Dell Appliance for Wyse - vWorkspace™

Dell Wyse Technical Marketing

June 2015

A Dell Appliance Architecture

Revisions

Date	Description
June 2015	Initial release

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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 and shared session desktops via Wyse vWorkspace™ 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 that 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 guidance on user density per appliance.

2 Solution Architecture Overview

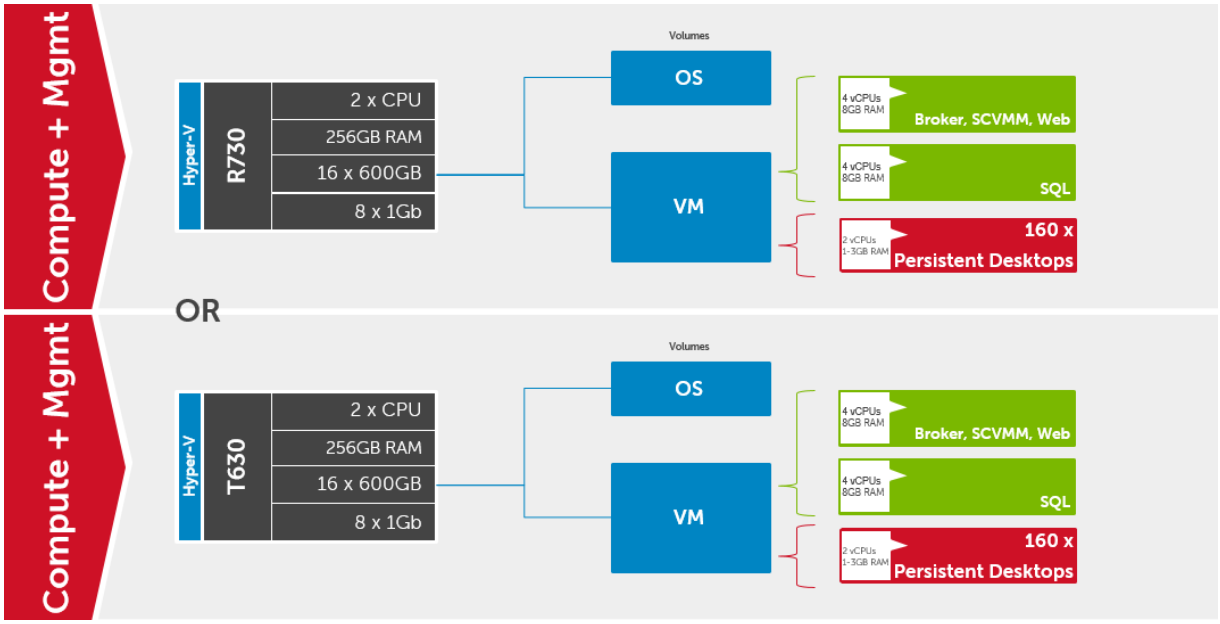
2.1 Introduction

The incredible versatility of the PowerEdge R730 server delivers outstanding functionality in just 2U of rack space. With the combination of powerful processors, large memory and versatile storage options, the R730 performs exceptionally well in a number of demanding environments. The PowerEdge T630 2-socket tower server, a member of the 13th generation of PowerEdge servers accelerates demanding workloads while providing power and flexibility.

The Dell R730 and T630 series deliver an out-of-the-box infrastructure solution for virtual desktops that eliminates the high cost, variable performance, and extensive risk of conventional solutions.

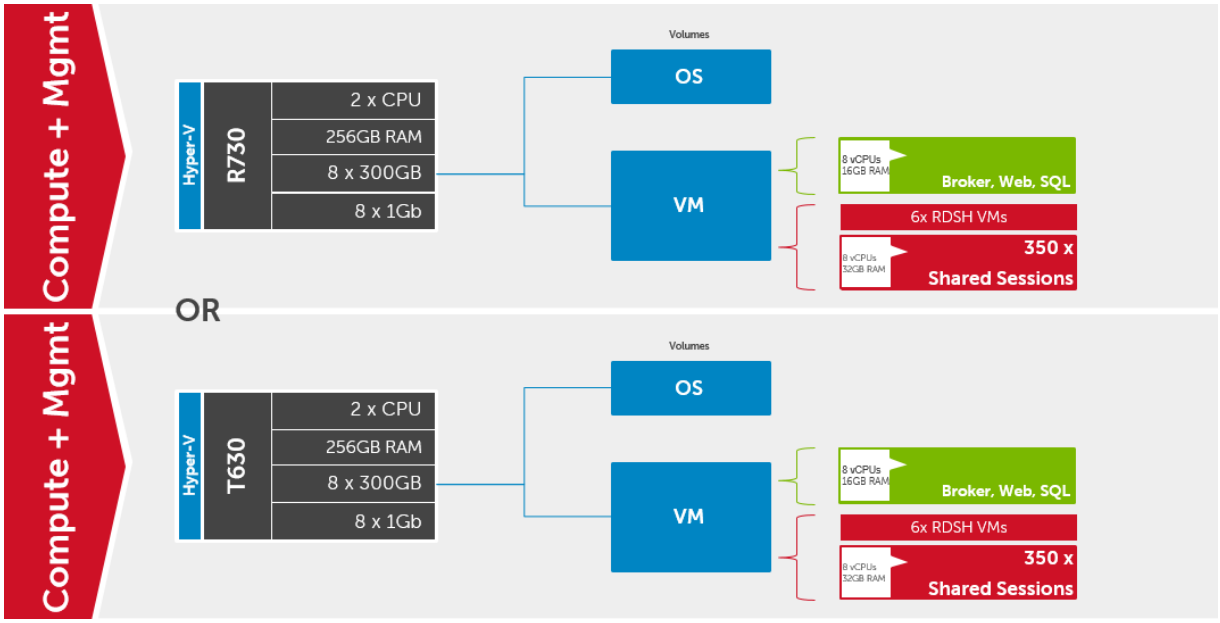
2.2 Dell - Solution

The compute, management and storage layers are 'converged' into a single appliance, hosting Microsoft Hyper-V hypervisor and Dell Wyse vWorkspace. The appliance setup is simplified and automated using Dell's Quick Start Tool which deploys a complete, ready to use, virtualization environment on the appliance. Local storage is split in to volumes for the hypervisor management OS and for virtual machine storage. Either persistent (full clone) or non-persistent virtual desktop types can be chosen with ample storage space provided for the maximum number of persistent desktops allowed per appliance.



The appliance can also be used for application virtualization. In this configuration, processor core count is increased while storage capacity is reduced as only six Windows Server 2012 R2 RDSH VMs are required. Additionally, Microsoft System Center Virtual Machine Manager is not required for this

configuration reducing the number of management VMs to a single VM for all management roles and Microsoft SQL Express for database.



3 Hardware Components

3.1 Appliance

There are two servers available for this appliance-rack based R730 or the Tower R630.

3.1.1 PowerEdge R730

The rack server platform for the Dell Wyse Datacenter solution is the best-in-class Dell PowerEdge R730. This dual socket CPU platform runs the fastest Intel Xeon E5-2600 v3 family of processors, can host up to 768GB RAM and supports up to 16 2.5" SAS disks. The Dell PowerEdge R730 offers uncompromising performance and scalability in a 2U form factor. For more information, please visit: [Link]

Desktop Virtualization

- High core CPUs
- High density RAM
- Local Storage
- vWorkspace Hyper-V

SAP < $350 per user

PowerEdge R730	
CPU	2 x E5-2690v3 (2.6GHz, 12C)
Memory	16 x 16GB 2133MHz RDIMMs
Storage	16 x 600GB 15K SAS 2.5" (RAID10)
RAID Ctrls	H730P (2GB cache)
Network	4 x 1Gb NDC, 4 x 1Gb NIC
iDRAC	iDRAC8 Ent w/ vFlash, 8GB SD
Power	2 x 750W PSUs

Application Virtualization

- High core CPUs
- High density RAM
- Local Storage
- vWorkspace Hyper-V

SAP < $500 per user

PowerEdge R730	
CPU	2 x E5-2697v3 (2.6GHz, 14C)
Memory	16 x 16GB 2133MHz RDIMMs
Storage	8 x 300GB 15K SAS 2.5" (RAID10)
RAID Ctrls	H730P (2GB cache)
Network	4 x 1Gb NDC, 4 x 1Gb NIC
iDRAC	iDRAC8 Ent w/ vFlash, 8GB SD
Power	2 x 750W PSUs

3.1.2 PowerEdge T630

Desktop Virtualization

- High core CPUs
- High density RAM
- Local Storage
- vWorkspace Hyper-V

SAP < $350 per user

PowerEdge T630	
CPU	2 x E5-2690v3 (2.6GHz, 12C)
Memory	16 x 16GB 2133MHz RDIMMs
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- High core CPUs
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Power	2 x 750W PSUs

3.2 Dell Wyse Cloud Clients

The following Dell Wyse clients will deliver a superior Microsoft and vWorkspace user experience and are the recommended choices for this solution.

