Microsoft Office SharePoint Server EMC Celerra Unified Storage Platforms
Reference Architecture

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Executive summary

Microsoft Office SharePoint Server 2007 is a server application for the enterprise that facilitates collaboration, provides full content management features, implements business processes, and provides access to information essential to organizational goals and processes. It provides an integrated platform to plan, deploy, and manage intranet, extranet, and Internet applications across and beyond the enterprise.

SharePoint uses multiple servers in various roles to organize and deliver website collaboration and information sharing across organizations. SQL Server is used to organize and hold the data that is served to users. All SharePoint data from the user files to the configuration data of web portals is maintained by SQL Server. Management of a SharePoint environment includes the SQL databases and all of the servers used to share data. Backup and protect solutions should be application aware to produce consistent data that can be successfully restored.

Introduction

When considering a SharePoint implementation it is important to understand that each server has an impact on the load imparted to any one user. All servers should be monitored to ensure that no bottlenecks occur. The design of the environment, the structure of the relationships between the servers, and the web applications that access the SharePoint data all play a role in determining system performance.

Audience

This document is intended for internal EMC personnel, EMC partners, and customers.

Business benefits

Enterprises are increasingly challenged to manage SharePoint sites that contain critical business information that is rapidly increasing. As knowledge workers collaborate on projects and author documents:

♦ More storage is required
♦ Data compliance and security are increasingly more important
♦ Process and policies require a comprehensive backup strategy
♦ Backup tools to increase user productivity are a necessity

In addition, these enterprises must manage IT costs and reduce the risk of business disruption.

This solution addresses each of these challenges using tested and proven solutions validated by EMC Engineering in the NAS Product Validation Lab in Research Triangle Park, North Carolina.
Table 1 provides the details about the benefits of the Solution.

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Details</th>
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<tbody>
<tr>
<td>Maintains service levels</td>
<td>This solution keeps critical and revenue-generating Microsoft applications available and running at peak performance.</td>
</tr>
<tr>
<td>Reduces costs</td>
<td>This solution minimizes the cost of server, database and information management.</td>
</tr>
<tr>
<td>Reduces risk</td>
<td>This solution offers a reference architecture that includes tested and proven configurations that improve performance and scalability.</td>
</tr>
<tr>
<td>SharePoint object protection</td>
<td>• Protection of all SharePoint data in the farm, including content, configuration, search and index databases.</td>
</tr>
<tr>
<td></td>
<td>• Point-in-time Microsoft VSS snapshot data can be retained on storage volumes for quick access.</td>
</tr>
<tr>
<td></td>
<td>• Instant recoveries of persistent snapshots.</td>
</tr>
<tr>
<td></td>
<td>• Disaster recovery of an entire SharePoint farm.</td>
</tr>
<tr>
<td></td>
<td>• Optimization of large site backup.</td>
</tr>
<tr>
<td>Database level backup and restore</td>
<td>Individual content databases and search/index databases offer backup and restore capabilities.</td>
</tr>
<tr>
<td>Schedule backups</td>
<td>• Automate full or incremental backup jobs.</td>
</tr>
<tr>
<td></td>
<td>• Available quick view of backup and restore job history.</td>
</tr>
<tr>
<td></td>
<td>• Support for schedule and incremental backup.</td>
</tr>
<tr>
<td>Enhanced interface</td>
<td>• Snapshot management for rollover, rollback and recovery.</td>
</tr>
<tr>
<td></td>
<td>• Create and manage backup catalogs.</td>
</tr>
<tr>
<td></td>
<td>• Access to log files to aid issue resolution.</td>
</tr>
</tbody>
</table>

**Technology challenges**

SharePoint systems are environments, not applications by themselves. As such there are many factors to consider when deploying solutions into an existing environment, or planning a new application deployment. EMC Proven Solutions allow you to start from a known reference configuration, and then customize it for your needs by examining the similarities and differences between various methods of accomplishing common tasks in a database environment. This includes options for:

- Server virtualization
- Data backup and recovery
- Database replication and protection
System configuration

Figure 1 outlines the configuration of the solution as tested. There are several permutations that are still considered part of the proven solution that are explained in the later sections.
Storage architecture

Figure 2 outlines how storage is provisioned in one possible configuration of the validated solution.

