Dell Appliance for Wyse - Citrix® Reference Architecture

Dell Engineering
April 2016
## Revisions

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 2015</td>
<td>Initial release</td>
</tr>
<tr>
<td>September 2015</td>
<td>Revision 1.1. Qualification of latest hardware configurations.</td>
</tr>
<tr>
<td>January 2016</td>
<td>Revision 2.0 Scale Out option added</td>
</tr>
<tr>
<td>April 2016</td>
<td>Version 2.1. New Broadwell processors and other adjustments to hardware configuration.</td>
</tr>
</tbody>
</table>

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1 Introduction

1.1 Purpose
This document addresses the architecture design, configuration and implementation considerations for the key components required to deliver virtual desktops or shared session desktops using the Dell Appliance for Wyse. The underlying technology is Citrix® XenDesktop® and XenApp® on Microsoft® Windows Server® Hyper-V® 2012 R2.

1.2 Scope
Relative to delivering the virtual desktop environment, the objectives of this document are to:

- Define the detailed technical design for the solution.
- Define the hardware requirements to support the design.
- Define the constraints which are relevant to the design.
- Define relevant risks, issues, assumptions and concessions – referencing existing ones where possible.
- Provide a breakdown of the design into key elements such that the reader receives an incremental or modular explanation of the design.
- Provide component selection guidance where applicable.

1.3 What’s New

- Updated hardware configurations including Intel Broadwell processors (E5-2600v4)
- Removed network card restrictions with 10Gb network cards as default option
- Introduce support for new Dell Networking options
- New Quick Start Tool functionality including support for additional desktop OS options for image template
2 Solution Architecture Overview

2.1 Introduction
The Dell Appliance for Wyse delivers an out-of-the-box infrastructure solution for virtual desktops that eliminates the high cost, variable performance, and extensive risk of conventional solutions. The appliance is an offering in the Dell Wyse Datacenter Solution portfolio and is a PowerEdge R730 server that can be used in a single server standalone deployment or with multiple appliances in a scale out deployment. With the combination of powerful processors, large memory and versatile storage options, the R730 performs exceptionally well in a number of demanding environments and delivers outstanding functionality in just 2U of rack space.

The appliance is also available in a tower form factor (the PowerEdge T630 server) using equivalent hardware components.

2.2 Physical Architecture Overview
The core Dell Wyse Datacenter architecture consists of two models: Local Tier1 and Shared Tier1. “Tier 1” in the Dell Wyse Datacenter context defines from which disk source the VDI sessions execute. Tier 2 storage is present in both solution models and, while having a reduced performance requirement, is utilized for user data and Management VM execution. Management VM execution occurs using Tier 2 storage for all solution models. Dell Wyse Datacenter is a 100% virtualized solution architecture.

NOTE: This model differs for single server standalone deployments of the Dell Appliance for Wyse with all VMs (management and VDI) residing on the same local disks.
2.3 Solution Layers

The Dell Wyse Datacenter Solution leverages a core set of hardware and software components consisting of five primary layers:

- Networking Layer
- Compute Server Layer
- Management Server Layer
- Storage Layer (shared storage can be used to provide high availability for the management layer in a scale out deployment of the Dell Appliance for Wyse)
- Thin Client Layer (please refer to section 3)

These components have been integrated and tested to provide the optimal balance of high performance and lowest cost per user. The Dell Wyse Datacenter stack is designed to be cost effective allowing IT departments to implement high-performance fully virtualized desktop environments.

2.4 Optimized Appliance Configurations

This architecture is non-distributed with all VDI, Management, and storage functions on a single host running Microsoft Hyper-V hypervisor and Citrix XenDesktop/XenApp. Local Tier 1 storage is split in to volumes for the hypervisor management OS and for virtual machine storage. The optimized configurations are sold as Small and Large appliances which differ by the processors, amount of memory, and number of local disks. These appliances have been validated by Dell engineering to determine the maximum density and performance they can provide.
2.5 Custom Appliance Configuration

The architectural design of the custom appliance configuration is the same as the optimized configuration but it allows for flexibility in choosing hardware components.

**NOTE**: Because of the various combinations/choices of processors, memory, and disks allowed in the custom appliance, Dell does not provide density or performance guidance for the resulting appliance configuration. For known density numbers, you must order a large or small optimized appliance configuration.

2.6 Scale Out

The Dell Appliance for Wyse can be scaled easily by adding incremental compute nodes for desktop or XenApp/RDSH VMs and separating the management infrastructure onto its own physical servers.
### 2.6.1 Local Tier 1 – Non-HA

In a scale out deployment, a small appliance will be used as a dedicated management node and large appliances will be used as dedicated compute nodes.

<table>
<thead>
<tr>
<th>Network</th>
<th>1-3 x</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dell Networking</td>
<td></td>
</tr>
<tr>
<td>S3048/S4048/S4820T</td>
<td></td>
</tr>
<tr>
<td>1/10Gb</td>
<td>LAN</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compute (Large)</th>
<th>2-26x (N+1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R730</td>
<td>2 x CPU</td>
</tr>
<tr>
<td></td>
<td>384GB RAM</td>
</tr>
<tr>
<td></td>
<td>10 x 15K HDD</td>
</tr>
<tr>
<td></td>
<td>VDI Desktops</td>
</tr>
<tr>
<td>or</td>
<td>RDSH VMs</td>
</tr>
<tr>
<td></td>
<td>Shared Sessions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mgmt (Small)</th>
<th>1 x</th>
</tr>
</thead>
<tbody>
<tr>
<td>R730</td>
<td>2 x CPU</td>
</tr>
<tr>
<td></td>
<td>128GB RAM</td>
</tr>
<tr>
<td></td>
<td>6 x 600GB</td>
</tr>
<tr>
<td></td>
<td>SQL</td>
</tr>
<tr>
<td></td>
<td>Web</td>
</tr>
</tbody>
</table>

Refer to the Scaling Guidance section for details.
2.6.2 Local Tier 1 – HA Management Layer with Shared Tier 2

For High Availability of the management layer, add another small appliance for an additional management node along with EqualLogic Tier 2 shared storage to form a cluster.