3.2.1 Dell Wyse T10D

The T10D handles everyday tasks with ease and also provides multimedia acceleration for task workers who need video. Users will enjoy integrated graphics processing and additional WMV9 & H264 video decoding capabilities from the Marvell ARMADA™ PXA2128 1.2 GHz Dual Core ARM System-on-Chip (SoC) processor. In addition, the T10D 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 T10D's small size enables discrete mounting options: under desks, to walls, and behind monitors, creating cool workspaces in every respect.

3.2.2 ThinOS – D10D

Designed for knowledge workers and power users, the new Dell Wyse D10D 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 D10D combines Dell Wyse ThinOS with a dual-core AMD 1.4 GHz processor and a revolutionary unified graphics engine for an outstanding user experience. The D10D 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 D10D offers a unique combination of performance, efficiency, and affordability. The D10D 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

3.2.3 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

WE8S

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, potentially lowering your overall carbon footprint.

3.2.1 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 help lower an organization's carbon footprint through power requirements that are a fraction of traditional desktop PCs.

3.2.2 Dell Wyse Cloud Connect

Designed to promote bring-your-own-device (BYOD) environments, Dell Wyse Cloud Connect allows you to securely access and share work and personal files, presentations, applications and other content from your business or your home. Managed through Dell Wyse Cloud Client Manager software-as-a-service (SaaS), IT managers can ensure that each Cloud Connect device is used by the appropriate person with the right permissions and access to the appropriate apps and content based on role, department and location. Slightly larger than a USB memory stick, Cloud Connect is an ultra-compact multimedia-capable device. Simply plug it into any available Mobile High-Definition Link (MHL) / HDMI port on a TV or monitor, attach a Bluetooth keyboard and mouse, and you're off and running. Easy to slip into your pocket or bag, it enables an HD-quality window to the cloud, great for meetings and presentations while on business travel, or for cruising the internet and checking email after a day of work. For more information, please visit: Link

3.2.3 Dell Chromebook 11

The lightweight, easy-to-use Dell Chromebook 11 helps turn education into exploration - without the worries of safety or security. Priced to make 1:1 computing affordable today, Chromebook 11 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 4th Gen Intel® processor provides up to 10 hours of power. Encourage creativity with the Chromebook 11 and its multimedia features that include an 11.6" screen, stereo sound and webcam.

4 Software Components

4.1 Broker Technology

The solution is based on Wyse vWorkspace™ 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.

Wyse vWorkspace 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.

Wyse vWorkspace is an enterprise class desktop virtualization management solution which enables blended deployment and support of virtual desktops, shared sessions and virtualized applications. The core components of vWorkspace are:

- **Connection Broker**

  The vWorkspace Connection Broker helps users connect to their virtual desktops, applications, and other hosted resource sessions. The user's [endpoint?] sends a request to the connection broker to access their virtual environment. The connection broker processes the request by searching for available desktops, and then redirects the user to the available managed desktop or application.

- **Management Database**

  The vWorkspace Management Database is required to perform administrative functions. The management database stores all the information relevant to a vWorkspace farm, such as configuration data, administrative tasks and results, and information regarding client connections to virtual desktops and RDSH environments.

- **Management Console**

  The vWorkspace Management Console is an integrated graphical interface that helps you perform various management and administrative functions and can be installed on any workstation or server.

- **Data Collector Service**

  The vWorkspace Data Collector service is a Windows service on RDSH servers, virtual desktops, and Hyper-V hosts in a vWorkspace farm that sends a heartbeat signal and other information to the connection broker.

- **Hyper-V Catalyst Components**

  vWorkspace Hyper-V Catalyst Components increase the scalability and performance of virtual computers on Hyper-V Hosts. Hyper-V catalyst components consist of two components: HyperCache and HyperDeploy. HyperCache provides read IOPS savings and improves virtual desktop performance through selective RAM caching of parent VHDs. HyperDeploy manages parent VHD deployment to relevant Hyper-V hosts and enables instant cloning of Hyper-V virtual computers.

- **Diagnostics and Monitoring**

  Built on Dell Software's Foglight platform, vWorkspace Diagnostics and Monitoring provides real-time and historical data for user experience, hypervisor performance, RDSH servers/applications, virtual desktops, Connection Broker servers, Web Access servers, Secure Access servers, profile servers, EOP Print servers, and farm databases.

- **User Profile Management**

  vWorkspace User Profile Management uses virtual user profiles as an alternative to roaming profiles in a Microsoft Windows environment including virtual desktops and RD Session Hosts. The virtual user profiles eliminate potential profile corruption and accelerate logon and logoff times by combining the use of a mandatory profile with a custom persistence layer designed to preserve user profile settings between sessions.

- **Web Access**

  vWorkspace Web Access is a web application that acts as a web-based portal to a vWorkspace farm. It helps users to retrieve the list of available applications and desktops by using their web browser. After successful authentication, their published desktops and applications are displayed in the web browser.

- **Secure Access**

  vWorkspace Secure Access is an SSL gateway that simplifies the deployment of applications over the Internet and can provide proxy connections to vWorkspace components such as RDP sessions, the Web Access client, and connection brokers.

- **EOP Print Server**

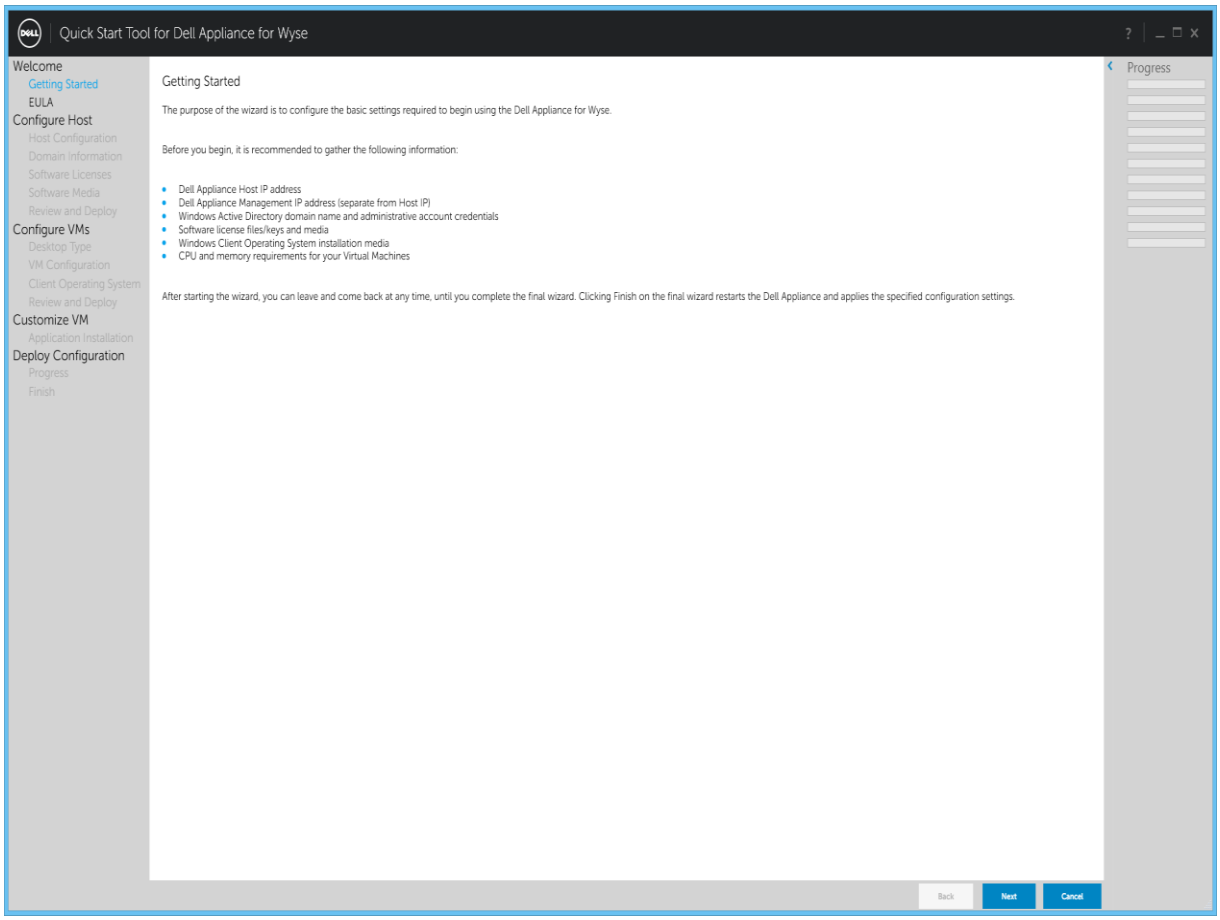
  vWorkspace EOP Print is a single-driver printing solution that satisfies both client-side and network printing needs in a vWorkspace environment by providing bandwidth usage control, intelligent font embedding, native printer feature support and clientless support for LAN connected print servers and remote site print servers.

vWorkspace 8.5 includes support for Microsoft Windows Server R2, Windows 8.1, Lync 2013, and App-V 5.0 as well as provides several enhancements to Diagnostics and Monitoring, Hyper-V Catalyst Components, Dell EOP and more.