The validated solution can use storage through the NFS, CIFS, and iSCSI protocols. The NFS protocol is used to provide storage for the system disks of various virtual machines that are used in the solution. The CIFS protocol provides access to the area used for database backups. The iSCSI protocol is used to provide data storage to the primary database application. The underlying architecture of each storage area will be based on the anticipated workload that will be applied to that area. These areas can have vastly different I/O performance, space, and protection requirements and should be maintained separately. For information on specific considerations for database area, refer to the Storage Sizing and Scaling chapter.

NFS Area – Virtual machine boot disks (if applicable)

The validated solution uses virtual machines for several of the SharePoint farm servers that can boot from the primary database cluster. These systems can be implemented as either physical or virtual servers with no impact to the database portion of the solution. If virtual machines are required, refer to several implementation options that are outlined in the Virtualization Options chapter.

If this solution is implemented with virtual machines, it is possible to use networked storage for the virtual machine boot disks. Therefore, the array-based methods such as snapshots, replication, and NDMP backups can be implemented to protect the virtual machines. It is also possible to protect these virtual machines using server-based techniques. The method of protection is not specified by the solution.
Solution Overview

CIFS Area – Database backups

Database backups are critical to the administration of production applications. The CIFS area exposed from the Celerra® provides storage space to accommodate full and incremental backups as required.

iSCSI Area – Database and Log files

The validated solution allows both physical and virtual servers for the database server. To accommodate a range of potential implementations, and to allow several array-based functions, the validated solution specifies that the primary application database should reside on Celerra iSCSI storage. This area must be sized according to the needs of your specific database application. For information on sizing and scaling for specific considerations, refer to the Storage Sizing and Scaling chapter.

Network architecture

System-wide network design and architecture are outside the scope of this document and solution. This section presents recommendations for proper functionality that are consistent with industry accepted best practices and should be compatible with existing network infrastructure and policies.

Switches

In any highly available solution there should be multiple network paths between each component in the system so that no single failure can disrupt communication. The solution architecture diagram (refer to Figure 1 on page 10) defines a set of logical networks that are recommended for the solution. The networks do not provide failover protection. Therefore, the networks should be designed so that they are highly available on their own.

The validated solution uses Gigabit Ethernet (GbE) switches.

Virtual local area networks

When creating highly available networks, the requirement to have multiple switches on multiple networks can quickly become costly. Virtual Local Area Networks (VLANs) allow each physical network switch to maintain multiple virtual networks that are logically isolated from each other. This solution was validated using VLANs within a highly available network and can be implemented with logical separation using them, or with physical separation using distinct physical switches.

EMC Celerra NS40

The EMC Celerra NS40 contains two Data Movers. The Data Movers can operate independently. They can also operate in the active/passive mode, with the passive Data Mover serving as a failover device for the active Data Mover. In this solution, the Data Movers operate in active/passive mode.
The NS40 Data Mover has four network ports. Figure 3 shows the ports on the rear of an EMC Celerra NS40 Data Mover.

![Figure 3 EMC Celerra NS40 Data Mover ports](image)

Ports cge0 and cge1 handle the storage traffic. Ports cge2 and cge3 are left open for future requirements.

The Data Mover supports several types of link aggregation for IP traffic. However, in this configuration, no link aggregations or Ethernet channels were configured, because Celerra also supports iSCSI Multiple Connections per Session (MC/S), which is recommended by Microsoft.

**Note:** As a best practice, the Data Mover network ports connected to the storage network should be dedicated to storage traffic. However, if the ports are not heavily used, they can be shared with non-storage network traffic. EMC recommends monitoring the network to avoid bottlenecks.

**Virtualization layer**

The validated solution uses multiple virtual components to save space in the data center and also to reduce power and cooling costs. The solution is validated for both physical and virtual implementations as described in the Virtualization Options chapter.

