# Microsoft SQL Server 2012 Solutions for OLTP Applications on Dell PowerEdge VRTX

*This whitepaper discusses the usage of VRTX as the backbone for the enterprise class database platform, Microsoft SQL server 2012*

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# Executive Summary

Generally, workload and application-centric IT infrastructures are engineered for large enterprises and do not address the needs of quickly growing remote/branch office (ROBO) or small-to-medium business (SMB) customers. Following that customer focus, Dell recently introduced PowerEdge VRTX, the first shared infrastructure IT solution designed specifically for remote and small office environments. PowerEdge VRTX provides enterprise-class capabilities in a desk-side, space-saving design and enables customers and partners to experience greater simplicity, realize improved efficiency, and achieve greater value with a pre-configured solution.

This reference architecture whitepaper discusses the usage of VRTX as the backbone for the enterprise class cloud-ready database platform, Microsoft SQL server 2012. The major use case scenarios discussed are branch/remote office and small business deployments. Microsoft Data Protection Manager (DPM) is discussed in detail as part of a robust data protection mechanism for database deployments on PowerEdge VRTX.

# Introduction

Today, even the small businesses and remote offices require enterprise-class infrastructure to support high-end applications. With this come the challenges of simplified and efficient infrastructure management capabilities which suit the resources available at these small offices. The database deployments at these sites present additional challenges for the organizations due to the deployment complexities and the additional compliance requirements imposed. In addition, these databases should have operational efficiency, taking advantage of technological advances of both hardware and software.

PowerEdge VRTX integrates servers, storage, networking and management into a single, compact chassis optimized for office environments power and acoustics, ranging from SMB offices to the remote offices/branch offices (ROBO) of Large Enterprises and Public organizations.

PowerEdge VRTX is primed to serve customers across the full range of industry verticals. VRTX's compute power, storage capacity, and high availability make it a highly attractive platform for a wide range of workloads in a broad spectrum of industries. VRTX's simplified systems management enables management of all resources inside the chassis, as well as a global geographical view of all deployed VRTX systems through a unified tool in a single console.

## Objective

The scope of this whitepaper is to discuss the use case scenarios for PowerEdge VRTX to be used as a Microsoft SQL Server database platform. The scope of this paper is limited to generic OLTP (Online Transaction Processing) database workloads. Any other database workload or application architecture is out of the scope of this whitepaper.

## Audience

The intended audience of this whitepaper is system administrators and architects who are planning or designing a virtualized infrastructure for their SQL Server database deployment for their remote office, branch office, small office, or small business environments.

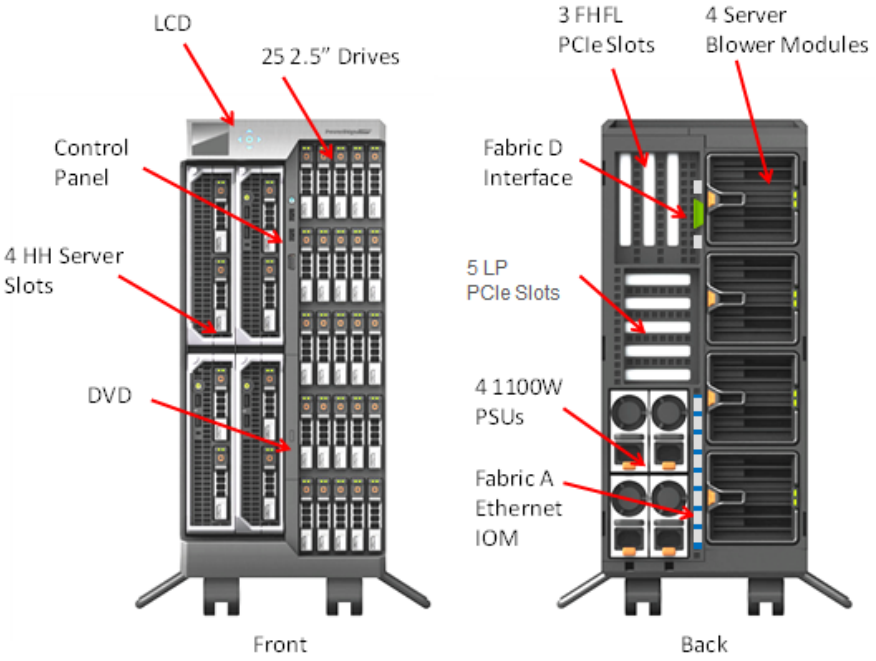
# Overview of PowerEdge VRTX

PowerEdge VRTX is a new shared infrastructure product focused on remote, branch, and small offices. The solution combines servers, shared storage, IO in the form of PCIe slots, and networking into a 5U tower, rackable chassis (Figure 1) that is suitable for the small and remote offices in which it is specifically designed to operate.

Figure 1. PowerEdge VRTX with 2.5" HDDs

PowerEdge VRTX is optimized to run virtualized workloads, giving both large and medium enterprise branches and SMB offices the same capabilities to consolidate, virtualize, and make their applications highly available with the use of advanced capabilities, such as LiveMigration, Disaster Recovery, and so on.

Figure 2. PowerEdge VRTX – The Hardware details



The front and rear view of PowerEdge VRTX along with the the basic hardware details is depicted in Figure 2. PowerEdge VRTX is available with 2.5" HDD as well as 3.5"HDD configurations to suit the differing customer needs. This product consists of a control panel, LCD screen, DVD, four half-height server blade slots and the hard drives in the front side. At the backside, it has server blower modules, Full Height Full Length (FHFL) PCIe slots, Low Profile (LP) PCIe slots, Redundant Power Supplies, Ethernet IO Module (switch/pass-through) and the Central Management Console (CMC) interface (fabric D).

> **Note:** For more information on the PowerEdge VRTX, please refer the PowerEdge VRTX documentation

## Major Feature Highlights of PowerEdge VRTX

PowerEdge VRTX features many of the exciting technology advancements that make it optimal for small offices:

- Convergence of up to 4 server nodes, storage and networking into a single chassis the size of a tower server, all integrated, pre-tested and certified.
- Unified systems management of servers, storage and networking, presented in a single console.
- Optimized specifically for office environments (as opposed to data center environments):
    - Small size: Upright (tower) server form factor, to fit conveniently beside a desk or under a countertop.
    - Quiet: Low noise output so it fits unobtrusively into office environments.
    - Power: Runs on the 110-volt AC power typically found in offices; no need to re-wire the office to support products designed for data centers. In addition, VRTX supports 220v for those users who want to install VRTX in their data centers.

# SQL Server 2012 Database Reference Architectures for PowerEdge VRTX

Microsoft SQL Server is an enterprise class database engine that supports various OLTP and OLAP workloads. It is designed for organizations looking to efficiently protect, unlock, and scale the power of their data their enterprise. Key value propositions are around greater uptime, blazing-fast performance, and enhanced security features for mission-critical workloads.

Dell offers many great platforms and reference architectures for SQL Server database use cases. Through its alliance with Microsoft, Solution engineering, Professional Services and Proven infrastructure, Dell's SQL Server based database solutions offer customers choice and flexibility.

PowerEdge VRTX, as a virtualized platform, provides an excellent platform to host different types of applications specifically for small customer environments. Microsoft SQL server database engine serves as a good computing platform which suits both small and large computing requirements. The latter sections of this whitepaper discuss the sample SQL Server database reference architectures using the PowerEdge VRTX. These Reference architectures are designed to address the following two major use cases that PowerEdge VRTX is targeted for:

- Remote Office/Branch Office(ROBO)
- Small Office Environments

## Prerequisites

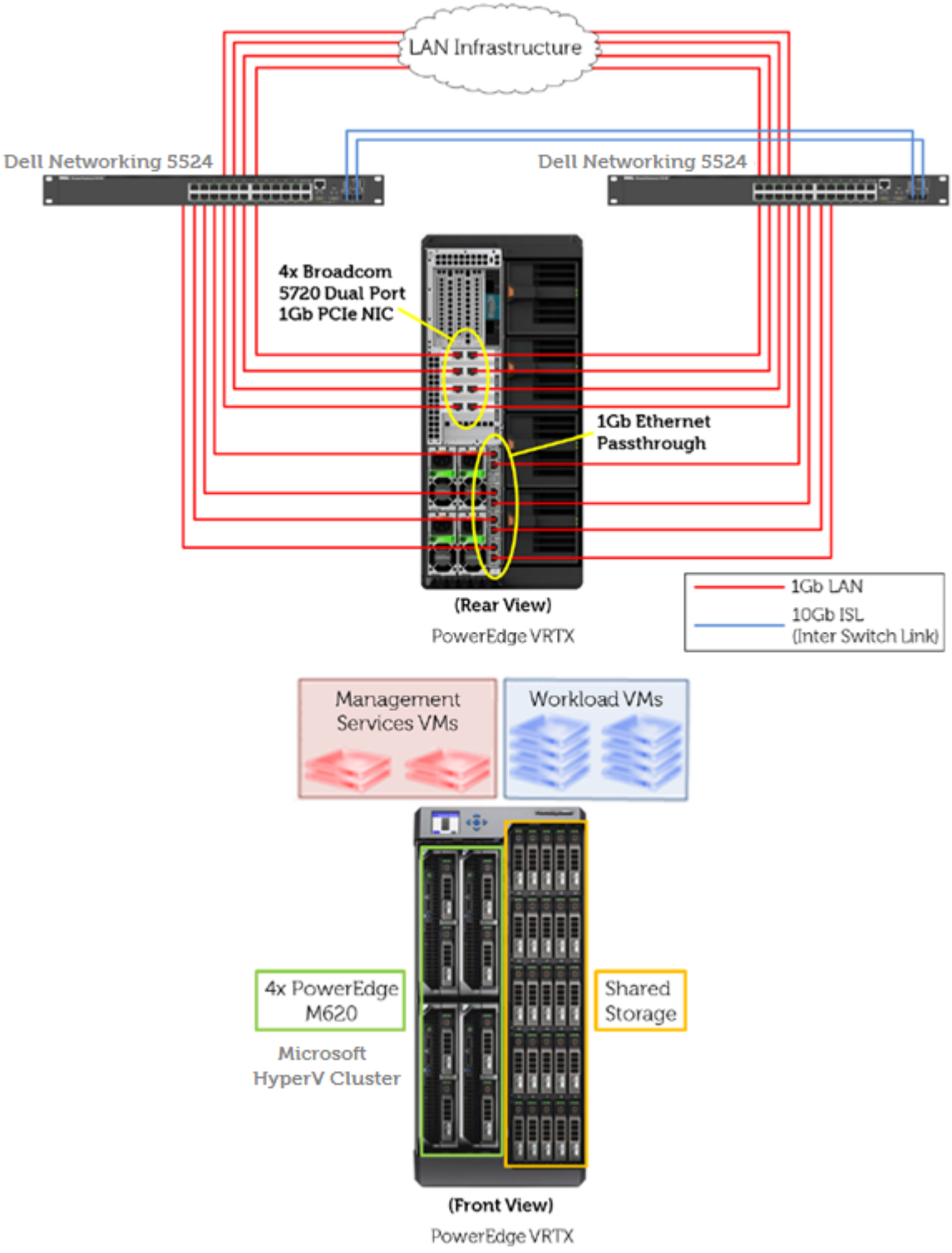
The below section discusses the major prerequisites for the SQL Server Reference Architectures outlined in this whitepaper.

### Microsoft HyperV Reference Architecture with PowerEdge VRTX

The SQL Server database reference architectures described in this whitepaper leverages the base Windows HyperV architectural stack as described in the "Remote Office Infrastructure – A Microsoft Hyper-V Server 2012 Reference Architecture on Dell PowerEdge VRTX" whitepaper.

Figure 3 depicts the major architectural components of the Dell recommended Microsoft Windows Server 2012 Hyper-V stack for PowerEdge VRTX.

Figure 3. Dell PowerEdge VRTX - Microsoft Hyper-V Server 2012 Reference Architecture




The above Dell Microsoft HyperV stack on PowerEdge VRTX addresses many failure scenarios (such as server, network, and so on), through a robust hardware/software synergy.

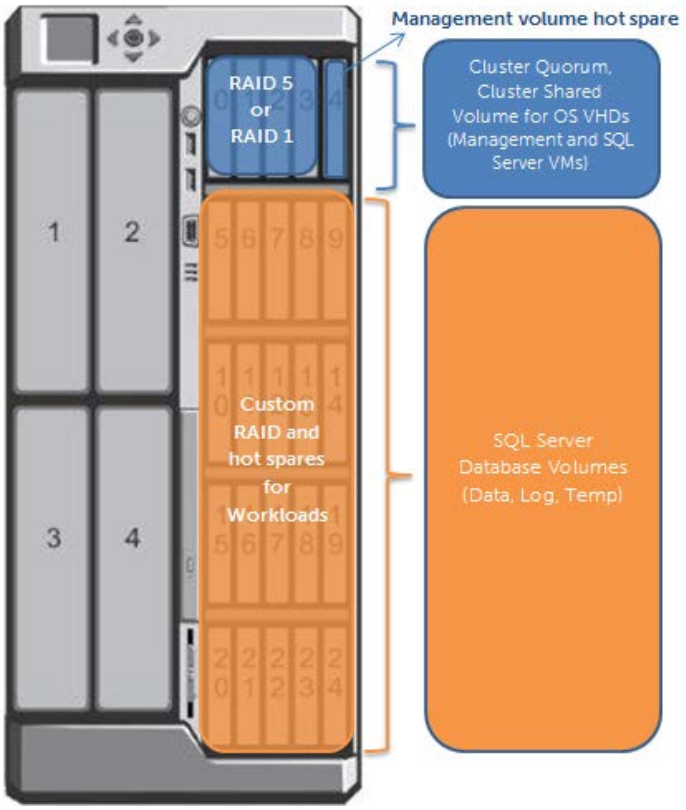
The major highlights of this configuration are:

- Recommended design of the Microsoft HyperV environment incorporating PowerEdge VRTX
- Recommended design of the set of validated management components for the Microsoft Windows HyperV infrastructure
- Recommended disk layout for the management/infrastructure virtual machines considering disk redundancy, performance, and hot spares
- High Availability built at the several levels of the software/hardware stacks:
    - Hosts/Servers – Robust failover mechanism using Microsoft Windows Clustering
    - Network – Highly available network infrastructure built with PCIe Network adapters, onboard NICs, the Ethernet pass-through module, and the external 1Gb networking switches using Windows Server 2012 Network Teaming feature

For more information on the Dell Recommended Microsoft HyperV architecture for PowerEdge VRTX, please refer to the complete whitepaper at http://en.community.dell.com/techcenter/extras/m/white_papers/20395858.aspx.

Figure 4 shows the storage volume configuration for the SQL server reference configurations derived from the above HyperV architecture.

Figure 4. Storage layout for the SQL server reference configurations



The discussed SQL server architectures are designed to have the VM OS virtual hard disk (VHD) share the same Management Cluster Shared Volume (CSV) which is used to hold the management and infrastructure VM VHDs. The database drives were carved out of the rest of the drives based on the database requirements (RAID redundancy, disk type, and so on).

The management infrastructure and the optional infrastructure VM components mentioned in the proposed HyperV stack may be leveraged as is for the SQL server Reference architecture, based on the customer interests.

## Domain Connectivity

The proposed reference configuration assumes that an Active directory/DNS server exists in the network for the domain connectivity. The DNS server may be hosted on either a virtualized or physical platform. It may also be located on the PowerEdge VRTX itself as a virtual component as discussed in the "Remote Office Infrastructure – A Microsoft Hyper-V Server 2012 Reference Architecture on Dell PowerEdge VRTX" whitepaper.

The referenced whitepaper mentions several other optional architectural/management components, such as DHCP, Dell Open Manage essentials, Microsoft System Center 2012 Data Protection Manager (DPM), Microsoft System Center 2012 Operations Manager (SCOM), and Microsoft System Center 2012 Virtual Machine Manager (SCVMM). Any of those components may also be integrated with the SQL Server reference architecture based on the business needs.

## Quest Spotlight on SQL Server

To monitor SQL Server on PowerEdge VRTX, Dell strongly recommends to have "Quest Spotlight on SQL server" to be deployed as part of the infrastructure. Spotlight on SQL Server is a powerful database diagnostic and resolution tool that is capable of performing various monitoring and troubleshooting actions on multiple SQL server deployments. Its unique user interface provides you with an intuitive, visual representation of the SQL server activity. The monitoring components include

- Diagnose CPU
- Diagnose IO
- Diagnose Blocking
- View Historical Data
- Identify Expensive SQL statements
- Report on Database growth
- Analyze Wait statistics
- Find long running SQL

Figure 5 shows a snapshot of the SQL server monitoring window of Quest Spotlight.

Figure 5. SQL server monitoring using Spotlight


For more information and deployment details on Spotlight on SQL server product, please refer http://www.quest.com/spotlight-on-sql-server-enterprise/.

