

# Microsoft® SharePoint® Server 2010

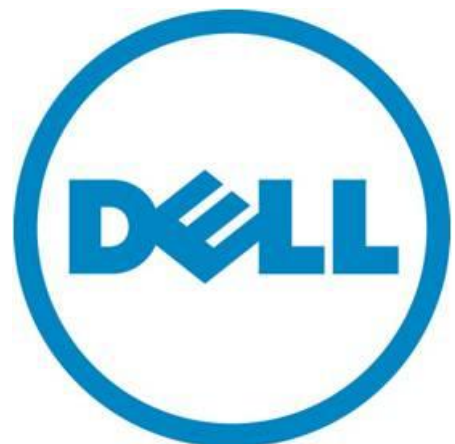
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Small Farm Performance Study

Dell™ | SharePoint Solutions

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November 2010



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## Executive Summary

A Microsoft® SharePoint® Server 2010 farm hosts the core platform services and applications that provide many different functions for its users. A SharePoint 2010 farm deployment usually employs a multi-tier architecture. Understanding sizing of each of the tiers of a SharePoint farm requires a comprehensive study of the workload requirements and performance capabilities of each hardware component.

This white paper includes such a comprehensive study and describes how a small SharePoint farm, built using Dell PowerEdge™ rack servers and Dell EqualLogic™ storage, performed under load testing. It is a priority for Dell to be able to provide accurate guidance to customers when recommending infrastructure elements of a SharePoint implementation. Through our testing, we have provided guidance on how to choose the best farm architecture to increase performance and help keep client response times less than one second. Dell's SharePoint engineering team developed a load generation framework to perform this load testing so that we would be able to share these results with our customers. This data is being provided to our customers to help them understand the performance impact of SharePoint collaboration workload, and how to size and design the best farm architecture to support these workloads.

The paper details information on how the farm was configured, some of the factors considered while designing the farm, how Dell performs SharePoint load testing, and finally provides several performance metrics of various farm components. This paper also details information on how the recommended farm architectures could support more than 20,000 users with 10% concurrency or 2000 concurrent users and achieve below one second response times.

In a similar white paper, *SharePoint Server 2010: Virtualized Small Farm - Performance Study*, is available from [www.dell.com/sharepoint](http://www.dell.com/sharepoint). It describes how a small SharePoint server farm was built and configured on virtual machines using Microsoft Windows Server® 2008 R2 Hyper-V. The white paper also provides details the performance results of the virtual small SharePoint farm under the load test.

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

Another companion paper, *SharePoint 2010: Designing and Implementing a Small Farm*, is available from [www.dell.com/SharePoint](http://www.dell.com/SharePoint). This companion paper provides the reference architecture and infrastructure best practices for implementing a SharePoint 2010 small farm. These reference architectures formed the basis of the performance study described in this paper.

## Introduction

Microsoft SharePoint Server 2010 builds on the capabilities that were offered in Microsoft Office SharePoint Server 2007 to provide a rich platform for collaboration, information sharing, and document management. SharePoint 2010 adds several new features, and introduces important architectural changes and product improvements.

Capacity planning for a SharePoint farm deployment needs a thorough study of the existing requirements and future growth. A SharePoint implementation can be used in several ways including custom developed applications. This brings in the complexity factor while sizing the servers and storage for a SharePoint implementation. There are, however, six pillars<sup>1</sup> that can be used to create clarity around how SharePoint will be used. This performance study paper intends to provide performance capacity details of SharePoint 2010 small farm configured with Dell PowerEdge servers and Dell EqualLogic iSCSI storage in the context of SharePoint collaboration<sup>2</sup>.

## SharePoint 2010 Farm Topologies

A SharePoint server farm is a set of servers which collectively provides the services needed by a SharePoint deployment. Some of these services, or sets of services, comprise predefined roles and must be configured within the solution. Other services and components are optional, but they provide additional features and functionality that are often desirable. These optional components may include some of the service applications such as managed metadata service, Excel services, and etc. There are some constraints and best practices that help determine which components should be located on each server in the farm. Also, by considering how the components are distributed, the farm can be designed to more easily accommodate later growth.

**NOTE:** In SharePoint Server 2010, components generally provide functionality for a given service application. As a result, this paper may use the terms “role” and “component” interchangeably. In this context, SharePoint roles refer to one or more components that provide a farm service, and should not be confused with Windows Server roles, which generally include one or more Windows services to provide operating system functionality.

The size and capacity of a SharePoint 2010 implementation can vary based on several factors such as number of concurrent users, service application in the farm, the expected uptime SLA, anticipated requests per second, and etc. These factors dictate how many servers are needed in the SharePoint farm and how the overall farm architecture looks. Based on these factors, SharePoint 2010 farm implementations can be classified into small farm, medium farm<sup>3</sup> and a large farm<sup>4</sup> deployments.

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<sup>1</sup> SharePoint capabilities - <http://sharepoint.microsoft.com/en-us/product/capabilities/Pages/default.aspx>

<sup>2</sup> SharePoint collaboration capabilities - <http://sharepoint.microsoft.com/en-us/product/capabilities/communities/Pages/default.aspx>

<sup>3</sup> SharePoint 2010 – Designing and implementing a medium farm  
[http://www.dell.com/downloads/global/services/dell\\_large\\_sharepoint\\_farm.pdf](http://www.dell.com/downloads/global/services/dell_large_sharepoint_farm.pdf)

<sup>4</sup> SharePoint 2010 – Designing and implementing a large farm  
[http://www.dell.com/downloads/global/services/dell\\_large\\_sharepoint\\_farm.pdf](http://www.dell.com/downloads/global/services/dell_large_sharepoint_farm.pdf)

## Small Farm Topology

A typical SharePoint Small server farm<sup>5</sup> consists of two tiers: Web front-end / application, and database. Dedicated servers are used to host each tier to provide process isolation and to allow for future growth. A server farm deployment model helps ensure that the solution infrastructure is scalable, flexible, and resilient to hardware failures. To achieve these goals, a small farm implementation uses multiple servers at all tiers of the farm deployment. The farm model uses a dedicated database server and generally distributes Web front-end server roles and application server roles across multiple hosts at the front-end tier. This performance study paper used SharePoint 2010 small farm architecture to understand how several components of a farm perform at incrementing user loads. Within the scope of this paper, a physical small farm configuration with four servers was used. The following sections explain how this farm was configured and performed during the load test.