For additional information about the enhancements in Wyse vWorkspace 8.5, please visit: LINK

4.2 Dell Quick Start Tool

The Dell Quick Start Tool or QST is a lightweight utility that helps immensely reduce complexity and time required to deploy the appliance. It takes a minute to install and then reduces the number of deployment steps from roughly 375 down to 35-37 which is a 90% reduction. The only pre-requisite software to deploy the QST is Microsoft .NET 4.5. It can be installed on Windows 7/8.1 or Windows Server 2008 R2/2012 R2. Deployment time is down to between 2 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.



4.3 Hypervisor Platform

4.3.1 Microsoft 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 processors 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 vWorkspace virtualization environment is Microsoft Systems Center Virtual Machine Manager 2012 R2 (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. For additional information about the enhancements to Hyper-V in Microsoft Windows Server 2012 R2, please visit: LINK

4.4 Operating Systems

4.4.1 Microsoft Windows Server 2012 R2

Microsoft Windows Server 2012 R2 is the latest iteration of the Windows Server operating system environment. This release introduces a host of new features and enhancements, including virtualization, storage, networking, management, security and applications. With this release also come the introduction of Microsoft Cloud OS and an update of products and services to further enable customers' shift to cloud enablement.

For additional information about the enhancements in Microsoft Windows Server 2012 R2, please visit: LINK

4.4.2 Microsoft Windows 8.1

Microsoft Windows 8.1 is an update to the latest Windows desktop operating system, providing several user centric features. With updates to the user interface, applications, online services, security and more, Windows 8.1 helps keeps a consistent user experience across virtual and physical instances.

For additional information about the enhancements in Microsoft Windows 8.1, please visit: LINK

4.4.3 RDSH Integration into Dell Wyse Datacenter Architecture

The RDSH servers can exist as physical or virtualized instances of Windows Server 2012 R2. A total of 6 RDSH virtual machines are installed per physical compute host. Since RDSH instances are easily added to an existing vWorkspace stack, the only additional components required are:

- One or more Server OS instances running the vWorkspace Terminal Server Role and Instant Provisioning client and added to the vWorkspace site

The total number of required virtual RDSH servers is dependent on application type, quantity and user load and appliance capability ensuring that proper NUMA architecture boundaries are adhered to. Deploying RDSH virtually and in a multi-server farm configuration increases overall farm performance, application load balancing as well as farm redundancy and resiliency.

5 Solution Architecture for vWorkspace

5.1 Management Infrastructure

5.1.1 Traditional Virtual Desktop Configuration

The recommended number of Management VMs and their Hyper-V configurations are summarized below.

Role	vCPU	Startup RAM (GB)	Dynamic Memory			vNIC	OS vDisk	
			Min|Max (GB)	Buffer	Weight		Size (GB)	Volume
Broker, SCVMM, Web	4	4	2|8	20%	Med	1	140	DATA
SQL	4	4	2|8	20%	Med	1	140	DATA
Total	**8**	**8**	**4|16**	**-**	**-**	**2**	**280**	**-**

5.1.2 Application Virtualization Configuration

The recommended number of Management and RDSH VMs with their Hyper-V configurations are summarized below.

Role	vCPU	Startup RAM (GB)	Dynamic Memory			vNIC	OS vDisk	
			Min|Max (GB)	Buffer	Weight		Size (GB)	Volume
Broker, SQL, Web	8	8	4|16	20%	Med	1	140	DATA
RDSH VM (x6)	8	16	8|32	20%	Med	1	140	DATA
Total	**56**	**104**	**52|208**	**-**	**-**	**8**	**1120**	**-**

5.1.3 SQL Databases

The vWorkspace and Microsoft databases are hosted by a single dedicated Windows Server 2012 R2 VM in the Management layer for the desktop configuration. For application virtualization, SQL Express is used and installed to same Management VM as all other management roles. The Quick Start Tool (QST) creates all the necessary databases for:

- Dell Wyse vWorkspace
- SCVMM (desktop configuration only)

5.1.4 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 Dell 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.

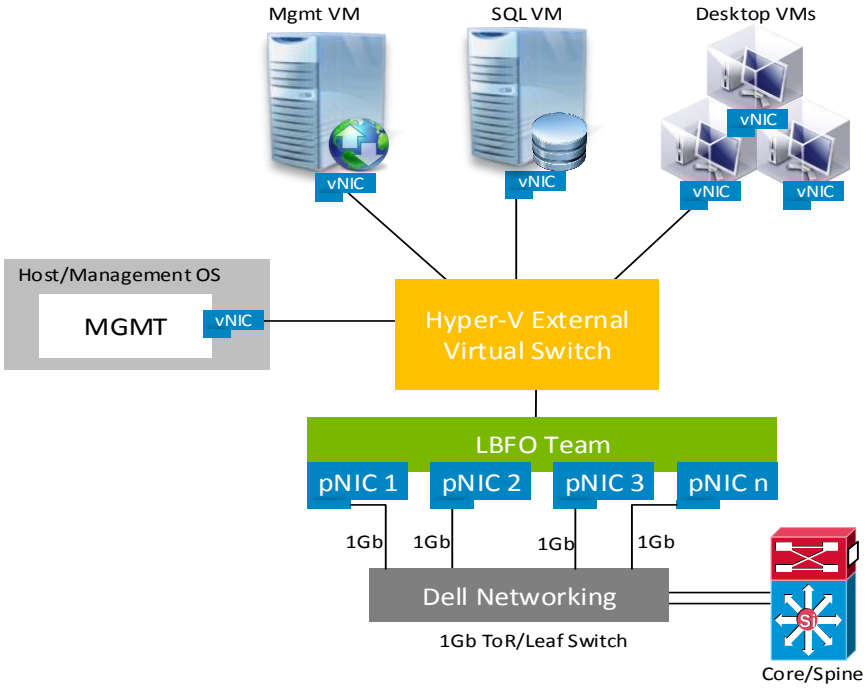
5.2 Storage Architecture Overview

The appliance comes with local storage that includes 15k SAS drives. These drives are shared for appliance operating system as well as virtual machine storage.

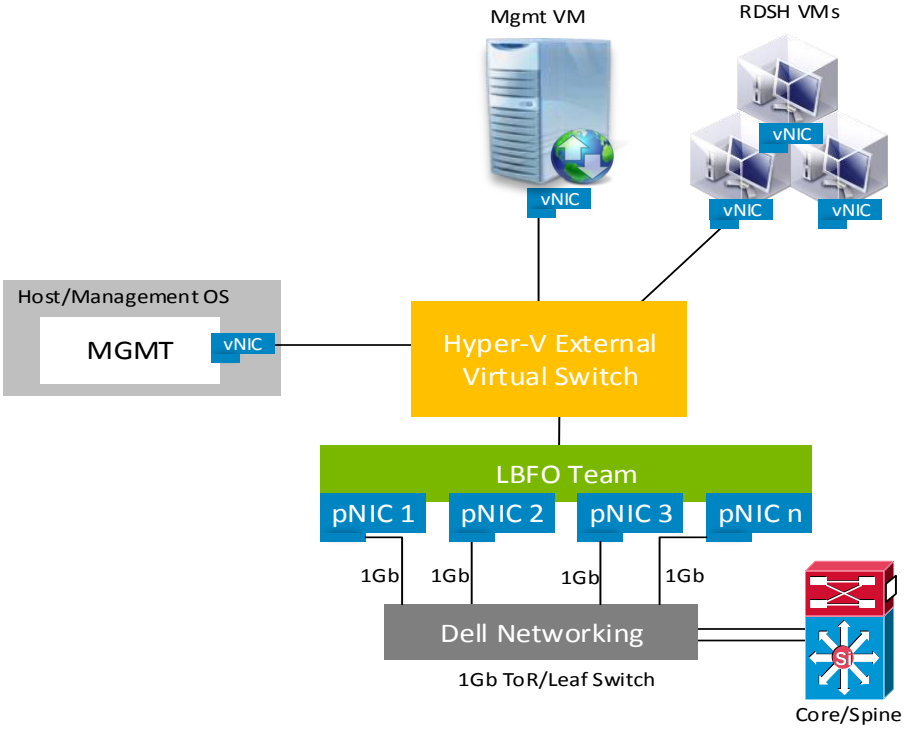
5.3 Networking

As shown in the diagram 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 consisting of eight physical NICs is configured to connect to a Hyper-V virtual switch for external traffic. 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 on the vNICs by default but can be enabled if used in the environment.

