
DVS Enterprise with VMware Horizon View 5.2: Reference Architecture

Dell Desktop Virtualization Solutions (DVS) Engineering

Revision: v1.5



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1 Introduction

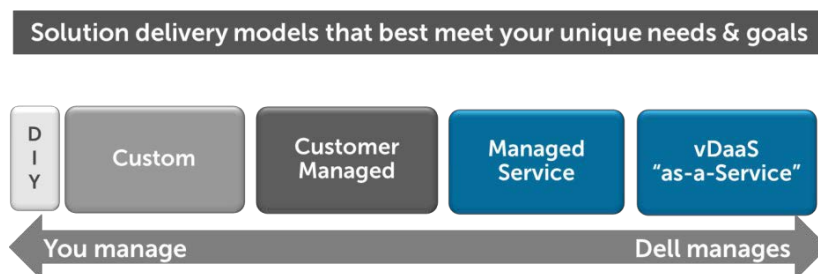
1.1 Desktop Virtualization Solutions Overview

Dell Desktop Virtualization Solutions' offers a comprehensive solution portfolio designed to deliver the benefits of virtual end user and Cloud Client Computing. While there are several ways of delivering virtual desktops, this solution is built on the Virtual Desktop Infrastructure (VDI) model. In a VDI environment, user desktops are hosted as virtual machines (VMs) in a centralized infrastructure and delivered over a network to an end user's client device.

Getting the most out of a VDI infrastructure requires a well-developed, reliable architecture. If the VDI architecture is undersized in terms of processing, memory or storage, then performance will suffer and the experience will be less user-friendly than a traditional PC. If the architecture is oversized, then the cost per virtual desktop will be economically unfeasible for VDI adoption.

In order to enable Dell to compete efficiently in the VDI space and to accelerate the sales cycle, a Solution Source Architecture (SSA) approach has been developed. Accelerate your time to benefit and increase your operating efficiency with this tested methodology.

Our extensively pre-tested Dell Desktop Virtualization Solutions leverage purpose built hardware, software and services ingredients to enable a "capable" architecture that maximizes IT control while enhancing the end user experience. Choose a clear path to flexible options, expedient upgrades and support through the solution life cycle with industry standard ingredients. Dell invests in extensive R&D and solution validation to ensure you experience a fine-tuned deployment process that leads to deterministic operational costs. And you can minimize your capital costs with Dell's subscription based Desktop- as-a-Service.



1.2 The DVS Enterprise Solution Today

Dell Desktop Virtualization Solutions deliver a range of purpose-built horizontal architectures. These architectures are designed and battle-tested to be modular and scalable for an array of your needs and a defined and tested services methodology. To provide a simplified solution stack we have designed and enhanced the original DVS Enterprise Solution to address the vast majority of your needs and use cases for Desktop Virtualization. Simultaneously, we have worked to make the solution easier to deploy and scale.

Initially there were the ISS Enterprise and ISS Enterprise+ bundles; both with strict guidelines and constraints on sizing and scaling. Subsequently, the DVS Enterprise solution has been refined and enhanced to be custom-tailored and sold as one cohesive stack known as DVS Enterprise. The solution now has the ability be sold initially as an entry level rack-based solution for as few as 50

users. Alternatively, the solution can either grow into, or be customized and sold as a highly scalable, blade-based solution serving 50,000 users or more.

The DVS Enterprise solution is an architecture incorporating a VMware vSphere hypervisor with a Horizon View 5.2 desktop virtualization solution. On top of this foundation runs Dell's core architecture components for networking, compute and storage designed from a tested and effective selection of ingredients.

1.3 Product Positioning

The Dell Desktop Virtualization Solution is a prescriptive, highly scalable, flexible architecture designed to meet the wide array of your VDI needs that exist today. The DVS Enterprise Solution has the ability to scale anywhere from 50 to 50000 users with a high degree of prescription at every user level along the way. This granularity of scale allows you to leverage Dell DVS's accurate pay-as-you-grow model and add VDI capability as their VDI needs increase.

	Minimum Base Configuration	Rack Server, Local Tier 1	Rack Server, Shared Tier 1	Blade Server, Shared Tier 1
Virtual Desktops	Yes	Yes	Yes	Yes
Redundancy	Optional	Yes	Yes	Yes
Recoverability	Optional	Yes	Yes	Yes
Live Migration	No	No	Yes	Yes
High Density	No	No	No	Yes

To provide this level of proven prescription, the DVS Enterprise leverages a core set of hardware and software components that have been tested and proven to provide optimal performance at the lowest cost per user. To provide this level of flexibility, the DVS Enterprise also includes an extended list of optional/upsell components that you can choose from for environments with unique VDI feature, scale or performance needs. Whether you require a Managed Solution from Dell or prefer to manage the solution in-house, the tenants of the DVS Enterprise Solution remain consistent and will be leveraged as the horizontal platform. If the various approved configurations do not meet your requirements then a custom solution can be provided.

1.4 Feature Overview

1.4.1 Design Principles

The design principles for the flexible computing solution are:

- Secure – Security risks, concerns and policies are addressed or mitigated
- Manageable – The solution includes the tools and software services required to manage the environment
- Standards-based – Makes use of commodity, off-the-shelf components wherever possible
- Distributed – Non-blocking and built with distributed components to maximize the use of available computing resources and eliminate bottlenecks
- Scalable – Capable of scaling up or down to support business needs
- Resilient – Capable of withstanding the failure of a single infrastructure component.

1.4.2 Architecture Scalability

The architecture is designed to provide a scalable platform:

- The components can be scaled either horizontally (by adding additional physical and virtual servers to the server pools) or vertically (by adding virtual resources to the infrastructure)
- The architecture eliminates bandwidth and performance bottlenecks as much as possible
- This scalability enables the reduction of the future cost of infrastructure ownership.

Component	Horizontal scalability	Vertical scalability
Virtual Desktop Compute Servers	Additional servers added as necessary.	Additional RAM or CPU compute power.
View Connection Servers	Additional physical servers added to the Management cluster to deal with additional management VMs.	Additional network and I/O capacity added to the servers.
VMware vCenter	Deploy additional servers and use linked mode to optimize management.	Additional vCenter Management VMs.
Database Services	Migrate databases to a dedicated SQL server and increase the number of management nodes.	Additional RAM and CPU for the management nodes.
File Services	Split user profiles and home directories between multiple file servers in the cluster. File services can also be migrated to the optional NAS device for high availability.	Additional RAM and CPU for the management nodes.

2 The DVS Enterprise Solution Architecture

2.1 Introduction

The DVS Enterprise Solution leverages a core set of hardware and software components in the following categories:

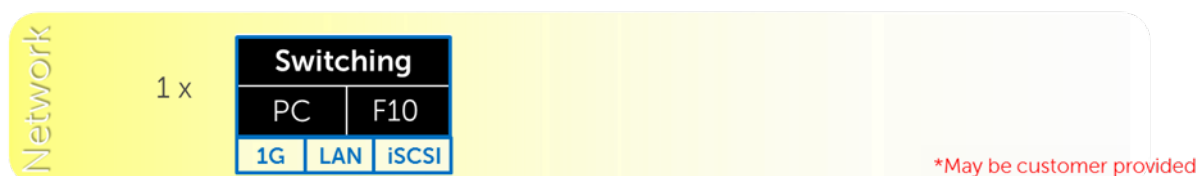
- Networking
- Virtualization Compute Servers
- Management Servers
- Storage Tiers

These components have been tested and proven to provide the optimal balance of high performance and lowest cost per user. Additionally, the DVS Enterprise also includes an approved extended list of optional/upsell components in all the same categories. This extended list of components you can choose from to custom tailor the solution for environments with unique VDI feature, scale or performance needs.

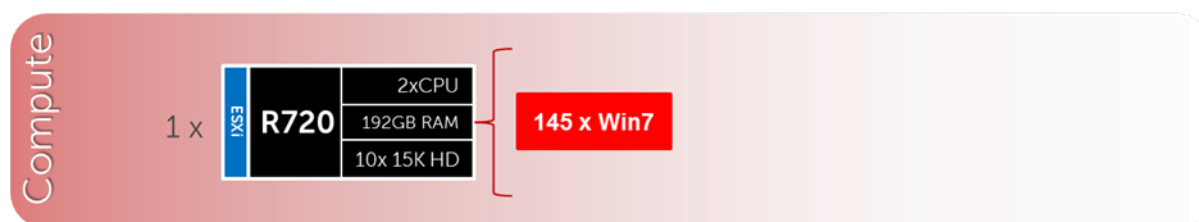
The Enterprise stack is designed to be a cost effective starting point when you want to start your transition to a fully virtualized desktop environment slowly, allowing you to grow the investment and commitment as needed or as you become comfortable with VDI as a solution.

2.2 DVS Enterprise Solution Layers

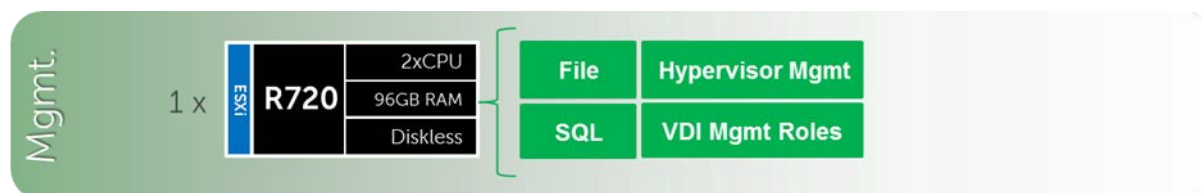
Only a single high performance PowerConnect or Force10 48-port switch is required to get started in the Network layer. This switch will host all solution traffic consisting of 1Gb iSCSI and LAN sources for smaller stacks. Above 1000 users we recommend that LAN and iSCSI traffic be separated into discrete switching fabrics. Additional switches can be added and stacked as required to provide High Availability for the Network layer.



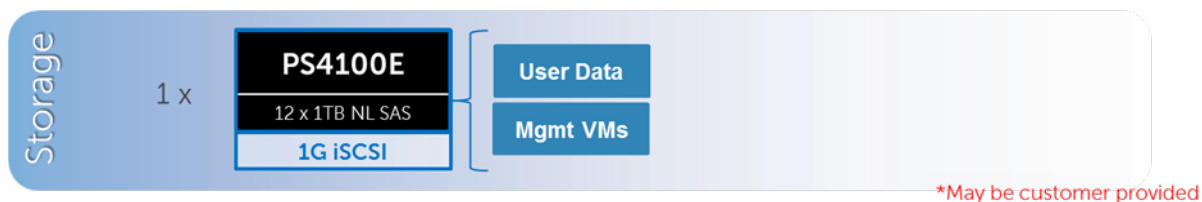
The Compute layer consists of the server resources responsible for hosting the user sessions.



VDI 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 VMs necessary to support the VDI infrastructure.



The Storage layer consists of options provided by EqualLogic for iSCSI and Compellent arrays for Fibre Channel to suit your tier 1 and tier 2 scaling and capacity needs.



3 VMware

3.1 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 (VM) 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 5.2 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, see www.vmware.com/products/vsphere.

3.2 VMware Horizon View 5.2

VMware Horizon View 5.2 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 5.2 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 5.2, 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.

3.3 Summary of Horizon View 5.2 Features

End User Experience

- Support for Windows 8 based desktops
 - View5.2 offers support for Windows 8 desktops.
 - Facilitates a smooth transition in rolling out Windows 8.
 - Enables IT to leverage the latest Windows capabilities in VDI

Hardware Accelerated 3D Graphics

- Horizon View5.2 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

- View5.2 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

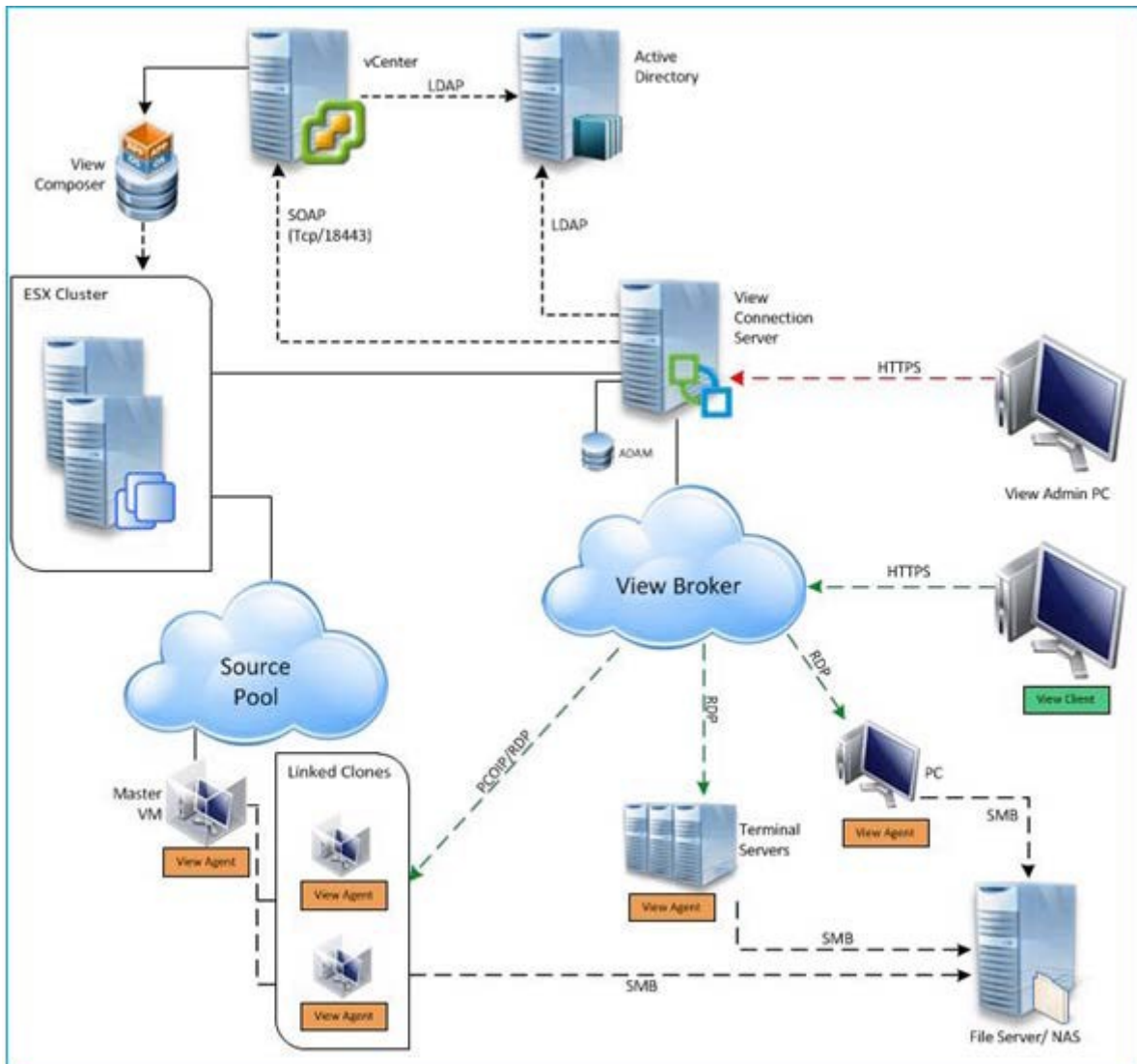
- Large Pool creation with elimination of 8 host limits and multiple vLAN support
 - View5.2 has support for large View pools with more than 8 hosts.
 - This offers OPEX savings with less admin time spent on common operations.
 - Even more OPEX savings with fewer pools to manage in multi-thousand user deployments.
- Tech Preview of a new Integrated Service Console in the VC Web Client
 - View5.2 offers 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
 - View5.2 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 5.2 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

3.4 VMware Horizon View 5.2 Infrastructure

VMware Horizon View 5.2 Infrastructure



The DVS Enterprise architecture with VMware Horizon View 5.2 is designed to provide maximum performance and scalability starting at very low user counts for SMBs and up to tens of thousands of users for large enterprise deployments. VMware Horizon View 5.2 brings with it many new features, as outlined above. This solution architecture follows a distributed model where solution components exist in tiers. The Compute tier is where VDI desktop VMs execute, the Mgmt tier being dedicated to the broker management server role VMs. Both tiers, while inextricably linked, scale independently.

