Dell DVS Enterprise:
Reference Architecture for
Dell vWorkspace 8.0
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1 Introduction

1.1 Purpose of this document

This document describes the Dell DVS Enterprise Reference Architecture for Dell vWorkspace. This document addresses the architecture design, configuration and implementation considerations for the key components of the architecture required to deliver virtual desktops, RD Session Host sessions or applications via Dell vWorkspace on Hyper-V 2012.

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 design 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 solution scaling and component selection guidance.
2 vWorkspace Solution Architecture Overview

2.1 vWorkspace Solution Overview

The Dell vWorkspace Solution provides access to virtual desktops or applications via VDI, Physical PCs, and Virtual or Physical RD Session Hosts. vWorkspace also provides access to virtualized applications by way of Microsoft App-V and Linux Application Workloads by way of Linux Hosted Virtual Desktops or Physical Linux PCs.

While vWorkspace supports a variety of hypervisors, this DVS Enterprise Solution architecture is based on Microsoft Hyper-V.

2.2 vWorkspace Physical Architecture Overview

The core architecture design consists of the Local Tier1 solution model. "Tier 1" in the DVS context defines from which disk source the VDI sessions execute and in this case means local disks. Local Tier 1 applies to rack servers only while Shared Tier 1 can be rack or blade. Tier 2 shared storage is utilized for user profile/data and Management VM execution.
2.3 Layouts and Breakpoints

The solution architecture will follow the traditional DVS distributed design model consisting of 4 primary layers: Network, Compute, Management, and Storage. The Network and Storage layers can be optionally provided by the customer if suitable infrastructure is already in place. The Compute layer contains the hosts that serve the VDI sessions and the Management layer contains the components required to support the Dell vWorkspace infrastructure.

The following highlights the key layout and scaling elements of the solution.

2.3.1 Local Tier 1 – Solution Layers

Only a single high performance Force10 S55 48-port switch is required to get started in the Network layer. This switch will host all solution traffic consisting of 1Gb iSCSI and LAN sources (500 users or less). Additional switches can be added and stacked as required to provide High Availability for the Network layer.

The Compute layer consists of the server resources responsible for hosting the user sessions, whether shared via RD Session Host VMs (RDSH - formerly Terminal Server) or vWorkspace Desktops on Hyper-V (see section 4.5.1 for a detailed explanation of each role). The Hyper-V role requires hardware assisted virtualization. The RDSH role is enabled within dedicated VMs on the same or dedicated hosts in the Compute layer.

Management components are dedicated to their own layer so as to not negatively impact the user sessions running in the Compute layer. This physical separation of resources provides clean, linear, and predictable scaling without the need to reconfigure or move resources within the solution as you grow. The Management layer will host all the Dell vWorkspace VMs necessary to support the infrastructure as well as a file server to host SMB shares for user data.

The Storage layer is made up by the capacity dense and performance capable Equallogic iSCSI arrays, sized depending on scale. 12TB is provided in base form with the PS4100E that can scale to over 48TB in the PS6500E to suit your capacity and performance requirements.
2.3.2 Dell DVS 10-Seat Trial Kit

To get up and running as quickly as possible with pooled VDI, Dell is offering an extremely affordable solution capable of supporting 10 concurrent users for a minimal investment. This architecture leverages an inexpensive single server platform intended to demonstrate the capabilities of VDI for a small environment or focused POC/ trial. Networking is provided optionally in this solution and all VDI roles/ sessions are hosted on a single server.

For more information on the 10-Seat Trial Kit, please see Appendix A.

2.3.3 Local Tier 1 – 50 User/ Pilot

For a very small deployment or pilot effort to familiarize yourself with the DVS Enterprise solution architecture, we offer a 50 user/ pilot solution completely scalable to the maximum supported configuration. The architecture for the 50 user pilot follows a non-distributed model with all VDI and Management functions running on a single host. If additional scaling is desired, you can grow into a larger distributed architecture seamlessly with no loss on initial investment.
2.3.4 Local Tier 1 – Combined

As a logical entry point to the distributed Dell vWorkspace solution stack, a combined architecture is offered to host both the vWorkspace Desktops and RDSH role within the same physical Compute host while separating the Management layer. This will enable users requiring either shared RDSH or pooled VDI sessions to be hosted on the same physical server. The value of this solution is a minimal infrastructure investment with maximum VDI flexibility easily tailored to shared and pooled user types. Horizontal scaling is achieved simply by adding additional Compute hosts. Additional information on the hardware components can be found in section 3 below.

2.3.5 Local Tier 1 – Distributed

In the base distributed architecture the vWorkspace Desktops or RDSH role are assigned to a dedicated Compute host. This architecture can support either a single vWorkspace Desktops or RDSH Compute host or one of each. This solution provides maximum Compute host user density and allows clean linear upward scaling. You’ll notice that the hardware spec is slightly different for the two Compute host types, giving additional RAM to the vWorkspace Desktops host. This of course can be adjusted to suit your specific needs. Additional information on the hardware components can be found in section 3 below.
2.3.6 Local Tier 1 – Scale Out

The solution architecture provides linear upward scale for both the vWorkspace Desktops and RDSH roles optimized for 5000 pooled VDI sessions or shared RD sessions. This solution supports up to 22 Compute hosts of any combination running either vWorkspace Desktops or RDSH roles to meet the needs of the enterprise. Additional information on the hardware components can be found in section 3 below.
2.3.7 High Availability

High availability (HA) is offered to protect all layers of the solution architecture. Additional ToR switches are added to the Network layer and stacked to provide redundancy as required, additional Compute and Mgmt hosts are added to their respective layers, Hyper-V clustering is introduced in the Management layer, SQL is mirrored, and a NAS device can be used to host file shares. Please see section 4.6 for more detailed information regarding HA in this architecture.

2.3.8 Local Tier 1 – Converged Infrastructure

The solution architecture can also be configured using a 10Gb converged infrastructure methodology if desired. This architecture changes the ToR switches, network connectivity and Equallogic arrays used in the solution to 10Gb models. All LAN and iSCSI traffic is combined on the Force10 S4810 switches with a 1Gb switch provided for hardware management traffic. The same basic scaling elements persist between the solutions.
### Solution Density Summary

<table>
<thead>
<tr>
<th>Design Scale</th>
<th>Management</th>
<th>Compute</th>
<th>RDSH Sessions</th>
<th>RDVH Sessions</th>
<th>HA</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 User POC</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>10</td>
<td>-</td>
</tr>
<tr>
<td>50 User / Pilot</td>
<td>0</td>
<td>1</td>
<td>120 or 50</td>
<td>50</td>
<td>+1 ToR Switch</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+1 Compute</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+1 Mgmt</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+NAS</td>
</tr>
<tr>
<td>Combined</td>
<td>1</td>
<td>1</td>
<td>120 and 85</td>
<td></td>
<td>+1 ToR Switch</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+1 Compute</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+1 Mgmt</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+NAS</td>
</tr>
<tr>
<td>Distributed</td>
<td>1</td>
<td>1</td>
<td>230 or 230</td>
<td></td>
<td>+1 ToR Switch</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+1 Compute</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+1 Mgmt</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+NAS</td>
</tr>
<tr>
<td>Scale out</td>
<td>1</td>
<td>22</td>
<td>5060 or 5060</td>
<td>5060</td>
<td>+1 ToR switch</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+1 Compute</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+1 Mgmt</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>+NAS</td>
</tr>
</tbody>
</table>

### Cabling Diagrams

#### Local Tier 1 – Network Architecture

In the Local Tier 1 architecture, a single Force10 S55 switch can be shared among all network connections for both Management and Compute layer components, to the upper limit of 500 pooled VDI sessions. Over 500 users DVS recommends separating the network fabrics to isolate iSCSI and LAN traffic as well as making each network stack redundant. Only the Management servers connect to iSCSI storage in this model. All ToR traffic has been designed to be layer 2/
switched locally, with all layer 3/ routable VLANs trunked from a core or distribution switch. The following diagrams illustrate the logical data flow in relation to the core switch.

