MICROSOFT SHAREPOINT SERVER: BEST PRACTICES AND DESIGN GUIDELINES FOR EMC STORAGE

EMC VNX Family, EMC Symmetrix VMAX Systems, and EMC Xtrem Server Products

- Design and sizing best practices
- SharePoint performance acceleration with flash technologies
- SharePoint farm availability, protection, and recovery considerations

EMC Solutions

Abstract

This paper identifies best practices and key decision points for planning and deploying Microsoft SharePoint Server with the EMC® VNX® family, EMC Symmetrix® VMAX® Systems, EMC Xtrem™ Server products, EMC VPLEX®, and EMC RecoverPoint®.

December 2013
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Executive summary

In the planning and design phases of a Microsoft SharePoint Server infrastructure, it is important to understand how the SharePoint collaboration platform across various server roles interacts with the storage platform. It is also critical to know which practices to follow to avoid bottlenecks and achieve best performance while maintaining availability and protecting the content and configurations of the SharePoint Server.

From a storage design aspect, SharePoint architecture and usage profile characteristics may vary widely, depending on a common set of usage patterns, database configuration, and content types. SharePoint Server 2013 storage architecture introduces several infrastructure related changes:

- Server side disk input/output (I/O) pressure has been reduced significantly due to the introduction of several new features, such as shredded storage, minimum download strategy, and database schema update, which optimizes multiple list items concurrently.

- SharePoint search service application has been redesigned. Its I/O characteristics are different from previous search architectures, especially those with larger write I/Os.

- In previous versions of SharePoint, social database features in a scaled environment could present an I/O bottleneck. In SharePoint Server 2013, social data is moved from a social database and now resides in the content database of personal user sites.

EMC recommends you follow the best practices for SharePoint Server storage design to take full advantage of the features of SharePoint Server and EMC technologies.
Introduction

Purpose
The purpose of this document is to assist technology professionals and SharePoint architects in designing the optimal infrastructure for SharePoint Server 2010 and 2013 using EMC® VNX® family storage, EMC Symmetrix® VMAX® series storage, EMC XtremSF™, or EMC XtremCache™ in both physical and virtual environments.

Audience
This white paper is intended for customers, EMC partners, and service personnel who want to implement an intranet or internet web site environment with Microsoft SharePoint Server or upgrade an earlier version of SharePoint Server. You should be familiar with Microsoft SharePoint Server, EMC storage families such as VNX family and Symmetrix VMAX; XtremSF and XtremCache; and VMware or Microsoft Hyper-V virtual environments.

Scope
Best practices documented in this white paper include sizing guidelines and design examples based on EMC’s proven approaches. Details and end-to-end implementation instructions are beyond the scope of this document.

Terminology
This white paper includes the terminology listed in Table 1.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise multi-level cell (eMLC) flash</td>
<td>Enterprise multi-level cell. Multi-level cells designed for low error rates. A flash memory technology using multiple levels per cell to allow more bits to be stored using the same number of transistors.</td>
</tr>
<tr>
<td>Multi-level cell (MLC) flash</td>
<td>A flash memory technology using multiple levels per cell to allow more bits to be stored using the same number of transistors.</td>
</tr>
<tr>
<td>Multipath I/O</td>
<td>Multiple paths between the CPU in a computer system and its mass storage devices that achieve fault-tolerance and enhance performance.</td>
</tr>
<tr>
<td>NAS</td>
<td>Network-attached storage, a network-based computer data storage system.</td>
</tr>
<tr>
<td>RAID</td>
<td>Redundant array of independent disks. A method for storing information where the data is stored on multiple disk drives to increase performance and storage capacity and to provide redundancy and fault tolerance.</td>
</tr>
<tr>
<td>SAN</td>
<td>Storage area network, an architecture that attaches computer storage remotely and connects servers with Fibre Channel (FC).</td>
</tr>
<tr>
<td>Single-level cell (SLC) flash</td>
<td>A type of solid state storage (SSD) that stores one bit of information per cell of flash media.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Storage pool</td>
<td>Storage pools are virtual constructs that enable data to move dynamically across different tiers according to the data's business activity. With VNX and VMAX systems, storage pools are fully automated and self-managing.</td>
</tr>
<tr>
<td>SQL Server 2012 AlwaysOn</td>
<td>Refers to the comprehensive high availability and disaster recovery solution for SQL Server 2012. AlwaysOn presents new and enhanced capabilities for both specific databases and entire instances, providing flexibility to support various high availability configurations.</td>
</tr>
</tbody>
</table>
Microsoft SharePoint Server farm architecture

Microsoft SharePoint Server

Microsoft SharePoint Server provides a business-collaboration web application platform for enterprise and commercial organizations.

Microsoft SharePoint Server 2013 is a framework for sharing ideas, content, and the vision of the customer’s company. SharePoint Server 2013 can be scalable enough to organize and manage all information assets. It is designed to organize and store documents, which enables personal productivity and keeps teams synchronized and projects on track. Using SharePoint Server 2013, you can find experts, share knowledge, connect to people, and find information. For developers, SharePoint Server 2013 is a hub to build and deploy modern applications. SharePoint Server 2013 is built with the cloud in mind, which enables Information Technology professionals to manage costs and compliance risks.

Microsoft SharePoint Server 2010 is the previous release of SharePoint Server 2013. It provides a business-collaboration platform for enterprise and commercial organizations.

Microsoft SQL Server

SharePoint Server 2010 and 2013 use a Microsoft SQL Server database backend to store content and SharePoint configurations. For both SharePoint Server 2010 and 2013, 64-bit SQL Server is required.

Microsoft Windows Server

SharePoint Server 2013 is supported on the following:

- 64-bit edition of Windows Server 2008 R2 Service Pack 1 (SP1) Standard, Enterprise, or Data Center
- 64-bit edition of Windows Server 2012 Standard or Data Center

Server Core installation of Windows and Web Edition is not supported.

SharePoint Server 2010 is supported on the following:

- 64-bit edition of Windows Server 2008 Standard, Enterprise, Data Center, or Web Server with SP2
- 64-bit edition of Windows Server 2008 R2 Standard, Enterprise, Data Center, or Web Server
- 64-bit edition of Windows Server 2008 R2 Service Pack 1 (SP1) Standard, Enterprise, Data Center, or Web Server

**Topology overview**

Designing or implementing a SharePoint farm is similar to designing or implementing a SharePoint topology. A SharePoint farm is made up of logical and physical components.

**SharePoint logical architecture**

SharePoint contains the following components which form the logical architecture:

**SharePoint farm**

A SharePoint farm is a set of one or more server computers working together to provide SharePoint foundation functionality to clients.

**Web application**

At a physical level, a web application is a collection of one or more Microsoft Internet Information Server (IIS) websites configured to map incoming Hypertext Transfer Protocol (HTTP) requests to a set of SharePoint sites. SharePoint foundation is built on top of IIS and relies on IIS websites to handle incoming HTTP requests. An IIS website provides an entry point into the IIS web server infrastructure. SharePoint foundation creates an abstraction on top of IIS that is known as a web application.

**Content database**

The web application maps each SharePoint site to one or more specific content databases. SharePoint uses content databases to store site content such as list items, documents, and customization information.

**Service application**

Service applications provide SharePoint functionality to other web and service applications in the farm. Service applications facilitate the sharing of resources across sites running in different web applications and different farms. The service application architecture enables the scaling of a SharePoint farm by offloading processing cycles from the front-end web servers to dedicated application servers.

**Site collection**

A site collection is a container of sites. Each site must be created within a site collection.

**Site**

A site is defined as follows:

- An endpoint that is accessible from across a network such as the Internet, an intranet, or an extranet.
- A storage container that allows users to store and manage content, such as list items and documents.
- A customizable entity that allows privileged users to add pages, lists, and child sites.
- A securable entity whose content is accessible to a configurable set of users.
Lists and libraries

Lists and libraries are stored in SharePoint sites. A list is a collection of pieces of information. A library is a special list that each item in the list refers to a file.

The SharePoint containment hierarchy is described in Figure 1.
A SharePoint environment consists of physical components with multiple server roles, which are combined into units called farms. The SharePoint Server 2010 and 2013 farm includes the following three-tier server roles:

- **Web server role**—Responsible for the actual SharePoint pages that a user views. A web server hosts web pages, web services, and the web functionality that is required to process requests from users. The web server directs these requests to the application server, which returns the results back to the web server.

- **Application server role**—Runs all the SharePoint application services, including index crawling and search query services. This server also hosts the SharePoint Central Administration website. You can add application servers to host services that can be deployed to a single server to be used by all the servers in a farm. Services with similar usage and performance characteristics can be logically grouped on a server and, if necessary, hosted on multiple servers if a scale out is required to respond to performance or capacity requirements.

- **Database server role**—Runs the SharePoint databases, including the content databases, configuration database, and search databases.

**SharePoint farm topology**

The topology for a SharePoint farm can vary widely depending on the following key factors:

- **Scale size**—Reflects the size of the total content and the active users accessing the SharePoint web applications from time to time. Refer to Farm topology with different scale sizes for details.

- **Business purpose**—Reflects the workloads and the general uses that differentiate architectures, such as search and user profile architectures. For example, some customers use the search function in SharePoint to establish a search portal for business cases, while others only use SharePoint to manage large numbers of documents. Refer to Farm topology with different search architectures and Farm topology with different user profile architectures for details.

**Farm topology with different scale sizes**

The farm topology can be both physical topology and virtual topology. Virtualized topologies include both SharePoint components and hypervisors. Virtual topologies depend on the capacity of physical hosts, the number of hosted virtual machines, and the underlying virtualization technology.

SharePoint topologies include the service, server role distribution among servers, and farm scale.
Table 2 illustrates the general scale of the SharePoint farm topologies.

**Note:** Size and design of SharePoint farm topology varies according to the business needs of the customer.

<table>
<thead>
<tr>
<th>Topology scale</th>
<th>Configured user or item numbers</th>
<th>Server count</th>
<th>General purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limited deployment</td>
<td>&lt; 10,000</td>
<td>1~2</td>
<td>Product evaluation, deployment and testing, or environments that have a limited number of users and do not require fault-tolerance.</td>
</tr>
<tr>
<td>Small farm</td>
<td>10,000–20,000</td>
<td>3~4</td>
<td>Small farm architectures serve a larger number of users and scale out based on how heavily services are used. Not all small farms are fault-tolerant.</td>
</tr>
<tr>
<td>Medium farm</td>
<td>&gt; 30,000 or content up to 40 million items</td>
<td>6+</td>
<td>Medium farm architectures can be multipurpose or optimized for specific purposes. Medium-size farms are fully fault-tolerant. Some environments might require more web servers. Factor 10,000 users per web server as a starting point.</td>
</tr>
<tr>
<td>Large farm</td>
<td>&gt; 50,000 or content up to 100 million items</td>
<td>10+</td>
<td>Large farm architectures are scaled out to group service applications, services, or databases with similar performance characteristics onto dedicated servers and then scale out the servers as a group.</td>
</tr>
</tbody>
</table>

**Note:** To calculate the number of items for different types of content databases, use the scripts in Appendix E: Scripts to break down items in the content database.

“Configured user number” is the total number of users in the SharePoint farm. The Content database I/O and capacity characteristics section discusses the active user number. “Active user number” is the average number of concurrent users visiting the SharePoint farm at any point-in-time. The number of active users can be calculated as the formula below:

\[
\text{active user number} = \text{configured user number} \times \text{concurrency at peak time}
\]

The information in Table 2 applies to both SharePoint Server 2010 and 2013.

To design the distribution of services and server roles, the customer must provide their requirements, such as number of users, farm capacity, services that will be used, and how they will use the service. Refer to the topology sizing details for SharePoint Server 2010 and 2013 in Appendix C: Sample storage designs and reference architectures.
Farm topology with different search architectures

Search architecture in SharePoint Server 2010

Search in SharePoint Server 2010 is redesigned from Microsoft Office SharePoint Server 2007 with new components to create better redundancy and better scalability.

Components in SharePoint Server 2010 can be divided into two categories:

- **Query architecture**—Includes the following components:
  - **Index partitions**—Logical portion of the entire index. The index is the aggregation of all index partitions.
  - **Query components**—Components that process search results for their own portions of the index. A mirror for each query component can be created. Add a query component mirror to a different server to achieve redundancy of the query partition.
  - **Property databases**—Storage of the metadata and security descriptors for the items in the index. They are involved in property based queries and return standard document attributes for all query results.

- **Crawl architecture**—Includes the following components:
  - **Crawl components (crawler)**—Searches content based on what is specified in the crawl databases. Each crawler is associated with one crawl database. Add crawlers to address capacity requirements and to increase search performance.
  - **Crawl databases**—Stores the crawl history and manages crawl operations. Each crawl database can have one or more crawlers associated with it.
  - **Property databases**
    - **Query server**—Server hosting the components of the query architectures.
    - **Crawl server**—Server hosting crawl components.
Figure 2 shows an example of the typical search architecture with backend storage in SharePoint Server 2010.

Figure 2. Typical search architecture in SharePoint Server 2010

For more information, refer to Search Technologies for SharePoint 2010 Products technical diagram.

Search architecture in SharePoint Server 2013

In SharePoint Server 2013, Microsoft has fully integrated its highly scalable FAST Search product. SharePoint Server 2013 search capabilities include:

- Metadata extraction, visual search, and advanced linguistics
- Content and analytics processors that are added to the logical architecture
- Search-related components managed by a specialized search administrator
- A dedicated analysis engine which performs both search and usage analytics

The search architecture is divided into the following components:

- **Crawl component**—Collects crawled properties and metadata from crawled items and sends this information to the content processing component.
- **Content processing component**—Transforms the crawled items and sends them to the index component. This component also maps crawled properties to managed properties and interacts with the analytics processing component.
• **Analytics processing component**—Analyzes the crawled items and the methods that users use to interact with the search results. The analyses are used to improve the search relevance and to create search reports as well as recommendations.

• **Index component**—Receives the processed items from the content processing component and writes the items to the search index. This component also handles incoming queries, retrieves information from the search index, and sends back the result set to the query processing component.

• **Query processing component**—Analyzes incoming queries, which helps to optimize precision, recall, and relevance. The queries are sent to the index component, which returns a set of search results.

• **Search administration component**—Runs the system processes for search and also adds and initializes new instances of search components.

The following databases are created to support these search components:

• **Crawl database**—Stores tracking information and details about crawled items such as documents and uniform resource locators (URLs). Also stores information such as the last crawl time, the last crawl ID, and the type of update (add, update, delete) during the last crawl.

• **Link database**—Stores unprocessed information that is extracted by the content processing component and information about search clicks. The analytics processing component analyzes this information.

• **Analytics reporting database**—Stores the results of usage analysis, such as the times an item has been viewed. It also stores statistics from different analysis. These statistics are used to create the usage reports.

• **Search administration database**—Stores the settings for the search service application, such as the crawl rules, topology, query rules, and the mapping between crawled and managed properties.
Figure 3 shows an example of the SharePoint Server 2013 typical search topology.

For more information, refer to *SharePoint Server 2013 Search technical diagram.*

**Farm topology with different user profile architectures**

A user profile is a collection of properties that describes a single user and the policies and other settings associated with each property. The set of user profiles for a SharePoint Server 2010 and 2013 farm is stored in the profiles database associated with the user profile service application.

When you create a user profile service application, SharePoint Server creates three types of databases for storing user profile information and associated data:

- **Profile database**—Stores user profile information.
- **Synchronization database**—Stores configuration and staging information for synchronizing profile data from external sources such as the Active Directory Domain Services.
- **Social tagging database**—Stores social tags and notes created by users. Each social tag and note is associated with a profile ID.
Table 3 shows two typical SharePoint use profiles that describe how the SharePoint workload includes various user activities.

<table>
<thead>
<tr>
<th>Use profile</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Publishing Portal</td>
<td>A starter site hierarchy that can be used for an Internet site or a large intranet portal. The site includes a home page, a sample press releases site, a search center, and a log-in page. Typically, this site has many more readers than contributors, and it uses approval workflows to publish the web pages.</td>
</tr>
<tr>
<td>Document Management Portal</td>
<td>A site on which you can centrally manage and collaborate on documents in your enterprise.</td>
</tr>
</tbody>
</table>
SharePoint I/O and capacity characteristics

Understanding the characteristics of I/O in SharePoint is useful in determining deployment requirements for any given workload and designing and sizing a SharePoint farm. A well-performing I/O subsystem is a critical component in any SharePoint farm.

This section focuses on SharePoint I/O and capacity characteristics.

Content database I/O and capacity characteristics vary among different workload types. The following sections focus on two workload types:

- **Publishing Portal**—The most common workload type, used mostly for browsing operations mixed with slight document operations and searches.
- **Document Management Portal**—Another common workload type, used for document operations.

I/O characteristics and capacity for content database in SharePoint Server 2010

**Publishing Portal I/O characteristics**

In this workload, the content database host input/output operations per second (IOPS) is determined by several factors—most importantly, the active user number.

The correlation between the content database host IOPS and the number of active users is shown in Figure 4.

![Figure 4. Correlation between content database IOPS and active user number for the Publishing Portal in SharePoint Server 2010](image)

**Note:** The correlation in Figure 4 is observed when the SQL server memory is 64 GB with incremental crawl running every half hour.
For example, if 5,600 active users access the Publishing Portal in SharePoint 2010, the host IOPS for the content database is calculated as follows:

\[
\text{average host IOPS for content database} = 0.0003 \times 5,600^{1.7048} = 737
\]

Table 4 shows the I/O characteristics for the content database.

### Table 4. I/O characteristics for content database

<table>
<thead>
<tr>
<th>Database name</th>
<th>Read size (KB)</th>
<th>Write size (KB)</th>
<th>Read/write ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content database</td>
<td>24</td>
<td>32</td>
<td>3:1</td>
</tr>
</tbody>
</table>

**Document Management Portal I/O characteristics**

Compared with the Publishing Portal, this workload generates more IOPS over the content databases. The correlation between the content database host IOPS and the number of active users is shown in Figure 5.

![Graph showing correlation between content database IOPS and active user number](image)

**Figure 5.** Correlation between content database IOPS and active user number for Document Management Portal in SharePoint Server 2010

**Note:** The correlation in Figure 5 is observed when the SQL Server memory is 64 GB with incremental crawl running every half hour.

For example, if 3,600 active users access the Document Management Portal in SharePoint 2010, the host IOPS for the content database is calculated as follows:

\[
\text{average host IOPS for content database} = 0.0007 \times 3,600^{1.7703} = 1,383
\]
Table 5 shows the content database characteristics for the Document Management Portal.

Table 5. Content database characteristics for Document Management Portal

<table>
<thead>
<tr>
<th>Database name</th>
<th>Read size (KB)</th>
<th>Write size (KB)</th>
<th>Read/write ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content database</td>
<td>24</td>
<td>32</td>
<td>2:1</td>
</tr>
</tbody>
</table>

To calculate host IOPS for the content database, refer to the examples in Formula to size content database.

*Capacity characteristics of SharePoint Server 2010 content database*

For more information about the capacity of content database, refer to *Storage and SQL Server capacity planning and configuration.*

*I/O characteristics and capacity for content database in SharePoint Server 2013*

*Publishing Portal I/O characteristics*

The correlation between the content database host IOPS and the number of active users is shown in Figure 6.

![Figure 6. Correlation between content database IOPS and active user number for Publishing Portal in SharePoint Server 2013](image)

**Note:** The correlation in Figure 6 is observed when the SQL server memory is 32 GB with incremental crawl running every half hour.

For example, if 8,000 active users access the Publishing Portal in SharePoint 2013, the host IOPS for the content database is calculated as follows:

\[
\text{average host IOPS for content database} = 0.2397 \times 8,000 = 1,918
\]
The I/O characteristics for the content database are shown in Table 6.

**Table 6. Content database I/O characteristics for Publishing Portal**

<table>
<thead>
<tr>
<th>Database name</th>
<th>Read size (KB)</th>
<th>Write size (KB)</th>
<th>Read/write ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content database</td>
<td>24</td>
<td>32</td>
<td>3:1</td>
</tr>
</tbody>
</table>

**Document Management Portal I/O characteristics**

The correlation between the content database host IOPS and the number of active users is shown in Figure 7.

![Figure 7. Correlation between content database IOPS and active user number for Document Management Portal in SharePoint Server 2013](image)

**Note:** The correlation in Figure 7 is observed when the SQL server memory is 32 GB with incremental crawl running every half hour.

For example, if 4,000 active users access the Document Management Portal in SharePoint 2013, the host IOPS for the content database is calculated as follows:

\[
\text{average host IOPS for content database} = 0.4173 \times 4,000 = 1,670
\]

Table 7 shows the I/O characteristics for the content database.

**Table 7. Content database I/O characteristics for Document Management Portal**

<table>
<thead>
<tr>
<th>Database name</th>
<th>Read size (KB)</th>
<th>Write size (KB)</th>
<th>Read/write ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content database</td>
<td>24</td>
<td>32</td>
<td>2:1</td>
</tr>
</tbody>
</table>

To calculate host IOPS for the content database, refer to the examples in Formula to size content database.
**Summary of I/O characteristics of content database**

Table 8 summarizes the I/O characteristics of the content database in two versions of SharePoint with different use cases.