4 Storage Infrastructure

The leading cause of slow end-user experience in a VDI deployment is inadequate or poorly designed storage architecture. From the moment a user authenticates into a VDI environment, multiple tiers of the VDI storage architecture are being accessed, sometimes heavily. It is this reason that if any element of a storage array; network interface, disk speed, disk type, disk quantity, free space, or similar, is not up to the task of supporting the workload associated with the user population, performance will suffer greatly and failures may occur. The DVS Enterprise solved these potential problems by providing storage options which exceed the performance and \$/user requirements and at the same time provide additional storage options to custom-tailor performance and capacity characteristics to your specific needs.

The DVS Enterprise leverages tiered storage architecture. The tier 2 storage model remains constant throughout the stack no matter what server or networking choices are made. When choosing a rack server-based DVS Enterprise solution stack however, the tier 1 model has two options to choose from;

- Local tier 1 storage for virtual desktop images
- Shared tier 1 storage for virtual desktop images

4.1 Storage Networking

The DVS Enterprise solution has greatly expanded tier 1 and tier 2 storage strategy and flexibility over prior releases. You have the choice to leverage best-of-breed iSCSI solutions from EqualLogic or Fibre Channel solutions from Dell Compellent while be assured the storage tiers of the DVS Enterprise solution will consistently meet or outperform user needs and expectations.

4.2 EqualLogic iSCSI

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

If iSCSI is the selected block storage protocol, then the Dell EqualLogic MPIO plugin is installed on all hosts that connect to iSCSI storage. This module is added via a command line using a Virtual Management Appliance (vMA) from VMware. This plugin allows for easy configuration of iSCSI on each host. The MPIO plugin allows the creation of new or access to existing data stores and handle IO load balancing. The plugin will also configure the optimal multi-pathing settings for the data stores as well. Some key settings that were used as part of the configuration:

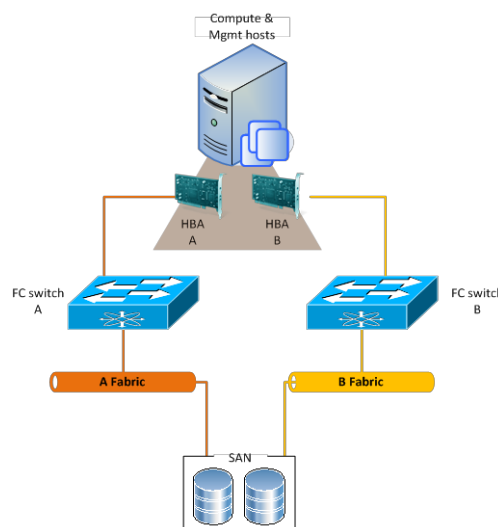
- Specify 2 IP Addresses for iSCSI on each host
- Specify NICs (vmnic2, vmnic3)
- Specify Jumbo Frames at 9000 MTU (Broadcom NICs cannot support both iSCSI offload and jumbo frames)
- Initialize iSCSI initiator
- Specify IP for the EqualLogic Storage group.

4.3 Compellent Fibre Channel

Based on Fluid Data architecture, the Dell Compellent Storage Center SAN provides built-in intelligence and automation to dynamically manage enterprise data throughout its lifecycle. Together, block-level intelligence, storage virtualization, integrated software and modular, platform-independent hardware enable exceptional efficiency, simplicity and security.

Storage Center actively manages data at a block level using real-time intelligence, providing fully virtualized storage at the disk level. Resources are pooled across the entire storage array. All virtual volumes are thin-provisioned. And with sub-LUN tiering, data is automatically moved between tiers and RAID levels based on actual use.

If Fibre Channel(FC) is the selected block storage protocol, then the Compellent Storage Center Integrations for the VMware vSphere client plug-in is installed on all hosts. This plugin enables all newly created data stores to be automatically aligned at the recommended 4MB offset. Although a single fabric can be configured to begin with, as a best practice recommendation, the environment should be configured with two fabrics to provide multi-pathing and end-to-end redundancy.

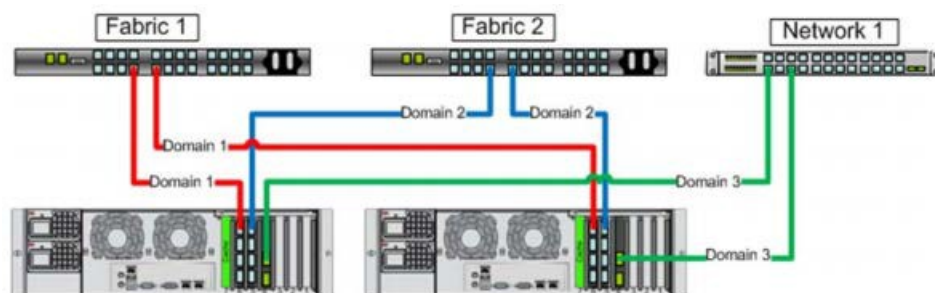


When using QLogic HBAs the following BIOS settings should be used:

- The "connection options" field should be set to 1 for point to point only
- The "login retry count" field should be set to 60 attempts
- The "port down retry" count field should be set to 60 attempts
- The "link down timeout" field should be set to 30 seconds.
- The "queue depth" (or "Execution Throttle") field should be set to 255.
- This queue depth can be set to 255 because the ESXi VMkernel driver module and DSNRO can more conveniently control the queue depth.

4.4 Zoning

At least 1 port from each server HBA should be zoned to communicate with a single Compellent fault domain. The result of this will be two distinct FC fabrics and four redundant paths per server. Round Robin or Fixed Paths are supported. Compellent Virtual Ports should be leveraged to minimize port consumption as well as simplify deployment. Each controller's front-end virtual ports within a fault domain should be zoned with at least one ESXi initiator per server.



4.5 Local Tier 1 Storage

Choosing the local tier 1 storage option means that the virtualization compute servers use ten (10) locally installed 146GB 15k drives to house the user desktop vDisk images. In this model, tier 1 storage exists as local hard disks on the compute hosts themselves. To achieve the required performance level, RAID 10 must be used across all local disks. A single volume per local tier 1 compute host is sufficient to host the provisioned desktop VMs along with their respective write caches.

4.6 Shared Tier 1 Storage

Choosing the shared tier 1 option means that the virtualization compute servers are deployed in a diskless mode and all leverage shared storage hosted on a high performance Dell storage array. In this model, shared storage will be leveraged for tier 1 used for VDI execution. Based on the heavy performance requirements of tier 1 VDI execution, it is recommended to use separate arrays for tier 1 and tier 2 above 500 users for EqualLogic and above 1000 users for Compellent. We recommend using 350GB LUNs for VDI and running 50 VMs per volume to minimize disk contention. Sizing to 1000 basic users, for example, we will require 20 x 350GB volumes per array. Each volume should contain a VMware Horizon View replica.

Volumes	Size (GB)	Storage Array	Purpose	File System
VDI-1	350	Tier 1	50 x desktop VMs + Replica	VMFS 5
VDI-2	350	Tier 1	50 x desktop VMs + Replica	VMFS 5
VDI-3	350	Tier 1	50 x desktop VMs + Replica	VMFS 5
VDI-4	350	Tier 1	50 x desktop VMs + Replica	VMFS 5
VDI-5	350	Tier 1	50 x desktop VMs + Replica	VMFS 5
VDI-6	350	Tier 1	50 x desktop VMs + Replica	VMFS 5
VDI-7	350	Tier 1	50 x desktop VMs + Replica	VMFS 5
VDI-8	350	Tier 1	50 x desktop VMs + Replica	VMFS 5
VDI-9	350	Tier 1	50 x desktop VMs + Replica	VMFS 5
VDI-10	350	Tier 1	50 x desktop VMs + Replica	VMFS 5

4.7 Shared Tier 2 Storage

Tier 2 is shared iSCSI storage used to host the Management server VMs and user data. EqualLogic 4100 series arrays can be used for smaller scale deployments (local tier 1 only) or the 6500 series for larger deployments (up to 16 in a group). The Compellent tier 2 array scales simply by adding disks. The table below outlines the volume requirements for tier 2. Larger disk sizes can be chosen to meet your capacity needs. The user data can be presented either via a file server VM using RDM for small scale deployments or via NAS for large scale deployments. This is the only native NTFS volume on the array. All SQL disks should be presented as VMDKs. RAID 50 can be used in smaller deployments but is not recommended for critical environments. Larger scale and mission critical deployments with higher performance requirements should use RAID 10 or RAID 6 to maximize performance and recoverability. The following depicts the component volumes required to support a 500 user environment. Additional Management volumes should be created as needed along with size adjustments as applicable for user data and profiles.

Volumes	Size (GB)	Storage Array	Purpose	File System
Management	350	Tier 2	vCenter, View Connection Server, File and SQL	VMFS 5
User Data	2048	Tier 2	File Server/ NAS	NTFS
User Profiles	20	Tier 2	User profiles	VMFS 5
SQL DATA	100	Tier 2	SQL	VMFS 5
SQL LOGS	100	Tier 2	SQL	VMFS 5
TempDB Data	5	Tier 2	SQL	VMFS 5
TempDB Logs	5	Tier 2	SQL	VMFS 5
SQL Witness	1	Tier 2	SQL (optional)	VMFS 5
Templates/ ISO	200	Tier 2	ISO storage (optional)	VMFS 5

5 Virtualization Compute Server Infrastructure

A major building block when designing a VDI solution is that of virtualization compute server. This building block is required in all implementations and the choice of server determines what loads can be supported and how agile the environment will be when meeting changing business needs. By offering a broad array of choices, Dell gives you the ability to select the specific platform that is right for your environment.

5.1 DVS Enterprise R720 Rack Compute Server

The DVS Enterprise beings with a minimum configuration design based on the R720 rack mounted server. This server is the gold standard and a core server component providing the best performance at the lowest dollar-per-user. However, just as when deciding on the optimal switching architecture, there are certain deployment use cases where an upgrade or change in the server architecture makes sense, either from a management, power consumption, end-user desktop performance, or user density perspective.



PowerEdge R720 Virtualization Host Server For Local Tier 1 Storage	PowerEdge R720 Virtualization Host Server for Shared Tier 1 Storage
2 x Intel Xeon E5-2680 Processor (2.9Ghz)	2 x Intel Xeon E5-2680 Processor (2.9Ghz)
192GB Memory (12 x 16GB DIMMs @ 1600Mhz)	192GB Memory (12 x 16GB DIMMs @ 1600Mhz)
10 x 146GB SAS 6Gbps 15k Disks	Diskless
PERC H710 Integrated RAID Controller – RAID10	Broadcom 57800 2 x 10Gb SFP+ + 2 x 1Gb NDC
Broadcom 5720 1Gb QP NDC (LAN)	1 x Broadcom 5720 1Gb DP NIC (LAN)
Broadcom 5720 1Gb DP NIC (LAN)	1 x Intel X520 2 x 10Gb SFP+ DP NIC (iSCSI)
iDRAC7 Enterprise w/ vFlash, 8GB SD	iDRAC7 Enterprise w/ vFlash, 8GB SD
2 x 750W PSUs	2 x 750W PSUs

In the above configuration, the R720-based DVS Enterprise Solution can also support the following single server user counts.

- Basic Workload: 145 Users
- Standard Workload: 116 Users
- Premium Workload: 95 Users

5.2 DVS Enterprise M620 Blade Compute Server

The Dell M1000e Blade Chassis along with the M620 blade server option can be considered the option of choice for a high-density data center configuration. Although configured similarly to the R720, the M620 server brings with it a host of ancillary benefits.

The 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 16 cores, with the introduction of the new Intel Xeon (Sandy Bridge-EP, EP-2600) 2 socket processors and 24 DIMMs (384GB+ RAM) of DDR3 memory in an extremely compact half-height blade form factor.

When comparing a rack versus blade VDI solution there are several considerations; while the initial acquisition costs are higher than comparable rack servers, blades use less power for the same amount of processing. In testing, Dell blades yield 20% more performance per watt or more compared to rack servers. They can be key elements for reducing ever-growing power costs and for implementing environmentally conscious IT initiatives.

A blade-based environment can help reduce total cost of ownership (TCO) with features such as power efficiency, built-in security and advanced systems management capabilities. Designed to handle memory-intensive applications, it is an ideal choice for virtualized workloads. Dell high-density blade solutions let you do more with less — more processing with less space and power, and with fewer resources. In the DVS Enterprise solution, the M620 compute server is configured as follows;

PowerEdge M620 Virtualization Host Server for Shared Tier 1 Storage
2 x Intel Xeon E5-2680 Processor (2.7Ghz)
192GB Memory (12 x 16GB DIMMs @ 1600Mhz)
VMware vSphere 5 on internal SD
Diskless
Broadcom 57810-k 10Gb DP KR NDC (iSCSI)
1 x Intel i350 1Gb QP mezzanine (LAN)
iDRAC7 Enterprise w/ vFlash, 8GB SD

In the above configuration, the M620-based DVS Enterprise Solution can also support the following single server user counts.

