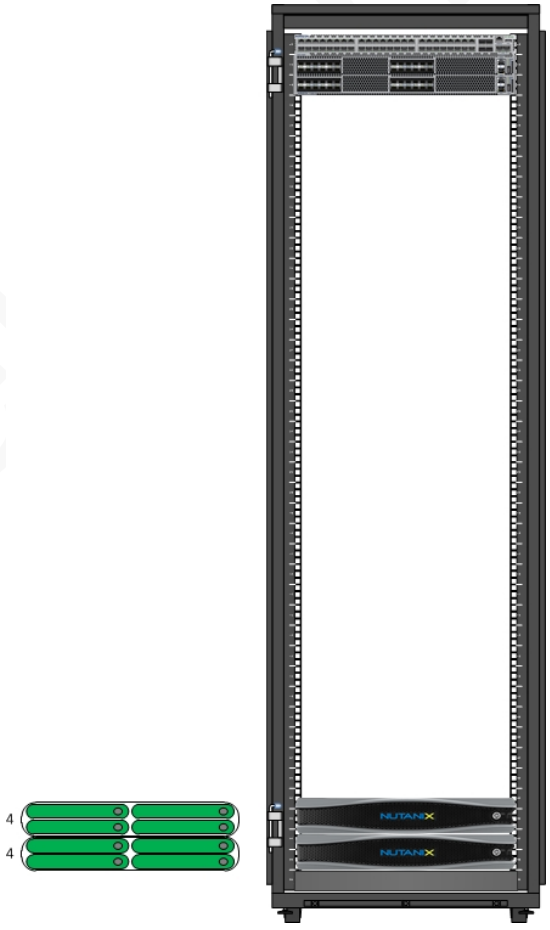

Figure 14. Rack Layout – 8 x Nodes

Scale Out Guidance for HVD

This section outlines the sizing metrics applicable to the Nutanix NX-3060 nodes, network switch ports, Hyper-V hosts, Infrastructure server VMs and the required Citrix and Microsoft licenses[10] to stand up the HVD solution based on the suggested scale-out increment.

The solution can be scaled out incrementally by adding additional server nodes.

Notes on Microsoft Licensing used as per the below samples[11].

- **# of MS Core Infrastructure Suite (CIS) Standard.** MS CIS includes System Center 2012 R2 Standard and licenses for 2 x Windows Server 2012 Standard VMs or Operating System Environment). Refer to http://www.microsoft.com/licensing/about-licensing/SystemCenter2012-R2.aspx
- **# of MS SQL Server 2012 Standard Server.** Assumes SQL Server is licensed as a 2 VCPU (v-cores) virtual machine with MS Software Assurance. SQL Server license requires minimum of 4 core licenses. Active-Passive SQL Server deployment means no additional licenses are required for secondary passive SQL Server. Refer to http://www.microsoft.com/licensing/about-licensing/sql2014.aspx

Scenario: 3 x Nodes (Minimum Requirement)

Hardware Components	Qty	Infrastructure Components	Qty
# of NX-3060 nodes (256GB)	3	# of SCVMM server	1
# of RU (Nutanix nodes)	2	# of Hyper-V hosts	3
# of 10GbE Ports (Hyper-V)	6	# of Hyper-V Cluster	1
# of 1GbE Ports (IPMI)	3	# of Nutanix Cluster	1
Total # of 10GbE Ports	6	# of XenDesktop Sites	1
Total # of 1GbE Ports	3	# of HVD users	250
# of Arista 7150S-24 10GbE Switch	2	# of VDIs	250
# of Arista 7048T-A Switch	1		

Table 11. Hardware Component Breakdown - 3 x Nodes

Citrix/Microsoft License Components	Qty
# of Citrix XenDesktop Enterprise User/Device	250
# of MS Virtual Desktop Access	250
# of MS System Center 2012 R2 CMS Client ML	250
# of MS Core Infrastructure Suite (CIS) Standard	5
# of MS SQL Server 2012 Standard Server	1

Table 12. Component Breakdown - 3 x Nodes

[10] Each customer will have different Citrix and Microsoft license agreements and as such should be factored into the final configuration.
[11] Actual customer licensing requirements may differ based on their situation, agreements or other factors.

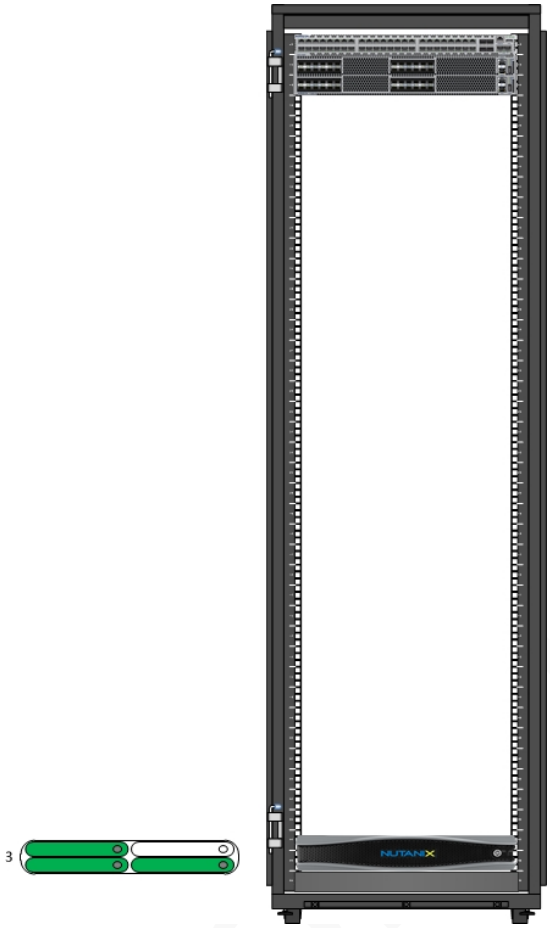

Figure 15. Rack Layout – 3 x Nodes

Scenario: 4 x Nodes (Full Block)

Hardware Components	Qty	Infrastructure Components	Qty
# of NX-3060 nodes (256GB)	4	# of SCVMM server	1
# of RU (Nutanix nodes)	2	# of Hyper-V hosts	4
# of 10GbE Ports (Hyper-V)	8	# of Hyper-V Cluster	1
# of 1GbE Ports (IPMI)	4	# of Nutanix Cluster	1
Total # of 10GbE Ports	8	# of XenDesktop Sites	1
Total # of 1GbE Ports	4	# of HVD users	360
# of Arista 7150S-24 10GbE Switch	2	# of VDIs	360
# of Arista 7048T-A Switch	1		

Table 13. Hardware Component Breakdown - 4 x Nodes

Citrix/Microsoft License Components	Qty
# of Citrix XenDesktop Enterprise User/Device	360
# of MS Virtual Desktop Access	360
# of MS System Center 2012 R2 CMS Client ML	360
# of MS Core Infrastructure Suite (CIS) Standard	5
# of MS SQL Server 2012 Standard Server	1

Table 14. Component Breakdown - 4 x Nodes

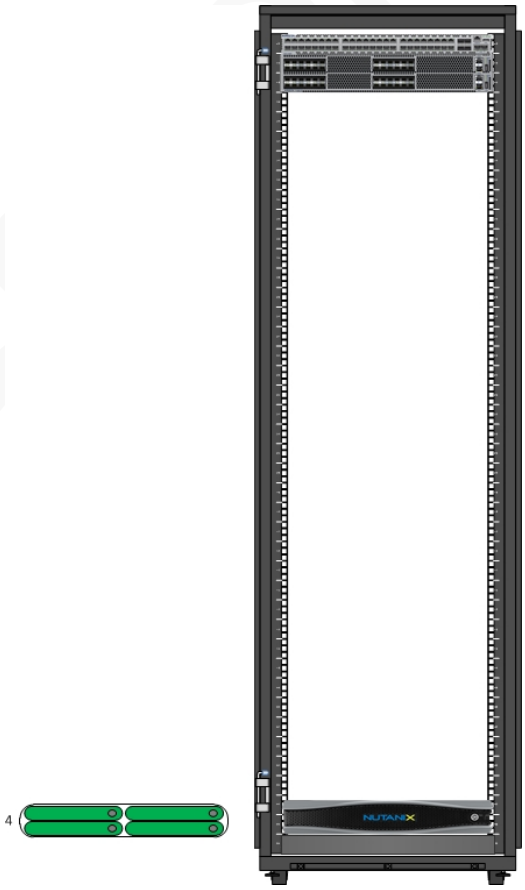

Figure 16. Rack Layout – 4 x Nodes

Scenario: 6 x Nodes (1½ Block)

Hardware Components	Qty	Infrastructure Components	Qty
# of NX-3060 nodes (256GB)	6	# of SCVMM server	1
# of RU (Nutanix nodes)	4	# of Hyper-V hosts	6
# of 10GbE Ports (Hyper-V)	12	# of Hyper-V Cluster	1
# of 1GbE Ports (IPMI)	6	# of Nutanix Cluster	1
Total # of 10GbE Ports	12	# of XenDesktop Sites	1
Total # of 1GbE Ports	6	# of HVD users	580
# of Arista 7150S-24 10GbE Switch	2	# of VDIs	580
# of Arista 7048T-A Switch	1		

Table 15. Hardware Component Breakdown - 6 x Nodes

Citrix/Microsoft License Components	Qty
# of Citrix XenDesktop Enterprise User/Device	580
# of MS Virtual Desktop Access	580
# of MS System Center 2012 R2 CMS Client ML	580
# of MS Core Infrastructure Suite (CIS) Standard	5
# of MS SQL Server 2012 Standard Server	1

Table 16. Component Breakdown - 6 x Nodes

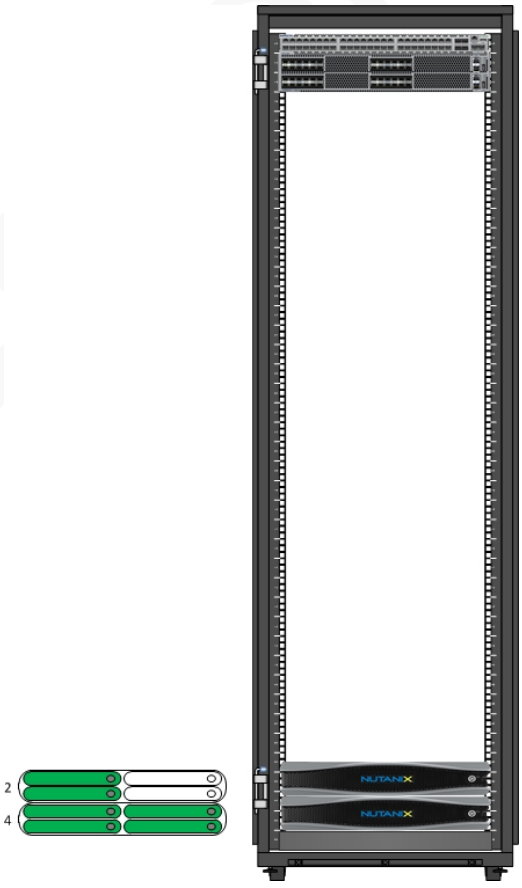

Figure 17. Rack Layout – 6 x Nodes

Scenario: 8 x Nodes (Two Full Blocks)

Hardware Components	Qty	Infrastructure Components	Qty
# of NX-3060 nodes (256GB)	8	# of SCVMM server	1
# of RU (Nutanix nodes)	4	# of Hyper-V hosts	8
# of 10GbE Ports (Hyper-V)	16	# of Hyper-V Cluster	1
# of 1GbE Ports (IPMI)	8	# of Nutanix Cluster	1
Total # of 10GbE Ports	16	# of XenDesktop Sites	1
Total # of 1GbE Ports	8	# of HVD users	800
# of Arista 7150S-24 10GbE Switch	2	# of VDIs	800
# of Arista 7048T-A Switch	1		

Table 17. Hardware Component Breakdown - 8 x Nodes

Citrix/Microsoft License Components	Qty
# of Citrix XenDesktop Enterprise User/Device	800
# of MS Virtual Desktop Access	800
# of MS System Center 2012 R2 CMS Client ML	800
# of MS Core Infrastructure Suite (CIS) Standard	5
# of MS SQL Server 2012 Standard Server	1

Table 18. Component Breakdown - 8 x Nodes

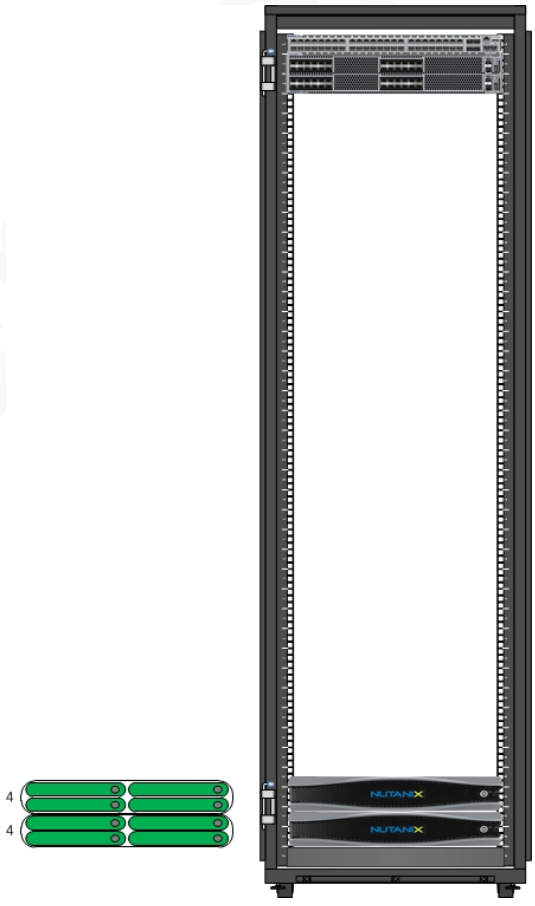

Figure 18. Rack Layout – 8 x Nodes

Scenario: 10 x Nodes (2½ Full Blocks)

Hardware Components	Qty	Infrastructure Components	Qty
# of NX-3060 nodes (256GB)	10	# of SCVMM server	1
# of RU (Nutanix nodes)	6	# of Hyper-V hosts	10
# of 10GbE Ports (Hyper-V)	20	# of Hyper-V Cluster	1
# of 1GbE Ports (IPMI)	10	# of Nutanix Cluster	1
Total # of 10GbE Ports	20	# of XenDesktop Sites	1
Total # of 1GbE Ports	10	# of HVD users	1,020
# of Arista 7150S-24 10GbE Switch	2	# of VDIs	1,020
# of Arista 7048T-A Switch	1		

Table 19. Hardware Component Breakdown - 10 x Nodes

Citrix/Microsoft License Components	Qty
# of Citrix XenDesktop Enterprise User/Device	1,020
# of MS Virtual Desktop Access	1,020
# of MS System Center 2012 R2 CMS Client ML	1,020
# of MS Core Infrastructure Suite (CIS) Standard	5
# of MS SQL Server 2012 Standard Server	1

Table 20. Component Breakdown - 10 x Nodes

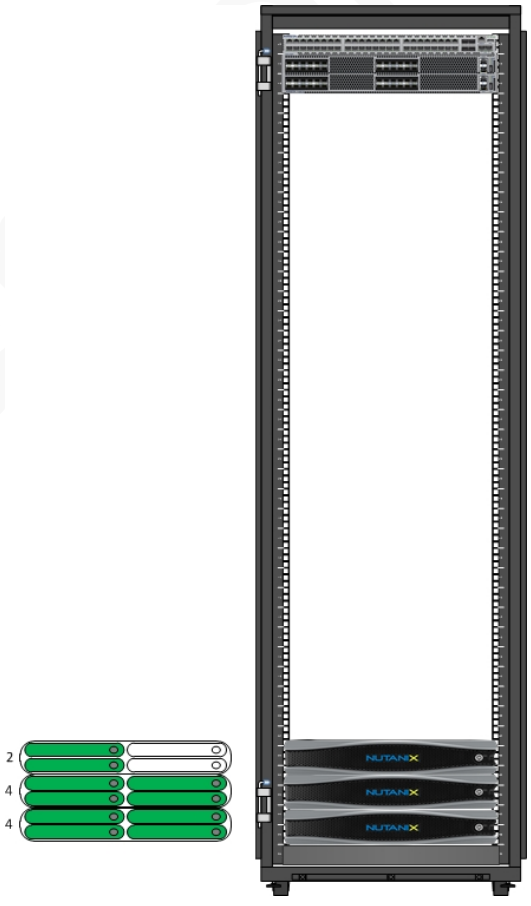

Figure 19. Rack Layout – 10 x Nodes

Solution at a Glance

This section defines the key decisions points and options offered by this Citrix Validated Solution. The subsequent sections within this document provide the detailed configuration of each element.

Category	Design Decision

Scalability	• The Nutanix Virtual Computing Platform can start with configurations for hundred users or so and scale to 10,000s of users with its Nutanix Distributed File System underlying the converged compute and storage architecture.
	• Minimum number of nodes – three (3) Nutanix NX-3060 nodes (also referred to as NX-3**3**60 with the second digit referring to the number of nodes within the 2RU chassis). Three nodes can support :
	  ○ 400 HSDs and the supporting XenDesktop Infrastructure components or
	  ○ 250 HVDs and the supporting XenDesktop Infrastructure components

XenDesktop	• XenDesktop 7.1 Enterprise • Machine Creation Services workload delivery • Highly scalable and redundant Delivery Controller servers • Vertical scalability by increasing CPU/RAM resources or Horizontal scalability by adding Delivery Controllers • VMs can be failed-over or live migrated within the Hyper-V cluster

Desktop Types	• Non-persistent Pooled desktop types
	• Persistent or Dedicated desktops can also be hosted on this platform
	• Hosted Shared Desktops (HSD) on Windows Sever 2008 R2 Standard
	  ○ 8 vCPUs, 16GB RAM, 100GB disk, 1 vNIC
	  ○ Horizontal scalability by deploying more VMs onto available hosts
	  ○ Redundancy by overprovisioning desktop capacity
	  ○ VMs can be failed-over or live migrated within the Hyper-V cluster
	• Hosted Virtual Desktops on Windows 7 Enterprise SP1 x64
	  ○ 2 vCPUs, 2.5GB RAM, 100GB disk, 1 vNIC
	  ○ Horizontal scalability by deploying more VMs onto available hosts
	  ○ Redundancy by overprovisioning desktop capacity
	  ○ VMs can be failed-over or live migrated within the Hyper-V cluster

Hypervisor	• Microsoft Hyper-V Server 2012 R2 (Windows Server 2012 R2 Datacenter with Server Core)[12] • Clustered Hyper-V deployment managed via System Center Virtual Machine Manager (SCVMM) • Hyper-V Failover Cluster allowing for Live Migration, HA and other functions • Horizontal scalability by deploying additional individual server nodes • Recommendation : up to 24 Hyper-V nodes per cluster

[12] Each node runs Microsoft Windows Server 2012 R2 (Server Core and Data Center are supported) with Hyper-V Server 2012 R2 role enabled.