As with all of the other layers in the solution stack, care should be taken to make sure that the impact of any virtualization technology on the performance, availability, and recoverability of the system is well understood before implementing it in a production environment.

**Application architecture**

The solution assumes that the SharePoint databases run on a single database server instance. The Microsoft SQL Server 2005 binary files are installed on the SQL server. Database files, database log files, tempdb files, and other system database files reside on EMC Celerra iSCSI LUNs. The database log files reside on a single LUN. The LUN resides on its own Celerra file system, and is physically isolated from the spindles used for the database files. The SharePoint Web server and the SharePoint Index server both use Celerra iSCSI LUNs to hold index files generated by the web crawling process.

For the validated solution the system temporary database (tempdb) resides on a single iSCSI LUN on separate spindles from the SharePoint databases. The test workload that is used for the validated solution has a minimal impact on tempdb. In real-world applications this usage pattern can be drastically different. It is a best practice to evaluate tempdb as a completely separate database and size it according to its measured workload.
Solution Overview

High availability and failover

The validated solution provides protection at the storage layer, the connectivity layer, and the host layer.

Storage layer

Celerra can have multiple Data Movers to provide high availability and load balancing. In the SharePoint 2007 NS Series solution, primary and standby Data Movers provide seamless failover capabilities for the Celerra storage. This minimizes the end-user disruption during routine Celerra maintenance such as upgrading the DART OS.

The RAID disk configuration on the Celerra back-end provides protection against hard disk failures.

Connectivity layer

Using the Microsoft iSCSI Initiator software, the Celerra platform supports Multiple Connections per Session (MC/S). This provides high availability, failover, and load balancing. The MC/S supports multiple TCP/IP connections from the initiator to the target within the same iSCSI session. If a connection fails, another connection can continue processing I/O without interrupting the application. In the validated solution, MC/S also provides “round-robin” load-balancing capabilities.

Note: There are other multi-path technologies available with the Microsoft iSCSI Initiator Software. However, as a best practice Microsoft recommends using Multiple Connections per Session if it is supported by both the initiator and target.

The solution configuration also includes separate network interface cards (NICs) at the source of each I/O path, a separate network infrastructure (cables, switches, routers, and so on), and separate target ports.

Host layer

The application hosts have redundant power supplies and network connections to reduce the impact of host hardware failure. In the validated solution, the application host is clustered using Microsoft Cluster Services, providing further redundancy.

Conclusion

This document provides a reference architecture for solutions based on Microsoft Office SharePoint Server 2007 with EMC Celerra. While several technologies, products, and considerations are presented as working together to create a system that can meet performance, reliability, availability, and recovery targets, a customer environment can have different needs. For that reason in each of the subsequent chapters the reference configuration for a specific functionality will be discussed, along with other options that can be used.

SharePoint is a highly configurable and variable application environment, and every customer will have a different set of availability needs, performance goals, and recovery targets. This document attempts to provide a framework for implementing these solutions that addresses the inherent complexity of many environments, while retaining the ease-of-use that characterizes the EMC Celerra platform.

Related documents

The following documents, located on Powerlink.com, provide additional, relevant information. Access to these documents is based on your login credentials. If you do not have access to the following content, contact your EMC representative:


♦ EMC Solutions for Microsoft Office SharePoint Server Data Backup for EMC Celerra - Validation Test Report
EMC Solutions for Microsoft Office SharePoint Server Data Storage for EMC Celerra – Validation Test Report
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Introduction

Discussions of sizing and scaling are critical to the deployment of this solution or any other solution for database environments. Sizing systems for database workloads is a complex task that deserves a great deal of thought and planning to ensure that a system behaves in a manner that is acceptable to the various stakeholders involved in a project.

Reference configuration

This section outlines one configuration that has been validated in the NAS Product Validation lab in Research Triangle Park, North Carolina, with all the solutions modules presented here working together. This is one example of a system that could be implemented, but it is not the answer to all customer issues. Database solutions can vary drastically based on individual customer requirements. So each customer environment must be evaluated, analyzed, and sized individually. The configuration presented in this chapter is used to have a common point of reference so that the interactions between solution components can be explored.