- Basic Workload: 135 Users
- Standard Workload: 110 Users
- Premium Workload: 90 Users

5.3 Management Server Infrastructure

5.3.1 DVS Enterprise R720 Rack Management Server

In addition to the Virtual Desktop hosts there will be a dedicated management server that will provide compute resources for infrastructure services. These services will be provided by virtual server instances. Initially these servers are also based off a Dell PowerEdge R720 with the following specifications.



PowerEdge R720 Management Server For Local Tier 1 Storage	PowerEdge R720 Management Server for Shared Tier 1 Storage
2 x Intel Xeon E5-2680 Processor (2.9Ghz)	2 x Intel Xeon E5-2680 Processor (2.9Ghz)
96GB Memory (6 x 16GB DIMMs @ 1600Mhz)	96GB Memory (6 x 16GB DIMMs @ 1600Mhz)
10 x 146GB SAS 6Gbps 15k Disks	Diskless
PERC H710 Integrated RAID Controller – RAID10	Broadcom 57800 2 x 10Gb SFP+ + 2 x 1Gb NDC
Broadcom 5720 1Gb QP NDC (LAN)	1 x Broadcom 5720 1Gb DP NIC (LAN)
Broadcom 5720 1Gb DP NIC (LAN)	1 x Intel X520 2 x 10Gb SFP+ DP NIC (iSCSI)
iDRAC7 Enterprise w/ vFlash, 8GB SD	iDRAC7 Enterprise w/ vFlash, 8GB SD
2 x 750W PSUs	2 x 750W PSUs

The 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. Tier 2 volumes with a special purpose (called out above) should be presented in the format specified below:

Role	vCPU	RAM (GB)	NIC	OS + Data vDisk (GB)	Tier 2 Volume (GB)
VMware vCenter	2	8	1	40 + 5	100 (VMDK)
View Connection Server	2	8	1	40 + 5	-
SQL Server	2	8	1	40 + 5	210 (VMDK)
File Server	1	4	1	40 + 5	2048 (RDM)
TOTALS	7	28	4	180	2358

5.3.2 DVS Enterprise M620 Blade Management Server

When the Dell M1000e Blade Chassis along with the M620 blade server option is selected, the management servers are also based on the M620 blade. In the DVS Enterprise solution, the M620 management server is configured as follows;

PowerEdge M620 Virtualization Management Server for Shared Tier 1 Storage
2 x Intel Xeon E5-2680 Processor (2.7Ghz)
96GB Memory (12 x 16GB DIMMs @ 1600Mhz)
VMware vSphere 5 on internal SD
Diskless
Broadcom 57810-k 10Gb DP KR NDC (iSCSI)
1 x Intel i350 1Gb QP mezzanine (LAN)
iDRAC7 Enterprise w/ vFlash, 8GB SD

6 DVS Enterprise Server Scalability

As workloads increase, the solution can be scaled to provide additional compute and storage resources independently. Based on the best practices from VMware and DVS Engineering validation work the following scaling guidelines have been established for the virtual management infrastructure and the hosts.

6.1 R720 Rack-based Server Scalability

Basic Users	Standard Users	Premium Users	Physical Mgmt Servers	Physical Host Servers - Basic	Physical Host Servers - Standard	Physical Host Servers - Premium
145	116	95	1	1	2	2
1000	815	667	2	7	9	11
2000	1630	1333		14	18	22
3000	2444	2000		21	26	32
4000	3259	2667	3	28	35	43
5000	4074	3333		35	44	53
6000	4889	4000		42	52	64
7000	5704	4667	4	49	61	74
8000	6519	5333		56	69	85
9000	7333	6000		63	78	95
10000	8148	6667	5	69	87	106

6.2 M620 Blade-based Server Scalability

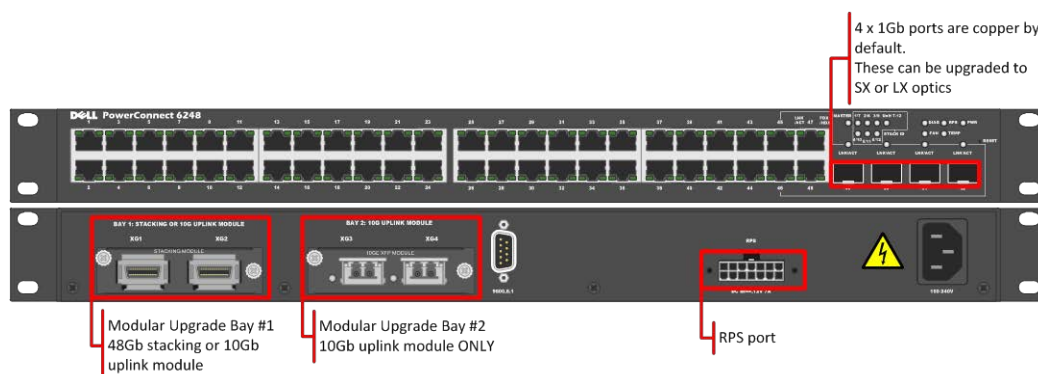
Basic Users	Standard Users	Premium Users	Physical Mgmt Servers	Physical Host Servers - Basic	Physical Host Servers - Standard	Physical Host Servers - Premium
135	110	90	1	1	2	2
1000	815	667	2	8	10	12
2000	1630	1333		16	19	24
3000	2444	2000		24	29	36
4000	3259	2667	3	32	38	48
5000	4074	3333		40	48	59
6000	4889	4000		48	57	71
7000	5704	4667	4	56	67	83
8000	6519	5333		64	76	95
9000	7333	6000		72	85	106
10000	8148	6667	5	80	95	118

7 Network Infrastructure

The DVS Enterprise initial base configuration begins with either a single Force10 S55 or PowerConnect PC6248 top of rack switch. This is rack-based solution meets the minimum switching requirements, with no switching high-availability option. Routing decisions will be made at the network core.

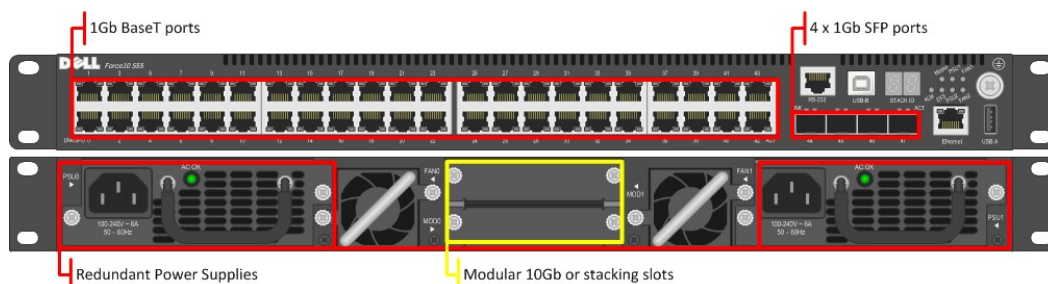
7.1 PowerConnect PC6248 1GbE Switch

The PC6248 is a 48 port, 1GbE, layer 2 edge switch. The PC6248 switch supports up to four 10 Gigabit Fibre (SFP+) & two 10GBase-T copper Ethernet uplinks for connectivity directly to 10GE servers, routers, enterprise backbones and data centers.



7.2 Force10 S55 1GbE Switch

The Dell Force10 S-Series S55 1/10 GbE ToR (Top-of-Rack) 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 DVS Enterprise 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 S55 switches can be stacked to create a single logical switch by utilizing Dell Force10's stacking technology and high-speed stacking modules.

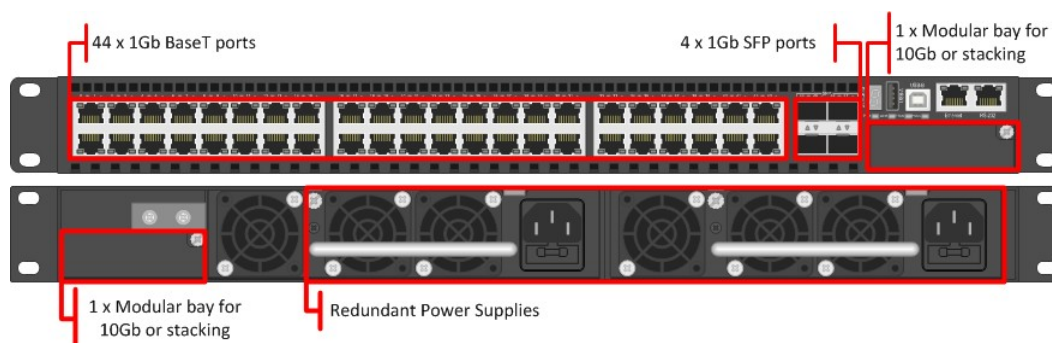


7.3 High Performance Ethernet Switching Options

As environments expand and VDI user requirements grow, or a shared tier 1 storage solution chosen as a part of the DVS Enterprise, you can choose to implement alternate top of rack network solutions in lieu of the PowerConnect PC6248 or Force10 S55. Taking DVS top of rack switching to the next level, you have more choices in the newly added switching model options.

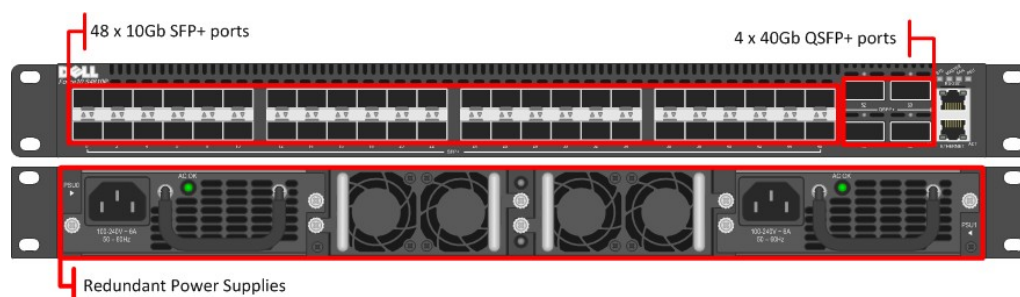
7.3.1 Force10 S60 1GbE Switch

The Dell Force10 S-Series S60 is a high-performance 1/10 GbE access switch optimized for lowering operational costs at the network edge and is recommended for DVS Enterprise deployments over 6000 users. The S60 answers the key challenges related to network congestion in data center ToR (Top-of-Rack) and service provider aggregation deployments. As the use of bursty applications and services continue to increase, huge spikes in network traffic that can cause network congestion and packet loss, also become more common. The S60 is equipped with the industry's largest packet buffer (1.25 GB), enabling it to deliver lower application latency and maintain predictable network performance even when faced with significant spikes in network traffic. Providing 48 line-rate GbE ports and up to four optional 10 GbE uplinks in just 1-RU, the S60 conserves valuable rack space. Further, the S60 design delivers unmatched configuration flexibility, high reliability, and power and cooling efficiency to reduce costs.



7.3.2 Force10 S4810 10GbE Switch

The Dell Force10 S-Series S4810 is an ultra-low latency 10/40 GbE Top-of-Rack (ToR) switch purpose-built for applications in high-performance data center and computing environments. Leveraging a non-blocking, cut-through switching architecture, the S4810 delivers line-rate L2 and L3 forwarding capacity with ultra-low latency to maximize network performance. The compact S4810 design provides industry-leading density of 48 dual-speed 1/10 GbE (SFP+) ports as well as four 40 GbE QSFP+ uplinks to conserve valuable rack space and simplify the migration to 40 Gbps in the data center core (Each 40 GbE QSFP+ uplink can support four 10 GbE ports with a breakout cable). Priority-based Flow Control (PFC), Data Center Bridge Exchange (DCBX), Enhance Transmission Selection (ETS), coupled with ultra-low latency and line rate throughput, make the S4810 ideally suited for iSCSI storage, FCoE Transit & DCB environments.



7.4 Fibre Channel Switching Options

7.4.1 Brocade 6510 Fibre-Channel Switch

The Brocade® 6510 Switch meets the demands of hyper-scale, private cloud storage environments by delivering market-leading speeds up to 16 Gbps FC technology and capabilities that support highly virtualized environments. Designed to enable maximum flexibility and investment protection, the Brocade 6510 is configurable in 24, 36, or 48 ports and supports 2, 4, 8, or 16 Gbps speeds in an efficiently designed 1U package. It also provides a simplified deployment process and a point-and-click user interface—making it both powerful and easy to use. The Brocade 6510 offers low-cost access to industry-leading Storage Area Network (SAN) technology while providing “pay-as-you-grow” scalability to meet the needs of an evolving storage environment.



7.4.2 Brocade M5424 Blade Switch



The Brocade M5424 switch and the Dell™ PowerEdge™ M1000e blade enclosure provide robust solutions for FC SAN deployments. Not only does this solution help simplify and reduce the amount of SAN hardware components required for a deployment, but it also maintains the scalability, performance, interoperability and management of traditional SAN environments. The M5424 can easily integrate FC technology into new or existing storage area network (SAN) environments using the PowerEdge™ M1000e blade enclosure. The Brocade M5424 is a flexible platform that delivers advanced functionality, performance, manageability, and scalability with up to 16 internal fabric ports and up to eight 2GB/4GB/8GB auto-sensing uplinks. Integration of SAN switching capabilities with the M5424 also helps to reduce complexity and increase SAN manageability.

7.4.3 QLogic QME2572 Host Bus Adapter

The QLogic® QME2572 is a dual-channel 8Gb/s Fibre Channel host bus adapter (HBA) designed for use in PowerEdge™ M1000e blade servers. Doubling the throughput enables higher levels of server consolidation and reduces data-migration/backup windows. It also improves performance and ensures reduced response time for mission-critical and next generation killer applications. Optimized for virtualization, power, security and management, as well as reliability, availability and serviceability (RAS), the QME2572 delivers 200,000 I/Os per second (IOPS).



7.4.4 QLogic QLE2562 Host Bus Adapter

The QLE2562 is a PCI Express, dual port, Fibre Channel (FC) Host Bus Adapter (HBA). The QLE2562 is part of the QLE2500 HBA product family that offers next generation 8 Gb FC technology, meeting the business requirements of the enterprise data center. Features of this HBA includes throughput of 3200 MBps (full-duplex), 200,000 initiator and target I/Os per second (IOPS) per port, and StarPower™ technology-based dynamic and adaptive power management. Benefits include optimizations for virtualization, power, reliability, availability, and serviceability (RAS), and security.



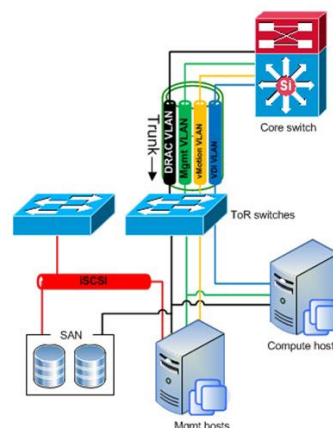
7.5 Logical Networking

The logical network is designed with four VLANs for added security and traffic isolation as outlined below:

We created a number of VLANs to isolate and manage traffic.

