Dell PowerEdge VRTX and VMware Horizon View

Reference Architecture for the PowerEdge VRTX and VMware Horizon View 5.3

Dell Wyse Solutions Engineering
February 2014

A Dell Reference Architecture

Revisions

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February 2014	Initial release v.6.0

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1 Introduction

1.1 Purpose of this document

This document describes:

- The maximum user density for a maximally outfitted PowerEdge VRTX (VRTX) chassis of PowerEdge M620 Servers
- Optimal shared storage drive configuration to support the maximum users above at the lowest cost per seat basis
- The verification of hybrid drive performance and value proposition characteristics
- The maximum user density in a minimally configured PowerEdge VRTX

This document also addresses the architecture design, configuration, and implementation considerations for the key components of the architecture required to deliver virtual desktops via VMware Horizon View 5.3 on the Dell PowerEdge VRTX consolidated platform using VMware vSphere.

1.2 Scope of this document

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 examples 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 Solution architecture overview

2.1 Introduction

The Dell Wyse Datacenter solution leverages a core set of hardware and software components consisting of 4 primary layers:

- Networking
- Compute server
- Management server
- Storage

These components have been integrated and tested to provide the optimal balance of high performance and lowest cost per user. Additionally, the Dell Wyse Datacenter solution includes an approved extended list of optional components in the same categories. These components give IT departments the flexibility to custom tailor the solution for environments with unique VDI feature, scale or performance needs.

2.1.1 Physical architecture overview

The core Dell Wyse Datacenter architecture for ROBO consists of the Shared Tier1 solution model within a single VRTX chassis. "Tier 1" in the VDI context defines the high performance disk source from which the VDI desktop sessions execute. Tier 2 defines storage that prioritizes capacity over performance for management VM and user data storage. The tiers are separated by default to maximize user performance. Dell Wyse Datacenter is a 100% virtualized solution architecture.

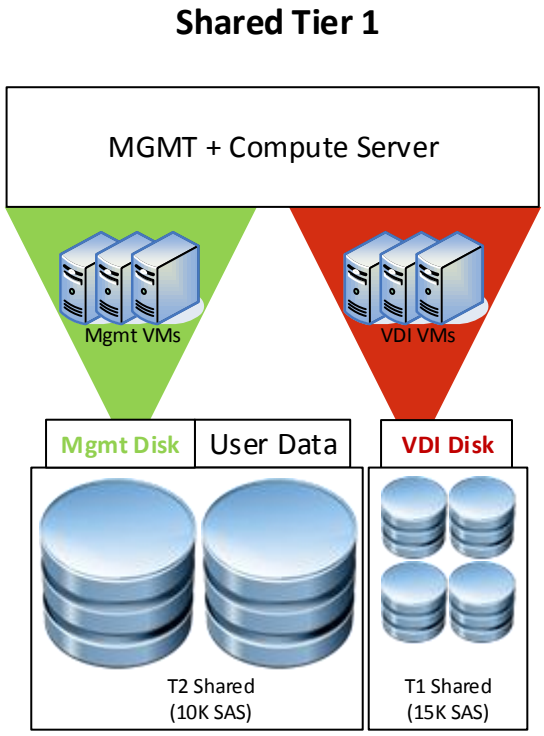
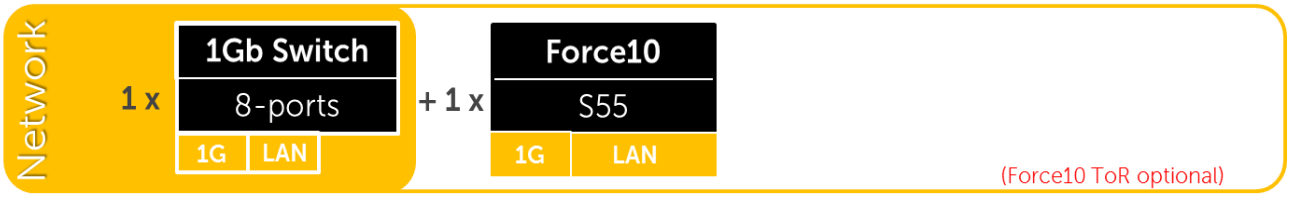


Figure 1 Shared Tier 1 solution model

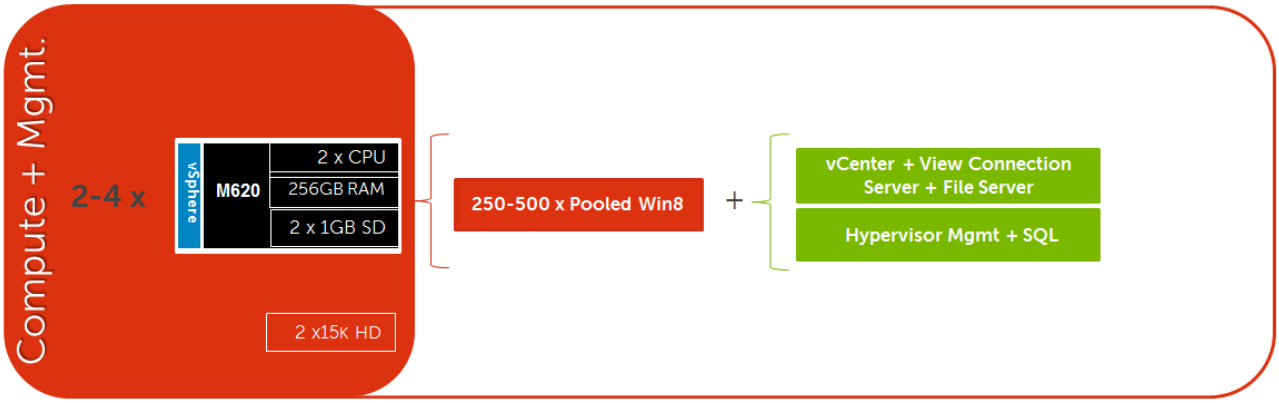
In the Shared Tier 1 solution model for the ROBO use case, the compute and management functions are combined across all hosts with shared Tier 1 and Tier 2 defined by their rotational speed. This "cluster in a box" methodology makes use of hypervisor clustering functionality to balance all VMs across all hosts present in the VRTX chassis.

2.1.2 Dell Wyse Datacenter solution layers

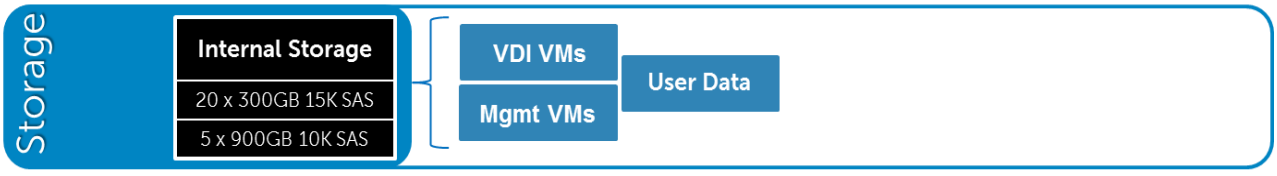
The Dell VRTX includes an integrated 8-port switch which can be connected up to an existing switching infrastructure or optional high performance Force10 switch. This integrated switch connects two 1Gb NICs to the A fabric of all blade hosts in the chassis.



The compute and management layers are combined in this solution and consist of the server resources responsible for hosting the VMware Horizon View user sessions and management VMs necessary to support the VDI infrastructure. These are hosted by VMware vSphere.



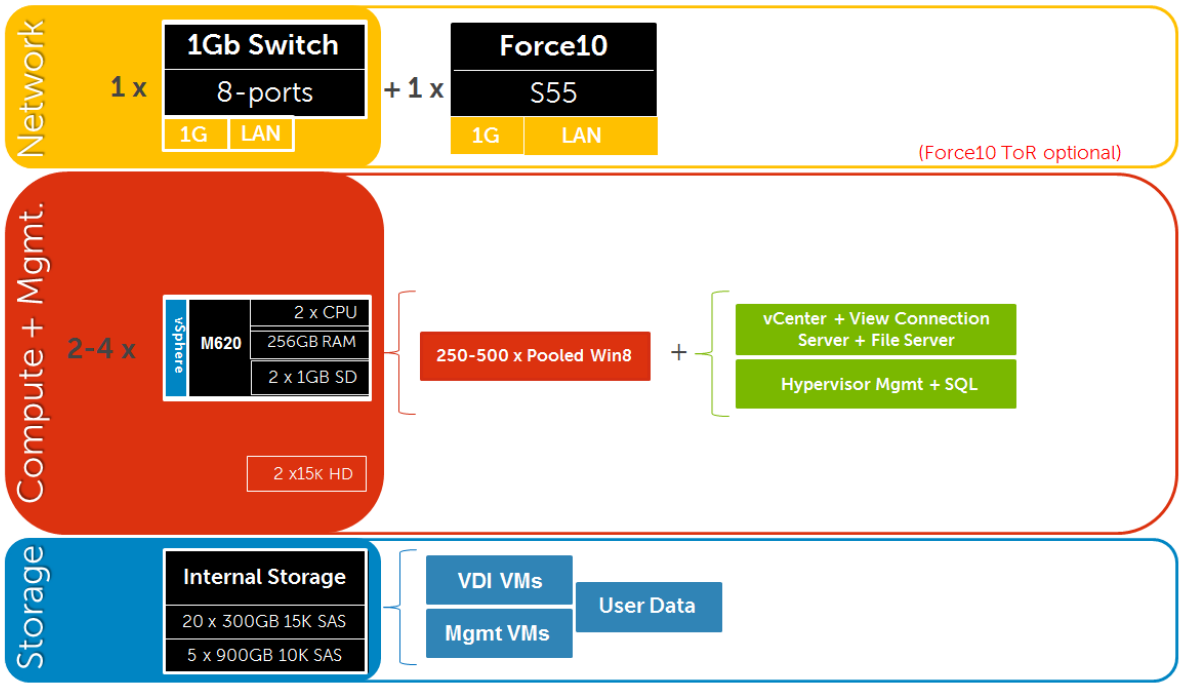
The Storage layer consists of two tiers of internal storage to suit the VDI VMs and management components individually.