Compute and Storage Hardware	• Nutanix NX-3060 node • Nutanix OS (NOS) Version 3.5.1 or later • Dual-socket Intel 10-core Xeon E5-2680v2 processors @ 2.8Ghz • 128GB RAM nodes for HSD workloads • 256GB RAM nodes for HVD workloads • Nutanix CVM with its Nutanix Distributed File System (NDFS) presenting SMB3 volume to the Hyper-V nodes within the cluster • Disk storage and storage controller (CVM) redundancy • Storage tiering and deduplication provided by Nutanix CVM • Storage is presented as a local share by the Nutanix CVM – no external SAN or NAS is utilized • Multiple NX-3060 nodes within a Nutanix cluster with all nodes accessing a single Storage Pool. Storage performance is scaled out as more Nutanix nodes are added.
Networking and Related Hardware	• DNS round robin will be utilised to load balance the Citrix StoreFront servers • Customer can leverage existing load balancer hardware investment or alternatively deploy a pair of Citrix NetScaler appliances in High Availability (HA) to provide both load balancing and remote-access capability • Pair of Arista 7150S-24 10GbE 24-port ToR switches is required to interconnect the nodes; alternatively, customer can leverage existing 10GbE switching fabric. Refer to Appendix for Network Requirements. • Customer can leverage existing 1GbE network switches to integrate the IPMI node management NICs into their environment. Alternatively, an Arista 7048T-A 100/1000 Mbps switch can be procured. Refer to Appendix for Network Requirements.
File Storage	• Windows File Server VM with DFS solution • File Server to support user profile data only up to 1GB per user for maximum of 1,000 users. Capability to support more users, however File Server virtual disks capacity would need to be adjusted. • Additional storage requirements will require scale-out of the Windows file server solution or scale-up by provisioning the Windows file servers with larger capacity virtual hard drives
Applications	• Baseline applications installed as per the SOE (Tier-1) • Integration and deployment of Line of Business (LoB) or customer-specific applications (Tier-2) would need to be catered for. Additional services and infrastructure may be required.
Access	• Redundant StoreFront servers with DNS round robin for simplicity and low cost. Recommendation to leverage Citrix NetScaler HA appliances as the environment is scaled-out. • Additional load balancing capability can be used via Citrix NetScaler appliances • Vertical scalability to StoreFront servers by increasing CPU/RAM resources • Remote Access solution, i.e. in the form of Citrix NetScaler or other is out of scope and would need to be factored in, if required.
Availability/Redundancy	• Assumes single datacenter (physical location) only • Delivery Controllers – redundant servers (N+1 VMs placed on different hosts) • Hyper-V hosts – fail-over cluster with up to 24 hosts per cluster, with capability for VM Live Migration and HA; overprovision capacity by having N+1 servers

- Hyper-V NICs – active/active NIC teaming
- StoreFront servers – redundant servers (N+1 VMs placed on different hosts). DNS round-robin configured which can be further improved by integrating Citrix NetScaler
- SQL 2012 DB Servers – redundant servers (N+1 VMs placed on different hosts)
- XenDesktop Databases – database mirroring in active/passive setup
- SCVMM Server and Database – none, stand-alone setup. Minimal impact to XenDesktop environment.
    - If SCVMM server is unavailable, power functions of the VMs are affected.
    - All VMs that are running will continue to run, any connected user will notice no service disruption
    - Any user who tries to connect to a session will succeed.
    - Power functions can still be managed manually from the local console if needed.
- Windows Filer Services – redundant servers (N+1 VMs placed on different hosts). DFS-N in active/passive setup for user profile data
- Windows DHCP Services – redundant servers (N+1 VMs placed on different hosts)
- Citrix License Server – stand-alone, built in 30-day grace period
- Storage – Data redundancy, performance, data protection and storage tiering capabilities managed by the Nutanix CVM.
- Arista Network Switches – redundant configuration, N+1 setup

SECTION 2: DESIGN

User Layer Design

User Topology

This design is focused on the delivery of non-persistent virtual desktops using Citrix XenDesktop as discussed in the section, Citrix Virtual Desktops Types. However, persistent or dedicated virtual desktops can also be deployed and hosted on the Nutanix Virtual Computing Platform.

There are a number of classifications that can be used to define a user's role within an organisation and determine the most appropriate virtual desktop type that is best suited for a customer's environment and circumstances[13].

The table below provides some example "User Type" classifications and Flex Cast type, this Citrix Validation Solution is focused:

Example: User Type	Example: Description	Example: Location / Remote LAN / WAN	Example: Desktop Types (Citrix Flex Cast)
Kiosk Worker	Public non trusted user	LAN / WAN	Hosted Shared
Task Workers	Call Centre	LAN	Hosted Shared
Knowledge Workers	Finance department	Remote / LAN / WAN	Hosted Shared or Hosted Virtual
Power Users	Developers	Remote / LAN / WAN	Persistent / Dedicated Virtual Desktops

Table 21: Example User Role Classifications

Endpoints

A current and supported version of Citrix Receiver must be deployed to ensure all Citrix XenDesktop features and components of this Citrix Validated Solution are at a supported level, refer to the following link for the latest Citrix Receiver Downloads.

13 A desktop transformation assessment to determine the best fit of a user Role to desktop type is out of scope for this document.

Access Layer Design

The Access Layer explains how a user group will connect to their assigned virtual desktop. User location, connectivity and security requirements play a critical role in defining how users authenticate

Citrix Storefront provides a unified application and desktop aggregation point. Users can access their desktop through a standard Web browser using Citrix Receiver.

The key design decisions for the Access Layer are as follows:

Decision Point	Description / Decision
Version, Edition	StoreFront Version 2.5
Authentication Point	Active Directory
Security	A server certificate will be installed to secure authentication traffic: • https will be required for all web sites, ensuring that user's credentials are encrypted as they traverse the network.

Table 22: Citrix StoreFront Configuration

StoreFront Configuration. A single store will be created to provide the required access and enumeration of the HSD or HVD desktops. The StoreFront servers will be added into a single server group, providing additional capacity and increasing availability. A server Group provides a unified configuration and synchronisation of user settings.

Desktop Layer Design

The desktop layer focuses on the design considerations for the user's desktop, which must provide them with the right set of applications, capabilities and resources based on their needs.

Each of the virtual desktops within the Citrix Validated Solution represent true-to-production configuration consisting of a core set of applications that are pre-installed as part of the virtual desktop "master image".

Each of the virtual desktops, Windows 7 or Windows Server 2008 R2 RDS workloads will be deployed using Citrix Machine Creation Services.

User Personalisation

Providing the right level of personalisation requires an understanding of the needs for the user group. Personalisation decisions must be weighed against user location, data centre connectivity and security requirements.

Utilising technologies like profiles and policies a user group can receive a desktop where user-level personalisation changes are persisted between logins of the pooled desktops types that are described within this document.

Citrix Profile Management will be leveraged and enabled through a Windows service that provides a mechanism for capturing and managing user personalisation settings within the virtual desktop environment. Citrix Profile Management is installed by default during the installation of the Virtual Desktop agent.

The key design decisions for Citrix Profile Management are as follows:

Application	Description / Decision
Version, Edition	Citrix User Profile Management version 5.1
Profile Storage Location	DFS (Distributed File System) namespace example: • \\customer.domain.com\ProfileData\HVD-UPM\#SameAccountName
Folder redirection	Enabled: Applied using Group Policy: (minimum requirements): • Application Data Redirected folder location: • \\customer.domain.com\ProlfieData\HVD-UserData\%username% Refer to the Appendix for further information: DECISION POINT

Table 23: Citrix Profile Management Key Decisions

Citrix Profile Management together with standard Microsoft Windows Folder Redirection that leverages Active Directory GPOs will be deployed to support the user personalisation configuration requirements.

Storage presented via a Windows SMB file share will be provided by the File servers discussed in this Citrix Validated Solution. A Distributed File System (DFS) namespace will be utilised to unify the real share location while DFS Replication will be utilised to mirror data between the primary and secondary File servers for redundancy.

Applications

The Citrix Validated Solution was tested utilising application sets representative of enterprise-level Standard Operating Environment ('SOE') applications. These applications are pre-installed or embedded as part of the "master image".

Note a number of pre-requisite applications we're required to drive the Login VSI scalability testing.

The following table represents the application set that formed the desktop workload profile:

Hosted Shared Desktop Application Set

Application	Description / Decision
HSD Operating System	• Microsoft Windows Server 2008 R2 Standard Edition with Service Pack 1 • Hyper-V Integration Services 6.2.9200.16433
Citrix Applications	• Citrix Virtual Delivery Agent 7.1.0.4033 • Citrix Profile Management v5.1 • Citrix ShareFile Desktop Widget v2.26.1 • Citrix Receiver v14.1.0.0
Productivity Applications	• Microsoft Excel Professional 2010 x86 • Microsoft Outlook Professional 2010 x86 • Microsoft PowerPoint Professional 2010 x86 • Microsoft Word Professional 2010 x86
Baseline Applications	• Adobe Acrobat Reader v9.1[14] • Adobe Flash Player v11.7.700.202[15] • Adobe Shockwave Player v11.6.636 • Adobe AIR v4.0.0.1390 • Apple QuickTime v7.72.80.56 • Bullzip PDF Printer v7.2.0.1304[16] • Google Chrome v31.0.1650.57 • Java 7 Update 13 v7.0.130[17] • Mozilla Firefox v14.0.1 • Microsoft .NET Framework 4 Client Profile v4.5.50938 • Microsoft Internet Explorer 9 • Microsoft Silverlight v5.1.20913.0 • Microsoft Windows Firewall • Microsoft Windows Media Player v12.x • Skype v5.10.116 • WinZip v16.5.10095

Table 24: HSD Application Set

14 Application required and deployed by Login VSI for scalability testing.
15 Application required and deployed by Login VSI for scalability testing.
16 Application required and deployed by Login VSI for scalability testing.
17 Application required and deployed by Login VSI for scalability testing.

Hosted Virtual Desktop Application Set

Application	Description / Decision
HVD Operating System	• Microsoft Windows 7 Professional Service Pack 1 x64 • Hyper-V Integration Services 6.2.9200.16433
Citrix Applications	• Citrix Virtual Delivery Agent 7.1.0.4033 • Citrix Profile Management v5.1 • Citrix ShareFile Desktop Widget v2.26.1 • Citrix Receiver v14.1.0.0
Productivity Applications	• Microsoft Excel Professional 2010 x86 • Microsoft Outlook Professional 2010 x86 • Microsoft PowerPoint Professional 2010 x86 • Microsoft Word Professional 2010 x86
Baseline Applications	• Adobe Acrobat Reader v9.1[18] • Adobe Flash Player v11.7.700.202[19] • Adobe Shockwave Player v11.6.636 • Adobe AIR v4.0.0.1390 • Apple QuickTime v7.72.80.56 • Bullzip PDF Printer v7.2.0.1304[20] • Google Chrome v31.0.1650.57 • Java 7 Update 13 v7.0.130[21] • Mozilla Firefox v14.0.1 • Microsoft .NET Framework 4 Client Profile v4.5.50938 • Microsoft Internet Explorer 9 • Microsoft Silverlight v5.1.20913.0 • Microsoft Windows Firewall • Microsoft Windows Media Player v12.x • Skype v5.10.116 • WinZip v16.5.10095

Table 25: HVD Application Set

18 Application required and deployed by Login VSI for scalability testing.
19 Application required and deployed by Login VSI for scalability testing.
20 Application required and deployed by Login VSI for scalability testing.
21 Application required and deployed by Login VSI for scalability testing.

Master Image

The master image is defined by an operating system, image size and a set of applications that are installed into the image.

Configuration settings will be applied directly to the master image and using Active Directory Group Policies where appropriate, ensuring consistent deployment and optimisation.

Hosted Shared Desktop Workload

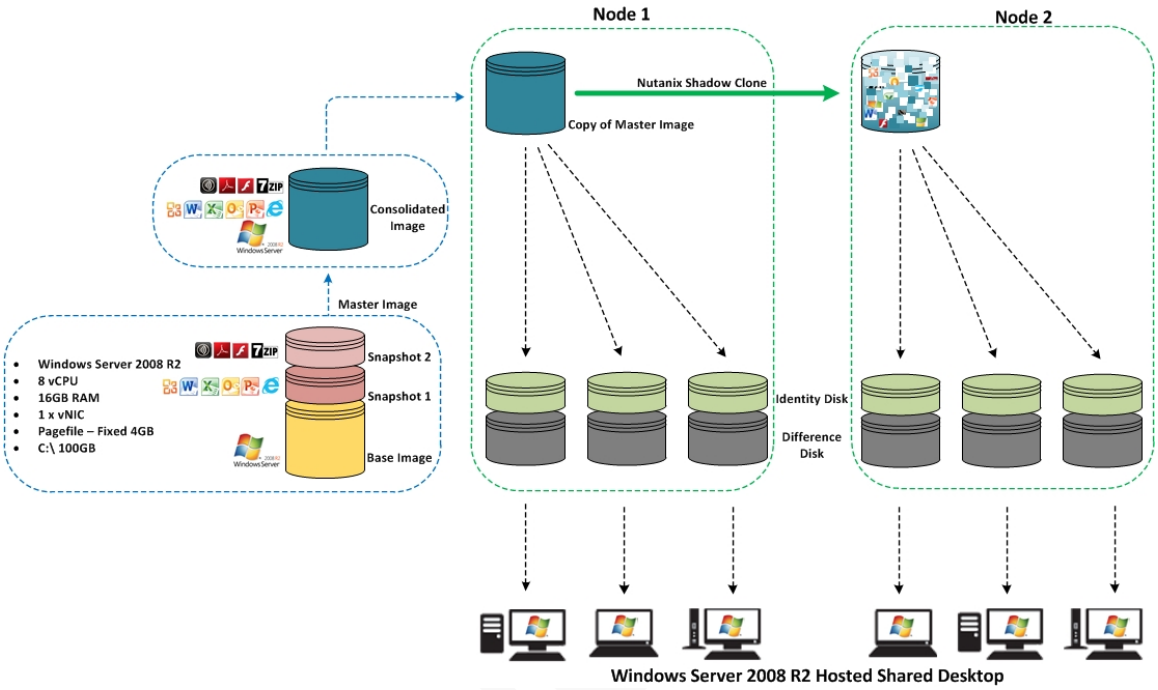

Figure 20. HSD Workload Configuration

Based on the system testing carried out, the following table describes the most optimal configuration for HSD on Windows Sever 2008 R2 RDS workloads for user/session density.

Server Node	# of VMs per Node	RAM	vCPU	User Sessions per VM	Total # of Users per Node[22]
Shared Infrastructure & Desktop Node	4	16 GB	8	~25	100
Desktop Node	8	16 GB	8	~25	200

Table 26: HSD Virtual Machine Specification and Sizing Estimates

[22] Density figures quoted do not include the overhead incurred by running an Anti-Virus agent.

Virtual Machine Specifications	Description / Decision
Storage	System Drive: (Difference Disk) C:\ = 100GB
Pagefile	Fixed 16GB (1 x Assigned Memory)
Network Interface	Single - Synthetic NIC for production traffic
Memory	16GB Dynamic Memory not used
vCPU	8
Operating System	Microsoft Windows Server 2008 R2 Standard Edition with Service Pack 1
Total Storage IO Profile per User[23]	Logon – 8 (2% read 98% write) Steady State – 4 (10% read 90% write) Logoff – 5 (10% read 90% write)

Table 27: HSD-Windows Server 2008 R2 RDS Virtual Machine Specification

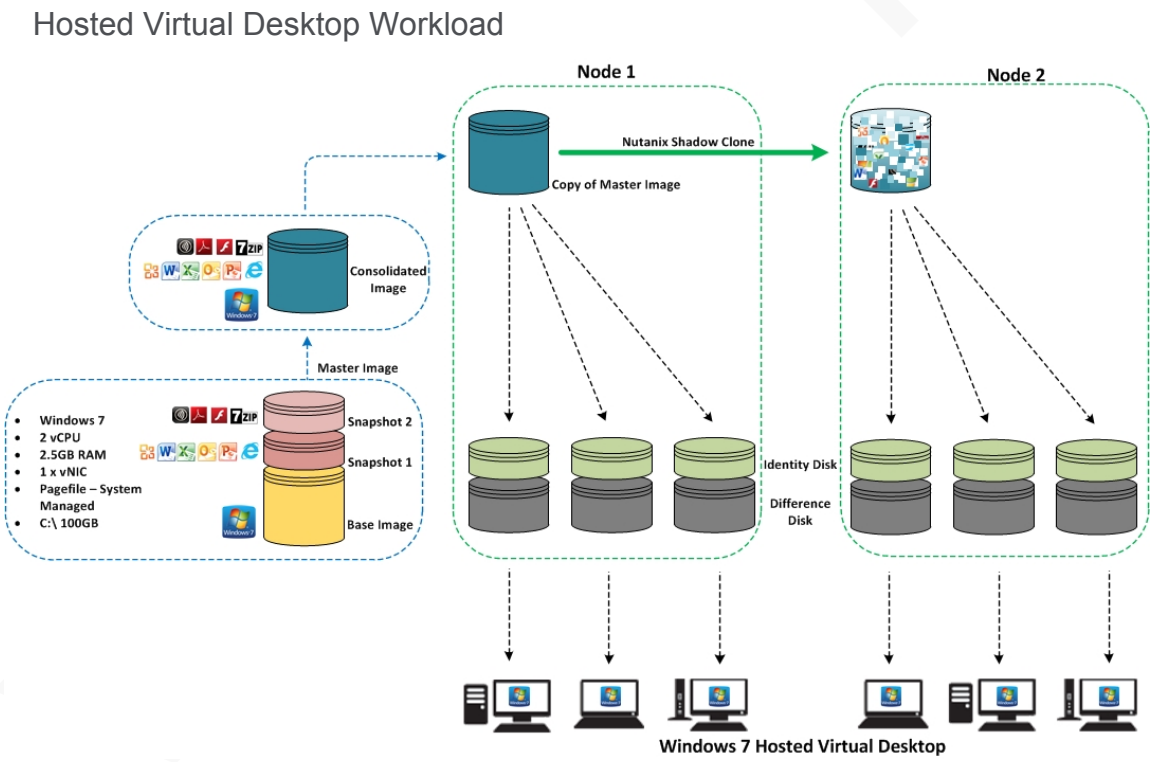

Figure 21. Hosted Virtual Desktop Workload Configuration

[23] Storage analytics reported by the Nutanix CVM with measurements captured every 15 seconds.

Based on the system testing carried out, the following table describes the most optimal configuration for the Windows 7 workload for user/VM density:

Server Node	# of VMs per Node	RAM	vCPU	Total # of Users per Node[24]
Shared Infrastructure & Desktop Node	70	2.5GB	2	70
Desktop Node	110	2.5GB	2	110

Table 28: HVD Virtual Machine Specification and Sizing Estimates

Virtual Machine Specifications	Description / Decision
Storage	System Drive: (Difference Disk) C:\ = 100GB
Pagefile	5GB (2 x Assigned Memory)
Network Interface	Single - Synthetic NIC for production traffic
Memory	2.5GB Dynamic Memory enabled. Please refer to the VMM section for further details
vCPU	2
Operating System	Microsoft Windows 7 Professional Service Pack 1 x64
Total Storage IO Profile per User[25]	Logon – 16 (60% read 40% write) Steady State – 8 (70% read 30% write) Logoff – 6 (75% read 25% write)

Table 29: HVD-Windows 7 Virtual Machine Specification

The virtual workloads are deployed using Citrix Machine Creation Services (MCS). MCS utilises the hypervisor APIs to deploy, stop start and delete virtual machines. A master image must first be deployed that contains the virtual machine resource requirements such as vCPU and memory. Applications and agents are installed in the master image that is required for the virtual machine deployment. Finally a snapshot is created within the hypervisor that will be used for the Catalogs base image deployment by MCS.

A XenDesktop Catalog is deployed based on this master image snapshot, for each virtual machine created within this Catalog MCS will create the following virtual disks:

- Identity disk. An Identity disk which is used to provide each VM with a unique identity.
- Difference disk. A Difference disk which is used by each VM to store writes that are typically made to the system.

Pooled stateless (non-persistent) desktops using MCS are unique in that the differencing disk is deleted and recreated at each boot ensuring that the VM is set back to a clean state after each reboot effectively deleting any newly written or modified data. In this scenario, certain processes are no longer efficient and optimisation of this image is required.

[24] Density figures quoted do not include the overhead incurred by running an Anti-Virus agent.
[25] Storage analytics reported by the Nutanix CVM with measurements captured every 15 seconds.