- iSCSI VLAN: a switched only VLAN.
- ESXi VLAN: ESXi management traffic – routed
- VDI Vlan: VDI infrastructure traffic – routed.
- Management Vlan: all hardware management traffic, managing via ESXi hosts iDRACs, EqualLogic storage units, network switches etc. -routed

Three VLANs have routing interfaces on the core network.



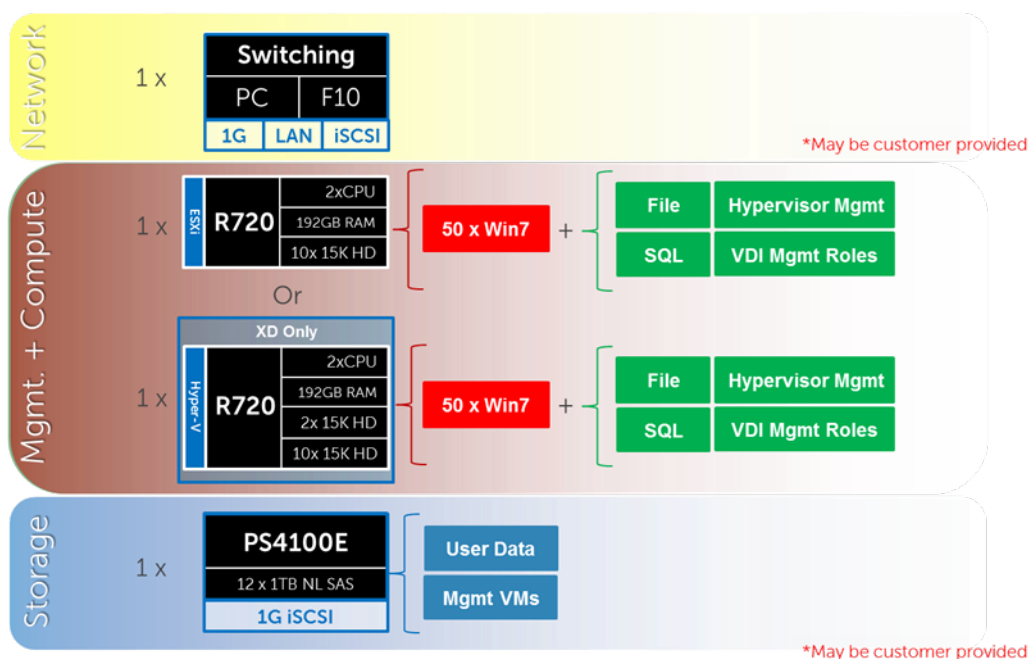
8 Scaling the Solution

As your VDI needs grow, so does the depth and breadth of the DVS Enterprise. The various management components exist as virtual server instances running on physical servers. This provides tremendous flexibility when adding resources to the solution while keeping the existing components intact and untouched. This also adds a level of resiliency in being able to backup copies of the server virtual images. The following tables gives an overview of Dell's recommended scaling of management components.

8.1 Local Tier 1

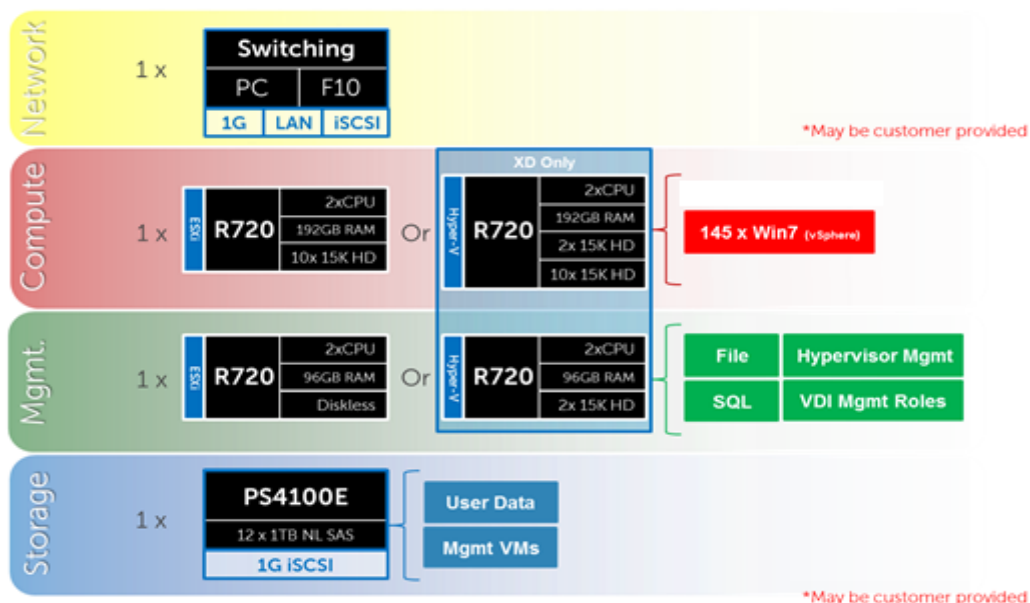
8.1.1 Local Tier 1 – 50 User/ Pilot

For a very small deployment or pilot effort, we offer a 50 user/pilot solution. This architecture is non-distributed with all VDI and Management functions on a single host. If additional scaling is desired, you can grow into a larger distributed architecture seamlessly with no loss on your initial investment.



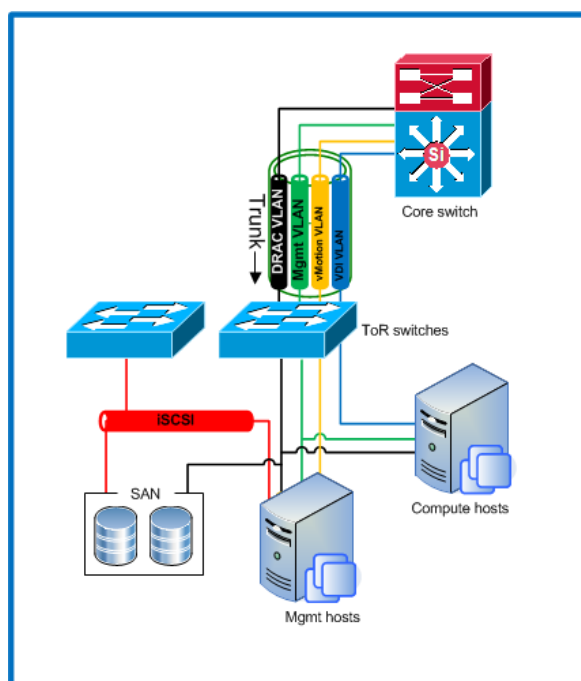
8.1.2 Local Tier 1 (iSCSI)

The local tier 1 solution model provides a scalable rack-based configuration that hosts user VDI sessions on local disk in the Compute layer.



8.1.2.1 Local Tier 1 – Network Architecture (iSCSI)

In the local tier 1 architecture, a single PowerConnect or Force10 switch can be shared among all network connections for both Management and Compute, up to 1000 users. Over 1000 users DVS recommends separating the network fabrics to isolate iSCSI and LAN traffic as well as making each stack redundant. Only the Management servers connect to iSCSI storage in this model. All Top of Rack (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.



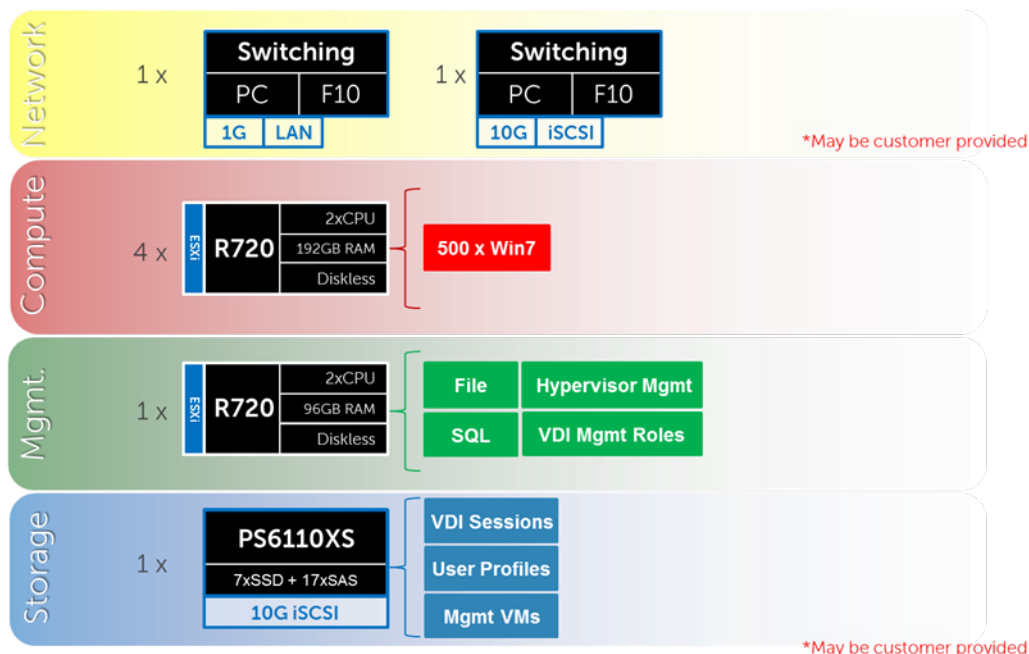
8.1.2.2 Local Tier 1 Rack Scaling Guidance (iSCSI)

Local Tier 1 HW Scaling (iSCSI)				
User Scale	ToR LAN	ToR 1Gb iSCSI	EQL T2	EQL NAS
0-1000	S55	S55	4100E	
0-1000 (HA)	S55	S55	4100E	FS7600
1000-3000	S55	S55	4100X	FS7600
3000-6000	S55	S55	6500E	FS7600
6000+ users	S60	S60	6500E	FS7600

8.2 Shared Tier 1 Rack

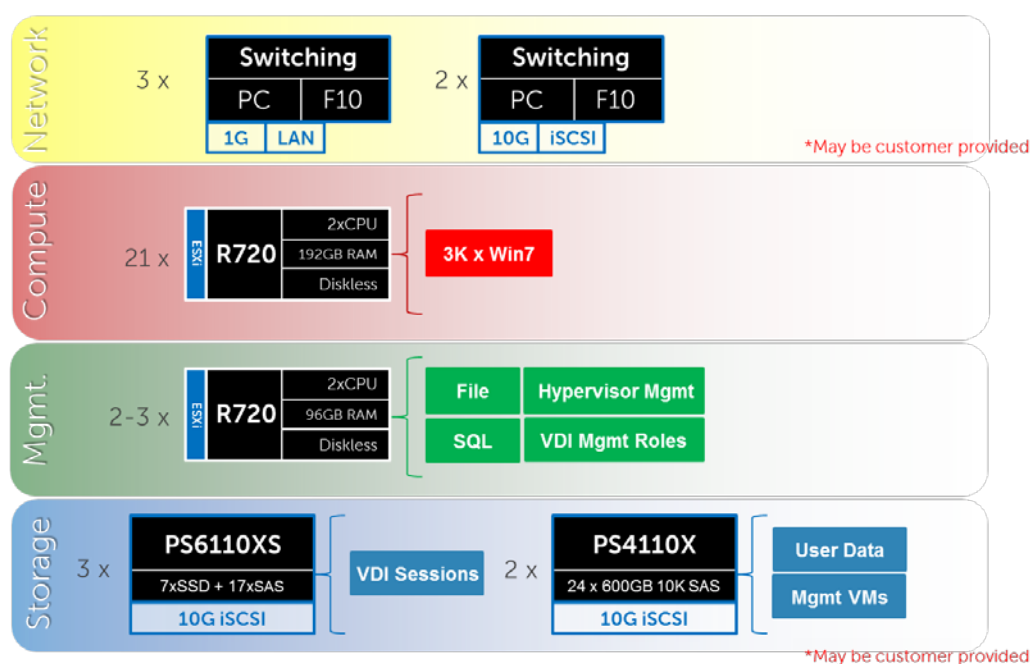
8.2.1 Shared Tier 1 – Rack – 500 users (iSCSI – EqualLogic)

For POCs or small deployments, tier 1 and tier 2 can be combined on a single 6110XS storage array. Above 500 users, a separate array needs to be used for tier 2.



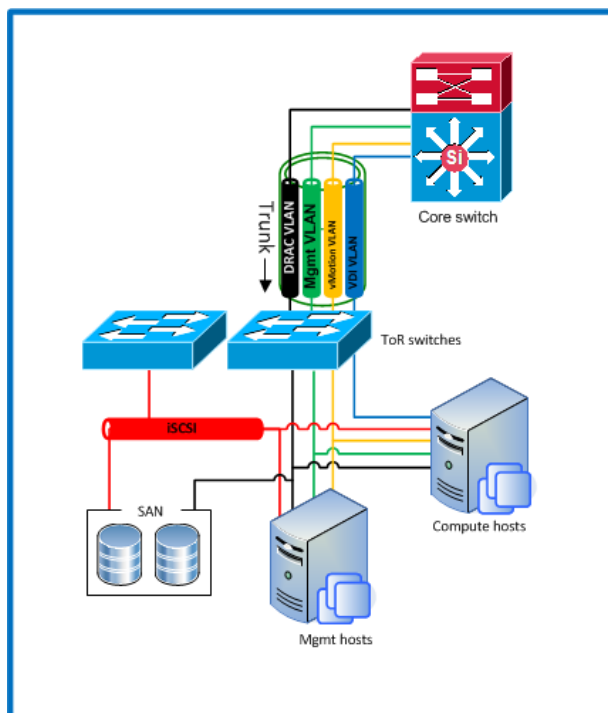
8.2.2 Shared Tier 1 – Rack (iSCSI – EqualLogic)

For 500 or more users on EqualLogic, the Storage layers are separated into discrete arrays. The drawing below depicts a 3000 user build where the network fabrics are separated for LAN and iSCSI traffic. Additional 6110XS arrays are added for tier 1 as the user count scales, just as the tier 2 array models change also based on scale. The 4110E, 4110X, and 6510E are tier 2 array options. The addition of a NAS head is recommended above 1000 users as well as when optionally when providing high availability to file share services.



8.2.2.1 Shared Tier 1 Rack – Network Architecture (iSCSI)

In the Shared tier 1 architecture for rack servers, a single PowerConnect or Force10 switch can be shared among all network connections for both Management and Compute, up to 1000 users. Over 1000 users DVS recommends separating the network fabrics to isolate iSCSI and LAN traffic and making each stack redundant. Both Management and Compute servers connect to all VLANs in this model. All ToR traffic has designed to be layer 2/ switched locally, with all layer 3/ routable VLANs routed through a core or distribution switch. The following diagrams illustrate the server NIC to ToR switch connections, vSwitch assignments, as well as logical VLAN flow in relation to the core switch.