2.2 Shared Tier 1

2.2.1 VRTX – Up to 500 users

For remote or branch office deployment scenarios, Dell Dell Wyse Datacenter offers a 2 or 4 blade cluster plus 25-disk Direct Attached Storage (DAS) solution, all contained within a single 5U chassis. All switching, compute, management, and storage are included. This solution can support up to 500 pooled VDI users in an incredibly efficient, small, and cost effective platform. Additional top-of-rack (ToR) switching is available if required.



10 Gb Ethernet (options)

- Intel 82599 10Gb Ethernet controller dual port mezzanine card
- Intel X540 dual port 10 Gb Ethernet Base-T adapter
- Intel X520-DA dual port 10 Gb SFP+ adapter

2.2.2 Shared Tier 1 rack – Conceptual network architecture

All ToR traffic connecting to the VRTX integrated switch should be layer 2 (switched locally), with all layer 3 (routable) VLANs trunked from a core or distribution switch. The following diagram illustrates the logical relationship of the VRTX chassis to the integrated switch connections, VLAN assignments, as well as logical VLAN flow in relation to the core switch.

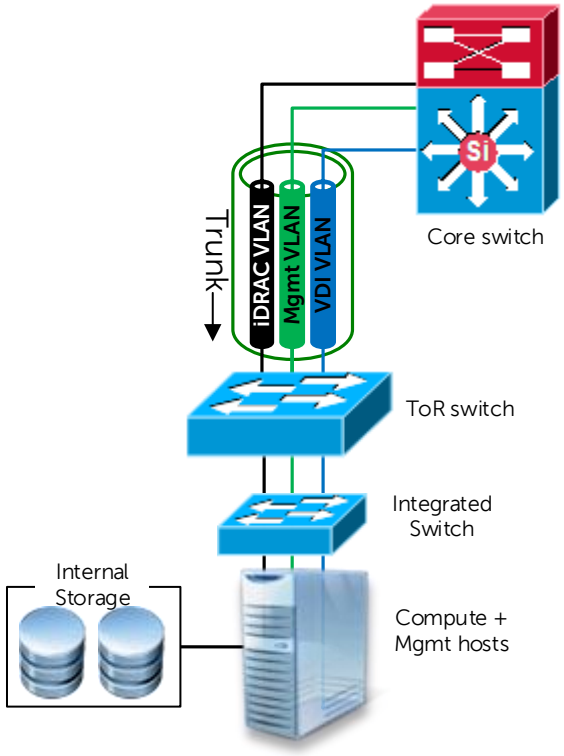
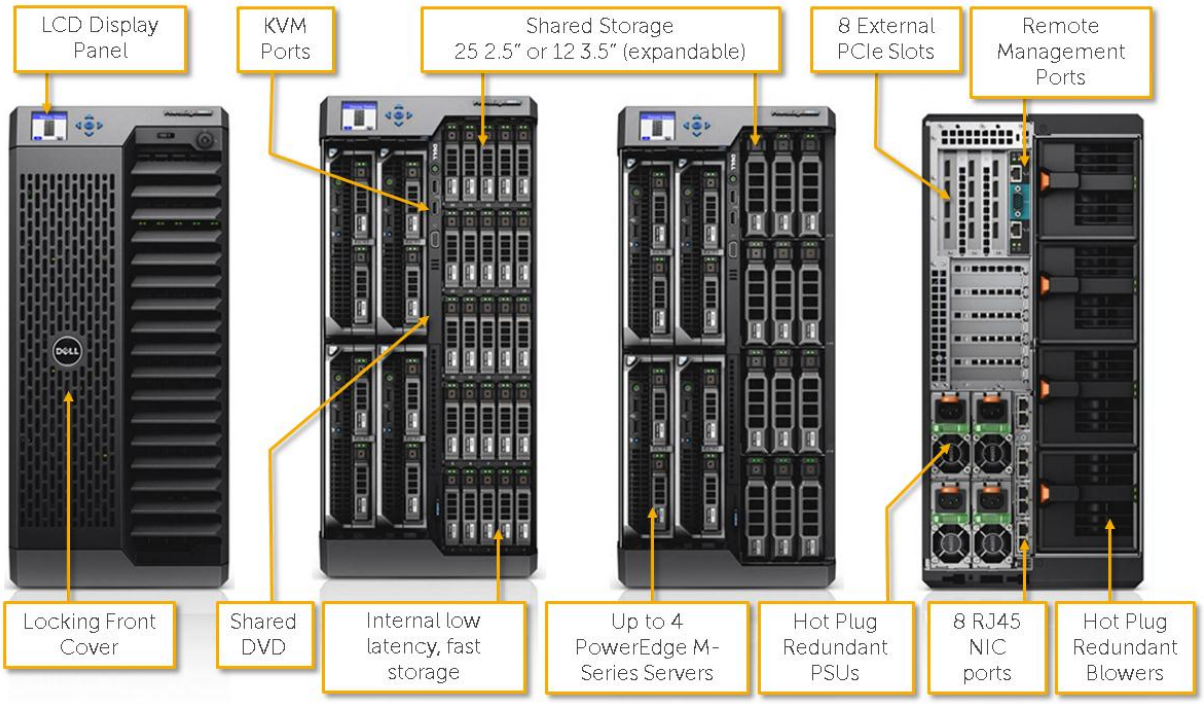


Figure 2 Conceptual network architecture

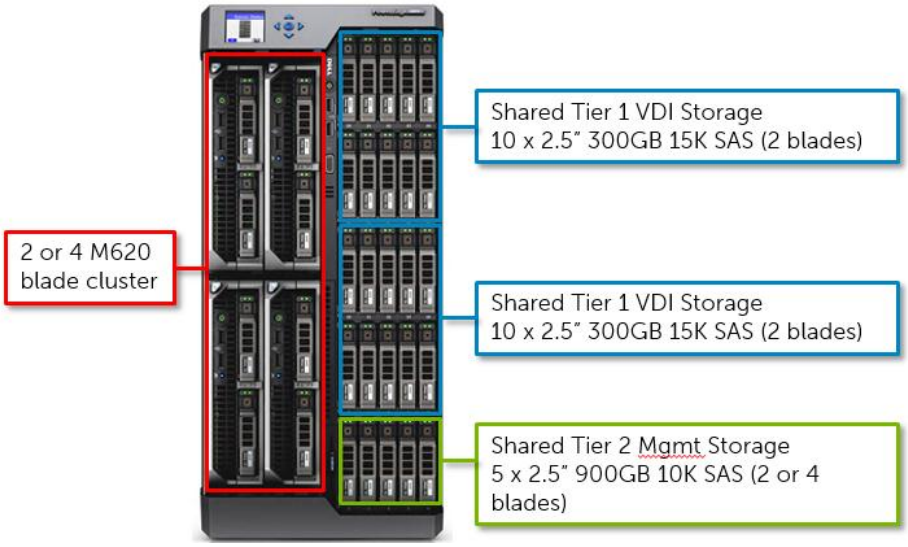
3 Hardware components

3.1 PowerEdge VRTX

The Dell PowerEdge VRTX is designed to reduce complexities of deployment in remote and branch offices by combining servers, storage, and networking into a consolidated 5U chassis. The VRTX chassis supports a maximum of 4 blade servers and also includes an internally shared storage infrastructure using a SAS based RAID controller (PERC) with 1GB cache across all four blades. An internal Ethernet switch also provides external connectivity to the client network. This unique packaging eliminates the need for external storage arrays and fabrics for connectivity to the compute nodes.

