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1 Scope

Electronic correspondence, or email, forms an essential part of nearly all business processes today. Security and availability of email support are critical to operations, and therefore must be provided with the very best technology. As the demand for more data storage increases, the classic methods are being overrun with too much data. Microsoft Exchange 2007 in conjunction with Windows Server 2003 and 2008 provides an increasingly common approach to meeting this challenge within various organizations, both large and small.

This document provides information on use of ETERNUS® storage in support of Microsoft Exchange 2007 environments. When coupled with a family of servers, this critical storage array effectively supports the email needs of an organization.

2 Background – Microsoft Exchange Server

Microsoft Exchange Server provides a client-server solution to the primary tasks of company and workgroup messaging and information exchanges. It supports secure access to mailboxes, mail storage, and address books, and it provides a primary function of electronic mail transmission between users. In addition, Microsoft Exchange Server provides a convenient family of appointment and calendar functions within an organization to support scheduling of meetings and facilities. Other features include publication through public folders and web storage, electronic forms, and additional user-defined applications. The documents available through Microsoft Exchange Server 2007 provide additional details on the capabilities and considerations for using Microsoft Exchange Server.

Microsoft Exchange Server 2007 is the latest in a family of Exchange products that have been offered by Microsoft over the last several years. Each member of the family has added functions and capabilities to the basic product. Exchange 2007 made the transition from a 32-bit architecture to a full 64-bit architecture. This provides increases in both the number and sizes of the databases supporting the mailboxes.

Exchange 2007 SP1 includes a number of new and improved features, including new deployment options and improvements to the Client Access server role in support of Outlook Web Access. It also includes improvements in the core transport functionality for both the Edge and Hub Transport Server roles. Improvements to the Mailbox Server Role through enhanced management operations are also part of the SP1 version. Additional details on the additions are available from Microsoft through Exchange Server 2007 with SP1.

Note that Exchange Server 2007 is only available as a 64-bit application for the x64 architectures, that is Intel CPUs with the EMT64 and the AMD Opteron CPUs. There is no version of Exchange Server 2007 available for the IA64 (Itanium) architecture, which means it is not supported on PRIMEQUEST® servers. It is well supported on the latest family of PRIMERGY® servers, which include the x64 architectures.

Exchange Server performance is directly related to the cache memory it can use, and the 64-bit architecture opens up that constraint from the previous version of Exchange. Physical memory that can be used by Exchange has been expanded to 32 GB for the Standard Edition, and to 2 TB for the Enterprise Edition.
Exchange Server 2007 has introduced the concept of assigning specific roles for the servers, a scenario in which only the portion of the whole environment that is needed for a specific responsibility is included in a server. Exchange Server 2007 can take on the following roles:

- **Edge Transport Server** provides connections to the outside world, and is equipped with anti-virus and anti-spam utilities, along with message routing.
- **Hub Transport Server** provides message routing within the environment, but may also be equipped to support connections to the outside world in smaller configurations.
- **Mailbox Server** provides the support for the mailbox databases, including calendar management and continuous replication. It also supports primary clustering operations that are key to enhanced reliability configurations.
- **Client Access Server** provides format conversions between the different forms used by the different client systems, including support for mobile users.
- **Unified Messaging Server** provides an integration of voice and fax messaging into the same configuration – tying into the telephone network.

These different Exchange Server 2007 server roles can be installed in separate servers or combined in a number of multi-role server combinations, as needed to support the demands of a customer environment.

A high degree of reliability can be achieved with Exchange 2007 through the use of Microsoft Clustering Service for the Mailbox Server role. This capability is included in the Enterprise Edition and Datacenter Edition of Windows Server® 2003 or Windows Server 2008.


Microsoft Exchange Server 2007 is available in two configurations:

<table>
<thead>
<tr>
<th>Exchange Server 2007</th>
<th>Maximum of 5 Storage Groups</th>
<th>Platform suited for small and medium sized companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Edition</td>
<td>Maximum of 5 Databases</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Support for LCR</td>
<td></td>
</tr>
<tr>
<td>Exchange Server 2007 Enterprise Edition</td>
<td>Maximum of 50 Storage Groups</td>
<td>Platform suited for medium to very large global companies with the highest reliability, security and scalability requirements</td>
</tr>
<tr>
<td></td>
<td>Maximum of 50 Databases</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supports SCC, LCR, CCR, SCR</td>
<td></td>
</tr>
</tbody>
</table>
2.1 Exchange 2007 Server Roles

As indicated, there are a number of different roles that can be assigned to servers within an Exchange 2007 environment. The requirements and restrictions for each of the roles are noted in the following sections. It is also possible to combine certain of the roles into a single server.