## SQL Server Deployment Use Cases for PowerEdge VRTX

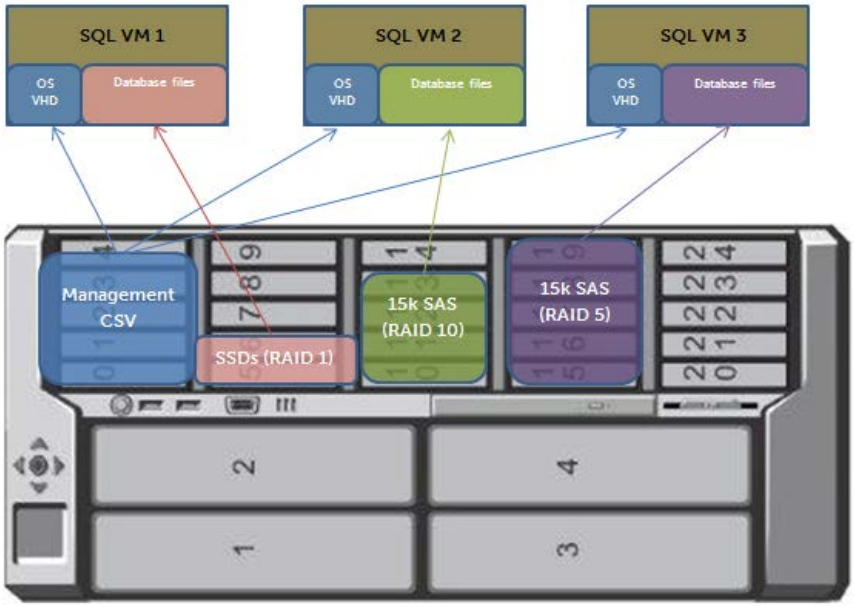
The below sections discuss some of the major use cases for SQL Server database deployments using PowerEdge VRTX.

### Catering to varying Database Requirements

Databases may have different types of requirements. Best practices often recommend specific HDD and RAID layouts, as well as other architectural guidelines.

PowerEdge VRTX provides the best of single box platform which offers the flexibility to host databases with different disk redundancy/performance requirements. The shared DAS architecture allows us to abide by the many potential recommended options for database layout. Figure 6 depicts the possible database deployments to cater to such differing necessities.

Figure 6. Catering to varying database requirements




The database performance is directly impacted by different RAID implementations, so proper planning is important in terms of optimizing for transaction volume and response times. Figure 7 and Figure 8 depict the observed OLTP (TPC-C workload) performance differences when a 100GB database was deployed on the below RAID levels.

- SSD RAID 1 volume using two 400GB SAS SSD drives
- RAID 10 volume using four 15k 300GB SAS drives
- RAID 5 volume using five 15k 300GB SAS drives

The details of the test configuration are provided in the Table 1 given in the Appendix A – Configuration details section.

Figure 7. Observed OLTP workload Performance – Transactions per Second

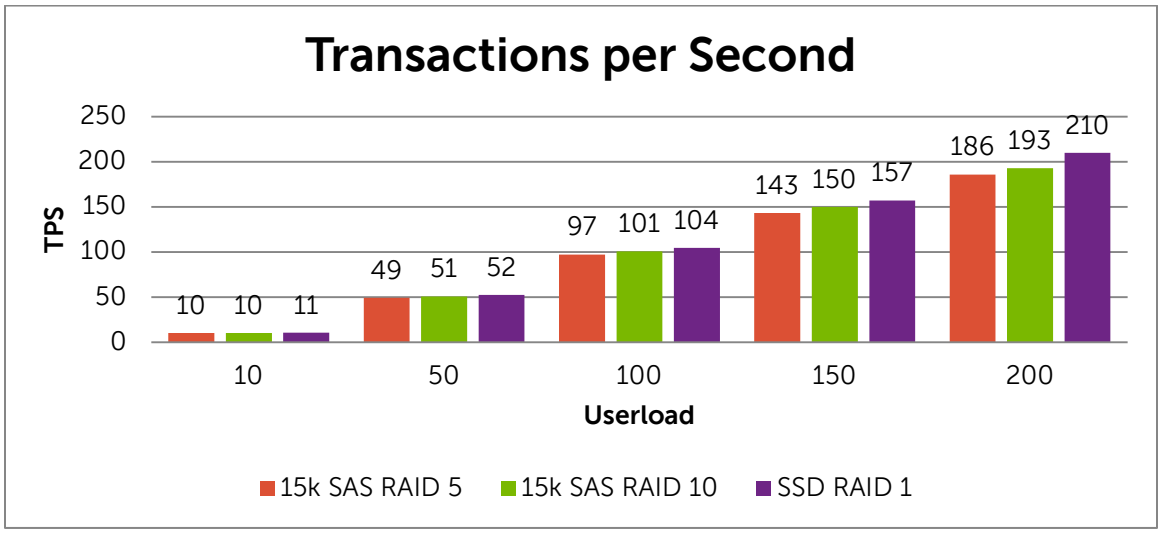
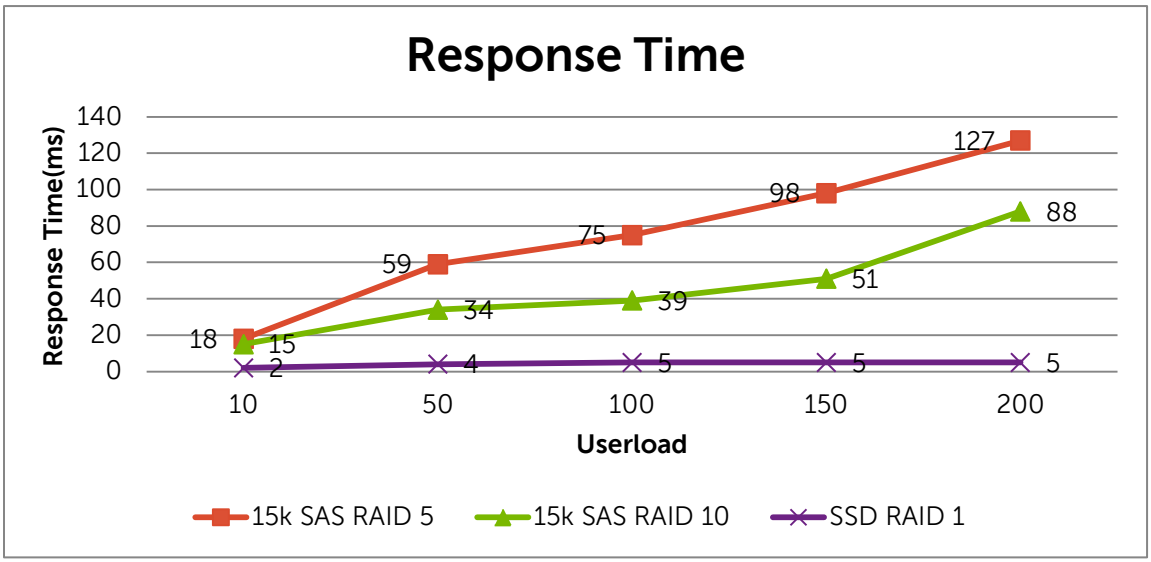


Figure 8. Observed OLTP workload Performance – Response Time




As shown in Figure 7 and Figure 8, the SSD volume delivered the best of database response time for the specific read-write workload. This is due to the low latency block access owing to the non-moving parts within the SSD drives. The RAID 5 configuration showed less performance than the RAID 10 volume. This is due to the overhead associated with the parity calculations for the write transactions.

To summarize, database performance is directly related to the type of drives and the RAID level configured. Therefore careful planning of the database deployment design has to be carried out to ensure that the database backend will be sufficient enough to meet the customer performance requirements. PowerEdge VRTX provides the flexibility and capability to support the several database performance and disk redundancy necessities of several applications.

## Local Data Center for business agility and continuity in a branch office

PowerEdge VRTX is designed to be an excellent platform for remote office environments. The main advantages of having a local datacenter at remote office environment are reducing environment complexity, license consolidation, and increasing operational efficiency.

The SQL server reference architecture discussed in this section is primarily designed considering a remote (branch) office environment. It is assumed that a primary data center exists at a different site, for disaster recovery operations.

### SQL Server 2012 Database Virtual Machine Design Considerations

The major design considerations for a SQL Server virtual machine adhering to a remote site scenario are discussed in the sections below.

### SQL Server Availability Considerations

The design of the architecture takes care of the internal node failures within the PowerEdge VRTX virtualized infrastructure. One of the other availability considerations is to have an automatic/manual failover of the database to the head office in case of a disaster at the branch site,

### SQL server backup considerations

The design of the specific reference architecture helps to have a flexible backup strategy either at the branch office or at the Head office (recommended).

### Network considerations

The design of the proposed SQL server reference architecture assumes that there is good network connectivity between the sites. All the network requirements confining to a windows multi-site cluster environment should be taken care of for the successful deployment of this architecture.

