

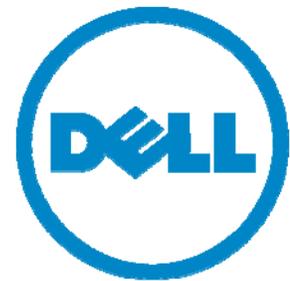
Microsoft® SharePoint® Server 2010

Designing and Implementing a Small Server Farm

Dell™ Solutions Engineering

Ravikanth Chaganti and Kevin Guinn

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Executive Summary

A Microsoft SharePoint Server 2010 farm hosts service applications that provide many different functions for its users. These functions are available through Web servers, and store configuration information and data in SQL Server® databases. The interaction between components means that a three-tier model is appropriate for SharePoint Server 2010. However, for small scale farms, it is possible to consolidate the presentation and application tiers. This paper provides a basic reference architecture that maps SharePoint roles into this consolidated model, and then extends the architecture to provide high-availability and redundancy across the server farm.

The paper discusses key criteria and decision points that determine what server and storage hardware is appropriate for a small-sized SharePoint Server 2010 farm. It offers guidelines for determining how much storage space should be allocated, and when separate storage volumes are needed. The intent of this paper is to describe the important planning criteria, and for administrators to begin mapping their plan to a specific farm topology and well-suited hardware components; Dell offers specific guidance through consulting and other services.

A companion paper, *SharePoint Server 2010: An Introduction*, is available from www.dell.com/sharepoint. It offers an overview of SharePoint Server 2010, and provides common concepts and definitions that form a good basis for understanding the reference architectures presented in this paper.

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Introduction

Microsoft SharePoint Server 2010 builds on the capabilities offered in Microsoft Office SharePoint Server 2007 to provide a rich platform for collaboration, information sharing, and document management. SharePoint 2010 adds several new features, and introduces important architectural changes and product improvements. For a complete overview of SharePoint Server 2010, its features, and key dependencies, see *SharePoint Server 2010: An Introduction*, a companion to this white paper that is available from <http://www.dell.com/sharepoint>.

The remainder of this paper defines the reference architectures that illustrate how a small-sized SharePoint Server 2010 server farm can be designed. There are many factors, such as information isolation policies, or the need to provide Enterprise Search capabilities for content outside of the farm, that can introduce the need for additional servers or more complex designs.

Designing and Building a Small Server Farm

Organizations planning to implement a SharePoint 2010 solution must plan for increased workloads, changing user requirements, and server failures. You can use a server farm deployment model to help ensure that the infrastructure solution is scalable, flexible, and resilient to hardware failures. The following sections explain the infrastructure elements in a small server farm and the purpose of server roles in the farm.

Small Farm Topology

The SharePoint Server 2010 installation offers a choice between a stand alone or a server farm installation. The stand alone installation is intended for single-server deployments; it installs SQL Server 2008 Express Edition and the required SharePoint components on a single host server. When SharePoint Server 2010 is configured using the stand alone option, it is not possible to add any additional servers to create a farm-based installation. This design precludes the ability to scale one or more roles in the future, and is generally only recommended for small test environments. In fact, if only one host server is available, it is often preferable to build a farm configuration using virtual machines.

To overcome the limitations associated with a standalone installation, and to provide a flexible configuration that allows for future scalability, it is recommended that a true server farm be the baseline topology for a SharePoint 2010 deployment. A basic small farm, in which the SQL Server database is hosted by one server and the SharePoint application and Web front-end roles are consolidated onto another server is illustrated in Figure 1; for simplicity, this example relies exclusively on internal disks in each host server. Additional external storage arrays can provide more physical spindles that make it easier to separate database volumes and improve overall farm performance.