2.1.1 Mailbox Server Role

The heart of an Exchange 2007 environment is in the Mailbox Servers. This is the only server role that can be supported in a clustered configuration, and it is recommended that they be clustered to provide enhanced reliability. It is important to properly size the databases that contain the user mailboxes, and several factors come into play in the process. Microsoft provides an advanced tool that helps identify these factors, and relates them for practical sizing of the storage for the Mailbox servers. ETERNUS storage array products offer a number of features to support their role in providing the storage required for the mailboxes. Greater detail is provided in section 3 of this paper regarding the consideration of sizing the array components to suit the Exchange 2007 needs. Whereas, Exchange 2003 limited the number of databases per server to only 5, Exchange 2007 has raised that limit to 50. This provides much more flexibility in assigning the databases. In addition, Exchange 2007 includes facilities for Continuous Replication in three forms, detailed in a following section. These capabilities offer improved recovery times and additional levels of backup for the mailbox contents.

Sizing of the mailbox servers requires an understanding of the average user profile to be supported. Users are usually classified into one of four types, based on their message traffic, assuming a nominal message size of 50 KB:

- **Light User** – Sends 5, receives 20 messages per day
- **Average User** – Sends 10, receives 40 messages per day
- **Heavy User** – Sends 20, receives 80 messages per day
- **Very Heavy User** – Sends 30, receives 120 messages per day

Microsoft has a tool available that can be used to collect estimated statistical information on mailbox usage from a single mailbox store or across an Exchange Server organization. For an organization with an installed Microsoft Exchange environment, the Microsoft Exchange Server Profile Analyzer can provide useful information on the usage patterns within the current users. This can aid in planning the new Exchange Server 2007 component sizes.

2.1.2 Client Access Server Role (CAS)

The ability to exchange email with many different email systems is supported through the Client Access Servers. The CAS role may be combined with the Active Directory server and Hub Transport server roles, depending upon traffic levels. The CAS must be within the Exchange Servers Active Directory security group. This means that a CAS cannot be in a perimeter network, and such placement is not supported by Microsoft. At least two CAS role servers should be installed to ensure uninterrupted service. Further information on the CAS server role can be found through Planning for Client Access Servers. The following client applications require the CAS role:

- **Exchange ActiveSync** supports mobile device users
- **Outlook Web Access** permits users to access their Exchange mailbox from a Web browser
- **Microsoft Office Outlook** depends on the Autodiscover and Availability services provided by the CAS, even though it directly accesses the Mailbox server
- **Outlook Anywhere** supports user access over the Internet without using a VPN connection
- **POP3 and IMAP4 Clients** are supported when the service is enabled within the CAS
2.1.3 Hub Transport Server Role (Hub)

The server in this role provides internal message forwarding services, including security and policy services. The Hub role may be combined with the CAS role within the same machine, but it is recommended that at least two such units be installed within the network to ensure service during times when servers must be taken out of service. Further information on the Hub server role can be found through Planning for Hub Transport Servers.

When Hub and CAS roles are combined in a single server, the processor and memory requirements of each need to be included within that unit. Sufficient processor and memory resources are necessary to ensure smooth flow of messages through the network.

2.1.4 Edge Transport Server Role (Edge)

The Edge Transport Server provides anti-virus and anti-spam protection for the Exchange environment. Installed as part of an organization’s perimeter or boundary network, it applies policies to messages transported between organizations. The Edge Transport Server may be deployed as a stand-alone server or as a member of a perimeter Active Directory domain. Further information on the Edge server role can be found through Planning for Edge Transport Servers.

2.1.5 Unified Messaging Server Role (UM)

Unified messaging provides support for telephone voice mail within an Exchange 2007 environment. It is a specialized extension to the email capabilities provided to support voice mail and email access from any telephone, as well as access fax messages, calendaring and contact information. It is not necessary to include a UM within an Exchange 2007 environment, if the additional services are not required by an organization. Further information on UM can be found through Planning for Unified Messaging Servers.
2.1.6 Replication in Exchange 2007

Exchange 2007 introduced some new features to reduce costs and increase uptime for the environment. These features include:

- **Local Continuous Replication (LCR)** provides a single-server solution to create and maintain a copy of a storage group on a second set of disks connected to the same server as the set of production disks. LCR provides asynchronous log shipping, log replay, and a quick manual switch to a copy of the data. See [Planning for Local Continuous Replication](#) for further information.

- **Cluster Continuous Replication (CCR)** combines replication and replay features for Exchange 2007 with failover features of Microsoft Cluster services. CCR can be deployed in a single datacenter or between two datacenters. See [Planning for Cluster Continuous Replication](#) for further information.

- **Single Copy Clusters (SCC)** were known as shared storage clusters in previous versions of Exchange, and were enhanced in Exchange 2007. See [Planning for Single Copy Clusters](#) for further information.

- **Standby Continuous Replication (SCR)** was introduced to Exchange 2007 with SP1. SCR is provided to enable use of standby recovery servers, extending the LCR and CCR features to enable new data availability options and configurations. See [Planning for Standby Continuous Replication](#) for further information.