## SharePoint Farm Configuration

The following reference architecture shows a high level overview of the farm configuration, storage & network connections as used in this performance study.

Figure 1. Small Farm Reference Architecture

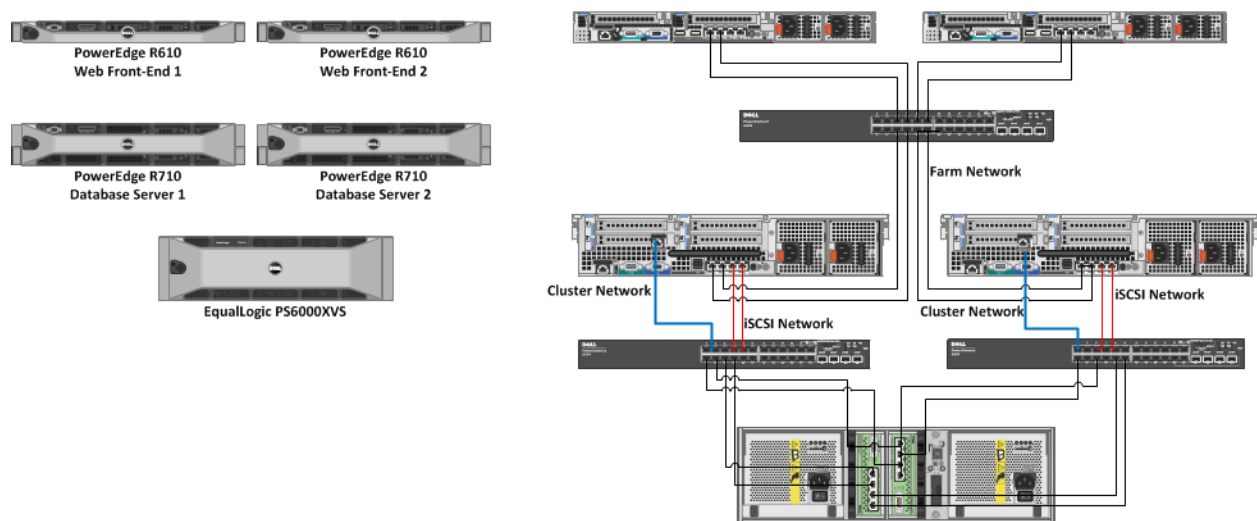


Table 1 provides an overview of server and storage hardware used in the small farm deployment.

<sup>5</sup> SharePoint 2010 – Designing and Implementing a small farm  
[http://www.dell.com/downloads/global/services/dell\\_small\\_sharepoint\\_farm.pdf](http://www.dell.com/downloads/global/services/dell_small_sharepoint_farm.pdf)

**Table 1. Overview of Physical Farm Configuration**

Small Farm Configuration	
Web Front-End and Application Servers	Two PowerEdge R610 Servers
Database Servers	Two PowerEdge R710 Servers
Storage Arrays	Dell EqualLogic PS6000XV Arrays

Table 2 provides complete configuration details of each server used within the small farm configuration shown in Table 1.

**Table 2. Server Configuration Details**

	Web Front-End	Database Server
Server Model	Two PowerEdge R610	Two PowerEdge R710
Processor	Two Intel® Xeon® X5570 2.93GHz, 12MB cache	Two Intel Xeon X5570 2.93GHz, 12MB cache
Memory	12GB (6 x 2GB, DDR3)	24GB (6 x 4GB, DDR3)
Local Storage	Two RAID 1 connected to SAS 6i	Two RAID 1 connected to SAS 6i
Drives	Four 146GB, 15K RPM SAS drives	Four 146GB, 15K RPM SAS drives
Network Controller	Two Broadcom LOMs in a load balancing team	Two Broadcom LOMs for Public (in a load balancing team ) farm network; two Broadcom LOMs for iSCSI network connections in MPIO; and one Broadcom add-on NIC for SQL failover cluster private network

As shown in Figure 1, the farm configuration used in the performance study employed PowerEdge rack servers at all tiers and an EqualLogic storage array for the database backend. The following sections describe the server choice for each of the farm roles and provide a technical overview of the servers used in this performance study.



## Dell PowerEdge R610

The PowerEdge R610<sup>6</sup> is a two-socket, 1U rack server that supports up to 192GB of physical RAM with 12 x 16GB DDR3 DIMMs. This server supports the latest quad-core and six-core Intel Xeon processors and up to six internal SAS disk drives. This server also supports a maximum internal disk storage capacity of 3.6TB when using six 600GB, 10K RPM SAS drives in a RAID 0 configuration.

Within the scope of this performance study paper, the R610 server was used for the web front-end and application server roles (running the crawler service). The farm configuration (as shown in Figure 1) used four 146GB, 15K RPM SAS drives connected to a SAS 6iR controller. Two RAID 1 volumes were configured - one for the OS volume and another one for storing search query index.

## Dell PowerEdge R710

The PowerEdge R710<sup>7</sup> is a two-socket, 2U rack server with support for up to 192GB of physical RAM and the latest quad-core and six-core Intel Xeon processors. The R710 supports a maximum internal disk storage capacity of 4.8TB when using eight 600GB, 10K RPM SAS drives in a RAID 0 configuration. The PowerEdge R710 has more PCIe expansion slots (4) than R610 (2). This server supports up to four 1GB network connections without using any additional expansion cards.