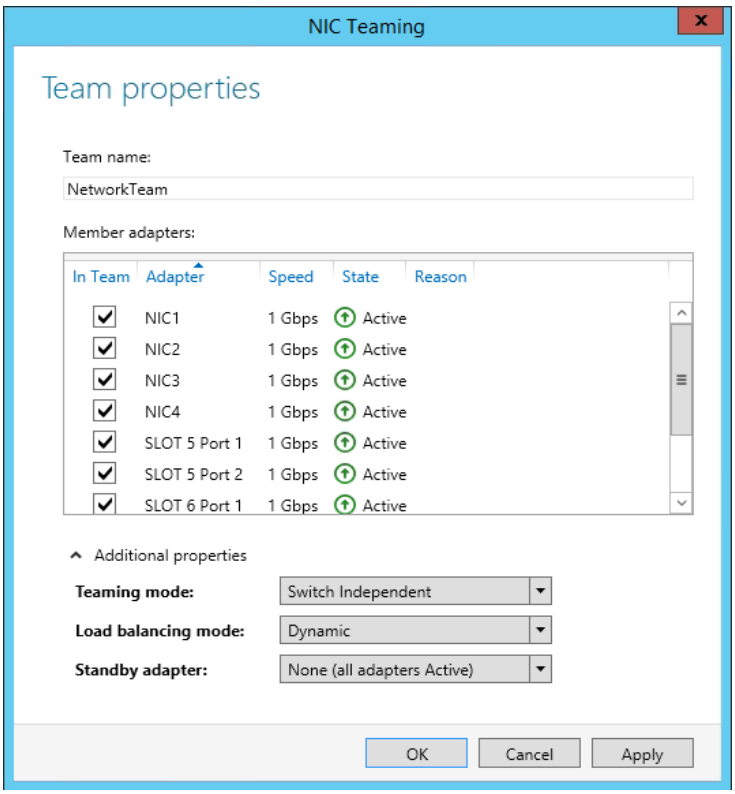
Virtual Desktop Configuration:



Application Virtualization Configuration:



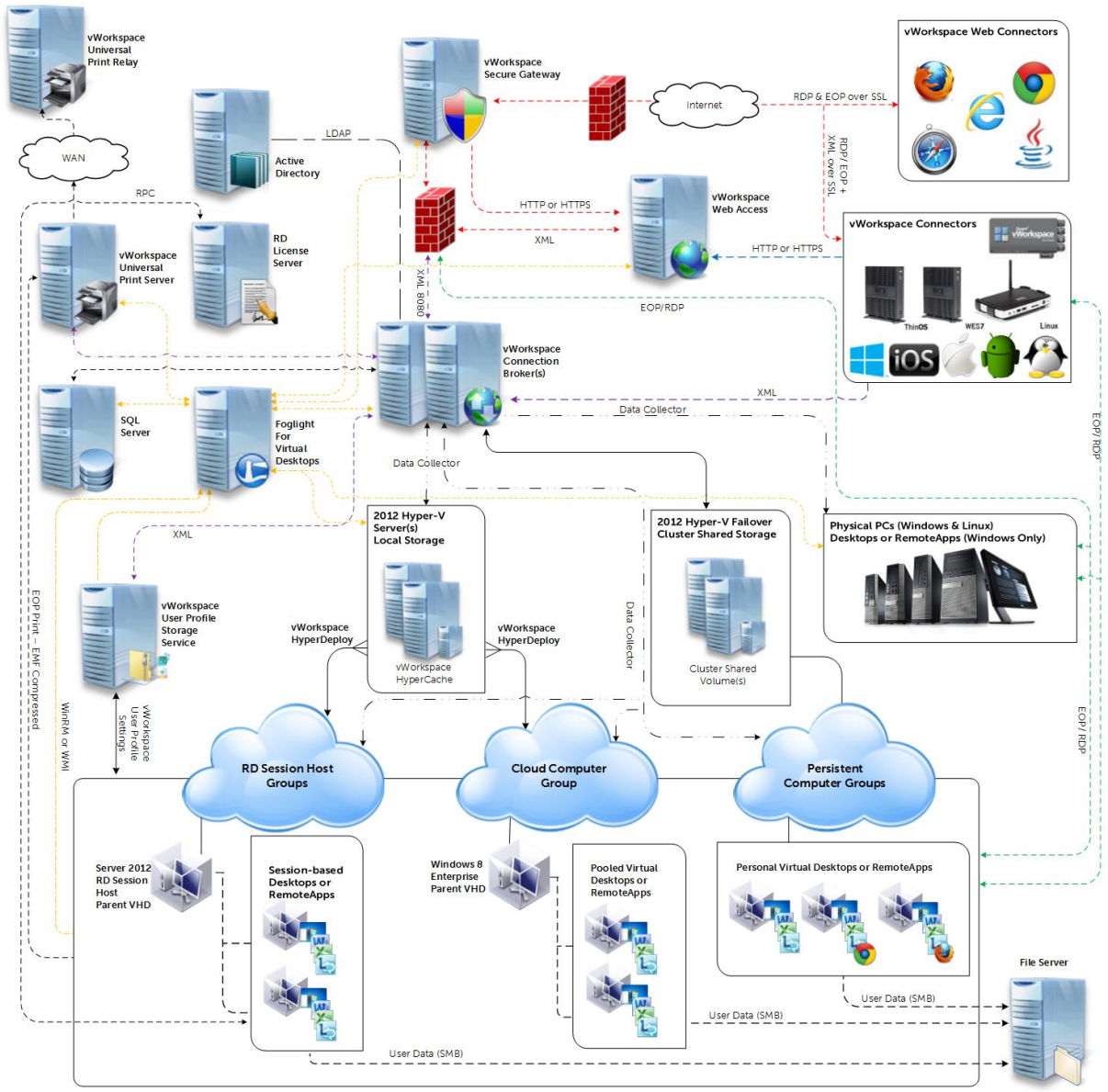
The NIC team for the Hyper-V switch is configured as switch independent, Dynamic for the load balancing mode with all adapters set to active. This team is used exclusively by Hyper-V.



5.4 Appliance Density

Hypervisor	Provisioning	Workload	User Density
Hyper-V	vWorkspace	Standard	200
Hyper-V	vWorkspace	Enhanced	160
Hyper-V	vWorkspace	Professional	130
Hyper-V	RDSH (1-5 apps)	Enhanced	350

5.5 Wyse vWorkspace Communication Flow



6 Solution Performance and Testing

6.1 Load Generation and Monitoring

6.1.1 Login VSI (Login Consultants) Load Generation

Login VSI is the de-facto industry standard tool for testing VDI environments and server-based computing / terminal services environments. It uses launcher systems to connect a specified number of users to available desktops within the environment and then executes a standard collection of desktop application software (e.g. Microsoft Office, Adobe Acrobat Reader etc.) on each VDI desktop/session. Once the user is connected, a logon script configures the user environment and then starts the test workload. Each launcher system can launch connections to multiple 'target' machines (i.e. VDI desktops). A centralized management console is used to configure and manage the Login VSI environment and launcher systems.

6.1.2 Storage Layer Monitoring

The storage disks are internal to the appliance.

6.1.3 Host Monitoring

Microsoft Performance Monitor was utilized to collect resource utilization data for tests performed on the desktop VMs, RD Session Hosts, and Hyper-V platform.

6.1.4 Appliance Setup

Management and compute resources are contained within the appliance. The management is split out into 2 virtual machines one performing the management functions (Broker / Provisioning) and the other as a dedicated SQL Server (desktop virtualization only).

6.1.5 Dell Wyse Datacenter Workloads and Profiles

It's important to understand user workloads and profiles when designing a desktop virtualization solution in order to understand the density numbers that the solution can support. At Dell, we use five workload / profile levels, each of which is bound by specific metrics and capabilities. In addition, we use workloads and profiles that are targeted at graphics-intensive use cases. We present more detailed information in relation to these workloads and profiles below but first it is useful to define the terms "workload" and "profile" as they are used in this document.

- **Profile**: This is the configuration of the virtual desktop - number of vCPUs and amount of RAM configured on the desktop (i.e. available to the user).

- **Workload**: This is the set of applications used by performance analysis and characterization (PAAC) of Dell Wyse Datacenter solutions e.g. Microsoft Office applications, PDF Reader, Internet Explorer etc.

6.1.6 Dell Wyse Datacenter Profiles

The table shown below presents the user profiles used during PAAC on this solution. These profiles have been carefully selected to provide the optimal level of resources for common use cases.

Standard user profile equates to a task worker, Enhanced to a knowledge worker and Professional to a power user.