It is recommended that the SQL server virtual machine network interfaces (as well as the host machine interfaces) are resilient to underlying physical network adapter failures. This may be achieved using Network teaming feature of the Windows Server 2012 or using teaming software available from the network vendors like Broadcom.

### Storage considerations

In a branch office scenario, it is recommended to have similar disk configurations at the branch office and head office to ensure the similar database performance from both the sites. The organizations may choose to have different disk configurations if the business needs of the specific organizations mandate so.

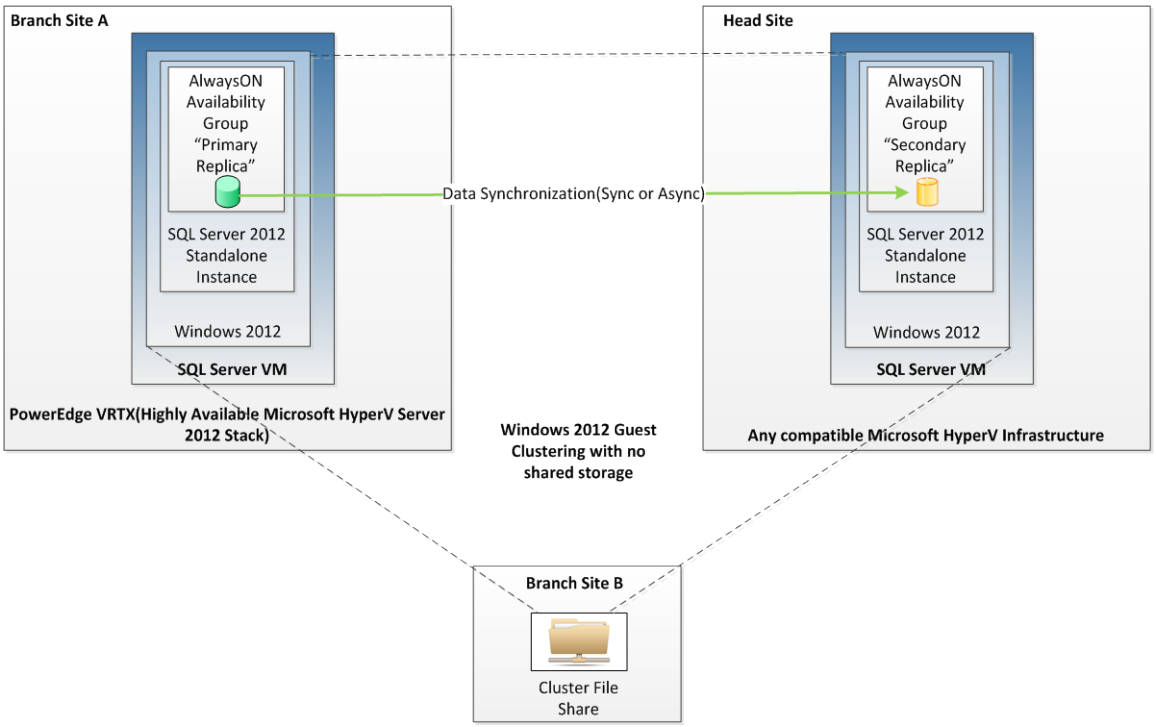
### SQL Server Reference Architecture

The SQL server reference architecture for ROBO was designed using a special feature called AlwaysON, SQL server enterprise edition feature introduced in SQL Server 2012. AlwaysON helps in achieving a robust Disaster recovery solution across sites by covering the best aspects of Windows Clustering and database mirroring.

For more information on SQL server AlwaysON, please refer to the link [http://msdn.microsoft.com/en-us/library/ff877884.aspx.](http://msdn.microsoft.com/en-us/library/ff877884.aspx)

The proposed reference architecture is depicted in Figure 9.

Figure 9. SQL Server Reference Architecture for Remote Offices



As shown in Figure 9, the primary database replica is hosted on "Branch Site A" on PowerEdge VRTX. The secondary (readable or non-readable) database replica is configured on the "Head Site". There is a cluster file share hosted on a different site (here "Branch site B") to ensure the maximum availability of the database.

The major architectural elements of this deployment are discussed in detail below.

**Host Clustering inside PowerEdge VRTX at the branch office**: Two or more nodes within the PowerEdge VRTX are clustered to avoid single server (instance) failures. On each server, multiple network adapters are teamed to provide a highly available networking backend. These configurations are leveraged as is from the "Remote office Infrastructure - Reference Architecture on Dell PowerEdge VRTX using Microsoft Hyper-V 2012" , which is used as a base for this configuration.

**Guest Clustering across sites**: The Windows Virtual machines meant for SQL server deployment at the branch site and the head office are clustered to enable the SQL server AlwaysON deployment. A two node VM cluster with the quorum configuration of Node and File Share majority is recommended. The Cluster File share has to be located on a third site for a good disaster recovery configuration. In this way, we can guarantee that the cluster stays online even if any of the sites goes down due to an unplanned disaster. There is no shared storage involved in this configuration. The hard drives may be exposed to the virtual machines either as VHDs or pass-through drives.

**SQL Server AlwaysON availability groups**: Standalone SQL server instances are deployed on each of the clustered virtual machines. SQL Server availability group is configured for the identified databases for disaster recovery. The configuration is done such that the primary SQL Server instance is located at the Branch office B1 and the secondary readable SQL server instance is deployed at the Head Office (HO).

These SQL server instances may be configured to be using either synchronous or asynchronous data mirroring. This conscious decision has to be made considering the disaster recovery guidelines of the organization, the network bandwidth between the sites, and the performance requirements.

Synchronous replication may be chosen if the network bandwidth between the sites is good and to keep the databases in sync as close as possible (minimal data loss). The database commits on the primary site will have to wait until the data is mirrored to the secondary site. Therefore there is a chance of the database performance getting slower at the primary site, if the data mirroring takes a longer time to complete. This kind of replication supports automatic failover as well as manual failover.

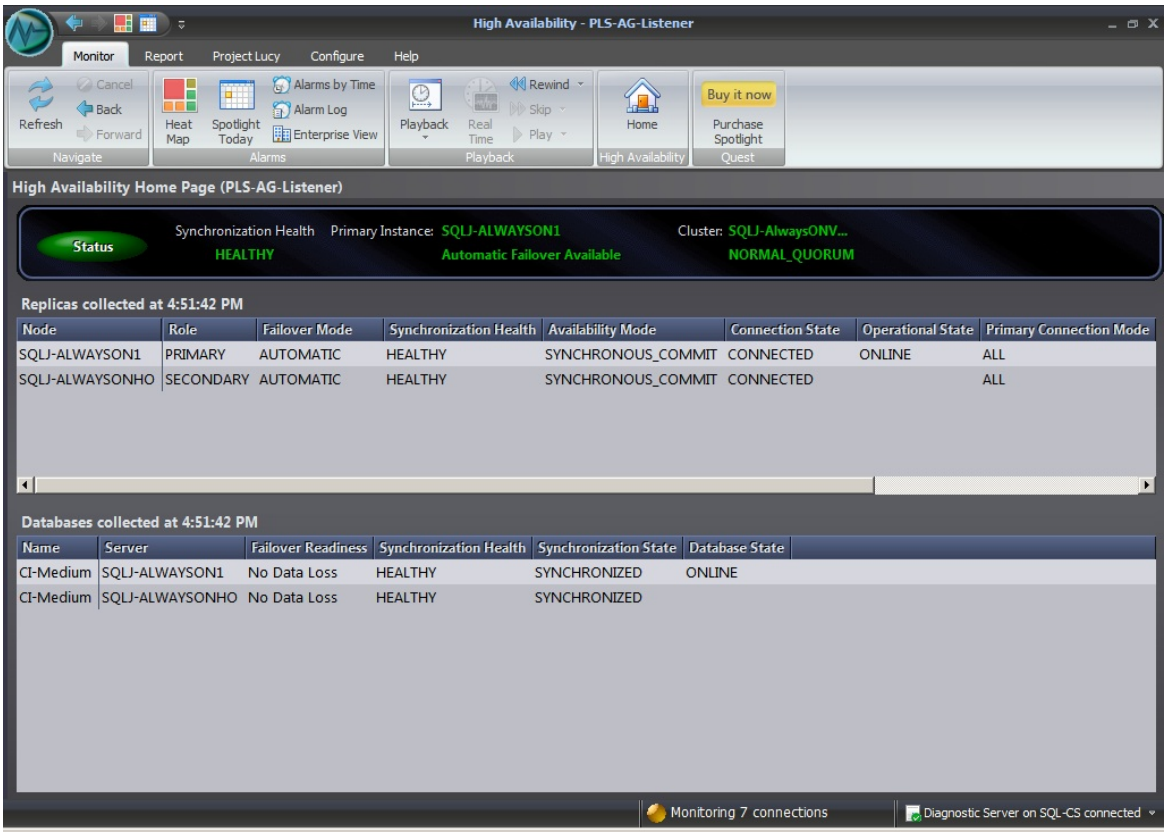
Asynchronous mirroring may be chosen if the organization is capable of affording a probable loss of data due to the commit pending at the secondary site. This configuration ensures the best of performance at the primary site. This would be a good option if there is less network bandwidth available between the sites or if it is unpredictable. This kind of data replication only supports manual or forced failover.