**Table 8. Summary of I/O characteristics of content database**

<table>
<thead>
<tr>
<th>Product</th>
<th>Use case</th>
<th>Host IOPS</th>
<th>Read size (KB)</th>
<th>Write size (KB)</th>
<th>Read/write ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>SharePoint Server</td>
<td>Publishing Portal</td>
<td>$y = 0.0003 \times x^{1.7048}$</td>
<td>24</td>
<td>32</td>
<td>3:1</td>
</tr>
<tr>
<td>2010</td>
<td>Document Management Portal</td>
<td>$y = 0.0007 \times x^{1.7703}$</td>
<td>24</td>
<td>32</td>
<td>2:1</td>
</tr>
<tr>
<td>SharePoint Server</td>
<td>Publishing Portal</td>
<td>$y = 0.2397x$</td>
<td>24</td>
<td>32</td>
<td>3:1</td>
</tr>
<tr>
<td>2013</td>
<td>Document Management Portal</td>
<td>$y = 0.4173x$</td>
<td>24</td>
<td>32</td>
<td>2:1</td>
</tr>
</tbody>
</table>

**Note:** In Table 8, $y$ represents the host IOPS while $x$ represents the active user number.

**Capacity characteristics of SharePoint Server 2013 content database**

For more information about the capacity of content database, refer to *Storage and SQL Server capacity planning and configuration*.

**Content database I/O characteristics with RBS**

The Remote BLOB Storage (RBS) feature enables SharePoint Server 2010 or 2013 to store binary large objects (BLOBs) in a location outside the content databases. Storing the BLOBs externally can reduce the required SQL Server database storage space. The metadata for each BLOB is stored in the SQL Server database and the BLOB is stored in the RBS store.

Because content databases store only the metadata of the BLOBs, the majority of the I/O happens in the BLOBs store, not in the content database.

Table 9 shows the I/O characteristics when RBS is enabled.

**Table 9. I/O characteristics for RBS**

<table>
<thead>
<tr>
<th>Name</th>
<th>Read size (KB)</th>
<th>Write size (KB)</th>
<th>Read/write ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content database with RBS enabled</td>
<td>8</td>
<td>8</td>
<td>Read dominant</td>
</tr>
<tr>
<td>BLOB store</td>
<td>40</td>
<td>8</td>
<td>Read dominant</td>
</tr>
</tbody>
</table>

Search service and user profile service are commonly used service applications in SharePoint. Table 10 and Table 11 list the details of the I/O characteristics of these two application services in SharePoint Server 2010 and 2013 when running crawl and user profile synchronization.
Table 10. Search and user profile service application I/O and capacity characteristics in SharePoint Server 2010

<table>
<thead>
<tr>
<th>Service application name</th>
<th>Database or component name</th>
<th>IOPS</th>
<th>Read size (KB)</th>
<th>Write size (KB)</th>
<th>Read/write ratio</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search service application</td>
<td>Content database</td>
<td>Read: High Write: Zero</td>
<td>8</td>
<td>N/A</td>
<td>All read</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Crawl database</td>
<td>Read: High Write: Low</td>
<td>8</td>
<td>96</td>
<td>6:1</td>
<td>0.046 × data set size</td>
</tr>
<tr>
<td></td>
<td>Property database</td>
<td>Read: 0 Write: High</td>
<td>8</td>
<td>From 16 to 96</td>
<td>N/A</td>
<td>0.15 × data set size</td>
</tr>
<tr>
<td></td>
<td>Search administration database</td>
<td>Read: 0 Write: 0</td>
<td>32</td>
<td>8</td>
<td>N/A</td>
<td>10 GB</td>
</tr>
<tr>
<td></td>
<td>Crawl component</td>
<td>Read: 0 Write: Low</td>
<td>32</td>
<td>64</td>
<td>Write dominant</td>
<td>1 GB for 100 GB data set</td>
</tr>
<tr>
<td></td>
<td>Query component</td>
<td>Read: Low Write: Low</td>
<td>32</td>
<td>128</td>
<td>Write dominant</td>
<td>2 GB for 100 GB data set</td>
</tr>
<tr>
<td>User profile service application</td>
<td>Synchronization database</td>
<td>Read: 0 Write: Low</td>
<td>64</td>
<td>32</td>
<td>Write dominant</td>
<td>630 KB per user profile</td>
</tr>
<tr>
<td></td>
<td>Profile database</td>
<td>Read: 0 Write: High</td>
<td>64</td>
<td>16</td>
<td>Write dominant</td>
<td>1 MB per user profile</td>
</tr>
<tr>
<td></td>
<td>Social database</td>
<td>Read: 0 Write: 0</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>0.009 MB per tag, comment or rating</td>
</tr>
</tbody>
</table>

Table 11. Search and user profile service application I/O and capacity characteristics in SharePoint Server 2013

<table>
<thead>
<tr>
<th>Service application name</th>
<th>Database or component name</th>
<th>IOPS</th>
<th>Read size (KB)</th>
<th>Write size (KB)</th>
<th>Read/write ratio</th>
<th>Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search service application</td>
<td>Content database</td>
<td>Read: High Write: Zero</td>
<td>8</td>
<td>N/A</td>
<td>All read</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Crawl database</td>
<td>Read: Medium Write: Medium</td>
<td>8</td>
<td>32</td>
<td>3:1</td>
<td>10 million items: 15 GB for data, 2 GB for log 100 million items: 110 GB for data, 2 GB for log</td>
</tr>
<tr>
<td>Service application name</td>
<td>Database or component name</td>
<td>IOPS</td>
<td>Read size (KB)</td>
<td>Write size (KB)</td>
<td>Read/write ratio</td>
<td>Capacity</td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------------------</td>
<td>------</td>
<td>----------------</td>
<td>-----------------</td>
<td>------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Link database</td>
<td>Read: 0</td>
<td>Write: 0</td>
<td>8</td>
<td>64</td>
<td>N/A</td>
<td>10 million items: 10 GB for data, 0.1 GB for log 100 million items: 80 GB for data, 5 GB for log</td>
</tr>
<tr>
<td>Search administration database</td>
<td>Read: 0</td>
<td>Write: 0</td>
<td>64</td>
<td>8</td>
<td>N/A</td>
<td>10 million items: 0.4 GB for data, 0.1 GB for log 100 million items: 1 GB for data, 2 GB for log</td>
</tr>
<tr>
<td>Analytics reporting</td>
<td>Read: 0</td>
<td>Write: 0</td>
<td>8</td>
<td>N/A</td>
<td>N/A</td>
<td>Usage dependent</td>
</tr>
<tr>
<td>Crawler</td>
<td>Read: 0</td>
<td>Write: 115</td>
<td>4</td>
<td>128</td>
<td>Write dominant</td>
<td>1 GB for 100 GB data set</td>
</tr>
<tr>
<td>Index partition</td>
<td>Read: Medium</td>
<td>Write: Low</td>
<td>2048</td>
<td>1024</td>
<td>3:2</td>
<td>2 GB for 100 GB data set</td>
</tr>
<tr>
<td>User profile service application</td>
<td>Synchronization database</td>
<td>Read: 0</td>
<td>Write: Low</td>
<td>64</td>
<td>32</td>
<td>Write dominant</td>
</tr>
<tr>
<td>Profile database</td>
<td>Read: 0</td>
<td>Write: Low</td>
<td>64</td>
<td>32</td>
<td>Write dominant</td>
<td>1 MB per user profile</td>
</tr>
<tr>
<td>Social database</td>
<td>Read: 0</td>
<td>Write: 0</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>0.018 MB per tag, comment or rating</td>
</tr>
</tbody>
</table>

For analysis details, refer to Appendix A: I/O characteristics analysis for SharePoint Server 2010 and 2013 search and user profile service application.

The storage and IOPS for all of the service applications in SharePoint Server 2013 remain the same as in SharePoint Server 2010 except for the search service application and the user profile service application, which are the most common service applications. For more information, refer to Storage and SQL Server capacity planning and configuration.
SharePoint Server hypervisor best practices

Overview

General virtualization considerations

SharePoint Server 2010 and 2013 are fully supported in a virtual environment that is supported by Microsoft Hyper-V technology or VMware vSphere ESXi technology. This section discusses the best practices and design guidelines for SharePoint Server 2010 and 2013 virtualization consideration and the compute resource for each role.

Organizations increasingly want to virtualize their modern multi-tiered application—SharePoint. The latest release, SharePoint 2013, has been redesigned to better suit virtualization requirements.

The main merits of virtualizing SharePoint farm servers include:

- **Easily scalable topology**—Business needs and use of a SharePoint farm evolves with time. Virtualized SharePoint farm allows you to easily add or remove specific server roles from the farm to accommodate the changes.

- **Flexible resource allocation**—Easily and quickly adjusts the CPU and memory to address the spikes in the usage of a specific virtualized SharePoint server. The spikes can be predicted.

- **Easy to maintain**—Most companies have multiple SharePoint environments, such as test, development, and training, to make sure the development and setting changes to the production environment are safe. As configuration drift happens frequently, over time, these systems often fall out of synchronization with production systems, resulting in inaccurate testing and quality assurance (QA) cycles, or even worse, down time. With hypervisors, you can create snapshots or clones of a virtualized SharePoint environment to achieve high efficiency and safe maintenance.

- **Cost savings**—Virtualization makes the best use of server hardware investments by consolidating workloads as separate virtual machines.

Virtualizing farm server roles

This section discusses the compute resource allocation of the SharePoint server roles:

- Web servers
- Application servers
- SQL servers

The web server and application server roles are usually the first choices for virtualization.

Virtual machines for web server roles can be configured to use fewer processors, less memory and fewer (and smaller) hard disks. The web server role also enables you to adjust the compute resources to meet burst performance requirements and is easier to plan for virtualization than other roles. It has the lowest virtualization host requirements and the lowest risk in a production environment.

Application servers are also initial candidates for virtualization. Depending on the degree of specialization, which is reflected by services they provide, application...
servers do not always have low resource requirements. A good example is an application server that hosts the search crawl component.

Conventional wisdom dictates that SQL Server instances not be virtualized. Using Microsoft Hyper-V and VMware vSphere 5.0 with increased scalability and performance capabilities, customers can now virtualize tier 1, mission-critical SQL Server workloads. EMC has proved that virtualized SQL Server can meet critical business performance and security needs.

**Note:** The business requirements of SharePoint farms can vary, leading to different compute resource allocations for the farm virtual machines.

### Virtualizing web servers

In performance testing, we found that the CPU is typically the first bottleneck for a web server because of the nature of the work carried out by the web server.

Table 12 and Table 13 include the recommended compute resources for virtualized web servers.

**Table 12. Resource recommendation for web server in SharePoint Server 2010**

<table>
<thead>
<tr>
<th>Compute resource for web server</th>
<th>Resource recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>vCPU</td>
<td>4 cores</td>
</tr>
<tr>
<td>Memory</td>
<td>4 GB</td>
</tr>
</tbody>
</table>

**Table 13. Resource recommendation for web server in SharePoint Server 2013**

<table>
<thead>
<tr>
<th>Compute resource for web server</th>
<th>Resource recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>vCPU</td>
<td>4 cores</td>
</tr>
<tr>
<td>Memory</td>
<td>12 GB</td>
</tr>
</tbody>
</table>

### Virtualizing application servers

Virtualized application servers usually have low resource requirements. However, at times their resource requirements may increase. A good example is an application server that hosts the search crawl component.

Table 14 and Table 15 include the recommended number of vCPUs and memory for virtualized application servers.

**Table 14. Resource recommendation for application server in SharePoint Server 2010**

<table>
<thead>
<tr>
<th>Purpose of the application server</th>
<th>Resource recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application server</td>
<td>vCPU 4 cores</td>
</tr>
<tr>
<td></td>
<td>Memory 4 GB</td>
</tr>
</tbody>
</table>

---

1 In this white paper, "we" and “our” refers to the EMC Solutions engineering team that validated the solution
Virtualizing SQL servers

The role of the SQL Server instance is storing, maintaining, and returning data to the other roles in the farm. This role has the highest amount of disk I/O activity and often has high memory and processor requirements. The SQL Server can migrate to a higher-powered server or provide greater resourcing through virtualization.

With virtualized SQL Server, it is easy to scale SQL Server roles vertically or horizontally in any SharePoint farm as required.

Table 16 and Table 17 include the recommended number of vCPUs and memory for different ranges of total users of virtualized SQL Server.

Table 15. Resource recommendation for application server in SharePoint Server 2013

<table>
<thead>
<tr>
<th>Purpose of the application server</th>
<th>Resource recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application server with search crawler</td>
<td>vCPU 12 cores</td>
</tr>
<tr>
<td></td>
<td>Memory 12 GB</td>
</tr>
<tr>
<td>Application server with other service applications</td>
<td>vCPU 4 cores</td>
</tr>
<tr>
<td></td>
<td>Memory 12 GB</td>
</tr>
</tbody>
</table>

Table 16. Resource recommendation for SQL Server in SharePoint Server 2010

<table>
<thead>
<tr>
<th>Combined size of content databases</th>
<th>Recommended number of vCPUs for SQL Server</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 1 TB</td>
<td>vCPU 4 cores</td>
</tr>
<tr>
<td></td>
<td>Memory 8 GB</td>
</tr>
<tr>
<td>1 TB to 5 TB</td>
<td>vCPU 8 cores</td>
</tr>
<tr>
<td></td>
<td>Memory 32 GB</td>
</tr>
</tbody>
</table>

Table 17. Resource recommendation for SQL Server in SharePoint Server 2013

<table>
<thead>
<tr>
<th>Total number of users</th>
<th>Recommended number of vCPUs for SQL Server</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1,000 users</td>
<td>vCPU 4 cores</td>
</tr>
<tr>
<td></td>
<td>Memory 8 GB</td>
</tr>
<tr>
<td>Between 1,000 and 10,000 users</td>
<td>vCPU 8 cores or 16 cores</td>
</tr>
<tr>
<td></td>
<td>Memory 16 GB</td>
</tr>
</tbody>
</table>

EMC recommends that you place only one SQL Server virtual machine per physical hypervisor server to avoid the whole farm becoming inoperable in the event of host failure. Server roles distribution provides details on distributing SharePoint server roles among hypervisors.
Server roles distribution

EMC recommends the distribution of server roles as follows:

- **Each hypervisor host should contain different farm server roles if possible**—Mixing SharePoint server roles that share the same hypervisor host maximize the overall throughput. For example, mixing of web servers and application servers reduces disk contention, because they usually do not write to disk at the same time.

- **Each kind of server role should be spread across different hypervisor hosts if possible**—For redundancy considerations, spread web servers, application servers, and database servers across different hosts, if possible. To achieve this you can implement Anti-Affinity rules in both Microsoft Hyper-V and VMware vSphere to keep related SharePoint virtual machines separate on hosts within a cluster. For details refer to *Best Practices for Virtualizing & Managing SharePoint 2013* and *VMware vSphere 5.1 Documentation Center*.

Hypervisor virtual networking

Each hypervisor host should have multiple connections to the user and storage Ethernet networks to guard against link failures. The connections should be separated across multiple Ethernet switches to guard against component failure in the network.

Regarding the details of networking design, refer to:

- *VMware Network Virtualization Design Guide* when using VMware vSphere.
- *Configuring Virtual Networks* when using Microsoft Hyper-V.

**VMware vSphere best practices**

VMware vSphere is the leading virtualization hypervisor used across thousands of IT environments around the world. Virtualizing SharePoint Server on VMware vSphere is commonly used in enterprises. This section introduces best practices of virtualizing SharePoint Server 2010 and 2013 on VMware vSphere.

**VMware VMFS versus VMware RDM best practices**

VMware Virtual Machine File System (VMFS) is a high-performance cluster file system that provides storage virtualization optimized for virtual machines. VMware raw device mapping (RDM) allows a special file in a VMFS volume to act as a proxy for a raw device.

VMFS is suitable in most cases, while RDM is the only option for the following three scenarios:

- Migrating an existing application from a physical environment to a virtual environment
- Using Microsoft Windows Server Failover Clustering (WSFC) for clustering in a virtual environment
- Using storage area network (SAN) management tasks for specific needs such as snapshots
VMFS and RDM provide similar performance. For SharePoint, EMC recommends you use VMFS for performance and management considerations and to provision multiple virtual disks with similar I/O characteristics in the same VMFS datastore.

EMC recommends considering the following scenarios to use RDM for SharePoint:

- Create a virtual disk over 2 TB to host a SharePoint content database. For VMware vSphere 5.0 and 5.1, 2 TB is the size limit for a single VMware virtual machine disk (VMDK) file.
- Use EMC Replication Manager for SharePoint protection and recovery.

**VMware DRS best practices**

VMware Distributed Resource Scheduler (DRS) dynamically balances computing capacity across a collection of hardware resources aggregated into logical resource pools. VMware DRS also continuously monitors utilization across resource pools and intelligently allocates available resources among the virtual machines based on pre-defined rules that reflect business needs and changing priorities.

VMware has published the *DRS Performance and Best Practices* white paper. The best practices introduced in this paper apply to SharePoint Server 2010 and 2013 virtualized environment.

When using VMware DRS, monitor the VMware DRS status regularly, and adjust virtual machine deployment among hosts according to business needs.

**VMware HA best practices**

VMware High Availability (HA) provides easy-to-use, cost-effective high availability for all applications running on virtual machines. In the event of server failure, affected virtual machines are automatically restarted in the cluster on other host machines that have spare capacity. VMware HA minimizes downtime and IT service disruption while eliminating the need for dedicated standby hardware and installation of additional software. VMware HA provides high availability across the entire virtualized IT environment without the cost and complexity of failover solutions tied to either OSs or specific applications.

All general VMware HA best practices apply to the SharePoint environment. Refer to the following VMware papers for more information about the VMware HA best practices:

- [VMware vSphere High Availability 5.0 Deployment Best Practices](#)
- [Automating High Availability (HA) Services with VMware HA](#)

**VMware vSphere networking best practices**

General networking best practices for VMware vSphere also apply to a SharePoint virtual environment. For details refer to [Best Practices for Virtual Networking](#).

EMC recommends ensuring no more than 1 ms of latency between web servers, application servers, and SQL Server instances to achieve robust performance of the whole SharePoint farm.

If you are using network-attached storage (NAS) for RBS, make sure the connection to the EMC storage responds to a ping within 1 ms and returns the first byte of data within 20 ms.
**EMC VSI best practices**

EMC Virtual Storage Integrator (VSI) for VMware vSphere is a plug-in to VMware vCenter that provides a single interface for managing EMC storage within the vSphere environment. EMC VSI for VMware vSphere can provision network file system (NFS) datastores on NAS and VMFS datastores, and provision RDM volumes on block storage. It can also perform array-based compression and array-based cloning of virtual machines in NFS datastores and array-based compression in VMFS datastores and RDM volumes. The cloning functions include full clones (copies), fast clones (snaps), and native clones of VMDK files. VMware administrators can also use it to manage NAS and block storage in VMware environments that use the existing vSphere Client user interface. Figure 8 shows the VSI in the vSphere Client interface.

![VSI in VMware vSphere client](image)

**Figure 8.** VSI in VMware vSphere client

Refer to the following two documents for detailed information:

- *EMC VSI for VMware vSphere Unified Storage Management Product Guide*
- *EMC VSI for VMware vSphere Web Client Product Guide*
Microsoft Windows Server 2012 with Hyper-V (Microsoft Hyper-V for short) is a good virtualization platform that can be used for deploying demanding and multi-tiered production applications, such as SharePoint. This section discusses the best practices for virtualizing SharePoint on Microsoft Hyper-V.

**General best practices**

EMC recommends the following general best practices for Microsoft Hyper-V:

- Use the 1:1 recommended ratio of virtual processor to logical processor for any virtual machine in a SharePoint farm. Oversubscribing the CPU on the virtualization host can decrease performance, depending on how much the CPU is oversubscribed.

- Do not use Dynamic Memory on any SharePoint Server 2013 virtual machines because certain features of SharePoint can suffer from performance degradation when Dynamic Memory is enabled. For example, the cache size for the search and distributed cache features is not resized when the memory allocated to the virtual machine is dynamically adjusted.

- Install the latest virtual machine integration services in each supported guest virtual machine. Virtual machine integration services help improve I/O throughput and decrease the overall CPU usage of guests because they include drivers for Microsoft Hyper-V-specific I/O devices that reduce CPU overhead for I/O.

- Disable the Microsoft Hyper-V Time Synchronization service on each SharePoint virtual machine. SharePoint Server 2013 uses timer jobs frequently and the latency during time synchronization causes unpredictable results in the SharePoint environment. Instead, ensure that your guest virtual machine's OS retrieves its time from an authoritative time source, such as a domain controller.

- Do not configure a SharePoint virtual machine to save its state when shutting down. Virtual machines that start from a saved state are out of synchronization with the other servers in the farm. We recommend that you configure the virtual machine to use a shutdown as its automatic stop behavior. This minimizes the chances of the virtual machines being corrupted. When a physical host shutdown happens, all running timer jobs finish and no synchronization issues occur when the virtual machine restarts.

**Microsoft Hyper-V storage options best practices**

**VHD and VHDX**

The Microsoft virtual hard disk (VHD) format is a common virtualization file format. It provides a uniform product support system, as well as more seamless manageability, security, reliability and cost-efficiency for customers.

VHDX file format is a new version of VHD introduced with Windows Server 2012.

Best practices for VHD and VHDX are as follows:

- When using Windows Server 2012, we recommend converting all VHD files to VHDX format. The only exception is when a virtual machine might be moved to a previous release of the Windows Server OS that supports Microsoft Hyper-V. In that case, it makes sense to keep the files in VHD format.
- For SharePoint Server 2010 and 2013, use VHDX (on Windows Server 2012) or VHD (on Windows Server 2008 R2). The capacity advantage better aligns with stronger protection against corruption, making it an ideal choice for key and mission-critical workloads.

- Avoid differentiating disks and dynamically expanding disks in a virtualized SharePoint environment.

**CSV**

Failover clustering provides an extra level of resiliency for SharePoint when compared with a physical implementation.

Cluster Shared Volume (CSV), a feature available with WSFC and Microsoft Hyper-V 2012 and later, simplifies the configuration and management of clustered virtual machines. With CSV, multiple clustered virtual machines can use the same LUN (disk) while maintaining the ability to fail over (or move from node to node) independently.

All nodes of a failover cluster can access volumes that are configured as CSVs. Each node can open and manage files on the volumes. Therefore, different nodes hosting different virtual machines can have files on the same volume.