Additional information on these aspects of Exchange 2007 is available from Microsoft through [High Availability Strategies](#). Some key points on Availability Requirements include:

<table>
<thead>
<tr>
<th>Availability Requirement</th>
<th>Exchange 2003 Solution</th>
<th>Exchange 2007 SP1 Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respond to User Errors</td>
<td>Seven (7) day dumpster default. After seven days, restore backups to identically rebuilt server.</td>
<td>Fourteen (14) day dumpster default. Over fourteen days, restore backups to any server.</td>
</tr>
<tr>
<td>Resiliency against failures: ** Disk ** Hardware ** Shared Storage</td>
<td>Restore backups to identically rebuilt server.</td>
<td>With Continuous Replication (LCR, CCR, SCR), no restore is required. Stand-alone failure or CCR dual failure – use alternate location or database portability.</td>
</tr>
<tr>
<td>Resiliency against site-wide disaster</td>
<td>Restore backups to identically rebuilt server.</td>
<td>With CCR or SCR to a second site, then no restore is required. Use standby server activation or database portability.</td>
</tr>
</tbody>
</table>

Table 1 - Availability Requirements
2.1.7 Backup and Restore with Symantec Backup Exec and SnapOPC

The different replication services within Exchange Server 2007 are complemented by the Windows Volume Shadow Copy Service (VSS). VSS enables use of the Advanced Copy functions within ETERNUS storage arrays to support creation of snapshot copies of the various storage elements used by Exchange Server 2007. By using VSS, One Point Copy (OPC) snapshot clones may be taken within the storage arrays, without placing a load on the Exchange Servers. See Best Practices for Using Volume Shadow Copy Service with Exchange Server 2003 for further background on planning use of VSS. Also see Database Backup and Restore for methods of backup with Exchange Server 2007.

In the sample configurations outlined in this paper, Backup Exec from Symantec is used to provide the backup functions. A VSS provider for the ETERNUS storage arrays enables Backup Exec to coordinate taking OPC snapshots from the CCR copies of the mailbox databases on the passive node or from the active mailbox databases on the active node. This technique limits the backup load on the primary node, ensuring that there is little impact on the operation response times for the users.

The ETERNUS Advanced Copy tool “Snap One Point Copy” (SOPC) is used to provide “copy on write” snapshot facilities of the database storage groups during the time that the backup operation is taking place. SOPC provides facilities to use a pool of allocated storage to reduce the requirement for an accurate prediction of the write rate on the different storage groups. An SOPC+ session is established for a storage group at the beginning of the backup for that group. This enables the backup process to provide the archive of a point in time that is consistent with the operational environment. Once the backup of the storage group is completed, then the session is no longer needed and will be canceled, thereby freeing the storage used in the pool for other group sessions and reducing the copy load on the source volume.

3 Exchange Server 2007 Sizing

For some of the earlier editions of Exchange, including Exchange 2000 and Exchange 2003, there were a number of published benchmarks and associated tools that could be used to establish the demand for an environment. From that demand, the sizes of the various elements could be derived. However, with Exchange 2007, no such benchmarks exist, so sizing from any sort of simulated or measured demand is not possible. There are many aspects to planning an Exchange 2007 installation that must be considered – too many for them all to be covered in this short paper. See Exchange 2007 System Requirements for a more complete set of information on the network, hardware, software, clients, and other elements required for Exchange 2007.

3.1 Hardware Requirements

Exchange Server 2007, as noted previously, has been designed for use only with the x64 version of Windows Server 2003 or Windows Server 2008. The advantage of the 64-bit architecture is the elimination of the 4GB virtual address restriction on main memory. Up to 32GB of main memory can now be used, so servers with much greater memory are now being recommended.

In addition, Microsoft has conducted extensive tests with various multi-core processors, and found that Exchange Server 2007 benefits significantly when running on multi-core technology. Multi-core processors provide an attractive option for Exchange 2007, based on both price and performance.

3.1.1 Processor Recommendations

The tables in this section (from Microsoft) provide guidance in selecting server hardware for Exchange 2007. Three levels of requirements are considered:

- **Minimum** This is the minimum processor and memory configuration supported by Microsoft for the specific server roles.

- **Recommended** This is the recommended processor and memory configuration for specific server roles, based on best price and performance. It provides a balance between processor and memory capacity, with the goal of matching the memory selection to the processor configuration so the server role can effectively use the processors without becoming constrained by the memory.
• **Maximum**  This is the maximum recommended processor and memory configuration for the specific server roles. Microsoft defines the maximum as the upper boundary of viable processor and memory configurations based on price and performance.

<table>
<thead>
<tr>
<th>Exchange 2007 Server Role</th>
<th>Minimum</th>
<th>Recommended</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edge Transport</td>
<td>1 x processor core</td>
<td>2 x processor cores</td>
<td>4 x processor cores</td>
</tr>
<tr>
<td>Hub Transport</td>
<td>1 x processor core</td>
<td>4 x processor cores</td>
<td>8 x processor cores</td>
</tr>
<tr>
<td>Client Access</td>
<td>1 x processor core</td>
<td>4 x processor cores</td>
<td>4 x processor cores</td>
</tr>
<tr>
<td>Unified Messaging</td>
<td>1 x processor core</td>
<td>4 x processor cores</td>
<td>4 x processor cores</td>
</tr>
<tr>
<td>Mailbox</td>
<td>1 x processor core</td>
<td>4 x processor cores</td>
<td>8 x processor cores</td>
</tr>
<tr>
<td>Multiple server roles</td>
<td>1 x processor core</td>
<td>4 x processor cores</td>
<td>4 x processor cores</td>
</tr>
</tbody>
</table>

**Table 2 - Processor Requirements**

Microsoft provides further information on the factors behind making a choice of processor for each of the Exchange 2007 Server roles through [Planning Processor Configurations](http://us.fujitsu.com/solutions).