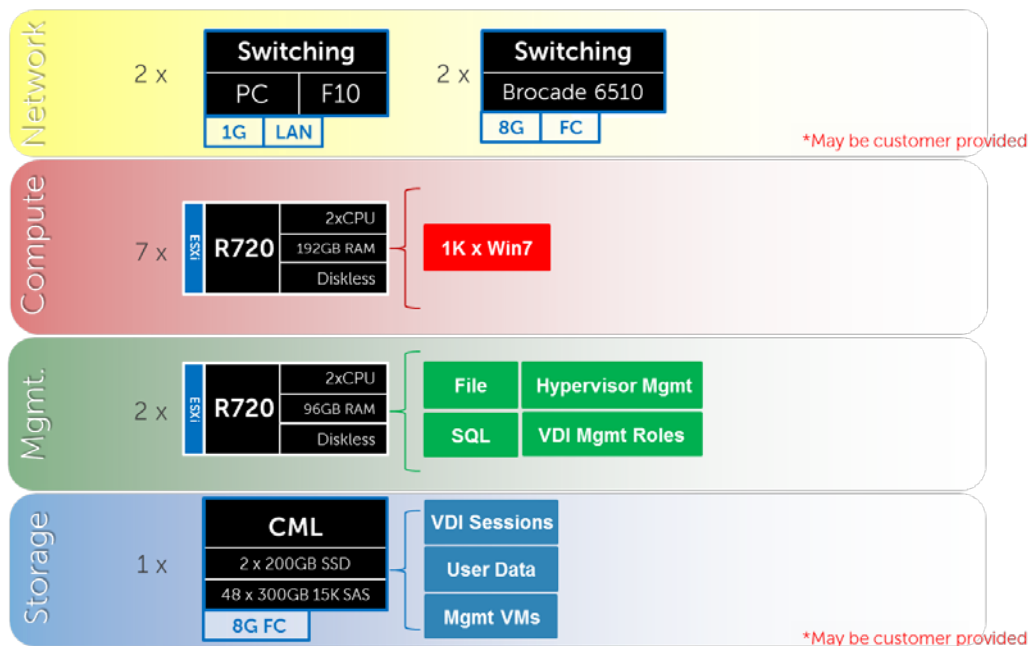


8.2.2.2 Shared Tier 1 Rack Scaling Guidance (iSCSI)

Shared Tier 1 HW scaling (Rack – iSCSI)					
User Scale	ToR LAN	ToR 10Gb iSCSI	EQL T1	EQL T2	EQL NAS
0-500	S55	S4810	6110XS	-	-
500-1000	S55	S4810	6110XS	4110E	-
0-1000 (HA)	S55	S4810	6110XS	4110E	NX3300
1000-3000	S55	S4810	6110XS	4110X	NX3300
3000-6000	S55	S4810	6110XS	6510E	NX3300
6000+	S60	S4810	6110XS	6510E	NX3300

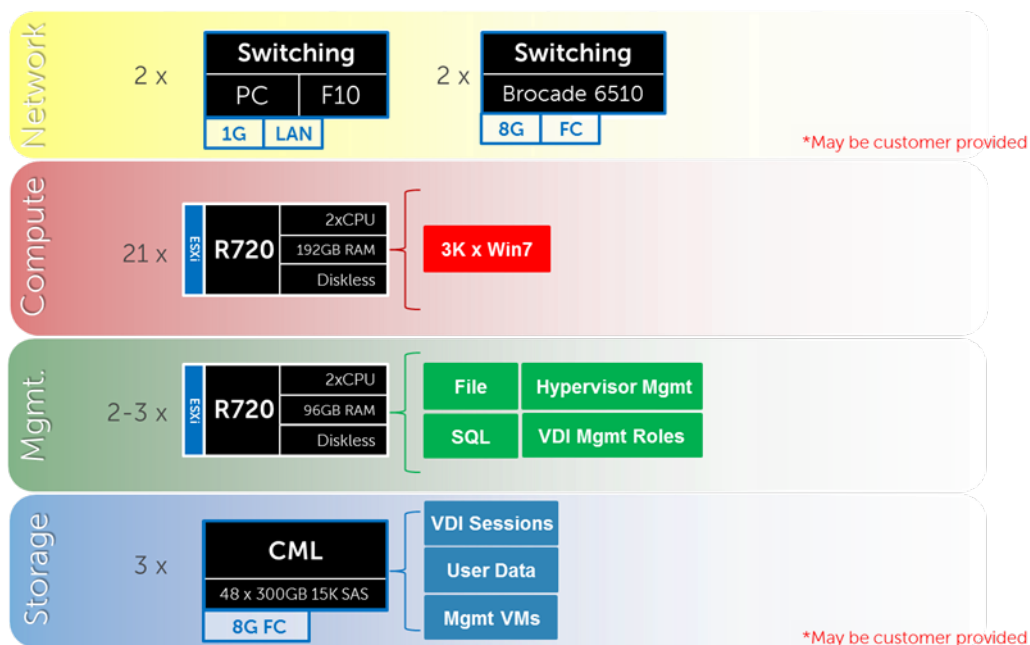
8.2.3 Shared Tier 1 – Rack – 1000 Users (FC – Compellent)

Utilizing Compellent storage for shared tier 1 provides a FC solution where tier 1 and tier 2 are functionally combined in a single array. Tier 2 functions (user data + Mgmt VMs) can be removed from the array if you have another solution in place. Doing this should net an additional 30% resource capability per Compellent array for user desktop sessions.



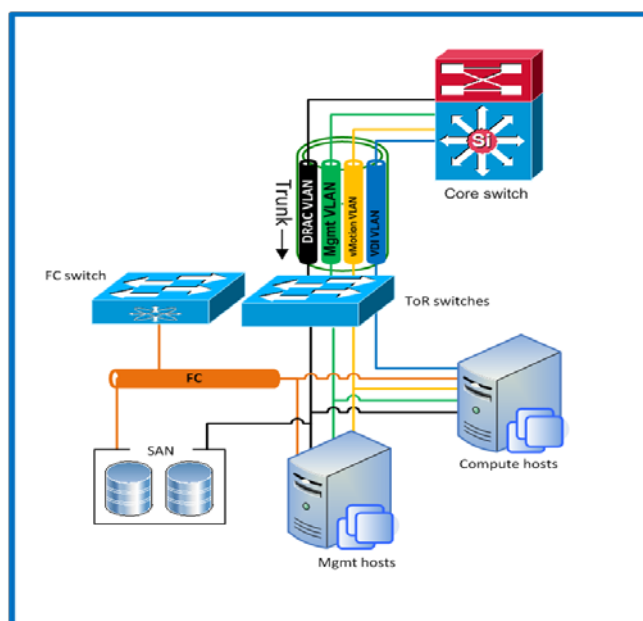
8.2.4 Shared Tier 1 – Rack (FC – Compellent)

FC is also supported in this model with discrete Compellent SC8000 arrays in tier 1 and tier 2. The Brocade 6510 is the FC switch of choice using 8Gb along with 8Gb FC IO cards in the Compellent array.



8.2.4.1 Shared Tier 1 Rack – Network Architecture (FC)

In the Shared tier 1 architecture for rack servers using FC, a separate switching infrastructure is required for FC. Management and compute servers will both connect to shared storage using FC. Both management and compute servers connect to all network VLANs in this model. All ToR traffic has designed to be layer 2/ switched locally, with all layer 3/ routable VLANs routed through a core or distribution switch. The following diagrams illustrate the server NIC to ToR switch connections, vSwitch assignments, as well as logical VLAN flow in relation to the core switch.



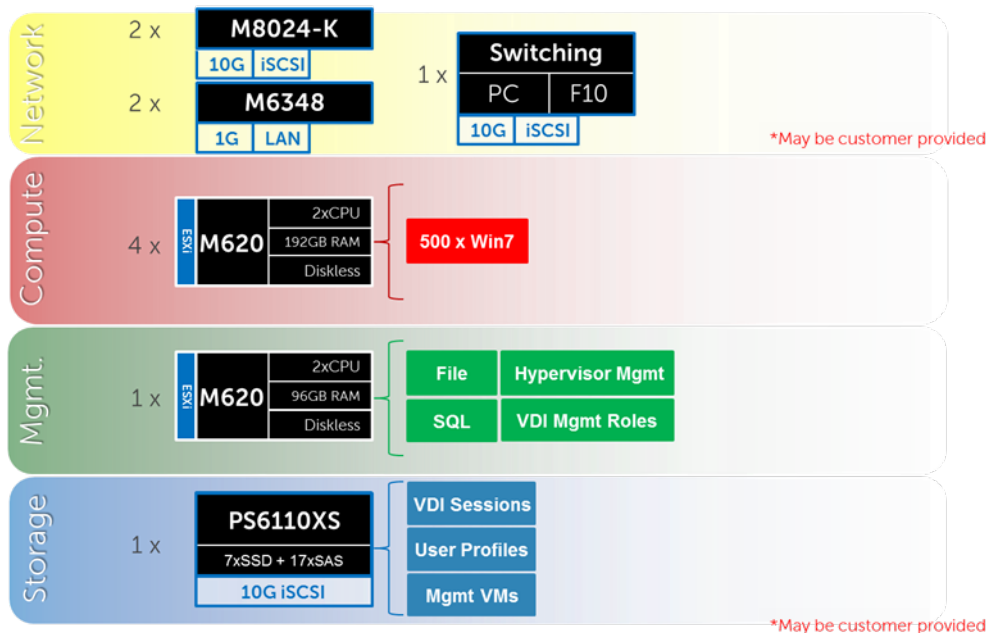
8.2.4.2 Shared Tier 1 Rack Scaling Guidance (FC)

Shared Tier 1 HW scaling (Rack - FC)					
User Scale	LAN Network	FC Network	CML T1	CML T2	CML NAS
0-1000	S55	6510	15K SAS	-	-
0-1000 (HA)	S55	6510	15K SAS	NL SAS	FS8600
1000-6000	S55	6510	15K SAS	NL SAS	FS8600
6000+	S60	6510	15K SAS	NL SAS	FS8600

8.3 Shared Tier 1 Blade

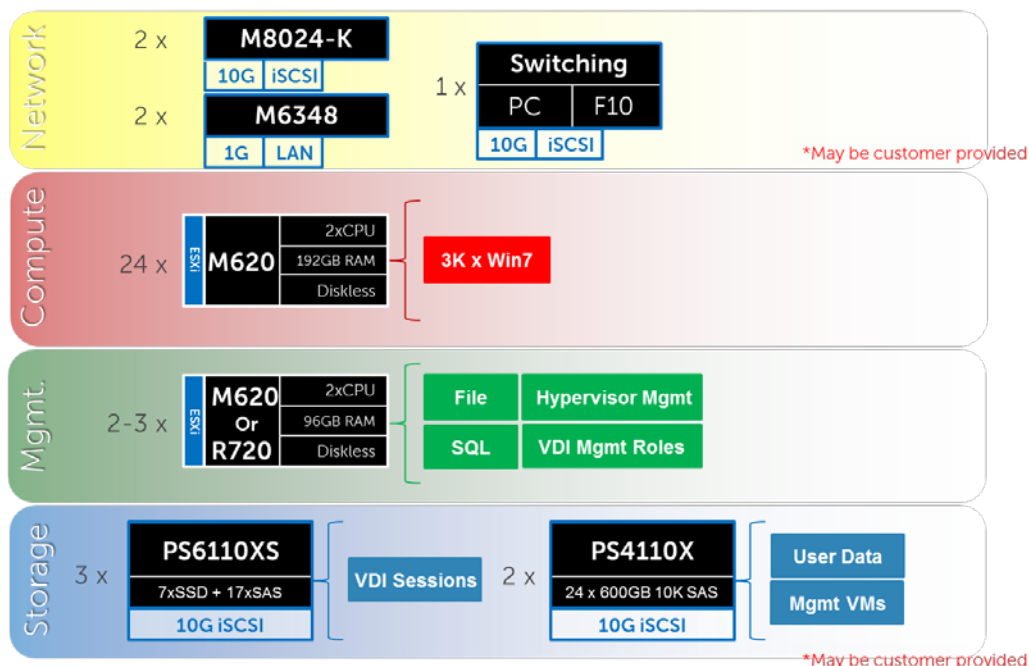
8.3.1 Shared Tier 1 - Blade - 500 users (iSCSI - EqualLogic)

As is the case in the Shared tier 1 model using rack servers, blades can also be used in a 500 user bundle by combining tier 1 and tier 2 on a single 6110XS array. Above 500 users, tier 1 and tier 2 storage should be separated into discrete arrays.



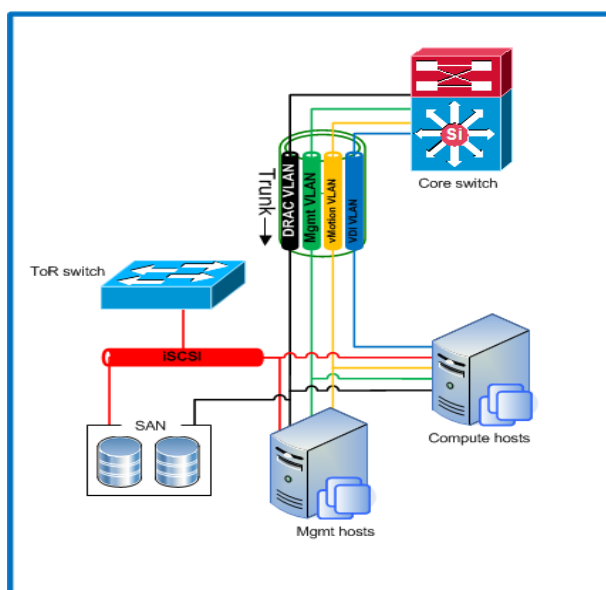
8.3.2 Shared Tier 1 – Blade (iSCSI – EqualLogic)

Above 1000 users the Storage tiers need to be separated. At this scale we also separate LAN from iSCSI switching as well as add load balancing and NAS for SMB file shares. The drawing below depicts a 3000 user solution:



8.3.2.1 Shared Tier 1 Blade – Network Architecture (iSCSI)

In the Shared tier 1 architecture for blades, only iSCSI is switched through a ToR switch. There is no need to switch LAN ToR since the M6348 in the chassis supports LAN to the blades and can be uplinked to the core directly. The M6348 has 16 external ports per switch that can be optionally used for DRAC/ IPMI traffic. For greater redundancy, a ToR switch used to support DRAC/IPMI can be used outside of the chassis. Both Management and Compute servers connect to all VLANs in this model. The following diagram illustrates the server NIC to ToR switch connections, vSwitch assignments, as well as logical VLAN flow in relation to the core switch.