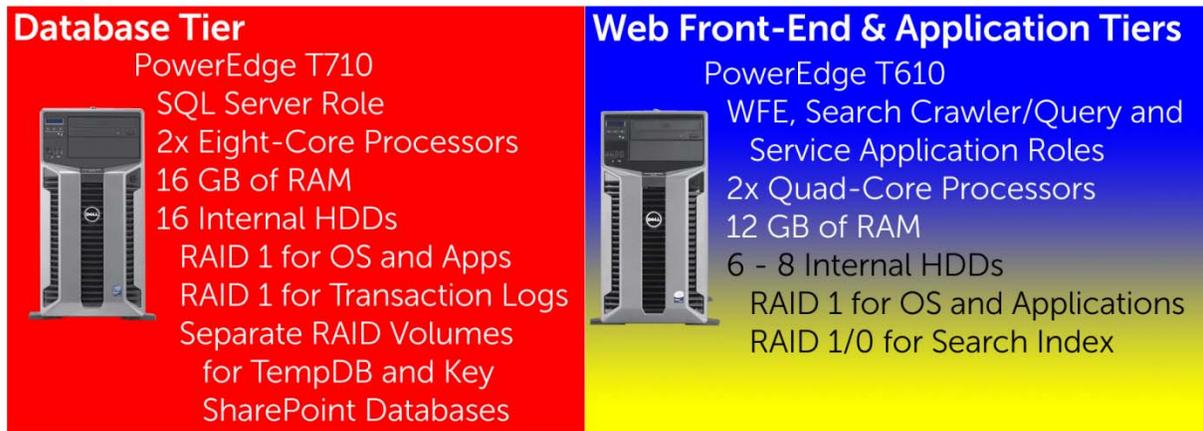


Figure 1: Basic Small Farm for SharePoint Server 2010

In general, this type of small farm is expected to host a few hundred gigabytes of content and to provide services for up to 1000 users, but a SharePoint deployment can be used in a variety of ways. The number and type of user requests ultimately determines whether a particular topology is suitable for the intended SharePoint farm use. Also, if most content is static or archival, then the farm capacity can grow considerably without placing additional stress on the servers.

Database Considerations

SharePoint 2010 brings significant changes to the database tier of a SharePoint farm. With the new shared service application model, there are additional SharePoint databases over the previous version. In contrast to the “Shared Services Provider” and its single database that was employed in MOSS 2007, each service application now stores content and configuration details in its own database. The database server remains an important aspect of a SharePoint 2010 farm; it is used to store SharePoint configuration details, to host user data and farm content, and to enable search functionality. To address all of these needs, the database server must have adequate processing power and system memory to provide a good user experience and meet overall farm service level agreements (SLAs).

The database server performs queries and updates in response to requests from front-end Web servers. When configuring a small server farm, install the Web and database server roles on separate machines to simplify planning, and to facilitate the process of adding additional servers to the farm as needed. The SQL Server host should be configured before configuring SharePoint components on the other farm server(s); it must be available before the configuration database, which stores information about the farm servers and their roles, can be created.

SharePoint relies heavily on the database server, perhaps more than any other server farm role, because it stores all configuration data and content. If there are any bottlenecks in the database server, performance is impacted across the entire server farm. To achieve high performance from the SharePoint farm, administrators should monitor and maintain the database server. One common method to increase farm performance is to provision additional volumes on dedicated physical disks for heavily-accessed SharePoint databases.

System Hardware Architecture

SharePoint 2010 is available only for 64-bit extended (x64) architecture. This allows the SQL Server host to use RAM beyond 4 GB efficiently, which can help increase the number of connections and

transactions that the database server can process. To satisfy this requirement, the host server must use x64 hardware and run an x64 edition of a supported Windows Server® OS. Dell PowerEdge™ servers with Intel® Xeon® or AMD Opteron™ processors, such as those featured in this paper, have x64 hardware and can be used in a SharePoint farm.

Operating System and Database Editions

Choosing among the various editions of Windows Server 2008 with SP2 or Windows Server 2008 R2, and SQL Server 2008¹ or SQL Server 2008 R2 is decided based on system specifications and software features that are important in the intended environment. The most important OS considerations are listed in Table 1, and those for the database software are listed in Table 2. The high-availability features listed in these tables—such as failover clustering and database mirroring— are examined later in this paper.