Within the scope of this performance study paper, the PowerEdge R710 server was used at the database tier of farm configuration (see Figure 1). In this farm configuration, four 146GB, 15K RPM drives were used and configured as two RAID 1 volumes - one for the OS volume and second for hosting the SQL server instance.

## Dell EqualLogic PS6000XV Storage Arrays

The EqualLogic<sup>8</sup> PS6000XV is a virtualized iSCSI storage area network (SAN) that combines intelligence and automation with fault tolerance to provide simplified administration, enterprise performance and reliability, and seamless scalability.

A PS Series array provides the following features:

- No-single-point-of-failure hardware:
  - Redundant, hot-swappable hardware components—disks, control modules, fans, and power supplies.
  - Component failover and disk sparing occur automatically without user intervention or disrupting data availability.
  - RAID technology is used to provide data protection in each array.
- High-performance control modules -- the PS6000 control module has four 1 Gigabit Ethernet interfaces
- Support for standard Gigabit Ethernet networks.

The farm configuration shown in Figure 1 used a single PS6000XV array with sixteen 146GB, 15K RPM drives configured in RAID10 as the storage backend for the SharePoint 2010 deployment.

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<sup>6</sup> Dell PowerEdge R610 - <http://www.dell.com/us/en/enterprise/servers/server-poweredge-r610/pd.aspx?refid=server-poweredge-r610&s=biz&cs=555>

<sup>7</sup> Dell PowerEdge R710 - <http://www.dell.com/us/en/enterprise/servers/server-poweredge-r710/pd.aspx?refid=server-poweredge-r710&cs=555&s=biz>

<sup>8</sup> Dell EqualLogic PS6000 - <http://www.dell.com/us/en/enterprise/storage/equallogic-ps6000XV/pd.aspx?refid=equallogic-ps6000XV&s=biz&cs=555>

## Farm Architecture and Configuration of Farm Roles

The experimental farm configuration -- as shown in Figure 1 -- included two web front-end servers and two database servers in a failover cluster. This farm was configured to use Windows authentication and hence all the requests during the load test were authenticated requests. The farm servers at all tiers used teamed network connections to provide load balancing and failover capabilities.

Table 3 lists the OS and software editions used in the above farm configurations. The rationale for the choices shown in this matrix is explained in the later sections of this paper.

**Table 3. OS and Software Matrix Used in the Performance Study**

	Web Front-End	Database Servers
<b>Operating System</b>	Windows Server 2008 R2 Enterprise Edition	Windows Server 2008 R2 Enterprise Edition
<b>SharePoint Server</b>	SharePoint Server 2010 Standard Edition	-
<b>Database Server</b>	-	SQL Server 2008 R2 x64 Standard Edition

**Note:** Step-by-step instructions for installing/configuring a SharePoint farm and any service applications used in this performance study are outside the scope of this performance study paper. For more information and resources, refer to the “[References](#)” section at the end of this paper.

## Configuration of Web Front-End Servers

The SharePoint 2010 small farm design included two web front-end servers. The software matrix for these web front-end servers is as shown in Table 3. SharePoint 2010 Standard edition was used as the performance study included only out-of-the-box features of SharePoint and was a collaboration workload only. As a part of the collaboration workload, only search service application was deployed and no other service applications such as Excel services or Visio Services were deployed.

All the web front-end servers were configured in a Network Load Balancing (NLB) cluster<sup>9</sup>. Using NLB, stateless applications like SharePoint web front-end can be made scalable by adding additional servers when the load increases. Since - as mentioned earlier, the network connections were made redundant by using Broadcom NIC teaming, NLB was configured to use multicast mode to avoid IP address conflicts<sup>10</sup> in the farm.

On Dell PowerEdge R610, simultaneous multi-threading or logical processor support was enabled for increased performance. This option is disabled by default in the system BIOS and needs to be enabled manually.

<sup>9</sup> NLB Deployment guide - [http://technet.microsoft.com/en-us/library/cc732855\(WS.10\).aspx](http://technet.microsoft.com/en-us/library/cc732855(WS.10).aspx)

<sup>10</sup> Using teaming adapters with network load balancing may cause network problems - <http://support.microsoft.com/kb/278431>

### ***HTTP Request Throttling***

SharePoint 2010 offers resource throttling features that can be configured to help increase server performance and protect server resources during peak usage times. SharePoint 2010 has a default timer job that checks server resources compared to configured throttle levels. By default, **Server CPU**, **Memory**, **Request in Queue**, and **Request Wait Time** are monitored. After three unsuccessful checks, the server enters a throttling period and remains in this state until a successful check is completed. Any requests that were generated prior to the server entering throttling mode will be completed. Any new HTTP GET and Search Robot requests will generate a 503<sup>11</sup> error message and will be logged in the event viewer.

The throttle settings can be modified to increase the overall load supported by the farm servers. However, this itself requires a complete study to be able to come up with accurate throttle setting recommendations for any given user load or requests per second. The default HTTP throttle monitor settings prevent an extensive load testing to find out the “real” capacity of the farm servers. Hence, HTTP request throttling was **turned off** during the load testing of SharePoint.

### ***Search Service Application Configuration***

SharePoint 2010 changed the search architecture and introduced high availability at the application tier or crawler. The new search service application architecture in SharePoint 2010 includes greater redundancy. The new design provides flexibility and allows the query and crawler roles to be scaled out separately on an as-needed basis. Search crawlers are now stateless; they do not store a copy of the index. The index does, however, still propagate and is stored locally on the query servers. Two application servers hosting the crawler role were used in this performance study.