Refer to the Solution High Availability section for details.
# 3 Hardware Components

## 3.1 Appliances (Servers)

The Dell Appliance for Wyse is offered in two server platforms: The PowerEdge R730 (rack) and the PowerEdge T630 (tower). Appliances can be ordered in two optimized configurations, Small and Large as shown below, or customized as needed. The Large model can be used as a standalone appliance in an all-in-one deployment or as a compute only appliance in a scale out deployment. The Small model can be used as a standalone appliance in a smaller all-in-one deployment, such as a pilot project, or as the dedicated management node in a scale out deployment.

<table>
<thead>
<tr>
<th>Component</th>
<th>Small model</th>
<th>Large model</th>
<th>Custom model</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU</td>
<td>2 x E5-2630v4 (10C, 2.2GHz)</td>
<td>2 x E5-2660v4 (14C, 2.0GHz)</td>
<td>Choice</td>
</tr>
<tr>
<td>Memory</td>
<td>128GB (8 x 16GB) 2400MT/s (Effective speed: 2133MT/s w/CPU)</td>
<td>384GB (24 x 16GB) 2400MT/s (Effective speed: 1866MT/s @ 384GB)</td>
<td>Choice</td>
</tr>
<tr>
<td>Storage Ctrls</td>
<td>PERC H730P (2GB cache)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Storage</td>
<td>6 x 600GB 15K SAS 2.5&quot; (RAID 10)</td>
<td>10 x 600GB 15K SAS 2.5&quot; (RAID 10)</td>
<td>Choice</td>
</tr>
<tr>
<td>Network</td>
<td>2 x 10Gb (SFP+/ BT) &amp; 2 x 1Gb NDC</td>
<td>2 x 10Gb (SFP+/ BT) &amp; 2 x 1Gb NDC</td>
<td>Choice w/ Default: 2 x 10Gb (SFP+/ BT) &amp; 2 x 1Gb NDS</td>
</tr>
<tr>
<td>iDRAC</td>
<td>iDRAC8 Ent w/ integrated Dell Remote Access Controller</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power</td>
<td>2 x 750W PSUs</td>
<td>2 x 750W PSUs</td>
<td>Choice</td>
</tr>
<tr>
<td>Form factor</td>
<td>Rack</td>
<td>Rack</td>
<td>Rack or Tower (T630)</td>
</tr>
</tbody>
</table>

**Optimized**

**Unknown density**
3.1.1 PowerEdge R730
The foundation of the Dell Wyse Datacenter solution portfolio is the best-in-class Dell PowerEdge R730. This dual socket CPU platform runs the fastest Intel Xeon E5-2600 v4 family of processors, can host up to 24 DIMMs of DDR4 RAM, supports up to 16 x 2.5" SAS disks and can be outfitted with 2 double-wide GPU accelerators from AMD or NVIDIA. The Dell PowerEdge R730 offers uncompromising performance and scalability in a 2U form factor.

For specific information on VDI optimized appliance configurations from Dell please refer to section 5 of this document, for more information on the R730, please visit: Link

3.1.2 PowerEdge T630
Accelerate demanding workloads with the powerful and flexible PowerEdge T630 2-socket tower server, a member of the 13th generation of PowerEdge servers. Equipped with the latest Intel® Xeon® processor E5-2600 v3 product family, up to 24 DIMMs of DDR4 memory, supports either 18 x 3.5" HDDs or up to 32 x 2.5" HDDs and seven I/O slots. Supports graphics accelerators from AMD, Intel and NVIDIA.

For more information on the T630, please visit: Link
3.2 Network

The following sections contain the core network components for the Dell Wyse Datacenter solutions. General uplink cabling guidance to consider in all cases is that TwinAx is very cost effective for short 10Gb runs and for longer runs use fiber with SFPs.

3.2.1 Dell Networking S3048 (1Gb ToR Switch)

Accelerate applications in high-performance environments with a low-latency top-of-rack (ToR) switch that features 48 x 1GbE and 4 x 10GbE ports, a dense 1U design and up to 260Gbps performance. The S3048-ON also supports Open Network Installation Environment (ONIE) for zero-touch installation of alternate network operating systems.

<table>
<thead>
<tr>
<th>Model</th>
<th>Features</th>
<th>Options</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dell Networking</td>
<td>48 x 1000BaseT 4 x 10Gb SFP+</td>
<td>Redundant hot-swap PSUs &amp; fans</td>
<td>1Gb connectivity</td>
</tr>
<tr>
<td>S3048-ON</td>
<td>Non-blocking, line-rate</td>
<td>VRF-lite, Routed VLT, VLT Proxy Gateway</td>
<td></td>
</tr>
<tr>
<td></td>
<td>performance</td>
<td>User port stacking (up to 6 switches)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>260Gbps full-duplex bandwidth</td>
<td>Open Networking Install Environment (ONIE)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>131 Mpps forwarding rate</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

48 x 1GB BaseT ports 4 x SFP+ ports

Redundant Power Supplies
3.2.2 Dell Networking S4048 (10Gb ToR Switch)

Optimize your network for virtualization with a high-density, ultra-low-latency ToR switch that features 48 x 10GbE SFP+ and 6 x 40GbE ports (or 72 x 10GbE ports in breakout mode) and up to 720Gbps performance. The S4048-ON also supports ONIE for zero-touch installation of alternate network operating systems.

<table>
<thead>
<tr>
<th>Model</th>
<th>Features</th>
<th>Options</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dell Networking S4048-ON</td>
<td>48 x 10Gb SFP+ 6 x 40Gb QSFP+</td>
<td>Redundant hot-swap PSUs &amp; fans</td>
<td>10Gb connectivity</td>
</tr>
<tr>
<td></td>
<td>Non-blocking, line-rate performance</td>
<td>72 x 10Gb SFP+ ports with breakout cables</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.44Tbps bandwidth</td>
<td>User port stacking (up to 6 switches)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>720 Gbps forwarding rate</td>
<td>Open Networking Install Environment (ONIE)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>VXLAN gateway support</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For more information on the S3048, S4048 switches and Dell Networking, please visit: [LINK](#)
3.3 Storage

3.3.1 EqualLogic Tier 2 – PS4100E

The Dell EqualLogic PS4100 series enables you to choose the storage solution that best suits your small or midsize business or enterprise branch office. For small T2 deployments the PS4100E is the core of our solution stack.