For more information on AlwaysON availability group Failover and Failover Modes, please refer to http://technet.microsoft.com/en-us/library/hh213151.aspx

The database level backups may be scheduled either from the branch or the head office. This is enabled due to the use of "readable secondary" configuration which is a sub-feature of the SQL server AlwaysON feature.

The health of SQL server AlwaysON configuration may be monitored from "Spotlight on SQL Server". Figure 10 shows the glimpse of the High Availability monitoring page on Quest Spotlight.

Figure 10. SQL Server AlwaysON Monitoring from Quest Spotlight




## Simplicity for small & mid-sized Customers

PowerEdge VRTX may be deployed as a virtual consolidation platform which may be used to host several different applications. It offers the resources sufficient to support the applications for a small local data center with low maintenance cost.

The below sections discuss the reference architecture for deployment of a local SQL server database on PowerEdge VRTX for a small SMB customer.

### SQL Server 2012 Database Virtual Machine Design Considerations

The major considerations for a design of a local SQL Server database instance on a virtualized PowerEdge VRTX are discussed in the below subsections.

### SQL Server Availability Considerations

Similar to the ROBO scenario, one of the design considerations is that the server node/instance failures should be taken care internally within the PowerEdge VRTX virtualized infrastructure itself.

### Network considerations

The virtual as well as the physical network connections should be resilient to underlying physical network adapter failures. This may be achieved using Network teaming feature of the Windows server 2012 or using teaming software available from the network vendors like Broadcom. This applies to both the host and the guest machines involved in the configuration.

### Storage considerations

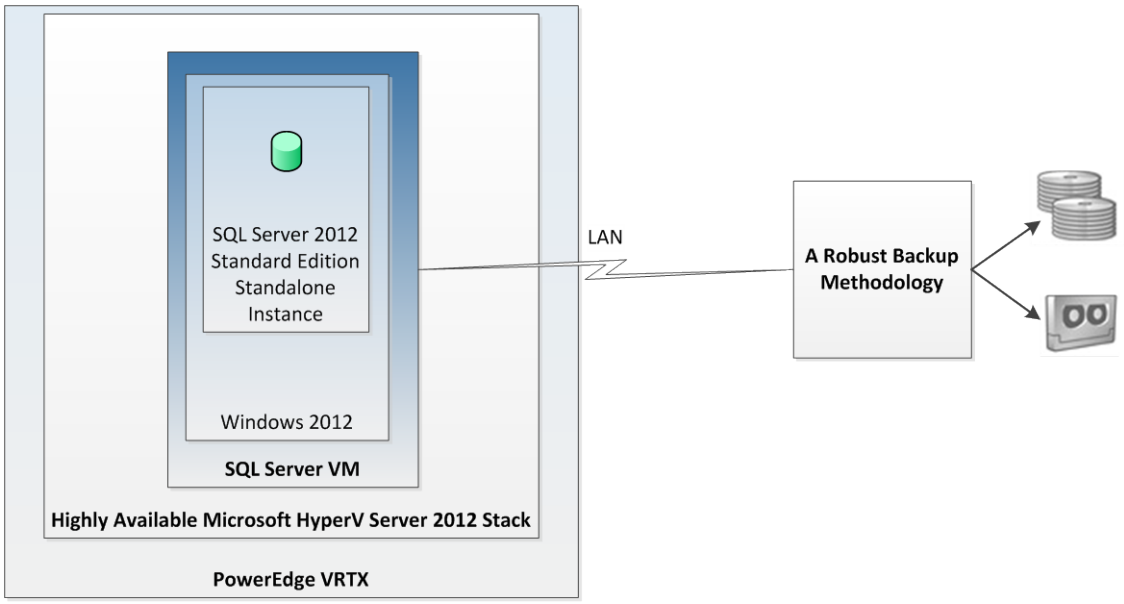
It is recommended to have the storage volumes, meant for the database files, exposed to the virtual machines as virtual hard disks (VHD) or pass-through disks.

### Sample Reference Architecture

The design of the below reference architecture was considered assuming a SQL Server standard edition deployment at the customer premises.

Figure 11 depicts a simple representation of the virtualized database reference architecture using VRTX.

Figure 11. SQL Server Reference Architecture for SMB offices




As mentioned earlier, the whole of the design is leveraged from the Microsoft horizontal Reference architecture which takes care of the several availability scenarios. This includes the failure at the different points including server, virtual machine, network, and so on.

In the above proposed reference configuration, the host (windows HyperV) clustering is configured to take of the individual server failures. Multiple network adapters are configured in teaming mode to tackle the physical network adapter failures.

As highlighted in Figure 11, it is highly recommended to have a separate backup infrastructure and a robust strategy to deal with the system failures in this scenario. It is also recommended to have the backup maintained at a different site to cover the site failures as well.

## Data Protection with Microsoft Systems Center 2012 Data Protection Manager

The PowerEdge VRTX solution offers flexible virtual Solution for customers who require running their local virtual applications at a remote or branch office. One of the challenges of remote office and branch office is data protection. How do you locally protect your environment without relying on the headquarters backup infrastructure? Relying primarily on a virtual infrastructure, despite clustering at the hypervisor layer, application level data is important to backup to ensure Recovery Point Objective

(RPO) and Recovery Time Objective (RTO) at the local branch are met to minimize downtime and data loss.

In this section we'll explore Microsoft Systems Center 2012 Data Protection Manager (DPM) and will provide an overview of the capabilities, installation options, and backup strategies to successfully backup and restore Virtual Machines running Microsoft SQL Server. Other applications such as Microsoft Exchange and SharePoint are outside the scope of this white paper. For more information, refer to http://technet.microsoft.com/en-us/library/hh758173.aspx.

## System Center 2012 Data Protection Manager

Microsoft System Center 2012 SP1 contains a module called Data Protection Manager (DPM). DPM is a disk-based and tape-based data protection solution. It provides a mechanism to push agents seamlessly to virtual or physical servers running on PowerEdge VRTX. Given that VRTX provides a virtual platform, the focus of DPM will be for backing and restoring virtual machines running Windows 2012 and Microsoft SQL Server 2012.

DPM includes the following features:

- Centralized management of multiple DPM servers.
- Disk-based data protection and recovery.
- Remote management of DPM servers.
- Command-line scripting using Windows PowerShell.
- Support for multiple DPM servers to share one instance of SQL Server for DPMDB.
- Certificate-based authentication for computers in workgroups or untrusted domains.
- Backup to Windows Azure Backup Services.
- Improved usage of tapes through protection group sets.
- Support for protecting VMM hosts.
- Tape-based backup and archive solutions.
- System state for protected file and application servers
- Disaster recovery solutions, which provides bare-metal recovery of servers running Windows.

## What's new in Systems Center 2012 – Data Protection Manager

Data Protection Manager (DPM) provides disk-based and tape-based recovery and backup capabilities. The focus of this white paper is the disk-based approach, as remote offices and branch offices may not have access to a tape library.

One of the advantages of PowerEdge VRTX is its portability and all-inclusive platform for running enterprise level applications in a very small footprint. Designed to provide a flexible virtual environment, customers can deploy a robust enterprise level virtual environment within a single VRTX leveraging Microsoft Hyper-V cluster for the internal blades and locally direct-attached storage (DAS), providing ease of configuration and setup.

Once the VRTX has been configured in a cluster and infrastructure virtual machines deployed, one or more infrastructure virtual machines can be deployed for DPM.