Persistent or Dedicated desktops are permanently assigned to a single user. When a user logs off, only that user can use the desktop, regardless if the desktop is rebooted. During reboots, any changes made will persist across subsequent start-ups.

Optimisations and configurations can be applied at several levels:

- **Workload Configuration master image.** Changes are made directly to the master image. These changes are considered inappropriate to be applied using GPOs or are required settings prior to MCS generalising the image. The master image is then shut down and a snapshot taken by the hypervisor. MCS is then used to deploy the master image (from the snapshot) either to create a new or update an existing XenDesktop Catalog.
- **Workload Configuration GPO**. These changes are applied via Active Directory GPO and are considered baseline configurations required in almost all instances. Typical use cases for this GPO are Event log redirection, Citrix Profile Management configuration and target device optimisations. In addition this GPO may have Loopback processing enabled allowing user based settings to be applied to the virtual desktop Organisation Unit level.
- **User Optimisations GPO.** This Active Directory GPO contains optimisations for the user within the virtual desktop environment. User optimisations cannot typically be deployed as part of the master image and are considered independent. Typical use cases for this GPO are folder redirection and user specific optimisations.

Control Layer Design

The control layer provides the design decisions for the underlying infrastructure supporting the virtual desktop layer.

The Control Layer design is unique per data centre and subdivided into the following components:

- Infrastructure
- Desktop Delivery Controllers (XenDesktop)
- Image Controllers (Machine Creation Services)
- Access Controllers (StoreFront)

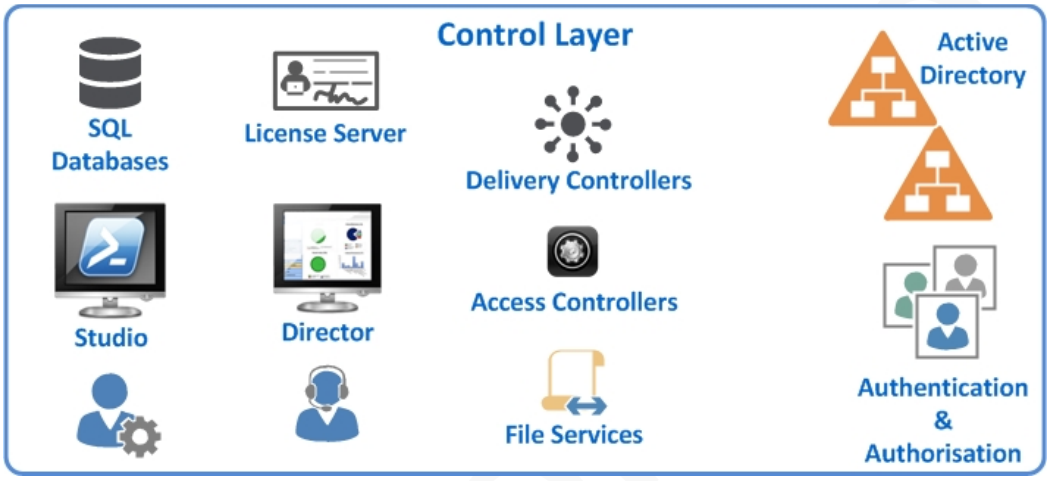

Figure 22. Control Layer Logical View

Infrastructure

The infrastructure for this Citrix Validated Solution provides a set of common components, namely a database, license server, Active Directory and network components. File Services are covered in a separate section.

Database

Citrix XenDesktop and Virtual Machine Manager require databases to store configuration metadata and statistical information. A highly available database platform utilising Microsoft SQL Server is required as the database platform. The database platform must be designed in such a way as to provide adequate resources and availability to support the environment.

Category	Design Decision
SQL Version	Microsoft SQL Server 2012 Standard Edition SP1 (used at the time of testing) Please refer to the following article for a list of Citrix supported database platforms: http://support.citrix.com/servlet/KbServlet/download/18493-102-706969/Database%20Chart.pdf
Redundancy	**XenDesktop:** • Mirrored: Synchronous mirroring Please refer to the following article for database fault tolerance: • http://support.citrix.com/proddocs/topic/xendesktop-71/cds-plan-high-avail-rho.html **Microsoft VMM:** Please refer to the following article for further details: • http://technet.microsoft.com/en-us/library/gg610574.aspx • http://technet.microsoft.com/en-us/sqlserver/gg490638.aspx
Number of Servers	2
Server O/S	Microsoft Windows Server 2012 R2 Standard Edition
CPU Allocation	2 vCPU (Example)
RAM Allocation	8GB (Example)
Storage Allocation	C:\ 100 D:\ 100 (Databases) (Example)

Table 30: Database Summary

This document provides sample sizing guidelines and the licensing requirements for the databases used in this Citrix Validated Solution, however it does not attempt to provide design guidelines for Microsoft SQL Server. The design and implementation for a highly available Microsoft SQL Server platform is required although considered out of scope for this design document.

Licensing

The licensing component (Microsoft and Citrix) grants each user access to the environment, as long as enough licenses are available. In addition, the type of license can also grant/deny different levels of functionality.

The key design decisions for the license server are as follows:

Category	Citrix	Microsoft
License Server Version	11.11.1	DECISION POINT
Redundancy	Built in Grace period and Hypervisor	DECISION POINT
Number of Servers	1	DECISION POINT
Server Name(s)	DECISION POINT	DECISION POINT
Server O/S	Microsoft Windows Server 2012 R2 Standard Edition	DECISION POINT
CPU Allocation	2	DECISION POINT
RAM Allocation	4GB	DECISION POINT
Storage Allocation	C:\ 100GB	DECISION POINT
License Type	DECISION POINT	DECISION POINT

Table 31: Licensing Summary

Redundancy. Redundancy is built into the Citrix License service via the built-in 30 day grace period. Service redundancy can be further facilitated by the underlying hypervisor; therefore a single server is recommended.

Active Directory Integration. The License server machine object will be logical located in a dedicated Organisational Unit with specific Group Policy Objects applied as appropriate to the role please refer to the Active Directory Section for more details.

Active Directory

This Citrix Validated Solution has a requirement to use Microsoft Active Directory Domain Services and as such, it is an assumption that such an environment already exists within the customer's environment. The decisions discussed below describe requirements from the existing Active Directory in the form of Organisational Units and Group Policy Objects.

Supplementary requirements must also be met, to ensure sufficient capacity from authenticating Domain Controllers can service any additional requirements or load placed on the system by adding further Users, Groups, machine Objects and policy processing load. DECISION POINT

Category	Decision / Description
Group Policy Application	Recommended:[26] • Each infrastructure server role will have a minimum security baseline applied (MSB) via GPO • All RDS workloads will have a minimum security baseline applied (MSB) via GPO • Windows 7 workloads will have a minimum security baseline applied (MSB) via GPO • RDS workloads will have a Machine GPO applied specific to their application delivery requirements. This GPO may have Loopback mode enabled to apply user based settings at the RDS workload OU level • Windows 7 workloads will have a Machine GPO applied specific to their application delivery requirements. This GPO may have Loopback mode enabled to apply user based settings at the machine workload OU level • User based policies may be applied at the user or machine level using the loopback mode • Infrastructure servers such as Hyper-V hosts will be deployed in relevant OUs and MSBs applied appropriate to their role.

Table 32: Active Directory Requirements

The suggested Group Policy and Organisational Unit strategy applied to this Citrix Validated Solution is based on deploying Group Policy Objects in a functional approach, e.g. settings are applied based on service, security or other functional role criteria. This ensures that security settings targeted for specific role services such as IIS, SQL etc. receive only their relevant configurations.

It is anticipated that the final design will be customer dependant and based on other factors such as role based administration and other typical elements outside the scope of this document. Refer to the Appendix: DECISION POINT

26 Reference to Minimum Security Baselines in the form of GPOs will be the customer's responsibility. GPOs described in this document in all cases will be integrated into the customer Active Directory environment.

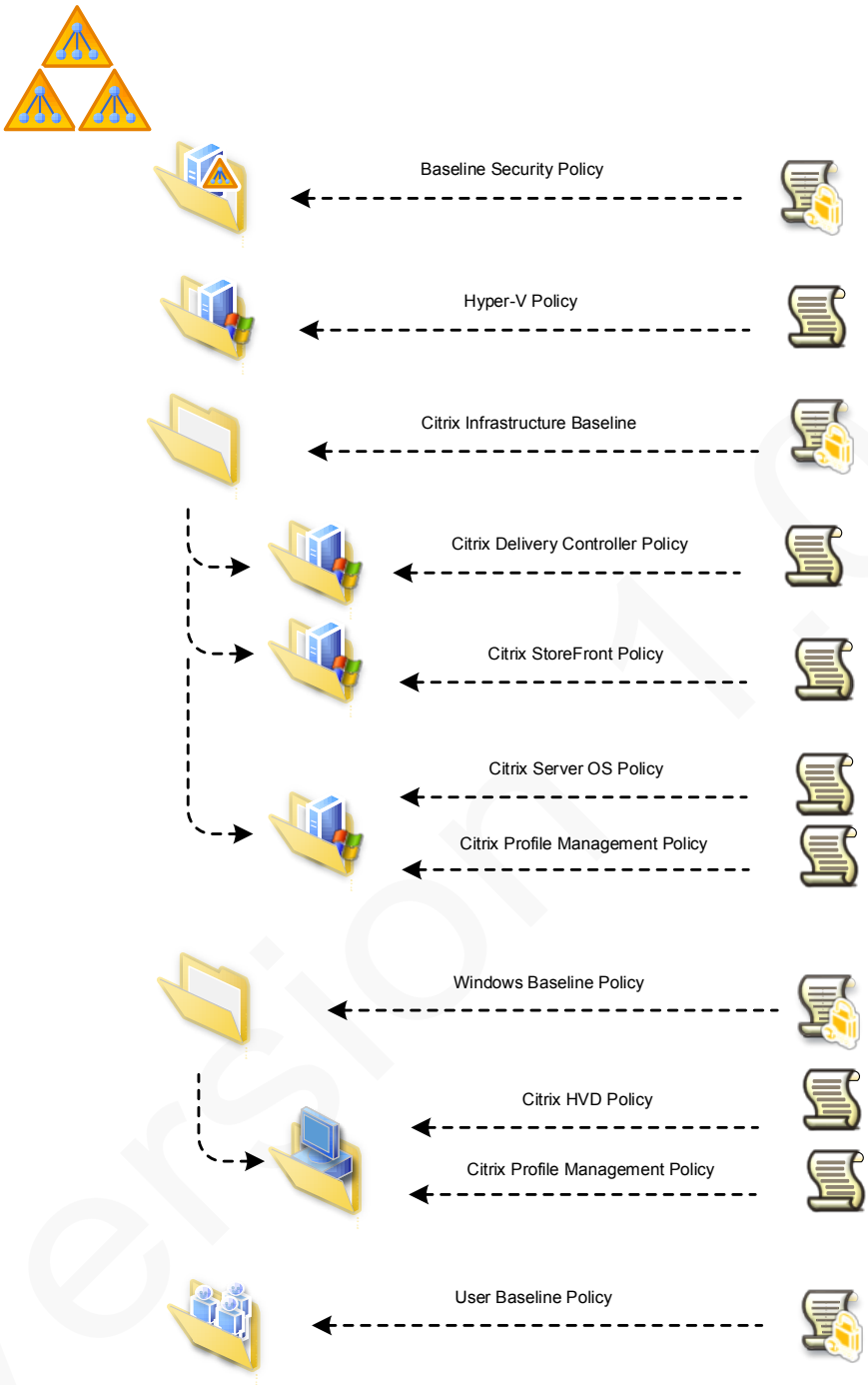

Figure 23. Sample Active Directory OU Structure and GPO Linking

Delivery Controllers (XenDesktop)

Delivery Controllers, also known as XenDesktop controllers (Image Controllers), are responsible for enumerating, allocating, assigning and maintaining virtualised desktops and applications. Delivery Controllers within a single data centre are grouped together into a XenDesktop site, which functions as a single administrative entity.

This Citrix Validated Solution specifically defines the Hosted Virtual Desktop and Hosted Shared Desktop FlexCast delivery models. From a XenDesktop perspective each desktop type will belong to a Catalog configured specifically for that FlexCast delivery type.

The Illustration below identifies the components of the XenDesktop Site describing the Hosted Shared Desktop Catalogs deployed as part of the Citrix Validated Solution:

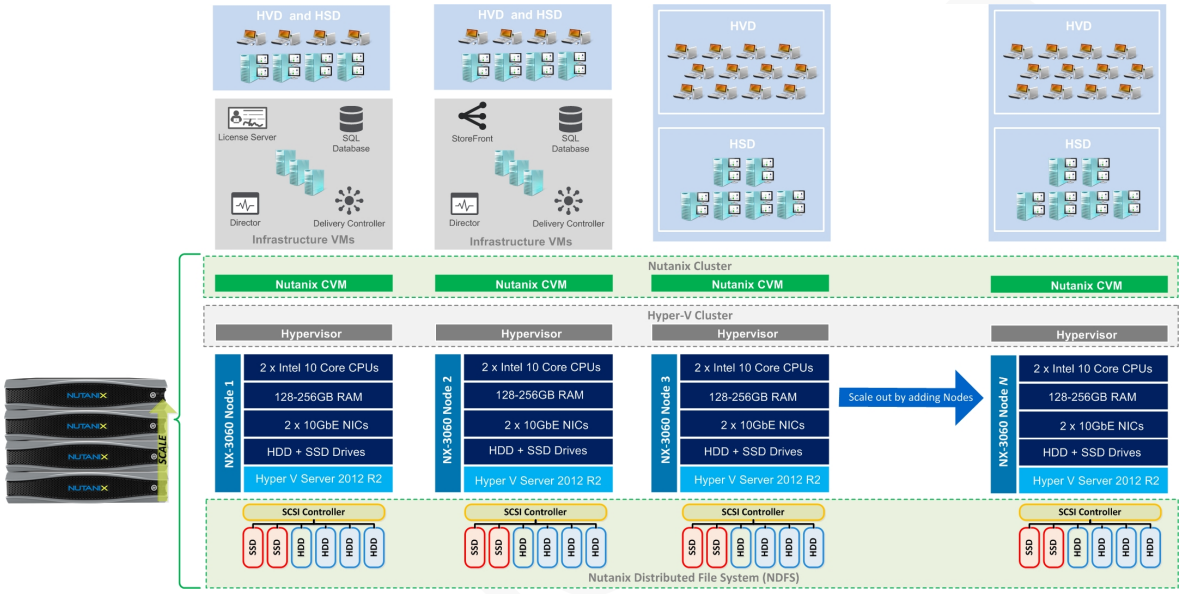

Figure 24. XenDesktop Site delivering both HVD and HSD Workloads

XenDesktop Site

Based on the validation testing and resiliency requirements of this Citrix Validated Solution the following table describes the XenDesktop site design parameters.

Category	Design Decision
Version, Edition	Citrix XenDesktop 7.1
Sites per Data Center	The Citrix Validated Solution is designed as a single Site for a single data centre
Site Name(s)	DECISION POINT
Server O/S	Microsoft Windows Server 2012 R2 Standard Edition
Controllers per Site	2 for server redundancy (Single Site Deployment) Each Delivery Controller also functions as an MCS Image Controller
XenDesktop Administrators	DECISION POINT
Site Database	Refer to the Section Databases
Configuration database	Refer to the Section Databases

Monitoring Database	Refer to the Section Databases
Catalog for HSD	• Windows Server OS • Server OS provisioned through MCS
Catalog for HVD	• Windows Desktop OS • Desktop OS provisioned through MCS • Random Pooled
Delivery Groups	A single Delivery Group will be created for each virtual desktop type. The Delivery Group will host desktops from multiple Catalogs of the same type
Citrix Policies	Refer to the Appendix for further details
Hypervisor integration	System Center Virtual Machine Manager 2012 R2 • VMM console installed on Delivery Controller servers
Host Connections	A single Host Connection will be created for each Hyper-V Host • Type: Microsoft System Center Virtual Machine Manager • Name: <Based on host server name Refer to the Appendix for further details • Address: Refer to the Appendix for further details Example: 1 per vlan / Storage Clustered Shared Volume

Table 33: XenDesktop Site Summary

For XenDesktop Catalogs hosting server operating systems (also known as XenApp), users are load balanced based on resource availability at user logon. Load management includes Load Throttling, which ensures that a new server brought into service does not initially receive a disproportional number of connections. This Citrix Validated Solution recommends implementing a “Custom” load evaluator with the following minimum parameters:

Load Evaluator	Parameter	Setting	Applied To
Custom	CPU Utilization	85% Full, 10% No load	All servers
	Memory Usage	80% Full, 10% No load	
	Server User Load	30 Full	

Table 34: XenApp Load Evaluator Details

XenDesktop Site. The XenDesktop Site consist of two virtualised Desktop Delivery Controllers. A host connection will be defined that establishes a connection to the VMM server and the Hyper-V Failover Cluster .

A host connection will be defined that establishes a connection to the VMM server and the Hyper-V failover cluster(s). A specified service account will be used for this purpose refer to the Appendix for further details. Within the host connection, a storage connection and network related resource will be specified for each the failover cluster. e.g.

- Cluster Name
- Shared Storage
- VLAN ID

Desktop Presentation. From the corporate LAN/WAN, StoreFront will be utilised for the presentation of desktops to end users.

Desktop Director and EdgeSight. Citrix EdgeSight is now integrated into a single console within Desktop Director, with its feature set enabled based on Citrix Licensing. The monitoring database used by EdgeSight will be separated from the site and logging database to allow appropriate management and scalability of the database. Historical data retention is available for 90 days by default with Platinum licensing. Administrators can select specific views delegating permissions concisely for helpdesk staff, allowing easy troubleshooting and faster resolution of problems. Citrix EdgeSight will provide the following key components:

- **Performance Management.** EdgeSight provides the historical retention with reporting capabilities.
- **Real Time.** Director provides the real time views for support staff to further investigate any reported problems.

Active Directory Integration. Each Machine object will be logical located in a dedicated Organisational Unit with specific Group Policy Objects applied as appropriate to the role please refer to the Active Directory Section for more details.

Image Controllers (Machine Creation Services)

Image Controllers are responsible for providing the actual desktop image for Pooled desktops. Pooled desktop images are created with the built-in Citrix Machine Creation Services (MCS) functionality on each Desktop Controller. MCS is a collection of services that work together to create virtual servers and desktops from a master image on demand, optimising storage utilisation and providing a pristine virtual machine to users every time they log on. Machine Creation Services is fully integrated and administrated in Citrix Studio and does not require additional servers. There are virtually no moving parts within MCS, as all operations are executed directly from the Citrix Delivery Controllers.

Each pooled desktop has one difference disk and one identity disk. The difference disk is used to capture any changes made to the master image while the identity disk stores machine identification information.

The key design decisions for the Image (Desktop Delivery) controllers are as follows:

Category	Description
Preferred Imaging Solution	Machine Creation Services
MCS Storage Type	Storage is managed through Hyper-V and presented by Nutanix Virtual Computing Platform. No additional configurations are required for MCS deployments.
Server Names	Desktop Delivery Controllers DECISION POINT
Server O/S	Microsoft Windows Server 2012 R2 Standard Edition
CPU Allocation	4 vCPU
RAM Allocation	8GB
Storage Allocation	C:\ 100GB

Table 35: Image Controllers Key Decisions

The figure below describes the high-level components showing the provisioning of HSD and HVD workloads through Machine Creations Services.