The PRIMERGY rack mount servers provide options over the entire range listed above, with up to 128GB of memory installable.
3.1.2 Memory Recommendations

By removing the previous 4GB main memory limit of Exchange 2003, the servers in an Exchange 2007 configuration can be expanded to significantly improve performance. Exchange 2007 can support servers with 32GB or more of memory, but a maximum of 32GB is recommended by Microsoft at this time. Many factors come into play in selecting memory for a server, including:

- Memory Speed - Different server architectures may require slower memory modules in order for the memory capacity to scale. It is important to match the memory speed with the desired capacity.

- Memory Module Size - Often it is less expensive to put in two 1GB memory modules than one 2GB module, yet it may not be possible to attain the desired capacity with many smaller modules.

- Number of Memory Slots - Specific servers are designed with a set number of memory module slots. This, coupled with the maximum module size supported in the server, determines the maximum memory configuration that the server will support.

Using the previous table as a guide in selecting the number of processor cores in each of the server roles, it is necessary to consider the amount of memory each of them needs to have installed.

<table>
<thead>
<tr>
<th>Exchange 2007 Server Role</th>
<th>Minimum Memory per Server</th>
<th>Recommended Memory per Server</th>
<th>Maximum Memory per Server</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edge Transport</td>
<td>2GB</td>
<td>1GB per core (2GB minimum)</td>
<td>16GB</td>
</tr>
<tr>
<td>Hub Transport</td>
<td>2GB</td>
<td>1GB per core (2GB minimum)</td>
<td>16GB</td>
</tr>
<tr>
<td>Client Access</td>
<td>2GB</td>
<td>1GB per core (2GB minimum)</td>
<td>16GB</td>
</tr>
<tr>
<td>Unified Messaging</td>
<td>2GB</td>
<td>1GB per core (2GB minimum)</td>
<td>4GB</td>
</tr>
<tr>
<td>Mailbox</td>
<td>2GB, depending upon the number of storage groups</td>
<td>2GB plus from 2MB to 5MB per mailbox</td>
<td>32GB</td>
</tr>
<tr>
<td>Multiple Roles</td>
<td>4GB, depending upon the number of storage groups</td>
<td>8GB plus from 2MB to 5MB per mailbox</td>
<td>32GB</td>
</tr>
</tbody>
</table>

Table 3 - Processor Memory Requirements
3.1.2.1 Mailbox Server Memory Recommendations

The Mailbox Server role has special memory requirements, either as a single/clustered server or when serving in multiple roles. The requirement can be estimated based on the following guidelines:

<table>
<thead>
<tr>
<th>User Type</th>
<th>Mailbox Server memory recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light</td>
<td>2GB plus 2MB per mailbox</td>
</tr>
<tr>
<td>Average</td>
<td>2GB plus 3.5MB per mailbox</td>
</tr>
<tr>
<td>Heavy</td>
<td>2GB plus 5MB per mailbox</td>
</tr>
</tbody>
</table>

Table 4 - Mailbox Server Memory Requirements

With the increase in the number of storage groups that can be defined in Exchange 2007, there is an impact on the minimum amount of memory that is required in a Mailbox Server. In addition, this minimum differs, depending upon the version of Exchange 2007 being installed.

<table>
<thead>
<tr>
<th>Storage Group Count</th>
<th>Exchange 2007 minimum required physical memory</th>
<th>Exchange 2007 SP1 minimum required physical memory</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – 4</td>
<td>2GB</td>
<td>2GB</td>
</tr>
<tr>
<td>5 – 8</td>
<td>4GB</td>
<td>4GB</td>
</tr>
<tr>
<td>9 – 12</td>
<td>6GB</td>
<td>5GB</td>
</tr>
<tr>
<td>13 – 16</td>
<td>8GB</td>
<td>6GB</td>
</tr>
<tr>
<td>17 – 20</td>
<td>10GB</td>
<td>7GB</td>
</tr>
<tr>
<td>21 – 24</td>
<td>12GB</td>
<td>8GB</td>
</tr>
<tr>
<td>25 – 28</td>
<td>14GB</td>
<td>9GB</td>
</tr>
<tr>
<td>29 – 32</td>
<td>16GB</td>
<td>10GB</td>
</tr>
<tr>
<td>33 – 36</td>
<td>18GB</td>
<td>11GB</td>
</tr>
<tr>
<td>37 – 40</td>
<td>20GB</td>
<td>12GB</td>
</tr>
<tr>
<td>41 – 44</td>
<td>22GB</td>
<td>13GB</td>
</tr>
<tr>
<td>45 – 48</td>
<td>24GB</td>
<td>14GB</td>
</tr>
<tr>
<td>49 – 50</td>
<td>26GB</td>
<td>15GB</td>
</tr>
</tbody>
</table>

Table 5 - Storage Group Memory Requirements

The primary memory sizing should be computed, based on the user type and number of users, using the previous table. Then the above table can be used to determine the maximum number of storage groups that can be supported with the selected memory size. If it is determined that more storage groups are needed, then additional memory will be required, as indicated in the above table.