2.4.2 Local Tier 1 Cabling (<500 users)
3 Hardware Components

3.1 Network

The following sections contain the core network components for the DVS local Tier 1 solution. General uplink cabling guidance to consider in all cases is that TwinAx is very cost effective for short 10Gb runs and for longer runs fiber with SFPs should be used.

3.1.1 Force10 S55 (ToR Switch)

<table>
<thead>
<tr>
<th>Model</th>
<th>Features</th>
<th>Options</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Force10 S55</td>
<td>44 x BaseT (10/100/1000) + 4 x SFP</td>
<td>Redundant PSUs</td>
<td>ToR switch for LAN and iSCSI in Local Tier 1 solution</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 x 1Gb SFP ports the support copper or fiber</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>12Gb or 24Gb stacking (up to 8 switches)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 x modular slots for 10Gb uplinks or stacking modules</td>
<td></td>
</tr>
</tbody>
</table>

Guidance:

- 10Gb uplinks to a core or distribution switch are the preferred design choice using the rear 10Gb uplink modules. If 10Gb to a core or distribution switch is unavailable the front 4 x 1Gb SFP ports can be used.
- The front 4 SFP ports can support copper cabling and can be upgraded to optical if a longer run is needed.

For more information on the S55 switch and Dell Force10 networking, please visit: [LINK](#)

3.1.1.1 Force10 S55 Stacking

The Top of Rack switches in the Network layer can be optionally stacked with additional switches, if greater port count or redundancy is desired. Each switch will need a stacking module plugged into a rear bay and connected with a stacking cable. Switch stacks greater than 2 should be cabled in a ring configuration with the last switch in the stack cabled back to the first. Uplinks should be configured on all switches in the stack back to the core to provide redundancy and failure.
3.2 Servers

3.2.1 Local Tier 1 Rack

The server platform for the Dell vWorkspace solution is the best-in-class Dell PowerEdge R720. This dual socket CPU platform runs the fastest Intel Xeon E5-2600 family of processors, can host up to 768GB RAM, and supports up to 16 2.5" SAS disks. The Dell PowerEdge R720 offers uncompromising performance and scalability in a 2U form factor.

In the Local Tier 1 solution model, VDI sessions execute on the local storage of each Compute server. Due to the local disk requirement in the Compute layer, this model supports rack servers only. In this model only the Management server hosts require access to shared storage to support the solution’s Management role VMs. Because of this, the Compute and Management servers are configured with different add-on NICs to support their pertinent network fabric connection requirements. Refer to section 2.3.1 for cabling implications. The management server host has reduced RAM, CPU and fewer disks, since its VMs execute on shared Tier 2 storage.

<table>
<thead>
<tr>
<th>Local Tier 1 Compute Host – PowerEdge R720</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 x Intel Xeon E5-2690 Processor (2.9Ghz)</td>
</tr>
<tr>
<td>256GB Memory (16 x 16GB DIMMs @ 1600Mhz) (VDI Hosts)</td>
</tr>
<tr>
<td>Or 128GB Memory (16 x 8GB DIMMs @ 1600Mhz) (RDSH Hosts)</td>
</tr>
<tr>
<td>Microsoft Windows Server 2012 Hyper-V</td>
</tr>
<tr>
<td>10 x 300GB SAS 6Gbps 15k Disks (OS + VDI)</td>
</tr>
<tr>
<td>PERC H710 Integrated 1GB RAID Controller – RAID10</td>
</tr>
<tr>
<td>Broadcom 5720 1Gb QP NDC (LAN)</td>
</tr>
<tr>
<td>Broadcom 5720 1Gb DP NIC (LAN)</td>
</tr>
<tr>
<td>iDRAC7 Enterprise w/ vFlash, 8GB SD</td>
</tr>
<tr>
<td>2 x 750W PSUs</td>
</tr>
</tbody>
</table>

Please reference the following Force10 whitepaper for specifics on stacking best practices and configuration: [LINK](#)
Local Tier 1 Management Host – PowerEdge R720

- 2 x Intel Xeon E5-2680 Processor (2.7Ghz)
- 48GB Memory (6 x 8GB DIMMs @ 1600Mhz)
- Microsoft Windows Server 2012 Hyper-V
- 2 x 300GB SAS 6Gbps 15k Disks (OS)
- PERC H710 Integrated 1GB RAID Controller – RAID1
- Broadcom 5720 1Gb QP NDC (LAN/iSCSI)
- Broadcom 5719 1Gb QP NIC (LAN/iSCSI)
- iDRAC7 Enterprise w/ vFlash, 8GB SD
- 2 x 750W PSUs

For more information on the Dell PowerEdge R720 server and other server offerings from Dell, please visit: [LINK](#)

### 3.3 Storage

#### 3.3.1 Equallogic Storage

<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, 2U chassis</td>
<td>12TB – 12 x 1TB HDs, 24TB – 12 x 2TB HDs, 36TB – 12 x 3TB HDs</td>
<td>Tier 2 array for 1000 total users or less in local Tier 1 solution model (1Gb)</td>
</tr>
</tbody>
</table>
For more information on the Dell Equallogic PS4100E and other networked storage options from Dell, please visit: [LINK](#)

### 3.3.1.2 PS6100E

<table>
<thead>
<tr>
<th>Model</th>
<th>Features</th>
<th>Options</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equallogic PS6100E</td>
<td>24 drive bays (NL-SAS/7200k RPM), dual HA controllers, Snaps/Clones, Async replication, SAN HQ, 1Gb, 4U chassis</td>
<td>14TB – 24 x 600GB HDs</td>
<td>Tier 2 array for 1000+ users in local Tier 1 solution model (1Gb)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24TB – 24 x 1TB HDs</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>48TB – 24 x 2TB HDs</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>72TB – 24 x 3TB HDs</td>
<td></td>
</tr>
</tbody>
</table>
### 3.3.1.3 PS6500E

<table>
<thead>
<tr>
<th>Model</th>
<th>Features</th>
<th>Options</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equallogic PS6500E</td>
<td>48 drive SATA/ NL SAS array, dual HA controllers, Snaps/Clones, Async replication, SAN HQ, 1Gb, 4U</td>
<td>48TB – 48 x 1TB SATA</td>
<td>Tier 2 array for 2500+ users in Local Tier 1 solution model (1Gb)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>96TB – 48 x 2TB SATA</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>144TB – 48 x 3TB NL SAS</td>
<td></td>
</tr>
</tbody>
</table>

### 3.3.1.4 NAS

### 3.3.1.5 FS7600

<table>
<thead>
<tr>
<th>Model</th>
<th>Features</th>
<th>Scaling</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equallogic FS7600</td>
<td>Dual active-active controllers, 24GB cache per controller (cache mirroring), SMB &amp; NFS support, AD-integration. Up to 2 FS7600 systems in a NAS cluster (4 controllers). 1Gb iSCSI via 8 x Ethernet ports.</td>
<td>Each controller can support 1500 concurrent users, up to 6000 total in a 2 system NAS cluster.</td>
<td>Scale out NAS for Local Tier 1 to provide file share HA.</td>
</tr>
</tbody>
</table>
### 3.4 Dell Wyse End Points

#### 3.4.1 Display Choices for Dell Wyse Endpoints

<table>
<thead>
<tr>
<th>Good</th>
<th>E2213*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1600x1050</td>
</tr>
<tr>
<td></td>
<td>VGA, DVI</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Better</th>
<th>P2212H</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1920x1080</td>
</tr>
<tr>
<td></td>
<td>VGA, DVI, USB</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Best</th>
<th>U3011*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2560x1600</td>
</tr>
<tr>
<td></td>
<td>VGA, DVI, DP, USB</td>
</tr>
</tbody>
</table>

*U3011 Not Available in Mainland China
*E2213 Not Available in South Korea

#### 3.4.2 Dell Wyse T10

The T10 handles everyday tasks with ease and also provides multimedia acceleration for task...
workers who need video. Users will enjoy integrated graphics processing and additional WMV & H264 video decoding capabilities from the Marvell ARMADA™ PXA 510 v7 1.0 GHz System-on-Chip (SoC). In addition, the T10 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 just 7 watts of electricity earns this device an Energy Star V5.0 rating. In addition, the T10’s small size enables discrete mounting options: under desks, to walls, and behind monitors, creating cool workspaces in every respect.