Table 1: Key Factors for Selecting an OS Edition

	Windows Server 2008 SP2 or 2008 R2 x64 Standard Edition	Windows Server 2008 SP2 or 2008 R2 x64 Enterprise Edition
Support for Failover Clustering	No	Yes, up to 16 nodes
Maximum Physical RAM	32GB	2TB

Table 2: Key Factors for Selecting a SQL Server Edition

	SQL Server 2008 or 2008 R2 x64 Standard Edition	SQL Server 2008 or 2008 R2 x64 Enterprise Edition
Support for Failover Clustering	2 nodes	Max number of nodes supported by OS
Database Mirroring	High-safety mode only	All high performance and high safety modes
SQL Server Reporting Services	Available	Available
SQL Server Analysis Services	Available	Available
Database Compression	Not Available	Available
Transparent Data Encryption	Not Available	Available
Resource Governor	Not Available	Available
Remote BLOB Storage	Not Available	Available

Consider the following example: A database server, with its content databases initially stored on internal disks, is deemed sufficient for a company's small farm; this server is configured with 16 GB of RAM, and not expected to require more than 32 GB throughout its service life. There is, however, a business need to enhance the availability of the farm by using database mirroring. Based on all of these factors, the Standard Edition of both Windows Server and SQL Server should meet the company's needs.

Selecting a PowerEdge Server for SQL Server

The SQL Server host will generally require more CPU and system memory resources than other farm servers. For a small farm, Dell recommends a minimum of eight processing CPU cores and 16 GB of RAM for this server.

¹ SQL Server 2008 with Service Pack 1 and Cumulative Update 2 is the minimum required version of SQL Server 2008. SQL Server 2005 with Service Pack 3 and Cumulative Update 3 is also supported.

Dell offers tower and rack-mountable servers that meet or exceed these requirements. For entry-level configurations, the PowerEdge T710 and R510 easily meet the CPU and memory requirements, and also provide a relatively large number of internal physical disks.

When external storage arrays, such as the PowerVault MD1200 or MD1220, are used to house the SharePoint databases, the primary considerations for the SQL Server host are processing, memory, and I/O capability. The R410 and R610 provide two processor sockets, and offer maximum memory configurations well beyond the above recommendations.

Database Storage Configuration

By default and without any additional configuration, SharePoint will store all of its data in a single content database, and a small farm can reasonably be expected to store up to a few hundred gigabytes (GB) of data. In MOSS 2007, the general rule-of-thumb was to limit the size of an individual SharePoint content database to 100 GB. SharePoint Server 2010 improves the content storage architecture and can mitigate some of the performance problems associated with large lists by utilizing throttling. To improve content isolation, reduce backup / recovery times, and generally make data management easier, it is still recommended to plan and implement an information architecture that includes multiple moderately-sized content databases and restricts the number of site collections that are associated with each individual content database. Similarly, to ensure the best farm performance, it is recommended that general-purpose content databases be limited to 200 GB or smaller; it is still strongly recommended that each site collection is limited to 100 GB, unless it is the only site collection within its content database.

Another new database in SharePoint Server 2010 is the usage and health data collection database, also known as the logging database. A SharePoint timer job collects, aggregates, and collates ULS logs from each farm server, and stores them in the logging database. For planning purposes, it is best to assume that this database will be large, heavily used, and write intensive.

Table 3 outlines some of the database entities that should optimally have dedicated volumes, and recommends appropriate RAID configurations. An overview of all SharePoint 2010 databases that includes planning and maintenance recommendations is available on Microsoft Technet². Physical disks that operate at 15k rpm are preferred for all transaction logs and for more-heavily-used SQL Server data volumes. If performance is a concern, configuring external storage arrays and providing additional physical spindles is preferred to using few larger-capacity disks.

Table 3: Database Storage Recommendations

Function	Preferred RAID Level	Notes
Transaction Logs	RAID 1/0	Optimized for writes, and should allow room for log growth.

² See "Database types and descriptions (SharePoint Server 2010)" at [http://technet.microsoft.com/en-us/library/cc678868\(office.14\).aspx](http://technet.microsoft.com/en-us/library/cc678868(office.14).aspx)

Function	Preferred RAID Level	Notes
Content Databases	RAID 1/0 for content databases that host site collections focused on collaboration or that will feature extensive write activity. RAID 5 for content databases that host site collections focused on portals or document repositories that feature predominantly read activity.	Consider dedicated content databases for any site collection that will have a high level of activity. Use separate databases for site collections with different access patterns, and optimize volumes by access pattern. Provision multiple data files for each configuration database.
TempDB	RAID 1/0	Use can be influenced by SQL Server factors outside of SharePoint, such as rebuilding indexes. Treat TempDB as if it will be heavily utilized.
Logging Database	RAID1/0	Considered to be heavily utilized.
Search Crawler database	RAID 5 or RAID 1/0	Read-heavy, but poor write performance could increase crawl complete time.
Search Property database	RAID 1/0	Optimize for good read and write performance. Typical access pattern favors writes, but poor read performance can impact search query times.