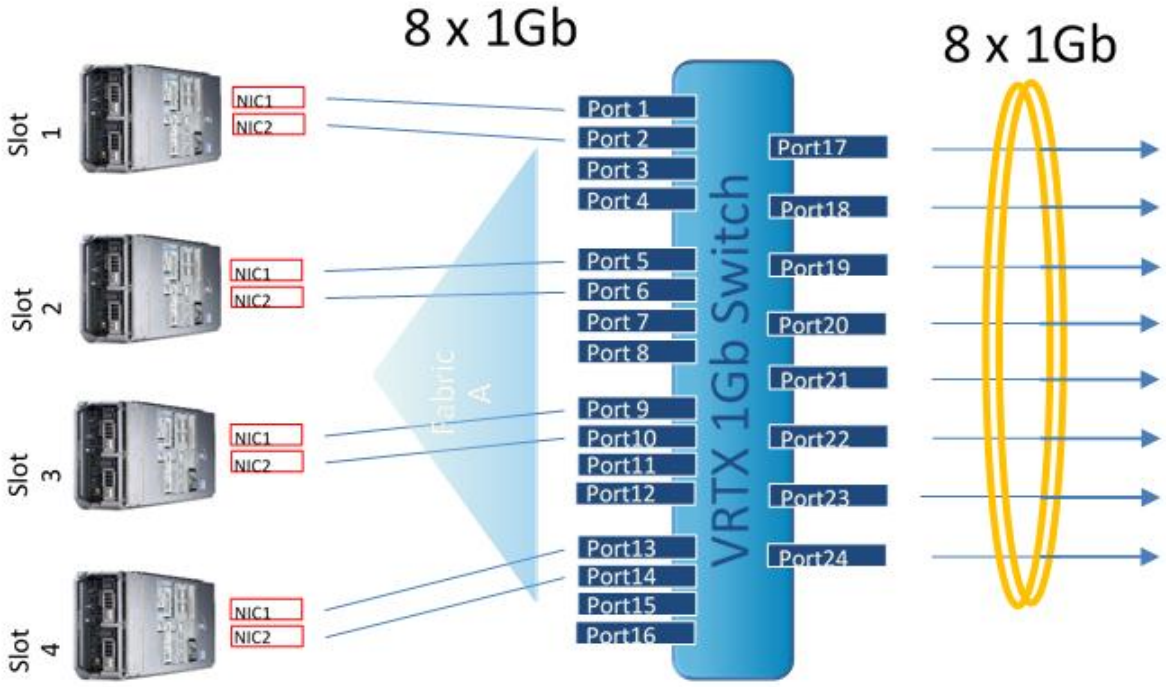


Two "cluster in a box" options for remote/branch office deployment are shown below. This solution leverages VMware's vSphere HA to protect all VMs across all blades. The storage configuration is optimized to support the best performance and capacity utilization providing two tiers of shared internal storage. The use of hypervisor clustering enables complete mobility for the management and desktop VMs within the cluster during periods of maintenance and migration. This solution is available in either 2 blade or 4 blade configurations including the required storage. The 2 blade solution requires 15 total SAS disks; the 4 blade solution requires the full 25 disks. The image below describes the blade and disk configuration options.



3.2 Network configuration

The VRTX chassis can be configured with either switched (default) or pass-through modules. The switched method, shown below also the Dell Wyse Datacenter solution default, supports up to 8 external ports for uplinks. This solution configuration only makes use of the single A fabric in default form. External uplinks should be cabled and configured in a LAG to support the desired amount of upstream bandwidth.



3.2.1 Networking high availability (HA)

For configurations requiring networking HA, this can be achieved by adding Broadcom 5719 1Gb NICs to the PCIe slots in the VRTX chassis that will connect to the pre-populated PCIe mezzanine cards in each blade server. This provides an alternative physical network path out of the VRTX chassis for greater bandwidth and redundancy using additional fabrics. A PCIe NIC must be added for each blade in the chassis as these connections are mapped 1:1. As you can see by the graphic below, each M620 in the VRTX chassis will use the 10Gb NDC (throttled to 1Gb) in the A fabric to connect to ports on the internal 1Gb switch. The PCIe mezzanine cards included in the B fabric will be used to connect to ports provided by the external 1Gb NICs in the PCIe slots of the VRTX chassis (1 per blade).

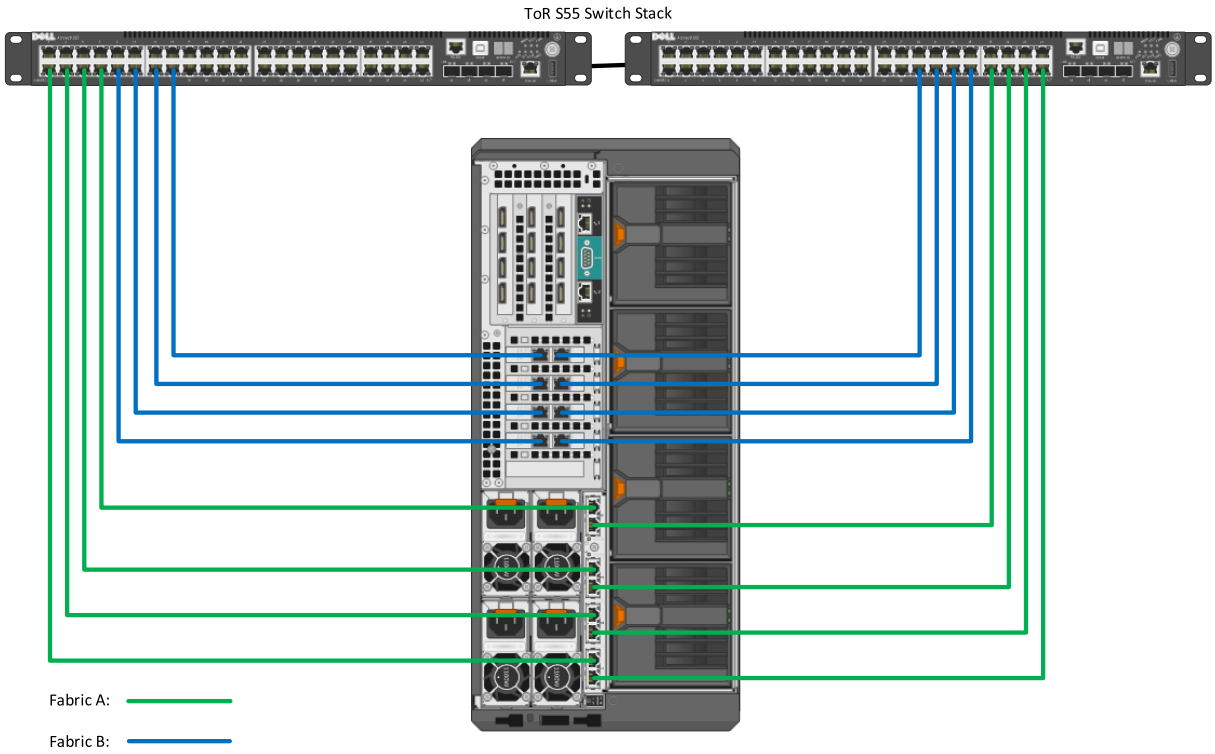


Figure 3 Physical cabling representation

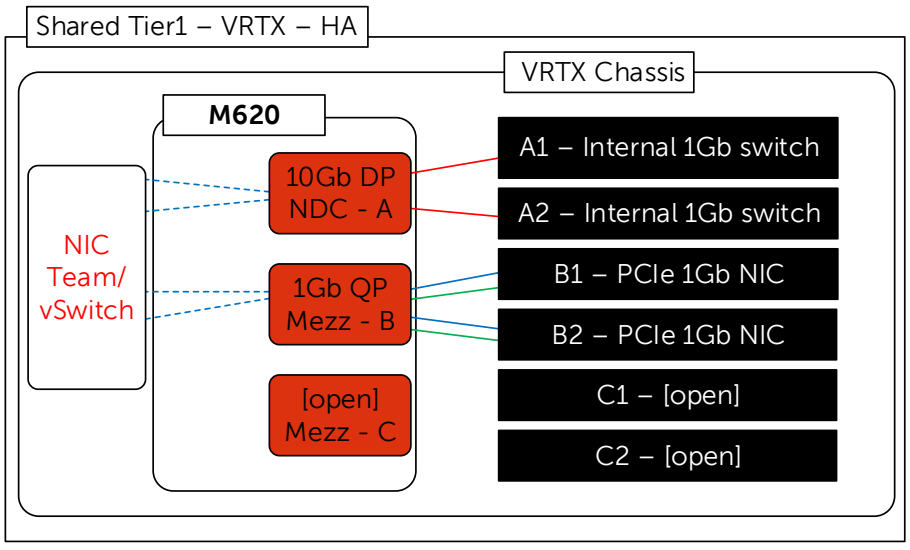


Figure 4 Logical cabling representation

3.3 Server configuration

The PowerEdge M620 is a feature-rich, dual-processor, half-height blade server which offers a blend of density, performance, efficiency and scalability. The M620 offers remarkable computational density, scaling up to 24 cores, 2 socket Intel Xeon processors and 24 DIMMs (768GB RAM) of DDR3 memory in an extremely compact half-height blade form factor.

Care has been taken to optimize the server platform for VMware Horizon View specifically. CPU is very important in VDI environments and is ultimately the key limiting factor in compute hosts in all scenarios. The more CPU performance you have available, the more users you can host on a single server, generally speaking.

3.4 Optional networking

3.4.1 Force10 S55 ToR switch

The Dell Force10 S-Series S55 1/10 GbE ToR switch is optimized for lowering operational costs while increasing scalability and improving manageability at the network edge. Optimized for high-performance data center applications, the S55 is recommended for Dell Wyse Datacenter deployments of 6000 users or less and leverages a non-blocking architecture that delivers line-rate, low-latency L2 and L3 switching to eliminate network bottlenecks. The high-density S55 design provides 48 GbE access ports with up to four modular 10 GbE uplinks in just 1-RU to conserve valuable rack space. The S55 incorporates multiple architectural features that optimize data center network efficiency and reliability, including IO panel to PSU airflow or PSU to IO panel airflow for hot/cold aisle environments, and redundant, hot-swappable power supplies and fans. A "scale-as-you-grow" ToR solution that is simple to deploy and manage, up to 8 Sx 55 switches can be stacked to create a single logical switch by utilizing Dell Force10's stacking technology and high-speed stacking modules.