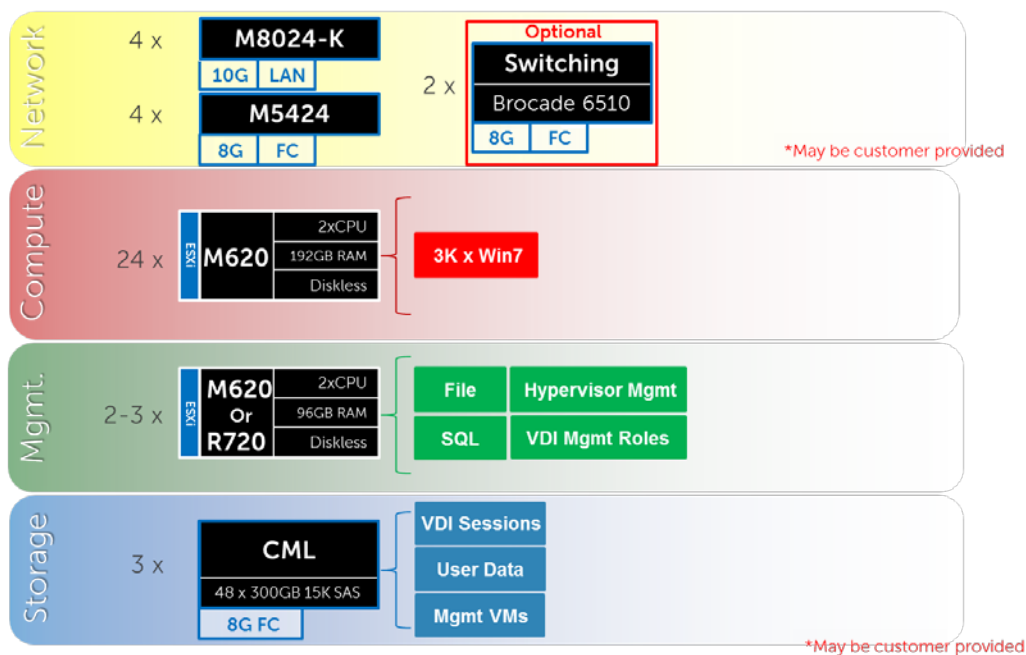


8.3.2.2 Shared Tier 1 Blade Scaling Guidance (iSCSI)

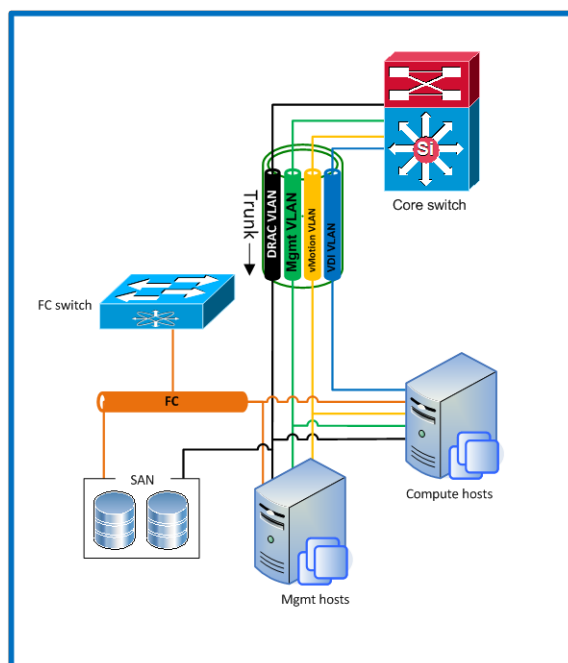
Shared Tier 1 HW scaling (Blade - iSCSI)							
User Scale	Blade LAN	Blade iSCSI	ToR LAN	ToR 10Gb iSCSI	EQL T1	EQL T2	EQL NAS
0-500	M6348	8024-K	S55	S4810	6110XS	-	-
500-1000	M6348	8024-K	S55	S4810	6110XS	4110E	-
0-1000 (HA)	M6348	8024-K	S55	S4810	6110XS	4110E	NX3300
1000-3000	M6348	8024-K	S55	S4810	6110XS	4110X	NX3300
3000-6000	M6348	8024-K	S55	S4810	6110XS	6510E	NX3300
6000+	M6348	8024-K	S60	S4810	6110XS	6510E	NX3300

8.3.3 Shared Tier 1 – Blade (FC – Compellent)

FC is again an option in Shared tier 1 using blades. There are a few key differences using FC with blades instead of iSCSI: Blade chassis interconnects FC HBAs in the servers, and there are FC IO cards in the Compellent arrays. ToR FC switching is optional if a suitable FC infrastructure is already in place.



8.3.3.1 Shared Tier 1 Blade – Network Architecture (FC)

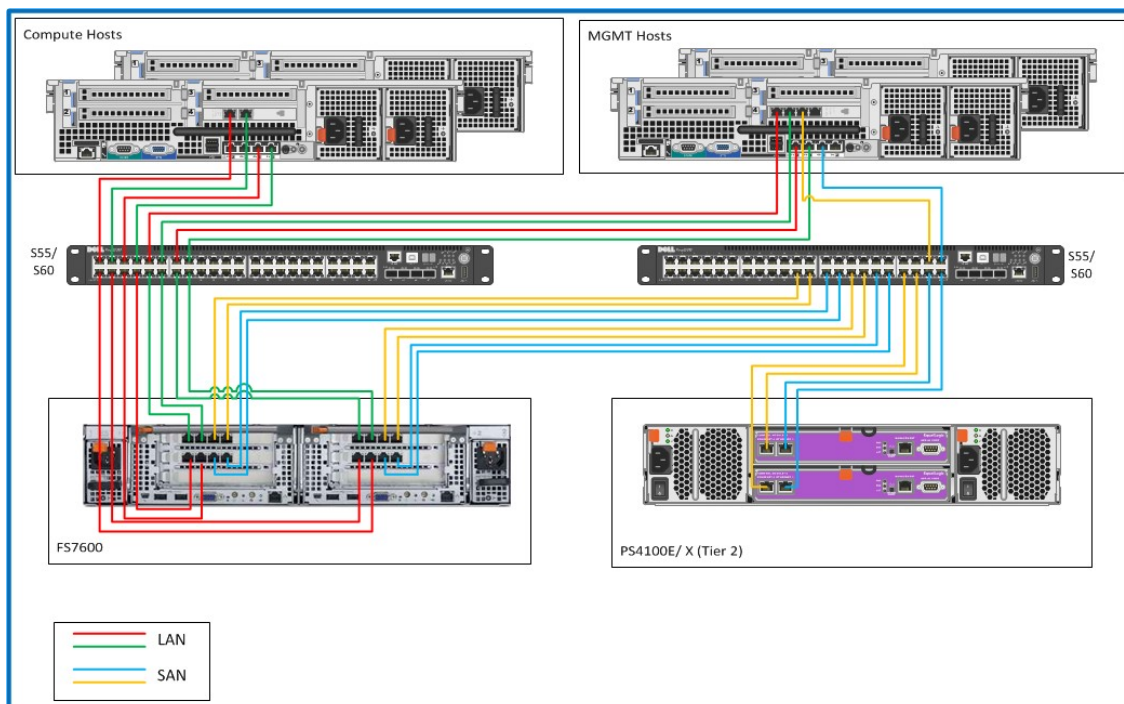


8.3.3.2 Shared Tier 1 Blade Scaling Guidance (FC)

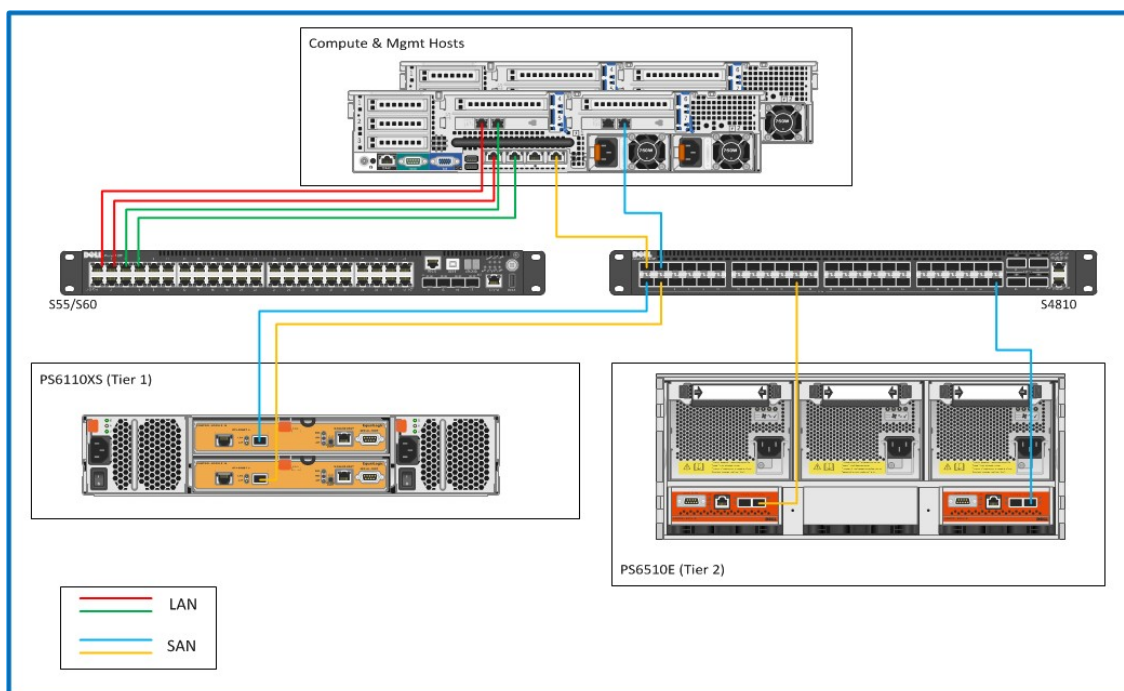
Shared Tier 1 HW scaling (Blade - FC)						
User Scale	Blade LAN	Blade FC	ToR FC	CML T1	CML T2	CML NAS
0-500	8024-K	5424	6510	15K SAS	-	-
500-1000	8024-K	5424	6510	15K SAS	-	-
0-1000 (HA)	8024-K	5424	6510	15K SAS	NL SAS	NX3300
1000-6000	8024-K	5424	6510	15K SAS	NL SAS	NX3300
6000+	8024-K	5424	6510	15K SAS	NL SAS	NX3300

8.4 Cabling Diagrams

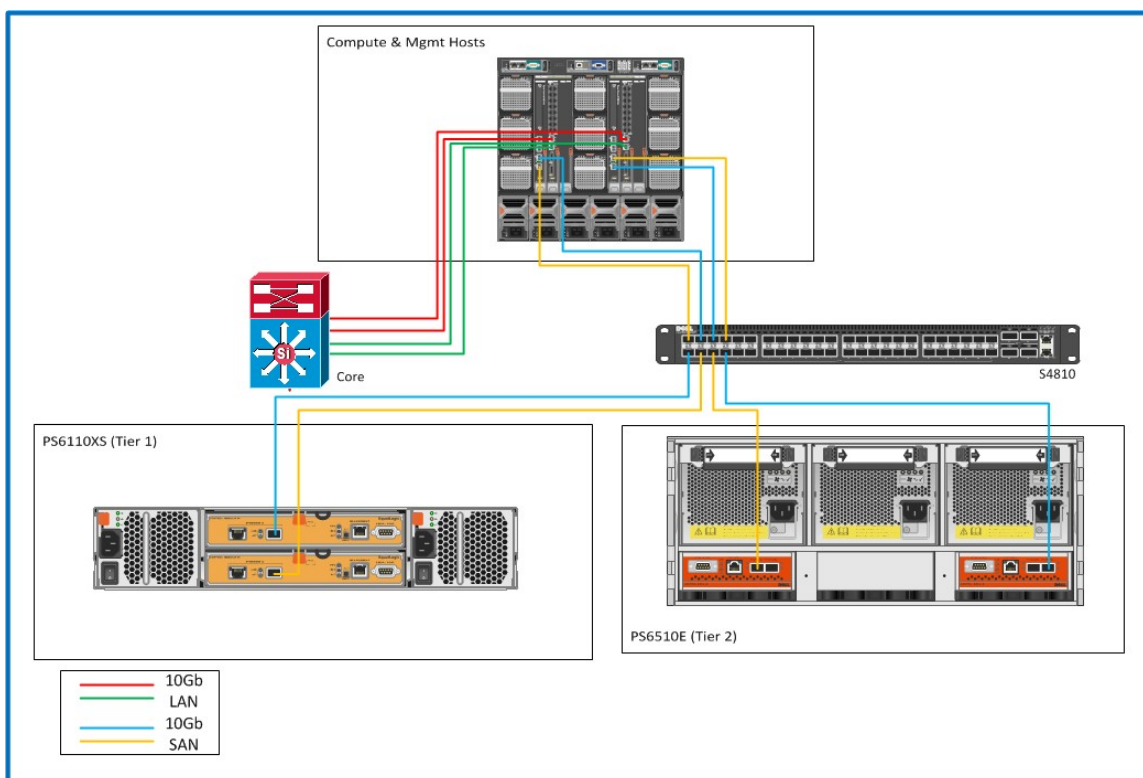
8.4.1 Local Tier 1 Cabling (iSCSI and LAN separated)



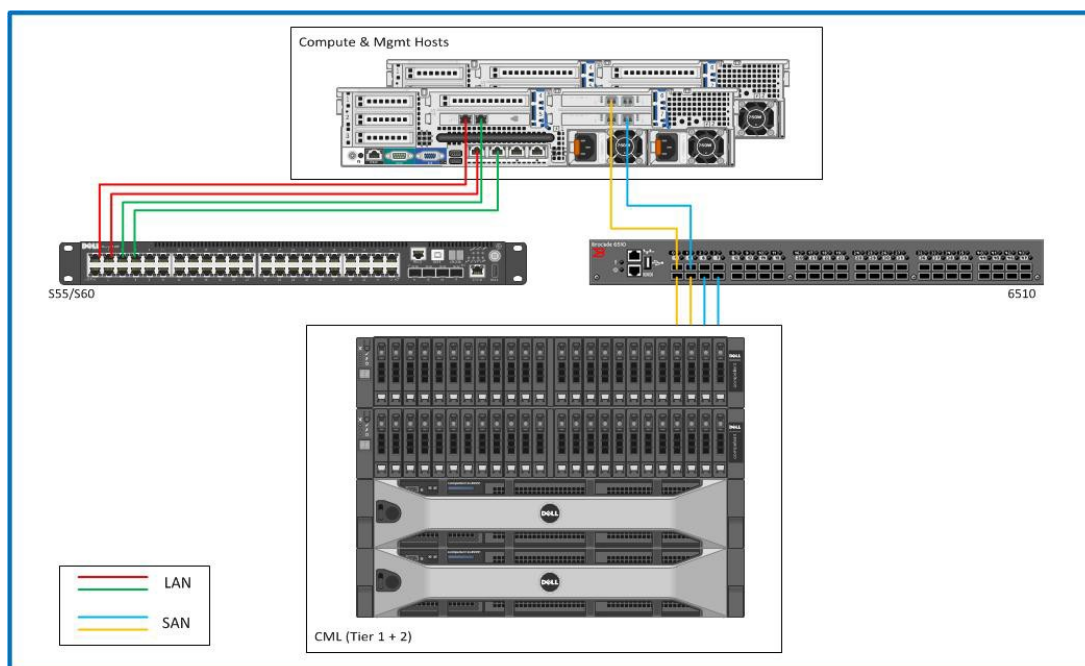
8.4.2 Shared Tier 1 Cabling (Rack - EqualLogic)