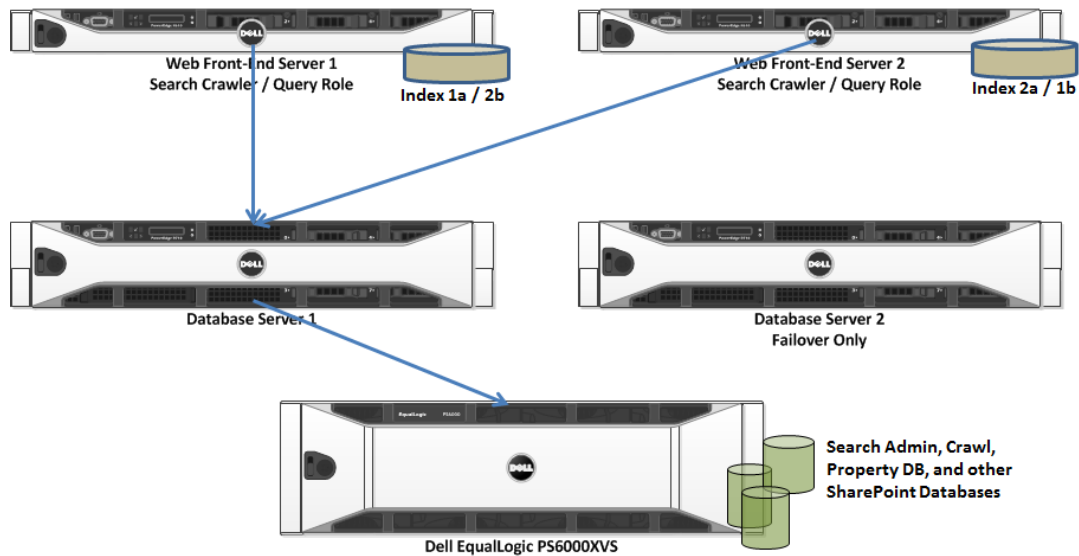
The small farm configuration used the search service application configuration as shown in Figure 2. The search crawler and query roles were hosted on both the web front-end servers to enable high availability and provide improved search performance. Both crawler roles were associated with the same crawl database and were crawling the same content source. Two index partitions were created and for redundancy; a copy (or mirror) of the index partition was placed on each web front-end. On both the web front-ends, a dedicated RAID 1 volume was used to store the index content.

This search architecture provides complete redundancy for both search crawler and query roles.

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<sup>11</sup> Throttling starts alert- Events 8032 8062 - <http://technet.microsoft.com/en-us/library/ee513044.aspx>

Figure 2. Search Service Application Configuration



## Network Configuration

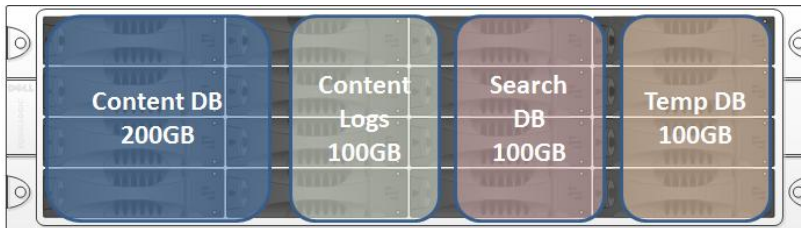
For both the web front-end servers and applications servers, teamed network connections were used. These teamed connections (shown in Figure 1) were configured to be in the smart load balancing (SLB) mode which supports both load balancing and failover.

## Configuration of Database Server

As shown in Figure 1, this performance study deployed PowerEdge R710 as the database server in the small farm configuration described earlier. Two DB servers were deployed in a failover cluster to enable redundancy at the database tier of the SharePoint farm.

A SharePoint farm's performance depends on the performance of the database server and the storage backend. The PowerEdge R710 supports eight internal disk drives, and in the experimental configuration, two internal drives in a RAID 1 configuration were dedicated to host the SQL instance. To add performance and storage capacity, one EqualLogic PS6000XV storage array was used. As mentioned earlier, this array included sixteen 146GB, 15K RPM SAS drives configured in a RAID 10 for storing several SharePoint databases. As shown in Figure 3, the SharePoint 2010 content, content logs, search and temp databases were placed on the EqualLogic iSCSI storage.

Figure 3. SharePoint 2010 Database Layout



### **SQL Server Memory Configuration**

By default, SQL Server uses all available physical memory<sup>12</sup>. This is because SQL Server dynamically grows and shrinks the size of its buffer pool depending on the physical memory reported by the operating system. However, this behavior can be adjusted to limit the amount of physical memory used by SQL Server. Within the scope of this paper, SQL server memory was limited to 80% of the actual physical memory available in the system. For example, on the PowerEdge R710 server used at the DB tier, out of 24GB of physical memory, 19.6GB was allocated to SQL server.

### **DB Server Network Configuration**

Similar to the web front-end and application tiers, database tier also used teamed network connections for the farm network - as shown in Figure 1. For the iSCSI storage network, two LOM connections were dedicated and MPIO was configured to provide load balancing and failover. The public network used to connect to the SharePoint farm network used teamed network connections and an add-on NIC was dedicated for all the cluster private communication.

## **Performance Study of a Small Farm**

Microsoft SharePoint 2010 is a versatile platform that can be used in a large variety of ways. Some SharePoint workloads work almost out of the box, others require or allow significant customization, and still others are the result of completely custom-developed applications. This flexibility results in a gazillion possible ways of using SharePoint which makes it almost impossible to accurately size servers and storage for a SharePoint farm. Also, there is no standard benchmark for sizing SharePoint workloads yet. It is very important to be able to provide right guidance to customers when it comes to recommending infrastructure elements of a SharePoint implementation. This led to the development of the Dell SharePoint Load Generation framework used to perform load testing of a SharePoint farm.

## **Dell SharePoint Load Generation Framework**

An internally developed load generation framework had been used in understanding the performance characteristics of the SharePoint farm. This framework includes load testing of SharePoint out of the box usage profiles such as collaboration and publishing.

The Dell's SharePoint load generation framework has two components - a content population tool and Visual Studio Team Suite (VSTS) web test framework.