The Force10 S55 switch features 44 BaseT 10/100/1000 + 4 SFP ports. Options available are: Redundant power supply units, 4 x 1 Gb SFP ports (copper or fiber), 12 Gb or 24 Gb stacking modules (up to 8 switches), and 2 x modular slots for 10 Gb uplinks or stacking modules.

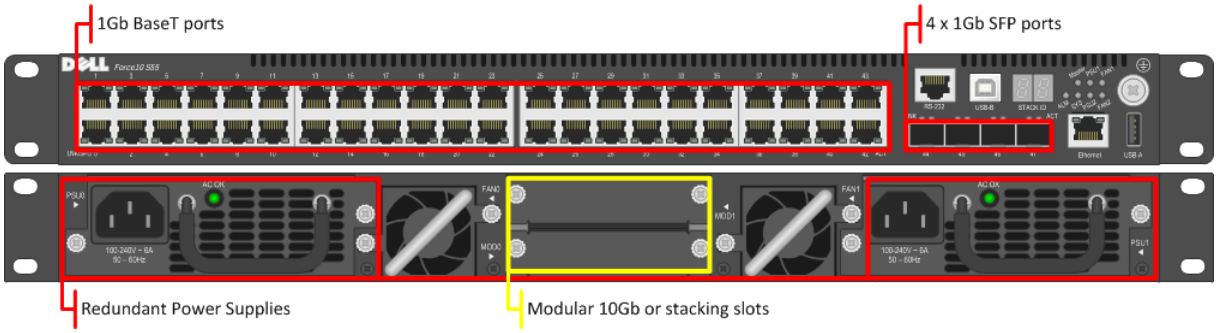


Figure 5 Force10 S55 switch front and rear views

Guidance:

- 10 Gb uplinks to a core or distribution switch are the preferred design choice using the rear 10 Gb uplink modules. If 10 Gb to a core or distribution switch is unavailable the front 4 x 1 Gb 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 http://www.dell.com/us/enterprise/p/force10-s55/pd

Force10 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. The best practice for switch stacks greater than 2 is to cable in a ring configuration with the last switch in the stack cabled back to the first. Uplinks need to be configured on all switches in the stack back to the core to provide redundancy and failure protection. For additional guidance, specifics, and best practices when stacking these switches, please refer to the white paper located here: http://www.force10networks.com/CSPortal20/KnowledgeBase/DOCUMENTATION/InstallGuidesQuickrefs/S-Series/S55_Installation_20-Oct-2011.pdf

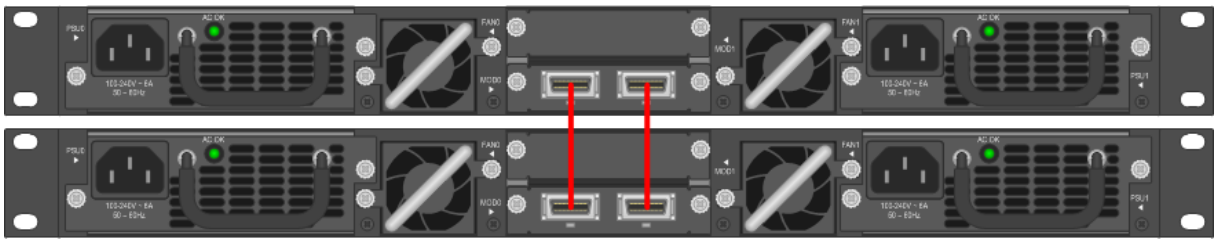


Figure 6 Stacking ports on the Force10 S55

3.5 Dell Wyse Cloud Clients

The following Dell Wyse Cloud Clients are the recommended choices for this solution.

3.5.1 Dell Wyse P25

Experience uncompromised computing with the benefits of secure, centralized management. The Dell Wyse P25 PCoIP zero client for VMware View is a secure, easily managed zero client that provides outstanding graphics performance for advanced applications such as CAD, 3D solids modeling, video editing and advanced worker-level office productivity applications. Smaller than a typical notebook, this dedicated zero client is designed specifically for VMware View. It features the latest processor technology from Teradici to process the PCoIP protocol in silicon, and includes client-side content caching to deliver the highest level of performance available over 2 HD displays in an extremely compact, energy-efficient form factor. The Dell Wyse P25 delivers a rich user experience while resolving the challenges of provisioning, managing, maintaining and securing enterprise desktops.

3.5.2 Dell Wyse P45

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3.5.3 Dell Wyse Z50D

Designed for power users, the Dell Wyse X50D is the highest performing thin client on the market. Highly secure and ultra-powerful, the X50D combines Dell Wyse-enhanced SUSE Linux Enterprise with dual-core AMD 1.65 GHz processor and a revolutionary unified engine for an unprecedented user experience. The Z50D eliminates performance constraints for high-end, processing-intensive applications like computer-aided design, multimedia, HD video and 3D modelling

3.5.4 Dell Wyse Z90D

This is super high performance Windows Embedded Standard 7 thin client for virtual desktop environments. Featuring a dual core AMD processor and a revolutionary unified engine that eliminates performance constraints, the Z90D7 achieves incredible speed and power for the most demanding embedded windows applications, rich graphics and HD video. With touch screen capable displays, the Z90D7 adds the ease of an intuitive multi touch user experience and is an ideal thin client for the most demanding virtual desktop workload applications.

3.5.5 Dell Wyse D10DP

The Dell Wyse D10DP is a high-performance and secure ThinOS 8 thin client that is absolutely virus and malware immune. Combining the performance of a dual core AMD G-Series APU with an integrated

graphics engine and ThinOS, the D10DP offers exceptional thin client PCoIP processing performance for VMware Horizon View environments that handles demanding multimedia apps with ease and delivers brilliant graphics. Powerful, compact and extremely energy efficient, the D10DP is a great VDI end point for organizations that need high-end performance but face potential budget limitations.

4 Software components

4.1 VMware vSphere 5.1

VMware vSphere 5.1 includes the ESXi hypervisor as well as vCenter Server which is used to configure and manage VMware hosts. Key capabilities for the ESXi Enterprise Plus license level include:

- VMware vMotion - VMware vMotion technology provides real-time migration of running virtual machines from one host to another with no disruption or downtime.
- VMware High Availability (HA) - VMware HA provides high availability at the virtual machine (VM) level. Upon host failure, VMware HA automatically restarts VMs on other physical hosts running ESXi. VMware vSphere 5.1 uses Fault Domain Manager (FDM) for High Availability.
- VMware Distributed Resource Scheduler (DRS) and VMware Distributed Power Management (DPM) - VMware DRS technology enables vMotion to automatically achieve load balancing according to resource requirements. When VMs in a DRS cluster need fewer resources, such as during nights and weekends, DPM consolidates workloads onto fewer hosts and powers off the rest to reduce power consumption.
- vSphere Storage DRS and Profile-Driven Storage - New integration with VMware vCloud Director enables further storage efficiencies and automation in a private cloud environment.
- VMware Storage vMotion - VMware Storage vMotion enables real-time migration of running VM disks from one storage array to another with no disruption or downtime. It minimizes service disruptions due to planned storage downtime previously incurred for rebalancing or retiring storage arrays.
- Space Efficient Sparse Virtual Disks - SE Sparse Disks introduces an automated mechanism for reclaiming stranded space. SE Sparse disks also have a new configurable block allocation size which can be tuned to the recommendations of the storage arrays vendor, or indeed the applications running inside of the Guest OS. VMware Horizon View 5.3 is the only product that will use the new SE Sparse Disk in vSphere 5.1.
- VMware vCenter Update Manager - VMware vCenter Update Manager automates patch management, enforcing compliance to patch standards for VMware ESXi hosts.
- Host Profiles - Host Profiles standardize and simplify the deployment and management of VMware ESXi host configurations. They capture and store validated configuration information, including host compliance, networking, storage, and security settings.
- vSphere Web Client - The vSphere Web Client is now the core administrative interface for vSphere. This new flexible, robust interface simplifies vSphere control through shortcut navigation, custom tagging, enhanced scalability, and the ability to manage from anywhere with Internet Explorer or Firefox-enabled devices.
- vCenter Single Sign-On - Dramatically simplify vSphere administration by allowing users to log in once to access all instances or layers of vCenter without the need for further authentication.

For more information on VMware vSphere, please visit: www.vmware.com/products/vsphere.

4.2 VMware Horizon View 5.3

VMware Horizon View 5.3 is a desktop virtualization solution that delivers virtual desktops as an on-demand service to any user, anywhere. With VMware's desktop delivery technology, Horizon View 5.3 can quickly and securely deliver individual applications or complete desktops to the entire enterprise, whether they are task workers, knowledge workers or mobile workers. Users now have the flexibility to access their desktop on any device, anytime, with a high-definition user experience. With VMware Horizon View 5.3, IT can manage single instances of each OS, application and user profile and dynamically assemble them to increase business agility and greatly simplify desktop management.