Workload

The real-world SharePoint installations can vary widely between customers or even between individual instances within a customer environment. This is because each SharePoint workload is different and is determined by the user requests accessing the database, the patterns of users making such requests, and the individual SharePoint database design. All these factors make it impossible to strictly define a mapping between hardware and a number of “users” that can be supported.

To properly test the SharePoint environment, a set of tools designed by KnowledgeLake (Microsoft gold certified partner) was used. KnowledgeLake developed a data population tool that uses the SharePoint front end to insert unique documents into the SharePoint farm. To generate and emulate client load, Microsoft Visual Studio Team Suite (VSTS) was used in conjunction with the KnowledgeLake tools to simulate real-world SharePoint user activity.

Server configuration

Four servers made up the SharePoint farm: web server, application server, index server, and SQL server. Both the web server and SQL server are configured with the same amount of memory (16 GB) and multiple processor cores. The physical server has eight processing cores in four physical processors, while the virtual node has four virtual CPUs (at the time of testing this was the maximum supported number of virtual cores). The index and application servers each used 4 GB of memory and two virtual processors.
Table 2 lists the hardware used for this solution.

<table>
<thead>
<tr>
<th>Name</th>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
</table>
| 2U server                   | Three    | • Two 3-GHz Intel Xeon dual-core processors  
• 16 GB of memory  
• One 60 GB SCSI disk  
• Two on-board 10/100/1000 Mb Ethernet NICs  
• Four additional 10/100/1000 Mb Ethernet NICs |
| 1U server                   | One      | • A dual-processor with a speed of 2.8 GHz and 4 GB of RAM.                                                                                   |
| Gigabit Ethernet switch     | Three    | • Copper GbE ports                                                                                                                          |
| EMC Celerra NS40             | One      | • Two Data Movers  
• Four GbE network connections  
• Two FC shelves  
• One ATA shelves  
• Eight 300 GB (15k) FC disks and five system disks  
• Five 1000 GB S-ATA disks |

Table 3 lists the software used for the SharePoint solution.

<table>
<thead>
<tr>
<th>Name</th>
<th>Quantity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows 2003 Server Enterprise Edition, 32-bit SP2</td>
<td>One</td>
<td>AD server</td>
</tr>
<tr>
<td>VMware ESX 3.5.0 (82633)</td>
<td>Four</td>
<td></td>
</tr>
<tr>
<td>Microsoft Office SharePoint Server 2007 Enterprise Edition 64-bit SP1</td>
<td>Three</td>
<td>Installed on the application, web, index and query servers.</td>
</tr>
<tr>
<td>Microsoft SQL Server 2005 SP2 Enterprise Edition 64-bit</td>
<td>One</td>
<td>Installed on the database server.</td>
</tr>
<tr>
<td>EMC NetWorker® 7.4 64-bit</td>
<td>One</td>
<td>NetWorker server installed on the virtual machine residing on ESX Server.</td>
</tr>
<tr>
<td>EMC NetWorker Module for Microsoft Applications 2.0</td>
<td>Three</td>
<td>Installed on application, web, and index servers.</td>
</tr>
</tbody>
</table>
Storage Sizing and Scaling

Storage configuration

The validated solution uses 14-disk spindles to host the SharePoint databases, index files, and logs with an additional five disk spindles hosting a location for backup files. The database disks are set up in RAID 5 groups to increase storage space for the SharePoint solution.

Figure 4 shows the configurations used.

![Disk layout diagram](image)

As with all of the other aspects of the system it is important to understand how the storage architecture supports high availability, and load balancing across various components.

The EMC Celerra platform is inherently highly available and has many architectural features to enable the system to continue running even when failures occur. Availability is enhanced for databases by separating the data and log files onto dedicated physical spindles, and using RAID 1 protection. Architectural features include redundant power, I/O pathways, and network connections.

For a complete description of how this configuration performed during validation testing, refer to *EMC Solutions for Microsoft Office SharePoint Server Data Storage for EMC Celerra -Validation Test Report*, available on Powerlink®.