<table>
<thead>
<tr>
<th>Model</th>
<th>Features</th>
<th>Options</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>EqualLogic PS4100E</td>
<td>12 drive bays (NL-SAS/7200k RPM), dual HA controllers, Snaps/Clones, Async replication, SAN HQ, 1Gb</td>
<td>12TB – 12 x 1TB HDs</td>
<td>Tier 2 array for 1000 users or less in Local Tier 1 solution model (10Gb – iSCSI)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24TB – 12 x 2TB HDs</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>36TB – 12 x 3TB HDs</td>
<td></td>
</tr>
</tbody>
</table>

12 x 7.2K SAS Drives

1Gb Ethernet Ports

Mgmt Ports
3.4 Dell Wyse Thin Clients

The following Dell Wyse clients will deliver a superior Citrix user experience and are the recommended choices for this solution.  [GENERAL LINK]

3.4.1 Wyse 3020 (ThinOS)

The 3020 sets the standard for thin clients. Providing an exceptional user experience, it features the incredibly fast Dell Wyse ThinOS, for environments in which security is critical—there’s no attack surface to put your data at risk. The 3020 delivers outstanding performance based on its dual core system-on-a-chip (SoC) design, and a built-in media CPU delivers smooth multimedia, bi-directional audio and Flash playback. Boot up in just seconds and log in securely to almost any network. In addition, the Wyse 3020 is one of the only affordable thin clients to support dual monitors with monitor rotation, enabling increased productivity by providing an extensive view of task work. Designing smooth playback of high bit-rate HD video and graphics in such a small box hasn’t been at the expense of energy consumption and heat emissions either. Using less than 7 watts of electricity, the Wyse 3020 small size enables discrete mounting options: under desks, to walls, and behind monitors, creating cool workspaces in every respect.

3.4.2 Wyse 5010 (ThinOS)

Designed for knowledge workers and power users, the Wyse 5010 (ThinOS) is a high-performance thin client based on Dell Wyse ThinOS, the virus-immune firmware base designed for optimal thin client security, performance, and ease-of-use. Highly secure, compact and powerful, the Wyse 5010 combines Dell Wyse ThinOS with a dual-core AMD processor and a revolutionary unified graphics engine for an outstanding user experience. The Wyse 5010 (ThinOS) addresses the performance challenges of processing-intensive applications like computer-aided design, multimedia, HD video and 3D modeling. Scalable enterprise-wide on-premise or cloud-based management provides simple deployment, patching and updates. Take a unit from box to productivity in minutes with auto configuration. Delivering outstanding processing speed and power, security and display performance, the Wyse 5010 (ThinOS) offers a unique combination of performance, efficiency, and affordability. The Wyse 5010 (ThinOS) is Citrix HDX, Microsoft® RemoteFX, and VMware® Horizon View certified. It also supports legacy peripherals via an optional USB adapter. For more information, please visit: [Link]
### 3.4.3 Wyse 5010 (Windows Embedded Standard 8)

In addition to Dell Wyse ThinOS, the Dell Wyse 5010 thin client is available with Windows Embedded Standard 8 and packs dual-core processing power into a compact form factor for knowledge workers who need performance for demanding virtual Windows® desktops and cloud applications. It’s also great for kiosks, and multi-touch displays in a wide variety of environments, including manufacturing, hospitality, retail, and healthcare. It features dual-core processing power and an integrated graphics engine for a fulfilling Windows® 8 user experience. Knowledge workers will enjoy rich content creation and consumption as well as everyday multimedia. Kiosk displays will look great on a thin client that is Microsoft RemoteFX®, Citrix® HDX, VMware PCoIP, and HD video-enabled. Operating with less than 9 watts of energy, the Dell Wyse 5010 (Windows) offers cool, quiet operations, potentially lowering your overall carbon footprint.

### 3.4.4 Wyse 7010 (Windows Embedded Standard 8)

The versatile Dell Wyse 7010 thin client runs Windows Embedded Standard 8 and gives people the freedom to mix and match a broad range of legacy and cutting edge peripheral devices. Ports for parallel, serial, and USB 3.0 offer fast, flexible connectivity. Like all Dell Wyse thin clients, the new Dell Wyse 7010 (Windows) is one cool operator. Its energy efficient processor – which out-performs other more power-hungry alternatives – and silent fan-less design, all contribute to help lower an organization’s carbon footprint through power requirements that are a fraction of traditional desktop PCs.

### 3.4.5 Wyse 5040 AIO

The Dell Wyse 5040 AIO all-in-one (AIO) offers versatile connectivity options for use in a wide range of industries. With four USB 2.0 ports, Gigabit Ethernet and integrated dual band Wi-Fi options, users can link to their peripherals and quickly connect to the network while working with processing-intensive, graphics-rich applications. Built-in speakers, a camera and a microphone make video conferencing and desktop communication simple and easy. It even supports a second attached display for those who need a dual monitor configuration. A simple one-cord design and out-of-box automatic setup makes deployment effortless while remote management from a simple file server, Wyse Device Manager
(WDM), or Wyse Cloud Client Manager can help lower your total cost of ownership as you grow from just a few thin clients to tens of thousands.

### 3.4.6 Dell Venue 11 Pro

Meet the ultimate in productivity, connectivity and collaboration. Enjoy full laptop performance in an ultra-portable tablet that has unmatched flexibility for a business in motion. This dual purpose device works as a tablet when you’re out in the field but also enables you to work on your desktop in the office thanks to an optional dock. For more information, please visit: [Link](#)

### 3.4.7 Dell Chromebook 13

The lightweight, easy-to-use Dell Chromebook 13 helps turn education into exploration - without the worries of safety or security. Priced to make 1:1 computing affordable today, Chromebook 13 is backed by Dell support services to make the most of your budget for years to come. The Chrome OS and Chrome browser get students online in an instant and loads web pages in seconds. A high-density battery supported by a 5th Gen Intel® CPU provides up to 12 hours of power. Encourage creativity with the Chromebook 13 and its multimedia features that include a 13.3” screen, stereo sound and webcam. For more information, please visit: [Link](#)
4 Software Components

4.1 Dell Quick Start Tool (QST)

The Dell Quick Start Tool or QST is a lightweight utility that helps immensely reduce complexity and time required to deploy a ready-to-use virtualization environment on the appliance. It takes a minute to install and then reduces the number of deployment steps by about 90% from several hundred steps to just under 40. The QST can only be executed on the appliance itself (Windows Server 2012 R2 host) and for virtual desktops, supports Windows 7, Windows 8.1, or Windows 10 client OS deployment (single template image only). Deployment time is down to between 1 to 4 hours depending on your environment and workflows - this is significantly less than the days it normally takes. The QST can be downloaded from here.