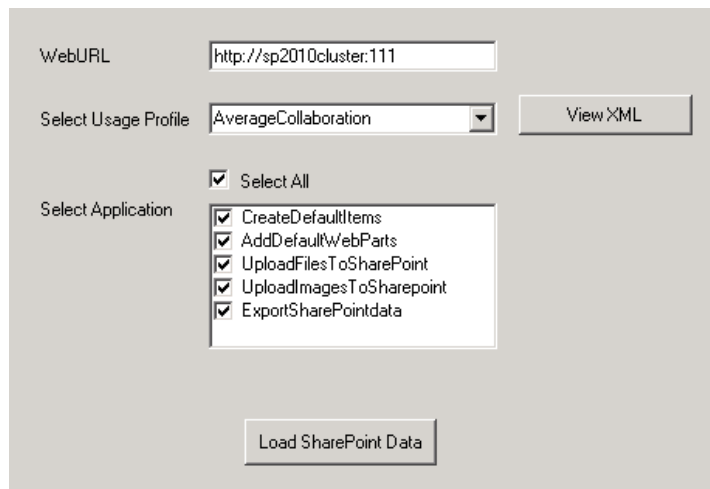
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<sup>12</sup> SQL Server memory options - <http://msdn.microsoft.com/en-us/library/ms178067.aspx>

## Content Population Tool

The content population tool is designed to prepare the SharePoint farm for load testing. This content population tool was designed to distribute the SharePoint content across multiple site collections.

**Figure 4. SharePoint Content Population Tool**



The screenshot shows the SharePoint Content Population Tool interface. It features a text input field for 'WebURL' containing 'http://sp2010cluster:111'. Below it is a dropdown menu for 'Select Usage Profile' set to 'AverageCollaboration', with a 'View XML' button to its right. A 'Select Application' section contains a 'Select All' checkbox and a list of five application tasks, each with a checked checkbox: 'CreateDefaultItems', 'AddDefaultWebParts', 'UploadFilesToSharePoint', 'UploadImagesToSharepoint', and 'ExportSharePointdata'. At the bottom center is a 'Load SharePoint Data' button.

The content population tool was developed to:

- Create SharePoint web applications
- Create site collections
- Add web parts to home pages
- Create document libraries
- Create SharePoint list items
- Upload documents/images, etc.

This utility is capable of populating hundreds of gigabytes of SharePoint content in few hours. The size of SharePoint content DB and other aspects such as number of site collections, etc., vary based on the usage profile selection. A usage profile is a collection of use cases closely mapped to real world SharePoint usage. To some extent, these usage profiles were mapped in to SharePoint Capacity Planner<sup>13</sup> (SCP) and other Microsoft recommendations. Although SCP was intended for MOSS 2007, there are several aspects of these recommendations<sup>14</sup> that still apply to SharePoint 2010 out of the box workloads. The content generated and uploaded by the content population tool serves as a baseline for SharePoint 2010 load testing using Visual Studio test framework.

## VSTS Load Testing Framework

Dell's SharePoint load generation framework uses VSTS 2010 to perform load testing. Within VSTS, each load test directly maps in to a SharePoint usage profile and each usage profile defines a list of use cases and how many use cases are run per hour per connected user. Using VSTS 2010 helps in rapid

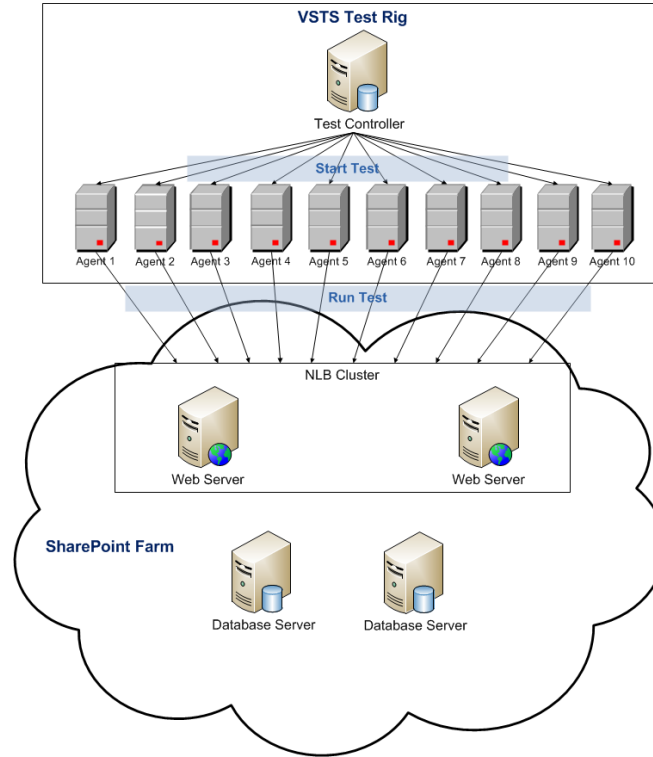
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<sup>13</sup> SharePoint capacity planner - <http://www.microsoft.com/downloads/details.aspx?FamilyID=dbee0227-d4f7-48f8-85f0-e71493b2fd87&displaylang=en>

<sup>14</sup> Microsoft SharePoint 2010 performance and capacity management - <http://technet.microsoft.com/en-us/library/cc262971.aspx>

creation of use cases and to parameterize those use cases. SharePoint load testing is performed using a test rig (shown in Figure 5) of several physical test agents and the results are captured in to a SQL database on the test controller.

Figure 5. VSTS Test Rig for SharePoint Load Testing



### Load Testing Workload Test Mix

As mentioned earlier, the load test usage profiles were based on the SCP and other Microsoft recommendations for SharePoint 2010. System Center SCP defines several usage profiles for both collaboration and publishing workloads. These usage profiles are categorized in to low, medium and heavy usage profiles. These categories define several aspects of a usage profile such as how many requests are sent per hour per connected user, what use cases constitute a load test, and what percentage (test mix) of each use case is used within each load test.

Within the scope of this performance study paper, heavy collaboration usage profile was used. Table 4 shows the heavy collaboration test mix as suggested by SCP. SCP defines only a high level test mix for each usage profile.