Applying the reference

The reference configuration provides a place to start when sizing a deployment in a real environment. By understanding how the workload relates to the test workload, and how changes to the test system impact that workload, you can gain some understanding of how changes should impact the real-world environment. This is not intended to be a guarantee that the changes and results indicated here will translate exactly into another environment, but rather as a starting point so that decisions that impact customers can be made with the best information available.
Workload evaluation

The first step in any sizing exercise is to evaluate the workload, or plan the workload, that will be handled by the system in question. It is important to understand how the workload will translate into the storage environment so that the I/O performance capacity can be determined. There are numerous ways to accomplish this task, which will vary based on the environment.

Server memory sizing

In SharePoint environments, memory and I/O are intrinsically linked. Having a larger amount of memory will allow web pages to be served from memory instead of disk, which is much more efficient.

Storage sizing

There are many options to consider when sizing database storage. Disks have two primary metrics of capacity and both must be considered in designing a storage system. They are the storage capacity, typically measured in gigabytes (GB) and the performance capacity, typically measured as Input/Output Operations per Second (IOPS). It is easy to determine the storage capacity in most environments. However, the performance capacity is often overlooked as it is difficult to discern the capacity.

The first item to consider when examining a disk is the performance capacity – once that number is known it is a simple matter to evaluate storage capacity – going in the reverse order is not as intuitive. For more information, refer to EMC Solutions for Microsoft Office SharePoint Server EMC Celerra Unified Storage Platforms - Applied Best Practices Guide available on Powerlink.

Conclusion

The reference configuration can be used as a starting point to evaluate the data storage options available in your environment. This configuration is intended as a reference only and should not be substituted for proper evaluation and testing of the actual environment and workload.
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Introduction

An increasing number of companies are exploring ways to virtualize SharePoint environments to reduce costs, increase flexibility, and use resources more efficiently. This section describes how various virtualization options can be used with the solution. The validated solution uses VMware Infrastructure 3 to allow a physical system to host more than one logical system. This is intended as a proof of concept, not as a requirement. There are no functions inherent in the solution that require virtualization.

VMware Infrastructure 3

VMware Infrastructure 3 allows guest operating systems to connect to storage using several methods. This reference architecture specifies that database storage be provided to the server using the iSCSI protocol without translation at the Hypervisor level. With the remaining connection methods some or all the modules in this solution may be supported as detailed in this section.

This section summarizes the options available for each connection method.

Figure 5 shows the configuration tested for VMware Infrastructure 3.
Virtualization Options

Guest OS Software iSCSI Initiator

A Windows guest running within VMware ESX Server is capable of connecting to Celerra iSCSI storage using the Microsoft iSCSI initiator just like a physical system. Using this connection method, all the modules in this solution will be supported.

ESX Server iSCSI initiator (Virtual Machine File System datastore)

Using a Virtual Machine File System (VMFS) datastore drastically changes the semantics of interacting with storage. This solution does not explicitly cover this scenario. However, there are several modules that can be applicable to this scenario that are not validated.

ESX Server iSCSI initiator (Raw Device Mapping)

This connection method is very similar to the Guest OS initiator method, and many of the same solution modules can be applied. This solution does not explicitly support Raw Device Mapping (RDM) devices, but can be used as a reference when designing such a system.

NAS datastore (NFS)

The EMC Celerra platform can become a NAS Datastore for an ESX Server using the NFS protocol. This solution was not implemented, but is covered in the document, EMC Solutions for Microsoft Office SharePoint Server 2007 on VMware ESX Server EMC Celerra NS Series over NFS - Build Document, available on Powerlink.

Additional options

Additional virtualization options exist, but have not been tested as part of this solution. Many of the concepts, practices, and recommendations that apply to this solution will be applicable in those systems, but they have not been tested and are not supported as part of this solution.

Conclusion

Virtualization provides opportunities to reduce costs, increase flexibility, and more efficiently use resources. Many of the components in this solution can be virtualized depending on your specific needs. However, there are no components in this solution that explicitly require virtualization in order to be considered part of the validated solution.
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Introduction

Data backups are an essential part of any production environment. Regardless of the RAID protection level, hardware redundancy, and other high-availability features present in EMC Celerra storage arrays, conditions exist where you may need to be able to recover the SharePoint environment to a previous point in time.