![Quick Start Tool for Dell Appliance for Wyse](image-url)
The QST can configure the virtualization environment to be used for shared session desktops (XenApp/RDSH) or non-persistent virtual desktops. The solution also supports persistent (full clone) virtual desktops configured via the broker management console after initial deployment.

<table>
<thead>
<tr>
<th>QST deployments</th>
<th>Optimized Large Standalone</th>
<th>Optimized Small Standalone</th>
<th>Custom Standalone</th>
<th>Scale Out (Non-HA)</th>
<th>Scale Out (HA Mgmt Layer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deployms Mgmt. VMs per architecture spec</td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
</tr>
<tr>
<td>For VDI: Std., Enh., or Pro. desktop profiles up to max density*</td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
</tr>
<tr>
<td>For RDSH: deploys RDSH VMs per architecture spec</td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
</tr>
<tr>
<td>Deploys single dedicated mgmt. node</td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
</tr>
<tr>
<td>Adds node to existing appliance deployment</td>
<td><img src="red" alt="No" /></td>
<td><img src="red" alt="No" /></td>
<td><img src="red" alt="No" /></td>
<td><img src="green" alt="Yes" /></td>
<td><img src="red" alt="No" /></td>
</tr>
<tr>
<td>Configures M5 Failover Clustering**</td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
</tr>
<tr>
<td>Configures multiple mgmt. nodes***</td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
</tr>
<tr>
<td>ProSupport available for QST issues</td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
<td><img src="green" alt="Yes" /></td>
</tr>
</tbody>
</table>

*Max density determined by testing optimized hardware configurations only

**Clustering and adding redundant mgmt. node must be performed manually. Mgmt. VMs must also be manually moved to shared storage after deployment.

4.2 Citrix

**NOTE**: The Quick Start Tool will install the XenDesktop, MCS, and XenApp components of Citrix. All other components are listed here for completeness only; however, they can be configured manually after your environment has been deployed.

4.2.1 Citrix XenDesktop

The solution is based on Citrix XenDesktop which provides a complete end-to-end solution delivering Microsoft Windows virtual desktops or server-based hosted shared sessions to users on a wide variety of endpoint devices. Virtual desktops are dynamically assembled on demand, providing users with pristine, yet personalized, desktops each time they log on.
Citrix XenDesktop provides a complete virtual desktop delivery system by integrating several distributed components with advanced configuration tools that simplify the creation and real-time management of the virtual desktop infrastructure.

The core XenDesktop components include:

- **Studio**
  Studio is the management console that enables you to configure and manage your deployment, eliminating the need for separate management consoles for managing delivery of applications and desktops. Studio provides various wizards to guide you through the process of setting up your environment, creating your workloads to host applications and desktops, and assigning applications and desktops to users.

- **Director**
  Director is a web-based tool that enables IT support teams to monitor an environment, troubleshoot issues before they become system-critical, and perform support tasks for end users. You can also view and interact with a user’s sessions using Microsoft Remote Assistance.
• **Receiver**
Installed on user devices, Citrix Receiver provides users with quick, secure, self-service access to documents, applications, and desktops from any of the user’s devices including smartphones, tablets, and PCs. Receiver provides on-demand access to Windows, Web, and Software as a Service (SaaS) applications.

• **Delivery Controller (DC)**
Installed on servers in the data center, the controller authenticates users, manages the assembly of users’ virtual desktop environments, and brokers connections between users and their virtual desktops.

• **StoreFront**
StoreFront authenticates users to sites hosting resources and manages stores of desktops and applications that user’s access.

• **License Server**
The Citrix License Server is an essential component at any Citrix-based solution. Every Citrix product environment must have at least one shared or dedicated license server. License servers are computers that are either partly or completely dedicated to storing and managing licenses. Citrix products request licenses from a license server when users attempt to connect.

• **Machine Creation Services (MCS)**
A collection of services that work together to create virtual servers and desktops from a master image on demand; optimizing storage utilization and providing a pristine virtual machine to users every time they log on. Machine Creation Services is fully integrated and administrated in Citrix Studio.

• **Provisioning Services (PVS)**
The Provisioning Services infrastructure is based on software-streaming technology. This technology allows computers to be provisioned and re-provisioned in real-time from a single shared-disk image.

• **Virtual Delivery Agent (VDA)**
The Virtual Desktop Agent is a transparent plugin that is installed on every virtual desktop or XenApp host (RDSH) and enables the direct connection between the virtual desktop and users’ endpoint devices.

### 4.2.2 Machine Creation Services (MCS)
Citrix Machine Creation Services is the native provisioning mechanism within Citrix XenDesktop for virtual desktop image creation and management. Machine Creation Services uses the hypervisor APIs to create,
start, stop, and delete virtual desktop images. Desktop images are organized in a Machine Catalog and within that catalog there are a number of options available to create and deploy virtual desktops:

- **Random**: Virtual desktops are assigned randomly as users connect. When they logoff, the desktop is reset to its original state and made free for another user to login and use. Any changes made by the user are discarded at log off.

- **Static**: Virtual desktops are assigned to the same user every time with three options for how to handle changes made to the desktop: Store on local vDisk, Personal vDisk, or discarded on user log off.

All the desktops in a random or static catalog are based off a master desktop template which is selected during the catalog creation process. MCS then takes snapshots of the master template and layers two additional virtual disks on top: an Identity vDisk and a Difference vDisk. The Identity vDisk includes all the specific desktop identity information such as host names and passwords. The Difference vDisk is where all the writes and changes to the desktop are stored. These Identity and Difference vDisks for each desktop are stored on the same data store as their related clone.