Further information on considerations for planning memory requirements is provided by Microsoft through Planning Memory Configurations.
3.1.3 Disk Storage Recommendations

Disk system bottlenecks cause more performance problems than server-side processor or memory deficiencies. Improperly matching the capabilities of the storage array with the demands of the Mailbox server can result in poor performance and unhappy mailbox users. Factors that are involved in preparing the storage array configuration include:

- Providing sufficient space for both the mailbox databases and log files, as well as the associated back-up storage space
- Ensuring that the array configuration provides acceptable disk latency for the transactional I/O (supporting the user accesses), and sufficient throughput to complete the non-transactional I/O within the allocated time periods.

Microsoft indicates that high disk latency is synonymous with slow performance, and recommends that performance should be considered before capacity. They indicate that it is better to have a greater number of smaller capacity disk drives, utilizing each spindle’s performance, than to use fewer spindles with greater capacity. “Fast storage with a sufficient amount of spindles is one of the most important investments you can make in your messaging infrastructure.”

The primary disk storage requirements within Exchange 2007 arise from the mailbox databases and associated log files. These are accessed by the Mailbox Servers. However, there are also disk storage requirements on the Edge and Hub Transport Servers.

3.1.3.1 Edge Transport Server Disk Storage

The Edge Transport Server requires disk storage for support of a number of logs, including Message Tracking Logs, Protocol Logs, Connectivity Logs, and Agent Logs. These support the transactional queue requirements involved in routing the messages into and out of the Exchange environment. There is a Message Queue database that is used to prevent back pressure, which is a term to describe a limiting relationship applied by the system to outside message requestors, slowing message transmission. The Message Queue database is used to hold messages in the queue that cannot be sent on to the next server at that time. It should be sized to hold the maximum number of permitted queued messages times the average message size. As an example, if there is a 500,000 item queue, with an average message size of 50KB, then there can be about 25 GB of data in the database. It is normally expected that this storage will be provided by disk drives directly attached to the server, avoiding the need to access the SAN and the larger storage required by the Mailbox Servers.

3.1.3.2 Hub Transport Server Disk Storage

In a manner much like the Edge Transport Server, the Hub Transport Server requires disk support for a number of logs, including Message Tracking Logs, Protocol Logs, and Transaction Logs. It also requires a Message Queue database for holding messages in the queue that cannot be sent on to the next server at that time. It should also be sized to hold the maximum number of permitted queued messages times the average message size.

In addition, when the Mailbox Servers are configured in a cluster and using Cluster Continuous Replication (CCR), or the Mailbox Servers have one or more storage groups enabled for Local Continuous Replication (LCR), then additional disk storage is required. In these cases, a set of storage called the Transport Dumpster needs to be provided. This storage serves to hold messages in transit to the Mailbox Server, in the event of a failover / recovery of the cluster with CCR, or activation of the replicate database with LCR. The space needs to provide space for at least one of the largest messages permitted for each of the defined storage groups. It is normally expected that this storage will be provided by disk drives directly attached to the server, avoiding the need to access the SAN and the larger storage required by the Mailbox Servers. Further information on both the Edge and Hub Transport Server Disk Storage requirements can be found through Transport Server Storage Design.

3.1.3.3 Mailbox Server Role Disk Storage

Ensuring sufficient mailbox capacity is critical. When a database runs out of space, the database goes offline, causing an interruption in service to all of the users supported by that database. When a transaction log runs out of space, then all of the databases in that storage group go offline, also causing a service interruption. Recovery from running out of disk storage space is complex and cannot be accomplished quickly, so the interruption will easily exceed most recovery time objectives (RTO).
Microsoft provides a very comprehensive tool for planning the storage requirements of an Exchange 2007 server in the Mailbox Server Role. A copy of this tool can be obtained from:

http://msexchangeteam.com/files/12/attachments/entry438481.aspx

This tool is a Microsoft Office Excel 2007 workbook with a number of sheets that provide the calculations, based upon inputs provided. The inputs determine the various selections and parameters of the Exchange 2007 environment that is to be built. The many fields on the input sheet have comments to guide the user in making the choices. This workbook is used as the primary tool in developing the server and storage requirements necessary to meet the environment to be built.