SharePoint built-in backup tools

Figure 6 shows the SharePoint built-in backup configuration.

Office SharePoint Server 2007 provides two built-in backup tools: Central Administration and the stsadm.exe command-line tool.

Limitations of these built-in tools include a lack of support for restoring backups of the configuration database and Central Administration content database taken from a running farm. This is because data in these databases may not be synchronized with data in other Office SharePoint Server 2007 databases. Therefore, the tools built in to SharePoint Products and Technologies do not recover these databases during a farm-level restore operation.

Size of the site collection can be a limiting factor for the SharePoint built-in tools. Site collection backups affect performance, and they can cause access errors. They are not designed to be used when the server is under active load. Site collection backups can be
Data Protection and Replication

slow when working with collections larger than 15 GB. It is recommended that SQL native backup is used if working with site collections larger than 15 GB.

Scheduling of backups is not available with Central Administration, only stsadm.exe allows for scheduling.

Additional backup options

In addition to the SharePoint built-in backup tools that are included in the validated solution other backup tools exist that may be more suitable for your needs. Any of the options listed in this section can be exchanged for the SharePoint built-in tool backup module in the solution without impacting other solution modules.

EMC NetWorker

Figure 7 shows the EMC NetWorker configuration.

![EMC NetWorker configuration diagram](image)

The EMC NetWorker product allows you to manage all your backups from various systems with one interface. The modular architecture allows you to incrementally extend functionality to various applications as they are introduced to your environment.
EMC NetWorker Module for Microsoft applications

The Microsoft Applications module provides a common interface for managing backups of SQL Server, Exchange, and SharePoint. The EMC NetWorker for Microsoft Applications module is independent of the SQL Server module. This module also integrates with EMC Celerra Replicator™ to minimize the performance impact of the backup operation. Recovery options for this backup tool, include complete farm recovery, single web site recovery, and individual file (single object) recovery.

Microsoft System Center Data Protection Manager

Microsoft System Center Data Protection Manager (DPM) expands the basic data protection capabilities included in SQL Server by adding the ability to provide backups for selected databases with more granular control over your recovery time objective (RTO) and recovery point objective (RPO). Using only the tools provided with Windows Server and SharePoint, it is possible to take periodic full backups, but the frequency of these backups will vary according to the speed of your backup system and the amount of data you need to back up. The frequency at which you can create backups will control both the RPO and the RTO available to you. For example, with nightly tape backup, your RPO or “potential data loss” will be one business day, meaning that any server outage will likely cost up to an entire business day of data (and productivity) that will be unrecoverable. Meanwhile, your RTO, which indicates how long it will actually take to recover, will vary according to the amount of data that has to be restored.

By contrast, DPM provides granular protection by combining VSS’s snapshot functionality with DPM’s block-level synchronization. After the initial baseline copy of the protected databases are on the DPM server, transaction logs can be continuously synchronized as often as every 15 minutes. DPM’s “express full” backup technology uses the SQL Server VSS writer to identify which blocks have changed on the disk. Those blocks, and only those blocks, are copied to the DPM server where they are applied to an active replica of the data. Previous iterations are stored as a set of differences within the preceding backup.
Figure 8 shows the architectural diagram of the setup of DPM Protect.

Third-party applications

In addition to the offerings from EMC, there are backup offerings from other companies. For a complete list of the software packages that have been tested, refer to *EMC Solutions for Microsoft Office SharePoint Server 2007 Data Backup for EMC Celerra – Validation Test Report* available on Powerlink.

Conclusion

A thoughtful and complete backup strategy is an essential part of database maintenance in a production environment. The validated solution uses SharePoint built-in backup tools to ensure recoverability using the no-cost included programs. The native backup tool is suitable for many types of customer environments, but is not appropriate in all cases. Some environments may have needs that are not addressed in the software. For those environments several additional options are presented that can replace that solution module without impacting the other modules that would be required in your environment.