4.3 Summary of VMware Horizon View 5.3 features

End User Experience

- Support for Windows 8, 8.1 and Windows Server 2008 R2 based desktops
  - View 5.3 offers support for Windows 8, 8.1 and Windows Server 2008 R2 desktops
  - Facilitates a smooth transition in rolling out Windows 8, 8.1 and Windows Server 2008 R2
  - Enables IT to leverage the latest Windows capabilities in VDI

Hardware Accelerated 3D Graphics

- Horizon View 5.3 provides a rich workstation class user experience with high performance graphics
  - Enables shared-access to physical GPU hardware for 3D and high performance graphical workloads
  - Very cost effective as multiple VMs share the same GPU resource
  - Offers full compatibility with hosts lacking physical GPUs

Improved Video and VOIP communications with Microsoft Lync 2013 support

- View 5.3 offers tighter integration with Microsoft Lync and Office applications
  - Full collaboration capabilities with Microsoft Lync on View Desktops
  - Full support for Unified Communications VoIP and Video using Lync client on View desktops
  - Support PCoIP

Streamlined access to View Desktops from Horizon

- View desktops can now be accessed via Horizon gateway
  - Horizon provides a single point of access for end users to desktops, data and apps
  - This provides a one-stop shop for all end-user access to their corporate workloads

Easily connect to desktops from any device with HTML Access

- View Desktops can now be accessed through a HTML5 capable web browser via Horizon

- This provides install-free access to Desktops from ANY modern device

Ease of Management

- Large Pool creation with elimination of 8 host limits and multiple vLAN support
  - View 5.3 has support for large View pools with more than 8 hosts
  - This offers OPEX savings with less admin time spent on common operations
  - Even more OPEX savings with fewer pools to manage in multi-thousand user deployments
- Tech Preview of a new Integrated Service Console in the VC Web Client
  - View 5.3offers a View plugin into vSphere Web client
  - Allows for easier desktop support and troubleshooting
  - Offers a simple interface for novice administrative users which allows for increased efficiency
- Support for VC Virtual Appliance based deployments
  - View 5.3 is fully compatible with Virtual Appliance-based VirtualCenter deployments
  - This eliminates VirtualCenter dependencies on Windows
  - Easier installation and upgrades

Total Cost of Ownership

- Substantial storage capacity savings for persistent desktops with Space Efficient Disks
  - View 5.3 leverages a vSphere capability to offer a new disk format for VMs on VMFS or NFS
  - Space Efficient disks provide reduced storage capacity requirements (lower CAPEX) for persistent desktops
  - Unused space is reclaimed and View composer desktops stay small
  - IO alignment and grain size - Space Efficient disks guarantee that there will be no misalignment on storage arrays that are 4k aligned

4.4 SQL Databases

The VMware databases will be hosted by a single dedicated SQL 2008 R2 Server VM in the Management layer, in base form. Care should be taken during database setup to ensure that SQL data, logs, and TempDB are properly separated onto their respective volumes. Create all databases that will be required for:

- VMware vCenter
- VMware View Composer
- vCenter Update Manager (optional)

Initial placement of all databases into a single SQL instance is fine unless performance becomes an issue, in which case database should be separated into separate named instances. Enable auto-growth for each DB. See evolutionary section below for more information.

Best practices defined by VMware for View should be adhered to, to ensure optimal database performance.

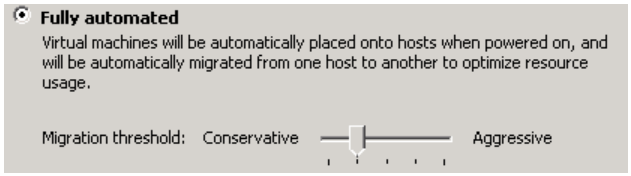
4.5 DNS

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 VMware 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 should be adhered to.

To plan for eventual scaling, access to components that may live on one or more servers (SQL databases, View infrastructure services) 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.

4.6 HA DRS – Load balancing – DNS

DRS provides the ability for automated VM placement within the cluster when it is powered on. DRS can be optionally used on the Compute layer set to Fully Automated with a Conservative migration threshold set. Affinity rules should be used on the Management servers to ensure that View broker roles are properly distributed.



The vSwitch that carries management traffic will need to be modified to add a Virtual Switch kernel port for VMotion on both Management hosts. The VLAN used for VMotion should be private (non-routable) and only accessible to each host in the cluster. The physical adapters in the vSwitch should be separated between SC/VMotion ports but configured to provide failover for each other. This can be achieved by specifying an explicit failover order.

5 Solution architecture for VMware Horizon View 5.3

5.1 vSphere

5.1.1 Compute + Management server infrastructure

The Dell Wyse Datacenter ROBO solution using VRTX consists of 2 or 4 nodes, clustered, sharing both management and VDI session hosting responsibilities across all available nodes. Please note that the PCIe mezzanine cards for the B and C fabrics are included in the M620 for VRTX. These cards must not be replaced for Ethernet or FC variants, only the prepopulated PCIe mezzanine cards are supported. The M620 blade server for VRTX is configured with the following specifications for vSphere.

Shared Tier 1 Compute + Mgmt. Host – PowerEdge M620
2 x Intel Xeon E5-2690v2 Processor (3Ghz)
256GB Memory (16 x 16GB DIMMs @ 1600Mhz)
VMware vSphere on 2 x 1GB internal SD
Broadcom 57810-k 1Gb/ 10Gb DP KR NDC
PCIe mezzanine cards for fabric B and C (included)
iDRAC7 Enterprise w/ vFlash, 8GB SD

The Management role requirements for the base solution are summarized below. Use data disks for role-specific application files and data such as, logs and IIS web files in the Management volume.

Two management role VMs at a minimum are required to support a VMware Horizon View environment on VRTX and should be spread amongst the available nodes. The values represented below are suggested based on our testing and validation. These should be adjusted as appropriate:

Role	vCPU	vRAM (GB)	vRAM Reservation	NIC	OS + Data vDisk (GB)	Tier 2 Volume (GB)
Connection Server + FileServer	2	8	4	1	40 + 10	2048
SQL + vCenter	2	8	4	1	40 + 10	50

The virtual desktop configuration based on workload type is summarized below and should be adjusted as appropriate:

User Type	vCPU	vRAM (GB)	vRAM Reservation	NIC	OS + Data vDisk (GB)
Standard	1	2	1	1	40
Enhanced	2	3	1.5	1	40
Professional	2	4	2	1	40

5.1.2 Storage architecture overview

The VRTX chassis contains up to 25 available 2.5" SAS disks to be shared with each server blade in the cluster.

Solution Model	Features	Tier 1 Storage (VDI disks)	Tier Storage (mgmt. + user data)
2 Blade	Up to 280 desktops	10 x 300GB 2.5" 15K SAS	5 x 900GB 2.5" 10K SAS
4 Blade	Up to 560 desktops	20 x 300GB 2.5" 15K SAS	5 x 900GB 2.5" 10K SAS

VRTX solution volume configuration:

Volumes	Size (GB)	RAID	Disk Pool	Purpose	File System
VDI	1024	10	Tier 1	VDI Desktops	VMFS
Management	200	5 or 6	Tier 2	vCenter, View Connection Server, File and SQL	VMFS
User Data	2048	5 or 6	Tier 2	File Server	VMFS
User Profiles	20	5 or 6	Tier 2	User profiles	VMFS
SQL DATA	100	5 or 6	Tier 2	SQL	VMFS
SQL LOGS	100	5 or 6	Tier 2	SQL	VMFS
TempDB Data	5	5 or 6	Tier 2	SQL	VMFS
TempDB Logs	5	5 or 6	Tier 2	SQL	VMFS
Templates/ ISO	200	5 or 6	Tier 2	ISO storage (optional)	VMFS

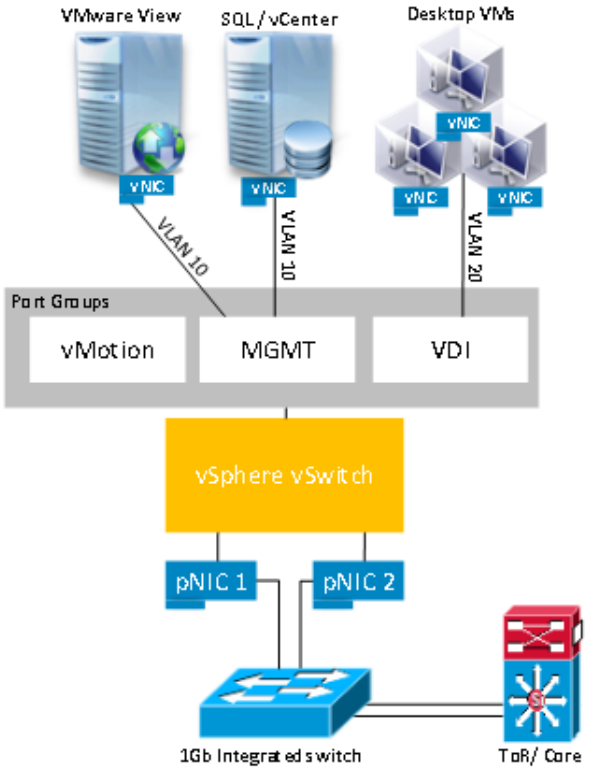
5.1.3 Virtual networking

The vSphere configuration utilizes the built-in vSwitch capabilities of ESXi to load balance and provide resiliency for network connections. One consolidated vSwitch should be configured for use by both the desktop VMs and ESXi management. The following outlines the recommended VLANs for use in the solution:

- Compute + Management hosts
  - Management VLAN: Configured for hypervisor and broker management traffic – L3 routed via core switch
  - VDI VLAN: Configured for VDI session traffic – L3 routed via core switch
  - Live Migration VLAN: Configured for Live Migration traffic – L2 switched only, trunked from Core

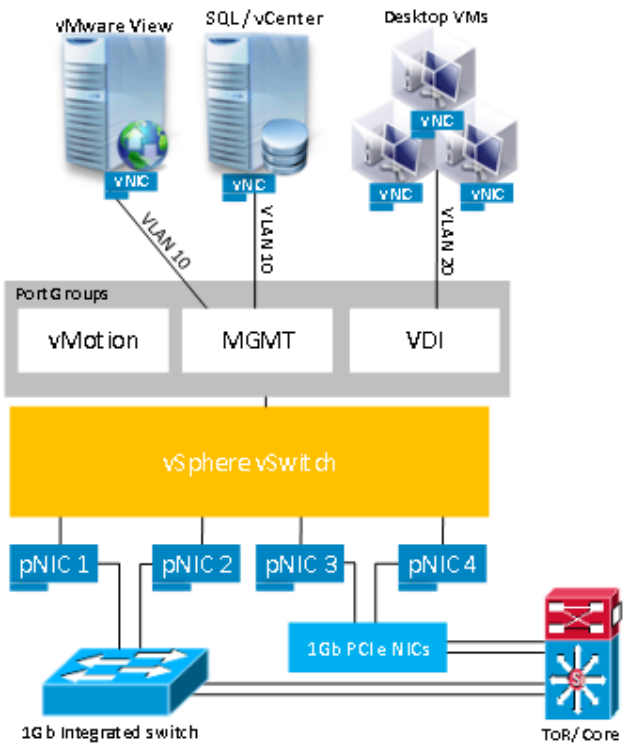
- An optional iDRAC VLAN should be configured for the VRTX iDRAC traffic – L3 routed via core switch

Per host ESXi vSwitch configuration:

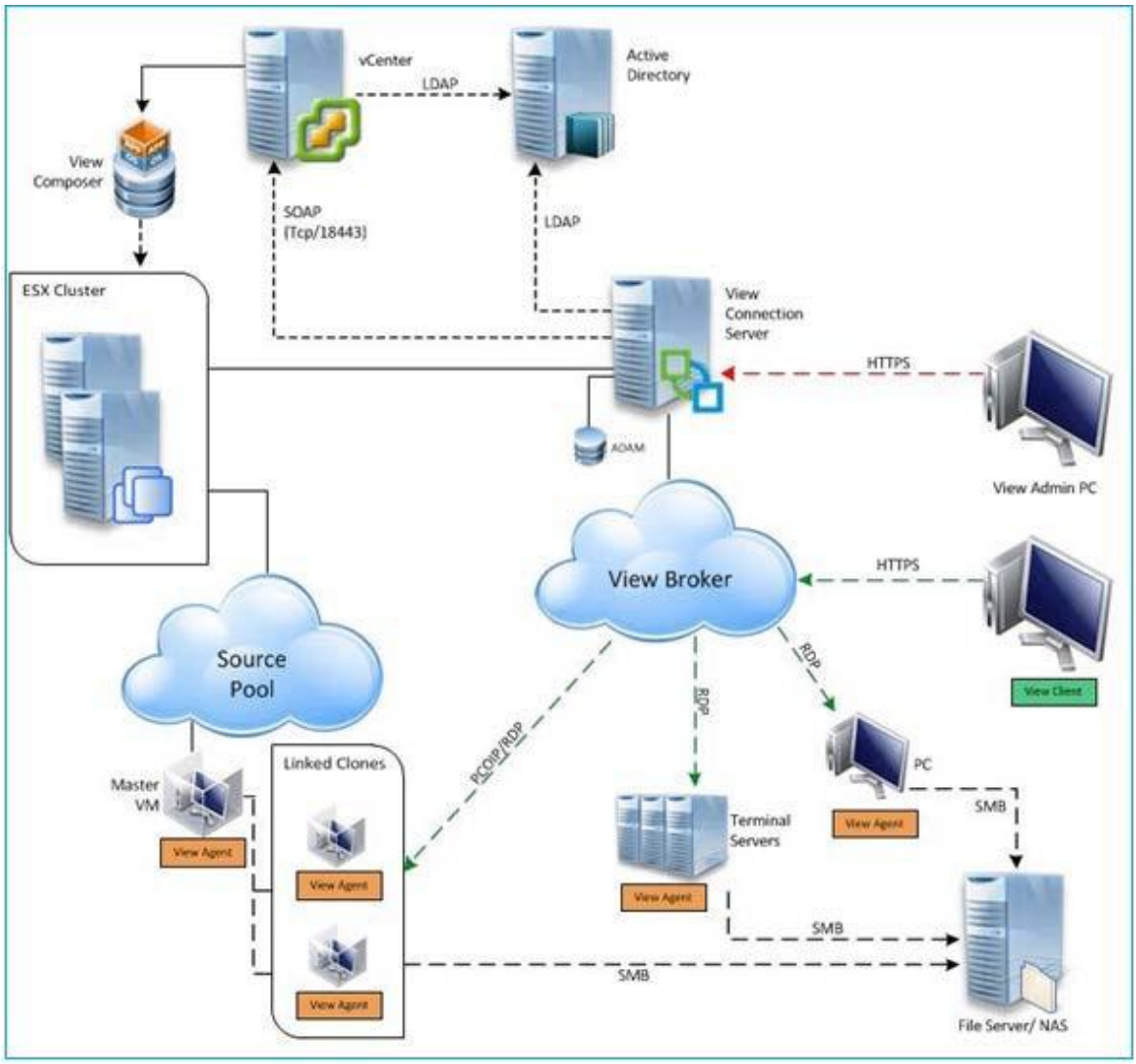


5.1.3.1 Virtual networking HA

As discussed in section 3.2.1 above, additional bandwidth and redundancy can be achieved by adding NICs to both the VRTX chassis as well as the B fabric of each M620 blade. These additional NICs in each blade can then be added to the NIC team, providing 4 total interfaces for failover and traffic load balancing across 2 physical external sets of interfaces.


vMware View
SQL / vCenter
Desktop VMs
VNIC
VNIC
VNIC
VNIC
VNIC
VNIC
VLAN 10
VLAN 10
VLAN 20
Port Groups
vMotion
MGMT
VDI
vSphere vSwitch
pNIC 1
pNIC 2
pNIC 3
pNIC 4
1Gb PCIe NICs
1Gb Integrated switch
ToR/ Core

5.1.4 VMware Horizon View communication flow



6 Solution performance testing

6.1 Load generation and monitoring

6.1.1 Login VSI – Login Consultants

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

6.1.2 Liquidware Labs Stratusphere UX

Stratusphere UX was used during each test run to gather data relating to user experience and desktop performance. Data was gathered at the host and virtual machine layers and reported back to a central server (Stratusphere Hub). The hub was then used to create a series of comma separated values (.csv) reports which have then been used to generate graphs and summary tables of key information. In addition the Stratusphere Hub generates a magic quadrant style scatter plot showing the Machine and IO experience of the sessions. The Stratusphere hub was deployed onto the core network therefore its monitoring did not impact the servers being tested. This core network represents an existing customer environment and also includes the following services: Active Directory, DHCP, DNS, and Anti-virus.

Stratusphere UX calculates the user experience by monitoring key metrics within the virtual desktop environment, the metrics and their thresholds are shown in the following screen shot:

Machine Experience Indicators

	Weight (%)	Good		Fair		Poor	
Login Delay : Time it takes to login (sec.) ?	20	0 <=	15	<=	60	<=	unbounded
Application Load Time : Avg. startup time for applications (sec.) ?	20	0 <=	10	<=	30	<=	unbounded
CPU Queue Length : Length of CPU queue at inspection time ?	20	0 <=	3	<=	6	<=	unbounded
Page Faults : Number of page faults during inspection interval ?	20	0 <=	2,000	<=	10,000	<=	unbounded
Non-Responding Applications : Number of unresponsive applications at inspection time ?	20	0 <=	2	<=	3	<=	unbounded

I/O Experience Indicators

	Weight (%)	Good		Fair		Poor	
Disk Load : Avg. disk IO per second ?	25	0 <=	25	<=	75	<=	unbounded
Disk Queue Length : Avg. length of disk queue(s) ?	25	0 <=	1	<=	3	<=	unbounded
Network Latency : Avg. network roundtrip time (ms) ?	25	0 <=	150	<=	300	<=	unbounded
Failed Connections : Number of outgoing connection attempts that failed ?	25	0 <=	5	<=	15	<=	unbounded

6.1.3 VMware vCenter

VMware vCenter has been used for VMware vSphere-based solutions to gather key data (CPU, memory and network usage) from each of the desktop hosts during each test run. This data was exported to .csv files for each host and then consolidated to show data from all hosts. While the report does not include specific performance metrics for the management host servers, these servers were monitored during testing and were seen to be performing at an expected performance level.

6.2 Testing and validation

6.2.1 Testing process

The purpose of the single server testing is to validate the architectural assumptions made around the server stack. Each user load is tested against 4 runs. A pilot run to validate that the infrastructure is functioning and valid data can be captured and 3 subsequent runs allowing correlation of data. Summary of the test results will be listed out in the below mentioned tabular format.