While traditionally used for small to medium sized XenDesktop deployments, MCS can bring along with it some substantial Tier 1 storage cost savings because of the snapshot/identity/difference disk methodology. The Tier 1 disk space requirements of the identity and difference disks when layered on top of a master image snapshot, is far less than that of a dedicated desktop architecture.
4.2.3 Provisioning Services (PVS)

PVS is an alternative method of image provisioning which uses streaming to share a single base vDisk image instead of copying images to VMs. PVS are used to deliver shared vDisk images to physical or virtual machines. Another potential use is the serial provisioning of XenApp to enable scale-out hosted shared desktop infrastructure. Provisioning Services enables real-time streamed provisioning and re-provisioning which enable administrators to completely eliminate the need to manage and patch individual systems.

Desktop images are organized in a Machine Catalog and within that catalog there are a number of options available to create and deploy virtual or physical desktops:

- **Random**: Virtual or physical desktops are assigned randomly as users connect. When they logoff, the desktop is reset to its original state and made free for another user to login and use. Any changes made by the user are discarded at log off.

- **Static**: Virtual desktops are assigned to the same user every time with user changes stored on a separate Personal vDisk.

Using Provisioning Services, vDisk images are configured in Standard Image mode, read-only, or Private Image mode, read/write. A vDisk in Standard Image mode allows multiple desktops to boot from it simultaneously greatly reducing the number of images that must be maintained and the amount of storage that is otherwise required (non-persistent). Private Image mode vDisks are equivalent to dedicated hard disks and can only be used by one target device at a time (persistent). The Provisioning Server runs on a virtual instance of Windows Server 2012 R2 on the Management Server(s).

4.2.3.1 PVS Write Cache

Citrix Provisioning Services delivery of standard images relies on write-caches to store any writes made by the target OS. The most common write-cache implementation places write-cache on the target machine’s storage. Independent of the physical or virtual nature of the target machine, this storage has to be allocated and formatted to be usable.

While there are 4 possible locations for storage of the write cache in PVS, the Dell Wyse Datacenter solution recommends placement of the PVS write cache in the target compute host’s RAM with overflow enabled. We recommend using a cache size of 512MB for virtual desktops and 21GB for XenApp VMs delivered via PVS.
4.2.4 Personal vDisk

Citrix Personal vDisk is an enterprise workspace virtualization solution that is built into Citrix XenDesktop. Personal vDisk provides the user customization and personalization benefits of a persistent desktop image with the storage savings and performance of a single/shared image.

Used in conjunction with a static desktop experience, Citrix Personal vDisk allows each user to receive personal storage in the form of a layered vDisk (3GB minimum). This personal vDisk enables users to personalize and persist their desktop environment while providing storage for any user or departmental apps.

Personal vDisk provides the following benefits to XenDesktop:
- Persistent personalization of user profiles, settings and data
- Enables deployment and management of user installed and entitlement based applications
- Fully compatible with Microsoft SCCM and App-V
- 100% persistence with VDI pooled Storage management
- Near Zero management overhead

4.2.5 AppDisks

Citrix AppDisk, included in XenDesktop 7.8, provides layering technology to manage departmental applications as an independent storage layer. AppDisk eases the management burden of maintaining multiple departmental images by instantly layering applications onto a single golden image that remains separate and pristine. AppDisks can be associated with either published desktops or published applications via XenApp. AppDisk does not replace the functionality provided by Personal vDisk but currently cannot be used within the same golden image. AppDisks when integrated with AppDNA provides the ability to analyze OS and application performance, compatibility as well as remediation capabilities.
4.2.6 HDX 3D Pro

XenDesktop with HDX 3D Pro is a desktop and app virtualization solution that supports high-end designers and engineers of 3D professional graphics applications and provides cost-effective support to viewers and editors of 3D data. With XenDesktop, you can deliver a persistent user experience and leverage other virtualization benefits such as single-image management and improved data security.

Use HDX 3D Pro technologies with:

- Computer-aided design, manufacturing, and engineering (CAD/CAM/CAE) applications
- Geographical information system (GIS) software
- Picture Archiving Communication System (PACS) workstations for medical imaging
- Latest OpenGL, DirectX, CUDA and CL versions supported
- Latest NVIDIA Grid cards
- Shared or dedicated GPUs or a mix of both on desktop or server OS VMs

HDX 3D Pro provides the best user experience over any bandwidth using Framehawk integration:

- On wide area network (WAN) connections: Deliver an interactive user experience over WAN connections with bandwidths as low as 1.5 Mbps.
- On local area network (LAN) connections: Deliver a user experience equivalent to that of a local desktop on LAN connections with bandwidths of 100 Mbps.

4.2.7 Citrix Profile Manager

Citrix Profile Management is a component of the XenDesktop suite which is used to manage user profiles and minimize many of the issues associated with traditional Windows roaming profiles in an environment where users may have their user profile open on multiple devices at the same time. The profile management toolset has two components: the profile management agent, installed on any device where the user profiles is managed, and a Group Policy Administrative Template, which is imported to a group policy.

In order to further optimize, the profile management folders within the user profile is redirected the users’ home drive. The folder redirection is managed via group policy objects within Active Directory. The following folders are redirected:
4.2.8 Citrix XenApp

Citrix XenApp 7.6 and higher include enhancements in the areas of faster access to virtual apps with higher connection resiliency, improved graphics rendering, and new app-usage reporting and monitoring tools.

Citrix XenApp delivers Windows apps as secure mobile services. With XenApp, IT can mobilize the business - increasing user productivity, while reducing costs by centralizing control and security of intellectual property. XenApp delivers high-performance apps to any PC, Mac, laptop, tablet or smartphone that enable the delivery of a native experience that is optimized for the type of device, as well as the network. XenApp is built on a 3rd generation FlexCast Management Architecture (FMA) and is the only hybrid cloud-ready platform that separates the management plane from the workload to enable IT to securely deliver published apps on-premises, and manage workers and mobile workspaces either on-premises or in the cloud.
Benefits of hosted desktop sessions and applications:

- Management of applications (single instance)
- Management of simple desktop images (no applications installed)
- PVS to stream XenApp servers as well as user desktops
- Scalability of XenDesktop compute hosts: CPU and IOPS reduction via application offload
- Shared storage scalability: less IOPS = more room to grow

Citrix XenDesktop with XenApp integration can effectively deliver a desktop/application hybrid solution as well. Specifically where a single or small number of shared VDI desktop images are deployed via XenDesktop, each with common shared applications installed within the golden image. A user-specific application set is then deployed and made accessible via the hosted application compute infrastructure, accessible from within the virtual desktop.

