



# **Microsoft Exchange 2010 on VMware Design and Sizing Examples**

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## 1. Introduction

Microsoft Exchange can be a very complex application to deploy and there are many design decisions to be made to build a solid solution. We know that running Microsoft Exchange Server 2010 on VMware vSphere® can positively impact design, deployment, availability, and operations, but what does such a solution look like?

In this document, we explore a sample architecture design that illustrates an Exchange 2010 environment running on vSphere. The focus of this architecture is to provide a high-level overview of the solution components, with diagrams to help illustrate key concepts. For detailed best practices, see the *Microsoft Exchange 2010 on VMware: Best Practices Guide*.

The sample design covers:

Design Concepts:

- Resource Management.
- Sample Physical Layout.
- Capacity Planning Process Overview.

Building Block Examples (Standalone Mailbox Servers):

- 8,000 mailboxes – 150 sent/received.
- 16,000 mailboxes – 150 sent/received.
- 64,000 mailboxes – 150 sent/received.

DAG Examples (Clustered Mailbox Servers):

- 8,000 active mailboxes – 150 sent/received.
- 16,000 active mailboxes – 150 sent/received.
- 64,000 active mailboxes – 150 sent/received.

Design and Deployment Considerations.

The examples show how these components contribute to the overall design and are only intended to provide a guideline. Customers should work with their infrastructure vendors to develop a detailed sizing and architecture plan designed for their requirements. After describing some important design concepts, we take a look at sizing examples of Exchange 2010 on vSphere for three different sized organizations. We'll make one pass with the VMware building block process for standalone mailbox servers, and a second pass for mailbox servers configured in a DAG.

8,000 mailboxes – 150 sent/received.

16,000 mailboxes – 150 sent/received.

64,000 mailboxes – 150 sent/received.

This document describes examples to help understand components and concepts. Official sizing for Exchange environments varies based on business and technical requirements, as well as server and storage hardware platforms. VMware recommends that you engage your server and storage vendors to help plan your design, or use one of the detailed, hardware-specific reference architectures found on our website and in the *Microsoft Exchange 2010 on VMware: Partner Resources Catalog*.

## 1.1 Benefits of Running Exchange 2010 on vSphere

Email is one of the most critical applications in an organization's IT infrastructure. Organizations increasingly rely on messaging tools for individual and organizational effectiveness. As a result, messaging administrators face a constant challenge as they continually seek to manage the conflicting demands of availability, agility, and cost.

Running Exchange on VMware offers many benefits:

Server Consolidation:

- Utilize all your server processor cores.
- Maintain role isolation without additional hardware expense.

Operational advantages:

- Design for today's workload rather than guessing about tomorrow.
- Design for specific business requirements.
- Rapidly provision Exchange servers with virtual machine templates.
- Reduce hardware and operational costs of maintaining an Exchange lab.
- Enhance testing and troubleshooting using cloned production virtual machines.

Higher availability with less complexity:

- Reduce planned downtime due to hardware or BIOS updates with VMware vSphere® vMotion®.
- Reduce unplanned downtime due to hardware failure or resource constraints.
- Implement simple and reliable Exchange disaster recovery.



## 2. Design Concepts

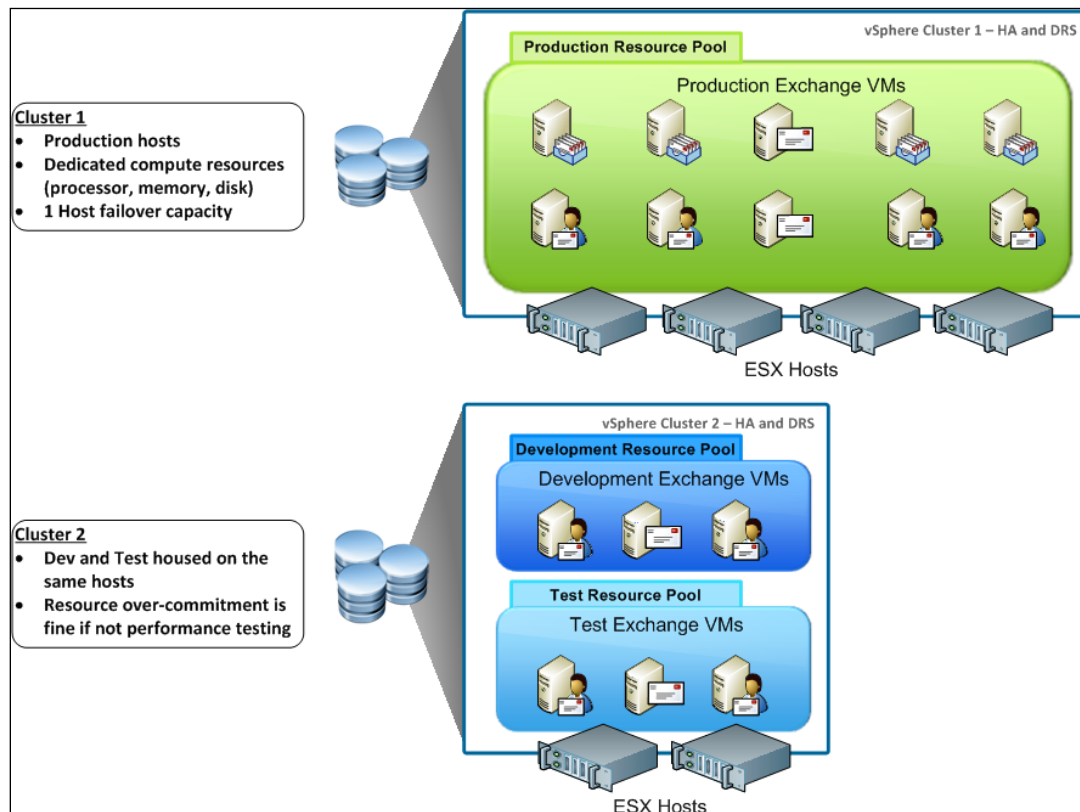
### 2.1 Resource Management

#### 2.1.1 Resource Pools

When working in vSphere environments it is important to classify and structure virtual machines logically as you would physical servers—using resource pools is a great way to accomplish this goal. Resource pools allow for easy grouping and logical separation of production, test, and development workloads. You can also employ some physical separation as a part of your infrastructure, separating the test and development environments from the production environment on different ESXi hosts as shown in Figure 1, but it is not required.

Resource pools provide the additional benefit of making sure that the most important workloads maintain priority for the use of the physical resources. To do this, each resource pool is allowed a certain number of *shares*. The number of shares designated for each resource pool depends on the workloads for each virtual machine. For example, a production resource pool would be given the most shares and a development or test resource pool would be given the least. In the event of resource contention, where two or more virtual machines are trying to use the same resource (for example, vCPU), the virtual machine with the most shares assigned to it takes priority while other virtual machines have to wait for the vCPU to become available. See *vSphere Resource Management* (<http://pubs.vmware.com/vsphere-50/topic/com.vmware.ICbase/PDF/vsphere-esxi-vcenter-server-50-resource-management-guide.pdf>) for more information about configuring and managing resource pools.

**Figure 1. Physical Separation of Resource Pools**



When running Microsoft Exchange Server 2010 on vSphere, it is important to consider which resource pools will reside on what hardware. It may be desirable (although not necessary) to separate the production environment on physical hardware, but make sure there are enough physical resources to provide the availability needed for proper operation of VMware HA, DRS, and vMotion (this depends on the overall size of the environment).

When deploying Exchange 2010 on vSphere, the same rules generally apply as for a physical design. For example, there are advantages to distributing workloads by separating the mailbox server from other peripheral server roles (CAS, Hub Transport, others) when you are working with physical servers, and they also apply when deploying Exchange on vSphere.