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.

Login VSI has two modes for launching user's sessions;

- **Parallel** - Sessions are launched from multiple launcher hosts in a round robin fashion; this mode is recommended by Login Consultants when running tests against multiple host servers. In parallel mode the VSI console is configured to launch a number of sessions over a specified time period (specified in seconds)
- **Sequential** - Sessions are launched from each launcher host in sequence; sessions are only started from a second host once all sessions have been launched on the first host- this is repeated for each launcher host. Sequential launching is recommended by Login Consultants when testing a single desktop host server. The VSI console is configured to launch a specific number of session at a specified interval specified in seconds

All test runs which involved the 6 desktop hosts were conducted using the Login VSI "Parallel Launch" mode, all sessions were launched over an hour to try and represent the typical 9am logon storm. Once the last user session has connected, the sessions are left to run for 15 minutes prior to the sessions being instructed to logout at the end of the current task sequence, this allows every user to complete a minimum of two task sequences within the run before logging out. The single server test runs were configured to launch user sessions every 60 seconds, as with the full bundle test runs sessions were left to run for 15 minutes after the last user connected prior to the sessions being instructed to log out.

7 End user workload characterization

7.1 Workload characterization overview

7.1.1 Standard workload characterization

The Standard User workload profile consists of simple task worker workloads. Typically a repetitive application use profile with a non-personalized virtual desktop image. Sample use cases may be a kiosk or call-center use cases which do not require a personalized desktop environment and the application stack is static. In a virtual desktop environment the image is dynamically created from a template for each user and returned to the desktop pool for reuse by other users. The workload requirements for a basic user is the lowest in terms of CPU, memory, network and Disk I/O requirements and will allow the greatest density and scalability of the infrastructure.

7.1.2 Enhanced workload characterization

The Enhanced User workload profile consists of email, typical office productivity applications and web browsing for research/training. There is minimal image personalization required in a standard user workload profile. The workload requirement for a Standard User is moderate and most closely matches the majority of office worker profiles in terms of CPU, memory, network and Disk I/O. This will allow moderate density and scalability of the infrastructure.

7.1.3 Professional workload characterization

The Professional User workload is an advanced knowledge worker. All office applications are configured and utilized. The user has moderate-to-large file size (access, save, transfer requirements). There is some graphics creation or editing done for presentations or content creation tasks. Web browsing use is typically research/training driven, similar to Standard Users. The Premium User requires extensive image personalization, for shortcuts, macros, menu layouts etc. The workload requirements for a Premium User are heavier than typical office workers in terms of CPU, memory, Network and Disk I/O. This will limit density and scalability of the infrastructure.

User Workload	VM vCPU	VM Memory	Approx. IOPs	VDI Session Disk Space	OS Image Notes
Standard	1	2 GB	3-4	3 GB	Task worker. Only 2 apps open simultaneously and session idle time is approx. 1 hour and 45 minutes
Enhanced	2	3 GB	5-6	3.75 GB	Medium knowledge worker. 5 apps open at a time and session idle time is approx. 45 seconds.
Professional	2	4 GB	7-8	6 GB	High level knowledge worker. 8 apps open at once, and session idle time is approx. 2 minutes

7.1.4 Workload characterization testing details

User Workload	VM Memory	OS Image	Workload Description
Standard	2GB	Shared	This workload emulates a task worker. • The light workload is very light in comparison to medium. • Only 2 apps are open simultaneously. • Only apps used are IE, Word and Outlook. • Idle time total is about 1:45 minutes
Enhanced	3GB	Shared	This workload emulates a medium knowledge working using Office, IE and PDF. • Once a session has been started the medium workload will repeat every 12 minutes. • During each loop the response time is measured every 2 minutes. • The medium workload opens up to 5 apps simultaneously. • The type rate is 160 ms for each character. • Approximately 2 minutes of idle time is included to simulate real-world users. Each loop will open and use: • Outlook 2010, browse 10 messages. • Internet Explorer, one instance is left open (BBC.co.uk), one instance is browsed to Wired.com, Lonelyplanet.com and heavy flash app gettheglass.com. • Word 2010, one instance to measure response time, one instance to review and edit document. • Bullzip PDF Printer & Acrobat Reader, the word document is printed and reviewed to PDF. • Excel 2010, a very large randomized sheet is opened. • PowerPoint 2010, a presentation is reviewed and edited. • 7-zip: using the command line version the output of the session is zipped.
Professional	4GB	Shared plus Profile Virt, *or*, Private	The heavy workload is based on the standard workload; the differences in comparison to the standard workload are: • Type rate is 130 ms per character. • Idle time total is only 40 seconds. • The heavy workload opens up to 8 apps simultaneously

7.2 Test results summary

This validation was performed for VMware View 5.3 delivering VDI desktops on 4 x M620 servers in a VRTX Chassis, running VMware ESXi 5.1 Update 1 with 256 GB RAM (1600 MHz) and dual 3.0 GHz Ivy Bridge E5-2690v2 processors. Validation was performed using Dell Wyse Solutions Engineering standard testing methodology using LoginVSI load generation tool for VDI benchmarking that simulates production user workloads. The management layer of the VDI stack was configured on the same hosts as the VDI desktops in order to minimize footprint and provide a self-contained solution, with the exception of basic networking services such as AD, DNS, and DHCP. To minimize the resources devoted to management, the Management roles were combined in the following configuration:

- 1 VM, 2 vCPU and 8 GB RAM for View Connection Server and FileServer
- 1 VM, 2 vCPU and 8 GB RAM for VMware vCenter 5.1 Update 1 and Microsoft SQL Server 2008 R2.

The VRTX chassis also provided the storage for the solution in its Shared PERC 8 enclosure with Tier 1 consisting of 20 x 300GB 15K SAS drives in RAID 10 and Tier 2 consisting of 5x 900 GB 10K SAS drives in RAID 5.

VMware Horizon View has configuration settings that control how many virtual desktops to be provisioned up-front or provisioned on demand. By default, the View Admin console uses provision all desktops up-front. Administrators may change this to suit their demand. In the case of this test, all desktops were provisioned up-front.

The test sequence follows three stages:

- Ramp-up phase – user sessions login gradually in 20 seconds intervals until the maximum number of sessions has been reached
- Steady-state phase – all sessions are logged in and running the planned workload continuously.
- Ramp-down phase – sessions are permitted to logoff when their planned activities are completed.

For the purpose of data collection the steady-state and ramp-down phases are set to predefined intervals or 60 minutes and 30 minutes respectively. Data collection begins with the ramp-up phase and continues until the predefined interval for ramp-down is elapsed.

In the following table, the Tier 1 IOPS data is measured during steady-state in order to better approximate real-world usage.

Tier 1 Read/Write Ratio	Tier 1 Total Ramp-up Phase IOPS	Tier 1 Ramp-up Phase IOPS per user	Tier 1 Total Steady State IOPS	Tier 1 Steady State IOPS per user
24/76	2297	4.10	2037	3.63

7.2.1 VMware ESX 5.1 Update 1

VMware ESXi 5.1 running on Ivy Bridge Processors provides a good user experience at a maximum 150 users per blade in the VRTX system (for reference). CPU Usage per blade remains below 90% during steady operations, and memory usage is within limits, especially considering that mgmt. VMs are also included. The IOPS on the Tier 1 storage were well within the limitations of the PERC adapter.

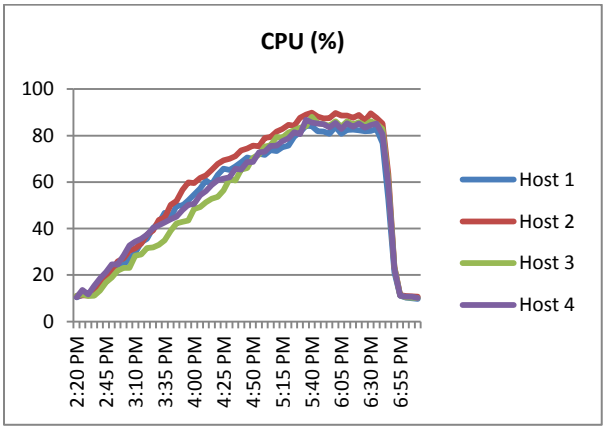
In this test the ramp-up phase was 186 minutes (560 sessions * 20 sec = 11200 sec = Approx. 186 min). The steady-state phase was defined as 60 minutes, and the ramp-down phase was defined as 30 minutes. This yields a total test duration of 276 minutes or 4 hours and 36 min.