Estimating Storage Capacity

Estimating the total data storage space required for a SharePoint 2010 farm can be challenging, and is dependent on how SharePoint 2010 will be used within the organization. A department or company-wide portal may demand significantly more storage than a team site or an individual MySite; however, there are likely to be many more of these smaller sites hosted within the farm. In addition, document libraries will generally require more storage than site features such as blogs, wikis, and other types of lists. If the versioning, recycle bin, or audit features of SharePoint will be used, then additional space must also be allocated for this data.

Table 4 outlines an estimation guideline³ and provides examples for estimating the required amount of storage for the content database. Specifying a lower fill factor provides additional space in the database that can be used to store document versions and site recycle bins, or can be used to meet audit requirements. This “unused space” also serves as a buffer that can accommodate content growth.

³ At publication of this paper, SharePoint Server 2010 was not released, and updated content database size estimation formulas based on document and list parameters were not available. This information is expected to be released in the future and made available on [http://technet.microsoft.com/en-us/library/cc298801\(office.14\).aspx](http://technet.microsoft.com/en-us/library/cc298801(office.14).aspx)

Table 4: Estimating Content Database Size Requirements

	Size of content to be stored	Database overhead	Fill factor (for growth and versioning)	Minimum disk space to allocate
Guideline	X	20% (0.2 * X)	50 - 70% recommended	~1.7 * X (70% fill factor) ~2.4 * X (50% fill factor)
150 GB content	150 GB	30 GB	50%	360 GB
350 GB content	350 GB	70 GB	70%	600 GB

NOTE: In Table 4, the examples all yielded recommended disk allocation sizes in excess of 200 GB. In these situations, it is recommended that site collections in the farm be split among several content databases, and that each individual general-use content database is no larger than 200 GB and each site collection is no larger than 100 GB.

In addition to the content databases, the SQL Server host will require space for the configuration, central administration, search (administration, crawl, and property), and service application databases. The configuration, central administration, and search administration databases are generally small (approximately 1-2 GB). The search crawl and property databases are based on the amount of content in the farm; based on initial Microsoft testing and analysis⁴, assume the following sizes for these databases:

- Crawl: 4.6% of the total combined size of all content databases
- Property: 1.5% of the total combined size of all content databases

In SharePoint 2010, trace logs & usage information are stored in the logging database. The default retention policy for this data is 14 days, but it can be configured to different values using PowerShell; longer retention periods will require additional storage space. Depending on how the Usage and Health Data Collection is configured, this database can store very granular information to enable Web analytics and usage monitoring; this information is collected and aggregated from every server in the SharePoint 2010 farm. For these reasons, the logging database can grow to a large size, and may do so within in a short time if several different health data points are collected. This database should generally be housed on a dedicated volume, and monitored carefully if a large amount of data will be collected for an extended period of time.

Employing quotas to limit the size of individual sites, and establishing governance policies to manage content and control the number of sites in the farm, can help control the total space required by a given farm. It is important to plan for capacity to increase over time, and to build a flexible and scalable infrastructure that will enable the farm to grow.

For optimal performance, consider using external storage arrays, such as the MD1220. This array provides up to 24 physical disks that can give the flexibility required to provide separate volumes for various SharePoint databases. As the farm grows, additional MD1220 units can be interconnected to expand overall storage capacity and performance.

⁴ See "Storage and SQL Server capacity planning and configuration (SharePoint Server 2010)" at [http://technet.microsoft.com/en-us/library/cc298801\(office.14\).aspx](http://technet.microsoft.com/en-us/library/cc298801(office.14).aspx)

Considerations for WFE and Application Servers

In a SharePoint farm, Web front-end servers render HTML to requesting clients and route requests to other services in the farm. Web servers also host the SharePoint Web application in Internet Information Services (IIS), and these servers send queries and updates to database servers in response to user requests. As the front-end Web server is the only server role that is directly exposed to the end user, install it behind a firewall or take appropriate steps to secure the server in the network. All SharePoint features, site definitions, rendering, and localization files are stored on the front-end Web server. SharePoint also installs a number of Windows services on front-end Web machines that are required to communicate with other farm servers and to perform administrative tasks.