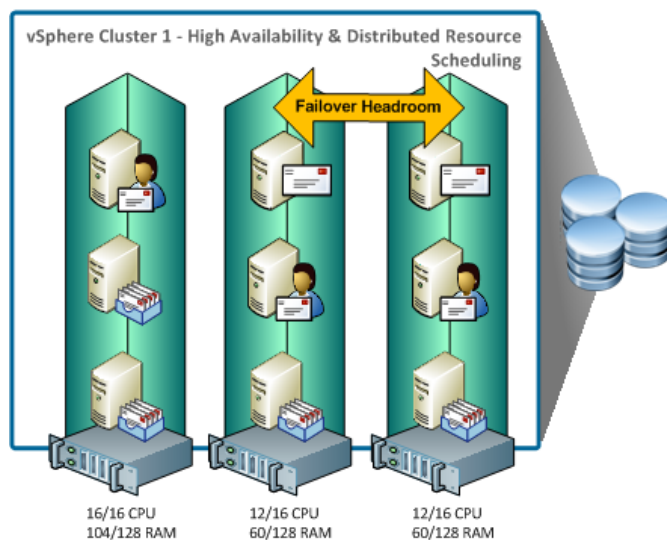
## 2.1.2 Dedicated Application Clusters

An alternative approach to using resource pools is to dedicate one or more VMware clusters as *Application Clusters*. Many of our customers have found that running Enterprise applications on vSphere necessitates a different management approach. A dedicated vSphere cluster could be configured with different properties than the general vSphere pool, such as rules to avoid over-commitment, limit HA/DRS/vMotion, or to dedicate storage to performance-intensive virtual machines.

## 2.1.3 Sample Physical Layout

Figure 2 demonstrates a sample 16,000 active mailbox environment, with each user sending/receiving 150 messages per day, and where each of the Exchange server roles runs in its own virtual machine. Each ESXi host has been sized to 16 CPUs and 128GB of RAM to handle the workload of 4 Mailbox Servers, 2 Hub Transport Servers, and 3 Client Access Server virtual machines. To achieve best results in a vSphere environment, it is a good practice to divide out each server role into its own virtual machine to allow for more efficient workload separation and increase the amount of redundancy in the system.

**Figure 2. Sample Physical Environment for 16,000 Mailboxes**



### Characteristics

- 16,000 Exchange 2010 users
- Availability: VMotion, DRS, HA
- Some failover capability (over-commitment during failover)

### Architecture Legend

- ESX 4.0 host  
4x4 pCore/128 GB
- Mailbox Server VM  
6 vCPU/48 GB
- Client Access Server VM  
4 vCPU/8 GB
- HUB Transport VM  
2 vCPU/4 GB

## 2.2 Capacity Planning Process Overview

Sizing of an Exchange 2010 environment is a complex process with many variables, including business requirements, anticipated mailbox workloads, and hardware platform, to name a few. The good news is that sizing an Exchange 2010 environment on vSphere is nearly the same as sizing for physical servers.

First, you must decide whether or not to cluster the mailbox servers. If you choose to use standalone mailbox servers protected by VMware HA, use the *building block* approach (defined in Section 3, Building Block Examples (Standalone Mailbox Servers), and in the *Microsoft Exchange 2010 on VMware Best Practices Guide*). However, if you decide to implement Database Availability Groups (DAGs), use the DAG approach (defined in Section 4, DAG Examples (Clustered Mailbox Servers), and in the *Best Practices Guide*).

Storage sizing and configuration can vary depending on the storage array used and many vendors have unique enhancements to the storage solution that can increase availability, speed recovery, enhance performance, and so on. To optimize performance and take advantage of these features, it is highly recommended that the storage partner be included in the design effort.

There are many facets to an Exchange 2010 deployment besides sizing. Exchange 2010 can be deployed into some very complex, multisite architectures that should be designed with the assistance of an Exchange expert, whether that person is an internal company resource or a partner with experience deploying both Exchange and vSphere. The high-level sizing guidelines are described in detail in the *Microsoft Exchange 2010 on VMware: Best Practices Guide*.

## 3. Building Block Examples (Standalone Mailbox Servers)

### 3.1 The Building Block Process

The building block approach is a recommended best practice for creating standalone Exchange Mailbox Servers running on vSphere using pre-sized virtual machine configurations. Exchange servers that have been divided into virtual machine building blocks (as opposed to larger, monolithic Exchange servers) can simplify server sizing during the initial deployment and create a highly scalable solution using virtual machines with predictable performance patterns. Testing by VMware and its partners has focused on four primary sizes for mailbox virtual machine building blocks consisting of 500, 1000, 2000, and 4000 users. These configurations have known performance profiles that can be leveraged for rapid Exchange server sizing as well as easily scaling environments as additional Exchange servers need to be brought online.

Table 1 presents some pre-sized virtual machine building block examples designed to host mailboxes with an average of 150 messages sent/received per day. The same principles are used for sizing profiles ranging from 50 to 550 messages sent/received per day.

**Table 1. Building Block CPU and RAM Requirements for Mailboxes with 150 Messages Sent/Received per Day\***

Building Block	500	1000	2000	4000
Profile	150 sent/received	150 sent/received	150 sent/received	150 sent/received
Megacycle Requirement	1,500	3,000	6,000	12,000
vCPU (based on 3.33GHz processor-based server)	2 (Minimum) (.6 Actual)	2 (Minimum) (1.3 Actual)	4 (2.6 Actual)	6 (5.1 Actual)
Cache Requirement	4.5GB	9GB	18GB	36GB
Total Memory Size	16GB	16GB	24GB	48GB

\* Based on <http://technet.microsoft.com/en-us/library/ee712771.aspx>

The sizing process begins with understanding and applying Microsoft guidelines for each server role, as represented by the following high-level processes:

Design the mailbox server building block:

- Define current workloads using the *Microsoft Exchange Server Profile Analyzer* (<http://www.microsoft.com/download/en/details.aspx?displaylang=en&id=10559>).
- Choose an appropriate building block (500, 1000, 2000, and 4000 user blocks have been tested and validated, although larger building blocks may be possible).
- Apply Microsoft guidelines to determine the CPU requirements.
- Apply Microsoft guidelines to determine the amount of memory required.
- Use the *Exchange 2010 Mailbox Server Role Requirements Calculator* (<http://blogs.technet.com/b/exchange/archive/2009/11/09/3408737.aspx>) from Microsoft to determine storage requirements.

Design the peripheral server roles:

- Determine how many mailbox server building blocks are needed.
- Calculate the number of mailbox server processor cores.
- Use *Microsoft Guidelines for Server Role Ratios* (<http://technet.microsoft.com/en-us/library/ee832795.aspx>) to calculate processor and memory requirements for the Hub Transport roles.
- Use *Microsoft Guidelines for Server Role Ratios* (<http://technet.microsoft.com/en-us/library/ee832795.aspx>) to calculate processor and memory requirements for the Client Access Server roles.
- Allocate one or more virtual machines for each server role to satisfy the previously calculated number of processor cores and amount of memory.

Determine how the virtual machines will be distributed across ESXi hosts.

Aggregate virtual machine requirements *plus some overhead* to size each ESXi host. The overhead is important if you want to minimize the performance impact during the loss of one of your ESXi hosts. A typical guideline when choosing the number of required hosts is  $n+1$ , where  $n$  is the number of hosts required to run the workload at peak utilization.  $N+1$  allows you to design for the possibility of losing one host from your VMware cluster without taking a huge performance hit during failover.

### 3.2 Sample Building Block Sizing – 4,000 Users/150 Sent/Received

Using the Microsoft sizing guidelines and the building block approach, we size a 4,000-user building block with each mailbox sending/receiving 150 messages per day. The following calculations are meant to serve as an example of the sizing process. Customers are encouraged to use these as guidelines but must also evaluate specific requirements to determine the most optimal deployment models for their needs.

Every environment is different and some organizations use email more heavily than others. To accurately determine your mailbox profile requirements, use the *Microsoft Exchange Server Profile Analyzer* (<http://www.microsoft.com/download/en/details.aspx?displaylang=en&id=10559>). It is also strongly recommended that you work with an internal or partner resource that is experienced with Exchange architectures to design for good performance in your environment. In our example, we use the following average mailbox profile definition:

150 messages sent/received per day.

Average message size of 75KB.

2GB mailbox quota.

Note that these examples do not take into account a particular storage solution. Many VMware storage partners have performed extensive testing on building blocks of varying capacities and workload characteristics. See the *Microsoft Exchange 2010 on VMware: Partner Resource Catalog* for storage-specific implementation details.

### 3.2.1 Mailbox Server Resource Requirements

The following table summarizes the resource requirements for our 4,000 user building block.