3.4.3 Dell Wyse D10D

The Dell Wyse D10D is a high-performance and secure ThinOS 8 thin client that is absolutely virus and malware immune. The D10D features an advanced dual-core AMD processor that handles demanding multimedia apps with ease and delivers brilliant graphics. Powerful, compact and extremely energy efficient, the D10D is a great VDI end point for organizations that need high-end performance but face potential budget limitations.

3.4.4 Dell Wyse D10D

Ultra-high performance in a compact package Power users and knowledge workers will love the
exceptionally fast speed and power from the new dual-core driven D10D. With a 1.4 GHz AMD G series APU with integrated graphics engine, the D10D handles everything from demanding multimedia applications to business content creation and consumption with ease. The D10D even supports power users’ most demanding workloads: high quality audio and video, unified communications, CAD/CAM, 3D simulation and modeling, HD Flash and multimedia, and dual digital high resolution displays with rotation. Users will enjoy smooth roaming and super-fast 802.11 a/b/g/n wireless at 2.4 and 5 GHz with dual antennas. The D10D is Citrix HDX, Microsoft® RemoteFX, and VMware® Horizon View certified. It also supports legacy peripherals via an optional USB adapter. Averaging 9 watts, each and every D10D contributes – quietly and coolly – to lowering your organization’s carbon footprint, with reduced power usage and emissions.

3.4.5 Dell Wyse D90D8

A strong, reliable thin client, the D90D8 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 D90D8 offers cool, quiet operations, contributing to lowering your overall carbon footprint.
3.4.6 Dell Wyse Z90D8

The versatile Z90D8 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 cloud clients, the new Dell Wyse Z90D8 is one cool operator. Its energy efficient processor – which out-performs other more power hungry alternatives – and silent fan-less design, all contribute to lowering an organization’s carbon footprint through power usage and emissions that are a fraction of traditional PC desktops.
4 Solution Architecture for Dell vWorkspace

4.1 Overview

The Dell vWorkspace solution architecture follows a distributed model where solution components exist in layers. The Compute layer is where vWorkspace Desktop VMs and/or Remote Desktop Session Host VMs execute. The Management layer being dedicated to the vWorkspace management role VMs. Both layers, while inextricably linked, scale independently.

<table>
<thead>
<tr>
<th>Solution Architecture Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypervisor</td>
</tr>
<tr>
<td>VDI Broker</td>
</tr>
<tr>
<td>Non-persistent provisioning</td>
</tr>
<tr>
<td>Database software</td>
</tr>
<tr>
<td>Server OS</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Desktop OS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Desktop Virtual Machine Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard Drive (Boot)</td>
</tr>
<tr>
<td>Hard Drive (Data)</td>
</tr>
<tr>
<td>Disk Type</td>
</tr>
<tr>
<td>Smart Paging File</td>
</tr>
<tr>
<td>Dynamic Memory (VDI)</td>
</tr>
</tbody>
</table>

4.1.1 vWorkspace Computer Group Options

Dell vWorkspace provides a number of delivery options to meet your needs, all within a single, simple, wizard-driven environment that is easy to set up and manage.

- **RD Session Host Sessions** provide easy access to a densely shared session environment. vWorkspace RD Session Hosts can deliver full desktops or seamless application sessions.
from Windows Server Virtual Machines running Windows Server 2003 R2 (32 or 64 Bit),
Windows Server 2008, (32 or 64 bit), R2 and 2012. RD Session Host Sessions are well suited
for task based workers using office productivity and line of business applications, without
needs for supporting complex peripheral devices or applications with extreme memory or
CPU requirements.

- **Computer Groups Types** – Computer Groups can be for virtual or physical computers
  running Windows XP Pro to Windows 8 Enterprise or Server 2003 R2 to 2012. Additionally
  there is limited support for Linux computer groups, but Linux is outside of the scope of this
  reference architecture.

  o **Desktop Cloud** – provides users with access to a single virtual machine from a pool
    of available virtual machines on one or more non-clustered Hyper-V Servers with
    local storage. Desktop Clouds are elastic in nature and automatically expand as
    additional Hyper-V Compute Hosts are added to vWorkspace. New Compute
    Hosts automatically receive instant copies of the virtual machine templates, from
    which they provision new virtual machines locally. Desktop Cloud virtual machines
    are temporarily assigned to a *user or device* at logon, and at logoff are re-
    provisioned from the parent VHDX (instant copy of the virtual machine template).
    Desktop Cloud virtual machines are well suited for task based workers using office
    productivity and line of business applications.

  o **Temporary Virtual Desktop** – are the non-persistent user desktop VMs traditionally
    associated with VDI. Each desktop VM is assigned a dedicated portion of the host
    server’s resources to guarantee the performance of each desktop. The desktop VM
    is dedicated to a single *user or device* while in use then returned to the computer
    group at logoff, or rebooted and reset to a pristine gold image state for the next
    user. Applications can be built into gold images or published via RemoteApps. A
    Microsoft VDA license is required for each non-Microsoft Software Assurance
    covered device accessing this type of environment.

  o **Persistent Virtual Desktop Groups** – 1-to-1 desktop VMs assigned to a specific
    entitled *user or device*. All changes made by Personal VM users will persist through
    logoffs and reboots making this a truly personalized computing experience. A
    Microsoft VDA license is required for each non- Microsoft Software Assurance
    covered device accessing this type of environment.

  o **Physical Computers** – Like Virtual Desktop Computer Groups, Physical Computers
    can be persistently or temporarily assigned to *users or devices*. Common use cases
    for connections to physical computers are remote software development and
    remote access to one’s office PC.

Please contact Dell or Microsoft for more information on licensing requirements for VDI.

### 4.2 Compute Server Infrastructure

The Compute host configuration varies slightly as to whether it will be hosting RDSH VMs or
vWorkspace Desktops, or both. The vWorkspace Hyper-V Catalyst Components are automatically
installed onto each Compute Host via the vWorkspace Management Console.

Up to 4 RD Session Host VMs may be provisioned to support up to 230 session-based users per
Compute host.
Up to 230 Windows 8 Enterprise VMs may be provisioned by vWorkspace on a single Compute host.

The requirements for RDSH VMs are outlined below. All applications and data should be installed within the system disk, to facilitate rapid provisioning via HyperDeploy.

<table>
<thead>
<tr>
<th>Role</th>
<th>vCPU</th>
<th>Startup RAM (GB)</th>
<th>Dynamic Memory</th>
<th>NIC</th>
<th>OS + Data vDisk (GB)</th>
<th>Tier 2 Volume (GB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RD Session Host</td>
<td>8</td>
<td>4</td>
<td>2GB</td>
<td>31GB</td>
<td>20%</td>
<td>Med</td>
</tr>
</tbody>
</table>

4.3 Management Server Infrastructure

The Management host configuration consists of VMs running in Hyper-V child partitions with the pertinent vWorkspace roles enabled. No vWorkspace roles need to be enabled in the parent partition of Management hosts, as the vWorkspace installer will enable any necessary roles. Please refer to the table below for the appropriate roles and number of server VMs required.
Management role requirements for the base solution are summarized below. Data disks should be used for role-specific application files/data, logs, IIS web files, etc and should exist in the Management volume on the Equallogic array. Please note that the Tier2 volume presented to the file server is designated as a pass-through disk (PTD).