User Profile	vCPUs	Hyper-V Start up Memory	Hyper-V Minimum Memory	Hyper-V Max Memory	OS
Standard	1	1GB	512MB	2GB	x86
Enhanced	2	1GB	512MB	3GB	x86
Professional	2	1GB	512MB	4GB	x64

6.1.7 Dell Wyse Datacenter Workloads

Load-testing on each of the profiles described in the above table is carried out using an appropriate workload that is representative of the relevant use case. In the case of the non-graphics workloads, these workloads are Login VSI workloads and in the case of graphics workloads, these are specially designed workloads that stress the VDI environment to a level that is appropriate for the relevant use case. This information is summarized in the table below:

Profile Name	Workload	OS Image
Standard	Login VSI Light	Shared
Enhanced	Login VSI Medium	Shared
Professional	Login VSI Heavy	Shared + Profile Virtualization

For the Application Virtualization testing, a custom Enhanced workload was used. This workload was a modified Login VSI Medium workload that only utilized the following applications:

- Microsoft Internet Explorer
- Microsoft PowerPoint
- Microsoft Excel
- Microsoft Word
- Login VSI Photoviewer

As noted in the table above, further information for each of the workloads is given below. It is noted that for Login VSI testing, the following login and boot paradigm is used:

- For single-server / single-host testing (typically carried out to determine the virtual desktop capacity of a specific physical server), users are logged in every 30 seconds.
- For multi-host / full solution testing, users are logged in over a period of 1-hour, to replicate the normal login storm in an enterprise environment.
- All desktops are pre-booted in advance of logins commencing.

For all testing, all virtual desktops run an industry-standard anti-virus solution (currently McAfee VirusScan Enterprise) in order to fully replicate a customer environment.

6.2 Testing and Validation

6.2.1 Testing Process

The purpose of the appliance testing is to validate the architectural assumptions made around the appliance. Each user load is tested against four runs. First, a pilot run to validate that the infrastructure is functioning and valid data can be captured, and then, three subsequent runs allowing correlation of data.

At different stages of the testing the testing team will complete some manual "User Experience" Testing while the environment is under load. This will involve a team member logging into a session during the run and completing tasks similar to the User Workload description. While this experience will be subjective, it will help provide a better understanding of the end user experience of the desktop sessions, particularly under high load, and ensure that the data gathered is reliable.

For all workloads, the performance analysis scenario will be to launch a user session every 15 seconds. Once all users have logged in, all will run workload activities at steady-state for 60 minutes and then logoffs will commence.

6.3 Test Results

6.3.1 Configuration for Testing RDSH and VDI

This validation was designed to evaluate the capabilities and performance of the following components on the Appliance:

- Microsoft Windows Server 2012 R2 with Hyper-V role on host.
- Microsoft Windows 8.1 with Office 2010 for VDI session.
- Dell vWorkspace 8.5
- Microsoft System Center VMM 2012 R2 for VDI Sessions Only.

Appliance configuration:

- Raid was configured as Raid 1/0.
- Host – Microsoft Windows Server 2012 R2 with Hyper-V role installed, acts as both management and compute resources.
- Dedicated Management VM (vWorkspace / Broker, System Center Virtual Machine Manager 2012 R2)
- Dedicated SQL VM (Microsoft SQL Server 2014) – used for VDI testing only.
- For RDSH the Management VM (vWorkspace / Broker, SQL Express 2014) – no additional SQL VM is required for this.

6.3.2 Summary of Results

The tables below summarize the resource utilizations and user densities that were obtained while remaining in acceptable limits (typically around 85% of available resources) for the appliance hardware platforms. For all platforms, Memory was the limiting resource.

	Workload	Users / Sessions	Peak CPU%	Peak Memory Consumed (GB)	Avg IOPS / User	Avg Network Usage Kbps / User
Virtual Desktops	Standard	200	42	215	3.22	71
	Enhanced	160	55	207	5.1	128
	Professional	130	72	212	6.0	232
RDSH	Custom	350	74	212	2.09	84

All average values are during steady state period and represent the host values.

CPU Utilization The values shown in the table is the Compute host steady state peak CPU Usage.

Memory utilization. The figure shown in the table above is the average memory **consumed** per host over the recorded test period (Compute and Management are on the same machine).

The IOPS results are calculated from the average **Disk IOPS** figure over the test period divided by the number of users.

Network Utilization The figure shown in the table is the average **Bytes/ps/User per host** over the recorded test period.

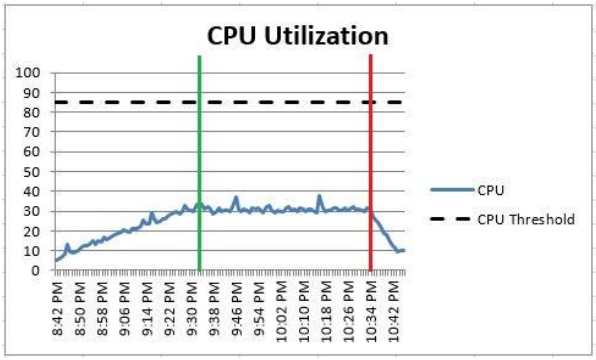
6.3.3 Persistent Virtual Desktop (Full Clone) Performance

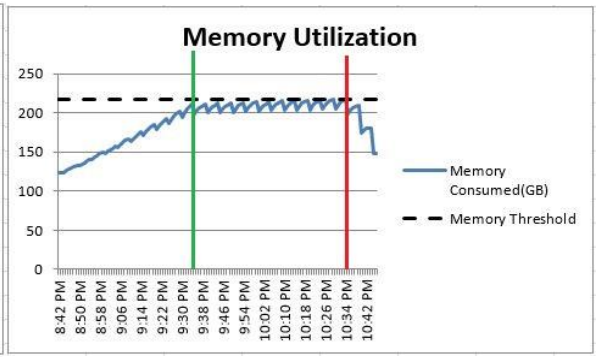
6.3.3.1 Standard User Workload (200 Users)

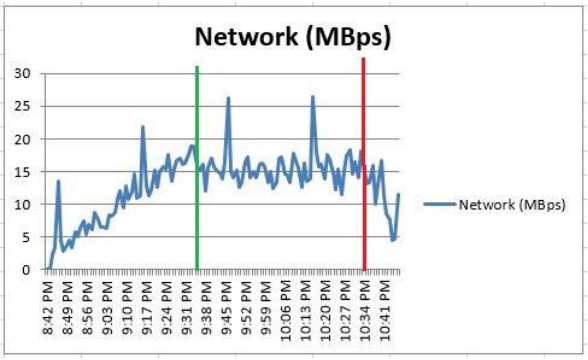
The results below were obtained from the host and management virtual machines with Hyper-V, SQL Server 2014, vWorkspace 8.5 and SCVMM 2012 R2 as configured in the appliance architecture. The VM load was split across the management and compute resources. All 200 users successfully logged on, executed the test workload, and logged off.

Performance Monitor Host Metrics

CPU utilization did not spiked above our 85% limit at various times on each host but on average, remained at or below the limit. Memory utilization is below the 218GB (85% of 256GB) threshold however there is no additional capacity as dynamic memory has been allocation. Network utilization spiked during logon and logoff but remained well within limits for 8 x 1Gbps (teamed) switching infrastructure.



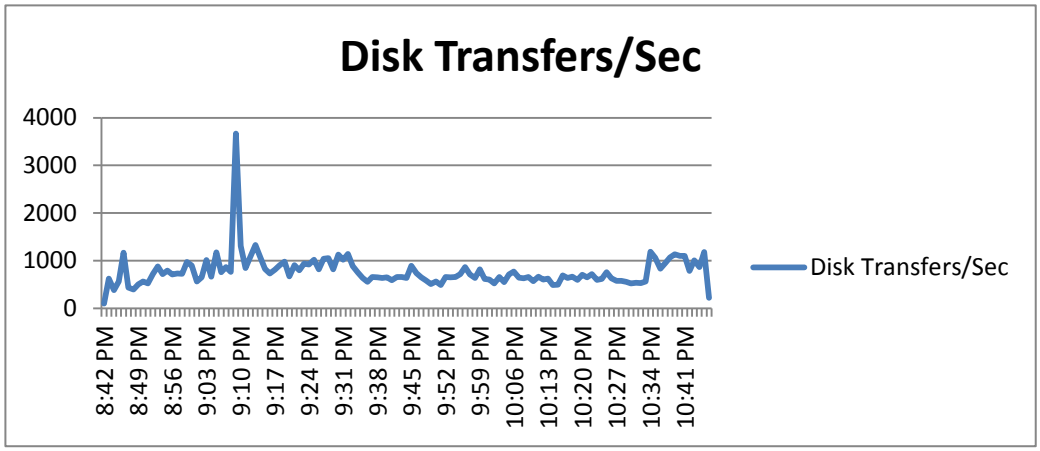




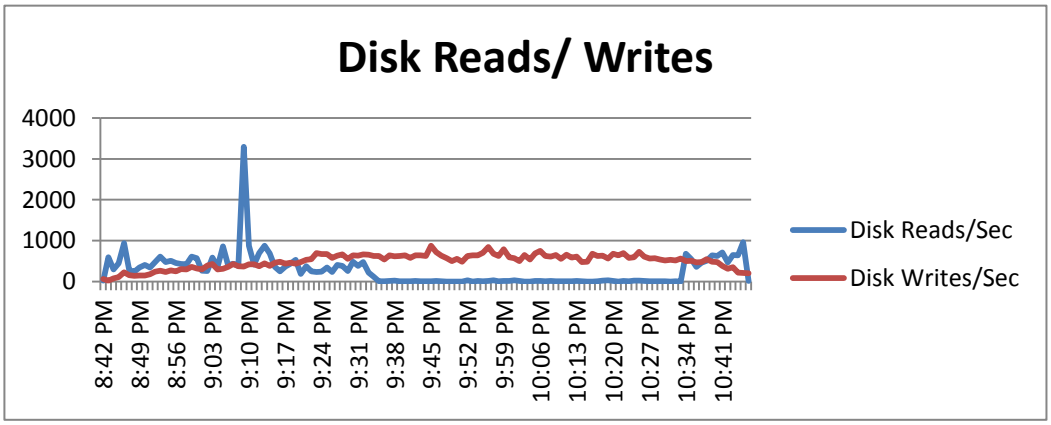
The charts above begin at the start of the logon period at 8:42PM which lasts until 10:46PM. The green vertical line indicates the beginning of the steady state period at 9:34PM which lasts until 10:34PM. The red vertical line indicates the beginning of the logoff period at 10:34PM which lasts until 10:46PM.