On a failover cluster that uses CSV, Microsoft Hyper-V stores and accesses the files used for clustered virtual machines by using the `\ClusterStorage` path on the system drive. For example, on a node that runs the OS from the C drive, the path is C:\ClusterStorage\.

Best practices for CSV are as follows:

- Store only the files that are created for the Microsoft Hyper-V role (such as VHD) on CSV. The creation, reproduction, and storage of files on CSV that were not created for the Microsoft Hyper-V role, including any user or application data stored under the `ClusterStorage` folder of the system drive on each node, are not supported and might result in unpredictable behavior, including data corruption or data loss on these shared volumes.

- For easier management, rename the volume folder name. However, you cannot rename the `ClusterStorage` folder.

**Pass-through disks**

Pass-through disks were a popular option prior to the release of Windows Server 2012. The VHD format used by Microsoft Hyper-V was limited to 2 TB, which was inadequate for some virtual machines. Pass-through disks were used as a way to break the 2 TB capacity limit. In Windows Server 2012, Microsoft introduced the VHDX format, which supports up to 64 TB of capacity.

Best practices for pass-through disks are as follows:

- Pass-through disks provide a slight performance improvement over virtual hard drives only when massive amounts of I/O are required and limits of the physical environment must be pushed.

- Do not use **Storage Live Migrations** in Microsoft Hyper-V with pass-through disks.

- When using pass-through disks, EMC Replication Manager works.
**Guest storage best practices**

In addition to presenting VHD or VHDX files to the respective SharePoint virtual machines, the administrator can choose to connect the guest OS of the SharePoint virtual machines directly to existing storage. Two methods provided in Microsoft Hyper-V allow you to use In-Guest Internet small computer system interface (iSCSI) or virtual Fibre Channel (FC) to connect to the storage elements.

**In-Guest iSCSI best practices**

Instead of using virtual disks, such as the VHD or VHDX files discussed earlier, and placing them on the iSCSI LUNs presented to the host, the administrator can choose to bypass the host and connect the virtual machines directly to the iSCSI array itself. The iSCSI target, part of the storage array itself, provides storage to the SharePoint virtual machine directly over the virtual machine’s network adaptors. The SharePoint virtual machine uses the in-box iSCSI initiator inside the Windows Server Guest OS to connect to the storage over a virtual network interface card (vNIC) that has connectivity on the iSCSI storage network. The respective SharePoint servers can store their information, logs, and other critical data directly on iSCSI disk volumes.

Best practices for In-Guest iSCSI are listed as follows:

- If running the virtual machine with In-Guest iSCSI on top of a Microsoft Hyper-V cluster, all cluster nodes must have the same iSCSI virtual switches created on the hosts. This helps to ensure that when the virtual machines are migrating around the cluster, connectivity to the underlying storage is not lost.

- For resiliency, the administrator can use multiple vNICs to connect the virtual machine to the iSCSI SAN. In that case, it is important to enable and configure Multipath I/O to ensure optimal performance and resiliency.

- In-Guest iSCSI can also be used to create guest failover clusters. In a SharePoint environment, guest failover clusters could create a SQL Server 2012 AlwaysOn Availability Group, as a resilient backend for the SharePoint databases.

**Virtual FC best practices**

Virtual FC for Microsoft Hyper-V helps to connect to FC storage from within a virtual machine, bypassing the host OS. It provides the guest OS with unmediated access to a SAN by using a standard World Wide Name associated with a virtual machine. Microsoft Hyper-V users can now use FC SANs to virtualize workloads that require direct access to SAN LUNs. FC SANs also allow you to operate in new scenarios, such as running the Failover Clustering feature inside the guest OS of a virtual machine connected to the shared FC storage.

As for In-Guest iSCSI, SQL Server 2012 AlwaysOn Availability Groups of failover cluster instances can be created as a resilient backend for SharePoint Server 2013 databases.

For virtualizing SharePoint Server 2010 and 2013, virtual FC for Microsoft Hyper-V allows you to use existing FC investments to drive the highest levels of storage performance access, while also retaining support for virtual machine live migration and Multipath I/O.
High availability best practices

Keeping mission-critical data continuously available has become a requirement over a wide range of customer segments from small business to datacenter environments. Enterprise environments that use Windows Server require zero downtime for key workloads, including file server, database, messaging, and other lines of business applications. This level of availability can be difficult and costly to achieve, and it requires that redundancy be built-in at multiple levels:

- Storage redundancy
- Backup to separate recovery servers
- Server clustering
- Redundancy of the physical path components between server and storage

Failover cluster best practices

A failover cluster is a group of independent computers that work together to increase the availability and scalability of clustered roles (formerly called clustered applications and services). The clustered servers (called nodes) are connected by physical cables and by software. If one or more of the cluster nodes fail, other nodes begin to provide service (a process known as failover). In addition, the clustered roles are proactively monitored to verify that they are working properly. If they are not working, they are restarted or moved to another node.

Failover clusters also provide CSV functionality that provides a consistent, distributed namespace that clustered roles can use to access shared storage from all nodes. With the WSFC feature, users experience minimal disruptions in service.

The aim of WSFC is to provide a resilient solution for SharePoint workloads that are running on top of the cluster. For virtualized SharePoint, the clustered role is virtual machines. For virtual machines running on top of a Hyper-V cluster, the virtual machines experience downtime if a Hyper-V cluster node fails. However, the remaining cluster nodes immediately start to work to bring the virtual machines up again on an alternative node within the cluster. This ensures minimal downtime and administrator intervention is not required. This supplies the SharePoint workload an extra level of resiliency when compared with a physical implementation, in which the administrator can only rely on application-level resiliency.

For more information about failover cluster, refer to Understanding Requirements for Failover Clusters.

Multipath I/O best practices

In SharePoint Server 2010 and 2013, EMC recommends that you use:

- Multipath I/O (MPIO) software for the highest level of redundancy and availability when connecting hosts to iSCSI or FC storage because Windows Server 2008 R2 has native MPIO capabilities.
- PowerPath or PowerPath/VE for automated data path management, failover and recovery, and optimized load balancing. Compared to Windows native MPIO, PowerPath ensures best performance, selects the right optimized data path algorithm automatically for data center environment, and does not have some limitations that native MPIO has.
For details of the comparison between PowerPath and Windows native MPIO, refer to
*EMC PowerPath vs. Windows Native MPIO.*
SharePoint storage sizing and provisioning

Storage design is one of the most important elements of a successful Microsoft SharePoint deployment. This section discusses the guidelines for successful storage design featuring optimal reliability, performance, cost, and ease of use.

**General storage considerations**

**Performance versus capacity considerations**

When designing storage for SharePoint, separately calculate the number of disks required to satisfy performance requirements and capacity requirements, and then choose the larger number.

**Note:** You can use the [VSPEX sizing tool](#) to automatically complete the sizing calculation. This tool implements the sizing logic in this section. It is easy to use and it saves time and energy for the sizing calculations.

**Disk types considerations**

Flash disk, Serial Attached SCSI (SAS) disk, and Near-Line Serial Attached SCSI (NL-SAS) disk are the three major types of hard disks used in storage arrays. Table 18 describes the three disk types.

<table>
<thead>
<tr>
<th>Drive type</th>
<th>Characteristics</th>
<th>Workload examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flash</td>
<td>Flash drives have the highest I/O speed with low power consumption.</td>
<td>FAST™ Cache, Extreme Performance Fully Automated Storage Tiering for Virtual Pools (FAST VP) Tier, best performance for transactional random workloads</td>
</tr>
<tr>
<td>SAS</td>
<td>An improvement over traditional small computer system interface (SCSI) drives. SAS disks provide high capacity with moderate I/O speed.</td>
<td>General performance tier</td>
</tr>
<tr>
<td>NL-SAS</td>
<td>As with Serial Advanced Technology Attachment (SATA) disks, NL-SAS disks are a good fit for the less demanding I/O requirements with large capacity.</td>
<td>Well-behaved streaming, aging data and archive purposes, and backups. NL-SAS is used in capacity cost-effective implementations. It provides limited performance and has higher failure rate than the other two types of disks. RAID 6 is recommended to guard against disk failure.</td>
</tr>
</tbody>
</table>

For SharePoint specifically, we recommend the following best practices:

- Use flash disk in FAST VP first to ensure SharePoint benefits from the flash disk investment.
- Use SAS disk for content and other databases and for data used in service applications.
- Use NL-SAS for low-access content, such as My Site content.
**Note:** Social media content such as tagging, comments, and likes, are stored in a social media database, so that feature performance is not affected.

**Pools and RAID type considerations**

EMC recommends using storage pools for virtualized SharePoint for the following reasons:

- Storage pools support more number of disks than traditional RAID groups and can:
  - House heterogenous disk types; for example, flash, SAS, NL-SAS.
  - House different RAID types; for example, RAID 10, RAID 5, and RAID 6.
  - Use FAST Suite to improve performance or reduce cost.
  - Use both thick and thin LUN types.
- Storage pools are extendable.

Table 19 compares RAID types for various disk types.

<table>
<thead>
<tr>
<th>RAID level</th>
<th>Random read</th>
<th>Random write</th>
<th>Sequential read</th>
<th>Sequential write</th>
<th>RAID write overhead value</th>
<th>Capacity utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAID 10</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>2</td>
<td>Low</td>
</tr>
<tr>
<td>RAID 5</td>
<td>Excellent</td>
<td>Moderate</td>
<td>Good</td>
<td>Moderate</td>
<td>4</td>
<td>High</td>
</tr>
<tr>
<td>RAID 6</td>
<td>Good</td>
<td>Poor</td>
<td>Good</td>
<td>Moderate</td>
<td>6</td>
<td>Medium</td>
</tr>
</tbody>
</table>

The RAID level characteristics also apply to storage pools, because storage pools internally are composed of one or more private RAID groups of disks.

SharePoint has three types of data with different I/O characteristics:

- **Content databases**—Medium IOPS requirement. However, when workload becomes heavier, I/O requirements expand linearly with end user requests. Disk read operations require more IOPS than write operations for content databases. Refer to Content database I/O and capacity characteristics for details.

- **Service application databases and Index files for search**—Increased IOPS requirement when certain service applications run, such as crawling and generating index files. For more information on I/O characteristics for search, refer to Appendix A: I/O characteristics analysis for SharePoint Server 2010 and 2013 search and user profile service application.

- **My Site databases**—Low IOPS requirement. Capacity is the main concern. NL-SAS with RAID 6 configuration can service these databases.
Choose the RAID type for each type of SharePoint data, as shown in Table 20.

### Table 20. RAID types for SharePoint data

<table>
<thead>
<tr>
<th>SharePoint data</th>
<th>RAID type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content databases data files</td>
<td>RAID 5</td>
</tr>
<tr>
<td>Service application database, content database log files, and search index files</td>
<td>RAID 10</td>
</tr>
<tr>
<td>My Site databases</td>
<td>RAID 6</td>
</tr>
</tbody>
</table>

### LUN selection considerations

Pool LUNs are created within pools. A pool LUN can be either thick or thin. You can determine whether to choose thick LUNs or thin LUNs for the SharePoint databases and service application files using the criteria listed in Table 21.

### Table 21. LUN selection criteria

<table>
<thead>
<tr>
<th>Pool-based thin LUN</th>
<th>Pool-based thick LUN</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Applications with moderate performance requirements</td>
<td>• Applications that require good performance</td>
</tr>
<tr>
<td>• Advanced data services, such as FAST VP, VNX Snapshots, compression, and deduplication</td>
<td>• Ease of setup and management</td>
</tr>
<tr>
<td>• Ease of setup and management</td>
<td>• Storage assigned to VNX for file</td>
</tr>
<tr>
<td>• Best storage efficiency</td>
<td></td>
</tr>
<tr>
<td>• Energy and capital savings</td>
<td></td>
</tr>
<tr>
<td>• Applications where space consumption is difficult to forecast</td>
<td></td>
</tr>
</tbody>
</table>

Using thin LUNs provides significant storage savings when deploying a large-content SharePoint environment because you can create LUNs with the required user capacity using less physical capacity in the storage array.

When creating pool LUNs for file, EMC recommends using thick LUNs. Refer to *EMC VNX Unified Best Practices for Performance White Paper*.

### Volume types considerations

Master boot record (MBR) disks use the standard Basic Input Output System partition table. The partition table is only saved at the beginning of the disk.

Globally unique identifier partition table (GPT) disks use a unified extensible firmware interface. Its partition table is saved in multiple locations. It can be easily recovered if any partition is corrupted.

GPT disks have the following advantages:

- More than four partitions per disk.
- Suitable for disks larger than 2 TB.
Two types of disk modes are supported:

- **Basic**—Contains primary partitions and optional extended partitions.
- **Dynamic**—A native host-based logical volume manager, responsible for aggregating disks into logical volumes with multiple options.

Table 22 describes the best practice for typical volumes created on EMC storage in a SharePoint Server 2010 or 2013 environment.

**Table 22. Typical SharePoint deployment for EMC storage**

<table>
<thead>
<tr>
<th>Volume partition</th>
<th>Disk</th>
<th>Volume</th>
<th>Allocation size</th>
<th>Formatting options</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBR</td>
<td>Basic</td>
<td>NTFS</td>
<td>64 KB</td>
<td>Quick format</td>
</tr>
<tr>
<td>GPT (for larger than 2 TB disks)</td>
<td>Basic</td>
<td>NTFS</td>
<td>64 KB</td>
<td>Quick format</td>
</tr>
</tbody>
</table>

**Note:** Because the EMC array provides storage RAID protection, dynamic disks should be avoided if possible because they complicate the management of storage and local and remote disaster recovery. Quick format options are required for thin LUNs.

SharePoint Server 2010 requires Windows Server 2008 or later and SharePoint Server 2013 requires Windows Server 2008 R2 or later. On these versions of Windows, partition alignment is usually performed by default. Partitions created on versions of Windows earlier than Windows Server 2008 maintain the properties under which they were created. That is, if partition alignment is not performed, these partitions are not aligned. This could affect SQL Server performance, and therefore, SharePoint performance. Refer to [Disk Partition Alignment Best Practices for SQL Server](#) for more information.

**NFS and SMB 3.0 considerations**

Network file system (NFS) and Server Message Block (SMB) 3.0 are both network file sharing protocols for NAS. Below are the file storage best practices for NFS and SMB 3.0.

**File storage best practices**

The recommended file system layout implements the following best practices:

- When the number of disks is set, the number of storage pools does not affect file system performance.
- In order to spread I/O across all the disks in a storage pool, divide the number of disks in the pool by four and round up to the nearest ten. The result is the number of LUNs to create in the pool.
- Use Automatic Volume Management to create the file system to achieve balance between performance and capacity.
- For versions of VNX OE for File earlier than 8.x, select **Direct Writes Enabled** so that asynchronous writes can be written directly to the back end for better performance.
• For versions of VNX OE for File 8.x or later, clear **Direct Writes Enabled**, because the VNX OE for File cached I/O path has been enhanced to support parallel writes.

• Set the parameter **asyncUncachedOpt** to 1 (true) on the Data Mover. If set to 1, asynchronous writes to a file system mounted with the uncached option will be written out without being buffered in cache. If set to 0, writes to a file system mounted with the uncached option will be written out via the buffer cache. The setting has no impact on file systems mounted without the uncached option. Execute the following command to set the parameter:

```
server_param server_2 -facility file -modify asyncUncachedOpt -value 1
```

**NFS**

NFS is a distributed file system protocol allowing a user on a client computer to access files over a network the way local storage is accessed.

Best practices for NFS:

• VMDKs created on NFS datastores are in thin provisioned format by default.

• Isolate storage traffic from other networking traffic.

• Select **No** for network interface card (NIC) teaming failback option.

For more information, refer to the [Best Practices for running VMware vSphere on Network Attached Storage](#) white paper.

**SMB 3.0**

SMB is based on the Common Internet File System protocol that the Microsoft Windows OS uses for distributing file sharing, printing, and communication services from a server over a network. SMB 3.0 protocol support is available with Windows Server 2012. For detailed configuration of SharePoint over SMB 3.0, refer to [EMC Integration for Microsoft Private Cloud Using EMC VNX Unified Storage White Paper](#).

Best practices for SMB 3.0:

• Do not use a computer running Microsoft Hyper-V as the file server for virtual machine storage. This forms a so-called “loopback” configuration which is not supported by Microsoft Hyper-V.

• Use multiple network adapters to take advantage of SMB multichannel when using SMB storage with Microsoft Hyper-V, as this provides increased performance and resiliency.

• Make sure the continuous availability (CA) feature is enabled on both the Windows server and the Data Mover.

  For details on how to use the CA feature with VNX, refer to the *EMC VNX Series: Introduction to SMB 3.0 Support White Paper*.

• Use a dedicated network between the SMB 3.0 server and the Data Mover.

• Test the CA and multichannel features during the deployment steps.
RBS (file and block) considerations

One significant challenge all SharePoint users face is the requirement to store BLOBs on the most expensive tier of storage (block) when alternative, less-expensive tiers of storage (file) could be used. For example, file-based content such as PDFs, Microsoft Office documents, and engineering drawings, are stored in SQL Server databases. However, BLOBs can reside on a lower-cost tier of storage and still meet SLAs.

RBS is designed to move the storage of BLOBs from database servers to commodity storage solutions. If the content databases in Microsoft SharePoint Server 2010 or SharePoint Server 2013 are 4 TB or larger, and the contents are read intensive, consider using RBS as part of your data storage solution.

RBS is composed of the following components:

- RBS client library
- RBS provider
  - Local RBS provider—Stores BLOBs on the same server, for example SQL FILESTREAM provider.
  - Remote RBS provider—Stores BLOBs on a separate server.
- BLOB store

Metalogix StoragePoint is an example of a third-party solution that is a good choice for both local and remote RBS providers. It is an easy-to-install RBS and archive solution that allows you to consolidate and optimize SharePoint storage. StoragePoint improves performance, scalability, and compliance requirements while decreasing overall storage and administrative costs of the growing SharePoint environment.

EMC recommends that you use well-established content management and content externalization vendors to host your StoragePoint solution and ensure that you have the flexibility to store unstructured SharePoint content on any tier of the storage device, including SAN, NAS, and cloud storage platforms.
Figure 9 shows an example of the reference architecture of using Metalogix StoragePoint with SharePoint.

![Sample reference architecture for Metalogix StoragePoint](image)

In this architecture, SharePoint BLOB is externalized by the RBS provider to external storage such as Isilon. Meanwhile the metadata is still stored in the content databases.

Best practices for RBS are as follows:

- Install an RBS provider on each server where SharePoint Server 2013 is installed and on each database server in the topology. The provider includes a set of DLLs that implement methods for the RBS application programming interfaces (APIs) and perform the actual operation of externalizing the BLOBs.

- Determine the limitations of each RBS provider. For limitations of a Microsoft FILESTREAM provider, refer to [Limitations of RBS](#).

- Use RBS to optimize the following environments:
  - Environments that store fewer large BLOBs (256 KB or larger) for read-intensive or read-only access.
- Environments where the resources on the computer that is running SQL Server could become a performance bottleneck.
- Environments where the expense of high-cost drive space is greater than the expense of increased complex IT operations that might be introduced by using RBS.

- When SharePoint Server 2013 is configured to use RBS, and the BLOBs reside on NAS storage, ensure that no more than 20 milliseconds elapses from the time that SharePoint Server 2013 requests a BLOB to the time it receives the first byte from the NAS.
- Plan for more time to upgrade an RBS-enabled SharePoint. Under some circumstances, an upgrade or software updates can enumerate and iterate through each object to include BLOB data regardless of where that data is stored. Therefore, upgrade operations are similar in duration whether inline or remote BLOBs are used.
- When using Metalogix StoragePoint, consider the following best practices:
  - Either arrange downtime or run externalization on servers that do not affect farm performance, for example the application server. Running externalization on all servers in the farm consumes resources. For details, refer to *EMC Efficient BLOB Storage Management for Microsoft SharePoint White Paper*.
  - The StoragePoint database is created on installation, and it can reside on any SQL Server to which a SharePoint farm server connects. Use the StoragePoint in the SQL Server that SharePoint farm uses.
  - Capacity is based on the size of the tasks that are being run. 4 TB content database externalizations make the StoragePoint database grow to approximately 100 GB. The growth is caused by the worker tasks that are added in batches. The completed batches are also recorded until the task is done.
  - After the externalization task is completed, the completed batches are removed from the StoragePoint database. You must manually shrink the database.

Table 23 lists the guidelines for sizing SharePoint components.

<table>
<thead>
<tr>
<th>SharePoint components</th>
<th>Guideline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Configuration and administration database</td>
<td>• <em>Storage and SQL Server capacity planning and configuration (SharePoint Server 2010)</em></td>
</tr>
<tr>
<td></td>
<td>• <em>Storage and SQL Server capacity planning and configuration (SharePoint Server 2013)</em></td>
</tr>
<tr>
<td>Content database</td>
<td>Sizing content database best practices</td>
</tr>
<tr>
<td>Search service related database and components</td>
<td>Sizing SharePoint search service best practices</td>
</tr>
<tr>
<td>SharePoint components</td>
<td>Guideline</td>
</tr>
<tr>
<td>-----------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>User profile service related database</td>
<td>Sizing SharePoint user profile service best practices</td>
</tr>
</tbody>
</table>
| Other service application related databases                | • *Storage and SQL Server capacity planning and configuration (SharePoint Server 2010)*  
|                                                    | • *Storage and SQL Server capacity planning and configuration (SharePoint Server 2013)*  |
| tempDB                                                    | Sizing tempDB best practices                                              |

**Sizing content database best practices**

The best practices for content databases are as follows:

- Content database data files and log files should reside on different LUNs.
- Two kinds of disks can be used for storing content database:
  - SAS—for consistent performance
  - NL-SAS +flash (FAST VP SSD)—for cost saving considerations
- Put content database data files on RAID 5 LUNs.
- Put content database log files on RAID 10 LUNs.
- Each content database must contain less than 60 million items, including documents and list items. For details on how to calculate the item count in an existing content database, refer to Appendix E: Scripts to break down items in the content database.