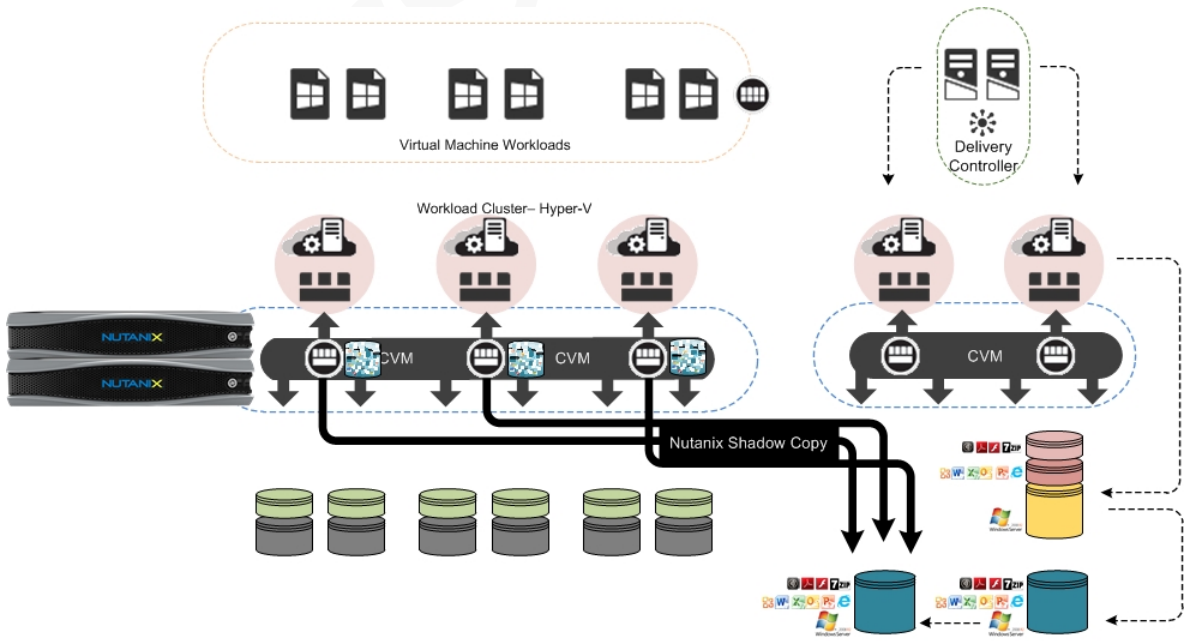

Figure 25. Citrix Machine Creation Services (MCS)

Access Controllers (StoreFront)

Access Controllers are responsible for user authentication and connectivity to the environment. They provide the framework allowing users to access the environment from any device and any location.

All users, regardless of being internal or external will need to gain access to a list of their virtualised resources via StoreFront.

The key design decisions for StoreFront controllers are as follows:

Category	Design Decision
Server O/S	Microsoft Windows Server 2012 R2 Standard Edition
Server per Site	2
Server Name(s)	DECISION POINT
CPU Allocation	2 vCPU
RAM Allocation	4 GB
Storage Allocation	C:\ 100GB
Access Method	Internal
Load Balancing	DNS Round Robin

Table 36: StoreFront Site Summary

Two virtualised StoreFront servers will be deployed. Each StoreFront virtual machine will always be separated on one of the two shared infrastructure/virtual desktop hypervisor hosts. This will ensure resiliency of the environment. Loss of a single infrastructure host or StoreFront server will not interrupt normal user operations.

The Citrix StoreFront servers may be load balanced using DNS round-robin. Optionally, Citrix StoreFront servers may be load balanced using Citrix NetScaler appliances configured in high availability mode (HA). Citrix specific service monitors can then be utilised to monitor the health of the StoreFront services to ensure intelligent load balancing decisions are performed increasing service availability.

Active Directory Integration. Each Machine object will be logical located in a dedicated Organisational Unit with specific Group Policy Objects applied as appropriate to the role please refer to the Active Directory Section for more details.

Hypervisor Layer

Microsoft Hyper-V Server® 2012 R2 Edition will be deployed to each Nutanix NX-3060 node. Hyper-V will provide the hypervisor hosting platform to the virtualised desktop and infrastructure server instances. Microsoft System Center Virtual Machine Manager (VMM) will be leveraged to provide the virtual machine operations and management interface to Hyper-V. VMM will also provide the integration interface between Citrix XenDesktop and the underlying hypervisor within the XenDesktop host connection.

The figure below depicts the relationship between Nutanix Virtual Computing Platform and the Hypervisor.

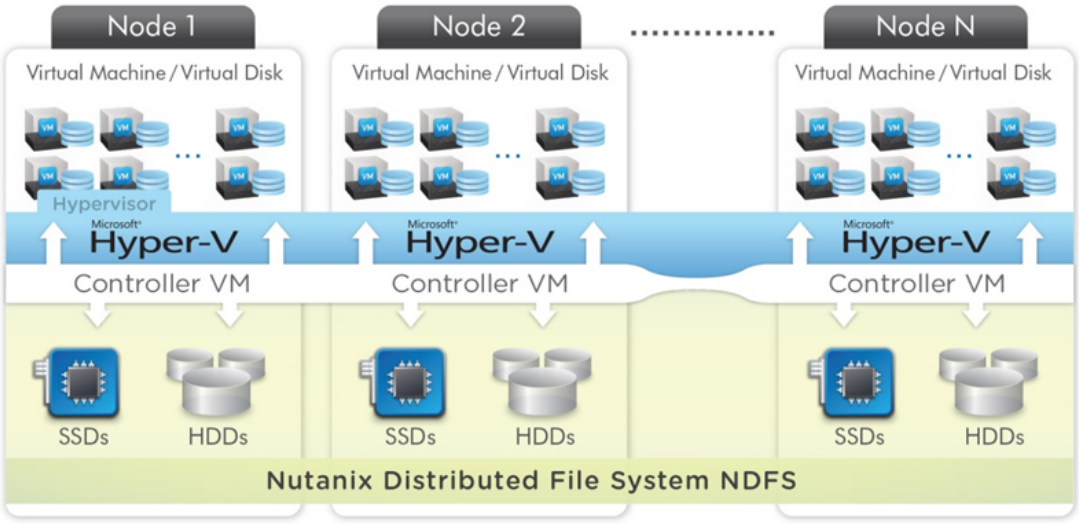

Figure 26. Hyper-V Host Deployment

Hyper-V Overview

The *Illustration below* depicts the physical components logically connected between a single Nutanix NX-3060 node, the Microsoft Hyper-V 2012 R2 hypervisor, local storage and associated switching infrastructure:

- **Network.** 2 x 10Gb On-board Ethernet Adapter for the hypervisor
- **Management.** 1 x 100/1000Mbps On-board Ethernet Adapter for IPMI Management
- **Network Teaming.** 1 x Network Team created consisting of 2 x Physical Network adapters (pNIC).
    - **Team A.** All traffic types including Host Management, Infrastructure VMs and Workload VMs (pNIC 1 + pNIC2).

HSD Hyper-V Host

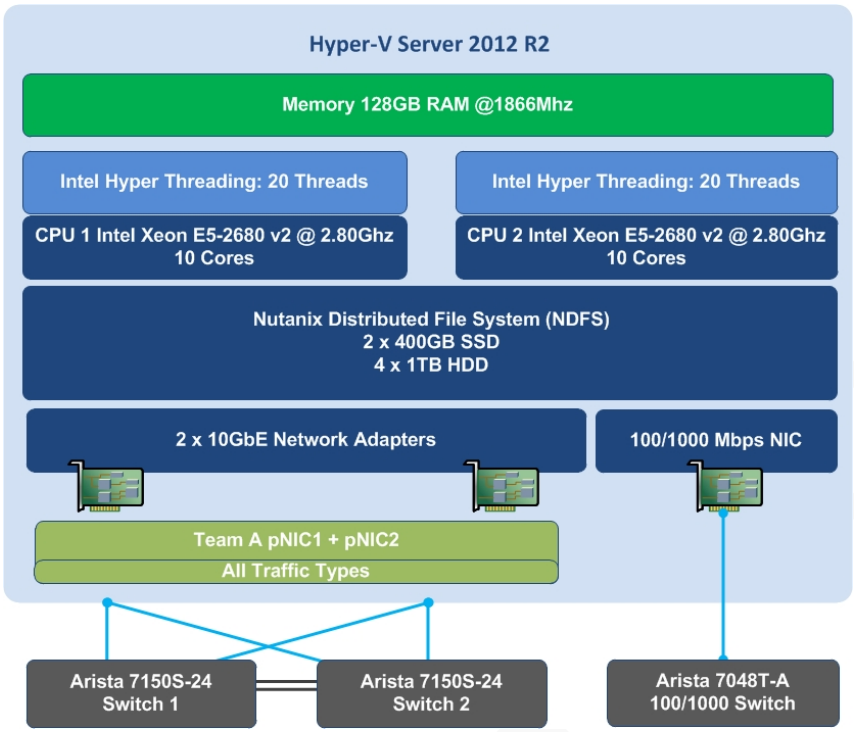

Figure 27. HSD Hyper-V Host Logical View

HVD Hyper-V Host

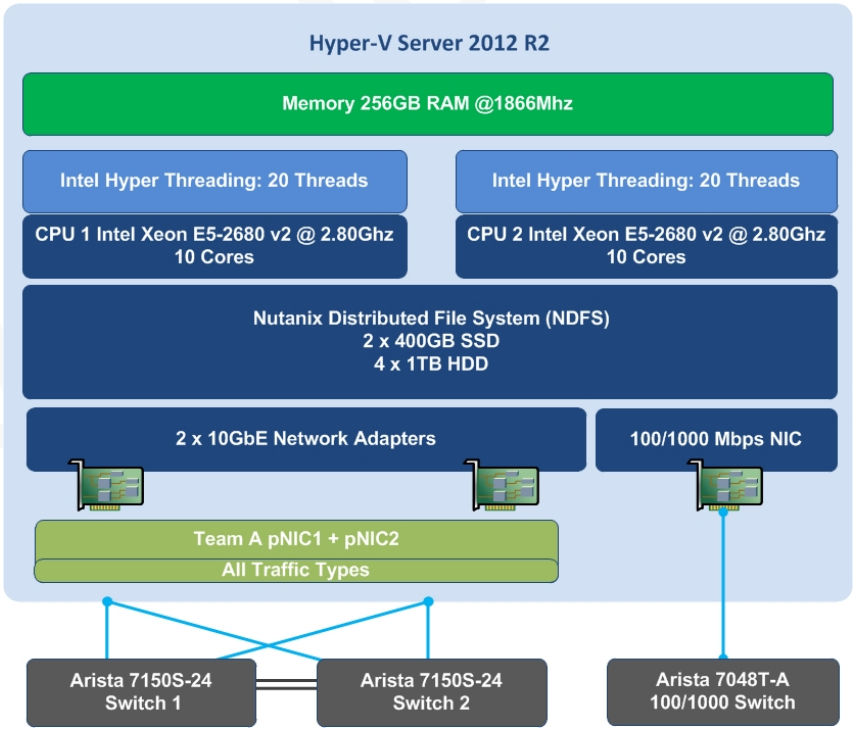

Figure 28. HVD Hyper-V Host Logical View

Hyper-V Hardware Details

Category	Decision / Description
Hardware	Refer to the section: Nutanix Virtual Computing Platform

Table 37: Hyper-V Hardware Details

Hyper-V General Details

Active Directory Integration. Each Machine object will be logical located in a dedicated Organisational Unit with specific Group Policy Objects applied as appropriate to the role please refer to the Active Directory Section for more details.

Category	Decision / Description
Host Configuration	Clustered Hyper-V deployment (Failover Cluster) For 1,000 HSD users - 6 x NX-3060 nodes at 128GB RAM per node For 1,000 HVD users - 10 x NX-3060 nodes at 256GB RAM per node
Version	• Microsoft Windows Hyper-V Server 2012 R2 (Windows Server 2012 R2 Datacenter with Server Core)[27]
Active Directory Integration	• Hosts joined to the Active Directory Domain "customer.domain.com"
Operating System Performance Power Scheme	• "High Performance"
Storage	Nutanix Distributed File System (NDFS) • Storage Pool: Citrix_StoragePool • Storage Container: Citrix_StorageContainer • Storage Type: SMB3
SMB3 Share Name	\\Nutanix-Cluster\Citrix_StorageContainer[28]
Storage Capacity	For HSD ~12TB with Replication Factor 2 (RF2) enabled, by consolidating local storage available from 6 x NX-3060 nodes within the cluster For HSD ~20TB with Replication Factor 2 (RF2) enabled, by consolidating local storage available from 10 x NX-3060 nodes within the cluster
Network Settings per Node	**NetAdapter Team** • 2 x 10 GbE NICs • Team Mode: Switch Independent • Load balancing mode: Hyper-V Port (for 'Switch Independent' mode only) **Node Management** • 1 x 100/1000 Mbps NIC
VM Switch	**InternalSwitch:** • Use: Hyper-V to CVM local communication

[27] Each node runs Microsoft Windows Server 2012 R2 (Server Core and Data Center are supported) with Hyper-V Server 2012 R2 role enabled.
[28] The SMB3 NDFS Share Name is derived by the name of the first Nutanix Node to be created within the Nutanix Cluster. Names are automatically created and generated within the Nutanix Cluster creation scripts.

	• Uplink(s): N/A **ExternalSwitch:** • Use: All external VM communication • Uplink(s): NetAdapterTeam
NTP	All Hyper-V Hosts will be members of an Active Directory domain and as such will inherit the proposed Active Directory time hierarchy
CPU Parking	• CPU core parking: Turned off for maximum performance
RDS Printer Mapping	• Disabled
Failover clustering	• Failover Clustering is enabled • High Availability is enabled • Node and Disk Majority (the default for a cluster with an even number of nodes)
Live Migration	Live Migration: Enabled Authentication Protocol: • Kerberos • See; http://technet.microsoft.com/en-us/library/jj134199.aspx
System Center 2012 R2-Virtual Machine Manager (VMM)	• Standalone server deployment
VM Placement Path	• Nutanix Distributed File System (NDFS) • Converged Local Storage • Native SMB3 Protocol
Scale-out Recommendation	Additional blocks should be deployed to scale out HSD or HVD capacity, thus additional Hyper-V host/failover clusters will be subsequently added.

Table 38: Hyper-V Key Settings

Nutanix Distributed File System (NDFS)

This solution combined with Nutanix Virtual Computing Platform, simplifies the creation and deployment of shared storage on the hypervisor level. Nutanix converges the storage of all Nutanix NX-3060 nodes available within the cluster and creates a single Storage Pool through its Nutanix CVM and the NDFS. This is made available to the Hyper-V Cluster as a SMB3 share.

The total available storage is based on the Replication Factor 2 (RF2), configured on Nutanix. RF2 provides an additional layer of redundancy during a node failure, through redundant copies of all data. Writes to the platform are logged in the high-performance SSD tier, and are replicated to another node before the write is committed and acknowledged to the hypervisor. If a failure occurs, NDFS automatically rebuilds data copies to maintain the highest level of availability.

Hyper-V Network Details

Each Hyper-V host will be configured with two default switches, to facilitate internal and external communication. The External Switch, as the name implies, is specifically used for external communication. This is split into 3 separate VLANs used primarily for VM, Infrastructure and Hyper-V host communications. This is connected to the 10GbE uplinks physically connected to the Arista Networks switches utilising Hyper-V Switch Independent Mode.

The Internal Switch is utilised solely for SMB I/O communications between the Hyper-V host and the Nutanix CVM.

The figure below defines the Hyper-V Virtual Switch Schematics. The configuration depicted directly relates to the network VLAN configurations.

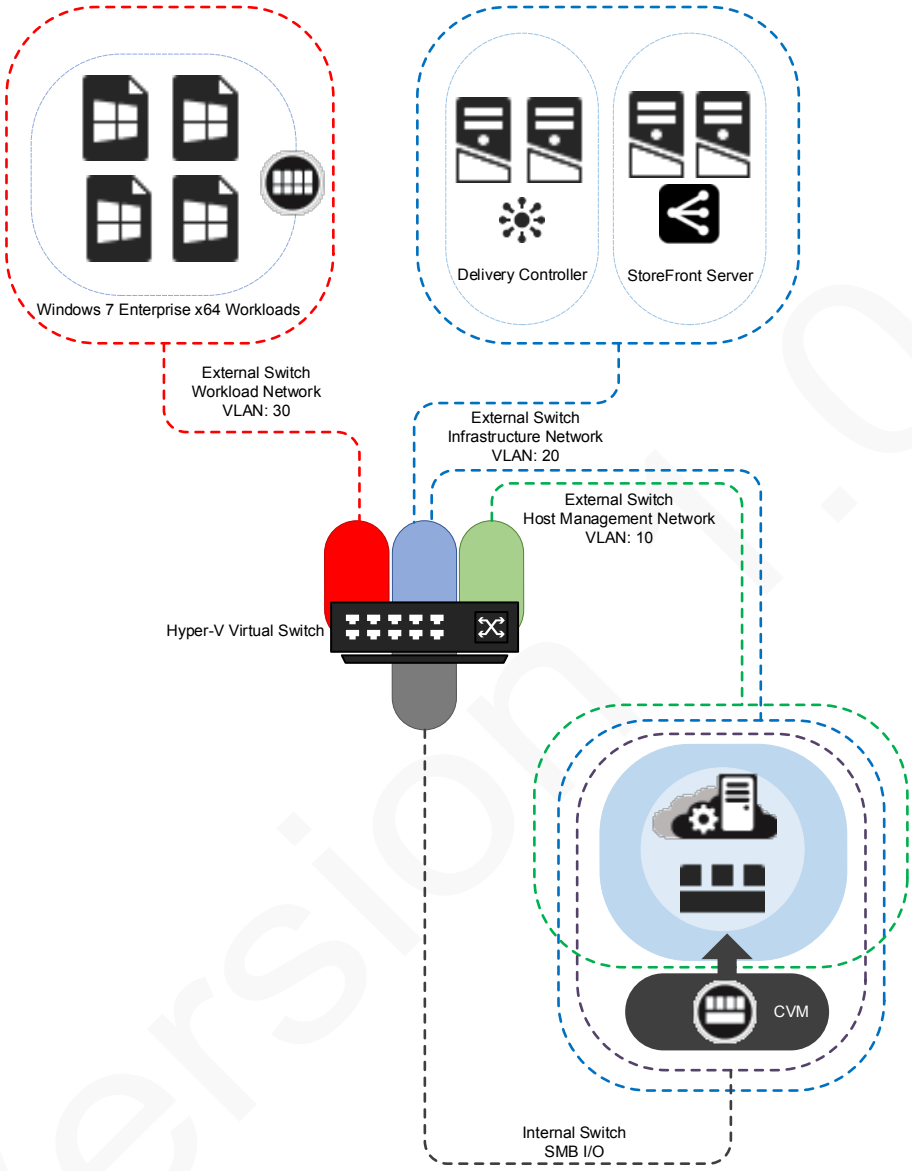

Figure 29. Hyper-V Virtual Switch Configuration

System Center Virtual Machine Manager

VMM General Details

Category	Decision / Description
Prerequisite Software	Microsoft .NET Framework 4.5 Windows Assessment and Deployment Kit (WADK) for Windows Server 2012 R2
VMM Management Server	VM Guest
Server O/S	Microsoft Windows Server 2012 R2 Standard Edition
Server Name(s)	DECISION POINT
CPU Allocation	2 vCPU
RAM Allocation	8GB dynamic memory not enabled
Storage Allocation	C:\ 100GB D:\ 150GB (Library Repository)
VMM Console	Installed on: • VMM Management server • XenDesktop Controllers • Other Management server(s)
VMM Library	Initially hosted on the VMM Management server Disk Space Requirements: • ~150GB Dependant on storage requirements (e.g. ISO images templates etc.) Note: Nutanix can also automatically create a native SMB3 share for SCVMM Library during setup. Using the Nutanix SMB share for VMM library cloning operations will be faster as the process can utilize ODX (MS Offloaded Data Transfers) for copy operations. MS ODX also reduces CPU consumption on the Hyper-V host as compared to using a regular SMB share. The default library share that gets created on Nutanix is referenced as "NTNX-HV-library. This also get automatically added to SCVMM.
VMM Database	Requirements: • Refer to the Database section for further details • Disk Space for database: ~5 - ~150 GB dependant on usage profile.
Service Accounts	• Run As Account (also used for XenDesktop Host Connection) • Service Account Refer to the Appendix for further details

Table 39: VMM General Details

VMM Network Details

Category	Decision / Description
Logical and VM Networks	The following VM and Logical Networks will be created: • Infrastructure VLAN (ID) • HVD VLAN (ID) • HSD VLAN (ID)

Table 40: VMM Network Details

VMM Guest Virtual Machine Details

Category	Decision / Description
Integration Services	Version: 6.2.9200.16433
Dynamic RAM	Configured on each VM Guest type where indicated throughout the design: Start-up Memory: • Value should be indicative of the expected working load of the guest to avoid excessive paging while expanding Maximum Memory: • Maximum as defined for the guest workload
Power Actions:	Action to take when the virtualisation server stops: • Turn off virtual machine (Avoids the creation of .BIN files reserved to the size of RAM assigned to each virtual machine, saving disk space)

Table 41: VM Guest Details

Virtual Machine Manager. System Center 2012 R2 - Virtual Machine Manager (VMM) will be deployed as the management solution for the virtualised environment. VMM will provide the management interface to the virtualised Hyper-V environment for VM Templates, logical networks, Hyper-V hosts and other related services.