In a basic small farm topology, the database server is hosted on one server and the remaining application server and Web front-end roles are consolidated onto another server. Unlike a single-server deployment, this topology enables additional servers to be added and roles to be reallocated as the farm grows to meet changing business needs. To configure a small farm, deploy the database server and then install and configure the server that will host the SharePoint 2010 application and Web front-end components. During SharePoint installation, select the Server farm option to avoid provisioning a single-server solution, and then select the complete option to enable all of the needed SharePoint components and services to be configured.

If search is configured, the host will require disk space to house the search index. A guideline for estimating disk size is based on the size of the crawl database; allocate space for approximately 2.5 times the size of the crawl database (roughly 12% of the crawled content size). In farms this size, the search index is not expected to be partitioned. While this guideline provides a starting point, the index size will vary based on the content source definitions. For the best results, store the search index on its own RAID 1/0 volume; read performance helps provide query results more quickly, and write performance helps reduce the time required to complete a crawl operation. Crawling content and building the index can be a CPU- and memory-intensive operation; administrators should generally schedule crawls at off-peak times.

Selecting PowerEdge Servers for the Web Front-End and Application Servers

For the Web and application host in a small farm, consider a server with at least eight processing cores and 12 GB of RAM. The PowerEdge R510 is a two-socket server that can be configured with eight or twelve internal disks, making it well suited for storing a search index. If the farm is using tower servers, the T610 offers eight hard disk drives that should also work well for this purpose.

Operating System and SharePoint Editions

It is uncommon for a SharePoint application server or Web front-end server to benefit from any Windows Server 2008 or Windows Server 2008 R2 Enterprise Edition enhancements that are not available in Standard Edition. At the application and Web front-end tiers, failover clustering is not utilized for availability; instead, SharePoint components are configured to run on multiple servers within a farm. This means that, in most cases, Windows Server 2008 or Windows Server 2008 R2 Standard Edition is sufficient for the application and Web front-end servers.

For SharePoint 2010, the biggest differentiator between Standard Edition and Enterprise Edition are the features and services used to develop solutions for business intelligence and analytics or to offer enhanced services for specific Microsoft client applications. These features are enabled by the Business Data Connectivity, Excel Services, Visio Services, etc. If these features are needed in the farm, use SharePoint 2010 Enterprise Edition; otherwise, the Standard Edition is sufficient.

Building High Availability and Redundancy

A SharePoint solution may provide functionality that is deemed to be of high importance for the business, so it is important to design the farm so that it enhances the availability of the solution. The basic two-server small farm outlined in Figure 1 features host servers with redundant hardware components, including power supplies and RAID volumes. Unfortunately, hardware redundancy is often insufficient to meet the service level agreement (SLA) demanded of important business infrastructure components. To overcome these limitations, additional hardware can be deployed to protect the solution against a greater range of potential failure scenarios, and to ensure that operations can continue in the event that a single server is completely offline.

This section discusses techniques for increasing the availability of a small SharePoint farm, and explains the benefits and limitations of the highly-available farm architecture; specific recommendations for backup and recovery, business continuity, and disaster recovery are outside the scope of this paper.

High Availability for the Database Server

Microsoft SQL Server 2008 provides features designed to ensure high-availability of applications. Table 5 summarizes and contrasts database mirroring and failover clustering, which are the two most-commonly used high-availability techniques.