**Formula to size content database**

In the section Content database I/O and capacity characteristics, we introduced the relationship between content database IOPS and concurrent user numbers with a few formulas. These are powerful tools for sizing the content database from a performance perspective.

The formulas were developed from a test environment featuring the following important conditions:

- 64 GB of memory was allocated for SQL Server.
  
  In SharePoint Server 2010, for up to 4 TB content databases, Microsoft recommends allocating 64 GB memory for SQL Server, while in SharePoint Server 2013 Microsoft recommends allocating 32 GB for memory. If SQL Server does not have enough memory, the disk I/O increases greatly due to memory swap.

- Incremental crawl was running as a background job every half hour.
  
  This simulated the workload I/O of a production environment in which search crawl and content processing run at regular intervals.

- Web server CPU usages were all under 70 percent.

When using these formulas, consider above three conditions to get the expected performance estimations.
Table 24 and Table 25 show formulas in two workload profiles.

**Table 24. SharePoint Server 2010 formulas**

<table>
<thead>
<tr>
<th>Workload profile</th>
<th>Formula</th>
<th>More</th>
</tr>
</thead>
<tbody>
<tr>
<td>Publishing Portal</td>
<td>$y = 0.0003 \times x^{1.7048}$</td>
<td>$y$ is the host IOPS</td>
</tr>
<tr>
<td>Document Management Portal</td>
<td>$y = 0.0007 \times x^{1.7783}$</td>
<td>$x$ is the number of concurrent users</td>
</tr>
</tbody>
</table>

For example, in SharePoint Server 2010 Publishing Portal with 20,000 users and a concurrency rate of 25 percent, the host IOPS for content databases is calculated as follows:

$$host\ IOPS = 0.0003 \times (20,000 \times 25\%)^{1.7048} = 607$$

**Table 25. SharePoint Server 2013 formulas**

<table>
<thead>
<tr>
<th>Workload profile</th>
<th>Formula</th>
<th>More</th>
</tr>
</thead>
<tbody>
<tr>
<td>Publishing Portal</td>
<td>$y = 0.2397x$</td>
<td>$y$ is the host IOPS</td>
</tr>
<tr>
<td>Document Management Portal</td>
<td>$y = 0.4173x$</td>
<td>$x$ is the number of concurrent users</td>
</tr>
</tbody>
</table>

For example, in SharePoint Server 2013 Document Management Portal with 20,000 users and a concurrency rate of 20 percent, the host IOPS for content databases is calculated as follows:

$$host\ IOPS = 0.4173 \times 20,000 \times 20\% = 1,669$$

To continue sizing the content database, we need the backend IOPS. The read/write ratio is needed to calculate backend IOPS. Refer to [Content database I/O and capacity characteristics](#) for details of the read/write ratios of different SharePoint use cases.

Using the storage RAID type combined with the read/write ratio, you can calculate the backend IOPS. [EMC VNX Unified Best Practices for Performance](#) provides methods of calculating the backend IOPS.

**Sizing SharePoint search service best practices**

The search service application is a very important part of the SharePoint farm. It contains many components that work together and can scaled according to the size of the farm.

Since SharePoint contains multiple components to support the search function, EMC recommends that you use the following sequence to size the SharePoint search service:

- **Size search components based on business needs**—Determine the scalability of the search topology to meet the business requirements. For example, the number of index partitions and crawlers.

- **Size storage for each search component**—Size storage for each search component based on its I/O characteristics.
The next two sections discuss the best practices for sizing search components for both SharePoint Server 2010 and 2013.

**Note:** You can use the **VSPLEX sizing tool** to automatically complete the sizing calculation. This tool implements the sizing logic in this section. It is easy to use and it saves time and energy for the sizing calculations.

Storage best practices for sizing SharePoint Server 2010 and 2013 are as follows:

- Put search service application-related contents (databases, index files) on RAID 10 SAS disks. Refer to Appendix A: I/O characteristics analysis for SharePoint Server 2010 and 2013 search and user profile service application for search related I/O characteristics.

- For detailed storage sizing for each component for search service, refer to Search and user profile service application I/O and capacity characteristics.

**Sizing SharePoint Server 2010 best practices**

A best practice for search components sizing in SharePoint Server 2010 is to scale topology according to the number of items. Table 26 shows different topology best practices for different numbers of items.

**Table 26. Topologies for different numbers of items**

<table>
<thead>
<tr>
<th>Number of items</th>
<th>Topology best practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1 million</td>
<td>All components could coexist on one or two servers.</td>
</tr>
<tr>
<td>1-10 million</td>
<td>One dedicated application server running crawl components.</td>
</tr>
<tr>
<td>10-20 million</td>
<td>Two dedicated servers running crawl component. Two index partitions. Two query components. Each query components should have a mirror. Application running index partitions also hosting query components.</td>
</tr>
<tr>
<td>20-40 million</td>
<td>Three index partitions with distributed query components. Two crawl databases. Each crawl server has two crawler components running on it.</td>
</tr>
<tr>
<td>40-100 million</td>
<td>Isolate each topology layer into server groups in which each role is deployed to its own servers. Scale server group to meet specific requirements for the components in that role. Add more crawl and query database for redundancy.</td>
</tr>
</tbody>
</table>

- Add crawl servers, crawlers, and crawl databases to improve full crawl time and refresh time.
- Add query servers and index partitions to improve high load query latency.
- Deploy redundant query components for the same index partition on different servers for redundancy.
• Use clustered or mirrored database servers to host crawl and property databases.

• Use multiple crawl components on redundant crawl servers and add crawl databases for high availability.

• For each search application in SharePoint Server 2010, there is only one search admin component. Putting this component on a dedicated server is a best practice, which means this server does not function as web front end, query server, or crawl server.

For details on sizing principles, refer to the Scale-out decision points section of the article Search Architectures for Microsoft SharePoint Server 2010.

For details of each component of SharePoint Server 2010, refer to Search Architectures for Microsoft SharePoint Server 2010.

**Sizing SharePoint Server 2013 best practices**

Search component sizing best practices are as follows:

• Add one index partition per 10 million items.

• Use two query processing components for redundancy. Above 80 million items, increase to 4.

• Add one crawl database per 20 million items.

• Add one link database per 60 million items.

• Add one analytics reporting database for each 500K unique items viewed each day or every 10-20 million total items.

• Use two search administration components for redundancy.

For details regarding each component of the search function in SharePoint Server 2013, refer to Overview of search in SharePoint Server 2013.

For information on how to scale search for performance and availability, refer to the documents below:

• Scale search for performance and availability in SharePoint Server 2013

• Enterprise Search Architectures for SharePoint Server 2013

**Sizing SharePoint user profile service best practices**

SharePoint user profile service sizing follows the same sequence of SharePoint search service sizing.

Refer to Best practices for people and profiles (SharePoint Server 2010) for details. The content applies for both SharePoint Server 2010 and SharePoint Server 2013.

For detailed storage sizing for each component for user profile service, refer to Search and user profile service application I/O and capacity characteristics.
**Sizing other components in SharePoint**

For other components in SharePoint, such as service application databases, EMC recommends storing the content on SAS RAID 10 disks to satisfy the random I/O requirements.

In some cases, such as browsing a long list with thousands of files, SharePoint generates many IOPS for SQL tempDB. The following section introduces some best practices for tempDB in a SharePoint environment.

**Sizing tempDB best practices**

TempDB is a temporary database that contains all temporary user objects such as global or local temporary tables, table variables, and cursors. It also includes internal objects created by the SQL Server Database Engine, such as work tables to store intermediate results for spools or sorting. TempDB handles and manages row versions. In SharePoint, almost every action and request generates work in the tempDB.

EMC suggests the following best practices for tempDB:

- Put tempDB on SAS RAID 10 disk LUNs because tempDB is write-intensive.
- Use a minimum of two tempDB data files for a small SharePoint farm, and a minimum of four tempDB data files for a medium SharePoint farm.
- Set the database autogrowth value as percentage instead of a fixed number of megabytes.

For compute resource sizing of SQL Server, refer to **Virtualizing SQL servers**.

For best practices in configuring SQL Server for SharePoint Server 2010 and 2013 farm, refer to **Best practices for SQL Server 2008 in a SharePoint Server 2010 farm**. The article is also applicable for SharePoint Server 2013 users.

Refer to the **Storage layout sizing for SharePoint 2013** section in **Appendix D of EMC VSPEx for Virtualized Microsoft SharePoint 2013 Design Guide** for more information about the tool’s sizing logic. The sizing logic is also applicable for SharePoint Server 2010 users.

**FAST Suite best practices**

The EMC FAST Suite (FAST VP and FAST Cache) provides two key technologies that enable automated high performance, as needed.

Enabling FAST Cache or FAST VP is a transparent operation to SharePoint and no reconfiguration or downtime is necessary. To make the best use of either of the FAST technologies, enable FAST VP on the SharePoint services storage pool first.

**Note:** Only FAST VP applies to Symmetrix VMAX, while both FAST Cache and FAST VP apply to VNX.

**FAST Suite in next-generation VNX best practices**

**Overview**

EMC next-generation VNX is a flash-optimized hybrid array that provides automated tiering to deliver the best performance for your critical data, while intelligently moving less frequently-accessed data to lower-cost disks.
In this hybrid approach, a small percentage of flash drives in the overall system can provide a high percentage of the overall IOPS. The flash-optimized VNX takes full advantage of the low latency of flash to deliver cost-saving optimization and high performance scalability. The EMC FAST suite (FAST Cache and FAST VP) tiers both block and file data across heterogeneous drives and boosts the most active data to cache, ensuring that customers never have to make concessions for cost or performance.

FAST Cache dynamically absorbs unpredicted spikes in system workloads. As data ages and becomes less active over time, FAST VP tiers the data from high performance to high-capacity drives automatically, based on customer-defined policies. This functionality has been enhanced with four times better granularity and with new FAST VP SSDs based on eMLC technology to lower the cost per gigabyte.

**FAST Cache best practices**

FAST Cache allows you to use the lower response time and better IOPS of flash drives without dedicating flash drives to specific applications. A single FAST Cache instance per storage system serves as a system-wide resource.

If a particular chunk of data is accessed frequently by the user application, that chunk is automatically promoted into the FAST Cache by copying from hard disk drives to the flash drives. Subsequent access to the same chunk is serviced at flash drive response times, thus boosting the performance of the storage system.

Applications that access a small area of storage with high frequency benefit the most from using FAST Cache. For example, in SharePoint, FAST Cache provides fast access to the crawl database and index files to accelerate the crawl rate.


For SharePoint specifically, consider the following:

- Content database access and service application database access benefit from FAST Cache, because a considerable portion of the access to these types of data comes from small-block random I/O.
- The search index may not benefit from FAST Cache when being generated, because of the large I/O. But when being queried, it benefits from FAST Cache due to the small random read on index partition. Refer to *Search service I/O and capacity characteristics* section for more details.
- When dealing with customized development in SharePoint, be careful when the storage related workload is small block sequential. This kind of data should be avoided when using FAST Cache. FAST Cache must be disabled at the pool level, so it is best to separate pools of LUNs storing this data.

**FAST VP best practices**

FAST VP can lower the total cost of ownership (TCO) and increase performance by intelligently managing data placement at a sub-LUN level. FAST VP automatically moves more active chunks (data that is more frequently accessed) to the best performing storage tier, and it moves less active chunks to a lower performing tier.
EMC recommends that you enable FAST VP on the VNX and add additional flash disks as a high performance tier into the SharePoint content database pool. For best use of the flash tier, set all LUNs to **Start High, then Auto-Tier.**


For SharePoint specifically, consider the following best practices:

- Plan for the growth of SharePoint content and maintain some unallocated capacity within the pool to help with relocation schedules when using FAST VP.
- Schedule relocations for off-peak hours so the primary workload does not contend with the relocation activity.
- During peak hours, EMC recommends you set the **Data Relocation Rate** to **Medium** to move the hot data to the highest performance tier as soon as possible without affecting the SharePoint performance. At non-peak hours, EMC recommends you set the **Data Relocation Rate** to **High.**
- For a medium to large SharePoint farm, EMC suggests you enable FAST VP on the SharePoint content database pool to aggressively reduce TCO. The percentage of the reduced TCO can vary widely, depending on the size of the SharePoint farm and the workload in this farm. The SharePoint workload can be serviced with a mix of tiers and a much lower drive count. Table 27 demonstrates details of this mixed pool after FAST VP is enabled.

<table>
<thead>
<tr>
<th>Storage pool name</th>
<th>RAID type</th>
<th>Disk type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content database pool</td>
<td>RAID 6</td>
<td>NL-SAS</td>
</tr>
<tr>
<td></td>
<td>RAID 10</td>
<td>FAST VP SSD</td>
</tr>
</tbody>
</table>

**Best practices for FAST VP on Symmetrix VMAX**

FAST VP monitors the performance of a LUN at fine granularity and moves only a small number of Symmetrix tracks between storage tiers. FAST VP proactively monitors workloads at a sub-LUN level in order to identify active areas that would benefit from being moved to higher-performing drives. FAST VP also identifies less active sub-LUN areas that could be moved to higher capacity drives, without affecting existing performance.

**FAST VP best practices**

For general best practices of FAST VP on VMAX, refer to *FAST VP for EMC Symmetrix VMAX Theory and Best Practices for Planning and Performance Technical Notes.*

For SharePoint specifically, consider the following best practices:

- FAST policies control tier capacities used by storage groups. When configuring policies for a typical SharePoint workload, EMC recommends setting a high performance tier at less than 100 percent of capacity, a performance tier equal to 100 percent of capacity, and a capacity tier equal to 100 percent of
capacity for a self-adjusting black box. Use different values as dictated by chargeback or other operational reasons.

- FAST VP has the following time windows:
  - **Performance time window**—Time window that the SharePoint is serving the user.
    - For most SharePoint applications where users generate the most data during the weekdays, simply setting the collection policy to be active only during the daytime from 7 AM to 7 PM, Monday to Friday helps to address the normal performance requirement.
    - For users in a globally distributed SharePoint farm, collecting statistics 24x7 would be a simple and comprehensive approach.
    - Each environment must make the decision based on their particular requirements and SLAs. No performance time window is applicable to all customer environments.
  - **Workload analysis period**—Affects decay rates and time to respond to changes. EMC recommends that you set this value to seven days (168 hours) a week.
  - **Data movement time window**—Defines when FAST VP is allowed to move data. EMC recommends an initial data movement time window of 24x7 for SharePoint.

- For a typical SharePoint deployment, EMC recommends keeping the default FAST VP Relocation Rate value at five.

- Use the PIN feature to override FAST VP. If, for example, the LUNs containing tempDB and log files do not need to be moved between the tiers, you can use the PIN feature.

### XtremSF

EMC XtremSF is a server-based peripheral component internet express (PCIe) flash hardware that reduces latency and increases throughput to dramatically increase application performance. XtremSF can be used as a direct-attached storage (DAS) device or as a caching device in conjunction with EMC XtremCache server flash caching software.

When XtremSF is used as DAS, data sets are stored locally for accelerated reads and writes.

When XtremSF is used with XtremCache, the intelligent caching algorithm accelerates reads, while all writes persist to the networked storage for HA, integrity and disaster recovery.

The following two sections focus on DAS use cases of XtremSF and XtremCache.

### XtremSF benefits

Applications with performance requirements (with or without protection requirements) that are read and write heavy can be a good fit for XtremSF DAS.
The large capacities offered in the XtremSF portfolio allow users to store large SharePoint content databases on a single PCIe flash device to improve both read and write performance.

**XtremSF Best practices**

The best practices for XtremSF as DAS are listed as follows:

- The eMLC flash-based PCIe cards are adequate for performance and endurance requirements for SharePoint Server 2010 and 2013 environments.
- You should know the SharePoint data set size with predictable future growth relative to the XtremSF card capacity. The entire data set can be placed on the XtremSF card for maximum performance benefit.
- Business-critical data in the SharePoint environment must be protected. This is because as DAS, XtremSF does not provide the data protection benefits inherently found on the backend storage arrays. Best practice is to use data protection features at the OS or SharePoint level. For the SharePoint out-of-box protection feature refer to General considerations for Backup and Recovery in SharePoint.

**XtremCache**

EMC XtremCache is a server flash-caching software that reduces latency and accelerates throughput to dramatically improve application performance, and is most effective when coupled with EMC XtremSF—EMC PCIe flash technology.

XtremCache accelerates reads and protects data by using a write-through cache to the networked storage to deliver persistent high availability, integrity, and disaster recovery.

**XtremCache benefits**

XtremCache can benefit SharePoint components with read-heavy high performance and protection requirements, such as content or crawl database data LUNs.

XtremCache accelerates block I/O reads that require the highest IOPS and/or lowest response times, when a LUN housing a SharePoint database is configured as the source device for XtremCache. At the same time, it can also offload the I/O processing from the storage array.

Our validation testing of XtremCache with SharePoint Server 2010 shows a significant reduction in both crawl duration, which is decreased by 20 percent, and content database latency, which is decreased by 80 percent, during the full crawl. In daily user workloads, XtremCache can also provide benefits based on the characteristics of the workloads.

**Note:** Performance gain and reduction in response times can vary based on each customer's SharePoint usage profile. We recommend that you use a pilot phase test in your environment to determine the exact benefits of this technology. However, all testing within EMC showed improvements in performance.

For detailed test results and configuration, refer to *EMC VSPEX with EMC XtremSF and EMC XtremCache Design Guide*. 
**XtremCache best practices**

Here are the best practices for both SharePoint Server 2010 and 2013 in virtual or physical environments:

- Use XtremCache Performance Predictor in the SharePoint Server 2010 and 2013 farm to view predicted performance in LUN granularity and choose the best LUNs to accelerate. For details on where to download this tool, refer to Appendix B: Tools for SharePoint Server performance testing, monitoring, tuning, and sizing.

- Exclude log LUNs and tempDB LUNs in the SharePoint Server 2010 and 2013 farm from the acceleration of XtremCache.

- There is no hard limit on the maximum number of server volumes on which XtremCache can be enabled. However, if you enable it on a large number of volumes or LUNs, resource starvation could result for those volumes that could benefit from XtremCache. EMC recommends that XtremCache not be enabled for those volumes or LUNs that are least likely to gain any performance benefit from XtremCache. This allows other volumes or LUNs that are a good fit for XtremCache to get the maximum processing and cache capacity resources.

- Manually stop and restart the XtremCache software driver for the source device if any operations modify the SharePoint data without the knowledge of the server that results in stale data in the XtremCache. For example, if a SharePoint LUN snapshot were taken on the array and later used to roll back changes on the source device, the SharePoint server would have no knowledge of any changes that had been done on the array.

  **Note:** As a generic best practice, EMC recommends you unmount the SharePoint LUNs when there are any changes which only apply to storage without the knowledge of the server.

- Set the page size to 64 KB (the default is 8 KB) and the maximum I/O size to 128 KB (the default is 64 KB) in XtremCache to accommodate the large I/O size of the content and crawl databases.

- Use the VSI plug-in for VMware vSphere vCenter to easily manage and monitor XtremCache in a virtualized environment.

**Best practices for SharePoint Server 2010:**

- Include content database data LUNs and crawl database data LUNs as the XtremCache source devices, since they are both read intensive when doing crawl.

- In SharePoint Server 2010, for each 1 TB of the content database, an XtremCache of 250 GB or more and for each 100 GB of the crawl database, an XtremCache of 40 GB or more can significantly improve the crawl performance.

**Best practices for SharePoint Server 2013:**

- The crawl mechanism is redesigned in SharePoint Server 2013. The crawl database does not experience heavy workloads during crawl as in SharePoint Server 2010. So it is not necessary to include the crawl database as the XtremCache source device.
• In SharePoint Server 2013, for each 1 TB of the content database, an XtremCache of 250 GB or more can significantly improve the crawl performance.

Best practices for SharePoint Server 2010 and 2013 in a virtualized environment:

• Clear the XtremCache before the virtual machine “suspend” and “remove” operations if the SharePoint farm is hosted in VMware environment. This is handled using scripts that are automatically installed when the XtremCache Agent is installed in the SharePoint virtual machine.

• Stop the source device volume where you want to take a snapshot in VMware. XtremCache metadata is kept in the virtual machine memory; therefore it is a part of the snapshot image when a virtual machine snapshot is taken. This means that when this snapshot image is used to roll back the virtual machine, the old metadata is restored and potentially causes data corruption.

For other best practices under virtualized environments, refer to Microsoft SQL Server Best Practices and Design Guidelines for EMC Storage White Paper.

Automation with ESI


ESI for Windows Suite contains a component named ESI Microsoft SharePoint Adapter. It can help SharePoint administrators easily complete storage related tasks.

SharePoint adapter in ESI currently supports only SharePoint Server 2010.

Figure 10 shows the site collections and content databases information in the ESI interface.

Figure 10. View site collections and content databases in ESI

SharePoint adapter in ESI can help perform the following functions with SharePoint farms:

• View SharePoint storage, farms, sites, and content databases.

• Connect to existing SharePoint farms and enumerate farm information, including servers, web applications, site collections, and content databases.

• Provision storage on the SharePoint server by partitioning, formatting, and assigning it a drive letter, and provisioning the storage to the SharePoint site.

• Support File Stream Remote BLOB Store.
- Create a web application and map it to the newly created content database.

For detailed steps of how to perform these tasks, refer to the Chapter 7 ESI Microsoft SharePoint Adapter in EMC Storage Integrator for Windows Suite Technical Notes.
Microsoft SharePoint Server: Best Practices and Design Guidelines for EMC Storage

EMC VNX family, EMC Symmetrix VMAX systems, EMC Xtrem Server products

SharePoint Server farm protection

Backup and Recovery

General considerations for Backup and Recovery in SharePoint

This section discusses the best practices for designing the high availability infrastructure.