- **VMM Database.** Refer to the section Database Platform
- **VMM Library Server.** The VMM Library server will initially be configured on the VMM server, once the environment is built and tested additional Library servers may be used to meet any expanding storage requirements of the virtual environment. e.g. additional virtual machine templates, ISO repository.
- **VMM Networking.** A VM network and Logical Network will be created for each VLAN with the associated VLAN ID defined at the Logical Network object. Each Logical network object will be associated with the Hyper-V Switch. Each VM Network will be associated with the appropriate guest virtual machine.

Active Directory Integration. The VMM machine object will be logical located in a dedicated Organisational Unit with specific Group Policy Objects applied as appropriate to the role please refer to the Active Directory Section for more details.

Network Layer

Overview

Arista Networks' switches and network operating system are designed from the ground up for reliable, economic data centre operations. Providing the industry's leading port density, lowest latency, and first extensible operating system, Arista switches scale seamlessly to meet application and storage demands. Standards-based layer 2 and layer 3 multi-pathing technologies provide an increase in scalable bandwidth and HA that is transparent to both users and applications.

Combining Arista Networks switches with Nutanix Virtual Computing Platform provides the perfect platform for Citrix XenDesktop workloads. The dynamic buffer allocation of the Arista 7150S-24 provides packet memory to congested interfaces on demand, as load dictates and helps to avoid packet loss. The Arista 7150S-24 additionally provides low latency and a suite of advanced traffic control and monitoring features to improve the agility of modern high performance environments. With enhanced microburst and latency analysis, visibility at even the slightest transient congestion at microsecond granularity is possible.

Scalable Network Design

Arista Networks Software Driven Cloud Network designs provides unprecedented scalability, performance and density without proprietary protocols, lock-ins or forklift upgrades. The network design for this Citrix CVS on Nutanix is very simple, yet may scale out to support thousands, or tens of thousands of Hosted Virtual or Shared Desktop deployments.

A single tier, "Spline" network design is utilised for this deployment. This single tier scale is determined by the number of interfaces available in the top of rack switch selected. This design includes a 24-port 10GbE switch. A spline design, with the various Arista switch models available, could potentially scale up to provide 10GbE connectivity for up to 2000 Nutanix nodes within a single tier of two Arista switches. A Spline design is inherently non-oversubscribed with a 1:1 contention ratio between compute and storage nodes.

Starting with a 24-port 10GbE switch and scaling out in the future is also possible. By converting the Spline design to a 2-tier, Spine/Leaf design, the network design can scale out while maintaining minimal to zero oversubscription to support tens of thousands of Citrix Hosted Virtual and Shared Desktops on Nutanix Virtual Platform nodes.

The Arista cloud network designs are illustrated below.

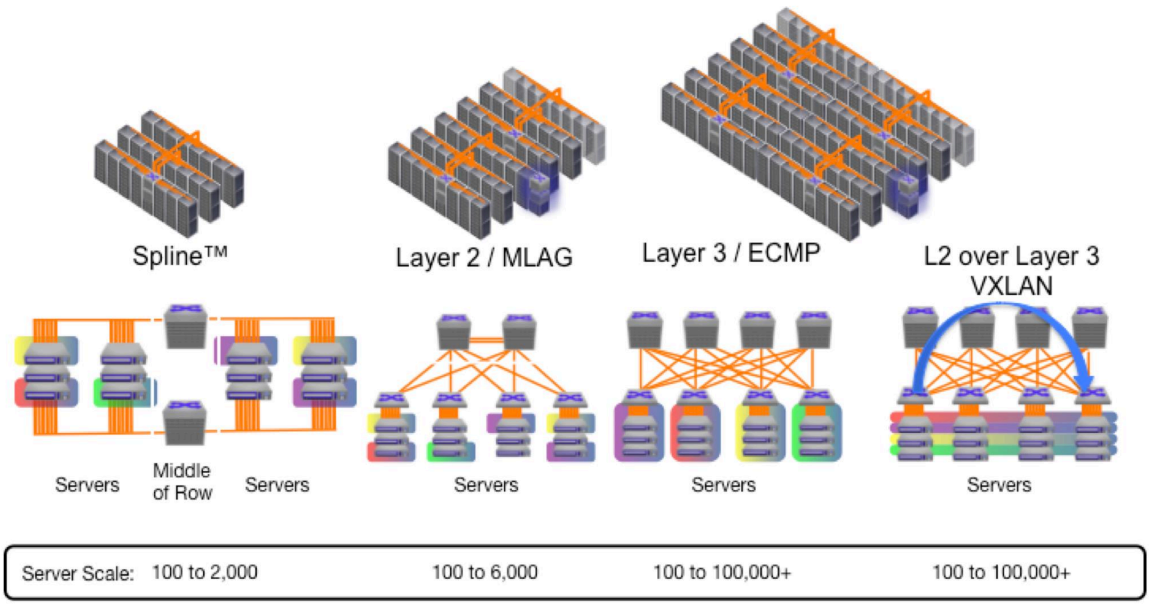

Figure 30. Arista Networks Design

Multi Chassis Link Aggregation

Modern infrastructure should be able to run active/active. Multi Chassis Link Aggregation (MLAG) at layer 2 and Equal Cost Multi-Pathing (ECMP) at layer 3 enables infrastructure to be built as active/active with no ports blocked so that networks can use all the links available between any two devices. In this design, MLAG is utilised to provide a redundant connection to the IPMI switch and may also be utilised to provide upstream network connectivity to core or edge network services.

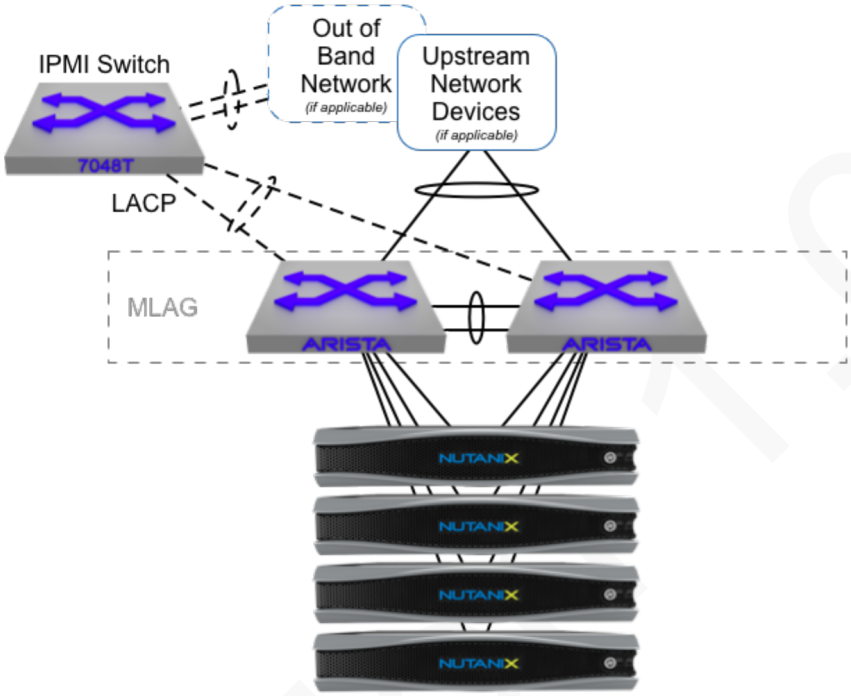

Figure 31. Sample Arista Networks MLAG Topology

Connectivity Design

Microsoft Hyper-V NIC teaming is available in two modes: switch independent and switch dependent.

- With a simple port-channel configuration between the Arista top of rack switches, Hyper-V may operate in switch independent NIC teaming mode.
- In switch independent mode, Hyper-V controls the switching intelligence to provide network redundancy and forwarding on all upstream links to the Arista switches.
- Should LACP be required from Hyper-V, MLAG configuration is available on the Arista switch platform as described above.

The Arista 7048T-A switch provides console management connectivity from the Nutanix nodes. The Nutanix Intelligent Platform Management Interface (IPMI) allows administrators out of band access to the Nutanix nodes. Through this interface, administrators have power control, console access and the ability to attach and remove devices to each node within the Nutanix block.

The *Illustration* below describes connection topology of the servers and their associated network traffic types.

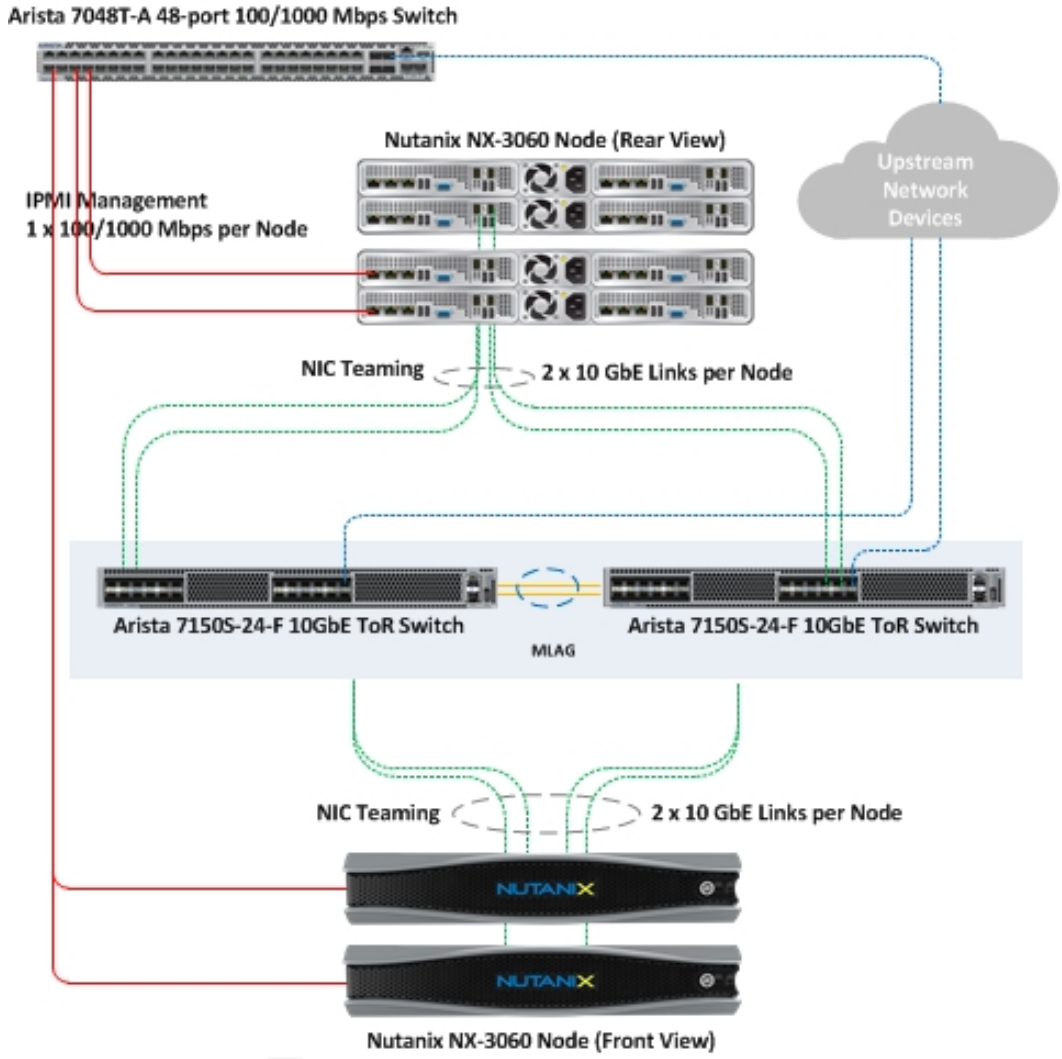

Figure 32. Network Connectivity Topology

Network Components

Category	Description / Decision
Switch	• Arista 7150S-24 10GbE Top of Rack (ToR) Switch • Arista 7048T-A 100/1000 Mbps Switch or Customer Defined Switches. Refer to Appendix for Network Switch Requirements
Connectivity	• 2 x 10GbE ports per NX-3060 node for Hyper- V traffic connected to pair of Arista 7150S-24 10GbE switches • 100/1000 Mbps port per NX-3060 node for IPMI traffic connected to Arista 7048T-A 100/1000 Mbps • Uplink from the1GbE Top of Rack Switches to upstream switching fabric
Switch Port Configuration	**Hyper-V Team A** (Host Management, Infrastructure and Desktop Workload VM Traffic and Live Migration traffic)

	• Trunked • Native VLAN = management VLAN **Management Interfaces**: • Access Port (out of bound management VLAN)
Sample Base Configuration	**Per Nutanix node facing interfaces:** interface Ethernet<int_if> switchport mode trunk switchport trunk native vlan 10 spanning-tree portfast **Inter-switch physical and port-channel interfaces:** interface Ethernet<intf_id> switchport mode trunk switchport trunk native vlan 10 channel-group <group_id> mode active ! interface Port-Channel<group-id> switchport mode trunk switchport trunk native vlan 10
Sample MLAG Configuration	vlan <mlag-peer_vlan-id> name mlag-peer-vlan ! interface vlan <mlag-peer_vlan-id> ip address <ip-addr>/<subnet_length> no autostate ! mlag configuration local-interface vlan <mlag-peer_vlan-id> peer-address <peer_ip-addr> peer-link port-channel <peer-link_port-channel-id> domain-id <identifier>

Table 42: Network Key Decisions

VLAN Information

VLAN Name	VLAN ID (ID reference only)	Description
Hostmgmt_vlan	VLAN 10	Hyper-V Host Management VLAN
Infraserver_vlan	VLAN 20	Infrastructure Server VLAN • Citrix and Microsoft Infrastructure Server VMs • Nutanix CVM
Infraworkload_vlan	VLAN 30	Infrastructure Workload VLAN • HSD VM Traffic
Infraworkload_vlan	VLAN 31	Infrastructure Workload VLAN • HVD VM Traffic

Table 43: VLAN Requirements

Each of the NX-3060 nodes' 10GbE NICs will be uplinked to a pair of Arista 7150S-24 10GbE Top of Rack (ToR) switches configured in a redundant fashion. The Arista switches in turn will be uplinked to upstream network infrastructure for Layer 3 routing capability and integration to the rest of the environment. Switch ports will be configured as trunk ports with the native VLAN defined for the Hyper-V management interfaces.

The dual 10GbE On-board NICs will be configured as Hyper-V "Load Balancing and Fail Over" Teams to provide bandwidth aggregation, and/or traffic failover to maintain connectivity in the event of a network component failure. The two network adapters that form each Team will be physically connected to separate switches. The switch ports for each Hyper-V NIC Team will be configured as Switch Independent mode.

DHCP

Category	Description / Decision
Version, Edition	Windows Server 2012 R2 DHCP Role enabled
Servers	If the customer does not have a suitable redundant DHCP service available the two File servers described in this design may have the DHCP Role enabled. These servers will then provide IP addressing requirements to the virtual desktops. Refer to the Appendix for DHCP Scope details.
(IPv4 Options) Failover	Failover Enabled

Table 44: DHCP Requirements

DHCP. The two File Servers will also host Microsoft DHCP Services for the IP addressing requirements of the virtual desktops. DHCP Relay will be configured on the Arista 7150S-24 switches, allowing client DHCP discover packets to be forwarded to their respective DHCP servers. DHCP scopes will be deployed as highly available in load balanced mode, using the capabilities of the Windows Server 2012 R2 DHCP Role.

Hardware Layer Design

The hardware layer defines the type and amount of physical resources that are required to support the Citrix Validated Solution.

Physical Architecture Overview

This Citrix Validated Solution is built using Nutanix Virtual Computing Platform NX-3060 nodes, Arista 7150S-24 10GbE ToR switches and Arista 7048T-A 100/1000 Mbps switches. The *illustration* below describes the physical hardware component view for the hosted virtual desktop platform delivered by Citrix XenDesktop.