<table>
<thead>
<tr>
<th>Role</th>
<th>vCPU</th>
<th>Startup RAM (GB)</th>
<th>Dynamic Memory</th>
<th>NIC</th>
<th>OS vDisk (GB)</th>
<th>Tier 2 Volume (GB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>vWorkspace Connection Broker</td>
<td>2</td>
<td>4</td>
<td>512MB</td>
<td>8GB</td>
<td>20% Med 1</td>
<td>40</td>
</tr>
<tr>
<td>Foglight for Virtual Desktops</td>
<td>1</td>
<td>4</td>
<td>512MB</td>
<td>6GB</td>
<td>20% Med 1</td>
<td>60</td>
</tr>
<tr>
<td>vWorkspace Web Access &amp; Secure Gateway</td>
<td>2</td>
<td>4</td>
<td>512MB</td>
<td>6GB</td>
<td>20% Med 1</td>
<td>-</td>
</tr>
<tr>
<td>vWorkspace Profiles, Universal Print Server &amp; Microsoft RD Licensing</td>
<td>2</td>
<td>4</td>
<td>512MB</td>
<td>6GB</td>
<td>20% Med 1</td>
<td>-</td>
</tr>
<tr>
<td>File Server</td>
<td>1</td>
<td>4</td>
<td>512MB</td>
<td>6GB</td>
<td>20% Med 1</td>
<td>40</td>
</tr>
<tr>
<td>SQL Server</td>
<td>2</td>
<td>8</td>
<td>512MB</td>
<td>10GB</td>
<td>20% Med 1</td>
<td>40</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>10</strong></td>
<td><strong>28</strong></td>
<td><strong>6</strong></td>
<td><strong>240</strong></td>
<td><strong>2158</strong></td>
<td></td>
</tr>
</tbody>
</table>

*Refer to section 4.4.3 for more information about specific volumes required.

### 4.4 Storage Architecture

#### 4.4.1 Local Tier 1

In this model, Tier 1 storage exists as local hard disks on the Compute hosts. A single RAID10 Array is used for the Local Server OS and provisioned desktop VMs along with their respective write caches. Virtual disks within the RAID controller configuration should be defined to separate the OS from the VDI volumes. To achieve the required performance level and redundancy, RAID 10 must be used across all 10 local disks used for storing the Virtual Hard Disks. Increased IO performance is provided via the 1GB cache module on the H710 RAID controller.

<table>
<thead>
<tr>
<th>Volumes</th>
<th>Size (GB)</th>
<th>RAID</th>
<th>Storage Array</th>
<th>Purpose</th>
<th>File System</th>
</tr>
</thead>
<tbody>
<tr>
<td>OS</td>
<td>100</td>
<td>1</td>
<td>Tier 1</td>
<td>Host Operating System</td>
<td>NTFS</td>
</tr>
<tr>
<td>VDI</td>
<td>1000</td>
<td>10</td>
<td>Tier 1</td>
<td>Pooled + Shared VDI</td>
<td>NTFS</td>
</tr>
</tbody>
</table>
vWorkspace Hyper-V Catalyst Components (HCC)

vWorkspace Hyper-V Catalyst Components are installed by vWorkspace in the Parent Partition of the Hyper-V Server hosting non-persistent Virtual Desktops or RD Session Host Virtual Machines. HCC includes the following features:

- HyperCache is an in RAM IO Cache in the Hyper-V Parent Partition that dramatically reduces the IO requirements of the disk subsystem. HyperCache typically reduces the number of hard disk spindles required to deliver optimal performance by 40%, and improves the perceived user experience as writes are optimized and most reads come directly from RAM.

- HyperDeploy offers instantaneous VM Template Replication and versioning for Hyper-V.

Shared Tier 2

Tier 2 is shared iSCSI storage used to host the Management server VMs and user data. The Equallogic 4100E array can be used for smaller scale deployments, with the 6100E and 6500E arrays used for larger deployments. Intent to scale should be considered when making the initial investment. The table below outlines the minimum volume requirements for Tier 2 storage. Larger disk sizes and additional volumes can be chosen to meet the capacity needs of the customer. The user data volume can be presented either via a VHDX or native NTFS pass-through disk to simplify a future upgrade to NAS. All vWorkspace management VM disks should be presented as VHDX.

<table>
<thead>
<tr>
<th>Volumes</th>
<th>Size (GB)</th>
<th>RAID</th>
<th>Storage Array</th>
<th>Purpose</th>
<th>File System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management</td>
<td>500</td>
<td>50</td>
<td>Tier 2</td>
<td>vWorkspace Infrastructure VMs, File Server</td>
<td>NTFS</td>
</tr>
<tr>
<td>SQL Data</td>
<td>100</td>
<td>50</td>
<td>Tier 2</td>
<td>SQL</td>
<td>NTFS</td>
</tr>
<tr>
<td>SQL Logs</td>
<td>100</td>
<td>50</td>
<td>Tier 2</td>
<td>SQL</td>
<td>NTFS</td>
</tr>
<tr>
<td>TempDB Data</td>
<td>5</td>
<td>50</td>
<td>Tier 2</td>
<td>SQL</td>
<td>NTFS</td>
</tr>
<tr>
<td>TempDB Logs</td>
<td>5</td>
<td>50</td>
<td>Tier 2</td>
<td>SQL</td>
<td>NTFS</td>
</tr>
<tr>
<td>User Data*</td>
<td>2048</td>
<td>50</td>
<td>Tier 2</td>
<td>File Server</td>
<td>NTFS</td>
</tr>
<tr>
<td>User Profiles (1-2MB Per User is Typical)</td>
<td>5</td>
<td>50</td>
<td>Tier 2</td>
<td>User profiles</td>
<td>NTFS</td>
</tr>
<tr>
<td>Templates/ISO</td>
<td>200</td>
<td>50</td>
<td>Tier 2</td>
<td>ISO/ gold image storage (optional)</td>
<td>NTFS</td>
</tr>
</tbody>
</table>

*User data volumes should be adjusted to suit the needs of the customer.
4.4.4 Virtual Hard Disk Format

In vWorkspace 8.0 the recommended Virtual Hard Disk format is VHDX. When vWorkspace replicates the VHDX from the Master VM to each of the Compute Hosts, HyperDeploy creates an instant copy of the original VHDX in a powered-off state that is requested by each Compute Host in the environment. Each Compute host will serve virtual desktops based on this replicated master image. Fixed or Dynamically Expanding VHDX formatting is ultimately less important in the vWorkspace environment as vWorkspace HyperDeploy only copies the used portions from the master VM to the Parent VHDX of each Compute Host. The “Parent VHDX” is the terminology vWorkspace uses for the disk that is replicated to each Compute host, from which new VMs and Differencing Disks are created. New Virtual Machines never reference the VHDX of the master VM, but rather reference an instant copy that is presented on each Compute host as the Parent VHDX.

The VHDX disk format provides numerous advantages over the older VHD specification and should be used for all virtual disks in the solution. Larger vDisk support, up to 64TB, corruption protection during power failures, and larger sector disk alignment are a few of the new features.

In default form, new VHDX files created from within Hyper-V are created with a 32MB block size, 4096B physical sector size and a 512B logical sector size. This results in a rapidly growing differencing disk that will increase up to 3GB in a short period of time.

Creating new VHDX files using the following PowerShell script will keep VHDX and differencing disk sizes low and more in line with what was experienced using the older VHD standard.

```
new-vhd -path "d:\<path to VHDX>\<VM name>.vhdx" -dynamic -SizeBytes 25GB -LogicalSectorSizeBytes 512 -PhysicalSectorSizeBytes 512 -BlockSizeBytes 2MB
```

4.4.5 DNS

DNS plays a crucial role in the environment not only as the basis for Active Directory but will be used to control access to the various 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 should be adhered to.

To plan for eventual scaling, access to components that may live on one or more servers should be considered during initial deployment. The use of CNAMEs and the round robin DNS mechanism should be employed to provide a front-end “mask” to the back-end server actually hosting the service or data source.

4.4.6 SQL Server

SQL Server is required to store vWorkspace configuration information. In environments fewer than 2500 seats SQL Server Express can be used to minimize licensing costs. This architecture provides configuration guidance using a dedicated SQL Server VM to serve the environment.

4.4.7 File Services

The File Services role will be provided via a dedicated VM. In the interest of portability and providing a clean path to an optional HA upgrade, the volumes can be presented to the file server VM in the form of a Pass-Through Disk. This will ensure a cleaner transition for customers who upgrade to HA and add a NAS head to their environments by keeping the data on the storage array and not inside a VHD that will need to be copied out.