By default, Microsoft SharePoint Server provides the ability for different levels of backup and recovery as listed in Table 28. EMC has a number of data protection products and options that can further protect your SharePoint environment from the loss of databases, servers, or entire sites.

EMC storage systems offer a wide range of features for SharePoint protection and high availability. EMC replication technologies such as EMC TimeFinder®, EMC Symmetrix Remote Data Facility (SRDF®), and VNX snaps and clones provide the best data protection in the industry. EMC RecoverPoint® with continuous protection and replication management tools such as Replication Manager, provide protection for the SharePoint server at the application level. Some third-party tools, such as Metalogix StoragePoint and Kroll Ontrack PowerControls, provide some advanced backup and recovery features that are not part of the standard SharePoint protection options.

Table 28. SharePoint backup and recovery in general

<table>
<thead>
<tr>
<th>Tool</th>
<th>Type of restorable objects</th>
<th>Maximum backup size supported</th>
<th>Supported backup type</th>
</tr>
</thead>
</table>
| SharePoint Farm Backup and Restore | • Farm  
• Service application  
• Web application  
• Content database  
• Site collection  
• Site  
• List item/document  
• Configurations  
• Customizations (if packaged as user solutions) | <200 GB | • Full  
• Incremental |
| SQL Server | • Content database  
• Site  
• List item/document | Content databases > 200 GB may require additional management | • Full  
• Differential |
| Windows PowerShell Site Collection Backup and Restore | Site collection (not recommend for site collections larger than 100 GB) | 100 GB | • Full  
• Differential |
<table>
<thead>
<tr>
<th>Tool</th>
<th>Type of restorable objects</th>
<th>Maximum backup size supported</th>
<th>Supported backup type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows PowerShell Import and Export</td>
<td>• Site</td>
<td>100 GB</td>
<td>Full</td>
</tr>
<tr>
<td></td>
<td>• List/Document Library</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• List items</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Customizations (if packaged as user solution)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For details of general best practices for SharePoint Server 2010, refer to [Backup and recovery best practices (SharePoint Server 2010)](#).

For details of general best practices for SharePoint Server 2013, refer to [Backup and restore best practices in SharePoint 2013](#).

**Content recovery with Kroll Ontrack PowerControls**
EMC is part of a technology partnership with Kroll Ontrack that provides granular, item-level recovery of SharePoint data for both NetWorker and EMC Avamar®. With Kroll Ontrack PowerControls, EMC can provide an appropriate solution to meet customer recovery performance requirements.

Kroll Ontrack PowerControl can:

- Restore data from content database backups
- Quickly and easily find, recover and restore SharePoint content, such as documents, lists, libraries and folders, or entire SharePoint sites
- Maintain data integrity during a SharePoint granular recovery

For best practices using Kroll Ontrack PowerControl with SharePoint, refer to [EMC Replication Manager and Kroll Ontrack PowerControls for Granular Recovery of SharePoint Items White Paper](#).

**Backup and recovery SharePoint content with RBS**
RBS is a SQL Server library API which enables applications, such as SharePoint Server 2013, to store BLOBs in a location outside the content databases. Storing the BLOBs externally can reduce requirements for SQL Server database storage space. The metadata for each BLOB is stored in the SQL Server database and the BLOB is stored in the RBS store.

These example scenarios benefit from RBS:

- The need to store fewer large BLOBs (256 KB or larger) for read-intensive or read-only access
- Huge content databases for archiving in order to reduce storage costs
- A great number of large unstructured data files, such as media files

**Note:** Although RBS supports the large file size, a single document still has the limitation of 2 GB.
RBS uses a provider to connect to any dedicated BLOB store that uses the RBS APIs. SharePoint Server 2013 supports a BLOB storage implementation that accesses BLOB data by using the RBS APIs through such a provider. RBS has two kinds of providers, local and remote.

The RBS FILESTREAM provider is a typical local RBS provider which uses the SQL Server FILESTREAM feature to store BLOBs in an additional resource. This provider supports only a local hard disk or an attached iSCSI device.

If you want to make BLOB stores in NAS or remote sites, you can use a third-party remote RBS provider such as Metalogix StoragePoint.

The combination of VNX snapshot technology, EMC Replication Manager, and Metalogix Selective Restore Manager offers unique advantages over many of the available technologies:

- Reduced backup and recovery times
- Complete and synchronized backup and recovery process
- Reduced management overhead through automated creation of point-in-time copies and intuitive recovery workflows

EMC recommends that you follow these best practices for backup and recovery in SharePoint with RBS:

- When protecting a SharePoint farm with remote BLOB stores with Replication Manager, inconsistencies might exist between the BLOB stores and the RBS databases. BLOBs can be present in the BLOB store replica while absent from the RBS database replica. We recommend that you run RBS database and BLOB store consistency checks and clean up orphaned BLOBs using RBS Maintainer after database restoration. For details about RBS maintainer, refer to Running RBS maintainer.

- If you are using Metalogix StoragePoint as the RBS provider, protect SharePoint farms in the following order so that the StoragePoint database is as close to being in sync with the SharePoint farm databases as possible. This ensures that StoragePoint's orphan control can identify and clean up any orphaned documents.
  - SharePoint farm
  - StoragePoint database
  - BLOB stores

- If you are using Metalogix StoragePoint as the RBS provider, use the following order to restore a single content database
  - BLOB store
  - StoragePoint database
  - Content database

**Note:** System Center 2012 Data Protection Manager cannot use the RBS FILESTREAM provider to back up or restore RBS. Meanwhile SQL backup can take care of FILESTREAM BLOB objects.
For details refer to *EMC Efficient BLOB Storage Management for Microsoft SharePoint White Paper*.

**SharePoint Server 2010 and 2013 VSS for backup replication**

Microsoft SharePoint foundation includes a referential volume shadow copy service (VSS) Writer (SPF-VSS Writer) that integrates with the Windows VSS backup framework, enabling backup applications to back up and restore SharePoint data. It supports a catastrophic overwrite scenario for the entire farm (search index included).

EMC Replication Manager, Networker Module for Microsoft Applications, and Avamar VSS plug-in are built on top of these technologies to provide data protection that suits different environments.

One general best practice for any solution which uses SPF-VSS Writer is that the number of LUNs mounted to a mount host should not exceed 32.

For details about SharePoint foundation and the VSS, refer to:

- *SharePoint Foundation and the Volume Shadow Copy Service*
- *Overview of SharePoint 2013 and the Volume Shadow Copy Service*

**EMC replication technologies**

EMC offers a wide range of options to provide replication technologies with SharePoint farm protection. Table 29 lists the options for EMC replication technologies.

<table>
<thead>
<tr>
<th>Category</th>
<th>Tool/System</th>
<th>Features</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous availability</td>
<td>RecoverPoint</td>
<td>Continuous data protection (CDP)</td>
<td>• Synchronous&lt;br&gt; • Local recovery protection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Continuous remote replication (CRR)</td>
<td>• Asynchronous&lt;br&gt; • Continuous remote replication</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Concurrent local and remote data protection (CLR)</td>
<td>• Concurrent local and remote data&lt;br&gt; • Combines CDP and CRR</td>
</tr>
<tr>
<td></td>
<td>VMAX/VNX with a built-in RecoverPoint splitter</td>
<td>CDP/CRR/CLR</td>
<td>Both VMAX and VNX arrays have options with a built-in RecoverPoint splitter that functions as native continuous availability</td>
</tr>
<tr>
<td></td>
<td>VMAX</td>
<td>SRDF</td>
<td>Continuous replication</td>
</tr>
<tr>
<td>Point-in-time rapid replication recovery</td>
<td>Replication Manager</td>
<td>Snapshot/Clone, SAN copy for VMAX and VNX</td>
<td>• A comprehensive data protection software&lt;br&gt; • Must install agent on SharePoint Server</td>
</tr>
<tr>
<td></td>
<td>VMAX</td>
<td>TimeFinder</td>
<td>General monitor and control operations for business continuance volumes (BCV)</td>
</tr>
<tr>
<td>Category</td>
<td>Tool/System</td>
<td>Features</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
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</tr>
<tr>
<td></td>
<td>CG</td>
<td>Consistency groups</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clone</td>
<td>Clone sessions generally consume the same size of production LUNs, but have no impact once created.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Snap</td>
<td>Snapshots consume less space than clones, but have more impact on production LUNs if the data changes frequently on the LUNs.</td>
<td></td>
</tr>
<tr>
<td>VNX</td>
<td>Clone</td>
<td>Clone sessions generally consume the same size of production LUNs, but have no impact once created.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Snap</td>
<td>Snapshots offer an alternative to clones in that they require less space, but because they are pointer-based they may cause spindle contention, in which case users may opt for the performance benefit provided by clones.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Avamar</td>
<td>Complete software and hardware solution</td>
<td>Variable-length deduplication significantly reduces the backup time by only storing unique daily changes while maintaining full daily backups for immediate, single-step restore.</td>
</tr>
<tr>
<td></td>
<td>EMC Networker</td>
<td>Traditional backup and restore software solution</td>
<td>Centralizes, automates, and accelerates data backup and recovery with a wide range of data protection options.</td>
</tr>
</tbody>
</table>

Each product has its own benefits and considerations. The decision depends on the service-level requirements of each use case.

EMC hardware-based snap and clone products have been integrated with Microsoft Virtual Device Interface (VDI) and VSS technology for many years. Symmetrix TimeFinder and VNX Snapshots (or advanced snap in the later version) enable local point-in-time snapshots and data clones for backup and recovery operations. These products enable simple, non-destructive backup operations with space-saving snapshots or full block-for-block clone copies of your SharePoint farm. With these products, backups and restores can occur in seconds.

**EMC TimeFinder**

TimeFinder software works by creating multiple, independently addressable BCVs for independent storage. The BCV is a Symmetrix device with special attributes created when the Symmetrix is configured. It can function either as an additional mirror to a Symmetrix logical volume or as an independent, host-addressable volume. Establishing BCV devices as mirror images of active production volumes allows you to run multiple simultaneous business continuance tasks in parallel.
EMC suggest you follow the best practices below when you use TimeFinder:

- Issue TimeFinder commands from a management host but not the SQL server for SharePoint. The reason is that in rare cases when consistent split is used, under heavy write activity Symmetrix management commands may be queued behind database writes, interfering with completing the replication. In such cases, the replica is deemed invalid.

- If TimeFinder spans Symmetrix array, use a composite group instead of device group.

- Remote TimeFinder replica creation from an SRDF/A target should always use the –consistent flag to coordinate SRDF/A cycle switching with the TimeFinder operation in order to guarantee that the replica is consistent.

**VNX Snapshots**

VNX Snapshots is a VNX software feature introduced in the EMC VNX operating environment for VNX OE 5.32. This feature creates point-in-time data copies that customers can use for data backups, software development and testing, repurposing, data validation, and local rapid restores.

EMC suggests you follow these best practices when you use VNX Snapshots in conjunction with SharePoint:

- Start with thin LUNs to implement VNX Snapshots for SharePoint LUNs. This is because traditional or thick LUNs are converted to thin LUNs once a VNX snapshot is created on them.

- Put all SharePoint components into a consistency group in order to snap them concurrently.

- Do not perform excessive deletion of snapshots during SharePoint busy I/O operations.

- Enable FAST Cache on the storage pools for SharePoint where you take snapshots to eliminate overhead. A very small amount of FAST Cache absorbs all the metadata.

**SnapView clones**

SnapView clones are fully populated point-in-time copies of LUNs that allow incremental synchronization between the source and destination LUNs.

General best practices for SnapView clones apply to SharePoint environment. Following are some key best practices to follow. For details refer to EMC CLARiiON SnapView Clones:

- Ensure that clones reside on different drives from the source LUN. In case the source LUN is not available due to some disk level hardware failure, the clone could still remain accessible.

- Place clones on the same type of drives as source LUNs to ensure optimal performance of source LUNs when working with clones.

- Proactively verify the state of the data in the replicas as soon as they are created. This ensures that the replica used for restoring the source LUN has the required data.
**EMC RecoverPoint bookmarks**

A bookmark is a named RecoverPoint snapshot. The bookmark uniquely identifies an image.

EMC suggests you follow these best practices when using bookmarks in RecoverPoint:

- Avoid creating too many shared bookmarks if you are using group sets to distribute the load between several RecoverPoint Appliances to protect your SharePoint environment. When creating a bookmark between the groups all the groups are quiescent. During this period writes are temporarily delayed to the host, and the bookmark is created. The amount of delay is not significant if few shared bookmarks are created.

- Modify the VMware vCenter Site Recovery Manager (SRM) timeout value if you want to restore from an older SharePoint farm bookmark. The older the bookmark, the longer it takes RecoverPoint to enable image access and consequently complete the failover. VMware SRM 5.x enforces a timeout of 300 seconds for all RecoverPoint storage replication adapter (SRA) operations. If SRA does not complete an operation within this time limit, the VMware SRM terminates the operation, possibly causing the environment to be in an undesired state. This timeout is more likely to be breached, the older the RecoverPoint point-in-time being used. Refer to VMware SRM document for details.

**EMC Replication Management tool**

The replication process can be simplified and centrally managed by tools and scripts. The following sections introduce some common tools for replication management and their best practices.

**EMC Replication Manager**

EMC Replication Manager enables the management of EMC point-in-time replication technologies for SharePoint protection through a centralized management console. Replication Manager coordinates the entire data replication process—from discovery and configuration to the management of multiple, application-consistent, disk-based replicas.

EMC strongly recommends a robust method that enables rapid SharePoint farm backup and restore. EMC Replication Manager, EMC Avamar, and EMC Networker offer features for log truncation and the mounting of databases to alternative hosts. EMC Replication Manager helps you safeguard SharePoint using EMC point-in-time replicas to off-load production for business repurposing activities, such as backup, development, and quality assurance. Some key benefits include:

- Using Replication Manager’s easy-to-use interface, you can automate management of EMC replication technologies for backup acceleration and operational recovery of SharePoint content databases in minutes, versus hours or days by using Microsoft VDI.

- Built-in application intelligence ensures the underlying Microsoft SQL server database backup is consistent.
- Enables you to set up replication jobs for backup acceleration on a scheduled basis or create a replica ad-hoc.
- Enables you to restore a replica of SharePoint content databases or perform a surgical repair to your production environment.
- Using Ontrack PowerControls for SharePoint software (available through EMC Select) enables SharePoint administrators to restore items, such as documents, lists, libraries, folders, tasks, calendar items, and attachments, from a previous full back up or replica of the content database.
- Replication Manager provides an easy-to-use graphical user interface (GUI) to manage, schedule, and monitor replication jobs. It is also flexible to script by using command line interface.
- Replication Manager Console is a portable Java application that lets you control Replication Manager from a Windows system that has a TCP/IP connection to the Replication Manager Server. A command line interface is also provided. It can be run interactively or in batch mode.
- Replication Manager can protect the whole SharePoint farm including remote BLOB stores within a virtualized SharePoint environment. For details, refer to *EMC Efficient BLOB Storage Management for Microsoft SharePoint—EMC VNX, EMC Replication Manager, Microsoft SharePoint 2010, VMware vSphere, Metalogix StoragePoint*.

Below are some best practices for protecting a SharePoint farm with EMC Replication Manager:

- Configure separate LUNs for SharePoint configuration databases, search databases, search indexes and content databases. This is necessary as certain databases and indexes are restored at specific points during the restore procedure.
- Put SharePoint search indexes on a dedicated LUN for protection instead of local drives.
- Replication Manager and SharePoint require permissions and rights to configure application sets, run jobs, and perform restores. Establish a common set of credentials for all SQL Server instances used by the SharePoint servers. The SharePoint farm account must have local administrative rights on the SharePoint VSS Writer host.

Table 30 shows the supported storage connectivity options for Replication Manager.

**Table 30. Supported storage connectivity options for Replication Manager**

<table>
<thead>
<tr>
<th>Options</th>
<th>Hyper-V</th>
<th>VMware</th>
</tr>
</thead>
<tbody>
<tr>
<td>iSCSI to guest</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>RDM</td>
<td>N/A</td>
<td>Yes</td>
</tr>
<tr>
<td>VHD/VHDX</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td>VMDK</td>
<td>N/A</td>
<td>No</td>
</tr>
<tr>
<td>Pass-through</td>
<td>Yes</td>
<td>N/A</td>
</tr>
</tbody>
</table>
EMC RecoverPoint kutils utility

RecoverPoint provides a kutils utility that can be used for creating consistent Microsoft SQL server database replicas used for backup and recovery. The kutils sqlsnap command sets SQL Server into a quiescent mode with the aid of SQL Server VDI mode while taking the snapshot. The VDI-enabled snapshot is then bookmarked by kutils and it can be restored using the kutil sqlRestore command.

By leveraging EMC RecoverPoint kutils in conjunction with Windows PowerShell, it is easy to automate a management job for RecoverPoint.

For details, refer to *EMC RecoverPoint Replicating Microsoft SQL Server Technical Notes*.

Disaster recovery scenarios introduction

Considering the various business requirements for disaster recovery in a SharePoint farm, there are several possible options for configuring a disaster recovery environment with storage or SAN based replication technology. Table 31 lists three specific scenarios: Failover farm, full farm replication, and stretched farm.

Table 31. Three disaster recovery scenarios

<table>
<thead>
<tr>
<th>Disaster recovery scenario</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failover farm scenario</td>
<td>Provides for two independent farms where only contents are replicated between the sites. Server roles are maintained separately between the farms.</td>
</tr>
<tr>
<td>Full farm replication scenario</td>
<td>All data and server roles are replicated to a passive site for the purpose of disaster recovery.</td>
</tr>
<tr>
<td>Stretched farm scenario</td>
<td>Provides a farm to stretch, otherwise has active server roles enabled between multiple data centers connected by high-bandwidth fiber optic links.</td>
</tr>
</tbody>
</table>

According to Microsoft, stretched farm in SharePoint Server 2013 is not supported, unless the following two prerequisites are met:

- There is a highly consistent intra-farm latency of <1ms (one way), 99.9 percent of the time over a period of ten minutes. Intra-farm latency is commonly defined as the latency between the front-end web servers and the database servers.
- The bandwidth speed is at least 1 gigabit per second.

For details, refer to *Create a high availability architecture and strategy for SharePoint 2013*.

All three disaster recovery scenarios support synchronous or asynchronous replication technologies. EMC recommends you carefully choose the mode based on your business requirements. Table 32 lists the advantages and disadvantages of each mode.
Table 32.  Synchronous replication mode vs. asynchronous replication mode

<table>
<thead>
<tr>
<th>Replication mode</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Synchronous replication mode</td>
<td>No data loss of committed transactions (RPO=0)</td>
<td>• Requires high bandwidth and low network latency.  &lt;br&gt;• Distance between two sites may not exceed 200 km.</td>
</tr>
<tr>
<td>Asynchronous replication mode</td>
<td>No limitation for replication distance</td>
<td>Consistent point-in-time image on the target devices that is only slightly behind the source devices</td>
</tr>
</tbody>
</table>

**General considerations and best practices in different disaster recovery scenarios**

Regardless of the specific disaster recovery technology you use, EMC recommends you follow some general best practices after the disaster recovery scenario is selected.

*Failover farm scenario*

The failover farm scenario, also referred to as a mirror farm within some Microsoft documentation, involves a source SharePoint farm contained in a production site and a target SharePoint farm contained in a remote or disaster recovery site. With independent farms implemented in both sites, the web, query, service application, database, and index servers are maintained separately in each of the farms. While it is possible to replicate several types of SharePoint databases, only the content databases and specific service application databases will be replicated. Any customizations to web servers or indexed data need to be configured and maintained separately in each farm. Users can be redirected between the farms as required using Domain Name System (DNS) updates or network load balancers.
Figure 11 demonstrates the reference architecture of a failover farm scenario.

**Failover Farm**

![Diagram of SharePoint farm A and B](image)

Figure 11. Failover farm
General best practices for a failover farm scenario:

- Ensure the virtual SharePoint server name and URL of the web application at the disaster recovery site match the production site. This is because, for client redirection, DNS can be modified to reference the web servers that host the appropriate URL in the failover farm.

- Use relative paths to link items within site, when creating and editing pages at the production site. In the event that the content database is used at the failover farm under a different web application name, relative paths ensure that links and images continue to work.

- Detach and re-attach the content database or refresh the configuration database using `RefreshSitesInConfigurationDatabase()` method periodically in the disaster recovery site. This is because each time a new site collection is created to a given content database, information about that site collection is also added to the configuration database. As failover farm only replicates content databases, the configuration database is not automatically updated with the information of the new site collection.

- Duplicate the following items at the target site:
  - Windows OS, including installed service packs and hotfixes.
  - SharePoint program installation, including installed service packs and hotfixes.
  - Active Directory replication.
  - IIS settings for the web front end servers, including any customization.

*Full farm replication scenario*

Under the full farm replication scenario, the disaster recovery site is intended to host the whole production farm. This requires that the disaster recovery site must be designed to exactly replicate the production site. The full farm replication allows index information to be replicated; however, OS information must also be replicated.
Figure 12 shows a typical architecture of a full farm replication scenario.

**Full Farm Replication**

![Diagram showing full farm replication setup](image)

**Figure 12. Full farm replication**
General best practices for a full farm replication include:

- Place all content databases, application server related databases, configuration databases, and indexed data into a consistency group to ensure they are replicated to the same dependent write point-in-time.

- Use virtualization technology to avoid the physical hardware restriction between the primary and disaster recovery site if you configure boot from SAN. By booting servers from SAN, it is possible to replicate the entire OS using SAN or storage based replication technologies. This allows any changes made to the source site to be automatically replicated to the disaster recovery site. Booting from the SAN has specific requirements, including the need from the server hardware at the remote site to exactly match the server hardware from the production site. By using virtualization technology, the OS has the same virtual hardware configured for both the source and disaster recovery site, even though the physical hardware may differ.