The tool enables designs with a single Mailbox Server or with multiple Mailbox Servers. When multiple Mailbox Servers are selected, it will attempt to balance the various mailboxes across the requested number of servers. In an organization there are often demands for different classes or tiers of mailboxes, each with different characteristics based on the demands of those users. The tool enables preparation of up to three tiers of user mailboxes, each with different operating characteristics. This provides the designer with flexibility in organizing the mailbox services for the different users. It is not necessary to use all three tiers, particularly if there are to be different Mailbox Servers for different groups of users. The multiple tiers should be used when the load is to be spread across all of the servers in the set. When the design is for separated sets of servers, then only a single tier may need to be used in each of the different design sets – but each set must be fully defined, independent of the other sets in that type of design.

There is a further section of the input to the tool that deals with the techniques to be used for backup of the mailbox data. Archiving and backup of mailbox data is critical in businesses today, and effective planning is required to accommodate all of the different aspects. Several factors go into calculating the size of the Logical Unit Numbers (LUNs) that are to hold the storage groups and hence the databases and associated logs. These include:

- **LUN Free Space** – This is a percentage of the calculated database LUN capacity that should be added to accommodate other data that resides in the database, but is not included in the calculations based solely on the number of mailboxes.

- **Mailbox Quota** – This is the first metric to establish. It establishes the amount of data that a user can store in the mailbox. It will change with time, but initial goals for quotas are essential.

- **Database White Space** – This represents the space within the database that is not in use at a given point in time. Free pages or white space within the database is constantly changing, and is spread throughout. When items are marked for deletion, they are not removed immediately, but rather are marked free during online maintenance. Regular maintenance is required to ensure adequate available space within the databases.

- **Database Dumpster** – Each database has a dumpster that stores soft-deleted items for a default of 14 days after they are removed from the Deleted Items folder. These items are finally removed during the online maintenance operation.

- **Content Indexing** – This creates an index of the mail items to enable rapid searches and adds about 5% to the total database size.

- **Recovery Storage Group** – Provides a group to use for recovery of a single storage group during a recovery operation

- **Backup to Disk** – The space to accomplish a disk backup must also be considered.

- **Log LUN Capacity** – Space for the LUNs supporting the transaction logs is also necessary, and these need to be assigned to separate LUNs from those supporting databases. Assuming an average message size of 50KB, then the following table provides estimates on the number of log entries generated:
<table>
<thead>
<tr>
<th>Mailbox Profile</th>
<th>Message Profile</th>
<th>Logs Generated per Mailbox</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light</td>
<td>5 sent / 20 received</td>
<td>6</td>
</tr>
<tr>
<td>Average</td>
<td>10 sent / 40 received</td>
<td>12</td>
</tr>
<tr>
<td>Heavy</td>
<td>20 sent / 80 received</td>
<td>24</td>
</tr>
<tr>
<td>Very Heavy</td>
<td>30 sent / 120 received</td>
<td>36</td>
</tr>
</tbody>
</table>

Table 6 - Log Generation Rates

Note that as average message size doubles, the logs generated per mailbox nearly doubles each time.

All of these factors and relationships as well as many others are included in the calculations made within the Excel workbook from the inputs provided. It is important to choose the input parameters with care to ensure a reasonable representation of the storage requirements for the planned Exchange 2007 environment.
3.2 Microsoft Storage Calculator Usage

The Exchange 2007 Mailbox Server Role Storage Requirement Calculator, available from Microsoft through the download link, provides a very effective tool for planning the storage requirements to support an Exchange 2007 organization. It is focused on the storage requirements - both I/O performance and capacity - to derive an optimal LUN layout, based on a set of input factors. The calculator uses all of the recommendations outlined in the previous sections, and the associated Microsoft references. Each should be reviewed carefully to understand how the calculator input choices are used in determining the recommended configuration. The calculator workbook includes extensive comments throughout to guide the user, and the following sections provide additional information on each of the worksheets and their content. The Microsoft Exchange Server 2007 Mailbox Server Blog provides additional information on the use of the tool.

Note that this tool requires use of Office 2007 Excel® for operation. It is incompatible with Office 2003 Excel, and can not be opened with Office 2003 Excel. A 60-day trial copy of Office 2007 may be downloaded from:


3.2.1 Notes on Input Sheet

The Input sheet is used to enter the specific information about the design, so that the calculator can generate the elements needed to achieve the design. Selection of each of the factors is critical for effective use of this tool. Each of the fields has extensive information contents attached that need to be reviewed as the choices are made. There are a number of sections, each focused on one aspect of the configuration parameters.

3.2.1.1 Server Configuration Input Factors

- Exchange Server Configuration – This is where the very high-level choices on the Exchange 2007 architecture being planned are provided. The choices here guide a number of other choice offerings on the sheet. One selection is the number of Exchange Mailbox Servers to be included. Note that a clustered pair of servers is really operating as one server, so if using CCR, then each number represents two physical servers, operating in a single Mailbox Server role.

- Exchange Data Configuration – This section provides some operational factors that impact the storage requirements of the design.

- IOPS Configuration – In the event that there are other applications that will be accessing the storage, such as some third-party mobility products.

- Standby Continuous Replication Configuration – If the design is to use SCR, then this section provides parameters for setting up the appropriate storage target groups.