Appliance IOPS

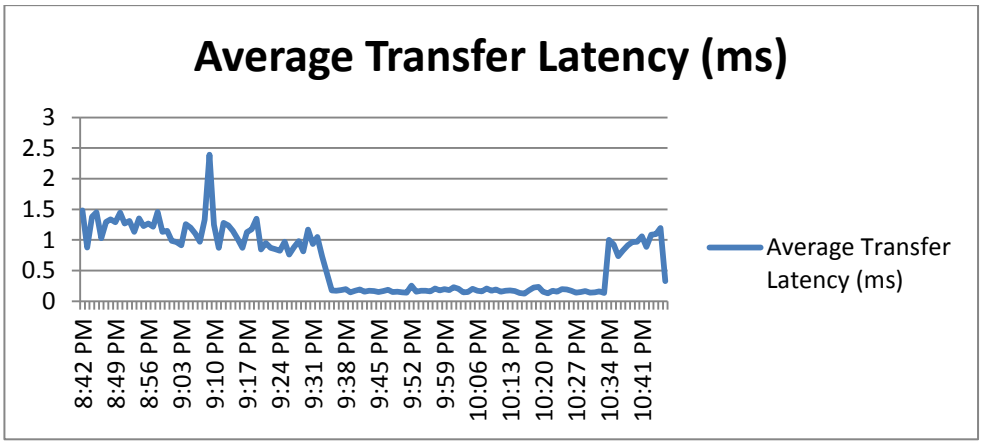
The IOPS spiked to 3665 during the logon period while users were logging in every 15 seconds. During steady state, all users are executing the test workload and IOPS averaged 644 yielding about 3.22 IOPS/user. During the logoff period, IOPS peaked at 1185. The chart below graphs the IOPS broken out by host.



Disk IOPS by Host



R/W Disk IOPS (Reads = Blue Line, Writes = Red Line)



Disk Latency

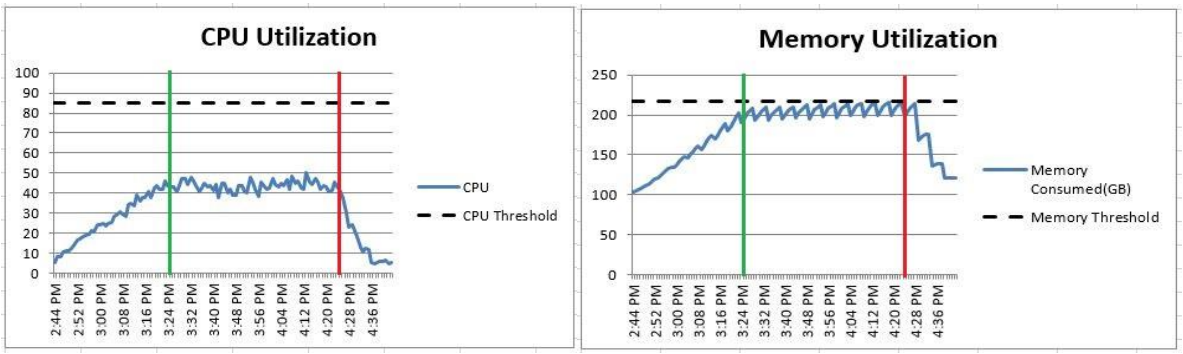
Disk latency peaked around 2.39ms but remained below our 20ms threshold.

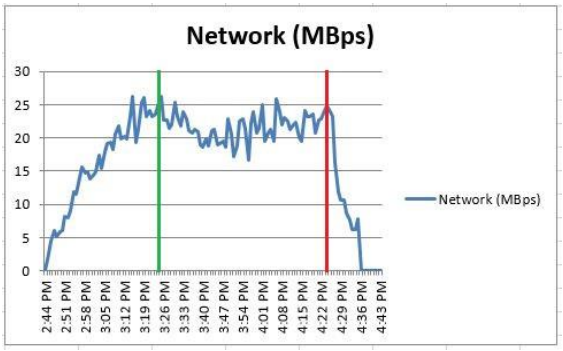
6.3.3.2 Enhanced User Workload (160 Users)

The results below were obtained from the host and management virtual machines with Hyper-V, SQL Server and vWorkspace 8.5 and SCVMM as configured in the Seminole appliance architecture. The VM load was split across the management and compute resources. All 160 users successfully logged on, executed the test workload, and logged off.

Performance Monitor Host Metrics

CPU utilization did not spiked above our 85% limit at various times on each host but on average, remained below the limit. Memory utilization is below the 218GB (85% of 256GB) threshold however there is no additional capacity as dynamic memory has been allocation. Network utilization spiked during logon and logoff but remained well within limits for 8 x 1Gbps (teamed) switching infrastructure.

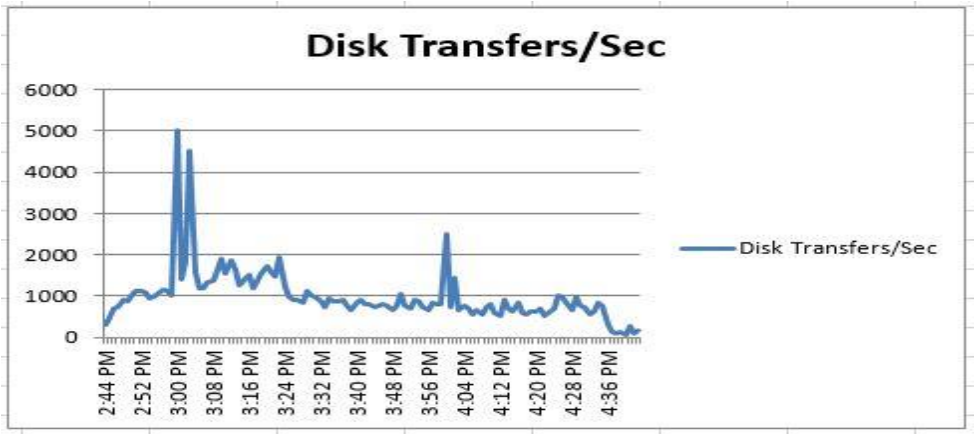




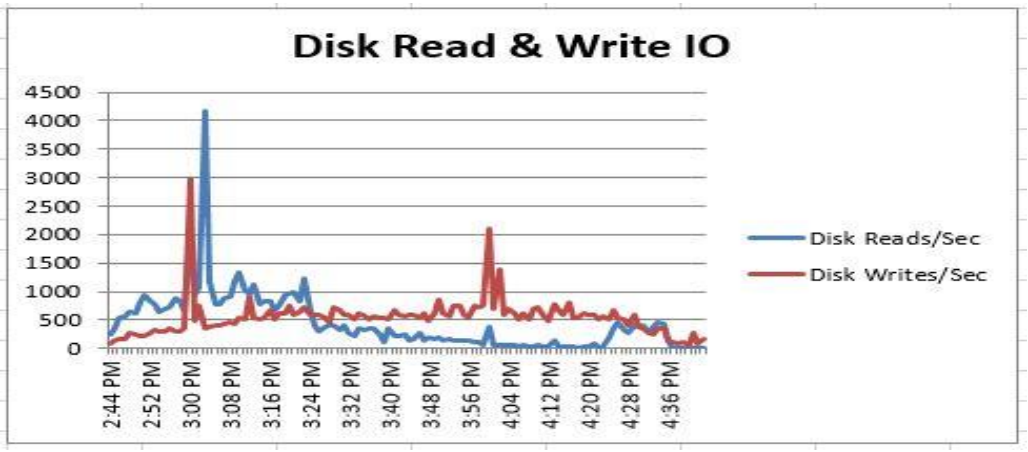
The charts above begin at the start of the logon period at 2:44PM which lasts until 4:38PM. The green vertical line indicates the beginning of the steady state period at 3:24PM which lasts until 4:24PM. The red vertical line indicates the beginning of the logoff period at 4:25PM which lasts until 4:38PM.