- Ensure the SQL instance name at the disaster recovery site matches the instance name from the production site, if the SQL instance is not booted from the SAN or otherwise virtualized.

*Stretched farm scenario*

In the stretched farm scenario, the disaster recovery site is intended to support the production site with separate servers that exist within the same farm. With this configuration, the hosts from the disaster recovery site are within the same farm as the servers of the production site, operating with redundant roles. All SQL Server databases are replicated, which also allows the possibility to replicate all farm databases including the configuration, content, and those supporting service applications. Web, query, crawl, and application servers are maintained independently, but within the same SharePoint farm.
Figure 13 demonstrates the reference architecture of a stretched farm scenario.

Figure 13. Stretched farm

General best practices for a stretched farm scenario include:

- Replicate the configuration database consistently with all content databases.
- Provision a redundancy central administration web site on a server at the disaster recovery site.
Choosing the right SharePoint disaster and recovery option

Three disaster and recovery scenarios provide different levels of protection. Table 33 lists the advantages and disadvantages for each scenario.

Table 33. Advantages and disadvantages for disaster and recovery scenario

<table>
<thead>
<tr>
<th>DR scenario</th>
<th>SharePoint components to replicate</th>
<th>Synchronous/Asynchronous</th>
<th>Customization</th>
<th>Crawl</th>
<th>Network</th>
<th>Additional consideration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Failover farm</td>
<td>• Content database</td>
<td>Both</td>
<td>Need to rebuild customization</td>
<td>Need to run increment al crawl to refresh data</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>• BLOB store</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full farm replication</td>
<td>Everything including in OS</td>
<td>Both</td>
<td>No need to rebuild customization</td>
<td>No need to run crawl, all index is up to date</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>If the network subnet in the disaster recovery site differs from that in production site, need to refresh IP in DNS</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>If SAN boot is used to replicate operation system volume, make sure the hardware in the remote site exactly matches the one in source</td>
</tr>
<tr>
<td>Stretched farm</td>
<td>SQL server</td>
<td>Both</td>
<td>Depends (if customization is deployed at both site, no need to rebuild customization)</td>
<td>No need to run crawl, all indexes are up to date</td>
<td>N/A</td>
<td>• Create a high availability architecture and strategy for SharePoint 2013</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Plan for availability (SharePoint Server 2010)</td>
</tr>
</tbody>
</table>

EMC recommends you consider the generic advantages and disadvantages for each scenario in Table 33 to decide which option to apply. For details, refer to Remote Disaster Recovery Concepts for Microsoft SharePoint Server 2010 with storage Based Replication White Paper.

EMC multi-site replication technologies

You can select multiple EMC multi-site replication technologies to implement the disaster recovery scenario you have chosen. The following sections introduce each technology and its associated best practices.

**SRDF**

SRDF is a Symmetrix-based business continuance and disaster restart solution. In simplest terms, the purpose of SRDF is to maintain real-time copies of host devices in more than one physical Symmetrix.
The local SRDF device, known as the source (R1) device, is configured in a pairing relationship with a remote target (R2) device, forming an SRDF pair. When the R2 devices are mirrored with R1 devices, the R2 devices are write-disabled to the remote host. After the R2 devices are synchronized with their R1 devices, they can be split at any time, making the R2 devices fully accessible to their hosts.

There are three basic operation modes for SRDF, SRDF/Synchronous (SRDF/S), SRDF/Asynchronous (SRDF/A), and SRDF Adaptive Copy. The following discussion only focuses on SRDF/S and SRDF/A.

SRDF best practices for SharePoint include:

- Always use a composite group with consistency enabled (also called a consistency group) for SharePoint content databases, configuration databases, service application databases and index partition. There is a common misconception that you must enable consistency, which is only required for SRDF/A. SRDF/S does not benefit from it.

- Have a clone copy (TimeFinder/Clone as an example) available at the SRDF target as a gold copy protection in order to avoid the rolling disasters of SharePoint farm.

- Use a TimeFinder copy created from the R2 devices to retain the disaster recovery SharePoint site online between refresh cycles while maintaining remote replication. Also, in order to refresh the data within the failover farm, the TimeFinder copy can be incrementally updated from the R2 devices.

- Maintain a third copy of the content databases to implement the TimeFinder scenario with SRDF. Using TimeFinder/Snap can alleviate the space concerns of a third copy; however, using snaps against an R2 device should be done carefully with performance implications in mind.

**EMC RecoverPoint**

EMC RecoverPoint provides synchronous and asynchronous continuous remote replication and data protection across heterogeneous storage arrays and SAN.

General best practices for EMC RecoverPoint include:

- Configure the whole SharePoint farm as a single consistency group in RecoverPoint.

- Configure the RecoverPoint repository and journal LUNs on RAID 10 to ensure the best performance for RecoverPoint.

- As a general rule, if changed data statistics for your SharePoint environment are not available, the journal size can accommodate 20 percent capacity of the data being replicated.

- Refer to the following validated results for change rate if your SharePoint usage profile is similar to that shown. After you have the change rate in your environment, use the following formula to estimate the journal size:
Table 34 shows the change rates for SharePoint servers.

Table 34. Validated change rate

<table>
<thead>
<tr>
<th>SharePoint Server version</th>
<th>Change rate for Publishing Portal</th>
<th>Change rate for Document Management Portal</th>
</tr>
</thead>
<tbody>
<tr>
<td>SharePoint Server 2010</td>
<td>1 MB/s</td>
<td>7 MB/s</td>
</tr>
<tr>
<td>SharePoint Server 2013</td>
<td>0.8 MB/s</td>
<td>5 MB/s</td>
</tr>
</tbody>
</table>

- If VMware SRM is built on top of this solution and orchestrating recovery from the production site to the disaster recovery site, the control of the RecoverPoint consistency groups must be passed over to the VMware SRM by selecting **Use VMware Site Recovery Manager (SRM) with Group is managed by SRM, RecoverPoint can only monitor**, as shown in Figure 14.

![Figure 14. VMware SRM configuration with RecoverPoint](image)

If you plan to use VMAX splitter, EMC recommends you follow the best practices below:

- Present protected LUNs on the same front end adapters (FAs) as the host splitting occurs at the FA level using Open Replicator for Symmetrix.
- Plan LUNs with no more than 32 FAs.
- Plan your VMAX port groups ahead of time because changes are not allowed for a RecoverPoint protected host.
- Plan your utilization of FAs ahead of time because with RecoverPoint, 100 percent additional writes apply to FA. For example, if you are using an FA that is currently 60 percent utilized with 3:1 Read Write ratio, RP drives utilization to 75 percent.

**EMC VPLEX**

The EMC Virtualization and Private Cloud (VPLEX) provides access to a single copy of data at different geographical locations concurrently, enabling a transparent migration of running virtual machines between data centers. It allows SharePoint data to be moved, accessed, and mirrored transparently between data centers, effectively...
allowing storage and applications to work between data centers as though those physical boundaries were not there.

The EMC VPLEX family consists of three viable configurations and offerings:

- **VPLEX Local**—For managing data mobility and access within the data center using a single VPLEX cluster.
- **VPLEX Metro**—For mobility across two sites separated by an inter-site latency of up to 5 ms round-trip time.
- **VPLEX Geo**—For access between two sites over extended asynchronous distances with the latency of up to 50 ms round-trip time.

Integrating with server virtualization technology, including VMware Storage VMotion and Microsoft Hyper-V Live Migration technology and the VPLEX family, allows the user to move SharePoint farms between different data centers without interrupting operations on the farm. It reduces the storage maintenance costs rather than building a mirror SharePoint farm.

While running the VMotion or Live Migration technology between sites, SharePoint web servers, index and SQL servers are migrated from Site A to Site B. During the migration, the response times are slightly impacted. However, it does not interrupt the running application and provides the data center with the capability to manually reallocate the resource across sites. To summarize, it provides a virtual infrastructure stretched across two sites with zero downtime for migration operation and very low downtime for a disaster scenario.

Storage best practices that apply to directly-accessed storage volumes apply to VPLEX virtual volumes as well. One important best practice to follow is partition alignment for x86-based OS platforms. Misaligned partitions can consume resources or cause additional work in a storage array, leading to performance loss.

For more details, refer to the following two white papers:

- **VMotion Over Distance for Microsoft, Oracle, and SAP—Enabled by VCE Vblock 1, EMC Symmetrix VMAX, EMC CLARiiON, and EMC VPLEX Metro—An Architectural Overview**
- **Long distance application mobility—Enabled by VPLEX Geo**

**SQL Server restart automation tools**

SharePoint can use SQL Server restart automation tools to achieve disaster recovery such as:

- Database mirroring
- AlwaysOn Availability Group

Although database mirroring is supported in both SharePoint Server 2010 and 2013, EMC does not recommend this technology to protect your SharePoint environment because this feature will be removed in a future version of Microsoft SQL Server. For details, refer to [Database Mirroring (SQL Server)](#).
To use AlwaysOn for SharePoint protection, EMC recommends you follow these best practices:

- If the connection between SharePoint AlwaysOn Availability Groups is across multi-subnet, configure `specifyMultiSubnetFailover=True`. This avoids issues caused by high network latency. For details, refer to [Availability Group Listeners, Client Connectivity, and Application Failover (SQL Server)](availability-group-listeners-client-connectivity-and-application-failover-sql-server).

- The asynchronous-commit mode for SQL Server AlwaysOn Availability Group is not supported for every SharePoint database. For a complete list of supported modes, refer to [Supported high availability and disaster recovery options for SharePoint databases (SharePoint 2013)](supported-high-availability-and-disaster-recovery-options-for-sharepoint-databases-sharepoint-2013).


**Virtualized instances automation tools**

EMC Cluster Enabler and VMware SRM use EMC disaster recovery solutions such as SRDF, RecoverPoint, and MirrorView in a virtualized environment.

**EMC Cluster Enabler in a virtualized environment**

EMC Cluster Enabler software enables geographically distributed Microsoft failover clusters to replicate their data using MirrorView, RecoverPoint, and SRDF.


For general best practices for RecoverPoint/Cluster Enabler, refer to [EMC RecoverPoint/Cluster Enabler White Paper](emc-recoverpoint-cluster-enabler-white-paper).

**VMware SRM**

VMware SRM enables you to build, manage, and execute reliable disaster recovery plans for the virtual environment.

VMware SRM best practices include:

- Group SharePoint virtual machines in fewer protection groups to enable faster recoveries, provided that those virtual machines have no constraints preventing them from being grouped under similar protection groups.

- In a recovery plan, the virtual machines being recovered can be assigned with high, normal, or low priority. The dependencies between virtual machines to be recovered should be clear so that only a certain number of required virtual machines can be assigned as high priority for performance. The recovery time increases as the number of virtual machines with high priority increases, because the operations of recovering high-priority virtual machines are executed sequentially. Based on this, EMC recommends you set all virtual machines to **Normal priority** if you are concerned about recovery time objective (RTO) of your SharePoint farm. Otherwise, you can set **High priority** to SQL server, and leave other virtual machines set to **Normal priority**.
• Install the Site Recovery Manager database as close as possible to the Site Recovery Manager server because the round trip from the VMware SRM database to the VMware SRM server may greatly impact the recovery time.

• Enable VMware DRS on the recovery cluster. By doing so, VMware SRM can utilize VMware DRS for load balancing the recovered virtual machines across the hosts for performance and RTO perspective.

• Install VMware Tools in all protected SharePoint virtual machines to accurately acquire their heartbeats and network change notification.
Conclusion

This document highlights the key decision points in planning a Microsoft SharePoint Server 2010 or 2013 deployment with EMC storage systems. Multiple configuration options are available to suit most requirements for any customer. EMC storage and data management software products are designed to provide customers the flexibility to manage their SharePoint environments in a manner that best meets their business needs.

Best practices for designing Microsoft SharePoint Server storage are constantly evolving. With storage technologies rapidly improving, traditional best practices may not apply to all configurations. This document presents a snapshot of the current best practices recommended by EMC for deploying Microsoft SharePoint Server with the EMC VNX family of unified storage or EMC Symmetrix VMAX series storage. Following these guidelines can greatly assist you in achieving an efficient, high-performance, and highly available Microsoft SharePoint Server environment that meets your requirements.

This paper presents concepts, principles, and formulas to help you:

- Understand the I/O characteristics of Microsoft SharePoint Server 2010 and 2013.
- Understand best practices for Microsoft SharePoint Server over VNX family or VMAX series storage.
- Use Microsoft SharePoint Server storage building block.
- Understand best practices for hypervisor which hosts the SharePoint environment.
- Become familiar with various data protection options for SharePoint Server.
References

EMC documentation

For additional information regarding to EMC solutions, see the documents listed below:

- Storage Pool Management Feature in EMC Virtual Storage Integrator
- EMC FAST Cache A Detailed Review
- EMC FAST VP for Unified Storage Systems A Detailed Review
- EMC VNX Virtual Provisioning Applied Technology
- EMC Efficient Blob Storage Management for Microsoft SharePoint
- EMC VNX Unified Best Practices for Performance
- EMC VNXe Series: Introduction to SMB 3.0 Support
- Implementing Full Automated Storage Tiering (FAST) for EMC Symmetrix V-Max Series Arrays Technical Note
- EMC VNX Series Configuring NFS on VNX
- EMC CLARiiON SnapView Clones
- EMC Backup and Recovery for Microsoft Exchange and SharePoint 2010
- EMC PowerPath vs. Windows Native MPIO
- EMC VNX Series: Introduction to SMB 3.0 Support
- EMC RecoverPoint Replicating Microsoft SQL Server Technical Notes
- Microsoft SQL Server Storage Best Practices and Design Guidelines for EMC Storage
- Remote Disaster Recovery Concepts for Microsoft SharePoint Server 2010 with storage Based Replication White Paper

VMware documentation

For additional information regarding to VMware, see the documents listed below:

- VMware Fault Tolerance Recommendations and Considerations on VMware vSphere 4
- Protecting Mission-Critical Workloads with VMware Fault Tolerance
- Best Practices for running VMware vSphere on Network Attached Storage
- Virtualizing Business-Critical Applications on vSphere
- VMware vSphere High Availability 5.0 Deployment Best Practices
- Best Practices for Virtual Networking
- VMware Network Virtualization Design Guide
- VMware vSphere 5.1 Documentation Center
For additional information regarding to Microsoft SharePoint, see the documents listed below:

- *Microsoft SharePoint 2010 on VMWare Best Practices Guide*
- *Microsoft SQL Server 2008 R2 Remote Blob Storage*
- *Best Practices for Virtualizing & Managing SharePoint 2013*
- *SharePoint Server 2013 Search technical diagram*

For additional information, see the product documents listed below:

- *Introduction to EMC XtremSF*
- *Introduction to EMC XtremCache*
- *EMC VNX Family*
- *EMC VNX Series Specifications*
- *EMC Symmetrix VMAX Family*
- *EMC Replication Manager*
- *EMC Storage Integrator (ESI) for Windows Suit*

Refer to the following topics on the Microsoft TechNet website:

- *Storage and SQL Server capacity planning and configuration*
- *Limitations of RBS*
- *Disk Partition Alignment Best Practices for SQL Server*
- *Overview of search in SharePoint Server 2013*
- *Scale search for performance and availability in SharePoint Server 2013*
- *Enterprise Search Architectures for SharePoint Server 2013*
- *Best practices for people and profiles (SharePoint Server 2010)*
- *Best practices for SQL Server 2008 in a SharePoint Server 2010 farm*
- *Backup and restore best practices in SharePoint 2013*
- *Backup and recovery best practices (SharePoint Server 2010)*
- *Create a high availability architecture and strategy for SharePoint 2013*
- *Database Mirroring (SQL Server)*
- *Supported high availability and disaster recovery options for SharePoint databases (SharePoint 2013)*
- *Plan for availability (SharePoint Server 2010)*
- *Understanding Requirements for Failover Clusters*
MSDN Library
Refer to the following topics in the MSDN Library:

- Running RBS maintainer
- SharePoint Foundation and the Volume Shadow Copy Service
- Overview of SharePoint 2013 and the Volume Shadow Copy Service
- Availability Group Listeners, Client Connectivity, and Application Failover (SQL Server)
- Bulk Loader—Create Unique Documents based on Wikipedia Dump File
- Load Bulk Content to SharePoint 2010
- SharePoint Performance Testing
Appendix A: I/O characteristics analysis for SharePoint Server 2010 and 2013 search and user profile service application

Sizing I/O characteristics and capacity for search in SharePoint Server 2010

During the full or incremental crawl, host I/O shows the following characteristics.

**Note:** The IOPS for SharePoint search related components, such as content database and crawl database, are positively correlated with the crawl rate, which can vary widely. The results below are from our validated test in a lab environment with the out-of-box crawl settings. The crawl rate is an average of 70 items per second with a 200 GB data set.

### Content database

Table 35 lists the I/O characteristics of the content database when running crawl.

<table>
<thead>
<tr>
<th>Avg. read IOPS</th>
<th>Avg. write IOPS</th>
<th>Read I/O size (KB)</th>
<th>Write I/O size (KB)</th>
<th>Read/write ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>3091</td>
<td>All read</td>
<td>8</td>
<td>N/A</td>
<td>All read</td>
</tr>
</tbody>
</table>

The content database shows a steady read I/O rate when running the crawl, as shown in Figure 15.

![Content database read IOPS distribution pattern](image)

**Figure 15.** Content database read IOPS distribution pattern

### Crawl database

Table 36 lists the I/O characteristics of the crawl database when running crawl.

<table>
<thead>
<tr>
<th>Avg. peak read IOPS</th>
<th>Avg. peak write IOPS</th>
<th>Read I/O size (KB)</th>
<th>Write I/O size (KB)</th>
<th>Read/write ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>305</td>
<td>40</td>
<td>8</td>
<td>96</td>
<td>6:1</td>
</tr>
</tbody>
</table>
Figure 16 shows a steady pulse wave pattern for the crawl database read IOPS.

![Figure 16. Crawl database read I/O pattern in SharePoint Server 2010](image)

The majority of the peak read IOPS is about 305

Figure 17 shows high write IOPS over the crawl database in the first few minutes after starting the crawl, then it maintains very low write IOPS.

![Figure 17. Crawl database write I/O pattern in SharePoint Server 2010](image)

Trendline, peak from 800 to 200

Average peak write IOPS is around 40

In our validated environment, the capacity of the crawl database is positively correlated with the total number of crawlable items and crawl times. Microsoft recommends using the following formula to calculate the capacity of the crawl database:

\[
crawl\ database\ size = 0.046 \times \text{sum of content database}
\]

For details, refer to the [Storage and SQL Server capacity planning and configuration](#).
**Property database**

Table 37 lists the I/O characteristics of the property database when running crawl.

**Table 37. Property database I/O characteristics in SharePoint Server 2010**

<table>
<thead>
<tr>
<th>Avg. peak read IOPS</th>
<th>Avg. peak write IOPS</th>
<th>Read I/O size (KB)</th>
<th>Write I/O size (KB)</th>
<th>Read/write ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near zero</td>
<td>Change with write I/O size</td>
<td>8</td>
<td>From 16 to 96</td>
<td>N/A</td>
</tr>
</tbody>
</table>

On average, although average read IOPS is almost zero, there are some spikes spread over the crawl process. Figure 18 shows the read IOPS spikes in SharePoint Server 2010.

![Figure 18. Property store database read I/O pattern in SharePoint Server 2010](image)

Property store database write size changes with time, reducing in size from 96 KB to 16 KB; as a result, the write IOPS size increases from 10 to 330, as shown in Figure 19 and Figure 20.

![Figure 19. Property store database write I/O size pattern in SharePoint Server 2010](image)
The size of the property store database is positively correlated with the number and size of metadata for each crawlable item. Microsoft recommends that you use the following formula to calculate the capacity of Property database.

\[
\text{property database size} = 0.015 \times \text{sum of content database}
\]

For details, refer to *Storage and SQL Server capacity planning and configuration*.

**Search administration database**

The search administration database shows almost no IOPS during crawl. Table 38 shows the I/O characteristics.

*Table 38. Search administration database I/O characteristics in SharePoint Server 2010*

<table>
<thead>
<tr>
<th>Avg. peak read IOPS</th>
<th>Avg. peak write IOPS</th>
<th>Read I/O size (KB)</th>
<th>Write I/O size (KB)</th>
<th>Read/write ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near zero</td>
<td>Near zero</td>
<td>32</td>
<td>8</td>
<td>N/A</td>
</tr>
</tbody>
</table>

The search administration database is typically small, with 10 GB allocated.

**Crawl component**

Table 39 shows the crawl component I/O characteristics.

*Table 39. Crawl component I/O characteristics in SharePoint Server 2010*

<table>
<thead>
<tr>
<th>Avg. peak read IOPS</th>
<th>Avg. peak write IOPS</th>
<th>Read I/O size (KB)</th>
<th>Write I/O size (KB)</th>
<th>Read/write ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near zero</td>
<td>32</td>
<td>64</td>
<td>64</td>
<td>Write dominant</td>
</tr>
</tbody>
</table>
Figure 21 shows that the pulse wave pattern of the crawl component write I/O with average peak IOPS around 32.

![Crawl component I/O read pattern in SharePoint Server 2010](image)

**Figure 21. Crawl component I/O read pattern in SharePoint Server 2010**

The crawl component only stores a temporary index file, so it is sufficient to allocate a small capacity to the crawl component. For 100 GB of content data, allocate 1 GB of capacity for the crawl component.

**Query component**

Table 40 shows the query component I/O characteristics.