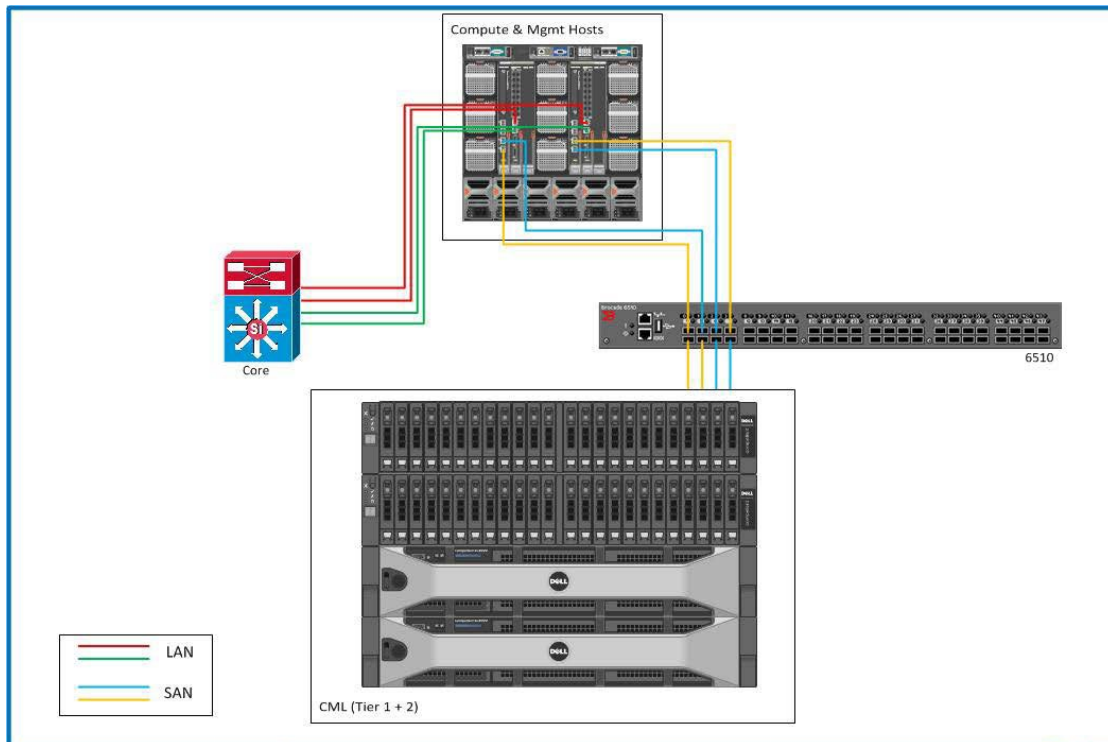
8.4.3 Shared Tier Cabling (Blade - EqualLogic)



8.4.4 Shared Tier 1 Cabling (Rack - Compellent)

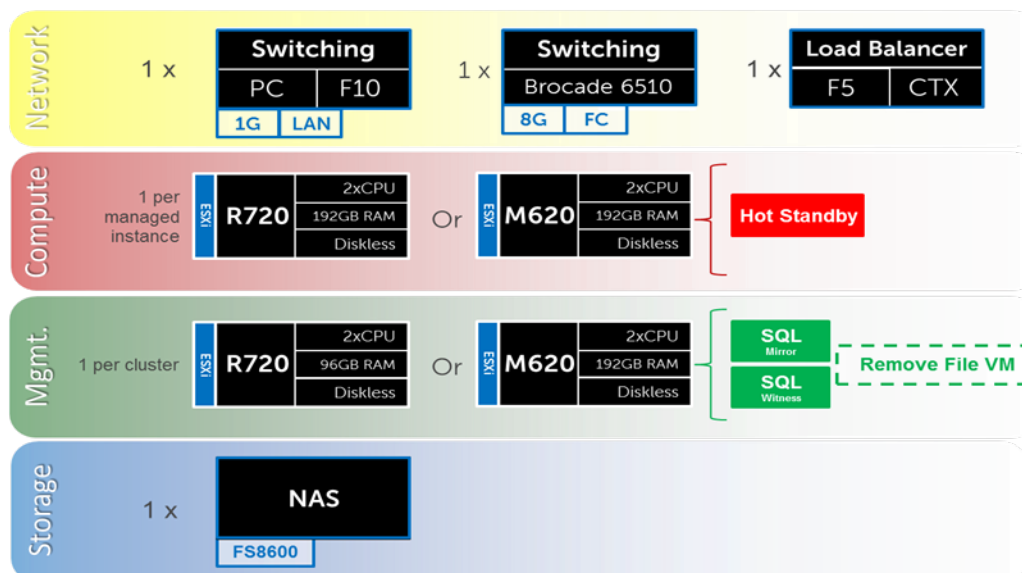


8.4.5 Shared Tier 1 Cabling (Blade - Compellent)



8.5 Building a Resilient Infrastructure

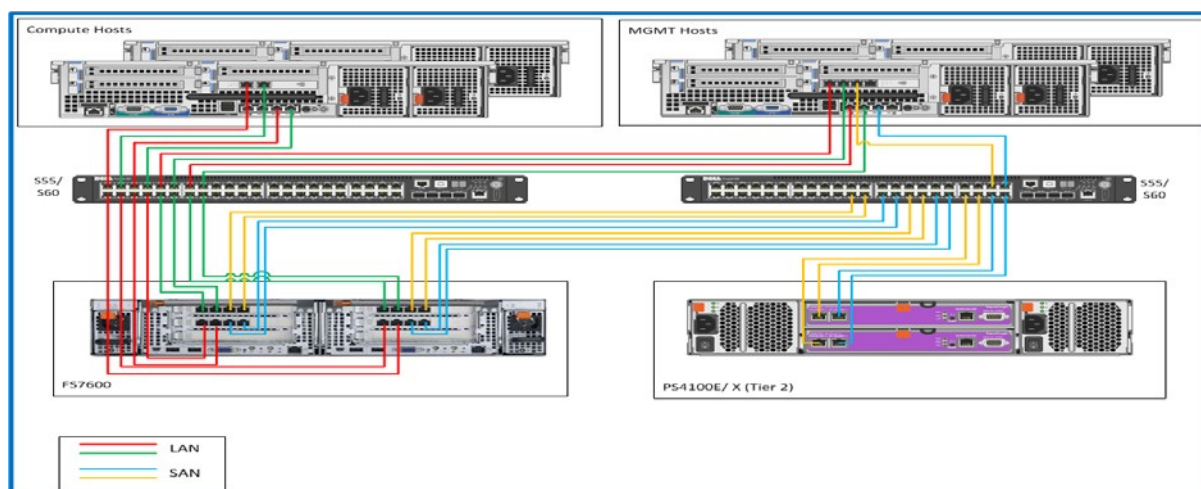
High Availability is achieved with a simple N+1 configuration for each component in the stack, with the exception of the storage arrays which have redundant controllers, network connections and RAID configured disks. The concept is similar for Enterprise blade solutions except top of rack switching would correspond to 10 GbE solutions.



The HA options provides redundancy for all critical components in the stack while improving the performance and efficiency of the solution as a whole.

- An additional switch is added at the network tier which will be configured with the original as a stack and equally spreading each host's network connections across both.
- A number of enhancements occur at the Management tier, the first of which is the addition of another ESXi host. The Management ESXi hosts will then be configured in an HA cluster with vMotion enabled. All applicable VMware server roles should then be duplicated on the new host. SQL will also receive greater protection through the addition and configuration of a SQL mirror with a witness.

8.5.1 High Availability Cabling



8.5.2 High Availability Networking

8.5.2.1 vSphere Virtual Networking

The optional HA bundle adds an additional ESXi host in the Management tier providing the ability to use an HA cluster between the hosts. vMotion will be enabled as well and should be added to the vSwitch housing the VMkernel ports on the Management hosts. Therefore will be no vSphere HA cluster in the compute tier.

Physical network connections should be spread across both switches, for each host, to ensure that each vSwitch has redundancy for each connection. The vSwitch housing the VMkernel ports on the Management hosts will need to be modified to add a VMkernel port for. The VLAN used for VMotion should be private (non-routable) and only accessible to each Management host. The physical adapters in the vSwitch should be separated between SC/VMotion and iSCSI ports but configured to provide failover for each other. This can be achieved by specifying an explicit failover order.

On the ESXi Host, the Dell EqualLogic MPIO plugin will be installed to handle load balancing. This module will be added via the command line tool using a Virtual Management Appliance (vMA) in vCenter. This tool will allow for easy configuration of iSCSI on each host. Some key settings that will be used as part of the configuration;

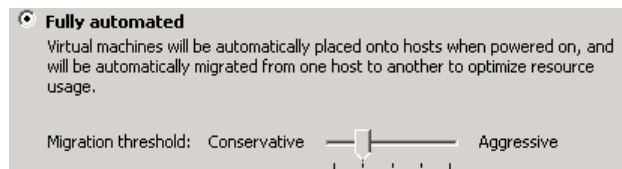
- Sets 2 IP Addresses for iSCSI on each host
- Specifies NIC (vmNIC2, vmNIC3)
- Sets the Jumbo Frame Settings (MTU 1500 – 9000 not supported with iSCSI offload on Broadcom NIC's)
- Initializes software iSCSI
- Sets IP for the EqualLogic Storage group.

Once the MPIO setup is complete the vSphere host is ready to access the storage and to either create or connect to VMFS data stores. The MPIO plugin will configure the correct multi-pathing for the data stores also.

Note: The iSCSI VLAN's need to be tagged on both iSCSI VMkernel ports, as the iSCSI VLAN is sharing the link with the Management Network. The MPIO script does not complete this step and this has to be performed on each host in vCenter. Each host will have dedicated LUNS assigned that will be visible to all hosts in that specific cluster.

9 HA DRS

DRS provides the ability for automated VM placement within the cluster as they power 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 VDVS Enterprise 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.

9.1 Management Server High Availability

High availability can be enabled on any or all layers in the solution. Following a N+1 methodology protects all layers of the solution architecture. Additional ToR switches can be added to the Network layer, additional Compute and Management hosts are added to each vCenter instance in their respective layers, and a NAS device is added to the Storage layer. Storage arrays are inherently redundant. The applicable core VMware View roles will be load balanced via DNS by default. A load balancing solution, such as F5, is recommended to manage load- balancing efforts for environments requiring HA.

9.2 Windows File Services High Availability

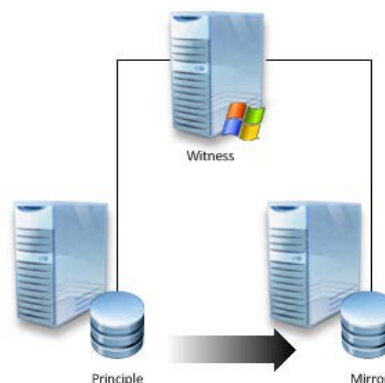
High Availability for file services will be provided by the FS7600, FS8600 or PowerVault NX3300 clustered NAS head. See section 6.6.5 for hardware details. To ensure proper redundancy, the NAS should have its cabling split between the switches, please refer to HA cabling diagram in Section 3.1 above as both NAS heads will need to be cabled accordingly.

Unlike the FS8600, the FS7600 and NX3300 do not support for 802.1q (VLAN tagging) so connecting switch ports should be configured with native VLANs, both iSCSI and LAN/ VDI traffic ports. Best practice dictates that all ports be connected on both controller nodes. The backend ports are used for iSCSI traffic to the storage array as well as internal NAS functionality (cache mirroring and cluster heart beat). Front-end ports can be configured using Adaptive Load Balancing or a LAG (LACP). The original file server VM was configured to use RDMs to access the

storage LUNs, therefore migration to the NAS will be simplified by changing the presentation of these LUNs from the file server VM to the NAS.

9.3 SQL Server High Availability

HA for SQL will be provided via a 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. DNS will be used to control access to the active SQL server, please refer to section 5.7.1 for more details. The principal VM that will host the primary copy of the data should exist on the first Management host. The mirror and witness VMs should exist on the second or later Management hosts. All critical databases should be mirrored to provide HA protection.



10 Customer Provided Stack Components

10.1 Customer Provided Storage Requirements

In the event that you wish to provide your own storage array solution for an Enterprise 6010-based solution, the following minimum hardware requirements must be met.

Feature	Minimum Requirement	Notes
Total Storage Space	User count and workload dependent	For user workload disk space requirements, see Section 4.1.
Drive Support	7200rpm 3.5" NLSAS	The minimum optimal drive configuration utilizes 6 drives for the best RAID 50 performance.
Tier 1 IOPS Requirement	(Total Users) x 10 IOPS	
Tier 2 IOPS Requirement	(Total Users) x 1 IOPS	
Data Networking	6x 1GbE RJ45	
Drive Controllers	1 with >4GB cache	4GB of cache minimum per controller is recommended for optimal performance and data protection.
RAID Support	50	RAID 50 is used on the external storage array. RAID 10 is leveraged only for local storage on compute servers.

10.2 Customer Provided Switching Requirements

In the event that you wish to provide your own rack network switching solution for the Enterprise - based solution, the following minimum hardware requirements must be met.

Feature	Minimum Requirement	Notes
Switching Capacity	180Gbps/switch	
10Gbps Ports	None Required	The base DVS Enterprise rack-based configuration is based on 1Gbps network connectivity.
1Gbps Ports	5x per Management server 5x per Compute Server 6x per Storage Array	
VLAN Support	IEEE 802.1Q tagging and port-based VLAN support.	
Stacking Capability	Yes	The ability to stack switches into a single management view for an HA configuration is highly recommended.