**Table 2. 4,000-User/150 Sent/Received Building Block Requirements**

Exchange Role	Physical Resources (per server)
Mailbox Server	<b>CPU:</b> 6 cores (60% max utilization) <b>Memory:</b> 48GB <b>OS and Application File Storage:</b> 64GB (OS and application files) <b>DB Storage:</b> 110 x 300GB 10K RPM FC/SCSI/SAS 3.5" (RAID 1/0) <b>Log Storage:</b> 6 x 300GB 10K RPM FC/SCSI/SAS 3.5" (RAID 1/0) <b>Restore LUN:</b> 12 x 300GB 10K RPM FC/SCSI/SAS 3.5" (RAID 5) <b>Network:</b> 1 Gbps

### 3.2.2 Guest Virtual Machine Configuration

The resource requirements in Table 2 are translated below into virtual machine resources.

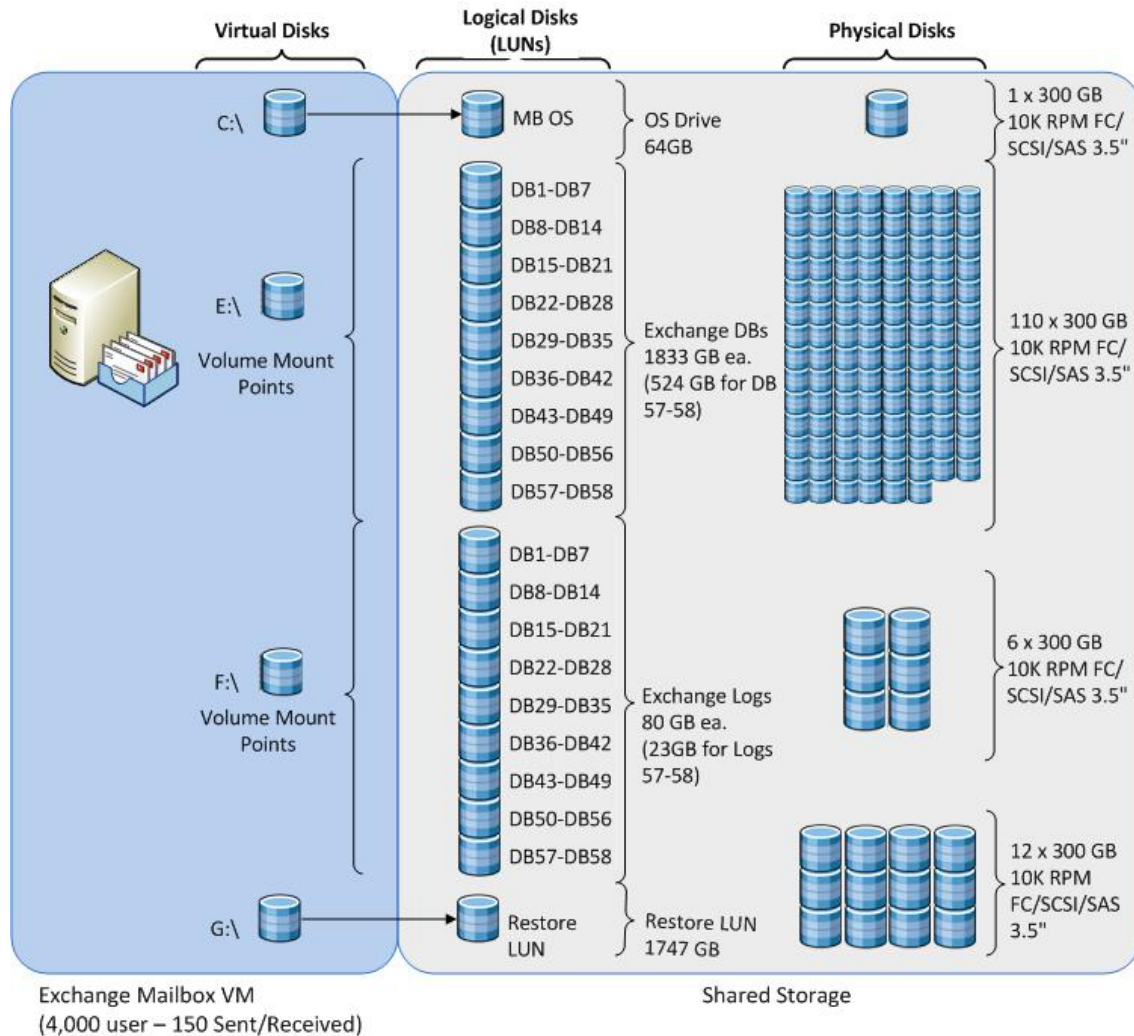
**Table 3. Exchange Virtual Machine Configuration**

Exchange Role	Virtual Hardware (per VM)
Mailbox Server	<p><b>CPU:</b> 6 vCPU</p> <p><b>Memory:</b> 48GB</p> <p><b>Storage:</b> SCSI Controller 0</p> <p>HDD 1: 64GB (OS and application files)</p> <p><b>Storage:</b> SCSI Controller 1</p> <p>HDD 2: 1833GB (DB1-DB7 databases)</p> <p>HDD 3: 1833GB (DB8-DB14 databases)</p> <p>HDD 4: 1833GB (DB15-DB21 databases)</p> <p>HDD 5: 1833GB (DB22-DB28 databases)</p> <p>HDD 6: 1833GB (DB29-DB35 databases)</p> <p>HDD 7: 1833GB (DB36-DB42 databases)</p> <p>HDD 8: 1833GB (DB43-DB49 databases)</p> <p>HDD 9: 1833GB (DB50-DB56 databases)</p> <p>HDD 10: 524GB (DB57-DB58 databases)</p> <p><b>Storage:</b> SCSI Controller 2</p> <p>HDD 11: 80GB (DB1-DB7 logs)</p> <p>HDD 12: 80GB (DB8-DB14 logs)</p> <p>HDD 13: 80GB (DB15-DB21 logs)</p> <p>HDD 14: 80GB (DB22-DB28 logs)</p> <p>HDD 15: 80GB (DB29-DB35 logs)</p> <p>HDD 16: 80GB (DB36-DB42 logs)</p> <p>HDD 17: 80GB (DB43-DB49 logs)</p> <p>HDD 18: 80GB (DB50-DB56 logs)</p> <p>HDD 19: 23GB (DB57-DB58 logs)</p> <p><b>Storage:</b> SCSI Controller 3</p> <p>HDD 20: 1747GB (Restore LUN)</p> <p><b>Network:</b> NIC 1</p>

### 3.2.3 Guest Virtual Machine Storage Interaction

The following figure shows how the building block virtual machine interacts with the shared storage.

**Figure 3. Building Block Virtual Machine Interaction with Shared Storage**





### 3.3 Example 1 – 8,000 Users/150 Sent/Received

This example uses our 4,000 active user building block numbers to estimate the number of mailbox servers and the amount of processing and memory needed for the CAS and Hub Transport Roles. We then translate the estimated resources into virtual machine and host configurations.

#### 3.3.1 Resource Requirements by Server Role

Using Microsoft and VMware best practices, we can estimate the resource requirements of each server role based on server role ratios and Microsoft sizing guidelines. In this case, we support 8,000 active users and thus need two 4,000 user building blocks. For an in-depth look at the sizing and configuration process, see the Microsoft *Exchange 2010 on VMware: Best Practices Guide*.

**Table 4. Exchange Server Role Resource Requirements**

Exchange Role	Physical Resources (per server)
Mailbox Server (2 servers)	<b>CPU:</b> 6 cores (60% max utilization) <b>Memory:</b> 48GB <b>OS and Application File Storage:</b> 64GB (OS and application files) <b>DB Storage:</b> 110 x 300GB 10K RPM FC/SCSI/SAS 3.5" (RAID 1/0) <b>Log Storage:</b> 6 x 300GB 10K RPM FC/SCSI/SAS 3.5" (RAID 1/0) <b>Restore LUN:</b> 12 x 300GB 10K RPM FC/SCSI/SAS 3.5" (RAID 5) <b>Network:</b> 1Gbps
Client Access Server (2 servers)	<b>CPU:</b> 4 cores <b>Memory:</b> 8GB <b>Storage:</b> 24GB (OS and application files) <b>Network:</b> 1Gbps
Hub Transport Server (2 servers)	<b>CPU:</b> 1 core <b>Memory:</b> 4GB <b>Storage:</b> 20GB (OS, application, and log files) 32GB (DB, protocol/tracking logs, and temp files) <b>Network:</b> 1Gbps

### 3.3.2 Virtual Machine Distribution

Now that we understand the physical resource requirements and associated virtual hardware configuration, we can plan physical ESXi host hardware to meet those requirements. To build infrastructure availability into the architecture, we distribute the six total virtual machines across two ESXi hosts. Initial placement of virtual machines is relatively unimportant, especially if you're using DRS.