<table>
<thead>
<tr>
<th>Avg. peak read IOPS</th>
<th>Avg. peak write IOPS</th>
<th>Read I/O size (KB)</th>
<th>Write I/O size (KB)</th>
<th>Read/write ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>43</td>
<td>32</td>
<td>128</td>
<td>Write dominant</td>
</tr>
</tbody>
</table>

Read IOPS shows a clear pulse wave pattern with 19 IOPS as peak, and the same applies to write IOPS, whose peak is around 43, as shown in Figure 22 and Figure 23.

![Query component read I/O pattern in SharePoint Server 2010](image)

**Figure 22. Query component read I/O pattern in SharePoint Server 2010**
The query component stores index files. EMC recommends allocating 2 GB for a 100 GB data set.

**Sizing I/O characteristics and capacity for search in SharePoint Server 2013**

FAST search technology was first introduced in SharePoint Server 2013 as the out-of-box server search technology. Therefore, the I/O characteristics are very different from what it was in SharePoint Server 2010.

**Note:** The IOPS for SharePoint search-related components, such as the content database and the crawl database, are positively correlated with the crawl rate, which can vary widely. The following results are from our validated test in a lab environment with out-of-box crawl settings. The crawl rate is an average of 76 items per second with a 200 GB data set.

**Content database**

Table 41 lists the I/O characteristics of the content database when running crawl.

**Table 41. Content database I/O characteristics when running crawl in SharePoint Server 2013**

<table>
<thead>
<tr>
<th>Avg. peak read IOPS</th>
<th>Avg. peak write IOPS</th>
<th>Read I/O size (KB)</th>
<th>Write I/O size (KB)</th>
<th>Read/write ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>3445</td>
<td>All read</td>
<td>8</td>
<td>N/A</td>
<td>All read</td>
</tr>
</tbody>
</table>

The content database shows a steady read I/O rate when running the crawl, as shown in Figure 24.
**Crawl database**

Table 42 lists the I/O characteristics of the crawl database when running crawl.

<table>
<thead>
<tr>
<th>Avg. peak read IOPS</th>
<th>Avg. peak write IOPS</th>
<th>Read I/O size (KB)</th>
<th>Write I/O size (KB)</th>
<th>Read/write ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>260</td>
<td>200/40</td>
<td>8</td>
<td>32</td>
<td>29:11</td>
</tr>
</tbody>
</table>

Read I/O for the crawl database shows a pulse wave pattern in the second half of the crawl process, where the majority of the read I/O happens, as shown in Figure 25.

**Figure 25.** Crawl database read IOPS pattern in SharePoint Server 2013

Write I/O shows a clear pulse wave pattern, as shown in Figure 26. The first half of the crawl generates more write IOPS than the second half.

**Figure 26.** Crawl database write IOPS pattern in SharePoint Server 2013
The Microsoft recommendation for crawl database capacity sizing in SharePoint Server 2013 is shown in Table 43.

**Table 43. Crawl database capacity planning**

<table>
<thead>
<tr>
<th>Database</th>
<th>10 M items</th>
<th>100 M items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crawl</td>
<td>15 GB for data, 2 GB for log</td>
<td>110 GB for data, 2 GB for log</td>
</tr>
</tbody>
</table>

For details, refer to *Storage and SQL Server capacity planning and configuration.*

**Link, analytics reporting, and search administration databases**

The link database, analytics reporting database, and search administration database show almost no IOPS during crawl. Table 44 lists the I/O characteristics of each database.

**Table 44. I/O characteristics of link, search administration and analytics reporting database**

<table>
<thead>
<tr>
<th>Database name</th>
<th>Avg. read IOPS</th>
<th>Avg. write IOPS</th>
<th>Read I/O size (KB)</th>
<th>Write I/O size (KB)</th>
<th>Read/write ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link database</td>
<td>Near zero</td>
<td>Near zero</td>
<td>8</td>
<td>64</td>
<td>N/A</td>
</tr>
<tr>
<td>Search administration database</td>
<td>Near zero</td>
<td>Near zero</td>
<td>64</td>
<td>8</td>
<td>N/A</td>
</tr>
<tr>
<td>Analytics reporting database</td>
<td>Near zero</td>
<td>zero</td>
<td>8</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Microsoft recommends the crawl database capacity sizing for SharePoint Server 2013 shown in Table 45.

**Table 45. Capacity planning of link, search administration and analytics reporting database**

<table>
<thead>
<tr>
<th>Database</th>
<th>10 M items</th>
<th>100 M items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link</td>
<td>10 GB for data, 0.1 GB for log</td>
<td>80 GB for data, 5 GB for log</td>
</tr>
<tr>
<td>Analytics Reporting</td>
<td>Usage dependent</td>
<td>Usage dependent</td>
</tr>
<tr>
<td>Search Administration</td>
<td>0.4 GB data, 1 GB log</td>
<td>1 GB data, 2 GB log</td>
</tr>
</tbody>
</table>

For details, refer to *Storage and SQL Server capacity planning and configuration.*

**Crawler**

Table 46 shows the I/O characteristics when running crawl.

**Table 46. Crawler I/O characteristics in SharePoint Server 2013**

<table>
<thead>
<tr>
<th>Avg. peak read IOPS</th>
<th>Avg. write IOPS</th>
<th>Read I/O size (KB)</th>
<th>Write I/O size (KB)</th>
<th>Read/write ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near zero</td>
<td>115</td>
<td>4</td>
<td>128</td>
<td>Write dominant</td>
</tr>
</tbody>
</table>
The crawler write IOPS rate produces a flat pattern, as shown in Figure 27.

![Crawler write I/O pattern in SharePoint Server 2013](image)

**Figure 27. Crawler write I/O pattern in SharePoint Server 2013**

Crawler capacity requirements are small because only temporary data is stored when running the crawl. Our validated tests in the EMC lab indicate that you should allocate 1 GB for each 100 GB data set.

**Index partition**

Table 47 shows the index partition I/O characteristics when running crawl.

<table>
<thead>
<tr>
<th>Avg. peak read IOPS</th>
<th>Avg. peak write IOPS</th>
<th>Read I/O size (KB)</th>
<th>Write I/O size (KB)</th>
<th>Read/write ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>35</td>
<td>2048</td>
<td>1024</td>
<td>3:2</td>
</tr>
</tbody>
</table>

Read IOPS for the index partition shows an increasing pulse wave pattern, as shown in Figure 28.

![Index partition read IOPS pattern in SharePoint Server 2013](image)

**Figure 28. Index partition read IOPS pattern in SharePoint Server 2013**
The write IOPS for the index partition produces a much steadier pattern, as shown in Figure 29.

![Index partition write IOPS pattern in SharePoint Server 2013](image)

Figure 29. Index partition write IOPS pattern in SharePoint Server 2013

The size of the index partition can vary depending on several factors, including file type and file size. In our validated lab environment, the majority of the file types are DOCX, XLSX, PPTX, and HTML; the average file size is 250 KB. In this scenario, a 100 GB data set requires a 5 GB index partition allocation.

### User profile service I/O and capacity characteristics

#### Sizing I/O characteristics and capacity for a user profile in SharePoint Server 2010

During full or incremental profile synchronization, host I/O shows the following characteristics:

**Synchronization database**

Table 48 lists the I/O characteristics of the synchronization database when running profile synchronization.

<table>
<thead>
<tr>
<th>Table 48: Synchronization database I/O characteristics in SharePoint Server 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Avg. Read IOPS</strong></td>
</tr>
<tr>
<td>Almost zero</td>
</tr>
</tbody>
</table>
Figure 30 shows the characteristics of write IOPS against a synchronization database as a pulsed wave pattern. The average peak IOPS is around 26, as shown in Table 48.

![Figure 30. Pulsed wave pattern for synchronization database write IOPS in SharePoint Server 2010](image)

Microsoft recommends that with default settings in an environment that has few groups per user, the synchronizing database requires approximately 630 KB per user profile. 90 percent of the space is used by the data file.

For details, refer to *Storage and SQL Server capacity planning and configuration*.

**Profile database**

Table 49 lists the I/O characteristics for a profile database when running profile synchronization.

**Table 49. Profile database I/O characteristics in SharePoint Server 2010**

<table>
<thead>
<tr>
<th>Avg. Read IOPS</th>
<th>Avg. Write IOPS</th>
<th>Read I/O size (KB)</th>
<th>Write I/O size (KB)</th>
<th>Read/write ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almost zero</td>
<td>300</td>
<td>64</td>
<td>16</td>
<td>Write dominant</td>
</tr>
</tbody>
</table>

Figure 31 shows the distribution pattern of write IOPS. Profile database write IOPS start in the second half of the profile synchronization cycle. The 300 average write IOPS in Table 49 are calculated only when the writes take place.

![Figure 31. Distribution pattern of profile database write I/O in SharePoint Server 2010](image)
Figure 32 shows the combination of the synchronization write IOPS chart and the profile database write IOPS chart. It shows that write IOPS for synchronization and the profile database happens in sequence.

![Graph showing write IOPS for both profile synchronization database and profile database in SharePoint Server 2010](image)

**Figure 32. Write IOPS for both profile synchronization database and profile database in SharePoint Server 2010**

Microsoft suggests that with default settings and in an environment configured to use Active Directory, the profile database requires approximately 1 MB per user profile.

For details, refer to [Storage and SQL Server capacity planning and configuration](#).

**Social database**

During profile synchronization, the social database is almost under no I/O pressure.

Microsoft recommends that, with default settings, the social database requires approximately 0.009 MB per tag, comment, or rating.

For details, refer to [Storage and SQL Server capacity planning and configuration](#).

**Sizing I/O characteristics and capacity for user profiles in SharePoint Server 2013**

Profile synchronization in SharePoint Server 2013 shares the same technology with SharePoint Server 2010. The I/O pattern during full or incremental crawl is similar between the two versions.

**Synchronization database**

Table 50 lists the I/O characteristics of the synchronization database when running profile synchronization.

<table>
<thead>
<tr>
<th>Avg. Read IOPS</th>
<th>Avg. Peak write IOPS</th>
<th>Read I/O size (KB)</th>
<th>Write I/O size (KB)</th>
<th>Read/write ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almost zero</td>
<td>27</td>
<td>64</td>
<td>32</td>
<td>Write dominant</td>
</tr>
</tbody>
</table>

Table 50. Synchronization database I/O characteristics in SharePoint Server 2013

Figure 33 shows the characteristics of write IOPS against the synchronization database as a pulsed wave pattern. The average peak IOPS is around 27, as shown in Table 50. The write IOPS are distributed in the first half of the profile synchronization cycle.
In our validated lab environment for the same Active Directory, the size of the synchronization database is four times larger than in SharePoint Server 2010. Based on this, EMC recommends allocating 2.5 MB of capacity for each user profile with default settings.

**Profile database**

Table 51 lists the I/O characteristics for a profile database when running profile synchronization. The write IOPS are much fewer than in SharePoint Server 2010 when running profile synchronization.

<table>
<thead>
<tr>
<th>Avg. Read IOPS</th>
<th>Avg. peak write IOPS</th>
<th>Read I/O size (KB)</th>
<th>Write I/O size (KB)</th>
<th>Read/write ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almost zero</td>
<td>31</td>
<td>64</td>
<td>32</td>
<td>Write dominant</td>
</tr>
</tbody>
</table>

Figure 34 shows the pulsed wave pattern of write IOPS over the profile database. The profile database write IOPS start at the second half of the profile synchronization cycle and the average peak write IOPS is around 31, as shown in Table 51.

Figure 35 shows the combination of the synchronization write IOPS chart and the profile database write IOPS chart. It shows that write IOPS for synchronization and the profile database happen in sequence.
In our validated lab environment, the profile database size in SharePoint Server 2013 is almost the same as in SharePoint Server 2010. Based on this, EMC recommends using 1 MB per user profile with default settings.

**Social database**
During profile synchronization, the social database is almost under no I/O pressure.

In our validated lab environment, the social database size in SharePoint Server 2013 is almost twice the size of the one in SharePoint Server 2010. It is recommended that with default settings, the social database requires approximately 0.009 MB per tag, comment, or rating.
Appendix B: Tools for SharePoint Server performance testing, monitoring, tuning, and sizing

The primary goal of monitoring is to ensure a healthy SharePoint Server 2010 or 2013 environment so that you can achieve service performance objectives, such as short response times. You can use the monitoring features from the SharePoint Central Administration website, System Center Management Pack for SharePoint Server 2010 and 2013, and Windows PowerShell scripts to monitor the SharePoint Server 2010 and 2013 environment and services.

Logs and reports track SharePoint Server 2013 environment and service status. You can read the logs from the logging database. The advantage of using the logging database is that you can configure your view and export the logs to Excel. The logs and reports from Central Administration help you to understand how the SharePoint Server 2010 or 2013 system is running, analyze and repair problems, and view metrics for the sites. In addition, System Center Management Pack for SharePoint Server 2010 and 2013 provides an end-to-end monitoring and reporting system that you can use to monitor SharePoint Server 2010 and 2013. Table 52 lists the tools for each level of use.

Table 52. Tools used for SharePoint Server performance monitoring, tuning and sizing

<table>
<thead>
<tr>
<th>Tool</th>
<th>Source/Links</th>
<th>Description</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMC DBclassify</td>
<td><a href="#">EMC Database Performance Tiering Solutions</a></td>
<td>Constantly monitors data, learns its patterns and past behavior, and then classifies and moves it according to business priorities.</td>
<td>Application</td>
</tr>
<tr>
<td>Developer dashboard</td>
<td>Microsoft (SharePoint Server 2010/2013 built-in feature)</td>
<td>Provides diagnostic information that can help a developer or system administrator to troubleshoot problems with page components that would otherwise be very difficult to isolate.</td>
<td>Application</td>
</tr>
<tr>
<td>Unified Logging System (ULS)</td>
<td>Microsoft (SharePoint Server 2010/2013 built-in feature)</td>
<td>A unified logging system to help administer all aspects of the entire SharePoint environment.</td>
<td>Application</td>
</tr>
<tr>
<td>Tool</td>
<td>Description</td>
<td>Category</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Microsoft SharePoint Server 2010 Products Management Pack for System Center Operations Manager 2007</strong></td>
<td>Enables operators and administrators to manage Microsoft SharePoint Server 2010 products</td>
<td>Application</td>
<td></td>
</tr>
<tr>
<td><strong>EMC workload performance assessment</strong></td>
<td>EMC mitrend Also known as Mitrend. Automated online workload performance assessment tool, which correlates and displays key performance information related to sizing.</td>
<td>Hypervisor, storage, OS and server cache</td>
<td></td>
</tr>
<tr>
<td><strong>PAL</strong></td>
<td>Performance Analysis of Logs (PAL) Tool Useful for troubleshooting performance issues.</td>
<td>OS and storage</td>
<td></td>
</tr>
<tr>
<td><strong>VSPEX SharePoint sizing tool</strong></td>
<td>EMC Business Value Can be used to determine the recommended VSPEX Proven Infrastructure for virtualized SharePoint Server based on the user requirements.</td>
<td>Application, OS and storage</td>
<td></td>
</tr>
<tr>
<td><strong>T-SQL</strong></td>
<td>Microsoft (comes with SQL server installation) Provides Transact-SQL system stored procedures to create traces on an instance of the SQL Server Database Engine.</td>
<td>Application</td>
<td></td>
</tr>
<tr>
<td><strong>SQL Server profiler</strong></td>
<td>Microsoft Provides SQL Trace capture and replay in a graphic user interface.</td>
<td>Application</td>
<td></td>
</tr>
<tr>
<td><strong>Perfmon</strong></td>
<td>Windows performance monitor (comes with windows server installation) Tracks the performance characteristics of SharePoint farm workloads.</td>
<td>Application, OS and storage</td>
<td></td>
</tr>
<tr>
<td><strong>vSphere Client GUI interface</strong></td>
<td>vSphere client GUI Primary tool to track performance and configure data for one or more ESX/ESXi hosts.</td>
<td>Hypervisor</td>
<td></td>
</tr>
<tr>
<td><strong>Resxtop/Esxtop</strong></td>
<td>ESX/ESXi Provides a performance matrix, but requires root access.</td>
<td>Hypervisor</td>
<td></td>
</tr>
<tr>
<td><strong>Unisphere Analyzer</strong></td>
<td>Included with EMC storage systems Provides performance monitoring for EMC storage systems.</td>
<td>Storage</td>
<td></td>
</tr>
<tr>
<td><strong>XtremCache performance predictor tool</strong></td>
<td>Search EMC support Provides a performance predictor tool for EMC XtremCache to assess and evaluate the SharePoint environment for the XtremCache.</td>
<td>Server cache</td>
<td></td>
</tr>
</tbody>
</table>
EMC Storage Configuration Advisor
Available through EMC pre-sales and post-sales
Assists in defining tiering policies for an existing environment; Tier Advisor monitors I/O and recommends tiering policy settings.
Storage

Bulk Loader
Bulk Loader-Create Unique Documents based on Wikipedia Dump File
Tool to create raw data to upload to SharePoint.
Application testing

LoadBulk2SP
Load Bulk Content to SharePoint 2010
Tool to load documents into SharePoint.

Sample script for SharePoint performance testing
SharePoint Performance Testing
Sample script in Visual Studio to provide load and stress tests for SharePoint functions.

---

**EMC DBclassify**
EMC DBclassify™ is a database optimization solution that reduces the TCO of database storage, while enhancing the performance of business applications.


**Developer dashboard**
The developer dashboard is introduced in SharePoint Server 2010 and enhanced in SharePoint Server 2013, which is designed to provide additional performance and tracing information that can be used to debug and troubleshoot issues. The dashboard is turned off by default, but can be enabled via the object model, stsadm and PowerShell.

Use the following Windows PowerShell cmdlets to enable the developer dashboard:

```
```

When the dashboard is turned on you can find information about SQL query, service call, ULS, and execution times that occur as part of the page rendering process.
Figure 36 shows a typical screen of the developer dashboard in SharePoint Server 2013.

<table>
<thead>
<tr>
<th>Server Info</th>
<th>Scopes</th>
<th>SQL</th>
<th>SPRequests</th>
<th>Asserts</th>
<th>Service Calls</th>
<th>ULS</th>
<th>Cache Calls</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>SP</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 36. Developer dashboard in SharePoint Server 2013**

EMC recommends using the developer dashboard for troubleshooting page-level performance issues.

**ULS**

Unified Logging System (ULS) can track problems with SharePoint components, provide quantifiable statistics for SharePoint, help troubleshoot issues, and monitor overall health.

EMC recommends the following best practices to use SharePoint ULS logging:

- Avoid keeping the log files on the same drive where SharePoint is installed. Use the following PowerShell cmdlet to change the default location for ULS log:
  ```powershell
  Set-SPDiagnosticConfig -LogLocation <PathToNewLocation>
  ```

- Restrict ULS log size. Use the following PowerShell cmdlet to configure disk space usage for ULS:
  ```powershell
  Set-SPDiagnosticConfig -LogMaxDiskSpaceUsageEnabled
  Set-SPDiagnosticConfig -LogDiskSpaceUsageGB <UsageInGB>
  ```

- Use verbose only when necessary, and then revert back. Use the following PowerShell cmdlet to set the verbose logging level:
  ```powershell
  Set-SPLogLevel -TraceSeverity Verbose
  ```

The Microsoft SharePoint Server 2010 and 2013 Management Pack is designed for:

- Health monitoring of SharePoint Server 2010 and 2013 product events
- Collecting SharePoint component-specific performance counters in one central location
- Raising alerts for operator intervention as necessary
- Indicating, correcting, and preventing possible service outages or configuration problems by detecting, sending alerts, and automatically correlating critical
events, allowing you to proactively manage SharePoint servers and identify issues before they become critical.

EMC Workload Performance Assessment Tool
The EMC Workload Performance Assessment tool is available to EMC partners. This automated online tool correlates and displays key performance information related to sizing. This tool is available from your reseller or EMC presales systems engineer.

PAL
You can use the open source Performance Analyzer of Logs (PAL) tool to troubleshoot performance issues (as opposed to sizing for migrations). You can use performance monitor with the PAL tool, which can be downloaded from the CodePlex website.

VSPEX SharePoint Server sizing tool
The VSPEX SharePoint Server sizing tool is available to size VSPEX Proven Infrastructure for virtualized SharePoint Server based on user requirements. You can also use the sizing estimate for other virtualized environments on EMC VNX storage. For details, refer to EMC VSPEX for Virtualized Microsoft SharePoint 2013 Design Guide.

Sample tool to create large number of random documents
In this validated testing environment, we used the Bulk Loader tool to create unique documents. This command-line tool, written using the Microsoft .NET 4.0 Framework, can create unique documents based on a Wikipedia dump file. The utility enables you to create up to 10 million unique Word, Excel, PowerPoint, and HTML files of various sizes so you can load different content types directly into the SharePoint Server 2013 Document Libraries.

For more information on the bulk loader tool, refer to Bulk Loader—Create Unique Documents based on Wikipedia Dump File.

Sample tool to load documents into SharePoint
In this validated testing environment, we used the LoadBulk2SP tool to load documents into the SharePoint Server. The tool was written using C# and the Microsoft .NET 3.5 Framework to be compatible with SharePoint Server. This tool takes the Bulk Loader tool disk output files as input for loading directly into the SharePoint Server, mimicking the same folder and file structure, and using the targeted web applications and document libraries specified in the application configuration.

For more information on the LoadBulk2SP tool, refer to Load Bulk Content to SharePoint 2010.

Sample code for SharePoint performance testing
In this validated testing environment, we used sample project in Visual Studio 2010 to provide load and stress testing for search, document download, and view pages scenarios. Refer to the sample project in SharePoint Performance Testing and customize in your own environment to validate the SharePoint Server 2013 performance.
Other tools listed in Table 52 also help to monitor and tune all aspects of SharePoint server performance. For details, refer to *Microsoft SQL Server Storage Best Practices and Design Guidelines for EMC Storage White Paper.*
Appendix C: Sample storage designs and reference architectures

Overview

This section introduces an example of how to size a SharePoint Server 2013 farm.