**Table 4. SCP Usage Profile Definition**

SCP Usage Profiles	Heavy Collaboration
Home Page Access (%)	30
List Page Access (%)	20
Document/Picture Download (%)	15
Document/Picture Upload (%)	8
Search (%)	15
Total requests/hour/connected user	60

Table 5 shows a more granular translation of this SCP heavy collaboration usage profile. Several use cases were mapped in to each of the categories described by SCP and the number of use cases per hour per connected user has been assigned.

**Table 5. Test Mix for a Heavy Collaboration Profile**

Heavy Collaboration Test Mix	Number of Tests/HR/User
<b>Home Page Access</b>	
Read Site Home Page	18
<b>List Page Access</b>	
Read Survey	6
Read Lists	6
<b>Document/Picture Download</b>	
Read Document Library	2
Read Home to Document Library	1
Read Wiki Page	2
Read Picture Library	1
Read Home to Wiki Page	2
Read Home to Picture Library	1
<b>Document/Picture Upload</b>	
Create Wiki Page	3
Upload Document	2
<b>Search</b>	
Search Site	10
<b>List Item Insertion/Deletion</b>	
Respond to Survey	2
Reply to Discussion Topic	1
Edit Wiki Page	2
Comment home to blog post	1
Total tests/hour/connected user	60



It is important to note that Dell’s test mix (shown in Table 5) is not a one-to-one mapping in to the above said SCP and Microsoft recommendations. For example, SCP defines total “requests” per hour per connected user. However, within Dell’s test mix for the heavy collaboration profile, this translates into more requests than 60 per hour as the usage profile uses 60 “tests” per hour per connected user. Additionally, one test could mean more than one request. Hence, the results published in this paper may or may not map directly to SCP recommendations and are specific to the workload mix defined in Table 5.

## Test Methodology

The intent of the experiments conducted as a part of this performance study was to understand the capacity of a small SharePoint farm as shown in Figure 1 with configuration described in Table 2. Several load test iterations were conducted with incrementing user load. For example, an initial user load of 250 virtual users was used and the same had been incremented by 250 users until the farm resources reached an optimal level of utilization. The overall goal of the load test was to ensure that the processor utilization is below 60% and the average farm response time is below one second.

The data set used to build the content database included several different types of files. This includes Microsoft Office documents, Adobe PDF documents, and several image formats. Table 6 shows a distribution of file content sizes used in this performance study.

**Table 6. Dataset**

Average File Size	Number of Files
1KB to 500KB	34,240
500KB to 1MB	5223
1MB to 10MB	13,003
10MB to 70MB	125

The aggregated SharePoint content database size was around 53GB. During the load test duration, this content DB grew by almost 20%. This performance study involved load testing of an out-of-the-box SharePoint deployment using a test mix shown in Table 5. A full content crawl was performed once at the beginning of the load tests. There were no subsequent crawls after or during the load test duration.

The performance data shown in this paper was a result of load testing on the final configuration of a SharePoint farm as described in Table 2. The following sections of this paper described the performance data and how several components within the farm performed at increment user loads.

## Performance Results and Analysis

As a part of this performance study, several performance metrics were collected and analyzed. Based on the results, the farm configuration was tweaked to reach the final farm configuration shown in Figure 1. This section describes several performance metrics captured during the load test. As mentioned earlier, this study included only a collaboration workload and the test mix shown in Table 5. Hence, all results shown here are relative to the workload used and may differ with any other implementation outside of the test mix shown in Table 5.

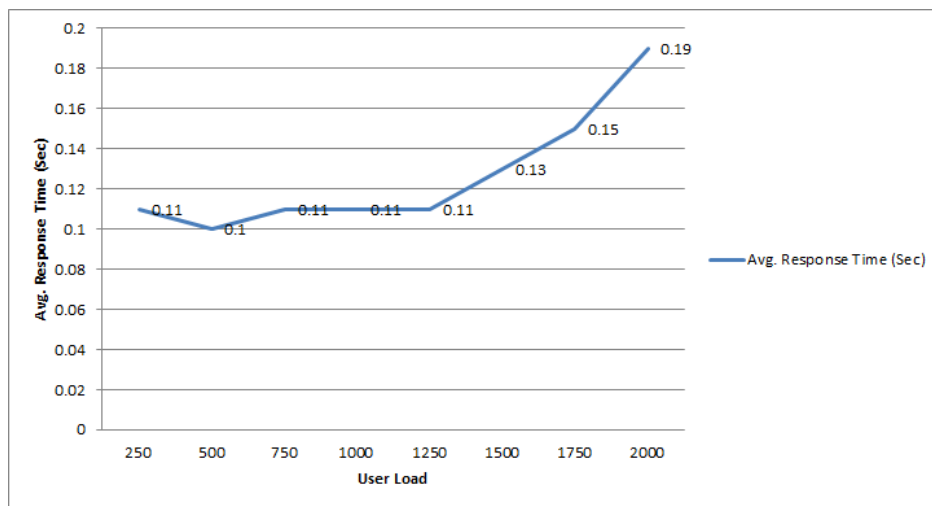
The following table shows, at a high level, how the SharePoint 2010 farm performed in terms of maximum concurrent user load achieved and requests per second.

**Table 7. Farm Performance**

SharePoint 2010 Small Farm	
Maximum concurrent user load achieved	2000
Requests per second <sup>15</sup> at max concurrent user load	100/sec

The experimental SharePoint 2010 farm (shown in Figure 1) used in this performance study could achieve up to 2,000 concurrent users with an average farm response time of 0.19 seconds at the maximum user load tested on the final farm configuration. This indicates that the farm architecture used for this performance study could support faster<sup>16</sup> less than one second farm response times even at the maximum concurrent user load.