**Table 5. Exchange Virtual Machine Distribution**

ESXi host	VM(s)
ESXi host 1	Exchange Mailbox VM 1 (6 vCPU/48GB RAM) Exchange Client Access VM 1 (4 vCPU/8GB RAM) Exchange Hub Transport VM 1 (1 vCPU/4GB RAM)
ESXi host 2	Exchange Mailbox VM 2 (6 vCPU/48GB RAM) Exchange Client Access VM 2 (4 vCPU/8GB RAM) Exchange Hub Transport VM 2 (1 vCPU/4GB RAM)

### 3.3.3 ESXi host Specifications

Each ESXi host should provide enough physical hardware resources to accommodate the planned workload and provide some headroom in the event of a VMware HA failover or planned vMotion migration of live virtual machines for host hardware maintenance. The following table summarizes the ESXi host hardware configuration based on our example architecture.

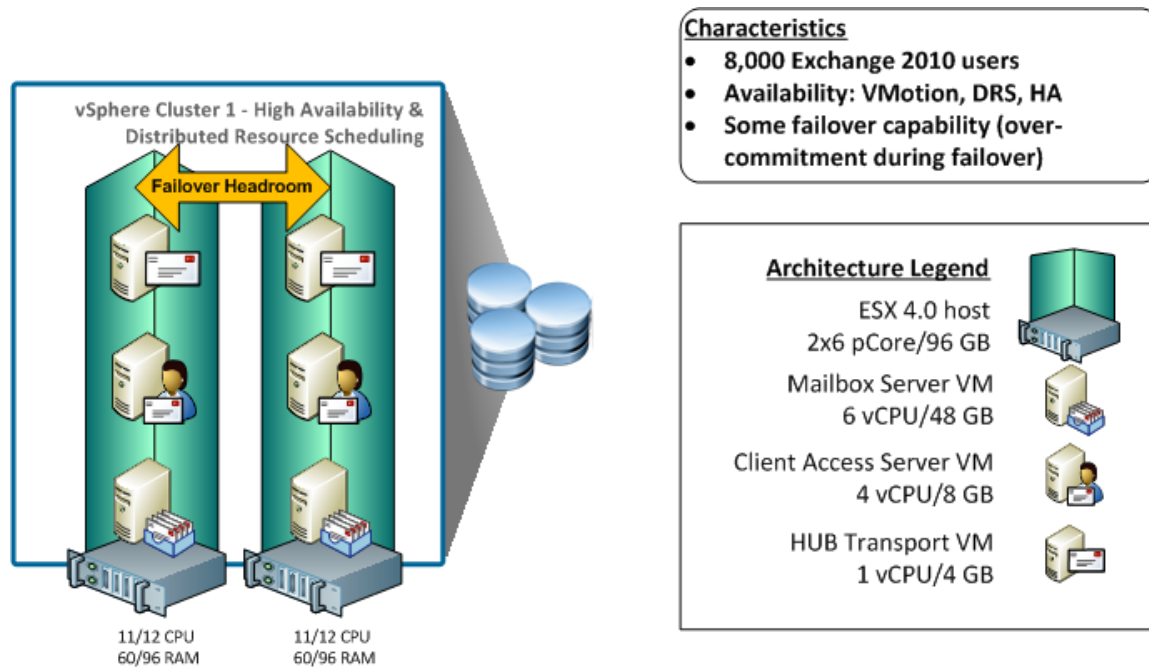
**Table 6. ESXi host Hardware Configuration Table**

ESXi host	VM(s)
ALL ESXi hosts	12 cores (2x6) 96GB RAM (extra 36GB above requirements for use in failover) 2 Fibre Channel HBAs 4 Gigabit network adapters

### 3.3.4 Initial Virtual Machine Placement

Although the workloads migrate automatically with DRS (including the mailbox servers), the following diagram is a useful planning tool for initial placement of virtual machines and for calculating host failover capacity. At initial placement, both ESXi hosts have some failover headroom.

**Figure 4. Initial Virtual Machine Placement**



## 3.4 Example 2 – 16,000 Users/150 Sent/Received

The second example uses our 4,000-user building block numbers to estimate the number of mailbox servers and the amount of processing and memory needed for the CAS and Hub Transport Roles. We then translate the estimated resources into virtual machine and host configurations.

### 3.4.1 Resource Requirements by Server Role

In this example, the Mailbox Server building block is the same, but we added two more of them. We also recalculated the number of CAS and Hub Transport virtual machines per Microsoft guidelines.

**Table 7. Exchange Server Role Resource Requirements**

Exchange Role	Physical Resources (per server)
Mailbox Server (4 servers)	<b>CPU:</b> 6 cores (60% max utilization) <b>Memory:</b> 48GB <b>OS and Application File Storage:</b> 64GB (OS and application files) <b>DB Storage:</b> 110 x 300GB 10K RPM FC/SCSI/SAS 3.5" (RAID 1/0) <b>Log Storage:</b> 6 x 300GB 10K RPM FC/SCSI/SAS 3.5" (RAID 1/0) <b>Restore LUN:</b> 12 x 300GB 10K RPM FC/SCSI/SAS 3.5" (RAID 5) <b>Network:</b> 1Gbps
Client Access Server (3 servers)	<b>CPU:</b> 4 cores <b>Memory:</b> 8GB <b>Storage:</b> 24GB (OS and application files) <b>Network:</b> 1Gbps
Hub Transport Server (2 servers)	<b>CPU:</b> 2 cores <b>Memory:</b> 4GB <b>Storage:</b> 20GB (OS, application, and log files) 32GB (DB, protocol/tracking logs, and temp files) <b>Network:</b> 1Gbps

### 3.4.2 Virtual Machine Distribution

In this example, we've chosen to use four ESXi hosts connected to shared storage to use advanced VMware features such as HA and DRS.

To build infrastructure availability into the architecture, we distribute the nine total virtual machines across four physical ESXi hosts. Initial placement of virtual machines is relatively unimportant, especially if you're using DRS.

**Table 8. Exchange Virtual Machine Distribution**

ESXi host	VM(s)
ESXi host 1	Exchange Mailbox VM 1 (6 vCPU/48GB RAM) Exchange Client Access VM 1 (4 vCPU/8GB RAM) Exchange Hub Transport VM 1 (2 vCPU/4GB RAM)
ESXi host 2	Exchange Mailbox VM 2 (6 vCPU/48GB RAM) Exchange Client Access VM 2 (4 vCPU/8GB RAM) Exchange Hub Transport VM 2 (2 vCPU/4GB RAM)
ESXi host 3	Exchange Mailbox VM 3 (6 vCPU/48GB RAM) Exchange Client Access VM 3 (4 vCPU/8GB RAM)
ESXi host 4	Exchange Mailbox VM 4 (6 vCPU/48GB RAM)

### 3.4.3 ESXi Host Specifications

Each ESXi host should provide enough physical hardware resources to accommodate the planned workload and provide some headroom in the event of a VMware HA failover or planned vMotion migration of live virtual machines for host hardware maintenance. The following table summarizes the ESXi host hardware configuration based on our example architecture.