4.4.8 vWorkspace User Profile Management

User Profile Management is a component of the vWorkspace solution which is used to manage user profiles. vWorkspace provides a cohesive method to manage user settings in a VDI and/or RD Session Host environment. The solution file server will be used to host the vWorkspace User Profile Storage Service storage location, as well as Desktop and My Documents data that shall be
redirected to dedicated shares via Group Policy.

4.5 Foglight for Virtual Desktops

Foglight™ for Virtual Desktops brings powerful diagnostics, rich visualization and reporting to vWorkspace. Built on Dell’s popular and industry-proven Foglight monitoring platform, Foglight for Virtual Desktops monitors Dell vWorkspace VDI and Terminal Server/RemoteDesktop Session Host (TS/RDSH) implementations providing IT with the real-time and historical data needed to keep these deployments running at peak performance. Foglight for Virtual Desktops goes well beyond merely alerting you to problems — it also provides diagnostics and analytics so you can identify and resolve VDI and TS/RDSH issues before they impact users. Please see Appendix D for more information.
Monitoring end user experience uniquely provides the capability to stay on top of the performance of your environment as it pertains specifically to the end user. Keep end users happy by fixing VM problems before they are impacted!

4.6 Hyper-V Configuration

The Local Tier 1 solution for Dell vWorkspace is built upon the Server 2012 Hyper-V hypervisor. All Microsoft best practices and prerequisites should be adhered to (NTP, DNS, Active Directory, etc).
4.6.1 Core Components

Each Compute and Management host will run the full GUI version of Server 2012 in this solution. All vWorkspace component roles will exist as VMs yielding a 100% virtualized architecture in both Compute and Management server layers. RD Session Hosts will be provisioned by vWorkspace on the Compute hosts, while the vWorkspace management components will be enabled in dedicated VMs on the Management hosts. The vWorkspace Hyper-V Catalyst Components will be enabled in the parent partition of all Compute hosts as discussed in section 4.2.

4.6.2 Hyper-V Networking (Local Tier 1)

The network configuration in this model will vary slightly between the Compute and Management hosts. The Compute hosts do not need access to iSCSI shared storage since they are hosting the VDI sessions on local disk. The following outlines the VLAN requirements for the Compute and Management hosts in this solution model:

- Compute hosts (Local Tier 1)
  - Management VLAN: Configured for Hyper-V infrastructure traffic – L3 routed via core switch
  - VDI VLAN: Configured for VDI session traffic – L3 routed via core switch
- Management hosts (Local Tier 1)
  - Management VLAN: Configured for Hyper-V Management traffic – L3 routed via core switch
  - iSCSI VLAN: Configured for iSCSI traffic – L2 switched only via ToR switch
  - VDI Management VLAN: Configured for VDI infrastructure traffic – L3 routed via core switch
- An optional DRAC VLAN can be configured for all hardware management traffic, which should be L3 routed via core switch

In this solution architecture, LAN and iSCSI traffic will be segmented in dedicated VLANs and discrete switch stacks for solutions over 500 users. Each Local Tier 1 Compute host will have a quad port NDC as well as an add-on 1Gb dual port PCIe NIC. The LAN traffic from the server to the ToR switch should be configured as a LAG to maximize bandwidth. The Compute hosts will require 2 Virtual Switches, one for VDI LAN traffic, and another for the Hyper-V Management.
The Management hosts have a slightly different configuration since they will additionally access iSCSI storage. The add-on NIC for the Management hosts will be a 1Gb quad port NIC. 3 ports of both the NDC and add-on NIC will be used to form 3 virtual switches. iSCSI should be isolated onto its own vSwitch with teamed NICs and connections from all 3 vSwitches should pass through both the NDC and add-on NIC per the diagram below. Care should be taken to ensure that all vSwitches are assigned redundant NICs that are NOT from the same PCIe device. The LAN traffic from the server to the ToR switch should be configured as a LAG. VLAN IDs should be specified in all virtual switches used within the Compute layer Hyper-V host.

NIC teaming should be configured in the Hyper-V host using Dell drivers or native Windows NIC teaming to ensure that the proper NICs from differing PCIe devices are bonded. The resulting teamed virtual NIC should then be assigned to the appropriate virtual switch within Hyper-V. VLAN IDs should be specified in all virtual switches used within the Management layer Hyper-V host. All NICs and switch ports should be set to auto negotiate.
4.7 Solution High Availability

Each layer in the solution architecture can be individually protected to prevent an extended service outage. The Network layer only requires an additional switch configured in a stack for each discrete switch stack. Please refer to section 3.1.1.1 that covers Force10 switch stacking.

Protecting the Compute layer for RDSH and vWorkspace Desktops is provided by adding an additional host to a group, thus effectively increasing the hosting capacity of a given group. Session requests will be fulfilled by all hosts in the group and as a result, each will have reserve capacity to insure against a host failure. **Care needs to be taken to ensure that user provisioning does not exceed the overflow capacity provided by the additional node.** vWorkspace provides Load Evaluators that can be assigned to Compute Hosts to ensure that the hosts are not overcommitted.

To implement HA for the Management layer, we will also add an additional host but will add a few more layers of redundancy. The following will protect each of the critical infrastructure components in the solution:

- The Management hosts will be configured in a Hyper-V cluster (Node and Disk Majority).
The shared storage volume that hosts the Management VMs will be upgraded to a Cluster Shared Volume (CSV).

SQL mirroring should be configured to further protect SQL.

vWorkspace Connection Brokers natively operate in HA mode, no clustering or load balancing needs to be added for the broker specifically, but the SQL Server Configuration DB must be HA.

The following storage volumes are applicable in a 2-node Management layer HA scenario:

<table>
<thead>
<tr>
<th>Volumes</th>
<th>Host</th>
<th>Size (GB)</th>
<th>RAID</th>
<th>Storage Array</th>
<th>Purpose</th>
<th>File System</th>
<th>CSV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management</td>
<td>1</td>
<td>500</td>
<td>50</td>
<td>Tier 2</td>
<td>vWorkspace Infrastructure</td>
<td>NTFS</td>
<td>Yes</td>
</tr>
<tr>
<td>Management</td>
<td>2</td>
<td>500</td>
<td>50</td>
<td>Tier 2</td>
<td>vWorkspace Infrastructure</td>
<td>NTFS</td>
<td>Yes</td>
</tr>
<tr>
<td>SQL Data</td>
<td>2</td>
<td>100</td>
<td>50</td>
<td>Tier 2</td>
<td>SQL Data Disk</td>
<td>NTFS</td>
<td>Yes</td>
</tr>
<tr>
<td>SQL Logs</td>
<td>2</td>
<td>100</td>
<td>50</td>
<td>Tier 2</td>
<td>SQL Logs Disk</td>
<td>NTFS</td>
<td>Yes</td>
</tr>
<tr>
<td>SQL TempDB Data</td>
<td>2</td>
<td>5</td>
<td>50</td>
<td>Tier 2</td>
<td>SQL TempDB Data Disk</td>
<td>NTFS</td>
<td>Yes</td>
</tr>
<tr>
<td>SQL TempDB Logs</td>
<td>2</td>
<td>5</td>
<td>50</td>
<td>Tier 2</td>
<td>SQL TempDB Logs Disk</td>
<td>NTFS</td>
<td>Yes</td>
</tr>
<tr>
<td>SQL Witness</td>
<td>1</td>
<td>1</td>
<td>50</td>
<td>Tier 2</td>
<td>SQL Witness Disk</td>
<td>NTFS</td>
<td>Yes</td>
</tr>
<tr>
<td>Quorum 1</td>
<td>-</td>
<td>500MB</td>
<td>50</td>
<td>Tier 2</td>
<td>Hyper-V Cluster Quorum</td>
<td>NTFS</td>
<td>Yes</td>
</tr>
<tr>
<td>User Data</td>
<td>-</td>
<td>2048</td>
<td>50</td>
<td>Tier 2</td>
<td>File Server</td>
<td>NTFS</td>
<td>No</td>
</tr>
<tr>
<td>User Profiles</td>
<td>-</td>
<td>20</td>
<td>50</td>
<td>Tier 2</td>
<td>User profiles</td>
<td>NTFS</td>
<td>No</td>
</tr>
<tr>
<td>Templates/ISO</td>
<td>-</td>
<td>200</td>
<td>50</td>
<td>Tier 2</td>
<td>ISO/ gold image storage (optional)</td>
<td>NTFS</td>
<td>Yes</td>
</tr>
</tbody>
</table>

For more information on vWorkspace Broker Scalability, please follow this link: [LINK](#)

### 4.7.1 SQL Database HA

HA for SQL Server 2012 is provided via an optional 3-server synchronous mirror configuration that includes a witness (High safety with automatic failover). This configuration will protect all critical data stored within the database from physical server as well as virtual server problems. The principal
VM that will host the primary copy of the data should exist on the first Mgmt host. The mirror and witness VMs should exist on the second or later Mgmt hosts. All critical databases should be mirrored to provide HA protection.