3.2.1.2 Mailbox and Client Configuration Input Factors

There are provisions for planning up to three different sets or classes of mailboxes, called tiers. When the Mailbox servers are to support multiple mailbox types, then each of these can be used. When only a single type of mailbox is to be assigned on the servers, then only the Tier-1 set of entries should be used. This is the section in which the characteristics of the mailboxes and the use of the mailboxes to be supported on the servers are defined.

3.2.1.3 Backup Configuration Input Factors

The backup methodology and frequency are chosen in this section. Although several options are available here, in the application of Backup Exec coupled with ETERNUS storage being addressed in this paper, the methodology chosen should be Hardware VSS Backup/Restore. An appropriate backup schedule should be selected, based on the overall planning.
3.2.1.4 Log Replication Configuration Input Factors

This section only applies when the plan includes replication between physical locations. This is beyond the scope of this paper, but if SCR was selected, then this section should be completed.

3.2.2 Notes on Storage Requirements Sheet

The Storage Requirements sheet provides the results of the calculations from the input parameters provided on the Input sheet. The upper portion of the sheet provides information from the input sheet regarding the overall configuration of the servers and mailboxes, along with some derived characteristics of those mailboxes.

The Solution Configuration section provides details on the primary server and storage sizing, based on the standard Microsoft recommendations for the specified input parameters. It includes the recommended size of the server memory and the recommended number of storage groups. The number of mailboxes per database is provided, and in a multi-tier configuration, the number for each tier is provided.

The Transaction Log section details the log generation rates, again based on the input parameters and the number of user mailboxes being defined.

The Disk Space section provides the calculated storage spaces that will be required for the configuration. One aspect is that the calculated LUN sizes can be greater than 2TB, which is the limit, if GUID Partition Tables (GPTs) are not used. There is a note regarding support of the GPT disk partition format in clustered configurations that applies when installing Exchange 2007 within a Windows Server 2003 environment.

3.2.3 Notes on LUN Requirements Sheet

The LUN Requirements sheet is really a continuation of the Storage Requirements section. It outlines the recommended LUN design based on the input factors and the analysis performed in the previous Storage Requirements section.

Note that the term LUN, as used in the calculator, refers to the representation of the disk storage that is exposed to the host operating system. It does not attempt to define the internal structures used within the storage array.

There are two approaches to relating LUNs to Storage Groups, either 2 LUNs per Storage Group or 2 LUNs per Backup Set. Each of these has advantages and issues. A recommendation is based on the selections on the input sheet for hardware based VSS and the frequency of planned full backups.

Details on the numbers of LUNs required in the various areas is provided, along with a listing of the specific databases and storage groups, showing the sizes of each and the recommended LUN sizes.

3.2.3.1 LUN Design – 2 LUNs per Storage Group

Assigning two LUNs per storage group - one for the database and one for the log - enables use of hardware based VSS at the storage group level, providing single group backup and restore. It also adds flexibility to isolate the performance between storage groups not sharing spindles between LUNs. The reliability of the solution is improved, since a problem with a single LUN will only affect one storage group.

On the other hand, with a large number of storage groups, using LCR or CCR, a great many LUNs will be required. This can increase administrative management complexity and costs.
3.2.3.2 LUN Design – 2 LUNs per Backup Set

A backup set is the number of databases that are fully backed up in a night. A solution that performs a full backup on 1/7th of the databases each night can reduce the complexity by placing all of the storage groups into the same pair of backup LUNs. One LUN would be used for all of the database files in the set of storage groups, and the other used for all of the log files in the groups. It may reduce the number of backup jobs that have to be managed.

However, use of this scheme limits the use of hardware-based VSS backups and restores. It can also encounter problems with the 2TB limit and require the use of GPT mount points. Additionally, a problem with a single LUN will affect several storage groups.

3.2.4 Notes on Backup Requirements Sheet

The Backup Requirements sheet is also a continuation of the Storage Requirements section. It outlines the recommended backup design, based on the input factors provided. There are a number of sections that are only filled out when a Streaming Backup plan has been selected. The Backup Methodology selected is indicated, along with the selected backup frequency.

A table is provided, listing each of the storage groups, and the backup schedule that should be applied, based on the backup frequency plan selected.

3.2.5 Notes on Log Replication Requirements Sheet

The Log Replication Requirements sheet is a further continuation of the Storage Requirements section. It outlines the recommended throughput required to replicate the transaction logs for SCR targets and for a geographically dispersed CCR structure. If multiple mailbox servers were selected in the Input sheet, then this sheet represents the total requirements for all of the mailbox servers.

3.2.6 Notes on Storage Design Sheet

The Storage Design sheet is provided to assist in configuring disk drives, usually in a DAS environment. It does not apply in the case of Exchange 2007 Mailbox servers with ETERNUS storage arrays. The configuration plan for the appropriate ETERNUS model should be developed with the assistance of a Fujitsu Storage SE.
4 Exchange 2007 Sample Configurations with CCR

This section outlines three different Exchange 2007 configurations, utilizing ETERNUS storage, for different size requirements. These all provide support for CCR with three levels of recovery to address the different types of recovery that can be encountered with an Exchange environment.