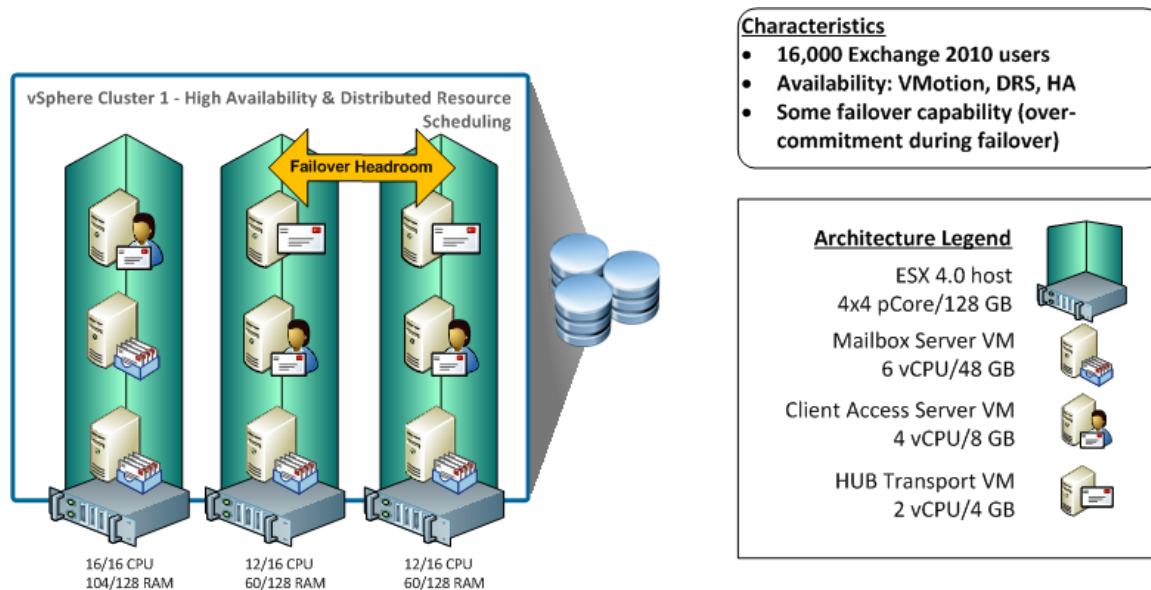
**Table 9. ESXi Host Hardware Configuration Table**

ESXi host	VM(s)
All ESXi hosts	16 cores (4x4) 128GB RAM (extra 14GB above requirements for use in failover) 2 Fibre Channel HBAs 4 Gigabit network adapters

### 3.4.4 Initial Virtual Machine Placement

Although the workloads migrate automatically with DRS (including the mailbox servers), the following diagram is a useful planning tool for initial placement of virtual machines and for calculating host failover capacity. At initial placement, ESXi hosts 2 and 3 have the most failover headroom.

**Figure 5. Initial Virtual Machine Placement**



## 3.5 Example 3 – 64,000 Users/150 Sent/Received

The following example uses our 4,000 active user building block numbers to estimate the number of mailbox servers and the amount of processing and memory needed for the CAS and Hub Transport Roles. We then translate the estimated resources into virtual machine and host configurations.

Although we've used the 4,000-user building block in this example, higher mailbox concentrations are certainly possible, depending on the specific workload. Mailbox Server virtual machines have been configured to run 11,000 mailboxes in production customer environments. That noted, the 4,000-user building block has been officially tested and recommended by our server and storage partners. See the *Microsoft Exchange 2010 on VMware: Partner Resource Catalog* in this solution kit for more information about building blocks and performance testing.

### 3.5.1 Resource Requirements by Server Role

In this example, the Mailbox Server building block is the same and we scaled to 16 virtual machines. We also increased the Client Access Server count to 12 and the Hub Transport count to 4.

**Table 10. Exchange Server Role Resource Requirements**

Exchange Role	Physical Resources (per server)
Mailbox Server (16 servers)	<b>CPU:</b> 6 cores (60% max utilization) <b>Memory:</b> 48GB <b>OS and Application File Storage:</b> 64GB (OS and application files) <b>DB Storage:</b> 110 x 300GB 10K RPM FC/SCSI/SAS 3.5" (RAID 1/0) <b>Log Storage:</b> 6 x 300GB 10K RPM FC/SCSI/SAS 3.5" (RAID 1/0) <b>Restore LUN:</b> 12 x 300GB 10K RPM FC/SCSI/SAS 3.5" (RAID 5) <b>Network:</b> 1Gbps
Client Access Server (12 servers)	<b>CPU:</b> 4 cores <b>Memory:</b> 8GB <b>Storage:</b> 24GB (OS and application files) <b>Network:</b> 1Gbps
Hub Transport Server (4 servers)	<b>CPU:</b> 4 cores <b>Memory:</b> 4GB <b>Storage:</b> 20GB (OS, application, and log files) 32GB (DB, protocol/tracking logs, and temp files) <b>Network:</b> 1Gbps

### 3.5.2 Exchange Virtual Machine Distribution

In this example, we've increased the physical server count to eight ESXi hosts and evenly balanced the initial virtual machine placement across them.

**Table 11. Exchange Virtual Machine Distribution for Eight ESXi hosts**

ESXi host	VM(s)
ESXi host 1	Exchange Mailbox VM 1 (6 vCPU/48GB RAM) Exchange Mailbox VM 2 (6 vCPU/48GB RAM) Exchange Client Access VM 1 (4 vCPU/8GB RAM) Exchange Client Access VM 2 (4 vCPU/8GB RAM)
ESXi host 2	Exchange Mailbox VM 3 (6 vCPU/48GB RAM) Exchange Mailbox VM 4 (6 vCPU/48GB RAM) Exchange Client Access VM 3 (4 vCPU/8GB RAM) Exchange Client Access VM 4 (4 vCPU/8GB RAM)
ESXi host 3	Exchange Mailbox VM 5 (6 vCPU/48GB RAM) Exchange Mailbox VM 6 (6 vCPU/48GB RAM) Exchange Client Access VM 5 (4 vCPU/8GB RAM) Exchange Client Access VM 6 (4 vCPU/8GB RAM)
ESXi host 4	Exchange Mailbox VM 7 (6 vCPU/48GB RAM) Exchange Mailbox VM 8 (6 vCPU/48GB RAM) Exchange Client Access VM 7 (4 vCPU/8GB RAM) Exchange Client Access VM 8 (4 vCPU/8GB RAM)
ESXi host 5	Exchange Mailbox VM 9 (6 vCPU/48GB RAM) Exchange Mailbox VM 10 (6 vCPU/48GB RAM) Exchange Client Access VM 9 (4 vCPU/8GB RAM) Exchange Hub Transport VM 1 (4 vCPU/4GB RAM)
ESXi host 6	Exchange Mailbox VM 11 (6 vCPU/48GB RAM) Exchange Mailbox VM 12 (6 vCPU/48GB RAM) Exchange Client Access VM 10 (4 vCPU/8GB RAM) Exchange Hub Transport VM 2 (4 vCPU/4GB RAM)
ESXi host 7	Exchange Mailbox VM 13 (6 vCPU/48GB RAM) Exchange Mailbox VM 14 (6 vCPU/48GB RAM) Exchange Client Access VM 11 (4 vCPU/8GB RAM) Exchange Hub Transport VM 3 (4 vCPU/4GB RAM)



ESXi host 8	Exchange Mailbox VM 15 (6 vCPU/48GB RAM)
	Exchange Mailbox VM 16 (6 vCPU/48GB RAM)
	Exchange Client Access VM 12 (4 vCPU/8GB RAM)
	Exchange Hub Transport VM 4 (4 vCPU/4GB RAM)

### 3.5.3 ESXi Host Specifications

Each ESXi host should provide enough physical hardware resources to accommodate the planned workload and provide some headroom in the event of a VMware HA failover or planned vMotion migration of live virtual machines for host hardware maintenance. The following table summarizes the ESXi host hardware configuration based on our example architecture.

To get the most out of our hardware consolidation, we chose to implement 24-core hosts for this configuration.