Table 5: Comparison of Failover Clustering and Database Mirroring

	SQL Failover Cluster	SQL Database Mirroring
Protection Provided	Data is stored on a single shared storage array and uses RAID, hardware redundancy, and multipath I/O for protection. The clustered SQL Server instance can run on any node in the cluster, providing tolerance for a wide range of hardware and software faults on the host servers. The design goal for a failover cluster is to militate against a single point of failure that causes the database to remain offline.	Both the primary SQL Server and its mirroring partner have their own data copy, and each node's storage subsystem features RAID and hardware redundancy. SharePoint 2010 databases and service applications can allow specification of mirror-aware connection strings that facilitate automated failover. Independent database servers and separate data copies provide protection against faults that adversely impact one of the database host servers, or its storage array.
Recovery Method	When there is a failover event, there is downtime as the SQL Server services are started on the alternate cluster node, and the database steps through the redo logs to ensure consistency. Once this is complete, services will resume without intervention.	SharePoint 2010 provides native support for SQL Server mirroring for many of the SharePoint 2010 databases. Specify a failover database server when Web and service applications are created; in case of primary SQL server failure, SharePoint automatically switches to a secondary; default failover switching time is 15 seconds.
Performance Impact	The overhead associated with running a clustered versus a stand alone SQL Server instance is generally considered negligible.	Logs are compressed and transmitted to the database mirroring partner; adds additional CPU, network, and I/O load to the primary SQL Server system.

	SQL Failover Cluster	SQL Database Mirroring
Operating System and SQL Server Editions	<p>Operating System: Enterprise Edition is required for failover clusters</p> <p>SQL Server: Standard Edition supports just two cluster nodes. Enterprise Edition supports as many nodes as the operating system.</p>	<p>Operating System: Standard Edition is generally sufficient.</p> <p>SQL Server: Standard Edition provides high-safety (synchronous) mirroring Enterprise Edition adds support for high performance (asynchronous) mirroring. To enable automated failover high-safety mode and a witness server are necessary.</p>

Failover Clustering

In a failover clustering scenario, the database is placed on an external shared-storage array with integrated RAID controllers, such as the PowerVault™ MD3000. SQL Server 2008 failover clustering works in a shared-nothing model; each node in the cluster owns and manages its own resources. In the case of node failure, services running on the failed node are moved to an active node.

Figure 2 shows a small SharePoint farm that is configured with a failover cluster that hosts the SQL Server databases. The two cluster nodes are connected to an external shared-storage array. An additional server has been provisioned to allow the Web front-end role, and service applications - including the search crawl and query components - to be configured to run on two servers. In this example, the search index is stored on an external storage array instead of using internal disks within each host.