11 Dell Wyse Cloud Clients

Dell Wyse Cloud Client devices and software provide superior security, reliability and energy efficiency when compared to a traditional PC. Dell Wyse desktop devices and software help streamline the delivery of VMware Horizon View 5.2 infrastructure to millions of users around the world. Thin Clients create a more secure environment that minimizes or eliminates exposure to data loss, viruses and malware. By utilizing thin clients as the access device for end user, deployments can benefit from centralized management and complete control of all endpoints. Since thin clients eliminate components with high failure rates, deployments can expect reduced costs and improved reliability over the life of a desktop virtualization deployment.

11.1 Dell Wyse P25

Experience uncompromised computing, with the benefits of secure, centralized management. The Dell Wyse P25 PCoIP zero client for VMware Horizon View 5.2 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 Horizon View 5.2. 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.

Dell Wyse P25 and Display Recommendations



Click [HERE](#) for more information on the Dell Wyse P25.

Display recommendations for the P25 Zero Client are listed below

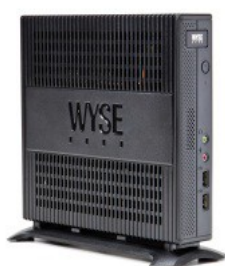


The P2412H shown above supports 1920x1080, VGA, DVI and USB. Other options include the E2213 with 1680x1050, VGA and DVI, and the E1913 with 1440x900, VGA and DVI.

11.2 Dell Wyse Z50D

Designed for power users, the new Dell Wyse Z50D is the highest performing thin client on the market. Highly secure and ultra-powerful, the Z50D combines Dell Wyse-enhanced SUSE Linux Enterprise with a dual-core AMD 1.6 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 modeling. Scalable enterprise-wide management provides simple deployment, patching and updates. Take a unit from box to productivity in minutes with auto configuration. Delivering unmatched processing speed and power, security and display performance, it's no wonder no other thin client can compare.

Dell Wyse Z50D and Display Recommendations



Click [HERE](#) for more information on the Dell Wyse Z50D.

Display recommendations for the Z50D are listed below



The U3011 shown above supports 2560x1600, VGA, DVI, DP and USB. Other options include the P2212H with 1920x1080, VGA, DVI and USB, and the E2213 with 1680x1050, VGA and DVI.

11.3 Dell Wyse P45

Experience uncompromised computing with the benefits of secure, centralized management. The Dell Wyse P45 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. About the size of a notebook, this dedicated zero client 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 display performance available over 4 HD displays in a compact, energy-efficient form factor. The Dell Wyse P45 delivers a rich user experience while resolving the challenges of provisioning, managing, maintaining and securing enterprise desktops.

Dell Wyse P45 and Display Recommendations



Click [HERE](#) for more information on the Dell Wyse P45.

Display recommendations for the P45 are listed below



The U3011 shown above supports 2560x1600, VGA, DVI, DP and USB. Other options include the U2212HM with 1920x1080, VGA, DVI and USB, and the U2711 with 2560 x 1440 (WQHD).

12 Appendix A – Dell Mobile Clinical Computing - AlwaysOn Point of Care

Dell and VMware Solution Architecture - Secure, Reliable and Continuous Access to EMR and Patient Care Applications

Digitized medical records can reduce medical errors, improve patient safety and produce better clinical outcomes—but if the caregiver cannot access Electronic Medical Record (EMR) and clinical information systems efficiently or are required to change workstations to access particular applications, productivity suffers and user frustration can increase. Furthermore, security and HIPAA compliance requirements may stipulate that users provide login credentials for each application that is accessed, then exit from each application and log off the system when finished. These processes are cumbersome and time consuming, and the log off process may be overlooked altogether creating potential security and data protection issues.

When electronic devices replace paper charts and physician prescription pads having quick secure and reliable access to the various applications from any device in clinical workspaces becomes critical. This is why modernization of the point-of-care desktop has become an urgent priority for hospital IT professionals as well as hospital caregivers. Desktops and patient care applications must be immediately accessible and available to caregivers regardless of workstation, device or location.

Dell Mobile Clinical Computing (MCC) and VMware have a solution. The Dell Mobile Clinical Computing – VMware AlwaysOn Point of Care™ solution provides an innovative virtualization architecture solution for the specific application access and stringent security requirements of medical organizations. By virtualizing desktops with VMware Horizon View 5.2™ and hosting them on VMware vSphere™, a key component of Dell's Mobile Clinical Computing architecture, and using this validated architectural design, healthcare organizations can now have unparalleled desktop and application reliability and availability – and secure rapid access from virtually any device. The caregiver can rapidly and securely access their desktop and application workspace by tapping a proximity card, swiping their finger on a biometric device or entering their username and password and they will be immediately presented with their clinical desktop to resume caring for patients.

The Dell MCC - AlwaysOn Point of Care offering allows clinicians and staff to achieve the rapid, secure access and continuous level of availability they demand. In a typical IT environment only the production environment is backed up. But by having an active-active desktop environment running identical desktop images, even if there is a failure at the primary site, end users can promptly access their desktops and applications. If a healthcare provider's infrastructure is compromised through a natural disaster or other unexpected outage, caregivers—who are many times among the first responders—can be assured they can reach their clinical desktops and applications where and when they are needed the most.

This new Dell and VMware architectural design features continuous monitoring capabilities, as well as load balancing with constant data replication across sites to ensure that if the primary site is

down VMware Horizon View 5.2 will seamlessly failover to the secondary site so the caregiver experiences minimal disruption. As a result, IT can now deliver non-stop point of care desktops with all applications and data readily available where and when they are needed most.

12.1 Benefits

- Validated Dell and VMware solution architecture
- Rapid secure non-stop access to clinical desktops and Electronic Medical Record applications
- Provides constant monitoring, load balancing and data replication features for optimizing performance and uptime
- Single sign on access, session mobility, highly reliable
- End-to-end Dell and VMware Horizon View 5.2 implementation with Dell Mobile Clinical computing Infrastructure
- High performance, secure, reliable Dell Wyse thin clients

12.2 Solution Elements

Dell and VMware have jointly validated the Dell Mobile Clinical Computing - AlwaysOn Point of Care offering. This purpose built architecture integrates Dell's Mobile Clinical Computing solution with VMware and additional Dell technology partner solutions to meet the uniquely stringent need for security, data protection, flexible scaling, and multiple single sign on mechanisms for health care organizations.

12.2.1 Imprivata OneSign

Imprivata OneSign® provides Single Sign On and strong authentication, permitting users to access all workstations and applications they are authorized to use. By configuring and linking multiple instances of virtual appliances at both sites with fault tolerance, during the site failover, desktop agents can continuously look up the next working instance without disrupting the workflow. Users easily connect to virtual desktops and applications via Imprivata OneSign single sign on from the access point all the way through to the EMR application.

12.2.2 Dell and VMware Solutions for secure, reliable and continuous access to EMR and patient care applications

Dell and VMware have created the Dell Mobile Clinical Computing - AlwaysOn Point of Care offering - an innovative virtualization architecture solution for the specific application access and stringent security requirements of medical organizations. It integrates technology and solutions from Dell, Dell Wyse, VMware and our thriving ecosystem of technology partners.

The solution leverages and integrates Dell's Mobile Clinical Computing and a highly available VMware virtualization infrastructure, with single sign on and secure high performance thin clients validated to health care industry requirements. Together, Dell, VMware, and our partners can deliver rapid and secure access to high performance continuous desktops, critical medical

applications and records. More than that, we deliver true peace of mind for medical professionals—and the highest levels of patient care.

For additional information about how the Dell Mobile Clinical Computing with VMware AlwaysOn Point of Care offer is built and validated, please consult the Reference Architecture at: www.dell.com/virtualdesktops or <http://www.vmware.com/solutions/industry/healthcare/point-of-care.html> or contact your Dell Partner Direct Reseller www.dell.com/partnerdirect

13 Appendix B - Dell DVS Enterprise - Mobile Secure Desktop

Dell and VMware Solution Architecture - Mobile, Secure Access to Applications and Data

Today's workforce is no longer tethered to traditional stationary desktops. New devices have proliferated in organizations of all sizes. Employees are increasingly mobile, and more than 60% of enterprise firms and 85% of SMB organizations are looking to initiate Bring Your Own Device (BYOD) programs. But while end users are eager to embrace "bring your own device" trends, IT departments—faced with tight budgets—are challenged with how to best support and manage these new devices while protecting corporate data as it is accessed across networks and locations.

Dell and VMware have a solution. The Dell Desktop Virtualization Solutions (DVS) Enterprise - Mobile Secure Desktop architecture provides an innovative way for IT to support device diversity and BYOD initiatives by improving user access and mobility, streamlining application updates, enhancing data security, and delivering the highest-fidelity user experience. This solution virtualizes desktops and hosts them on VMware® vSphere™, a key component of VMware Horizon View 5.2™, and uses Dell's DVS Enterprise infrastructure so organizations can now have unparalleled desktop and application access across devices and locations.

And because this solution ties desktop environments to user identities instead of devices, end users are free to access their data and applications from any qualified device, whether in the office or halfway around the world. This solution addresses three key requirements including:

13.1 Mobility

The Mobile Secure Desktop solution is built on Dell DVS Enterprise and VMware Horizon View 5.2. It places desktops in the datacenter and provides secure access to applications and data from a multitude of client devices including PC workstations, thin clients and mobile device. This enables BYOD support with persistence for true session mobility across devices—so users can access the same desktop from different devices. With persona management and optional support for user-installed applications, the Mobile Secure Desktop solution provides a personalized user experience across devices and sessions. In addition to providing session persistence across devices, VMware Horizon View 5.2 uses PCoIP protocol to deliver the best desktop user experience from any device.

13.2 Security

By integrating support for two-factor authentication (RSA SecurID, RADIUS authentication), the DVS Enterprise - Mobile Secure Desktop solution emphasizes data and application security. In addition to providing the right level of access to the right resources, it also simplifies patch management and update management. Since all the desktops are hosted in a centralized infrastructure, this solution streamlines deployment of updates and patches to desktops helping ensure that no vulnerabilities exist in the environment due to outdated, unpatched or orphaned systems. This solution also integrates VMware vShield™ to provide superior security for the environment.

13.3 Management

One of the key challenges facing organizations today is the ability to monitor and manage the entire end user compute environment including; desktops, access policies and service levels. The DVS Enterprise - Mobile Secure Desktop solution with optionally integrated vCenter Operations Manager (VCOps), provides an integrated dashboard with intelligent response on all desktop- related events. This helps IT admins to provide the right amount of intervention and guidance when the demands on the virtual infrastructure appear to exceed an expected range of behavior. The solution can also include vCenter Configuration Manager (vCM) for importing suggested configurations and to meet required regulatory compliance standards.

A critical aspect to mobile secure desktops and true BYOD support is securely managing and enabling corporate access. Dell Wyse project Stratus offers simple, secure, cloud-based management for today's dynamic IT environment. The integration of Dell Wyse Stratus into the Mobile Secure Desktop solution provides IT administrators with an intelligent and dynamic cloud-based console to securely manage and enable corporate access to any device, including smartphones, tablets, thin clients, zero clients, and PC's – regardless of whether the device is owned by the company or by an individual employee.

13.4 Solution Elements

Dell and VMware have jointly validated the Dell DVS Enterprise - Mobile Secure Desktop offering. This purpose built architecture integrates Dell's DVS Enterprise solution with VMware and additional Dell technology partner solutions to meet the need for flexible, mobile and secure end user computing in today's dynamic business environment.

13.5 Compliance - VMware vCenter Configuration Manager

A key requirements for many organizations is managing compliance to various government and industry regulations. vCenter Configuration Manager (vCM) automates critical configuration and compliance management tasks including configuration data collection, configuration change execution, configuration reporting, change auditing, and compliance assessment.

13.6 Cortado ThinPrint

Most of the use cases supported by this solution have a location-aware printing requirement. Cortado ThinPrint software, OEM'd by VMware, provides the ability to take advantage of location-aware printing from a wide range of devices.

13.7 Imprivata OneSign

Imprivata OneSign® provides Single Sign On and strong authentication, permitting users to access all workstations and applications they are authorized to use. By configuring and linking multiple instances of virtual appliances at both sites with fault tolerance, during the site failover, desktop agents can continuously look up the next working instance without disrupting the workflow. Users easily connect to virtual desktops and applications via Imprivata OneSign single sign on from the access point all the way through to the EMR application.

Dell and VMware solutions for mobile, secure access to applications and data

Dell and VMware have created the Dell DVS Enterprise - Mobile Secure Desktop solution – a validated architecture that integrates technology from Dell, VMware and the Dell technology partner ecosystem. The solution leverages Dell server, storage and networking infrastructure, mobile, wireless and wired networks, VMware Horizon View 5.2 and vSphere, vShield security services, management and monitoring components to protect data, monitor the infrastructure and secure access for virtual any end point device. This solution is optimized for organizations looking to drive higher levels of productivity by improving end-user access across devices and locations, reduce costs by streamlining desktop and application management, and enhance security and compliance.

The solution leverages and integrates Dell's DVS Enterprise end to end desktop virtualization infrastructure and highly available VMware virtualization platforms, with single sign on, personal management, and additional high performance industry recognized solutions. Together, Dell, VMware, and our partners deliver rapid and secure access to high performance desktops, business applications and corporate data with the Dell DVS Enterprise - Mobile Secure Desktop solution.

For additional information about how the Dell DVS Enterprise - Mobile Secure Desktop solution is built and validated, please consult the Dell DVS Enterprise - Mobile Secure Desktop Reference Architecture at www.dell.com/virtualdesktops or <http://www.vmware.com/solutions/desktop/mobile-secure-desktop/overview.html> or contact your Dell Partner Direct Reseller www.dell.com/partnerdirect

14 Reference

VMware references:

- [VMware vSphere Edition Comparisons](#)
- [VMware vSphere Availability Guide](#)
- [VMware vSphere 5.1 documentation](#)

Dell PowerEdge References:

- [Dell PowerEdge M1000e Technical Guide](#)
- [Dell PowerEdge M I/O Aggregator Configuration Quick Reference](#)

Dell EqualLogic references:

- [EqualLogic Technical Content](#)
- [Dell EqualLogic PS Series Architecture Whitepaper](#)
- [Configuring iSCSI Connectivity with VMware vSphere 5 and Dell EqualLogic PS Series Storage](#)
- [Configuring and Installing the EqualLogic Multipathing Extension Module for VMware vSphere 5.1, 5.0 and 4.1 and PS Series SANs](#)
- [How to Select the Correct RAID for an EqualLogic SAN](#)
- [Using Tiered Storage in a PS Series SAN](#)
- [Monitoring your PS Series SAN with SAN HQ](#)

Dell Management reference:

[Dell Management Plug-In for VMware vCenter references – Solution Brief](#)