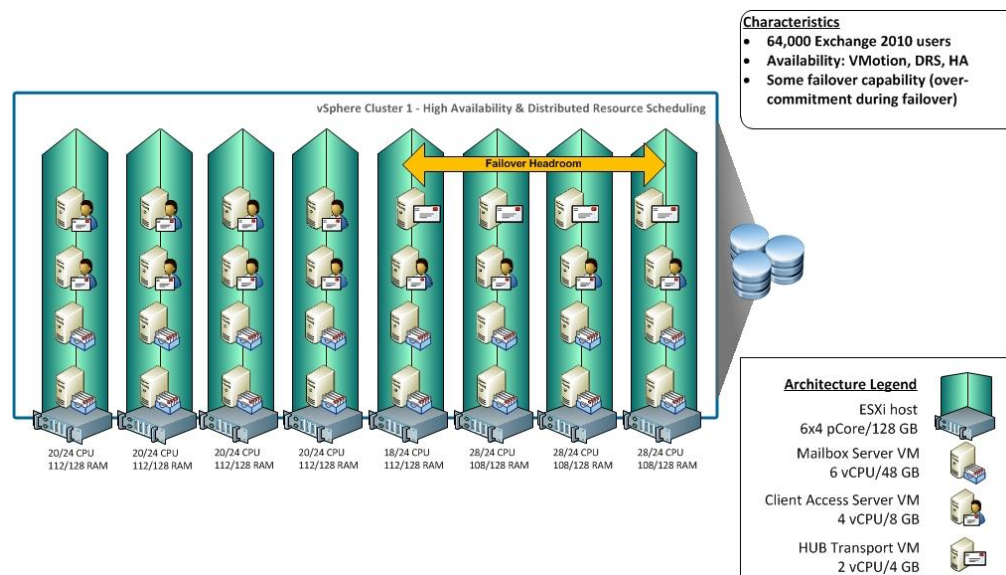
**Table 12. ESXi Host Hardware Configuration Table**

ESXi host	Specification
All ESXi hosts	24 cores (4x6)
	128GB RAM (extra 16GB above requirements for use in failover)
	2 Fibre Channel HBAs
	4 Gigabit network adapters

### 3.5.4 Initial Virtual Machine Placement

Although the workloads migrate automatically with DRS (including the mailbox servers), the following diagram is a useful planning tool for initial placement of virtual machines and for calculating host failover capacity. At initial placement, ESXi hosts 4 - 8 have the most failover headroom.

**Figure 6. Initial Virtual Machine Placement for 64,000 Active Users**



## 4. DAG Examples (Clustered Mailbox Servers)

### 4.1 The DAG Process

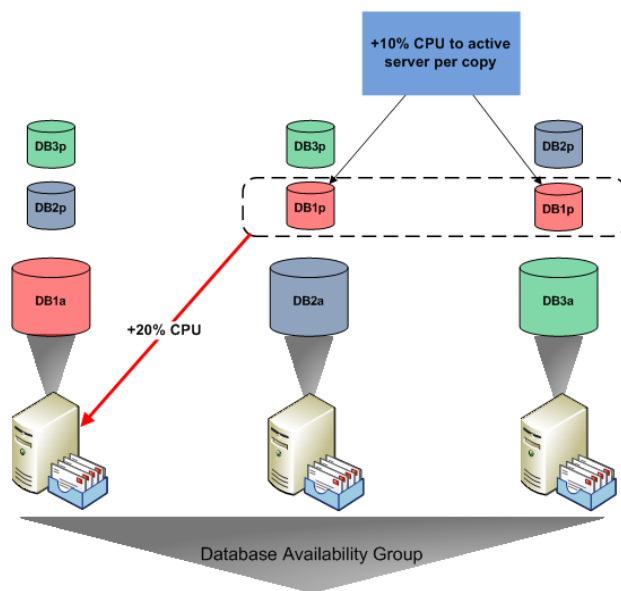
The new Database Availability Group (DAG) feature in Exchange 2010 necessitates a different approach to sizing the Mailbox Server role, forcing the administrator to account for both active and passive mailboxes. Mailbox Servers that are members of a DAG can host one or more passive databases in addition to any active databases for which they may be responsible.

Each passive database adds an additional 10% to the CPU requirements of the mailbox server hosting the active copy.

The following diagram illustrates this principle. There are three Exchange mailbox servers, each with an active database (DB1a denotes database 1 active) and two passive databases from the other two mailbox servers (DB1p denotes database 1 passive). Each passive copy of DB1a requires 10% extra processing on the server hosting DB1a, for a total of 20% extra CPU overhead.

So, each mailbox server in this example requires 20% additional processing power to account for passive database copies.

**Figure 7. DAG Layout with Overhead for Passive Databases**



The sizing process begins with understanding and applying Microsoft guidelines for each server role, as represented by the following high-level processes:

Design the Mailbox Server DAG nodes:

- Define current workloads using the *Microsoft Exchange Server Profile Analyzer* (<http://www.microsoft.com/download/en/details.aspx?displaylang=en&id=10559>).
- To simplify capacity planning, use the *Exchange 2010 Mailbox Server Role Requirements Calculator* (<http://blogs.technet.com/b/exchange/archive/2009/11/09/3408737.aspx>) to calculate CPU, memory, and storage sizing.
- Alternatively, if you prefer a manual process:

- Apply Microsoft guidelines to determine the CPU and memory requirements. Inputs include, number of mailboxes, mailbox profile, number of servers in the DAG, number of passive database copies, and several other custom parameters.
- Use the *Exchange 2010 Mailbox Server Role Requirements Calculator* (<http://blogs.technet.com/b/exchange/archive/2009/11/09/3408737.aspx>) from Microsoft to determine storage requirements.

Design the peripheral server roles.

- The *Exchange 2010 Mailbox Server Role Requirements Calculator* also recommends CPU and memory for the CAS and Hub Transport roles.
- Alternatively, if you prefer a manual process:
  - Count the number of mailbox server processor cores.
  - Multiply by expected CPU utilization. This should be less than 80% for a clustered mailbox server (for example, 16 cores \* .80 = 14 cores (rounded from 12.8)).
  - Use the modified number of mailbox cores and *Microsoft Guidelines for Server Role Ratios* (<http://technet.microsoft.com/en-us/library/ee832795.aspx>) to calculate processor and memory requirements for the Hub Transport roles.
  - Use the modified number of mailbox cores and *Microsoft Guidelines for Server Role Ratios* (<http://technet.microsoft.com/en-us/library/ee832795.aspx>) to calculate processor and memory requirements for the Client Access Server roles.

Allocate one or more virtual machines for each server role to satisfy the previously calculated number of processor cores and amount of memory.

Determine how the virtual machines will be distributed across ESXi hosts.

Aggregate virtual machine requirements plus some overhead to size each ESXi host. The overhead is important if you want to minimize the performance impact during the loss of one of your ESXi hosts. A typical guideline when choosing the number of required hosts is  $n+1$ , where  $n$  is the number of hosts required to run the workload at peak utilization.  $N+1$  allows you to design for the possibility of losing one host from your VMware cluster without taking a huge performance hit during failover.

## 4.2 DAG Sizing – 150 Sent/Received

Using the Microsoft guidelines we design our mailbox servers using Database Availability Groups for mailboxes sending/receiving 150 messages per day. The number of mailboxes varies in each example. The following calculations are meant to serve as an example of the sizing process. Customers are encouraged to use these as guidelines but must also evaluate specific requirements to determine the most optimal deployment models for their needs.

Every environment is different and some organizations use email more heavily than others. To accurately determine your mailbox profile requirements, utilize the *Microsoft Exchange Server Profile Analyzer* (<http://www.microsoft.com/download/en/details.aspx?displaylang=en&id=10559>). It is strongly recommended that you work with an internal or partner resource that is experienced with Exchange architectures to design for good performance in your environment. In our example, we use the following average mailbox profile definition.

150 messages sent/received per day.

Average message size of 75KB.

2GB mailbox quota.

Note that these examples do not take into account a particular storage solution. Many VMware storage partners have done extensive testing on building blocks of varying capacities and workload

characteristics. See the *Microsoft Exchange 2010 on VMware: Partner Resource Catalog* for storage-specific implementation details.

## 4.3 DAG Example 1 – 8,000 Active Mailboxes – 150 Sent/Received

The following example demonstrates the mailbox configuration needed to support 8,000 active users protected by DAG clustering. We use the mailbox calculations to estimate the amount of processing and memory needed for the CAS and Hub Transport Roles. We then translate the estimated resources into virtual machine and host configurations.

### 4.3.1 Mailbox Server Resource Requirements

The following table summarizes the resource requirements for the mailbox servers running in the DAG. For this example, we decided to spread our 8,000 users across three Mailbox Servers. Each server supports approximately 2,666 active users during normal operation and has the capacity to support approximately 4,000 active users during failover of one cluster node.

**Table 13. Mailbox Server Resource Requirements**

Exchange Role	Physical Resources (per server)
Mailbox Server (3 nodes)	<b>CPU:</b> 6 cores (69% max utilization) <b>Memory:</b> 48GB <b>Database and Log Storage</b> 96 x 300GB/10K RPM FC/SCSI/SAS 3.5" <b>Restore LUN Storage</b> 9 x 300GB/10K RPM FC/SCSI/SAS 3.5" <b>Network:</b> 1Gbps

### 4.3.2 Guest Virtual Machine Configuration

The resource requirements in Table 13 are translated into the following virtual machine resources.