HSD Physical Hardware View

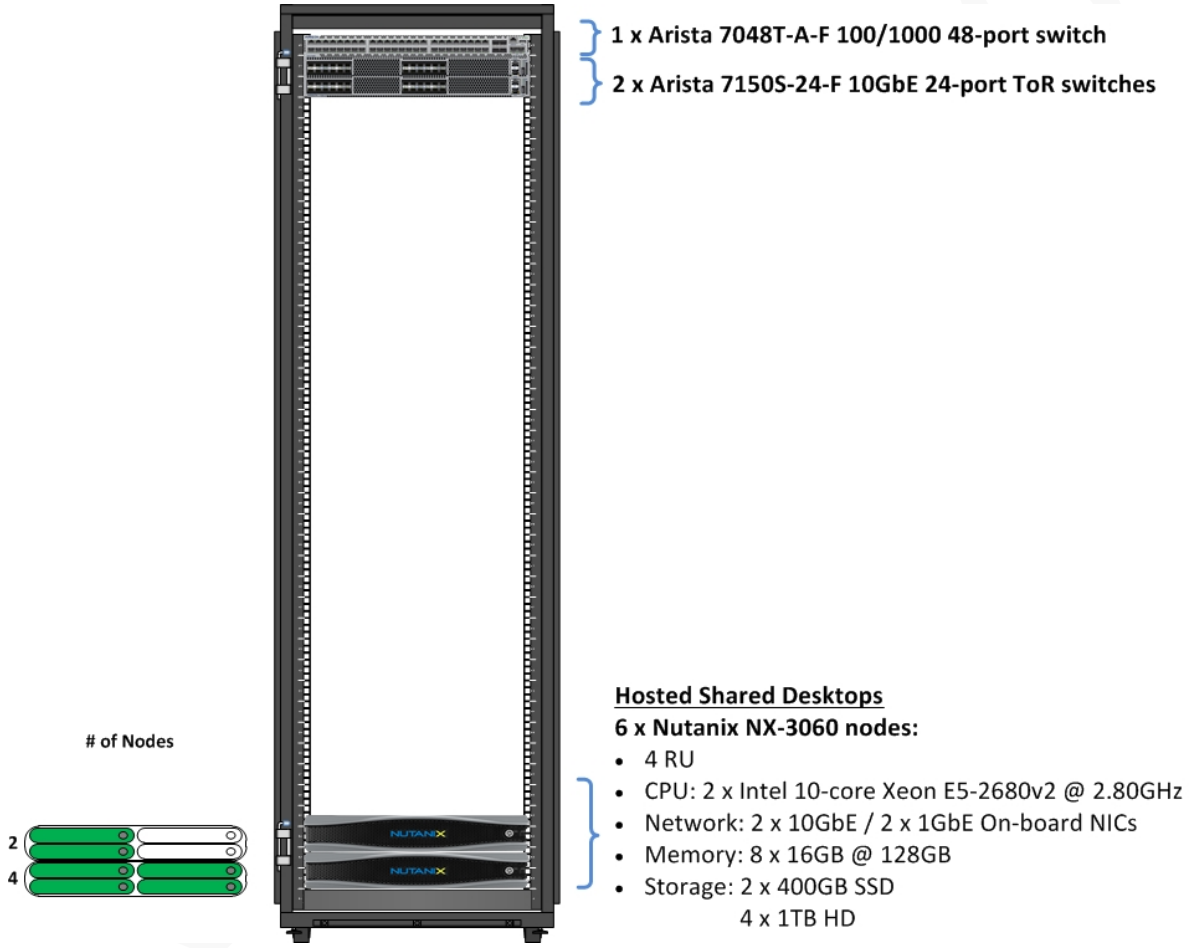

Figure 33. Hardware required to support 1,000 HSD users

HVD Physical Hardware View

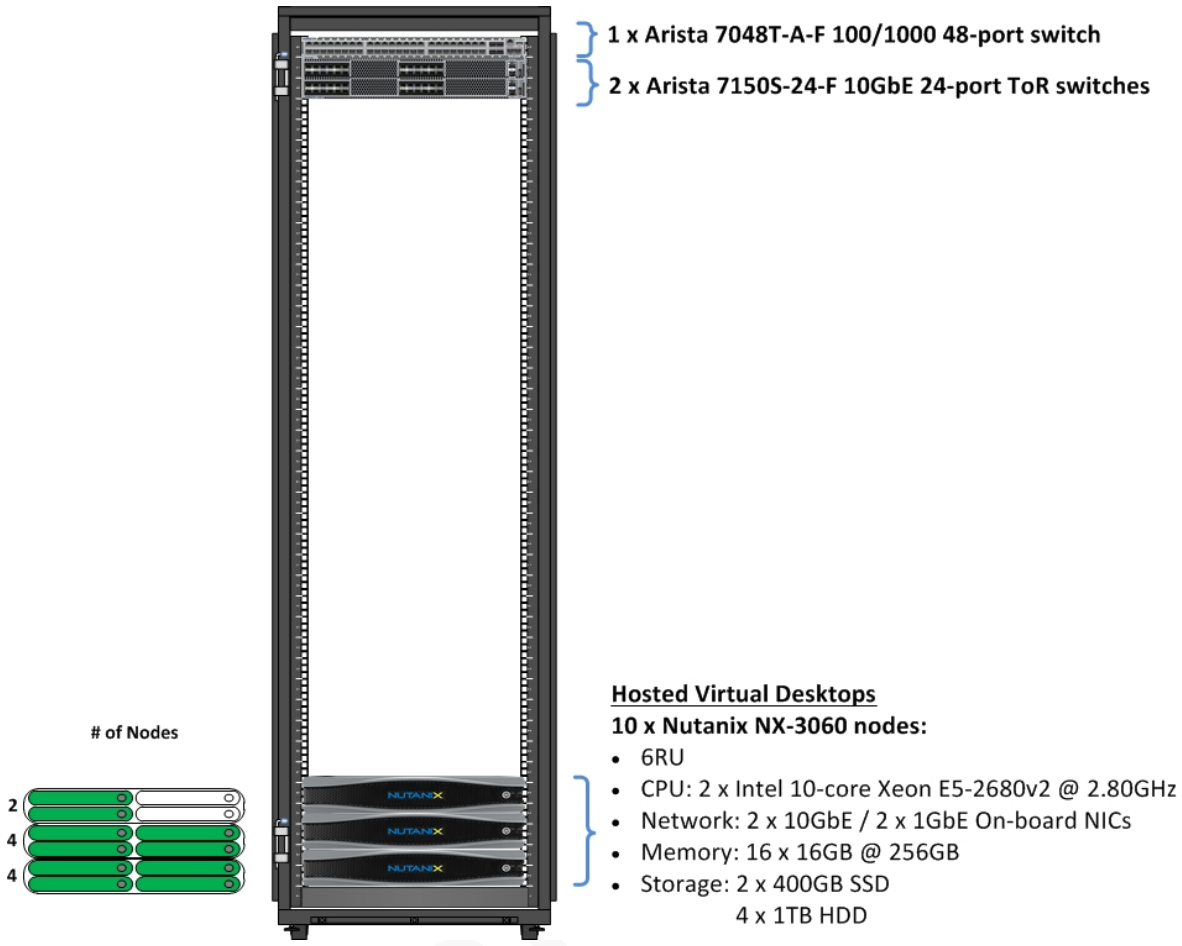

Figure 34. Hardware required to support 1,000 HVD users

Physical Component Overview

Hardware Component	Component Information/Revision
Compute/Storage	Nutanix NX-3060 Node: • 2 x Intel 10-core Xeon E5-2680v2 processors • 2 x 400GB SSD - 800GB SSD Capacity (for High Priority Data and MDS) • 4 x 1TB HDD - 4TB HDD Capacity (for Data Storage) • Nutanix Controller VM • Nutanix Foundation 1.2.1 – hypervisor-agnostic integration manager
Memory	Per NX-3060 node: • For nodes running HSD workloads: 128GB (8 x 16GB RAM) • For nodes running HVD workloads: 256GB (16 x 16GB RAM)
Network adapters	Per NX-3060 node: • On-board 2 x 10GbE NICs • On-board 2 x 100/1000 Mbps IPMI NICs
Network Switching	• 2 x Arista 7150S-24 10GbE ToR switches • 1 x Arista 7048T-A 100/1000 Mbps 48-port switch for IPMI

Table 45: Hardware Components

Nutanix Virtual Computing Platform

Nutanix Virtual Computing Platform is a web-scale converged infrastructure solution that consolidates multiple compute (server) with its corresponding storage into a single, integrated cluster. The NX-3060 integrates high-performance compute resources with enterprise-class local storage in a cost-effective 2U appliance. The storage is consolidated and controlled by the Nutanix CVM, making it available to all compute hosts and virtual machines. Storage and compute can be linearly scaled by simply adding additional nodes to the Nutanix cluster. This removes the need for network-based storage architecture, such as a storage area network (SAN) or network-attached storage (NAS).

Microsoft Hyper-V Server 2012 R2 operating system (Hyper-V) will be installed locally on the node, with the virtual machine hard disks and virtual machine configuration files stored on the SMB3 cluster shared volume.

- **Nutanix Control VM (CVM).** CVM is the instance of Nutanix OS that runs in a VM on the hypervisor on an individual node. It is serves all of the I/O operations for the hypervisor and all VMs running on that host. The CVM takes ownership of the local storage (SSD and HDD) and pools it across all different CVMs using the Nutanix Distributed File System (NDFS). NDFS and the CVM ensures data actively used by the local VMs are kept in SSD, automating the tiering between local SSD, HDD and remote nodes and provides functionality such as VM-granular snapshot, cloning and replication.
- **Prism.** Prism is the management gateway for component and administrators to configure and monitor the Nutanix cluster. This includes Ncli, the HTML5 UI and REST API. Prism runs on every node in the cluster and uses an elected leader like all components in the cluster. Prism has been built to handle millions of objects so it can manage clusters of any size
- **Foundation.** Foundation is a tool that allows administrators to completely bootstrap, deploy and configure a bare-metal Nutanix cluster from start-to-end with minimal interaction in matter of minutes. Foundation will request few general parameters about

network and in most cases even detect the Nutanix nodes using multicast Domain Name System (mDNS), also known as BonJour

- **Shadow Clones.** Nutanix Shadow Clones delivers distributed localized caching of virtual disks performance in multi-reader scenarios such as desktop virtualization using MCS using a master VM. With Shadow Clones, the CVM actively monitors virtual disk access trends. If there are requests originating from more than two remote CVMs, as well as the local CVM, and all of the requests are read I/O, the virtual disk will be marked as immutable. Once the disk has been marked immutable, the virtual disk is then cached locally by each CVM, so read operations are now satisfied locally by local storage.

The key design decisions for the server hardware are as follows:

Decision Point	Description / Decision
Hardware Model	Nutanix NX-3060
Compute	Nutanix NX-3060 • Rack Mounted Servers • Dual Intel(R) Xeon(R) CPU E5-2680 v2 @ 2.80GHz
Memory	NX-3060 configurable with 128 GB, 256 GB or 512 GB at 1333-MHz **HSD Servers:** • Includes Infrastructure VMS on shared hosts • Total of 128GB RAM per server node **HVD Servers:** • Includes Infrastructure VMS on shared hosts • Total of 256GB RAM per server node
Firmware Revisions	• Nutanix OS (NOS) Version 3.5 • Firmware Revision: 02.33 • Firmware Build Time: 2013-09-20 • Nutanix Prism
Hardware BIOS Settings	• Enable CPU Configuration / CPU Power Management Configuration / Energy/Performance Bias: Performance
Network	Host Management – IPMI: • 1 x 10/100 Mb Interface • Remote Control / Management of physical node Infrastructure: • 2 x 10GbE Interfaces • Jumbo Frames: Enabled • Trunk Native VLAN 10 (Hyper-V Management) • HVD / HSD Traffic (VLAN ID: 30-31)
MTU	• MTU 9000 • Jumbo Frames are requires for Cluster creation as well as maximum traffic throughput
Storage	Local Storage – total of 2.4TB usable capacity • 2x 400 GB SSD • 4x 1 TB HDDs
Nutanix Control VM (CVM)	• Virtual CPU Allocation: default 8 VCPUs pinned to 4 physical CPU cores • Virtual RAM Allocation: increase to 24GB static

Storage Pool	• Name: Citrix_StoragePool • Shadow Clones: Enabled
Storage Container	• Name: Citrix_StorageContainer • Free Reserved: 0 GB (Max Available) • De-duplication: Disabled • Compression: Disabled • Replication Factor: 2 (RF2)
File System Whitelist	• Microsoft Hyper-V Subnet
Scaling Guidelines	• Nutanix Cluster up to 24 nodes • 1 x Storage Pool per Nutanix Cluster • 1 x storage Container for all virtual machines • Upgrade Nutanix CVM 20 24GB RAM (static assignment)

Table 46: Nutanix Virtual Computing Platform Key Decisions

The NDFS Shadow Clone feature allows for distributed caching of vDisks or VM data which is in a 'multi-reader' scenario, i.e. Citrix Machine Creation Services. This will allow VMs on each node to read the Base VM's vDisk locally instead of forwarding read requests to a master 'Base VM'. In the case of VDI, this means the base disk can be cached by each Nutanix node and all read requests of the base data will be served locally. Where the Base VM is modified the Shadow Clone's data will be dropped and the process will start over.

Jumbo frames will be enabled and configured on the network switches and Hyper-V hosts. This is a requirement for configuring the solution and creating the Nutanix Cluster.

Bill of Materials - Hosted Shared Desktops

The following table describes the required bill of materials for a single Hosted Shared Desktop pod of 1,000 users.

Nutanix Hardware

Part Number	Description	Quantity
NX-3060 Purchased as: NX-3460 (1) NX-3260 (1)	**Nutanix Virtual Computing Platform - single node** - Hypervisor agnostic Integration Manager - 2 x Intel 10-core Xeon E5-2680v2 processors **Nutanix Virtual Computing Platform - Nutanix OS - Starter Edition** - Nutanix Controller VM - Nutanix Virtualization-ready Platform - Nutanix Information Lifetime Management - Nutanix Data Protection and Availability - Nutanix Automatic Storage Provisioning - Nutanix Advanced Storage Management - Nutanix Capacity Optimization - Nutanix Seamless Scale-out - 800GB SSD Capacity (for High Priority Data and MDS) - 4TB HDD Capacity (for Data Storage) **Nutanix Virtual Computing Platform - Management** **Accessories per Block (Single Block is 4 x nodes)** 1 x Bezel 1 x Rail Kit 1 x Rail Kit Adapter Kit (Round to square holes rail adapters and rail screw bag) 2 x C13/C14 Power Cables 1 x OEM Documentation Kit	6 nodes 1 1
C-MEM-128GB-3060	Config: Includes 128GB (8x 16GB) on each NX-3060 node	6
C-CBL-3M-SFP+-SFP+	3M Cable (SFP+ to SFP+) 2 x cables per node	12

Table 47: Nutanix BOM for HSD

Arista 10GbE ToR Switch Hardware

Part Number	Description	Quantity
DCS-7150S-24-F	Arista 7150S, 24x10GbE (SFP+) switch, front-to-rear air, 2xAC, 2xC13-C14 cords	2
LIC-FIX-1-Z	Monitoring & provisioning license for Arista Fixed switches 24-36 port 10G (ZTP, LANZ, TapAgg, API, Time-stamping, OpenFlow)	2
CAB-SFP-SFP-1M	10GBASE-CR Twinax copper cable with SFP+ connectors on both ends (1m)	2
SFP-10G-SR	10GBASE-SR SFP+ (Short Reach) for uplinks to Spine Switches	8

Table 48: Arista 10GbE ToR Switch BOM for HSD

Arista Management Switch Hardware

Part Number	Description	Quantity
DCS-7048T-A-F	Arista 7048-A switch 48xRJ45(100/1000), 4xSFP+(1 or 10GbE),ZTP, front-to-rear fans, 2xAC, 2xC13-C14 cords	1
CAB-SFP-SFP-1M	10GBASE-CR Twinax copper cable with SFP+ connectors on both ends (1m)	2

Table 49: Arista Management Switch BOM for HSD

Support and Maintenance

Part Number	Description	Quantity
	Nutanix	
S-PLAT-3460-3YR	3 YEAR PLAT System support for Nutanix NX-3460	1
S-PLAT-3260-3YR	3 YEAR PLAT System support for Nutanix NX-3260	1
	(Nutanix recommend evaluating support for specific needs)	
	Arista Networks	
SVC-7150S-24-1M-NB	1 Month A-Care Software & NBD Hardware Replacement/Same Day Ship for 7150S-24 per Switch	72
SVC-7048A-1M-NB	1-Month A-Care Software & NBD Hardware Replacement/Same Day Ship for 7048T-A per Switch	36

Table 50: Hardware Support and Maintenance

Bill of Materials - Hosted Virtual Desktops

The following table describes the required bill of materials for a single Hosted Virtual Desktop pod of 1,000 users.

Nutanix Hardware

Part Number	Description	Quantity
NX-3060 Purchased as: NX-3460 (2) NX-3260 (1)	**Nutanix Virtual Computing Platform - single node** - Hypervisor agnostic Integration Manager - 2 x Intel 10-core Xeon E5-2680v2 processors **Nutanix Virtual Computing Platform – Nutanix OS - Starter Edition** - Nutanix Controller VM - Nutanix Virtualization-ready Platform - Nutanix Information Lifetime Management - Nutanix Data Protection and Availability - Nutanix Automatic Storage Provisioning - Nutanix Advanced Storage Management - Nutanix Capacity Optimization - Nutanix Seamless Scale-out - 800GB SSD Capacity (for High Priority Data and MDS) - 4TB HDD Capacity (for Data Storage) **Nutanix Virtual Computing Platform - Management** **Accessories per Block (Single Block is 4 x nodes)** 1 x Bezel 1 x Rail Kit 1 x Rail Kit Adapter Kit (Round to square holes rail adapters and rail screw bag) 2 x C13/C14 Power Cables 1 x OEM Documentation Kit	10 nodes 2 1
C-MEM-256GB-3060	Config: Includes 256GB (16x 16GB) on each NX-3060 node	10
C-CBL-3M-SFP+-SFP+	3M Cable (SFP+ to SFP+) 2 x cables per node	20

Table 51: Nutanix BOM for HVD

Arista 10GbE ToR Switch Hardware

Part Number	Description	Quantity
DCS-7150S-24-F	Arista 7150S, 24x10GbE (SFP+) switch, front-to-rear air, 2xAC, 2xC13-C14 cords	2
LIC-FIX-1-Z	Monitoring & provisioning license for Arista Fixed switches 24-36 port 10G (ZTP, LANZ, TapAgg, API, Time-stamping, OpenFlow)	2
CAB-SFP-SFP-1M	10GBASE-CR Twinax copper cable with SFP+ connectors on both ends (1m)	2
SFP-10G-SR	10GBASE-SR SFP+ (Short Reach) for uplinks to Spine Switches	8

Table 52: Arista 10GbE ToR Switch BOM for HSD

Arista Management Switch Hardware

Part Number	Description	Quantity
DCS-7048T-A-F	Arista 7048-A switch 48xRJ45(100/1000), 4xSFP+(1 or 10GbE),ZTP, front-to-rear fans, 2xAC, 2xC13-C14 cords	1
CAB-SFP-SFP-1M	10GBASE-CR Twinax copper cable with SFP+ connectors on both ends (1m)	2

Table 53: Arista Management Switch BOM for HVD

Support and Maintenance

Part Number	Description	Quantity
	Nutanix	
S-PLAT-3460-3YR	3 YEAR PLAT System support for Nutanix NX-3460	2
S-PLAT-3260-3YR	3 YEAR PLAT System support for Nutanix NX-3260	1
	(Nutanix recommend evaluating support for specific needs)	
	Arista Networks	
SVC-7150S-24-1M-NB	1 Month A-Care Software & NBD Hardware Replacement/Same Day Ship for 7150S-24 per Switch	72
SVC-7048A-1M-NB	1-Month A-Care Software & NBD Hardware Replacement/Same Day Ship for 7048T-A per Switch	36

Table 54: Hardware Support and Maintenance

Windows File Services

This Citrix Validated Solution has a dependency for Windows SMB file shares to host User Profile data for each of the pooled or shared virtual desktop types discussed in this document.

Resiliency within this architecture is provided by Hyper-V failover clustering and utilisation of redundant components. E.g. if a single component fails there will be sufficient capability within the environment to allow end users to continue normal operations with minimal or no interruption to the business or their daily routine.

This section discusses design considerations to deploy two Microsoft Server 2012 R2 file servers. These File servers are intended to provide a redundant active/passive platform to host the files shares required to support the User Profile data of a single pod.

The illustration below describes the conceptual architecture:

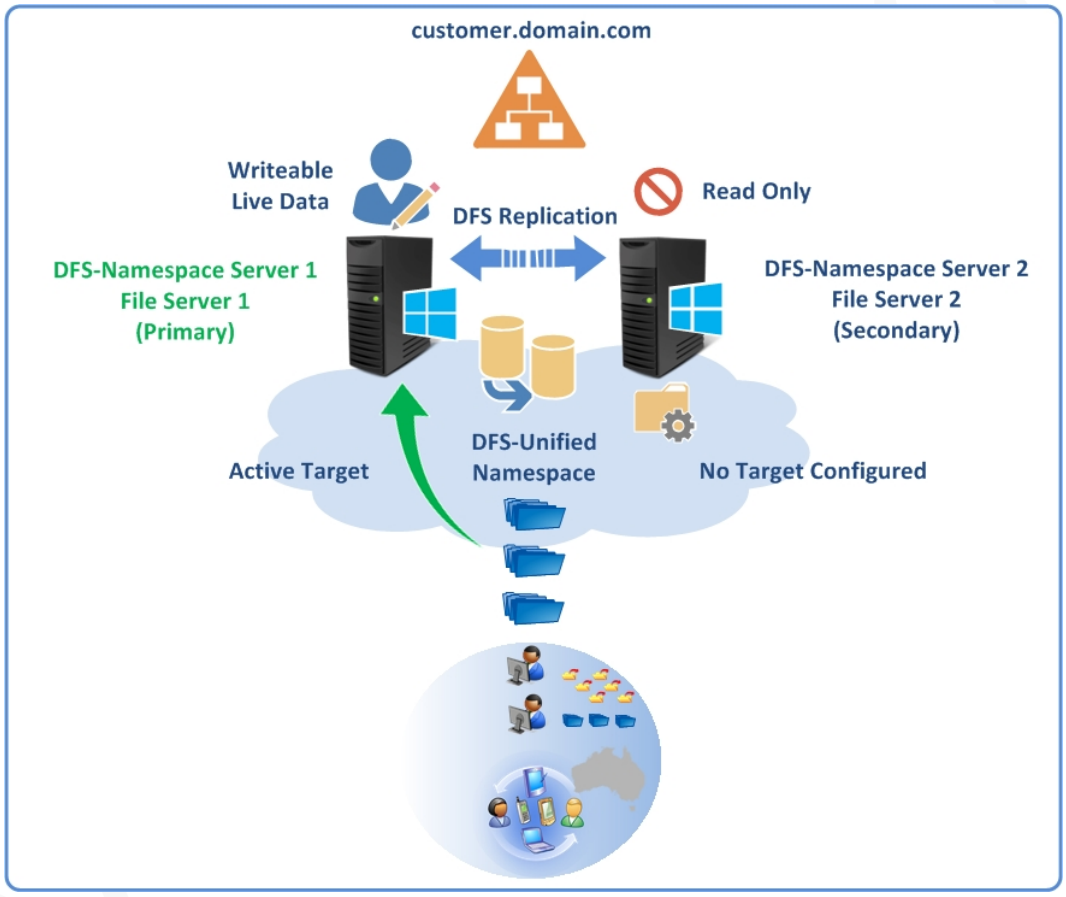

Figure 35. File Services – DFS Configuration

The architecture is based on two file servers using DFS (Distributed File System) Namespaces to provide a unified share name, utilising DFS Replication to replicate data from the primary file server to the secondary (read only) file server.