There are a number of steps required to successfully set up SQL mirroring per Microsoft and Dell best practices. Please refer to the Dell vWorkspace 8.0 product documentation for more information on supported configurations.

Please refer to the following Dell Quest support article for more information: LINK

4.8 Disaster Recovery and Business Continuity

DR and BC can be achieved natively via Hyper-V Replicas. This technology can be used to replicate VMs from a primary site to a DR or BC site over the WAN asynchronously. Hyper-V Replicas are unbiased as to underlying hardware platform and can be replicated to any server, network, or storage provider. Once the initial replica is delivered from the primary site to the replica site, incremental VM write changes are replicated using log file updates. Multiple recovery points can be stored and maintained, using snapshots, to restore a VM to a specific point in time.
4.9 vWorkspace Data Flow

4.10 Conclusion

The Dell vWorkspace solution provides a robust and scalable VDI platform for pooled, personal and Session based deployments. Using VDI-optimized hardware in a configuration that has been validated and proven by Dell DVS Engineering, you can deploy vWorkspace based VDI that is both cost effective and high performing. Our layered architecture provides flexibility to maximize your infrastructure investment with the capability to expand and contract where necessary.
Appendix A – Dell DVS 10-Seat Trial Kit

The 10 User POC bundle was purpose-built to provide high performance VDI using a modicum of infrastructure. Only 11 x 1Gb Ethernet ports are required (1 x server + 10 x end points) which can be provided using existing customer network infrastructure. If suitable network capacity is not in place, Dell recommends using a Force10 S55 1Gb switch.

Server Configuration

The PowerEdge T110 II is the server platform of choice for this offering, providing high performance at an extremely low price of entry. Supporting the Intel Xeon E3-1200 series of CPUs and up to 32GB RAM, the T110 provides a solid server platform to get started with VDI.

All VDI server roles and desktop sessions are hosted on a single server in this model so there is no need for external storage. Higher scale and HA options are not offered with this bundle.

10 User Compute Host – PowerEdge T110 II

| 1 x Intel Xeon E3-1220 V2 (3.1Ghz) |
| 32GB Memory (4 x 8GB DIMMs @ 1600Mhz) (VDI) |
| Microsoft Windows Server 2012 Hyper-V |
| 4 x 500GB SATA 7.2k Disks **RAID 10** (OS + VDI) |
| PERC H200 Integrated RAID Controller |
| Broadcom 5722 1Gb NIC (LAN) |
| 305W PSU |
Based on the server hardware configuration, 10 users will experience excellent performance with additional resource headroom available in reserve. The consumption numbers below are based on average performance:

<table>
<thead>
<tr>
<th>Task Worker Users</th>
<th>CPU (%)</th>
<th>RAM (GB Consumed)</th>
<th>Disk (IOPS)</th>
<th>Network (Kbps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>72</td>
<td>20</td>
<td>77</td>
<td>150</td>
</tr>
</tbody>
</table>

**Management and Compute Infrastructure**

The solution architecture for the 10 user POC bundle combines the Compute, Management, and Storage layers onto a single server-based platform. To maximize server resources, the connection broker and license server roles are enabled within the Hyper-V parent partition, while the File server and VDI sessions exist as VMs within child partitions.

As is the case in the larger distributed architecture, no roles will be enabled within the Hyper-V parent partition. All VDI management roles and VDI sessions will be enabled via VMs running in child partitions. A single Windows Server VM is sufficient to run the VDI mgmt. portions.
### Storage Configuration

The 10 User POC solution includes 4 total hard drives configured in RAID10 to host the Windows Server OS as well as VDI sessions. This configuration will maximize available performance and data protection.

<table>
<thead>
<tr>
<th>Volumes</th>
<th>Size</th>
<th>RAID</th>
<th>Storage</th>
<th>Purpose</th>
<th>File System</th>
</tr>
</thead>
<tbody>
<tr>
<td>OS + VDI</td>
<td>1TB</td>
<td>10</td>
<td>Tier 1</td>
<td>Host OS/ Mgmt roles + VDI Sessions</td>
<td>NTFS</td>
</tr>
</tbody>
</table>
Appendix B – Converged Infrastructure

The Dell DVS Reference Architecture for Dell vWorkspace 8.0 also offers a 10Gb converged infrastructure (CI) option. CI reduces the number of switch ports required, while dramatically increasing the available bandwidth and reducing cabling. Using CI in this solution architecture requires small changes to be made in each layer of the solution.

In the network layer, the 1Gb Force10 S55 switch is used to host hardware management traffic (iDRAC) only. 10Gb LAN and iSCSI are hosted together on a stacked pair of Force10 S4810 switches configured in a VLT.

The Compute layer remains largely the same with only a change required for the server NICs to 10Gb. The Compute hosts will connect to the same S4810 stack as the Mgmt hosts, but only LAN traffic will be sent to and from these hosts. All scaling and session hosting guidance does not change.

The Mgmt hosts will also require 10Gb NICs with both LAN and iSCSI traffic traversing the same interfaces. All vWorkspace-specific scaling does not change.

Lastly the Storage tier will be upgraded to a like 10Gb model and will serve the same purpose: Tier 2 storage.

The rest of the solution sizing and guidance is completely interchangeable.
Logical network architecture for converged infrastructure:
Appendix C – vWorkspace Desktop Cloud
Performance Analysis Results (non-persistent VMs)

Performance analysis of the above architecture was carried out using Login VSI software. Login VSI is a widely used tool to generate workloads that are representative of typical corporate IT users of centralized desktop environments such as Server Based Computing (SBC) and Virtual Desktop Infrastructure (VDI). The workload produced by Login VSI for the current performance analysis effort was representative of a typical set of activities performed by (i) a task worker (the basic workload) and (ii) a knowledge worker (the standard workload). Resource utilisation on the compute node was monitored using Microsoft best practices for measuring performance on Hyper-V as detailed at:


In addition to the above, end-user experience was monitored using the Liquidware Labs Stratusphere UX tool. This tool provides comprehensive information (including reports and charts) for IT personnel in relation to end-user experience in a centralized desktop environment; among these charts is a “golden quadrant” type chart, which aggregates parameters that contribute to the end-user experience seen by a centralized desktop environment user into a single chart; this is the chart used during the current performance analysis activity.

For the task worker scenario, the performance analysis scenario used was to pre-boot all virtual desktops and then login 230 task worker (basic) workloads using a login interval of 30 seconds. Once all users have logged in, all 230 users run workload activities at steady-state for 60 minutes and then logoffs commence. For the knowledge worker scenario, a similar test methodology was used with the standard workload and 170 users.

It should be noted that in order to replicate a real corporate user environment, an enterprise-level anti-virus infrastructure was deployed, with McAfee VirusScan Enterprise 8.8 installed on all virtual desktops and McAfee ePolicy Orchestrator 4.5 used for management and deployment purposes.