DPM includes an array of new features that improve performance and compatibility. For example:

- Improves performance for Cluster Share Volumes 2.0 (CSV) used in Hyper-V clusters.
- Protects Hyper-V remote SMB share that store VM files. Hyper-V can store virtual machine files on SMB shares, providing flexibility, and DPM is able to protect Hyper-V and the files stored on SMB shares. It also provides continued protection after live migration to another node.
- Excludes Page file from backups. This feature reduces storage usage and improves efficiency when backing up virtual machines.
- Supports Live Migration. DPM now provides uninterrupted protection when performing Live Migrations of virtual machines.
- Supports backups to the cloud. DPM now supports backing up data to Windows Azure Online Backup Services. This option provides maximum flexibility. An agent is required to communicate with Azure services. Windows Azure Online Backup supports up to 120 DPM recovery points.
- Includes support for protecting SQL Server.
- Includes support for protecting file server data.
- Includes support for protecting virtual machines.
- Includes support for protecting SQL Server 2012 databases that use AlwaysOn feature.
- Includes support for protecting file server using Resilient File System (ReFS).
- Includes support for protecting SharePoint 2013.
- Includes support for protecting Exchange Server 2013.
- Allows use of a stand-alone instance of SQL Server 2012 to host the DPM database.

This white paper focuses on protecting SQL Server databases hosted on PowerEdge VRTX.

### Prerequisites to install DPM in a Virtual Machine

Before you install DPM, you must first install .NET3.5 Framework version on the virtual machine. You will need the Windows 2012 installer or OS media in order to install .NET3.5.

1. Mount Windows Server 2012 DVD or ISO image to D:\ drive.
2. Open “Add Roles and Features” Wizard
3. Select .NET Framework 3.5 Features and click Next.
4. Select Specify an alternate source path link in the Confirm installation selections screen.
5. Specify the path as D:\Sources\SxS and click OK.
6. Finally, click Install button.

## Considerations for DPM Planning

An important aspect of DPM server is the concept of storage pool, a set of disks that store replicas and recovery points for protected data. Depending on the number of Virtual Machines and type of hard drive capacities installed on the PowerEdge VRTX, one example of how to configure the storage is shown in Figure 12 below. Four disks in RAID-10 can be dedicated for VM VHD files. Solid State drives can be configured as pass-through disks for a specific VM that requires the transactional performance. For generic SQL Server workloads, 15K or 10K RPM drives can be utilized to host more SQL Server databases or other applications. Lastly, the DPM Storage Pool needs to be 3 times the size of all the protected data. For example, if you have four 100GB Virtual Machines running SQL Server, the Storage Pool should be 800GB-1.2TB.

Configuring the DPM Storage Pool in RAID-5 offers balance between performance and high capacity. For more information on planning the Storage Pool refer to http://technet.microsoft.com/en-us/library/hh757941.aspx. This storage pool cannot be hosted inside a VHD – they must be either iSCSI-attached disks or pass-through disks.

The following 4 types of disk configuration are supported for DPM storage pool:

- Pass-through disk with host direct-attached storage (DAS)
- Pass-through iSCSI LUN which is attached to host.
- Pass-through FC LUN which is attached to host.
- iSCSI target LUN which is connected to DPM virtual machine directly.
- DPM does not support Universal Serial Bus (USB/1394 disks).
- DPM does not support Storage Spaces.

In this case, we'll use Pass-through disk with direct-attached storage (DAS). If the PowerEdge VRTX is attached to an iSCSI or FC SAN, then pass-through disks can also be utilized.

For more information about calculating capacity requirements and planning the configuration of the disks, see Planning the Storage Pool.

DPM installation location of the virtual machine needs to be at least 3 GB. In our case, the VM where DPM is installed is 100GB. In environments where virtual machine space requirements are lower, volume where DPM is installed should have 2-3 GB of free space for temporary data, buffers for change journals, and so on.

DPM can be installed with its own version of SQL Server 2008 R2 or other instances. The latter solution provides the most flexibility as multiple DPM Servers can host their databases on a dedicated instance that can also be protected by a secondary DPM server.

Whether on local instance or a shared SQL Server instance, DPM Database files require a minimum of 900 MB to store the metadata and catalog information.

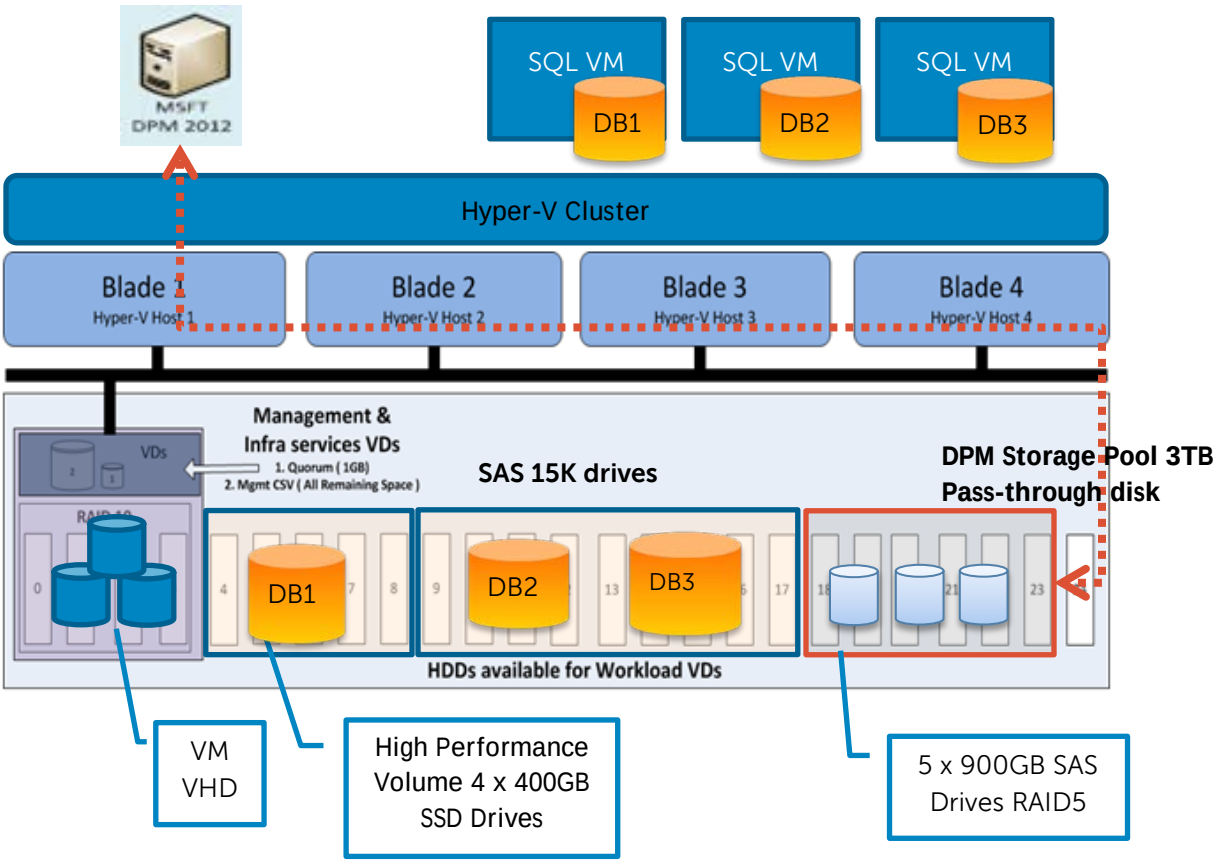
The system drive disk space requirement (at least 1GB) is necessary if you choose to install the dedicated instance of SQL Server from DPM Setup. If you use a remote instance of SQL Server, this disk space requirement is considerably less. For more information on hardware requirements refer to http://technet.microsoft.com/en-us/library/hh757757.aspx.

Use GUID partition table (GPT) dynamic disks for volumes larger than 2TB and up to 17TB. For sizes smaller than 2TB, master boot record (MBR) disks can be utilized.

DPM can protect branch or remote office DPM servers across geographically dispersed locations. As long as they are in the same domain or have a two-way trust between separate domain forests. In addition, DPM supports the use certificates to authenticate with SQL Servers that are in workgroups or untrusted domains.

To provide redundancy, a secondary DPM server can protect the primary DPM server. In the event of the primary DPM server failure, the secondary DPM server can continue to provide protection for the systems until the primary DPM server is restored.