Appliance IOPS

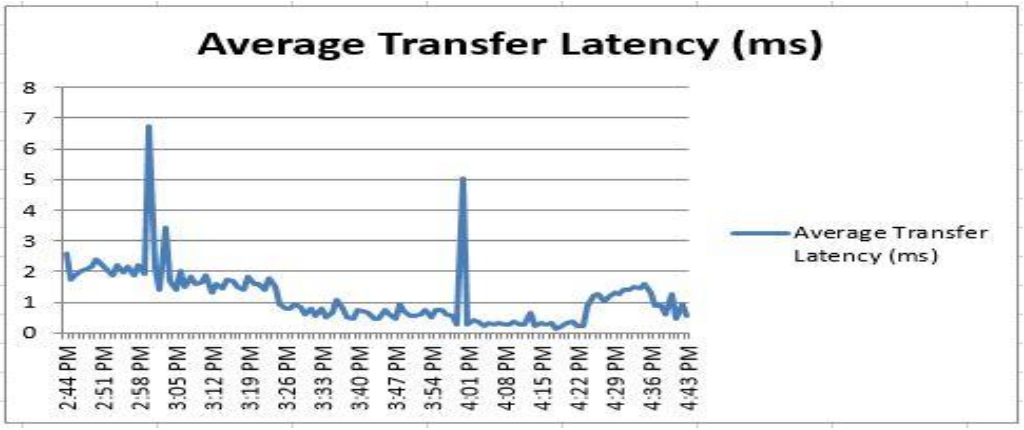
The IOPS spiked to 5002 during the logon period while users were logging in every 15 seconds. During steady state, all users are executing the test workload and IOPS averaged 815 yielding about 5.1 IOPS/user. During the logoff period, IOPS peaked did not peak above 976. The chart below graphs the IOPS broken out by host.



Disk IOPS by Host



R/W Disk IOPS Percentages (Reads = Blue Line, Writes = Red Line)



Disk Latency

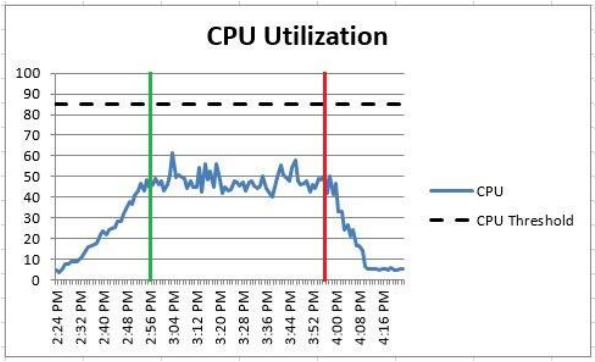
The latency peaked around 6.7ms but remained below our 20ms threshold.

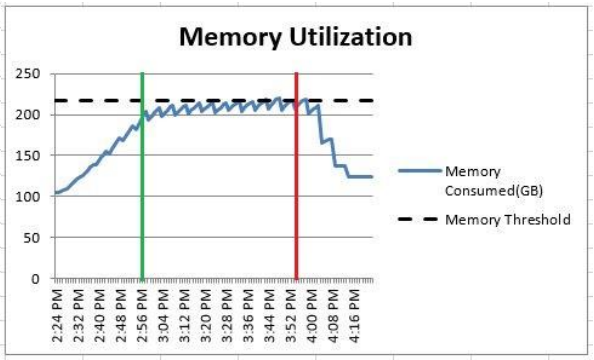
6.3.3.3 Professional User Workload (130 Users)

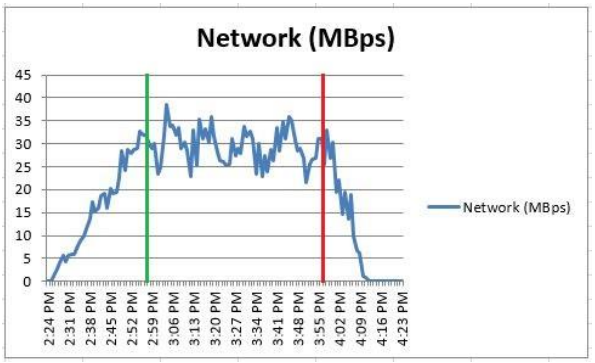
The results below were obtained from the host and management virtual machines with Hyper-V, SQL Server 2014 and vWorkspace 8.5 and SCVMM 2012 R2 as configured in the Seminole appliance architecture. The VM load was split across the management and compute resources. All 130 users successfully logged on, executed the test workload, and logged off.

Performance Monitor Host Metrics

CPU utilization did not spiked above our 85% limit at various times on each host but on average, remained below the limit. Memory utilization is close to the 218GB (85% of 256GB) threshold however there is no additional capacity as dynamic memory has been allocation. Network utilization spiked during logon and logoff but remained well within limits for 8 x 1Gbps (teamed) switching infrastructure.



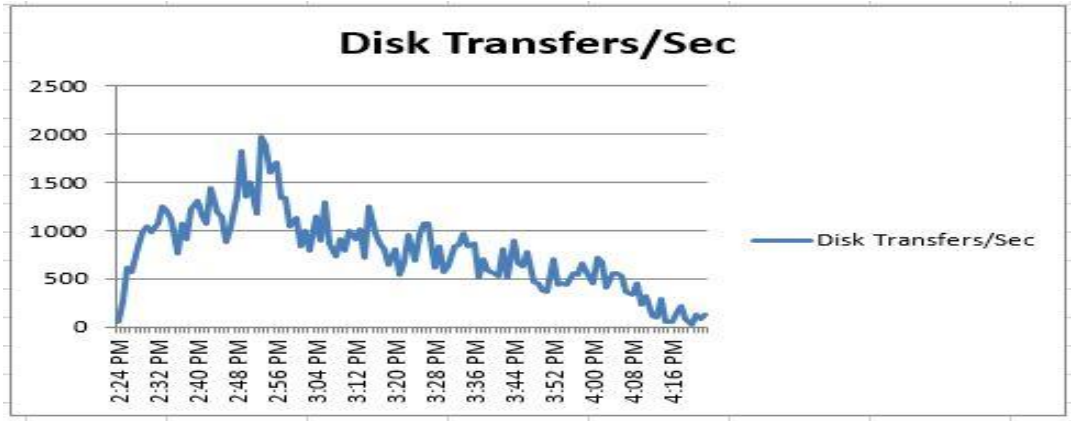




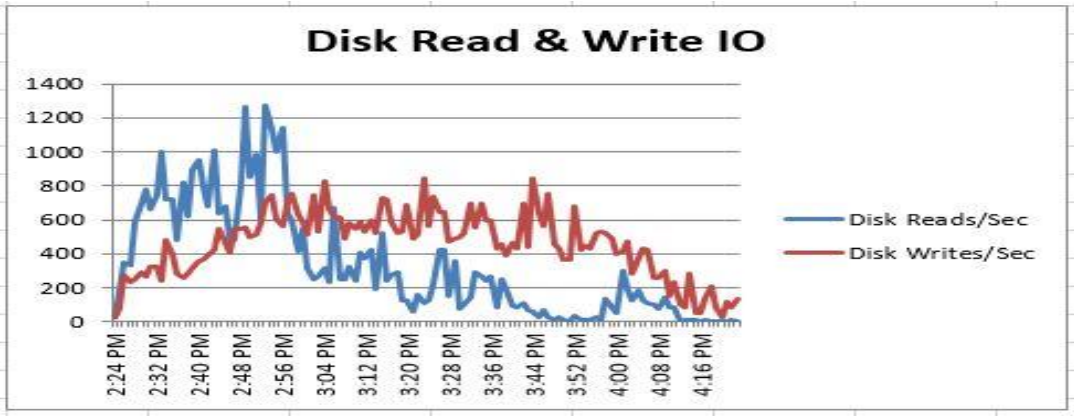
The charts above begin at the start of the logon period at 2:24PM which lasts until 4:23PM. The green vertical line indicates the beginning of the steady state period at 2:56PM which lasts until 3:56PM. The red vertical line indicates the beginning of the logoff period at 3:57PM which lasts until 4:23PM.

Appliance IOPS

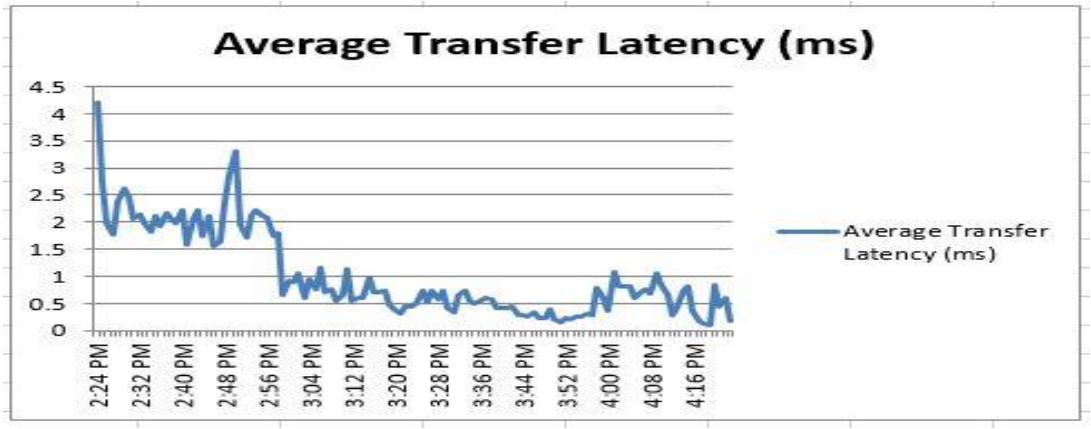
The IOPS spiked to 1977 during the logon period while users were logging in every 15 seconds. During steady state, all users are executing the test workload and IOPS averaged 806 yielding about 6.2 IOPS/user. During the logoff period, IOPS peaked at 717. The chart below graphs the IOPS broken out by host.