Additionally, vWorkspace Computer Groups were configured in Desktop Cloud mode, whereas users logged off, their temporarily assigned VM was powered-off, deleted, re-provisioned and powered on during the existing workload. User’s profile data was merged into each session at logon via vWorkspace User Profile Management and extracted at logoff. These were done to emulate real world usage of vWorkspace, as opposed to trying to get the maximum number of sessions on a server by way of over-tuning.
Configuration Summary – Workload Independent Settings

The table shown below summarizes the important configuration information in relation to the pooled VDI environment used for performance analysis of both the task and knowledge worker scenarios.

vWorkspace client settings were configured indicative of a production deployment, using standard Connection Policies in the vWorkspace Management Console to control the user experience. All tests (unless otherwise stated) had the following features enabled:

- EOP Multimedia Redirection
- EOP Flash Redirection
- EOP Graphics Acceleration (enabled for Internet Explorer and PowerPoint)
- User Profile Management

<table>
<thead>
<tr>
<th>Solution Configuration – Software Components</th>
<th>Description/Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>vWorkspace</td>
<td>Version 8.0</td>
</tr>
<tr>
<td>Hypervisor</td>
<td>Hyper-v 2012</td>
</tr>
<tr>
<td>Microsoft SQL Server</td>
<td>Version 2012 Enterprise Edition (64-Bit)</td>
</tr>
<tr>
<td>Windows 8 Enterprise 32Bit</td>
<td>VDI Clients for characterization tests Login VSI launchers</td>
</tr>
<tr>
<td>Windows Server 2012 Standard</td>
<td>VMs for hosting vWorkspace, MSSQL server and other infrastructure VMs.</td>
</tr>
</tbody>
</table>

Below is the Solution Hardware Configuration. For additional configuration information see the reference architecture document.

<table>
<thead>
<tr>
<th>Solution Configuration - Hardware Components:</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virtual Desktops</td>
<td></td>
</tr>
<tr>
<td>• 1 x Dell PowerEdge R720Servers:</td>
<td>Windows Server 2012 was installed and configured on the R720 Compute Host server. Enabled Hyper-v role on the server which will act as Hypervisor to host virtual environment Virtual Desktops VMs: Windows 8 Enterprise (32 Bit)</td>
</tr>
<tr>
<td>• Server 2012 Hyper-v</td>
<td></td>
</tr>
<tr>
<td>• 2 x 8-Core Intel® Xeon® E5-2690 2.9 Ghz Processors</td>
<td></td>
</tr>
<tr>
<td>• 256 GB RAM</td>
<td></td>
</tr>
<tr>
<td>• 10 x 146GB 15K SAS internal disk drives</td>
<td></td>
</tr>
<tr>
<td>• 1 x Broadcom 5720 1 GbE NIC, Quad port</td>
<td></td>
</tr>
<tr>
<td>• PERC H710 1GB RAID Controller</td>
<td></td>
</tr>
</tbody>
</table>
Test results and analysis

The primary focus of the tests is to determine the maximum number of desktops that can be deployed with vWorkspace without compromising performance. All tests included a single Management Server along with a single Compute host, for hosting virtual desktops. To determine the density data all tests were conducted on the Compute host. The virtual desktops created using vWorkspace are placed on local Tier 1 storage on each Compute host.

The primary objectives of the testing are:

- Determine the CPU, Memory, Disk and Network impacts of integrating vWorkspace using the Basic and Standard LoginVSI workloads.
- Determine the performance impact of the vWorkspace on the local disks during peak I/O activity such as boot storms and login storms.

Test 1: 230 Task Worker Users (Light)

The light workload runs a small number of applications that are representative of applications used by typical task workers (e.g. call center). The applications are closed immediately after use, resulting in relatively low memory and CPU consumption when compared to the standard workload. The applications used are Internet Explorer, Microsoft Word and Microsoft Outlook, with only 2 of these applications used simultaneously. The user idle time is approximately 17% of total run time.

The following validation was done for 230 light users on an R720 host with 2.9 GHz processors and 10 x 146GB 15K disks. Validation was performed using the DVS standard testing methodology leveraging Login VSI to manage the desktop cloud with stratosphere UX and Windows Performance Monitor to deliver performance results. The CPU usage for this test reached a reasonable 84.39% at peak, confirming that the Compute host with this configuration can support up to 230 basic users with acceptable head room in reserve.

The graphs below show the CPU, Active memory, Local Tier 1 disk IOPS, Network and VDI UX
scatter plot results from this validation.
As seen from the following graph (Figure 1), maximum CPU utilization was approximately 84.39%. After all users started logging in, CPU usage spiked from 10 to 90% and became stable between 74-84% once all users logged in, it then dropped as the users logged off.

![Figure 1](image)

A Spike is evident after all VMs start logging in however active memory is about 86.7% of available memory during the peak of validation activity providing sufficient reserve.

![Figure 2](image)

As seen from the graph below, overall network performance was very good with very low overall consumption.
A Spike is evident after all VMs start logging in however the read/write activity was fluctuating from 09:27 AM to 11:07 AM and became stable after all users finished logging in from 11:08 AM to 12:46 PM. Total Peak IOPS measured during the login state was 2194 giving an IOPS value of 9.53 per user and total peak IOPS in steady state (after all users logged in) was 1268 giving an IOPS value of **5.50** per user.

From the graph below we can see that 229 out of 230 sessions registered perfect performance, while all registered in the ideal upper right-hand quadrant. This is well within the acceptable tolerance for this test.
Test 2: 170 Knowledge Worker Users (Medium)

The medium workload runs a number of applications that are representative of applications used by knowledge workers (e.g. accountants). The applications used are Internet Explorer, a number of Microsoft Office applications (Excel, Outlook, PowerPoint and Word), Adobe Acrobat Reader, Bullzip PDF printer and 7-zip file compression software. Relative to the task worker workload discussed above, idle time is slightly lower as a percentage of overall runtime and a maximum of 5 applications are open simultaneously (compared to 2 for the task worker).

The following validation was done for 170 medium users on an R720 host with 2.9 GHz processors and 10 x 146GB 15K disks. Validation was performed using DVS standard testing methodology leveraging Login VSI to manage the desktop cloud with stratusphere UX and Windows Performance Monitor to deliver the performance results. The CPU usage for this test reached 85% at peak, confirming that the Compute host with this configuration can support up to 170 medium users with acceptable head room in reserve.

The following graphs show the CPU, Active memory, Local Tier 1 disk IOPS, Network and VDI UX scatter plot results from this validation.
As seen from the graph below, the maximum CPU utilization was approximately 77%. After all users started logging in, CPU usage was spiked from 10 to 78% and became stable between 60-70% once all users logged in, then dropped as the users logged off.

Figure 6

A Spike is evident after all VMs start logging in however active memory is about 80% of available memory during the peak of validation activity.

Figure 7

As seen from the following graph, overall network performance was very good with low overall bandwidth required.
A Spike is evident after all VMs start logging in however the read/write activity was fluctuating from 03:38 PM to 05:07 PM and became stable after all users finished logging in from 05:07 PM to 05:57 PM. Total Peak IOPS measured during the login state was 1589 giving an IOPS value of 9.34 per user and total peak IOPS measured during the steady state (after all users logged in) was 924 giving an IOPS value of **5.43** per user.

From the graph below we can see that 165 out of 170 sessions registered perfect user experience which is within the acceptable tolerance for this test.
Test 3: 500 Knowledge Worker Users (Medium)

The following validation was done for 500 Standard users on 3 x R720 hosts with 2.9 GHz processors and 10 x 146GB 15K disks each. Validation was performed using DVS standard testing methodology leveraging Login VSI to manage the desktop cloud with stratosphere UX and Windows Performance Monitor to deliver the performance results. The CPU usage for this test was 63% for Server1, 72% for Server2 and 83% for Server3, thus confirming that the server with this configuration can support up to 500 standard users with a comfortable 166 users per Compute host.

The graphs below show the CPU, Active memory, Local Tier 1 disk IOPS, Network and VDI UX scatter plot results from this validation.
As seen from the graph below, the maximum CPU utilization was approximately 76% for the first server. After all users started logging in, CPU usage was spiked from 10 to 76% and became stable between 55-63% once all users logged in, then dropped as the users logged off.

Figure 11

Server number 2 followed suit with a maximum CPU utilization of approximately 73%. After all users started logging in, CPU usage was spiked from 10 to 63% and became stable between 55-60% once all users logged in, then dropped as the users logged off.