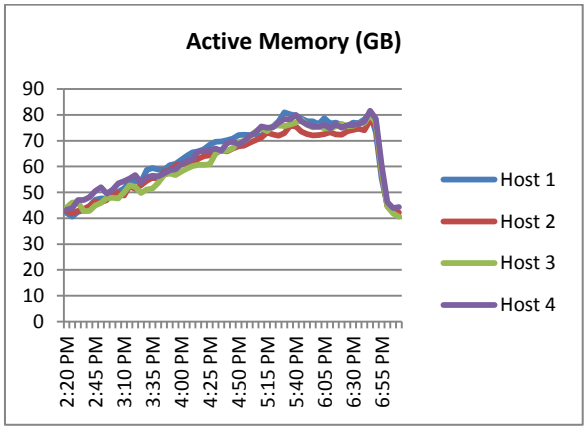
Phase durations (test started at 2:20 PM):

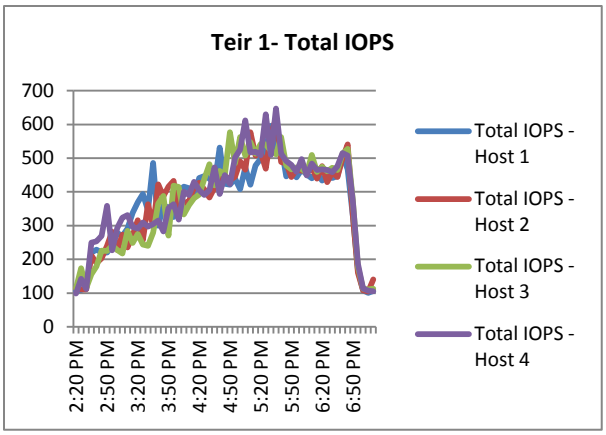
- Ramp-up: 2:20 PM to 5:26 PM
- Steady-state: 5:26 PM to 6:26 PM
- Ramp-down: 6:26 PM to 6:55 PM

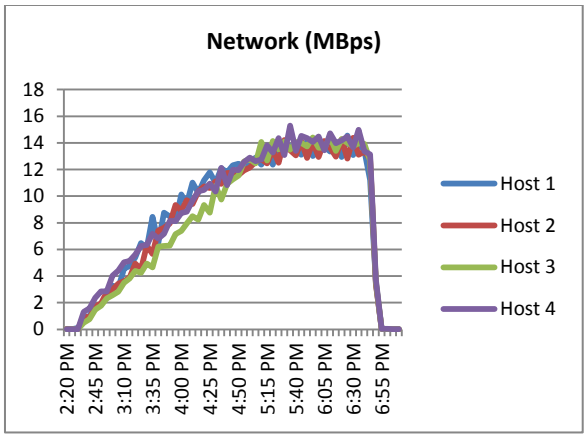
7.2.1.1 Standard user workload (560 users, 4 hosts)

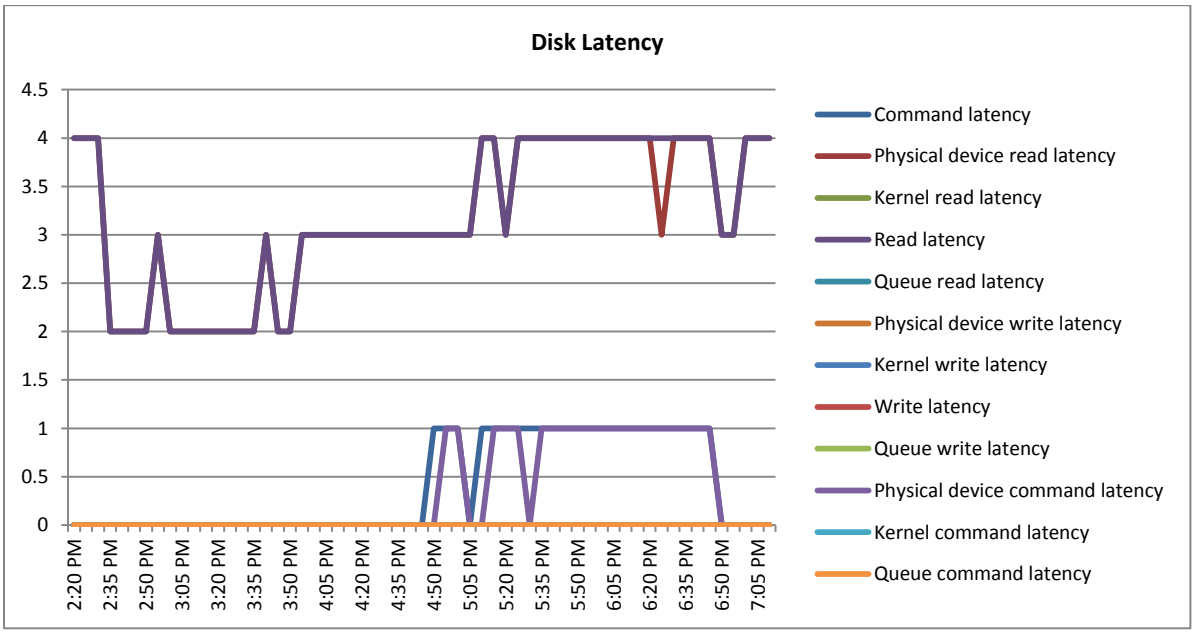
These graphs show CPU, memory, local disk IOPS, overall disk latency of VDI volumes, network and VDI UX scatter plot results.






Teir 1- Total IOPS
700
600
500
400
300
200
100
0
2:20 PM
2:50 PM
3:20 PM
3:50 PM
4:20 PM
4:50 PM
5:20 PM
5:50 PM
6:20 PM
6:50 PM
Total IOPS - Host 1
Total IOPS - Host 2
Total IOPS - Host 3
Total IOPS - Host 4


Network (MBps)
18
16
14
12
10
8
6
4
2
0
2:20 PM
2:45 PM
3:10 PM
3:35 PM
4:00 PM
4:25 PM
4:50 PM
5:15 PM
5:40 PM
6:05 PM
6:30 PM
6:55 PM
Host 1
Host 2
Host 3
Host 4


Disk Latency
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
2:20 PM
2:35 PM
2:50 PM
3:05 PM
3:20 PM
3:35 PM
3:50 PM
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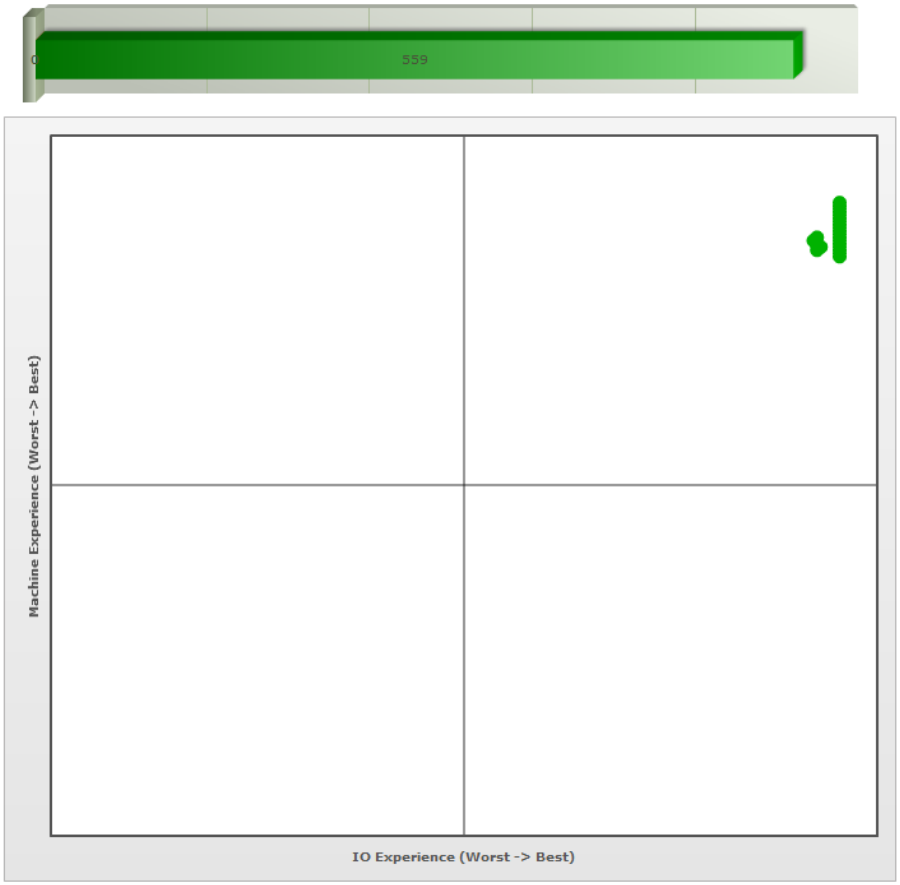
5:35 PM
5:50 PM
6:05 PM
6:20 PM
6:35 PM
6:50 PM
7:05 PM
Command latency
Physical device read latency
Kernel read latency
Read latency
Queue read latency
Physical device write latency
Kernel write latency
Write latency
Queue write latency
Physical device command latency
Kernel command latency
Queue command latency



7.2.2 Conclusion

Based on testing conducted, the impact on storage was found to be minimal. While evaluating the desktop density per server, we have found 20% Increase in density for each workload type compared to 2.9 GHz previous generation Sandy Bridge processors on compute host. It can be concluded on the basis of this testing that M620 with Ivy Bridge 3.0 GHz processors can support up to 140 Standard, 112 Enhanced and 90 Professional user with less than 90% CPU utilization and minimal impact on performance.

Solution Model	Features	Tier 1 Storage (VDI disks)	Tier Storage (user data)
2 Blade	Up to 280 desktops	10 x 300GB 2.5" 15K SAS	5 x 900GB 2.5" 10K SAS
4 Blade	Up to 560 desktops	20 x 300GB 2.5" 15K SAS	5 x 900GB 2.5" 10K SAS

User Workload	Maximum Users Per Physical Server
Standard User	140
Enhanced User	112