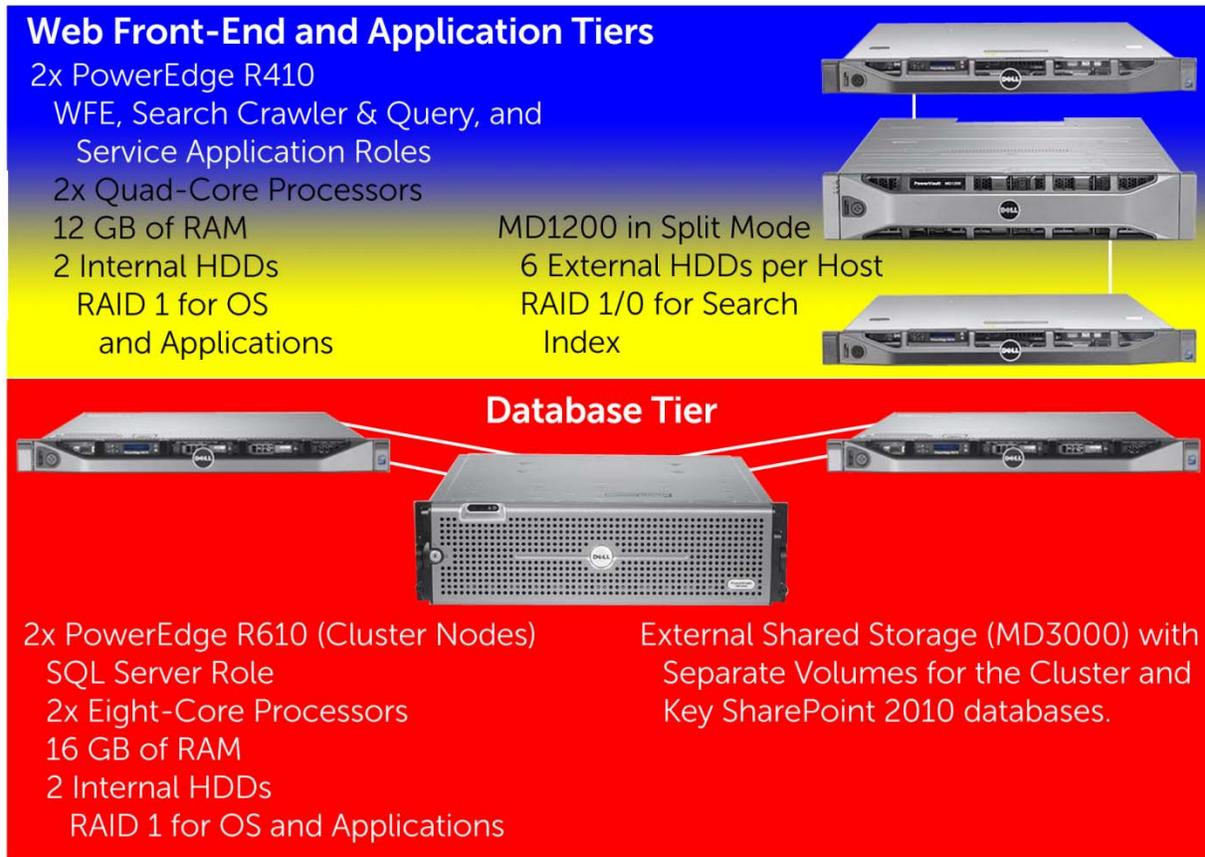


Figure 2: Highly-Available Small Server Farm with SQL Server Failover Cluster

Microsoft SQL Server 2008 failover clustering is active/passive with respect to a clustered SQL Server instance. A given SQL Server instance operates on a single cluster node at any given point in time, but additional cluster nodes may host other services or instances. If the node hosting a specific SQL instance fails, all of the requisite resources and services will failover to a surviving cluster node. Ideally, at least one cluster node should be configured to be fully passive; its role in the cluster is to provide the capacity to continue operations in the event that another node fails.

SQL Database Mirroring

In SQL Server 2008, database availability can be achieved using database mirroring; this feature is implemented on a per-database basis. Database mirroring works by compressing transactions logs from the primary database, and shipping them to the mirror database on a separate server. The logs are applied to the mirror database, which allows both copies to reflect the same updates, inserts, and other database changes. SharePoint 2010 generates connection strings that help enable automatic failover to the mirrored database instance for many of its databases. Configure mirrors in high-safety mode and employ a witness server for the best results; other mirror configuration types do not allow for automatic failover. This type of database mirroring configuration is illustrated in Figure 3, which also features an additional server to provide availability for the Web front-end and application tiers of a small SharePoint 2010 farm.