Manual intervention will be required to activate the secondary read only file server, however testing has shown that down time is minimal based on the applications tested.

This supported configuration is documented in the following Microsoft articles and should be used as a reference point.

- http://support.microsoft.com/kb/2533009
- http://blogs.technet.com/b/askds/archive/2010/09/01/microsoft-s-support-statement-around-replicated-user-profile-data.aspx

Note: At no point will the active primary file server be configured with secondary DFS targets. In the event of a failure or maintenance manual steps are required to add the secondary file server targets; this is documented in the above articles.

Both file servers will be configured identical, if the primary server is failed over to the secondary server for maintenance then the secondary server becomes the primary server from that point onwards.

In the event of system maintenance, system, failure or any other event that requires downtime of the primary file server, the existing target links are removed and replaced with targets that point to the secondary file server, DFS Replication keeps both targets synchronised at all times. The secondary server is always configured as a read only copy to avoid unwanted writes to the data.

The *illustration* below described this configuration after a failover event occurs:

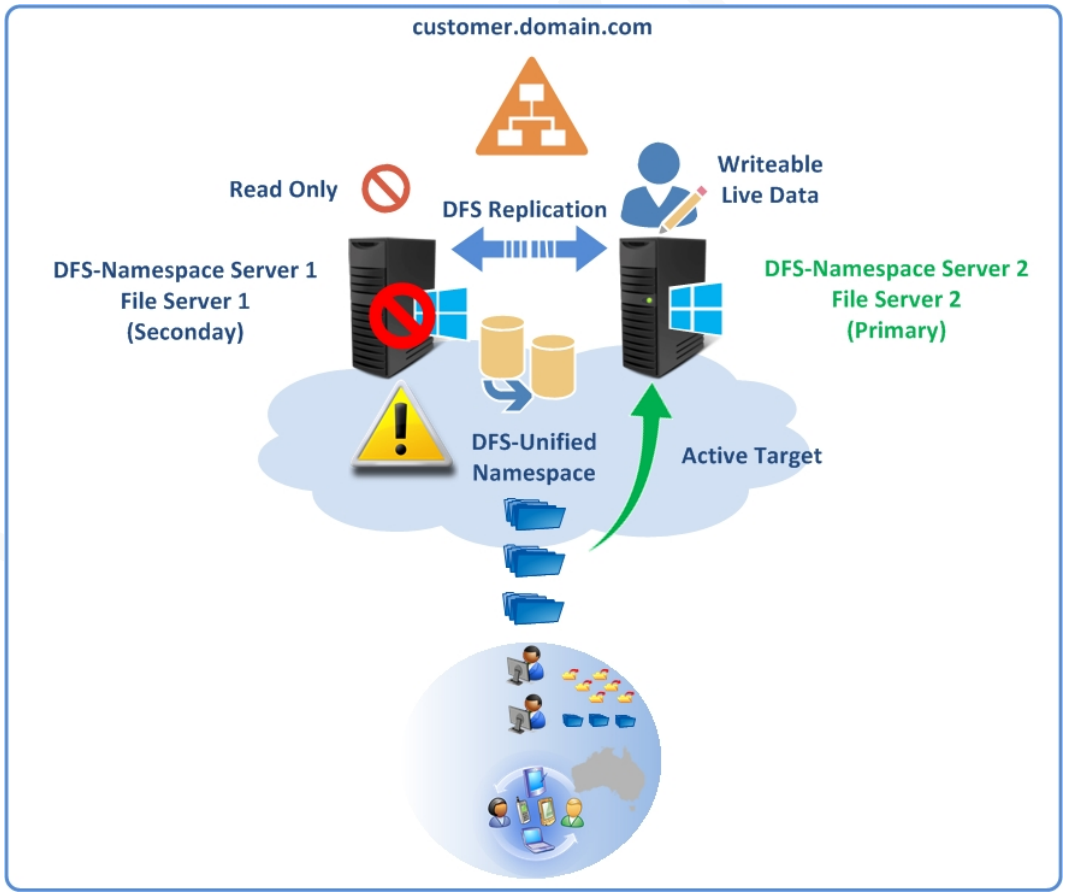

Figure 36. File Services – DFS Failover Configuration

The following tables describe configuration parameters used within the Citrix Validated Solution.

File Servers

Category	Decision / Description
File Servers	• File Server 1 • File Server 2
Server O/S	Microsoft Windows Server 2012 R2 Standard Edition
Server Name(s)	DECISION POINT
CPU Allocation	2 vCPU
RAM Allocation	8 GB
Storage Allocation	C:\ 100GB D:\ 1,000GB (User Profile Data – 1GB per user x 1,000 users)
Shared Folders	**File Server 1:** ShareName / Folder: (For HVD) • Share: \\FilerServer1\HVD-UPM – (D:\HVD-UPM) • Share \\FilerServer1\HVD-UserData – (D:\HVD-UserData) ShareName / Folder: (For HSD) • Share: \\FilerServer1\HSD-UPM – (D:\HSD-UPM) • Share: \\FilerServer1\HSD-UserData – (D:\HSD-UserData) **File Server 2:** ShareName / Folder: (For HVD) • Share: \\FilerServer2\HVD-UPM – (D:\HVD-UPM) • Share: \\FilerServer2\HVD-UserData – (D:\HVD-UserData) ShareName / Folder: (For HSD) • Share: \\FilerServer2\HSD-UPM – (D:\HSD-UPM) • Share: \\FilerServer2\HSD-UserData – (D:\HSD-UserData)
Storage Deduplication	Disabled. Leverage the deduplication features enabled in the underlying Nutanix Virtual Computing Platform

Table 55: File Server Configuration

DFS-Namespace

Category	Decision / Description
File Server Redundancy	• Active/Passive deployment of File Services to support User Profile data
DFS Namespace Servers	• File Server 1 • File Server 2
DFS Namespace	Domain Based: • Windows Server 2008 mode • Name: customer.domain.com\ProfileData (Example) • Path: \\File-Server1\ProfileData • Path: \\File-Server2\ProfileData • Referral Status: Enabled
DFS Targets	The following details describe the primary file server configured with active targets. In the event a failover to the secondary file server is required, for maintenance etc., the targets will be removed and recreated substituting only the file server name from “File-Server1” to “File-Server2”. From a directory structure and file share perspective the file servers will be configured identical. **For HSD:** (Example Path names shown) Name: HSD-UPM • Description: Citrix Profile Management User Data • Path: \\File-Server1\HSD-UPM (D:\HSD-UPM,) Name: HSD-UserData • Description: Redirected profile folders, User Data • Path: \\File-Server1\HSD-UserData (D:\HSD-UserData) **For HVD:** (Example Path names shown) Name: HVD-UPM • Description: Citrix Profile Management User Data • Path: \\File-Server1\HVD-UPM (D:\HVD-UPM,) Name: HVD-UserData • Description: Redirected profile folders, User Data • Path: \\File-Server1\HVD-UserData (D:\HVD-UserData)

Table 56: DFS Namespace Configuration

DFS-Replication

Category	Decision / Description
DFS Replication Servers	• File Server 1 • File Server 2
DFS Replicated Folders	• HSD-UPM • HSD-UserData • HVD-UPM • HVD-UserData File Filter: • “~*, *.bak, *.tmp, *.temp”
DFS Replication Group and membership	Replication Group Name: • File-Server1-File-Server2 Group Membership: • File Server 1 • File Server 2 **For HSD:** Folder Membership HSD-UPM: • Member: File-Server1 Path D:\HSD-UPM Replicated to: • Member: File-Server2 Path D:\HSD-UPM (Read only) Folder Membership HSD-UserData: • Member: File-Server1 Path D:\HSD-UserData Replicated to: • Member: File-Server2 Path D:\HSD-UserData (Read only) **For HVD:** Folder Membership HVD-UPM: • Member: File-Server1 Path D:\HVD-UPM Replicated to: • Member: File-Server2 Path D:\HVD-UPM (Read only) Folder Membership HVD-UserData: • Member: File-Server1 Path D:\HVD-UserData Replicated to: • Member: File-Server2 Path D:\HVD-UserData (Read only)
Staging	Testing showed the default size of the “Staging “ and “Conflict and Deleted” paths where sufficient for the file type that were replicated, however further analysis may be required for different workloads. Refer to the following Microsoft articles for further details: • http://technet.microsoft.com/library/cc754229.aspx

Table 57: DFS Replication Configuration

Active Directory Integration. Each Machine object will be logical located in a dedicated Organisational Unit with specific Group Policy Objects applied as appropriate to the role please refer to the Active Directory Section for more details.

SECTION 3: APPENDICES

Appendix A. Further Decision Points

This section defines elements of the Citrix Validated Solution which need further discussions with the Customer and are customer-specific:

Decision Point	Decision / Description
Naming Convention	• Component nomenclature will need to be defined by the customer during the Analysis phase of the project
Database Information	• Microsoft SQL Version • Server name • Instance name • Port • Database name • Resource Capacity (CPU Memory Storage)
Microsoft Volume Licensing	Microsoft licensing of the target devices is a requirement for the Citrix Validated Solution and will be based on the customer's existing Microsoft licensing agreement.
Microsoft RDS Licensing (Terminal Server CALS)	At least two Microsoft RDS License servers should be defined when using RDS workloads within the customer environment including the mode of operation: • per user • per device Once defined these configuration items will be deployed via Active Directory GPO.
Windows Pagefile	The final applications used and workload usage patterns required by the customer will influence the decision for the requirements and sizing of the Windows Pagefile. Further customer validation may be required, dependant on the sizing of the Pagefile and its associated storage footprint.
User Logon	Further analysis may be required for customers with aggressive user logon time frames to their desktops. In this scenario additional resources may be required. This may impact Citrix StoreFront, host Density or other related infrastructure.
Active Directory Domain services	The Active Directory Forest and domain will need to be discussed with the Customer to ensure sufficient capacity exists to support any additional authentication requirements the proposed solution may impose. Group Policy is likely to be deployed to suit the requirements of the customer. Assuming the existing deployment meets best practices, the GPOs described within this Citrix Validated Solution can be integrated into the customer environment or configurations may be added directly to existing GPOs. Reference to Minimum Security Baselines in the form of GPOs will be the customer's responsibility. GPOs described in this document in all cases must be integrated into the customer existing Active Directory.
User Personalisation	User Profile Management will need to be further defined to meet customer expectations and application specific requirements. This includes folder redirection using GPO objects. Currently this document only describes minimal requirements, that were used for testing and validation purposes Please refer to the following link for further details: http://support.citrix.com/article/CTX134081

Table 58: Further Decision Points

Appendix B. Server Inventory

HSD Servers (Support up to 1,000 User Desktop Sessions)

Qty	OS	Server role	Type	CPU	RAM	Disk	NIC
Physical Servers (Hyper-V Hosts)							
6	MS Hyper-V Server 2012 R2	Hyper-V Host	Nutanix NX-3060	2 x 10 - Core	128GB	2x400GB SSD 4x1TB HDD	2x10bE 2x1Mbps
Guest Virtual Machines							
2	Windows Server 2012 R2 Standard	Citrix Desktop Delivery Controllers	VM	4 vCPU	8GB	100GB	1 vNIC
2	Windows Server 2012 R2 Standard	Citrix StoreFront	VM	2 vCPU	4GB	100GB	1 vNIC
1	Windows Server 2012 R2 Standard	Citrix License	VM	2 vCPU	4GB	100GB	1 vNIC
2	Windows Server 2012 R2 Standard	Windows File Services and DHCP Services	VM	2 vCPU	8GB	C: \100GB D:\1,000GB	1 vNIC
1	Windows Server 2012 R2 Standard	Virtual Machine Manager	VM	2 vCPU	8GB	C:\100GB D:\150GB	1 vNIC
40	Windows Server 2012 R2 Standard	XenApp RDS	VM	8 vCPU	16GB	100GB	1 vNIC
Assume customer will leverage existing SQL Server environment. Sample configuration only.							
2	Windows Server 2012 R2 Standard	SQL Server 2012 Standard	VM	2 vCPU	8GB	C:\100GB D:\100GB	1 vNIC

Table 59: Server Inventory for HSD

HVD Servers (Support up to 1,000 Virtual Desktop Sessions)

Qty	OS	Server role	Type	CPU	RAM	Disk	NIC
Physical Servers (Hyper-V Hosts)							
10 nodes	MS Hyper-V Server 2012 R2	Hyper-V Host	Nutanix NX-3060	2 x 10 - Core	128GB	2x400GB SSD 4x1TB HDD	2x10bE 2x1Mbps
Guest Virtual Machines							
2	Windows Server 2012 R2 Standard	Citrix Desktop Delivery Controller	VM	4 vCPU	8GB	100GB	1 vNIC
2	Windows Server 2012 R2 Standard	Citrix StoreFront	VM	2 vCPU	4GB	100GB	1 vNIC
1	Windows Server 2012 R2 Standard	Citrix License	VM	2 vCPU	4GB	100GB	1 vNIC
2	Windows Server 2012 R2 Standard	Windows File Services and DHCP Services	VM	2 vCPU	8GB	C: \100GB D:\1,000GB	1 vNIC
1	Windows Server 2012 R2 Standard	Virtual Machine Manager	VM	2 vCPU	8GB	C:\100GB D:\150GB	1 vNIC
Up to 1,020	Windows 7 Enterprise x64 SP1	Hosted Virtual Desktop	VM	2 VCPU	2.5GB	100GB	1 vNIC
Assume customer will leverage existing SQL Server environment. Sample configuration only.							
2	Windows Server 2012 R2 Standard	SQL Server 2012 Standard	VM	2 vCPU	8GB	C:\100GB D:\100GB	1 vNIC

Table 60: Server Inventory for HVD

Appendix C. Network Switch Requirements

This section defines the network port requirements based on the number of Nutanix NX-3060 nodes that will be deployed.

To support IPMI/host management network, existing 100/1000 Mbps network switching infrastructure can be utilised to further minimise the integration and hardware acquisition costs associated with deploying this solution provided the following requirements are considered.

Switch Requirements

Requirements	Minimum Recommendation	Comments
10GbE NIC Ports	2 ports per Node	Hyper-V network traffic. Refer to the below Network Port Density Table for the scale out model
100/1000 Mbps	1 port per Node	IPMI host management traffic. Refer to the below Network Port Density Table for the scale out model
VLAN Support	802.1Q tagging	Capability to create VLANs
Stacking or Redundant Capabilities	Yes	Switches should be redundant
Uplink to Core or Upstream Switching	10GbE Uplink	Sufficient upstream bandwidth to Core network

Table 61: Network Requirements

Network Port Density

The below table defines the NIC Port density requirements with respect to the number of Nutanix NX-3060 nodes from a scale-out perspective, using 10 nodes[29] as an example.

Configuration	Value							
Number of HSD / HVD Users								
# of HSD Users	400	600	800	1,000	1,200	1,400	1,600	1,800
# of HVD Users	250	360	470	580	690	800	910	1,020
Hardware Specifics								
# of Nutanix NX-3060 Nodes	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
# of 10GbE Ports (Hyper-V)	6	8	10	12	14	16	19	20
# of 100/1000 Mbps Ports (IPMI)	3	4	5	6	7	8	9	10

Table 62: 10GbE and 100/1000 Mbps NIC Port Requirements

[29] The Citrix XenDesktop on Nutanix Solution can be scaled-out to support thousands of desktops by scaling out the cluster up to 24 nodes and subsequently deploy additional Pods for further capacity.

Appendix D. IP Addressing

The following tables should be completed on final deployment of the Citrix Validated solution for reference purposes.

Hyper-V Hosts:

IP Address	Host Name (Example Only)	Description
TBD	Hyper-V01	Hyper-V Host (Shared infrastructure and virtual desktop workload)
TBD	Hyper-V02	Hyper-V Host (Shared infrastructure and virtual desktop workload)
TBD	Hyper-V03	Hyper-V Host (Dedicated virtual desktop workload)
TBD	Hyper-V04	Hyper-V Host (Dedicated virtual desktop workload)
TBD	Hyper-V05	Hyper-V Host (Dedicated virtual desktop workload)
TBD	Hyper-V06	Hyper-V Host (Dedicated virtual desktop workload)
TBD	Hyper-V07	Hyper-V Host (Dedicated virtual desktop workload)
TBD	Hyper-V08	Hyper-V Host (Dedicated virtual desktop workload)
TBD	Hyper-V09	Hyper-V Host (Dedicated virtual desktop workload)
TBD	Hyper-V10	Hyper-V Host (Dedicated virtual desktop workload)
TBD	Hyper-V ”n”	Hyper-V Host (Dedicated virtual desktop workload)

Table 63: Hyper-V IP Addressing

Control Layer Guest VMS:

IP Address	Server Name (Example Only)	Description
TBD	DDC01	Desktop Controller
TBD	DDC02	Desktop Controller
TBD	SF01	Access Controller
TBD	SF02	Access Controller
TBD	DFS01	File server / DFS Name Space server
TBD	DFS02	File server / DFS Name Space server
TBD	LIC01	Citrix/Microsoft License server
TBD	VMM01	Virtual Machine Manager server

Table 64: Control Layer Guest VM IP Addressing

Sample HSD DHCP Scopes for up to 1,000 sessions:

IP Address Range	Scope Name	VLAN ID	Gateway	DNS Servers
~250 Addresses \24	HSD VLAN 1	HSD VLAN 1	TBD	TBD

Table 65: Sample DHCP Scope information

Sample HVD DHCP Scopes for up to 1,000 sessions:

IP Address Range	Scope Name	VLAN ID	Gateway	DNS Servers
~500 Addresses \23	HVD VLAN 1	HVD VLAN 1	TBD	TBD
~500 Addresses \23	HVD VLAN 2	HVD VLAN 2	TBD	TBD

Table 66: Sample DHCP Scope information

Appendix E. Service Accounts & Groups

The following tables described the minimal Groups and service accounts required to deploy the Citrix Validated Solution.

It is anticipated the final configuration will include many more groups or accounts to meet customer specific role based administrative delegation and security requirements.