**Figure 6. Average Response Time**

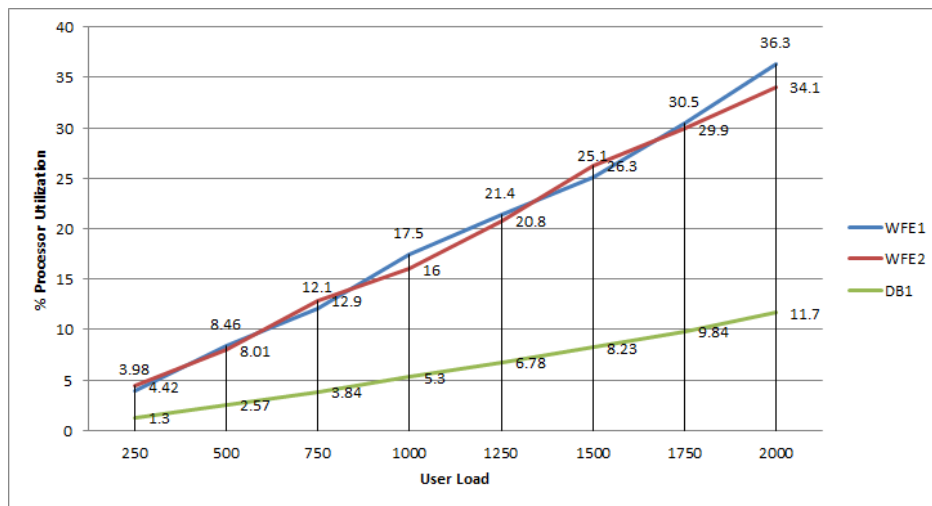


The average processor utilization on the web front-end servers in this farm configuration was below 50 percent even at the maximum user load. Since NLB was used at the web front-end (WFE) tier, all WFEs were more or less equally loaded.

<sup>15</sup> This number indicates the avg. requests per second generate during the load test duration and this is a VSTS reported metric

<sup>16</sup> A classification SharePoint response times [Estimated User Response Times section]  
[http://technet.microsoft.com/en-us/library/cc261795\(office.12\).aspx](http://technet.microsoft.com/en-us/library/cc261795(office.12).aspx)

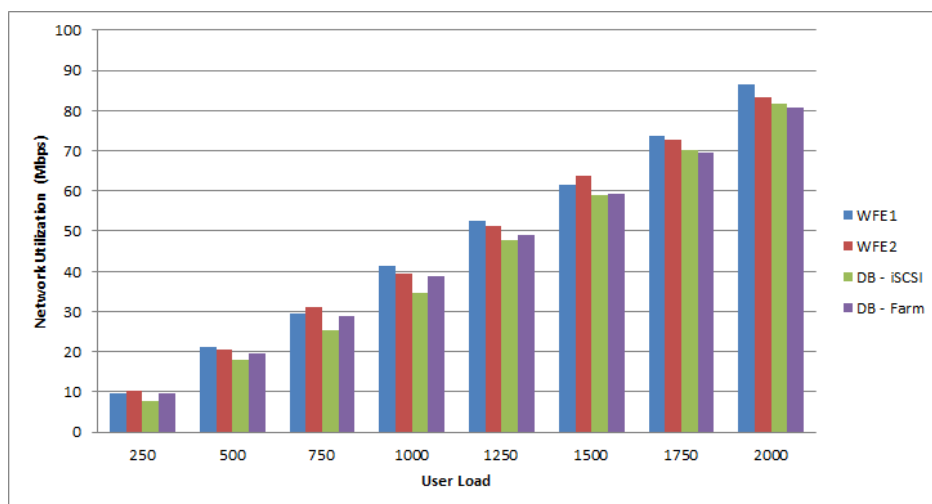
Figure 7. Processor Utilization



From Figure 7, it may seem that one web front-end would be sufficient to handle 2,000 users concurrent load on the farm. However, as shown in Figure 1, two front-ends were necessary to reach the maximum user load as shown in Table 7.

In a heavily loaded scenario, even though the average processor utilization is below 50 percent, the SharePoint 2010 farm (Figure 1) may not support a larger number of users than shown in Table 7. This is mainly because of the ASP.NET and IIS request queue length limitations. The out-of-the-box IIS and ASP.NET queue length settings can be tweaked to go beyond the concurrent user load shown in this performance study paper. However, this is outside the scope of this paper and may require an in-depth study in itself.

Figure 8. Network Utilization



The overall network utilization was well within 50 percent of the total available bandwidth, in this case 2 Gigabytes. The following charts capture the network utilization at web front-end and database tiers of the farm and show the aggregated performance numbers of the teamed NICs used on all the servers

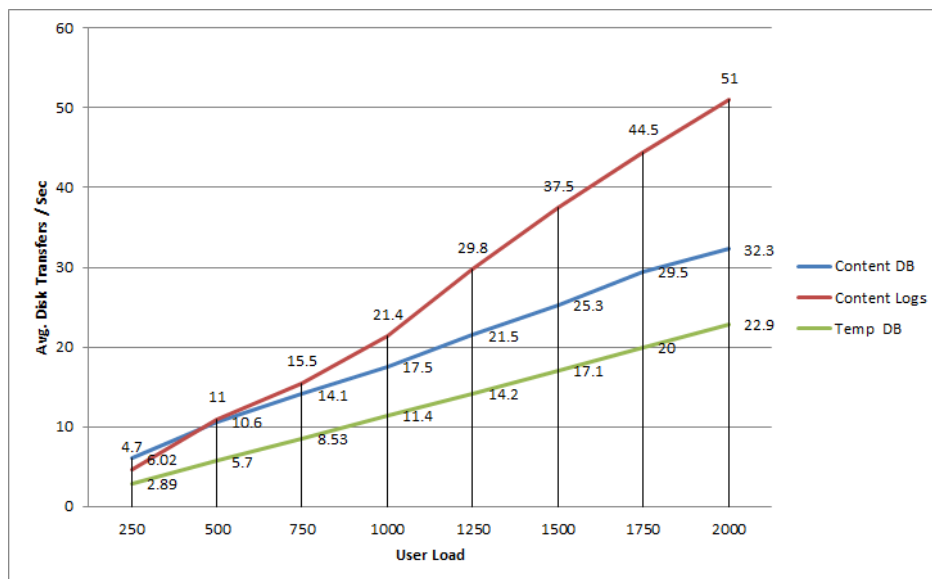
of the farm. The DB-farm network utilization numbers in the following chart indicated the aggregated utilization of all network channels used in MPIO.