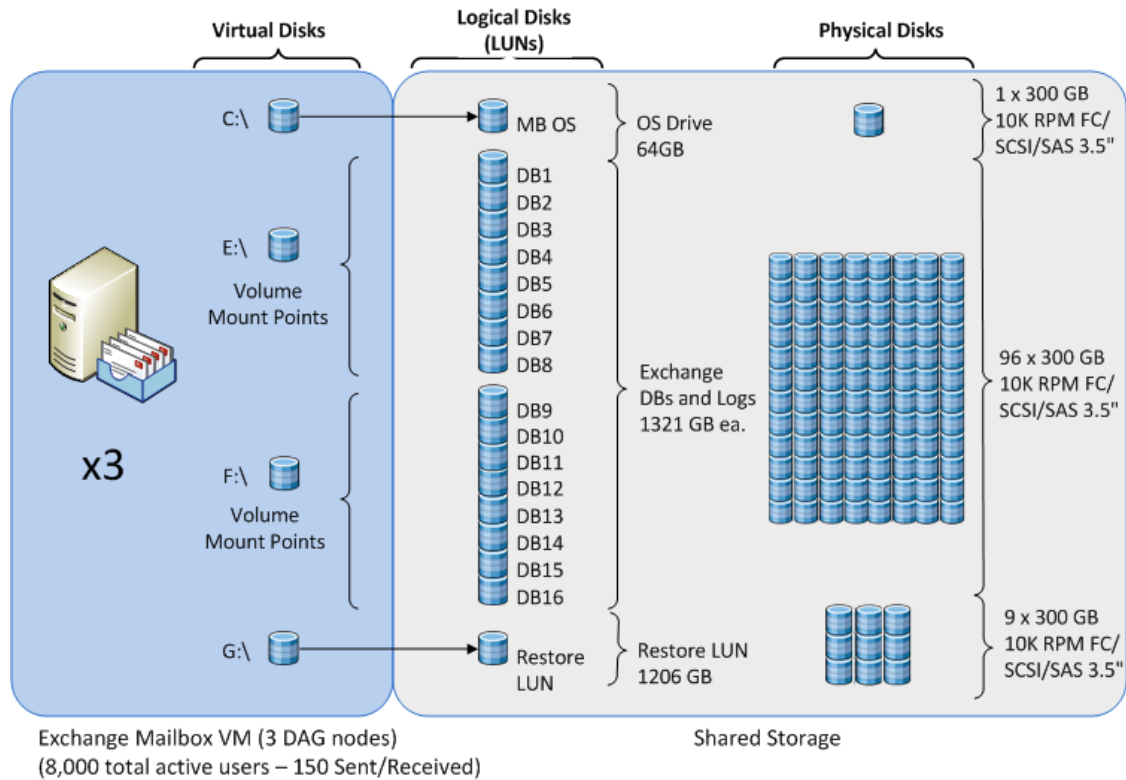
**Table 14. Exchange Virtual Machine Configuration**

Exchange Role	Virtual Hardware (per VM)
Mailbox Server (3 servers)	<b>CPU:</b> 6 vCPU <b>Memory:</b> 48GB <b>Storage:</b> SCSI Controller 0 HDD 1: 64GB (OS and application files) <b>Storage:</b> SCSI Controller 1 HDD 2: 1321GB (DB1) HDD 3: 1321GB (DB2) HDD 4: 1321GB (DB3) HDD 5: 1321GB (DB4) HDD 6: 1321GB (DB5) HDD 7: 1321GB (DB6) HDD 8: 1321GB (DB7) <b>Storage:</b> SCSI Controller 2 HDD 9: 1321GB (DB8) HDD 10: 1321GB (DB9) HDD 11: 1321GB (DB10) HDD 12: 1321GB (DB11) HDD 13: 1321GB (DB12) HDD 14: 1321GB (DB13) HDD 15: 1321GB (DB14) HDD 16: 1321GB (DB15) <b>Storage:</b> SCSI Controller 3 HDD 17: 1206GB (Restore LUN) <b>Network:</b> NIC 1

### 4.3.3 Guest Virtual Machine Storage Interaction

Figure 8 illustrates how the building block virtual machine interacts with the shared storage.

**Figure 8. Building Block Interaction with Shared Storage**



#### 4.3.4 Resource Requirements by Server Role

Using Microsoft and VMware best practices, we can estimate the resource requirements of each server role based on server role ratios and Microsoft sizing guidelines. In this case, we support 8,000 active users and thus need two Exchange mailbox servers. For an in-depth look at the sizing and configuration process, see the *Microsoft Exchange 2010 on VMware: Best Practices Guide*.

**Table 15. Exchange Server Role Resource Requirements**

Exchange Role	Physical Resources (per server)
Mailbox Server (3 servers)	<b>CPU:</b> 6 cores <b>Memory:</b> 48GB <b>Database and Log Storage</b> 96 x 300GB/10K RPM FC/SCSI/SAS 3.5" <b>Restore LUN Storage</b> 9 x 300GB/10K RPM FC/SCSI/SAS 3.5" <b>Network:</b> 1Gbps
Client Access Server (3 servers)	<b>CPU:</b> 2 cores <b>Memory:</b> 8GB <b>Storage:</b> 24GB (OS and application files) <b>Network:</b> 1Gbps
Hub Transport Server (2 servers)	<b>CPU:</b> 1 core <b>Memory:</b> 4GB <b>Storage:</b> 20GB (OS, application, and log files) 32GB (DB, protocol/tracking logs, and temp files) <b>Network:</b> 1Gbps

### 4.3.5 Virtual Machine Distribution

Now that we understand the physical resource requirements and associated virtual hardware configuration, we can plan physical ESXi host hardware to meet those requirements. To build infrastructure availability into the architecture, we distribute the eight total virtual machines across three physical VMware ESXi host servers. Initial placement of virtual machines is relatively unimportant, especially if you are using DRS.

**Table 16. Exchange Virtual Machine Distribution**

ESXi host	VM(s)
ESXi host 1	Exchange Mailbox VM 1 (6 vCPU/48GB RAM) Exchange Client Access VM 1 (2 vCPU/8GB RAM) Exchange Hub Transport VM 1 (1 vCPU/4GB RAM)
ESXi host 2	Exchange Mailbox VM 2 (6 vCPU/48GB RAM) Exchange Client Access VM 2 (2 vCPU/8GB RAM) Exchange Hub Transport VM 2 (1 vCPU/4GB RAM)
ESXi host 3	Exchange Mailbox VM 3 (6 vCPU/48GB RAM) Exchange Client Access VM 3 (2 vCPU/8GB RAM)

### 4.3.6 ESXi host Specifications

Each ESXi host should provide enough physical hardware resources to accommodate the planned workload and provide some headroom in the event of a VMware HA failover or planned vMotion migration of live virtual machines for host hardware maintenance. The following table summarizes the ESXi host hardware configuration based on our example architecture.