Alternatively, XenApp provides a platform for delivering Windows server-based sessions to users who may not need a full desktop VM. Hosted desktops increase infrastructure resource utilization while reducing complexity as all applications and sessions are centrally managed.

4.2.8.1 XenApp Integration into Dell Wyse Datacenter Architecture

The XenApp servers can exist as physical or virtualized instances of Windows Server 2012 R2. A minimum of one (1), up to a maximum of eight (7) virtual servers are installed per physical compute host. Since XenApp instances are easily added to an existing XenDesktop stack, the only additional components required are:

- One or more Windows Server OS instances running the Citrix VDA added to the XenDesktop site

The total number of required virtual XenApp servers is dependent on application type, quantity and user load. Deploying XenApp virtually and in a multi-server farm configuration increases overall farm performance, application load balancing as well as farm redundancy and resiliency.
4.2.8.2 XenDesktop with XenApp and Personal vDisk Integration

In a XenDesktop implementation that leverages hosted applications, these execute from a centralized Windows Server and are then accessed via the Citrix Receiver. There are some instances, however, where certain departmental or custom applications cannot run using XenApp. At the same time for organizational policy or certain storage considerations, delivering these applications as a part of a base image is not possible either. In this case, Citrix Personal vDisk technology is the appropriate solution.

With Citrix Personal vDisk, each user of that single shared virtual desktop image also receives a personal layered vDisk, which enables the user to personalize their desktop and receive native application execution within a Windows client OS and not from a server. When leveraging the integration of XenApp within XenDesktop, all profile and user data is seamlessly accessed within both environments.

4.2.8.3 XenApp Integration into Dell Wyse Datacenter Architecture

The XenApp servers can exist as physical or virtualized instances of Windows Server 2012 R2. A minimum of one (1), up to a maximum of eight (8) virtual servers are installed per physical compute host. Since XenApp instances are easily added to an existing XenDesktop stack, the only additional components required are:

- One or more Server OS instances running the Citrix VDA added to the XenDesktop site

The total number of required virtual XenApp servers is dependent on application type, quantity and user load. Deploying XenApp virtually and in a multi-server farm configuration increases overall farm performance, application load balancing as well as farm redundancy and resiliency.

4.2.8.4 PVS Integration with XenApp

One of the many benefits of PVS is the ability to quickly scale the XenApp instances within a farm. Bandwidth is a key consideration and PVS bandwidth utilization is mostly a function of the number of target devices and the portion of the image(s) they utilize. Network impact considerations include:

- PVS streaming is delivered via UDP, yet the application has built-in mechanisms to provide flow control, and retransmission as necessary.
- Data is streamed to each target device only as requested by the OS and applications running on the target device. In most cases, less than 20% of any application is ever transferred.
- PVS relies on a cast of supporting infrastructure services. DNS, DHCP need to be provided on dedicated service infrastructure servers, while TFTP and PXE Boot are functions that may be hosted on PVS servers or elsewhere.
4.2.8.5 NUMA Architecture Considerations
Best practices and testing has showed that aligning XenApp design to the physical Non-Uniform Memory Access (NUMA) architecture of the server CPUs results in increased and optimal performance. NUMA alignment ensures that a CPU can access its own directly-connected RAM banks faster than those banks of the adjacent CPU which are accessed via the Quick Path Interconnect (QPI). The same is true of VMs with large vCPU assignments, best performance will be achieved if your VMs receive their vCPU allotment from a single physical NUMA node. Ensuring that your virtual XenApp servers do not span physical NUMA nodes will ensure the greatest possible performance benefit.

4.2.8.6 Large Appliance NUMA Alignment
The large appliances contain dual Intel E5-2660v4 processors with 14 physical cores per CPU and 28 logical with Hyperthreading active giving us a total of 56 consumable cores per appliance which falls in line with a 2x oversubscription rate. Configuring the Management and XenApp/RDSH VMs as shown below will ensure that no NUMA spanning occurs which could lower performance.
4.2.8.7 Small Appliance NUMA Alignment

The small appliances contain dual Intel E5-2630v4 processors with 10 physical cores per CPU and 20 logical with Hyperthreading active giving us a total of 40 consumable cores per appliance which falls in line with a 2x oversubscription rate. Configuring the Management and XenApp/RDSH VMs as shown below will ensure that no NUMA spanning occurs which could lower performance.

4.2.9 Citrix NetScaler

Citrix NetScaler is an all-in-one web application delivery controller that makes applications run five times better, reduces web application ownership costs, optimizes the user experience, and makes sure that applications are always available by using:

- Proven application acceleration such as HTTP compression and caching
- High application availability through advanced L4-7 load balancer
- Application security with an integrated Application Firewall
- Server offloading to significantly reduce costs and consolidate servers

A NetScaler appliance resides between the clients and the servers, so that client requests and server responses pass through it. In a typical installation, virtual servers (vservers) configured on the NetScaler provide connection points that clients use to access the applications behind the NetScaler. In this case, the NetScaler owns public IP addresses that are associated with its vservers, while the real servers are isolated in a private network. It is also possible to operate the NetScaler in a transparent mode as an L2 bridge or L3 router, or even to combine aspects of these and other modes. NetScaler can also be used to host the StoreFront function eliminating complexity from the environment.
Global Server Load Balancing

GSLB is an industry standard function. It is in widespread use to provide automatic distribution of user requests to an instance of an application hosted in the appropriate data center where multiple processing facilities exist. The intent is to seamlessly redistribute load on an as required basis, transparent to the user community. These distributions are used on a localized or worldwide basis. Many companies use GSLB in its simplest form. They use the technology to automatically redirect traffic to Disaster Recovery (DR) sites on an exception basis. That is, GSLB is configured to simply route user load to the DR site on a temporary basis only in the event of a catastrophic failure or only during extended planned data center maintenance. GSLB is also used to distribute load across data centers on a continuous load balancing basis as part of normal processing.