Figure 12

Server number 3 experienced a maximum CPU utilization of approximately 84%. After all users started logging in, CPU usage was spiked from 10 to 73% and became stable between 65-70% once all users logged in, then dropped as the users logged off.
A Spike is evident after all VMs start logging in however active memory is about 80% of available memory during the peak of validation activity for all hosts used in the validation.
Figure 15

Active Memory (Server-2)

Active Memory

Figure 16

Active Memory (Server-3)

Active Memory
As seen from the graphs below, network performance was generally very good with very low overall consumption.

Figure 17

Figure 18
For disk performance, a spike is evident after all VMs start logging in however the read/write activity was fluctuating 12:45 PM to 2:20 PM and became stable after all users finished logging in from 02:20 PM to 3:20 PM. Total Peak IOPS measured during the login state was 1379 giving an IOPS value of 8.61 per user and total peak IOPS measured during steady state (after all users logged in) was 810 giving an IOPS value of 5.02 per user.

For server number 2, a spike is evident after all VMs start logging in however the read/write activity was fluctuating 12:45 PM to 2:15 PM and became stable after all users finished logging in from 02:10 PM to 03:20 PM. Total Peak IOPS measured during the login state was 1362 giving an IOPS value of 8.01 per user and total peak IOPS measured during steady state (after all users logged in) was 802 giving an IOPS value of 4.71 per user.
For server number 3, a spike is evident after all VMs start logging in however the read/write activity was fluctuating 12:45 PM to 02:20 PM and became stable after all users finished logging in from 02:21 PM to 3:20 PM. Total Peak IOPS measured during the login state was 1245 giving an IOPS value of 7.32 per user and total peak IOPS measured during steady state (after all users logged in) was 836 giving an IOPS value of 4.91 per user.

In the graph below, we can see that 468 out of 500 sessions registered perfect experience which is within the acceptable tolerance for this test.
Figure 23
Test 4: 230 Windows Server 2012 RD Sessions (Light)

The following validation was done for 230 light users on an R720 host with 2.9 GHz processors and 10 x 146GB 15K disks. Validation was performed using the DVS standard testing methodology leveraging Login VSI to manage the desktop cloud and Windows Performance Monitor to deliver the performance results. The CPU usage for this test reached 83% thus confirming that the server with this configuration can support up to 230 light users and this will be the baseline for testing RDSH with vWorkspace 8.0.

The graphs below show the CPU, Active memory, Local Tier 1 disk IOPS, Network and VDI UX scatter plot results from this validation.

As seen below (Figure 24), the maximum CPU utilization was approximately 83%. After all users started logging in, CPU usage was spiked from 10 to 83% and became stable between 72-82% once all users logged in, then dropped as the users logged off.

![CPU Graph](image1)

**Figure 24**

A Spike is evident after all VMs start logging in however active memory is about 80% of available memory during the peak of validation activity.

![Active Memory Graph](image2)

**Figure 25**
As seen from the graph below, overall network performance was very good.

![Total Bytes/Sec](image)

**Figure 26**

A Spike is evident after all VMs start logging in however the read/write activity was fluctuating from 05:47 PM to 07:45 PM and became stable after all users finished logging in from 07:48 PM to 08:46 PM. Total Peak IOPS measured during the login state was 559 giving an IOPS value of 2.43 per user and total peak IOPS in steady state (after all users logged in) was 502 giving an IOPS value of **2.18** per user.

![Reads/Sec and Writes/sec](image)

**Figure 27**
Test 5: 10-Seat Trial Kit

As seen from the graph below (Figure 28), the maximum CPU utilization was approximately 72%. After all users started logging in, CPU usage was spiked from 10 to 72% and became stable between 30-42% once all users logged in, then dropped as the users logged off.

Figure 28

A Spike is evident after all VMs start logging in however active memory is about 70% of available memory during the peak of validation activity.

Figure 29
As seen from the graph below, overall network performance was good.

![Total Bytes/Sec Graph](image)

Figure 30

A Spike is evident after all VMs start logging in however the read/write activity was fluctuating from 01:30 PM to 01:45 PM and became stable after all users finished logging in from 01:46 PM to 02:35 PM. Total Peak IOPS measured during the login state was 217 giving an IOPS value of 21.7 per user and total peak IOPS in steady state (after all users logged in) was 77 giving an IOPS value of 7.7 per user.

![Reads/Writes Graph](image)

Figure 31
## Results Summary

The summary table below shows the desktop densities and storage IOPS on a per server basis for Basic, Standard and Premium users.

<table>
<thead>
<tr>
<th>Workload</th>
<th>Server Density</th>
<th>CPU</th>
<th>Login State Tier-1 IOPS</th>
<th>Login State Tier-1 IOPS per User</th>
<th>Steady State Tier-1 IOPS</th>
<th>Steady State Tier-1 IOPS per User</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic</td>
<td>230</td>
<td>84%</td>
<td>2194</td>
<td>9.53</td>
<td>1268</td>
<td>5.51</td>
</tr>
<tr>
<td>Standard</td>
<td>170</td>
<td>77%</td>
<td>1589</td>
<td>9.34</td>
<td>924</td>
<td>5.43</td>
</tr>
<tr>
<td>Standard (3 R720 Compute Servers)</td>
<td>500</td>
<td>78%</td>
<td>3986</td>
<td>7.97</td>
<td>2448</td>
<td>4.89</td>
</tr>
<tr>
<td>Server-1</td>
<td>160</td>
<td>76%</td>
<td>1379</td>
<td>8.61</td>
<td>810</td>
<td>5.06</td>
</tr>
<tr>
<td>Server-2</td>
<td>170</td>
<td>73%</td>
<td>1362</td>
<td>8.01</td>
<td>802</td>
<td>4.71</td>
</tr>
<tr>
<td>Server-3</td>
<td>170</td>
<td>84%</td>
<td>1245</td>
<td>7.32</td>
<td>836</td>
<td>4.91</td>
</tr>
<tr>
<td>RDSH</td>
<td>230</td>
<td>83%</td>
<td>559</td>
<td>2.43</td>
<td>502</td>
<td>2.18</td>
</tr>
<tr>
<td>10-Seat Trial Kit</td>
<td>10</td>
<td>72%</td>
<td>217</td>
<td>21.7</td>
<td>77</td>
<td>7.7</td>
</tr>
</tbody>
</table>

Sustained Tier-1 IOPS per user can be calculated by taking the sustained IOPS on the Hyper-v Server local drive and dividing it by number of users. For light workloads per user IOPS will be 1268/230=5.51, similarly for medium it will be 5.43, Standard 500 user test Server1+Server2+Server3 which is 810+802+836/500=4.89, RDSH it is 2.18 and 10 User POC it is 7.7 per user

## Conclusion

Based on testing conducted, vWorkspace 8.0 delivers serious storage optimization and provides great Compute host density. The impact on storage was found to be minimal overall. While evaluating the desktop density per server, server CPU was monitored closely. We can conclude on the basis of this testing that 230 Basic, 170 Standard and 230 RDSH user sessions can be supported on the R720 platform with less than 90% CPU utilization and minimal impact on performance.
Appendix D - Foglight for Virtual Desktops Monitoring

Sample user run monitored by Foglight for Virtual Desktops:

The following performance data was captured using Foglight for Virtual Desktops while executing a 50 standard user test using a LoginVSI standard workload. The following sections show an example of the capabilities of Foglight for Virtual Desktops both in a steady state scenario with 100 desktops powered on followed by 50 desktop sessions that have been launched from LoginVSI.

Hyper-V Environment overview in a steady state with 100 desktops powered on:

Desktops Balanced on ComputeHost3:
Status of virtual desktops:

After 50 sessions launched:
Hyper-V Environment overview after 50 desktop sessions launched from LoginVSI. Increase in memory and disk I/O due to test activity within desktops.
Summary of Compute Hosts – Desktops Balanced on ComputeHost4

CPU used by VMs:

This chart shows the CPU Utilization summary for the specified Server.
- CPU % Used: Percent of available CPU used by Virtual Machines in this Server.
Disk Utilization by Read & Write Rates (GB/s):
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