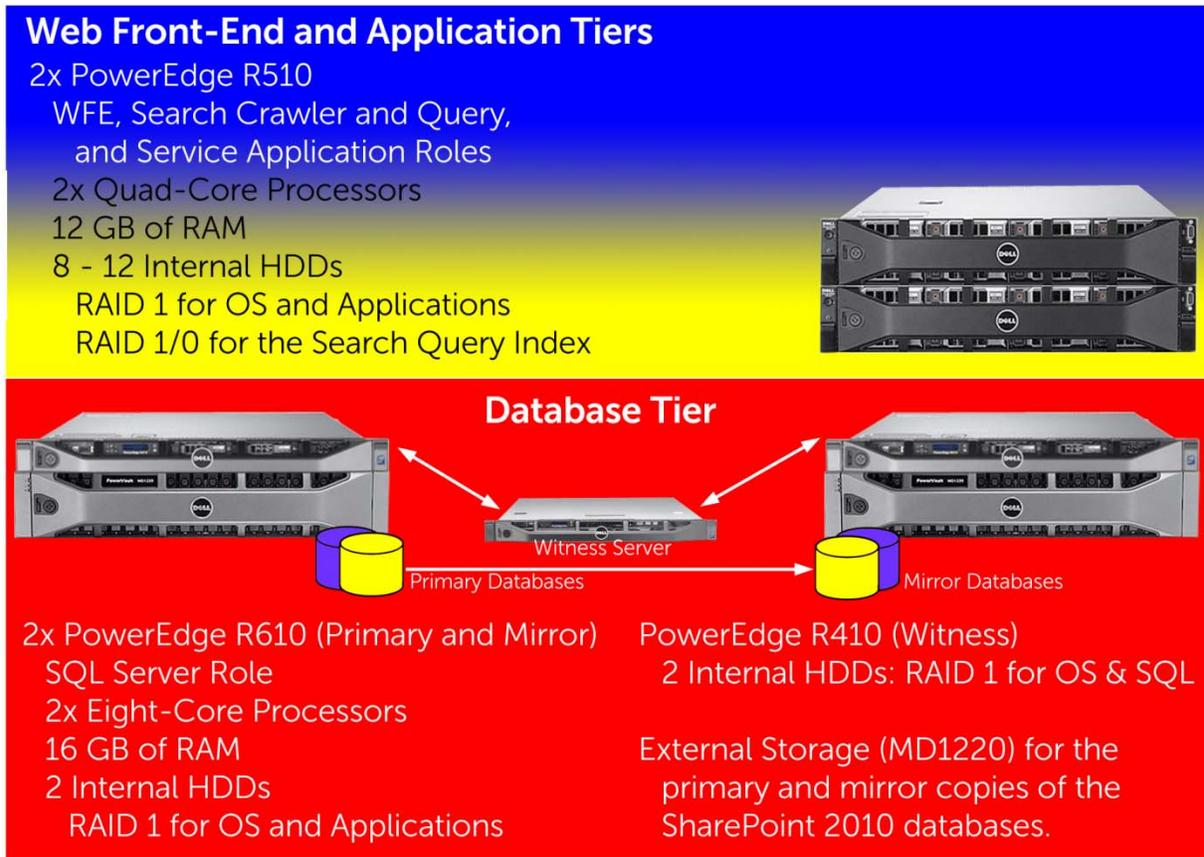


Figure 3: Highly-Available Small Server Farm with Database Mirroring

NOTE: The SharePoint logging database does not support mirroring, but if there is a SQL Server host failure this database can be manually recreated.

High Availability for Web Front-End and Application Servers

To increase availability and handle higher Web server workloads, Windows Server 2008 provides built-in software for network load balancing (NLB). In an NLB cluster, multiple servers share a common IP address and distribute the Web server workloads amongst the nodes. If advanced load balancing heuristics, detailed monitoring, or client statefulness are required, consider a hardware load balancer.

Multiple servers host the Web front-end and application roles in Figure 2 and Figure 3; because of SharePoint 2010 search component changes, both servers can provide search crawler and query functions, so that the loss of either server does not disrupt the user search request processing. The query component on each server can generally be assigned to a full index on the same server; little is gained by storing a second copy of the peer server index.

It may be possible, however, to gain efficiency by having each index server crawl a subset of the farm content, and then assign both query components to the partial indexes. While this would decrease the time required to complete crawl operations, loss of one of the servers could produce scenarios where new data has not been indexed (e.g. by the failed server's crawl component), and is therefore not available in search results; previously-indexed results would still be available in this scenario.

Summary

A companion paper, *SharePoint Server 2010: An Introduction*, is available from www.dell.com/sharepoint. That paper provides a high-level overview of SharePoint Server 2010, and introduces key concepts and terminology that are helpful for understanding the reference architectures presented in this paper.

A small SharePoint 2010 server farm consists of two or more servers, each provisioned with different SharePoint components. Small farms typically consolidate the presentation tier and application tier onto one or two servers. These servers provide the Web front-end, search index and query, and other service applications for the farm. The SharePoint databases that hold content and configuration for these services are located on a separate SQL Server host.

Using a small farm as the starting point for any production SharePoint Server 2010 deployment is recommended since additional servers can be added to the farm, SharePoint components can be redistributed, and the topology can scale to support growth. Using farm architecture also makes it easier to add hardware to provide redundancy and availability for services and data. For the SQL Server database, high availability options include failover clustering and database mirroring. SharePoint Server 2010 provides enhanced support for database mirroring, natively building SQL connection strings that are mirror-aware. At the application tier, SharePoint 2010 has enhanced its search architecture, and can be easily configured to offer redundant search crawlers. Similarly, most service applications and the search query component can be hosted on more than one server. Finally, a load-balancing solution is recommended for the Web front-end servers.

Dell tower and rack-mounted servers are well-suited to all SharePoint 2010 farm roles. Some of these servers have been highlighted in the reference architectures presented in this paper, along with external storage arrays that can house the SharePoint databases. Because SharePoint is both a content repository and a development platform, each farm is unique. Dell offers services to help design, deploy, optimize, and customize a SharePoint Server 2010 server farm.