XenDesktop HA with NetScaler White Paper: [Link]

Several of the management components of the XenDesktop stack are made highly-available using NetScaler to load balance traffic. The following management components require the use of a load balancer to function in a high availability mode:

- StoreFront Servers
- Licensing Server
- XenDesktop XML Service
- XenDesktop Desktop Director
- Provisioning Services TFTP Service
4.3 Hypervisor Platforms

4.3.1 Microsoft Windows Server 2012 R2 Hyper-V

Windows Server 2012 R2 Hyper-V™ is a powerful virtualization technology that enables businesses to leverage the benefits of virtualization. Hyper-V reduces costs, increases hardware utilization, optimizes business infrastructure, and improves server availability. Hyper-V works with virtualization-aware hardware to tightly control the resources available to each virtual machine. The latest generation of Dell servers includes virtualization-aware CPUs and network adapters.

From a network management standpoint, virtual machines are much easier to manage than physical computers. To this end, Hyper-V includes many management features designed to make managing virtual machines simple and familiar, while enabling easy access to powerful VM-specific management functions. The primary management platform within a Hyper-V based XenDesktop virtualization environment is Microsoft Systems Center Virtual Machine Manager SP1 (SCVMM).

SCVMM provides centralized and powerful management, monitoring, and self-service provisioning for virtual machines. SCVMM host groups are a way to apply policies and to check for problems across several VMs at once. Groups are organized by owner, operating system, or by custom names such as “Development” or “Production”. The interface also incorporates Remote Desktop Protocol (RDP); double-click a VM to bring up the console for that VM—live and accessible from the management console.
## 5 Solution Architecture for XenDesktop Appliance

### 5.1 Management Role Configuration

#### 5.1.1 Hyper-V

The Management role requirements for the virtual desktop and application virtualization configurations are summarized below. For all-in-one deployments, the standalone configurations are the same for both Small and Large models. For scale out deployments, the number of management VMs are expanded and exist only on the dedicated management node (Small appliance).

<table>
<thead>
<tr>
<th>Role</th>
<th>vCPU</th>
<th>Startup RAM (GB)</th>
<th>Dynamic Memory</th>
<th>NIC</th>
<th>OS vDisk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Min</td>
<td>Max</td>
<td>Buffer</td>
</tr>
<tr>
<td>Broker, StoreFront, &amp; SCVMM</td>
<td>4</td>
<td>8</td>
<td>2GB</td>
<td>8GB</td>
<td>20%</td>
</tr>
<tr>
<td>SQL</td>
<td>4</td>
<td>8</td>
<td>2GB</td>
<td>8GB</td>
<td>20%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>8</td>
<td>16</td>
<td>4GB</td>
<td>16Gb</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Role</th>
<th>vCPU</th>
<th>Startup RAM (GB)</th>
<th>Dynamic Memory</th>
<th>NIC</th>
<th>OS vDisk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Min</td>
<td>Max</td>
<td>Buffer</td>
</tr>
<tr>
<td>Broker &amp; Licensing</td>
<td>4</td>
<td>8</td>
<td>2GB</td>
<td>8GB</td>
<td>20%</td>
</tr>
<tr>
<td>Secondary Broker</td>
<td>4</td>
<td>8</td>
<td>2GB</td>
<td>8GB</td>
<td>20%</td>
</tr>
<tr>
<td>StoreFront</td>
<td>4</td>
<td>8</td>
<td>2GB</td>
<td>8GB</td>
<td>20%</td>
</tr>
<tr>
<td>SCVMM</td>
<td>4</td>
<td>8</td>
<td>2GB</td>
<td>8GB</td>
<td>20%</td>
</tr>
<tr>
<td>SQL</td>
<td>4</td>
<td>8</td>
<td>2GB</td>
<td>8GB</td>
<td>20%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>20</td>
<td>40</td>
<td>10GB</td>
<td>40Gb</td>
<td>-</td>
</tr>
</tbody>
</table>
### 5.1.2 XenApp/RDSH on Hyper-V

The recommended number of NUMA balanced XenApp (RDSH) VMs and their configurations on Hyper-V are summarized below based on applicable hardware platform.

<table>
<thead>
<tr>
<th>Appliance model</th>
<th>VMs per host</th>
<th>vCPU</th>
<th>Startup RAM (GB)</th>
<th>Dynamic Memory</th>
<th>NIC</th>
<th>OS vDisk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>3</td>
<td>8</td>
<td>16</td>
<td>Min</td>
<td>Max</td>
<td>Buffer</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8GB</td>
<td>32GB</td>
<td>20%</td>
</tr>
<tr>
<td>Large</td>
<td>6</td>
<td>8</td>
<td>16</td>
<td>Min</td>
<td>Max</td>
<td>Buffer</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8GB</td>
<td>32GB</td>
<td>20%</td>
</tr>
</tbody>
</table>

### 5.1.3 SQL Databases

The Citrix and Microsoft databases are hosted by a single dedicated Windows Server 2012 R2 VM in the Management layer. The Quick Start Tool (QST) creates all the necessary databases for:

- Citrix XenDesktop
- SCVMM

Due to the System Center VMM requirement, SQL Express cannot be used for this solution.

### 5.1.4 DNS

DNS plays a crucial role in the environment not only as the basis for Active Directory but is used to control access to the various Citrix and Microsoft software components. All hosts, VMs, and consumable software components need to have a presence in DNS, preferably via a dynamic and AD-integrated namespace. Microsoft best practices and organizational requirements are to be adhered to.

### 5.2 Storage Architecture Overview

The Dell Appliance for Wyse is available with local Tier 1 storage with the option to add shared Tier 2 storage to protect the management VMs.