Role Groups

Group Role Description	Name (Example Only)	Permissions/ACL
XenDesktop Administrators	XenDesktop-Site-Admins	XenDesktop Site Administrators
XenDesktop Server Administrators	XenDesktop-Server-Admins	XenDesktop Site Administrators Local Administrator: • XenDesktop Controllers
System Center & Hyper-V Administrators	VMM-Full-Admins	Local Administrator: • Hyper-V Hosts • SCVMM

Table 67: Group Recommendations

Service Accounts

Account Description	Name (Example Only)	Permissions/ACL
SCVMM Service Account	svc.scvmm	Member of: • Group: VMM-Full-Admins
SCVMM Run as Account Optionally used for XenDesktop host connection to VMM server	svc.scvmm-runas	Member of: • Group: VMM-Full-Admins

Table 68: Service Account Recommendations

Appendix F. XenDesktop Policies

The Policies described below where used throughout validation testing and are provided for reference only. These must be reviewed for customer/environmental suitability:

Sample Test Environment Policy Settings

Policy Setting	Configuration State / Value
ICA\Audio quality	• Medium – optimised for speech
ICA\Auto connect client drives	• Disabled
ICA\Auto-create client printers	• Do not Auto-create client printers
ICA\Automatic installation of in-box printer drivers	• Disabled
ICA\client driver redirection	• Prohibited
ICA\client microphone redirection	• Prohibited
ICA\Desktop wallpaper	• Prohibited
ICA\Legacy graphics mode	• Enabled
ICA\Menu animation	• Prohibited
ICA\Multimedia conferencing	• Prohibited
ICA\Target frame rate	• 10 fps
ICA\View window content while dragging	• Prohibited
Adobe Flash Delivery\Flash acceleration	• Disabled

Table 69: XenDesktop Policies used for testing of the Citrix Validated Solution

Appendix G. Nutanix NX-3000 Series Specifications

As per the information available from http://www.nutanix.com/the-nutanix-solution/tech-specs/

For more information on every model (NX-1000, NX-3000, NX-6000 and NX-7000 series) http://go.nutanix.com/rs/nutanix/images/Nutanix_Spec_Sheet.pdf

NX-3000 Series

Virtual Computing Platform Specifications – Per Node

Understanding Nutanix Model Numbering

	Per Node (4 per Appliance)			
Model	**NX-3050**	**NX-3051**	**NX-3060**	**NX-3061**
Server Compute	Dual Intel Ivy Bridge E5-2650v2 [16 cores / 2.6 GHz]		Dual Intel Ivy Bridge E5-2680v2 [20 cores / 2.8 GHz]	
Storage Capacity	2x 400 GB SSD, 4x 1 TB HDDs	2x 800 GB SSD, 4x 1 TB HDDs	2x 400 GB SSD, 4x 1 TB HDDs	2x 800 GB SSD, 4x 1 TB HDDs
Memory	Configurable; 128 GB or 256 GB		Configurable; 128 GB, 256 GB or 512 GB	
VM Density	Up to 100 Virtual Machines*		Up to 115 Virtual Machines*	
Network Connections	2x 10 GbE, 2x 1 GbE, 1x 10/100 BASE-T RJ45			
Certifications	CSAus, FCC, CSA, ICES, CE, KCC, C-TICK VCCI-A, BSMI, EAC, SABS, INMETRO, S-MARK, UKRSEPRO**			

* VM density dependent on use case

** For more information, email regulatory_compliance@nutanix.com

Appliance Specifications

Dimensions	Height: 3.5" (88mm), Width: 17.25" (438mm), Depth: 26.75" (679mm)
Weight	67.2 lbs. (30.5kg) stand-alone / 77.2 lbs. (35kg) package / 7 lbs (3.2kg) node
System Cooling	4x80mm heavy duty fans with PWM fan speed controls
Operating Environment	Op Temp Rng: 50°-95°F (10°-35°C) Non-Op Temp Rng: -40°-158°F (-40°- 70°C) Op Humidity Rng (non-condensing): 20-95% Non-Op Humidity Rng: 5-95%
Power Consumption	1350W maximum, 1100W typical
Power Supply (Dual supply)	1.62kW Out @180-240V, 10.5-8.0A, 50-60Hz
Thermal Dissipation	4610 BTU/hr maximum, 3750 BTU/hr typical
Operating Requirements	Input Voltage: 180-240V AC auto-range, Input Frequency: 50-60Hz

Figure 37. Nutanix NX-3000 Series Nodes

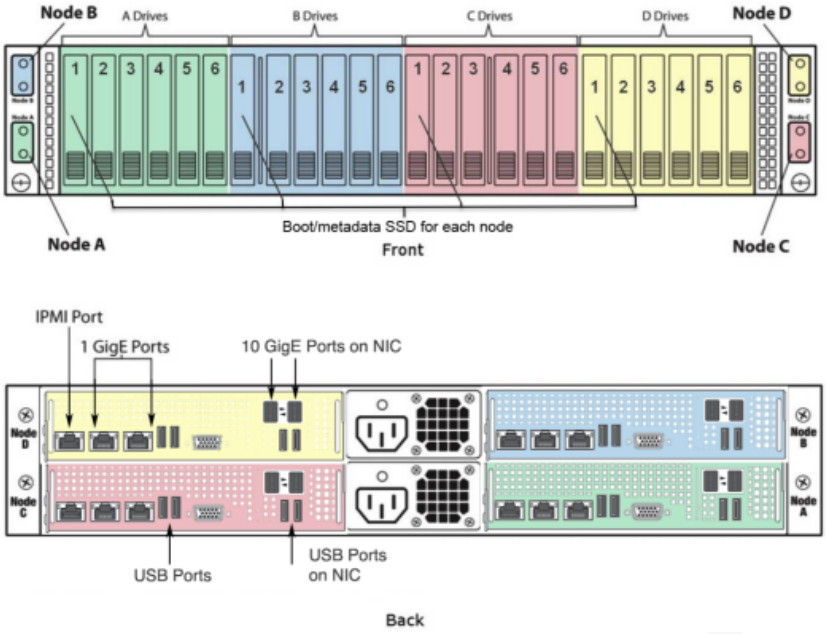

Figure 38. Nutanix NX-3000 Front and Rear View of Chassis depicting Nodes 1 to 4 (Nodes A to D)

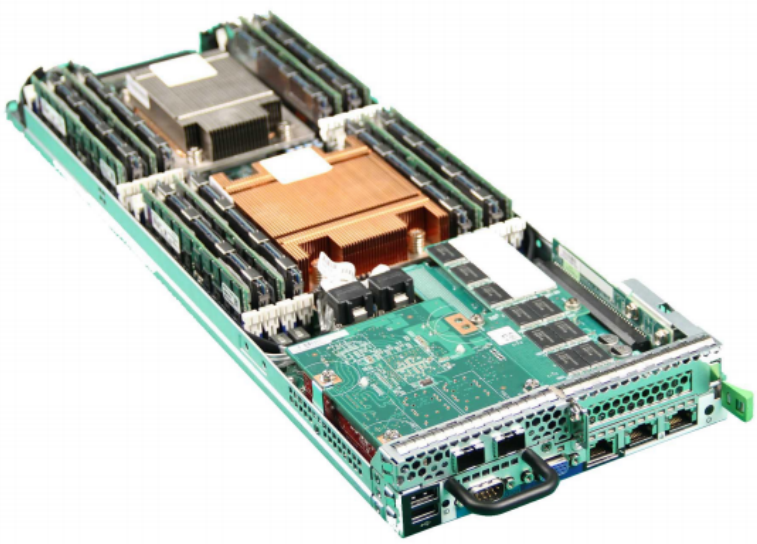

Figure 39. Nutanix NX-3000 Series Node – Physical View

Appendix H. Arista Networks Switch Specifications

Arista 7150S Series

The Arista 7150S series represents the industry's leading ultra-low latency 1RU 1/10/40GbE layer 2/3/4 wire speed switch family, offering a unique combination of performance, advanced functionality and extensive on-board resources.

Designed to suit the requirements of demanding environments such as ultra-low latency financial ECNs, HPC clusters and cloud data centres, the class-leading deterministic latency from 350ns is coupled with a set of advanced tools for monitoring and controlling mission critical environments.

Feature and benefits of the 7150S series

- Dynamic Buffer Allocation – Packet memory is dynamically allocated on demand to congested interfaces, to avoid packet loss. Packet buffering is important when a microburst or transient in-cast condition causes contention of an egress interface
- Latency and Application Analysis (LANZ) – Detect, capture, stream microbursts and transient congestion at microsecond rates
- Advanced Multi-port Mirroring – Avoid costly SPAN/TAP aggregators with in-switch capturing, filtering and time-stamping
- Wire-speed VXLAN Gateway – Enabling next generation data centre virtualisation
- Wire-speed Low Latency NAT – Reduce NAT latency by 10s of microseconds vs traditional high latency solutions
- IEEE 1588 Precision Time Protocol (PTP) – Provides hardware-based timing for accurate in-band time distribution with nanosecond accuracy
- Agile Ports – Adapt from 10GbE to 40GbE without costly upgrades. Configure 4x10GbE into a single 40GbE interface for connection to native 40GbE interfaces
-

Model Comparison

Configuration	7150S-24	7150S-52	7150S-64
Product – Front View			
Ports	24 x SFP+	52 x SFP+	48 x SFP+ 4 x QSFP+
Max 40GbE Ports	4	13	16
Max 10GbE Ports	24	52	64
Throughput	480Gbps	1.04Tbps	1.28Tbps
Packets/Second	360 Mpps	780 Mpps	960 Mpps
Latency (SFP+ Ports)	350ns	380ns	380ns
Packet Buffer Memory	9.5MB (Dynamic Buffer Allocation)		
100/1000 Mgmt Ports	1		
Hot-swap Power Supplies	2 (1+1 redundant)		
Hot-swappable Fans	4 (N+1 redundant)		
Reversible Airflow Option	Yes		
Typical Power Draw per 10GbE Port	~7.9 W	~3.6 W	~3.5 W

Table 70: Arista Networks 7150S Series Switch

Arista 7048T-A

The Arista 7048 switch offers unmatched performance for high-density data centre deployments. With 48 100/1000BASE-T and four 1/10GbE SFP+ ports, the switch delivers a non-blocking design with 40 Gbps of uplink bandwidth. The 7048 switch forwards at layer 2/3/4 with low latency at wire speed. Redundant power and cooling options along with a robust software architecture provide the foundation for a data centre class product. The switch comes with both front-to-back and back- to-front airflow options for energy efficiency. All SFP+ ports accommodate a full range of 10GbE Twinax copper cables and optical 1/10GbE transceivers.

Configuration	7048T-A
Product – Front View	
Ports	48 x 100/1000Base-T RJ-45 4 x 1/10GbE SFP+
Throughput	176Gbps
Packets/Second	132 Mpps
Latency (64 byte frame)	3 usec
Packet Buffer Memory	768MB
100/1000 Mgmt Ports	1
Hot-swap Power Supplies	2 (1+1 redundant)
Hot-swappable Fans	4 (N+1 redundant)
Reversible Airflow Option	Yes
Typical / Max Power Draw	174 / 212 W

Table 71: Arista Networks 7048T-A Switch

Appendix I. Test Results Validation

The operational layer focuses on performance monitoring and availability management that was utilised during testing of the Citrix Validated Solution environment[30]. Microsoft System Center Operations Manager was used for monitoring the infrastructure, end to end while Citrix Desktop Director and EdgeSight were used for monitoring Citrix specific components.

Additionally, Liquidware Labs, Stratusphere UX was used to verify the End User Experience: http://www.liquidwarelabs.com/products/stratusphere-ux during the Login VSI scalability test workload execution.

End User Experience Monitoring

Comparative analysis was reviewed based on the results from both Login VSI – "VSI MAX" and the "Stratusphere UX Score".

HSD Test Results

The *illustrations* below depict the Stratusphere UX "Diagnostic tool" and Login VSI results for a 1,000 user HSD test. Note all HSD sessions are in the "Best" UX Score quadrant".

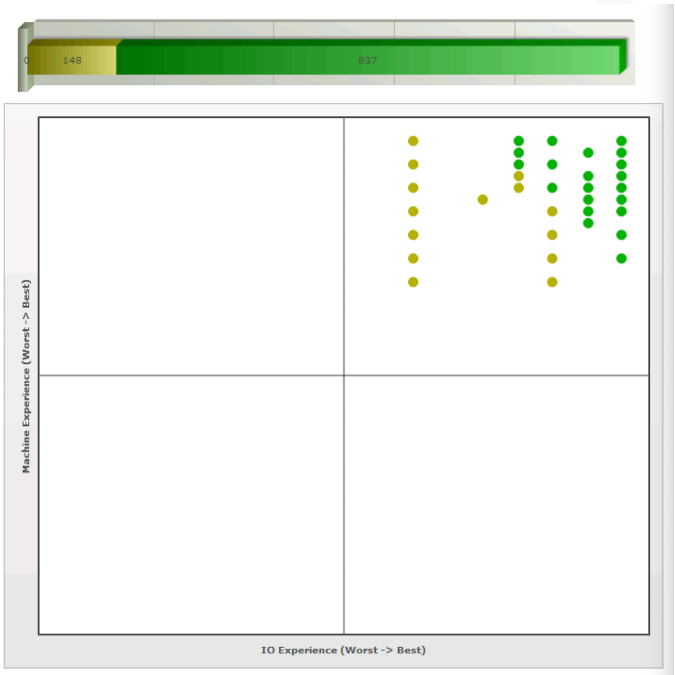

Figure 40. Stratusphere UX User Experience Rating

30 A comprehensive operational readiness and operations management guide is out of scope for this document.

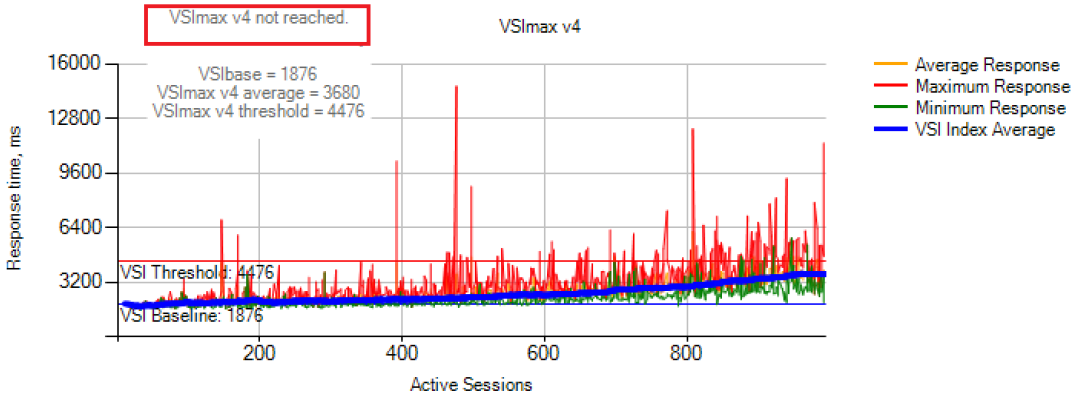

Figure 41. Login VSI Results

HVD Test Results

The *illustrations* below depict the Stratusphere UX "Diagnostic tool" and Login VSI results for a 1,000 user HVD test. Note all HVD sessions are in the "Best" UX Score quadrant".

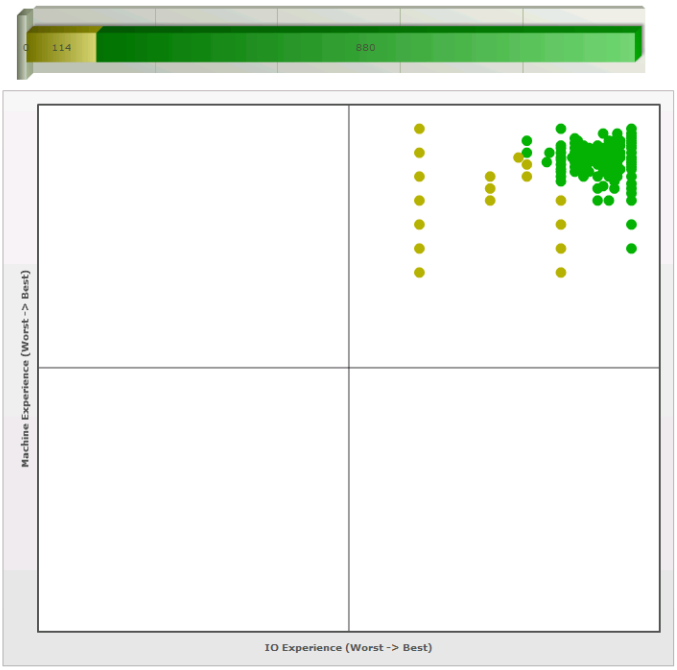

Figure 42. Stratusphere UX User Experience Rating

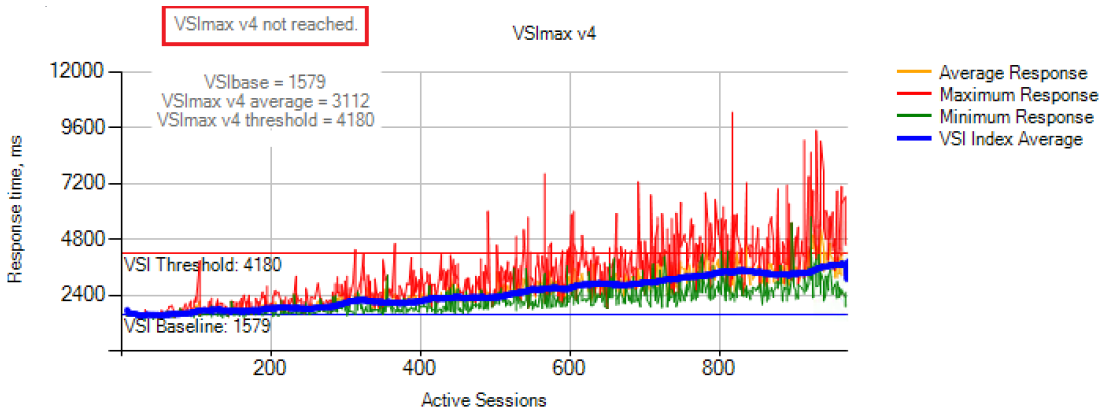

Figure 43. Login VSI Results

Appendix J. References

Citrix

For more information on Citrix products and other collateral, refer to the below:

Information	URL link
XenDesktop Tech Info	http://www.citrix.com/products/xendesktop/tech-info.html
Citrix FlexCast	http://www.citrix.com/products/xendesktop/use-cases.html
XenApp and XenDesktop eDocs	http://support.citrix.com/proddocs/topic/xenapp-xendesktop/xa-xd-library-wrapper.html
Citrix Articles and Support	http://www.citrix.com/support

Nutanix

For more information on Nutanix products and other collateral, refer to the below:

Information	URL link
Nutanix Product Info	http://www.nutanix.com/resources/product-info/#nav
Nutanix Tech Note - Performance	http://go.nutanix.com/TechNoteNutanixPerformance_LP.html
Nutanix Tech Note - Shadow Clone	http://go.nutanix.com/TechGuide-Nutanix-ShadowClones_LP.html
Nutanix Tech Note - System Scalability	http://go.nutanix.com/TechNoteNutanixSystemScalbility_LP.html

Arista Networks

For more information on Arista Networks products and other collateral, refer to the below:

Information	URL link
Arista 7150S	http://www.arista.com/assets/data/pdf/Datasheets/7150S_Datasheet.pdf
Arista 7048T-A	http://www.arista.com/assets/data/pdf/Datasheets/7048T-A_DataSheet.pdf
Arista EOS	http://www.arista.com/assets/data/pdf/EOSWhitepaper.pdf
Cloud Networking Designs	http://go.arista.com/l/12022/2013-11-05/jt893/12022/97352/Arista_Cloud_Networks.pdf
Software Driven Cloud Networks	http://go.arista.com/l/12022/2012-03-08/qz2/12022/1411/SDCNWhitepaper.pdf
MLAG Configuration	https://eos.arista.com/mlag-basic-configuration/
VXLAN	http://go.arista.com/l/12022/2012-07-25/31s92/12022/32531/VXLAN_white_paper_revised_August_2012.pdf

Revision History

Revision	Change Description	Updated By	Date
1.0	Document Created/Released	Citrix APAC Solutions	25th June 2014

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