Disk IOPS on Host



R/W Disk IOPS (Read = Blue Line, Write = Red Line)



Disk Latency

The latency peaked around 4.5ms but remained below our 20ms threshold.

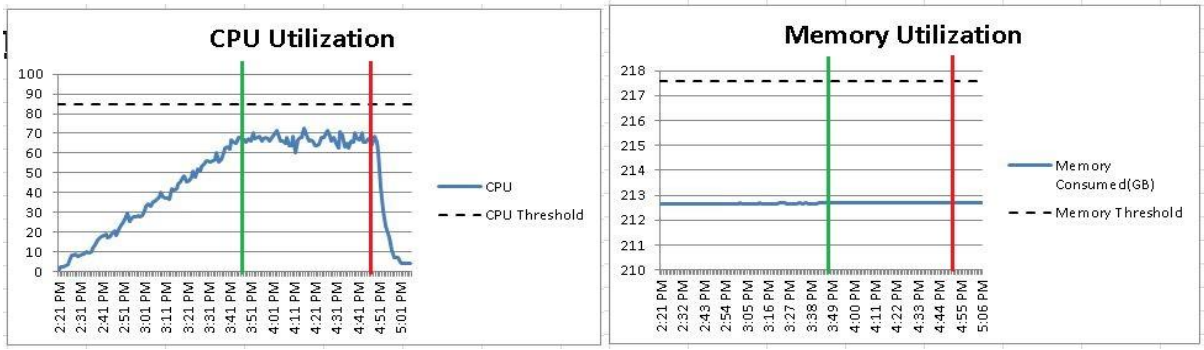
6.3.4 Shared Session (RDSH) Performance

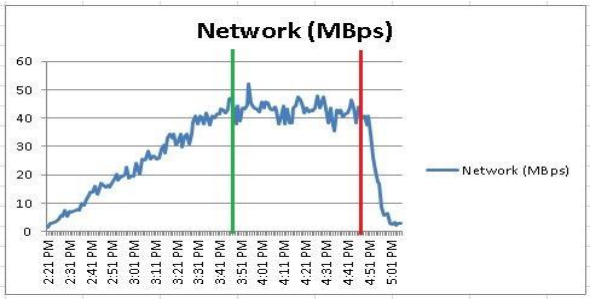
6.3.4.1 Custom User Workload (350Users)

The results below were obtained from the host and management virtual machines with Hyper-V, SQL Express 2014 and vWorkspace 8.5 as configured in the appliance architecture. The VM load was split across the management and compute resources. There is only 1 management VM in this configuration. All 350 users successfully logged on, executed the test workload, and logged off.

Performance Monitor Host Metrics

CPU utilization remained at or below the threshold for all hosts during steady state. Memory utilization is well below the 218GB (85% of 256GB) threshold. Network utilization spiked during logon and logoff but remained well within limits for 8 x 1Gbps (teamed) switching infrastructure.



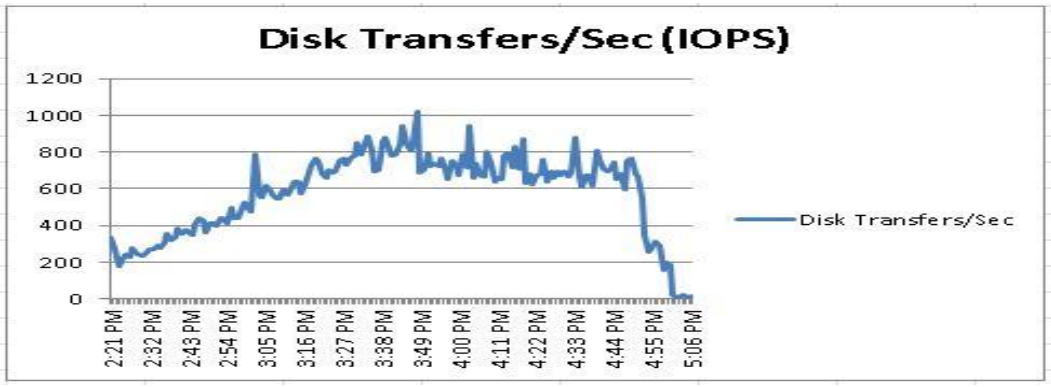


The charts above begin at the start of the logon period at 2:21PM which lasts until 5:01PM. The green vertical line indicates the beginning of the steady state period at 3:48PM which lasts until 4:48M. The red vertical line indicates the beginning of the logoff period at 4:49PM which lasts until 5:01PM.

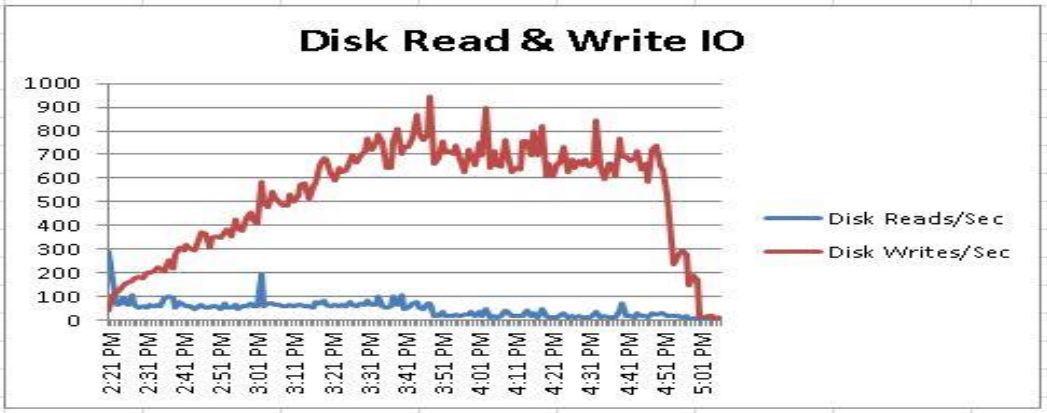
The Memory on the host shows a straight line this is due to the fact that the 6 RDSH VM have static Ram assigned to them as well as the management VM, hence this characteristic being shown in the Memory Utilization Graph.

Appliance IOPS

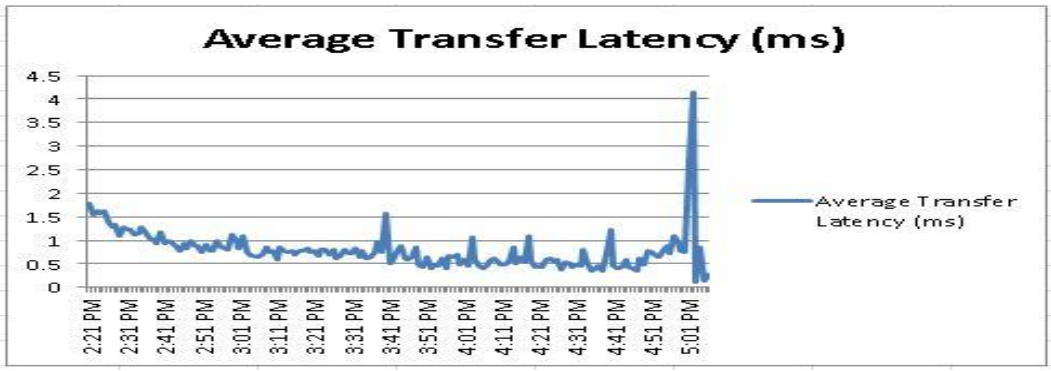
The IOPS spiked to 1019 during the logon period while users were logging in every 15 seconds. During steady state, all users are executing the modified test workload and IOPS averaged 717 yielding about 2.05 IOPS/user. During the logoff period, IOPS peaked at 748. The chart below graphs the IOPS broken out by host.



Disk IOPS on Host



R/W Disk IOPS (Read = Blue Line, Write = Red Line)



Disk Latency

The Disk latency peaked around 4.1ms at logoff but remained below our 20ms threshold.

6.3.5 Functionality

6.3.5.1 Chromebook

A Dell chrome book was tested for functionality connecting to the vWorkspace farm under test. Functionality testing was through a RDSH session. This functionality test was performed by opening MS Word, MS Excel, IE and browsing sites. Overall the functionality test proved positive with no issue encountered. Although it must be noted that the performance of this test is subjective and relates only to functionality testing.

About the Authors

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