#### 5.2.1 Local Tier 1 storage

The local Tier 1 storage model means that the appliances use up to 10 locally installed hard drives to house the appliance operating system and all virtual machines. In this model, Tier 1 storage exists as local hard disks (HDDs) in the Optimized configurations; however, SSDs can be ordered via the Custom configuration. To achieve the required performance level, RAID 10 is recommended for use across all local disks. A single volume per local Tier 1 appliance is sufficient to host the provisioned desktop VMs along with their respective write caches.
5.2.2 Shared Tier 2 Storage for Management VMs – EqualLogic iSCSI

Tier 2 is shared iSCSI storage used to host only the Management server VMs in order to provide high availability for the management layer. EqualLogic PS4100E 1Gb arrays are sufficient for this purpose and the recommended RAID configuration to use is RAID 10 or RAID 6 to maximize performance and recoverability. The following depicts the component volumes required to support a 500 user environment. Additional Management volumes are created as needed along with size adjustments as applicable for user data and profiles.

Dell’s iSCSI technology provides compelling price/performance in a simplified architecture while improving manageability in virtualized environments. Specifically, iSCSI offers virtualized environments simplified deployment, comprehensive storage management and data protection functionality, and seamless VM mobility. Dell iSCSI solutions give customers the “Storage Direct” advantage – the ability to seamlessly integrate virtualization into an overall, optimized storage environment.

When iSCSI is the selected block storage protocol, then the Dell EqualLogic MPIO plugin is installed on all hosts that connect to iSCSI storage. This plugin allows for easy configuration of iSCSI on each host. The MPIO plugin allows for the creation of new (or access to existing) data stores and handles IO load balancing. The plugin will also configure the optimal multi-pathing settings for the data stores. Some key settings to be used as part of the configuration:

- Specify 2 IP Addresses for iSCSI on each host
- Specify NICs
- Specify Jumbo Frames at 9000 MTU
- Initialize iSCSI initiator
- Specify IP for the EqualLogic Storage group

5.3 Virtual Networking

5.3.1 Hyper-V

As shown in the diagrams below, native Windows Server 2012 R2 NIC Teaming is utilized to load balance and provide resiliency for network connections. Since the appliance performs both the compute and management roles, a single LBFO NIC team is configured to connect to a Hyper-V virtual switch for external traffic. Recommended property settings for the NIC team include:

- Member adapters: 10Gbps ports
- Teaming mode: Switch independent
- Load balancing mode: Dynamic
- Standby adapter: None (all adapters Active)
All vNICs associated with the Management OS connect directly to the external Hyper-V virtual switch. For ease of deployment and compatibility, VLANs are not configured by default but can be enabled if used in the environment.

For Non-HA scale out deployments, the virtual networking is configured the same with roles split to their respective dedicated appliance (Management and Compute):
When protecting the management VMs, the virtual networking stays the same with the addition of shared storage providing high availability for the management layer:

**NOTE:** The primary 10Gb network adapters in the appliances also include two 1Gb ports. These can be used to further segment network traffic or for iSCSI traffic on dedicated management appliances.

### 5.3.2 QST Configuration

NIC teaming and virtual switches are no longer configured on the appliances in Dell factory. This makes it easier for customers to configure the virtual networking to best suit their environment. For those that want to control the networking configuration, the QST will look for an external virtual switch named `vSwitch` and use it for deploying the virtual machines. If there are multiple virtual switches and none are named `vSwitch`, the QST will attempt to use the first available external virtual switch.

For customers that are unfamiliar with these types of settings or those that choose not to configure, the QST will automatically attempt to team the first two 10Gb NICs and create a virtual switch as outlined in the Virtual Networking section.

### 5.4 Scaling Guidance

The solution can be scaled out to accommodate up to 5000 users. In this configuration, an additional compute node beyond the number required for desired density (N+1 model) should be added to the environment to provide compute redundancy.
The QST can be used to automate the configuration of the management VMs to a single dedicated management node to create the virtualization management infrastructure. Afterwards, the QST can be used to add the compute nodes to the environment and configure provisioning to complete the virtualization environment.

**NOTE:** The 5000 user limit is based on the configuration of the management VMs. To determine the maximum number of compute nodes to order, use the following formulas. **For virtual desktops:** 5000 user limit / Max Users (based on density results) per Node + 1 Redundant Node. **For purely RDSH (application virtualization) configurations:** use a maximum of 16 compute nodes (15 + 1 redundant). **For combined configurations:** (5000 - # RDSH Users) / Max Users (based on density results) per Node + 1 Node.

For a summary of density results, refer to the Solution performance and testing section.

### 5.5 Solution High Availability

Shared Tier 2 storage is used to protect the management layer in a scale out deployment by connecting two Small dedicated management appliances and manually configuring a failover cluster. The QST does not configure Microsoft Failover Clustering. The QST can be used to create the management VMs on one of the nodes but they must be manually moved over to the cluster and changed to clustered VMs.

For additional high availability options, refer to the Dell Wyse Datacenter for Citrix XenDesktop Reference Architecture as a guide to utilizing the appliances as the server base for the desired configuration.
Dell Wyse Datacenter Architecture for XenDesktop
7 Solution Performance and Testing

At the time of publication here are the available appliance density recommendations.

<table>
<thead>
<tr>
<th>Hypervisor</th>
<th>Provisioning</th>
<th>Workload</th>
<th>Template OS</th>
<th>LARGE Appliance User Density</th>
<th>SMALL Appliance User Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyper-V</td>
<td>XenDesktop MCS</td>
<td>Standard</td>
<td>Windows 8.1</td>
<td>245</td>
<td>95</td>
</tr>
<tr>
<td>Hyper-V</td>
<td>XenDesktop MCS</td>
<td>Enhanced</td>
<td>Windows 8.1</td>
<td>200</td>
<td>75</td>
</tr>
<tr>
<td>Hyper-V</td>
<td>XenDesktop MCS</td>
<td>Professional</td>
<td>Windows 8.1</td>
<td>150</td>
<td>55</td>
</tr>
<tr>
<td>Hyper-V</td>
<td>XenApp</td>
<td>Enhanced</td>
<td>Windows Srv 2012 R2</td>
<td>340</td>
<td>170</td>
</tr>
</tbody>
</table>

For detailed validation results and analysis of these reference designs and more, please visit: [LINK](#)
Acknowledgements

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