Figure 12. Example of Backup Protection Logical Design



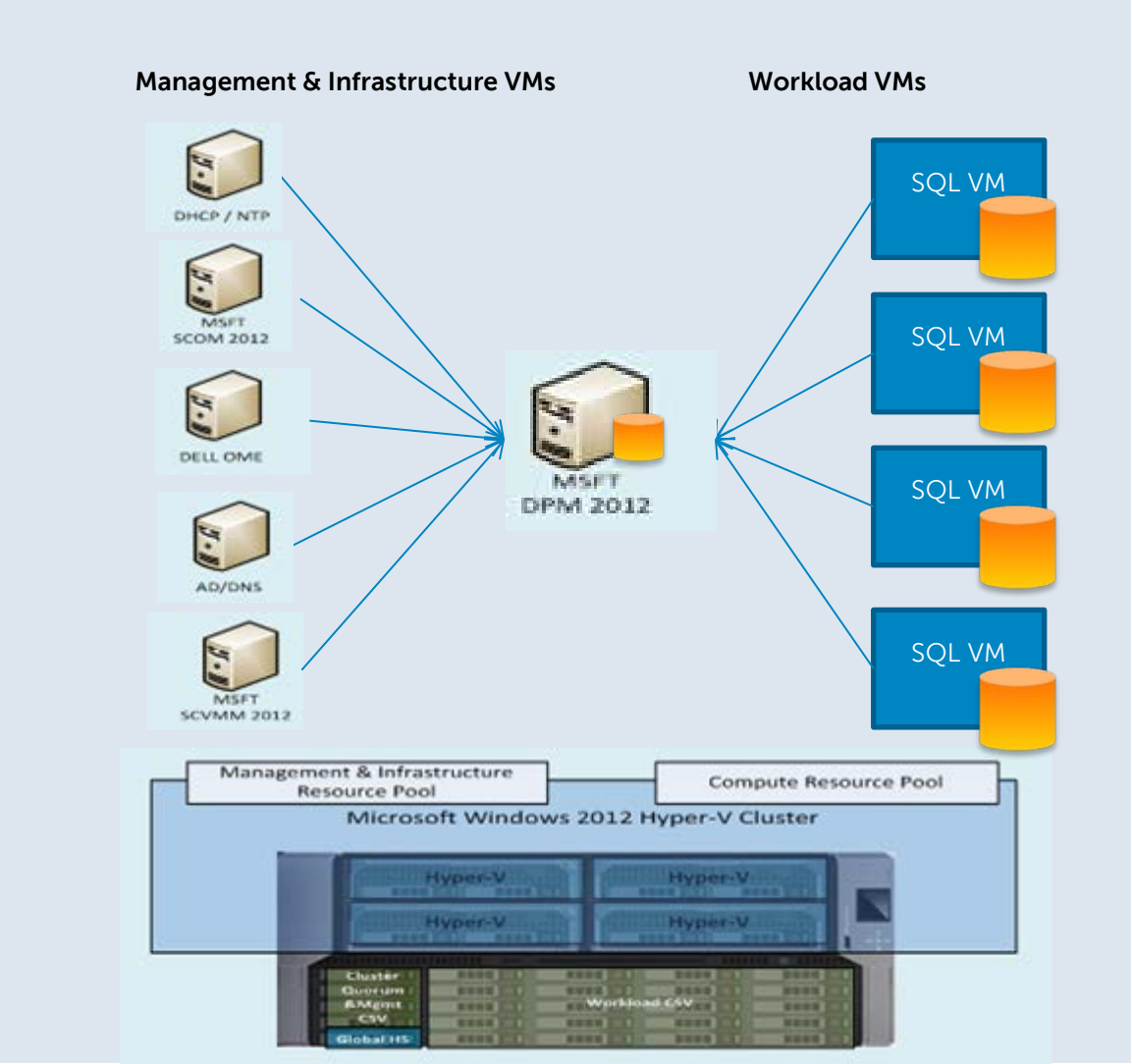

### Planning the DPM Server configurations

After the storage has been configured with Disk Groups for VM VHDs, Database files, and DPM Storage Pool, DPM can be installed on a virtual machine. We deployed one 100GB Virtual Machine to host the DPM Software with 2 vCPUs, 8GB of RAM, a 15-20GB pagefile, and a 3TB pass-through disk for Storage Pool. For minimum requirements see http://technet.microsoft.com/en-us/library/hh757829.aspx.

DPM requires a database to store journal and catalog information. The database can be hosted on an existing SQL Server instance or DPM installs a dedicated SQL Server 2008 R2 instance locally and does

not require a separate SQL Server license. For environments where a single DPM instance is sufficient, this option provides simplicity. Figure 13 represents a single DPM Server deployment.

Figure 13. Basic Strategy with single DPM Server




For environments that may require multiple DPM servers and/or backing up of the primary DPM server, using an existing SQL Server instance provides the most flexibility. A minimum of SQL Server 2008 R2 with latest updates or SQL Server 2012 is required with SQL Server Database Engine and Reporting Services. This instance of SQL Server for DPM databases needs to reside in the same domain and not be installed on the Domain Controller.

Keep in mind:

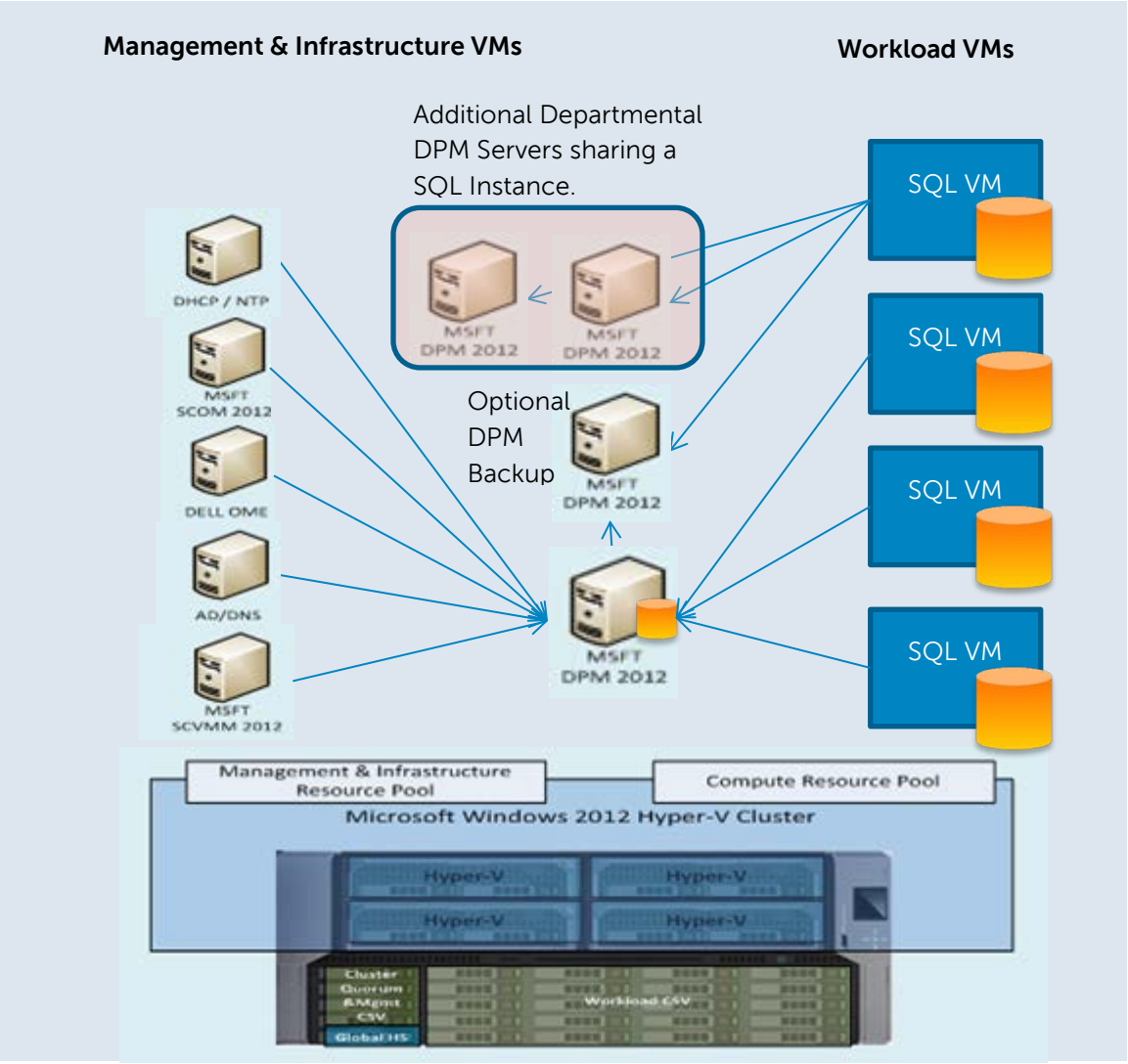
- Setup creates the **DPMDBReaders$<*DPM server name*>** and **DPMDBAdministrators$<*DPM server name*>** local groups on the computer that is running the remote instance of SQL Server. You must add DPM administrators to these groups for DPM to use the remote instance of SQL Server.