The methodology also applies to SharePoint Server 2010. Refer to I/O characteristics and capacity for content database in SharePoint Server 2010 to change the formula to size the content databases.

Note: You can use the VSPEX sizing tool to automatically complete the sizing calculation. This tool implemented the sizing logic in this section. It is easy to use and it saves time and energy for the sizing calculations.

High-level steps for SharePoint farm sizing

1. **SharePoint topology and compute resource sizing**—Determine the SharePoint topology based on customer requirements, including:
   - Number of web server roles and required compute resources
   - Number of application server roles and required compute resources
   - Database server compute resource sizing

2. **Storage layout sizing**—Determine the storage requirement for a SharePoint farm based on the customer requirements, including:
   - Content database pool storage layout
   - Services pool storage layout
   - My Site pool storage layout

Note: If the customer has more than one SharePoint farm, repeat Step 1 and Step 2 to size all the SharePoint farms.

SharePoint Server 2013 topology and compute resource sizing

The SharePoint farm is made up of SharePoint servers with different roles. Topology sizing and design determines how to distribute the roles on a certain number of servers. With a good topology design, compute resources are appropriately distributed and customer requirements for the SharePoint application are satisfied. This section introduces a high-level view of sizing the SharePoint farm topology and compute resources.

Servers in the SharePoint farm have three roles: web server, application server, and database server. EMC recommends that you to size the web servers first, use the result to size the application servers, and then size the database servers.

Sizing web servers

The web server directly manages user requests, handling the basic process and rendering the information required by the user. When necessary, it passes requests to the back-end application servers for further processing. The web server role helps you to size the farm.
The qualification sheet contains the information needed to size the farm. To size the web server for the SharePoint farm, you need the following information:

- The number of users
- The percentage of user concurrency at peak
- Whether or not the farm is accessed globally
- The main purpose of the web application (publishing or document management)

The answers to these questions help you to figure out the maximum number of active users. The formula for calculating the number of active users is as follows:

\[ \text{active user number} = \text{number of users} \times \text{user concurrency} \text{ (divided by 2 if it is global)} \]

Web applications with different purposes have different access characteristics, which can result in different web server resource consumptions. For example, we used the numbers in Table 53 to define the relationship between the number of active users and the number of web servers.

**Table 53. Sizing the number of web servers by the number of active users**

<table>
<thead>
<tr>
<th>Main purpose of web application</th>
<th>Number of active users</th>
<th>Number of web servers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Publishing Portal</td>
<td>Less than 120</td>
<td>1 (web server with application server on one machine)</td>
</tr>
<tr>
<td></td>
<td>From 120 to 750</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>From 751 to 1,506</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>From 1,507 to 2,948</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>From 2,949 to 3,785</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>From 3,786 to 4,528</td>
<td>5</td>
</tr>
<tr>
<td>Document Management Portal</td>
<td>Less than 120</td>
<td>1 (web server with application server on one machine)</td>
</tr>
<tr>
<td></td>
<td>From 120 to 582</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>From 583 to 1,152</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>From 1,153 to 2,094</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>From 2,095 to 2,652</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>From 2,653 to 3,144</td>
<td>5</td>
</tr>
</tbody>
</table>

**Note:** The number of active users can be transferred to request per second (RPS) under a specific kind of user load. For example, for a heavy user load where one user generates 60 requests per hour and with 600 active users, the calculation would be:

\[ RPS = \frac{600 \text{ active users} \times 60 \text{ request}}{3,600 \text{ second}} = 10 \text{ request/second} \]

RPS is a key metric to collect when validating the SharePoint solution.
Sizing compute resource for web servers

After finalizing the number of web servers, we used the following best practices to calculate the compute resource (vCPU and memory) of the web servers:

- Each web server should have four cores for vCPU and 12 GB of memory.
- If the web server also includes the crawler role of the search application (all-in-one topology), the best practice is to assign this server 12 cores for vCPU and 12 GB of memory.

Table 54 lists the detailed information we used to calculate the web server compute resources.

Table 54. Web server compute resource assignment

<table>
<thead>
<tr>
<th>Server type</th>
<th>vCPU</th>
<th>Memory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web server</td>
<td>4</td>
<td>12 GB</td>
</tr>
<tr>
<td>Web server (including application server role)</td>
<td>12</td>
<td>12 GB</td>
</tr>
</tbody>
</table>

After sizing the web servers, size the application servers.

Sizing application servers

The application server hosts most of the load from the service applications. Using the appropriate number of application servers ensures that the service application functions as expected.

Farm administrators can provision service applications and assign specific application servers to run them. We mainly focus on the application servers that host the search application.

The application server for the search service has six roles. General guidelines for scaling the application servers to satisfy common search usage are provided in Table 55 and Table 56.

We used the numbers from the web server sizing to establish a benchmark for the user load. A certain percentage of the requests generated by end users are search requests. There is a relationship between the number of active users and the search request load, as shown in Table 55 and Table 56.

Use Table 55 and Table 56 to confirm the number of application servers and their roles. If the customer has a large amount of content to be searched with a high expectation of search content freshness, refer to Table 55 to size the application servers. If not, refer to Table 56 to size the application servers.
Table 55. Sizing application servers for a normal farm

<table>
<thead>
<tr>
<th>Number of web servers</th>
<th>Number of application servers</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Web server and application role server co-exist in one box</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>All-in-one</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>One server is crawler-type</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The other is query-type</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>One is crawler-type</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The other one is query-type</td>
</tr>
</tbody>
</table>

Table 56. Sizing application servers to search a heavily used farm

<table>
<thead>
<tr>
<th>Number of web servers</th>
<th>Number of application servers</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Web server and application server role co-exist in one box</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>One server is crawler-type</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The other one is query-type</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>Two crawler-type</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Two query-type</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>Two crawler-type</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Two query-type</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>Two crawler-type</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Two query-type</td>
</tr>
</tbody>
</table>

Sizing compute resource for application servers
We used the following best practices to size the compute resources for the application servers:

- Application servers should have four cores for vCPU and 12 GB of memory.
- Any server running the crawler role of the search service application should have 12 cores of vCPU and 12 GB of memory.

Table 57 shows the compute resource details for each type of application server.

Table 57. Application server compute resource assignment

<table>
<thead>
<tr>
<th>Server type</th>
<th>vCPU</th>
<th>Memory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application (query-type)</td>
<td>4</td>
<td>12 GB</td>
</tr>
<tr>
<td>Application (crawler-type)</td>
<td>12</td>
<td>12 GB</td>
</tr>
<tr>
<td>Application (all-in-one)</td>
<td>12</td>
<td>12 GB</td>
</tr>
</tbody>
</table>
Sizing database servers

SharePoint Server 2013 uses SQL server as its database engine to store the content databases and the databases of the service applications. Assigning the proper compute resources to the database engine is important for a well-functioning SharePoint farm.

A SharePoint farm can contain more than one SQL Server instance. Customers can choose multiple SQL Server instances to serve the SharePoint farm. In this document, we used only one SQL Server instance. We sized the compute resources for this SQL Server as follows:

Sizing computing resource for database servers

The sizing process for the SQL Server for SharePoint Server 2013 can be divided into two parts: CPU and memory.

Table 58 and Table 59 show the detailed information of the vCPU and memory resources for SQL Server.

Table 58. Sizing SQL Server vCPU resource for SharePoint Server 2013

<table>
<thead>
<tr>
<th>Number of active users</th>
<th>Number of web servers</th>
<th>vCPU resource</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1,000</td>
<td>1 or 2</td>
<td>4 cores</td>
</tr>
<tr>
<td>Equal or more than 1,000</td>
<td>Less than 5</td>
<td>8 cores</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>16 cores</td>
</tr>
</tbody>
</table>

Table 59. Sizing SQL Server memory resource for SharePoint Server 2013

<table>
<thead>
<tr>
<th>Number of active users</th>
<th>Memory resource</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 1,000</td>
<td>8 GB</td>
</tr>
<tr>
<td>Equal or more than 1,000</td>
<td>16 GB</td>
</tr>
</tbody>
</table>

After the sizing of the SharePoint virtual machines and the SQL Server virtual machines is completed, size the storage backend next.

Sizing storage layout

SharePoint contents that need to be stored can be classified by their uses:

- **Content databases**—Site content and site settings, for example, site pages, documents, metadata, and permission settings.
- **Service application databases and files**—Data and settings of specific service applications.
- **Content database hosting My Sites**—User’s My Site content.
- **Server’s OS volumes**

These four kinds of content have different performance characteristics. According to their storage access characteristics, we divide the storage into four pools:

- Content database pool (RAID 5)
- SharePoint services pool (RAID 10)
- My Sites pool (RAID 6)
- Virtual machine OS pool that stores the OS volumes of the SharePoint servers (RAID 5)

When sizing storage pools, we should compare the results of both performance-based and capacity-based calculations. Choose the larger number. This ensures both requirements are satisfied.

**Sizing content database pool**
This section describes how to size the content database pool. EMC recommends calculating for performance first, and then for capacity.

**Sizing content database pool from performance perspective**
Figure 37 and Figure 38 show the test results of the relationship between the numbers of active users and host IOPS for the content database.

![Graph showing the relationship between active user number and host IOPS](image)

**Figure 37.** Test result of active user number and host IOPS relationship for search intensive Publishing Portal
As the number of active users grows, the host IOPS on content databases grow in a linear way. According to the linear relationship, we were able to calculate the host IOPS for any given number of active users. We used the host IOPS to size the content database storage pool.

Use the following formula to calculate the host IOPS:

- For the search intensive Publishing Portal:
  \[ \text{host IOPS} = 0.2397 \times \text{active user number} \]

- For the search intensive Document Management Portal:
  \[ \text{host IOPS} = 0.4173 \times \text{active user number} \]

Use the following formula to calculate the backend IOPS from the host IOPS:

- For the Publishing Portal, the read/write ratio is 3:1 with RAID 5.
  \[ \text{backend IOPS} = \text{host IOPS} \times \frac{3}{4} + \text{host IOPS} \times \frac{1}{4} \times 4 = \text{host IOPS} \times \frac{7}{4} \]

- For Document Management Portal, the read/write ratio is 2:1 with RAID 5.
  \[ \text{backend IOPS} = \text{host IOPS} \times \frac{2}{3} + \text{host IOPS} \times \frac{1}{3} \times 4 = \text{host IOPS} \times 2 \]

Use the following formula to calculate the number of disks:

\[ \text{disk number} = \frac{\text{required backend IOPS}}{\text{IOPS per disk}} \]

The IOPS per disk can vary for different types of disk.
Finally, we used RAID 5 (4+1). The final number of disks should be rounded up to five. An example of sizing content database pool provides an example of a detailed sizing calculation.

**Sizing content database pool from capacity perspective**

Use the following formula to calculate the content database LUN size. We reserved 30 percent of storage space as a buffer:

\[ \text{content database LUN size} = \text{content database size} \times (1 + \text{annual growth rate})^{\text{years}} \times 1.3 \]

Use the following formula to get the number of disks:

\[ \text{spindle requirement} = \frac{\text{total capacity}}{\text{usable capacity}} \]

When calculating the number of disks, we used the disk's usable capacity. This value can vary for different raw capacity disks.

**An example of sizing content database pool**

A customer has the requirements for his SharePoint Server 2013 farm, as shown in Table 60.

<table>
<thead>
<tr>
<th>Table 60. Example items for sizing SharePoint Server 2013 farm</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Items</strong></td>
</tr>
<tr>
<td>Content size annual growth rate</td>
</tr>
<tr>
<td>Web application globally access</td>
</tr>
<tr>
<td>Initial farm size</td>
</tr>
<tr>
<td>Number of users</td>
</tr>
<tr>
<td>User concurrency at peak</td>
</tr>
<tr>
<td>Main purpose of web application</td>
</tr>
<tr>
<td>My Site function</td>
</tr>
<tr>
<td>SharePoint search function</td>
</tr>
<tr>
<td>Enable FAST VP on storage</td>
</tr>
</tbody>
</table>

**Performance perspective**

For this example, you can calculate the content database pool from performance perspective as follows:

\[ \text{active user number} = 10,000 \times 50\% = 5,000 \]

\[ \text{host IOPS} = 5,000 \times 0.2397 = 1,198.5 \]

\[ \text{total backend IOPS for RAID 5} = \left(1,198 \times \frac{3}{4}\right) + 4 \times \left(1,198 \times \frac{1}{4}\right) = 2,097 \]

\[ \text{disk number} = \frac{\text{required backend IOPS}}{\text{IOPS per disk}} = 2,096.5/180 = 11.65 \]

Finally, round up the number of disks by five for RAID 5. In this example, 15 disks are needed from the IOPS perspective.
**Capacity perspective**

For this example, the initial farm content size is 4,000 GB. The growth rate is 20 percent and the number of years for growth is two.

\[
\text{farm capacity} = 4,000 \times 1.2^2 \times 1.3 = 7,488 \text{ GB}
\]

The usable capacity available per 600 GB 15k SAS drive is 537 GB.

\[
\text{SAS 600 GB requirement} = \frac{7,488}{536.81} = 13.9
\]

When rounded up by five for RAID 5, the capacity requirement is 15 disks.

**Performance versus capacity**

This example requires 15 disks from an IOPS perspective and 15 disks from a capacity perspective. If they are not equal, choose the larger one.

If the selected farm is not search intensive, subtract 15 percent of the host I/O from the previous calculation result to support the impact caused by frequent incremental crawls on the content databases.

To enable FAST VP, EMC recommends you use RAID 10 (1+1) flash disk and RAID 6 (6+2) NL-SAS for the content database storage pool.

**Sizing services pool**

This section describes how to size the service pool. As in sizing the content database pool, we calculated from both the performance perspective and the capacity perspective.

**Sizing services pool from performance perspective**

Table 61 and Table 62 detail the service pool sizing from a performance perspective. The search-intensive SharePoint farm generates sequential IOPS for the service pool. Refer to Table 61 and Table 62 to find the appropriate number of disks based on the customer’s business requirements.

<table>
<thead>
<tr>
<th>No. of web servers</th>
<th>No. of application servers</th>
<th>Description</th>
<th>VNXe (SAS 15K)</th>
<th>VNX (SAS 15K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Web server and application in one box</td>
<td>RAID 10 (3+3) 6 disks</td>
<td>RAID 10 (1+1) 2 disks</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>All-in-one</td>
<td>RAID 10 (3+3) 6 disks</td>
<td>RAID 10 (2+2) 4 disks</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>One query-type One crawler-type</td>
<td>RAID 10 (3+3) 6 disks</td>
<td>RAID 10 (4+4) 8 disks</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>One query-type One crawler-type</td>
<td>RAID 10 (3+3) 6 disks</td>
<td>RAID 10 (4+4) 8 disks</td>
</tr>
<tr>
<td>No. of web servers</td>
<td>No. of application servers</td>
<td>Description</td>
<td>VNXe (SAS 15K)</td>
<td>VNX (SAS 15K)</td>
</tr>
<tr>
<td>--------------------</td>
<td>----------------------------</td>
<td>------------------------------</td>
<td>----------------</td>
<td>---------------</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>One query-type One crawler-type</td>
<td>RAID 10 (3+3) 6 disks</td>
<td>RAID 10 (4+4) 8 disks</td>
</tr>
</tbody>
</table>

Table 62. Sizing the application server for intensive search farm

<table>
<thead>
<tr>
<th>No. of web servers</th>
<th>No. of application server</th>
<th>Description</th>
<th>VNXe (SAS 15K)</th>
<th>VNX (SAS 15K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>All Service Roles in one box</td>
<td>RAID 10 (3+3) 6 disks</td>
<td>RAID 10 (3+3) 6 disks</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>One query-type One crawler-type</td>
<td>RAID 10 (3+3) 6 disks</td>
<td>RAID 10 (4+4) 8 disks</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>Two query-type Two crawler-type</td>
<td>RAID 10 (3+3) 12 disks</td>
<td>RAID 10 (4+4) 16 disks</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>Two query-type Two crawler-type</td>
<td>RAID 10 (3+3) 12 disks</td>
<td>RAID 10 (4+4) 16 disks</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>Two query-type Two crawler-type</td>
<td>RAID 10 (3+3) 12 disks</td>
<td>RAID 10 (4+4) 16 disks</td>
</tr>
</tbody>
</table>

Sizing services pool from capacity perspective
EMC recommends that the services pool capacity requirement is 30 percent of the content capacity.

For example, if the farm content capacity requirement is 12 TB:

\[
SAS\ 600\ GB\ requirement = 12,000 \times 30\% / 537 = 6.7
\]

For the RAID 10 (3+3) service pool, we round up the number of disks to six. For RAID 10 (4+4) services pool, we need to round up the number of disks to eight. In this example, if the RAID 10 is (3+3), the capacity requirement should be 12 disks for the services pool.

Sizing My Site pool
For the My Site pool, we used RAID 6 with the NL-SAS disk type. Since My Site is used by fewer people, when sizing a My Site pool, we only consider the capacity.

The formula for calculating the number of disks for the My Site pool is:

\[
disk\ number = number\ of\ users \times percentage\ of\ My\ Site\ usage \times single\ user\ quota/disk\ usable\ capacity
\]
Appendix D: Optimized setting in SQL Server for SharePoint

The Optimized settings for SQL Server are listed as follows:

- Do not enable AUTO_CREATE_STATISTICS on a server that hosts SQL Server and SharePoint Server. Enabling AUTO_CREATE_STATISTICS is not supported for SharePoint Server. SharePoint Server configures the required settings during provisioning and upgrade. Manually enabling AUTO_CREATE_STATISTICS on a SharePoint database can significantly change the execution plan of a query. The SharePoint databases either use a stored procedure that maintains the statistics (proc_UpdateStatistics) or rely on SQL Server to do this.

- Set the maximum degree of parallelism option to 1 for SQL Server instances hosting SharePoint Server 2010 and SharePoint Server 2013 databases to ensure that each request is served by a single SQL Server process.

- Set the database autogrowth values as a percentage instead of a fixed number of megabytes. The larger the database, the larger the growth increment should be. Consider, for example, that we used 10 percent autogrowth for the SharePoint databases.

- EMC recommends that you continuously monitor SQL Server storage and performance to ensure that each production database server is adequately handling its load.

- Use the full recovery model for the SharePoint content database and the simple recovery model for the SharePoint services database:
  - The full recovery model enables administrators to back up the transaction logs incrementally. It enables recovery of the SharePoint content database from a specific point-in-time from log backup, even if the data files of the content databases are corrupt. EMC recommends that you monitor the growth of the log file and take log backups regularly for the full recovery model.
  - The simple recovery model automatically reclaims log space to keep the space requirement small, essentially eliminating the need to manage the transaction log space. However, simple recovery cannot support log backups.
Appendix E: Scripts to break down items in the content database

Understanding the detailed information of items in a SharePoint farm is very important for sizing and designing. The information includes: Item number, item type, average size, and the maximum item size.

In order to get the information, use the scripts in Figure 39 to generate a report for content database. Replace the content database name in the script with the actual name in your environment to prepare this script.

use master
go

if object_id('sumcontentsize') is not null drop table sumcontentsize
create table sumcontentsize(extension varchar(100), summation DECIMAL (20,5),countnum DECIMAL (20,5),maxsize DECIMAL(20,5))
go
sp_MSforeachdb 'use [?] if ''?'' like ''content database name'' begin
--need to change the content database name
insert into master.dbo.sumcontentsize
select extension, SUM (CAST ([size]/1000.00000 AS DECIMAL (20,5)))as [Size Summuation of Doc Type (kb)],
count(extension) as [Count], MAX (CAST ([size]/1000.00000 AS DECIMAL (20,5)))
from [?].dbo.alldocs
where extension like ''doc'' or extension like ''docx'' or extension like ''xlsx'' or extension like ''pptx'' or extension like ''mpp'' or extension like ''jpg'' or extension like ''gif''
or extension like ''vsd''
group by extension
end'
--need to change the file type above

select extension,
sum(convert(DECIMAL(20,5),summation)) AS [Total Summation],
sum(convert(DECIMAL(20,0),countnum)) AS [Total Count],
sum(convert(DECIMAL(20,5),summation))/sum(convert(DECIMAL(20,5),countnum)) AS [Avg doc size],
AVG(convert(DECIMAL(20,5),maxsize)) AS [MAX SIZE]
from sumcontentsize group by extension

Figure 39. Scripts to generate the report for a content database

Table 63 shows a sample output to break down items in a content database.

Table 63. Sample output to break down items in a content database

<table>
<thead>
<tr>
<th>Extension</th>
<th>Total summation (KB)</th>
<th>Total count</th>
<th>Average doc size (KB)</th>
<th>Maximum size (KB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>doc</td>
<td>1,182.72</td>
<td>55</td>
<td>21.504</td>
<td>21.504</td>
</tr>
<tr>
<td>docx</td>
<td>326,896,188.8</td>
<td>970,351</td>
<td>336.884476</td>
<td>49,137.197</td>
</tr>
<tr>
<td>gif</td>
<td>191.165</td>
<td>28</td>
<td>6.827321</td>
<td>24.363</td>
</tr>
<tr>
<td>Extension</td>
<td>Total summation (KB)</td>
<td>Total count</td>
<td>Average doc size (KB)</td>
<td>Maximum size (KB)</td>
</tr>
<tr>
<td>-----------</td>
<td>---------------------</td>
<td>-------------</td>
<td>----------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>jpg</td>
<td>73.84</td>
<td>7</td>
<td>10.548571</td>
<td>28.113</td>
</tr>
<tr>
<td>pptx</td>
<td>343,079,641.1</td>
<td>985,550</td>
<td>348.109828</td>
<td>742.837</td>
</tr>
<tr>
<td>xlsx</td>
<td>300,081,942.2</td>
<td>979,624</td>
<td>306.323591</td>
<td>2,813.764</td>
</tr>
</tbody>
</table>