In addition, performance results show that the maximum memory utilization on the web front-end servers at the maximum user load was within 50 percent of the available physical memory. This indicates that there is enough room for future growth and scalability while providing high availability for all the SharePoint roles hosted on the web front-end servers.

As shown in Figures 1 and 3, one Dell EqualLogic PS6000XV array was used and four SQL server databases were placed on the iSCSI LUNs provisioned on this array. The following charts show how these iSCSI LUNs performed during the load test with incrementing user loads.

The IO generated by the test mix shown in Table 5 was relatively small in size (~100KB) and was random IO. This resulted in approximately 100 disk transfers per second<sup>17</sup> (shown in Figure 9) to the LUNs<sup>18</sup> provisioned on the Dell EqualLogic iSCSI enclosure.

**Figure 9. Average Disk Transfers per Second**



With a 16 disk iSCSI backend, disk seconds per transfer was well below one second and showed that the Dell EqualLogic array was capable of handling a heavy collaboration workload of 2,000 concurrent users.

<sup>17</sup> Captured using Visual Studio

<sup>18</sup> Search DB is not included in the charts here as there was more or less no disk access during load test

Figure 10. Average Disk Seconds per Transfer

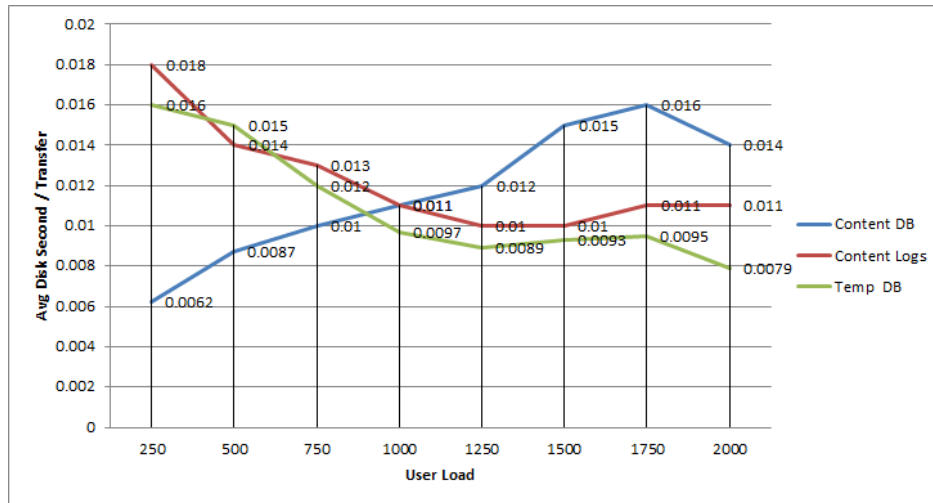
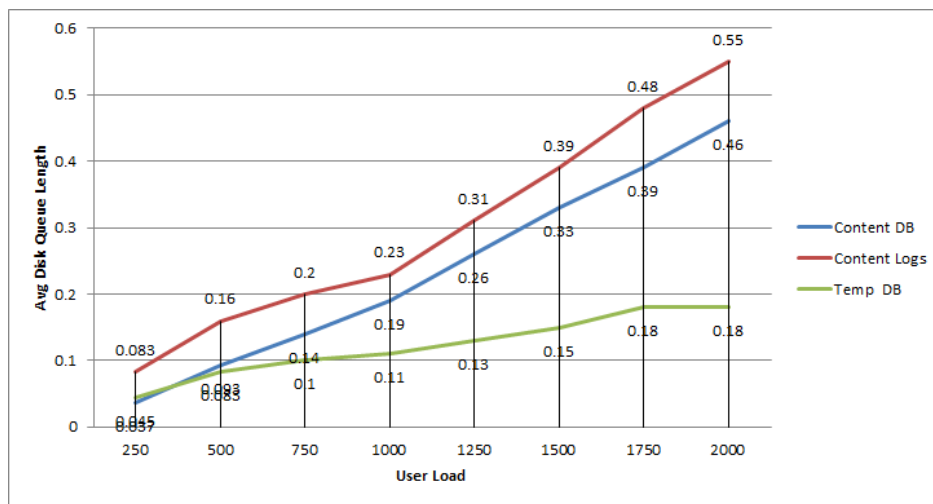


Figure 11 shows the average disk queue length for each iSCSI volume used to store the SharePoint 2010 databases.

Figure 11. Average Disk Queue Length



The Dell EqualLogic PS6000XV with a sixteen disk backend provided optimal performance for the SharePoint databases. All the performance metrics were seen to be well within the acceptable limits.

## Summary

A SharePoint 2010 farm consists of multiple servers, each of which is provisioned with different SharePoint components. A smaller SharePoint farm in general is a best choice for small and medium businesses with relatively low concurrent user load. A small SharePoint farm employs a two-tier architecture with all SharePoint web front-end and application roles hosted on the web front-end servers and, at the database tier, one or more SQL servers in a failover cluster are used to enable high availability of SharePoint databases. The reference architecture used in this performance study enables

high availability at all tiers of the farm and provides complete search service application redundancy by hosting two crawlers and mirroring the index partitions.

SharePoint 2010 can be used in many different ways and each implementation needs an in-depth study of requirements such as expected user load, requests per second and future growth. This performance study paper was intended to understand the performance capacity of a small SharePoint 2010 farm built using Dell servers and storage. This study showed that the configuration, as illustrated above, could support approximately 20,000 users with a minimum concurrency of 10 percent. Also, the average farm response time was well below one second. The Dell EqualLogic PS6000XV array provided highly optimal performance for the SharePoint 2010 deployment used in this performance study.

## References

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