All of the configurations include a Media Server that is running Backup Exec from Symantec. The Media Server may also be used to host some of the other Exchange Server roles, such as Client Access, Hub Transport, or Domain Controller. It is not expected that the Media Server would serve in the Exchange Edge Server role, as that would require that it be connected to the outside network, and that is not recommended. The Media Server would be expected to have a Tape Library included for archive storage purposes, with the sizing chosen according to the customer requirements.

These sample configurations have been prepared using the Exchange 2007 Mailbox Calculation tool outlined in a previous section. There are a number of the configuration parameters that were used with the default values.

<table>
<thead>
<tr>
<th>Configuration Parameter</th>
<th>Default Value</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exchange Server 2007 Version</td>
<td>SP1+</td>
<td>Most operations management programs have capacity thresholds that alert when a LUN is more than 80% utilized. This value ensures that each LUN has a certain percentage of disk space available so that the LUN is not designed and implemented at the maximum capacity.</td>
</tr>
<tr>
<td>Percentage Free Space</td>
<td>20%</td>
<td>This is the default for Exchange 2007</td>
</tr>
<tr>
<td>Delete Item Retention</td>
<td>14 days</td>
<td>This is the default for Exchange 2007</td>
</tr>
<tr>
<td>Data Overhead Factor</td>
<td>20%</td>
<td>This is the Microsoft recommendation for any extraneous growth that may occur.</td>
</tr>
<tr>
<td>Mailbox Moves per Week Percentage</td>
<td>5%</td>
<td>In terms of transactions, it is necessary to take into account how many mailboxes will be moving to this server or within this server, as transactions are generated to accomplish the move</td>
</tr>
<tr>
<td>I/O Overhead Factor</td>
<td>20%</td>
<td>This is the Microsoft recommendation to ensure adequate headroom, in terms of I/O to allow for abnormal spikes in I/O that may occur from time to time.</td>
</tr>
<tr>
<td>Projected Mailbox Number Growth</td>
<td>0%</td>
<td>This is an estimate of the expected growth in number of mailboxes during the lifecycle of the solution.</td>
</tr>
<tr>
<td>Send/Receive Capability per Mailbox per Day</td>
<td>20 sent / 80 received</td>
<td>This usage represents a Heavy user and is used to provide memory and processor requirements.</td>
</tr>
<tr>
<td>Average Message Size (KB)</td>
<td>50</td>
<td>This is the Microsoft expected size for most users. Represents an average message size of 51,200 bytes.</td>
</tr>
<tr>
<td>User Mailbox Size Limit (MB)</td>
<td>2048</td>
<td>This size is larger than typically seen with Exchange 2003, but is the Microsoft default for Exchange 2007</td>
</tr>
<tr>
<td>Outlook Mode</td>
<td>Cached Mode</td>
<td></td>
</tr>
</tbody>
</table>

Table 7 - Default Configuration Parameters
4.1 Small Configuration for 500 Mailboxes

The small configuration uses two Windows servers in a CCR cluster, supported by a single ETERNUS storage array with both active and passive protected storage areas. To support Symantec Backup Exec, an additional Windows server is included, along with snapshot and archive storage within the ETERNUS storage array. The storage space is configured to support 2GB mailboxes for each user.

4.1.1 Overview of Small Configuration

Figure 1 - Overview Diagram of Small Exchange 2007 Mailbox Server Configuration
4.1.2 Storage Planning for Small Configuration

Figure 2 - Small Configuration Storage Diagram
4.2 Medium Configuration for 1500 Mailboxes

The medium configuration also uses two Windows servers in a CCR cluster, supported by two ETERNUS storage arrays. One of the arrays provides the active storage. The other provides the passive storage, along with the archive storage in support of Symantec Backup Exec operating on the Windows media server. Each of the arrays also provides snapshot storage to enable the hardware supported backup process. The storage space is configured to support 2GB mailboxes for each user.

4.2.1 Overview of Medium Configuration

![Figure 3 - Overview Diagram of Medium Exchange 2007 Mailbox Server Configuration](image-url)
4.2.2 Storage Planning for Medium Configuration

Figure 4 - Medium Configuration Storage Diagram
4.3 Large Configuration for 5500 Mailboxes

The large configuration uses four Windows servers in two CCR clusters. These are supported by two ETERNUS storage arrays and a Windows server for operation of the Symantec Backup Exec as a media server. One of the storage arrays provides active storage to one cluster and passive storage to the other cluster, along with snapshot storage to support the backup process. The other storage array provides passive storage for the first cluster and active storage for the other cluster, as well as snapshot and archive storage for the backup process. The storage space is configured to support 2GB mailboxes for each user. The large configuration also includes 500 high usage mailboxes, such as Blackberry users.

4.3.1 Overview of Large Configuration

![Overview Diagram of Large Exchange 2007 Mailbox Server Configuration]

Figure 5 - Overview Diagram of Large Exchange 2007 Mailbox Server Configuration
4.3.2 Storage Planning for Large Configuration

Figure 6 - Large Configuration Storage Diagram
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