- For the DPM server to access a remote instance of SQL Server through Windows Firewall, you must configure an exception on the computer that is running SQL Server to use port 80.
- You cannot user a clustered instance of SQL Server 2012 to host a remote DPM database.
- You cannot host the DPM database on a SQL Server AlwaysOn deployment.
- To protect databases running on SQL Server 2012 you are required to add the NTAUTHORITY\System account to the SQL Server Roles user sysadmin.

For more information on setting up the DPM database refer to http://technet.microsoft.com/en-us/library/jj852163.aspx.

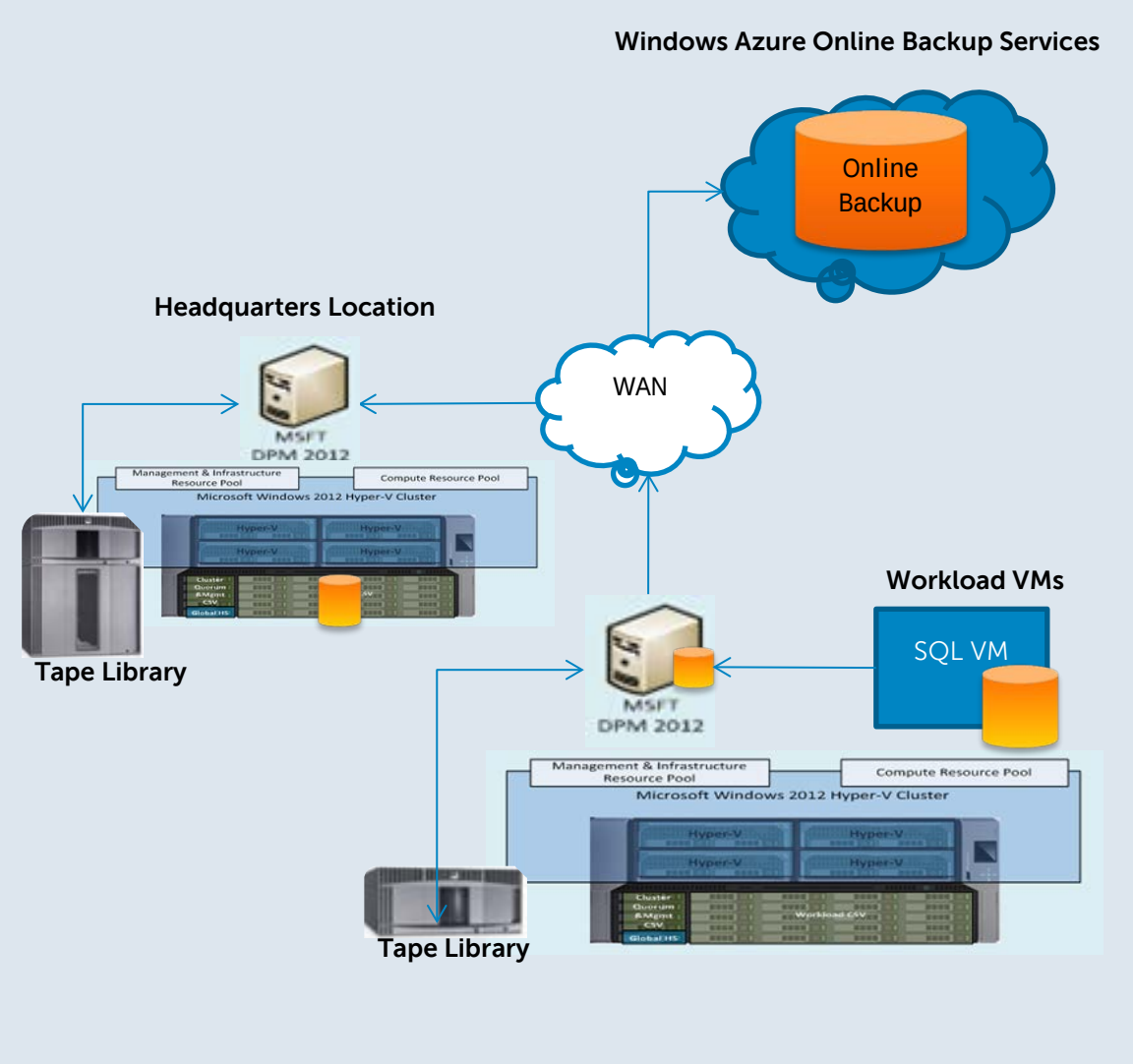
Figure 14 below shows an example of multiple DPM Servers using an existing SQL Server instance and a DPM instance used to back up the primary DPM server.

Figure 14. Multiple DPM Servers Design



For customer that require either long term retention or offsite backups of their data, Figure 15 depicts an example implementation where backups can either reside on local tape for long term retrieval of local data or stored offsite either on disk or tape. Another option that DPM 2012 offers is integration with Windows Azure Online Backup Services. This option provides the flexibility of customers that may not have a central headquarters office such as in the case of small businesses that don't have additional local resources to store data outside of the PowerEdge VRTX in the event of hardware failures. A Windows Azure Online Backup protection agent needs to be installed on the DPM server that will be communicating with the online services. For more information on supported configurations for Managing Windows Azure Online Backup Services with DPM refer to http://technet.microsoft.com/en-us/library/jj728752.aspx.

Figure 15. Offsite and Cloud Strategy




## Planning Protection Configurations

Once DPM is installed and running on a virtual machine hosted on the PowerEdge VRTX and other virtual machines are running SQL Server or other applications, there are various methods to protect data with DPM. DPM allows the grouping of systems that have the same profile or protection configuration called ***protection group***. There are two main methods to protect data: protect by entire

system/computer or by specific data type (for example, database or volume). Each method offers benefits and challenges. The benefit of protecting the entire system is that it is easier to restore the entire contents of the virtual machine; the challenge is that not all data within the virtual machine requires the same level of protection. When protecting by specific data, then multiple groups are required to separate the data with individual protection policies. For example, a SQL Server might require daily backups with 15 minute recovery points, but the rest of the databases might not need that level of protection. Files and application data within the same protection group can have different recovery goals.

> Note that for long term retention DPM supports tape-based backups. For the purpose of this white paper only disk-based backups are discussed.

Once it is determined the type of grouping desired to protect data, the next step is to define the recovery goals. The key areas to specify recovery goals are synchronization frequency, recovery point schedule, and retention range.

- Synchronization frequency specifies how often the protected data is synchronized with the DPM copy. The 15 minutes interval is the minimum frequency that can be achieved.
- The recovery point schedule is based on the frequency of synchronization. It also allows the day/time to be set for Express Full Backup. For SQL Server database that use log-shipping, read-only or use Recovery Model set to Simple, the recovery points will only be the Express Full backups.
- Transaction log backups, which DPM uses for incremental synchronization of application data, cannot be performed for a SQL Server database that is read-only, configured for log shipping, or configured to use the Simple Recovery Model. For those SQL Server databases, recovery points correspond to each express full backup.
- The retention range is how long you need the backed-up data available. The frequency of recovery points and full backups require space on the DPM Storage Pool. It is advisable to set the retention range to a reasonable range in days when it is required. For long term retention, it is recommended to use a tape library attached to the PowerEdge VRTX.

For more information on DPM Recovery Goals, see http://technet.microsoft.com/en-us/library/hh758197.aspx.

# Appendix A – Configuration details

Table 1. Test Configuration

| Component | Description |
|---|---|
| Server | Four PowerEdge M620s(Clustered using Microsoft Failover Clustering) |
| Hypervisor | Microsoft HyperV Server 2012 |
| Host Processors | Dual Intel Xeon CPU E5-2680 @2.7GHz (8 core processors) |
| Host Memory | 128GB |
| Guest Operating System | Windows server 2012 |
| Virtual processors(vCPUs) | 2 |
| Guest Memory | 10GB |
| Application | SQL Server 2012 SP1 |
| Database Size | Around 100GB |
| Test Workload | Standard TPC-C(OLTP) benchmark |

# Appendix B - Additional resources

Referenced or recommended Dell publications:

- Microsoft HyperV Reference Architecture using Dell PowerEdge VRTX:
  http://en.community.dell.com/techcenter/extras/m/white_papers/20395858.aspx
- Dell PowerEdge VRTX:
  http://www.dell.com/us/business/p/poweredge-vrtx/pd

Referenced or recommended publications:

- Overview of AlwaysOn Availability Groups (SQL Server):
  http://msdn.microsoft.com/en-us/library/ff877884.aspx
- Design for a Clustered Service or Application in a Multi-Site Failover Cluster:
  http://technet.microsoft.com/en-us/library/dd197430(v=ws.10).aspx
- Spotlight on SQL Server:
  http://www.quest.com/spotlight-on-sql-server-enterprise/
- Systems Center 2012 Data Protection Manager:
  http://technet.microsoft.com/en-us/library/hh758173.aspx