**Table 17. ESXi Host Hardware Configuration Table**

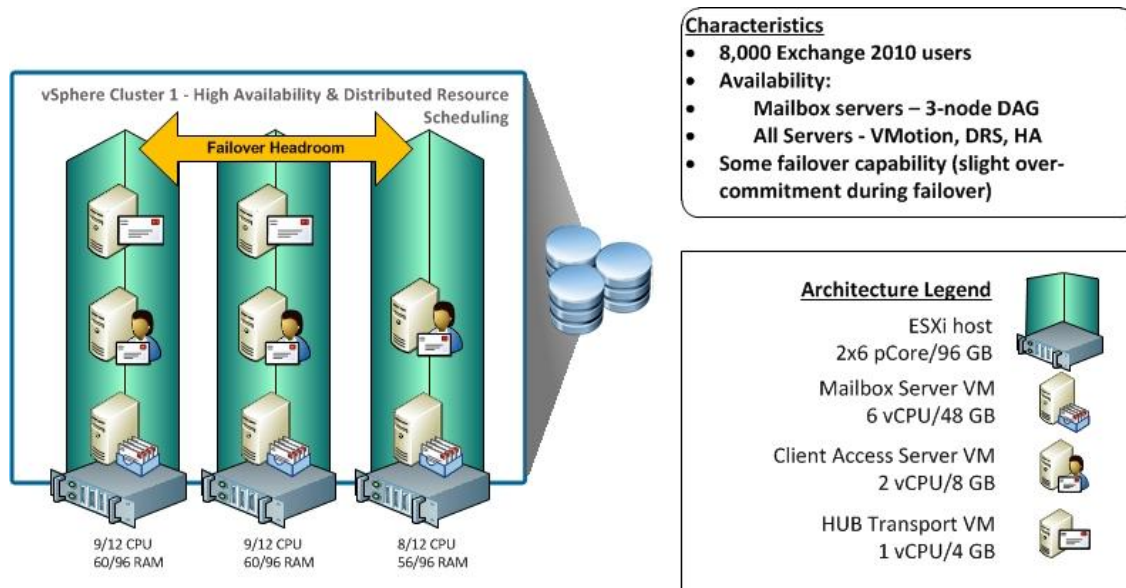
ESXi host	VM(s)
All ESXi hosts	12 cores (2x6) 96GB RAM (extra 36GB above requirements for use in failover) 2 Fibre Channel HBAs 4 Gigabit network adapters



### 4.3.7 Initial Virtual Machine Placement

Although the workloads migrate automatically with DRS (including the mailbox servers), the following diagram is a useful planning tool for initial placement of virtual machines and for calculating host failover capacity. At initial placement, all ESXi hosts have failover headroom, but ESXi host 3 has the most.

**Figure 9. Initial Virtual Machine Placement for 8,000 Active Users**



## 4.4 DAG Example 2 – 16,000 Active Mailboxes – 150 Sent/Received

The following example demonstrates the mailbox configuration needed to support 16,000 active users protected by DAG clustering. We use the mailbox calculations to estimate the amount of processing and memory needed for the CAS and Hub Transport Roles. We then translate the estimated resources into virtual machine and host configurations.

### 4.4.1 Mailbox Server Resource Requirements

The following table summarizes the resource requirements for the mailbox servers running in the DAG. For this example, we decided to spread our 16,000 users across four Mailbox servers. Each server supports approximately 4,000 active users during normal operation and has the capacity to support approximately 5,333 active users during failover of one cluster node.

**Table 18. 16,000 Active Mailboxes (150 Sent/Received) DAG Node Requirements**

Exchange Role	Physical Resources (per server)
Mailbox Server (4 nodes)	<b>CPU:</b> 8 cores (82% max utilization) <b>Memory:</b> 64GB <b>OS and Application File Storage:</b> 80GB (OS and application files) <b>Database and Log Storage</b> 138 x 300GB 10K RPM FC/SCSI/SAS 3.5" <b>Restore LUN Storage</b> 9 x 300GB/10K RPM FC/SCSI/SAS 3.5" <b>Network:</b> 1Gbps

### 4.4.2 Guest Virtual Machine Configuration

The resource requirements given in Table 18 are translated into the following virtual machine resources.

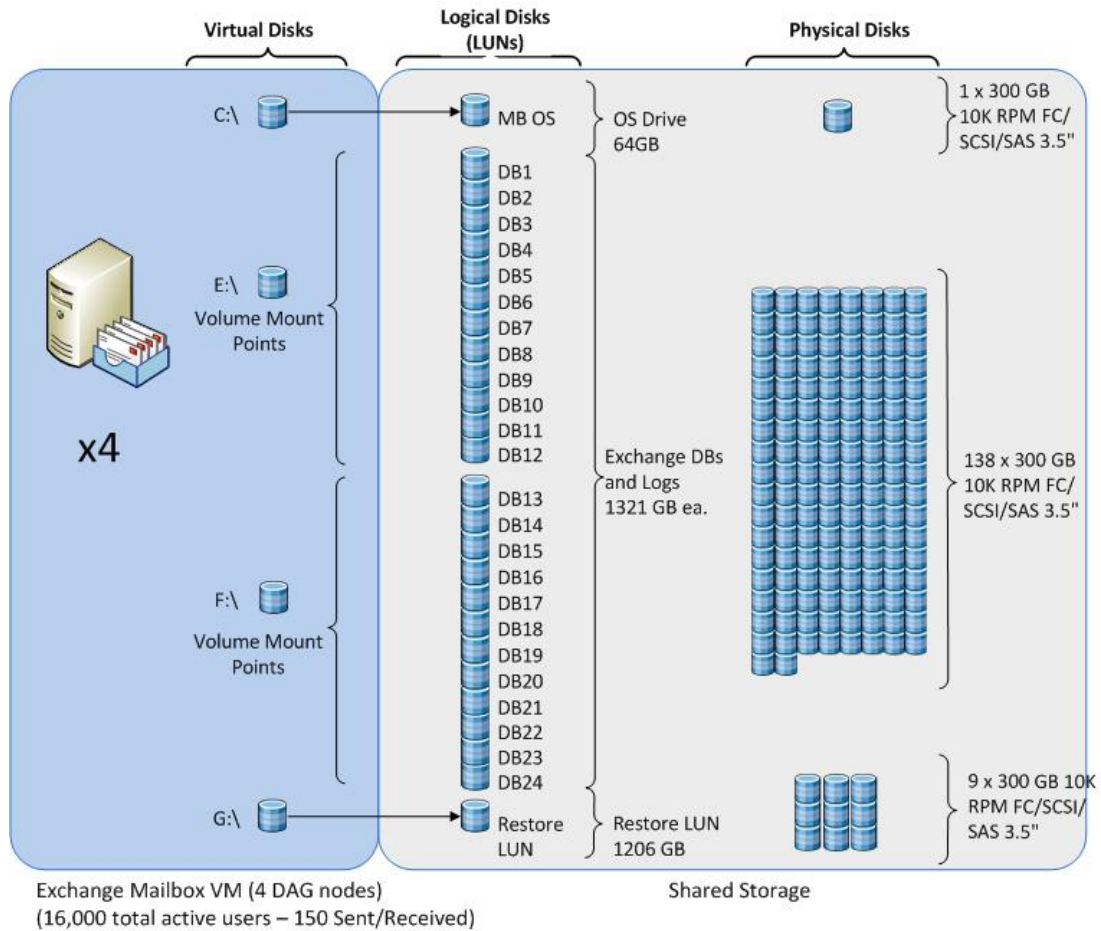
**Table 19. Exchange Virtual Machine Configuration**

Exchange Role	Virtual Hardware (per VM)
Mailbox Server (4 servers)	<p><b>CPU:</b> 8 vCPU</p> <p><b>Memory:</b> 64GB</p> <p><b>Storage:</b> SCSI Controller 0</p> <p>HDD 1: 80GB (OS and application files)</p> <p><b>Storage:</b> SCSI Controller 1</p> <p>HDD 2: 1321GB (DB1)</p> <p>HDD 3: 1321GB (DB2)</p> <p>HDD 4: 1321GB (DB3)</p> <p>HDD 5: 1321GB (DB4)</p> <p>HDD 6: 1321GB (DB5)</p> <p>HDD 7: 1321GB (DB6)</p> <p>HDD 8: 1321GB (DB7)</p> <p>HDD 9: 1321GB (DB8)</p> <p>HDD 10: 1321GB (DB9)</p> <p>HDD 11: 1321GB (DB10)</p> <p>HDD 12: 1321GB (DB11)</p> <p>HDD 13: 1321GB (DB12)</p> <p><b>Storage:</b> SCSI Controller 2</p> <p>HDD 14: 1321GB (DB13)</p> <p>HDD 15: 1321GB (DB14)</p> <p>HDD 16: 1321GB (DB15)</p> <p>HDD 17: 1321GB (DB16)</p> <p>HDD 18: 1321GB (DB17)</p> <p>HDD 19: 1321GB (DB18)</p> <p>HDD 20: 1321GB (DB19)</p> <p>HDD 21: 1321GB (DB20)</p> <p>HDD 22: 1321GB (DB21)</p> <p>HDD 23: 1321GB (DB22)</p> <p>HDD 24: 1321GB (DB23)</p> <p>HDD 25: 1321GB (DB24)</p> <p><b>Storage:</b> SCSI Controller 3</p> <p>HDD 26: 1206GB (Restore LUN)</p> <p><b>Network:</b> NIC 1</p>

### 4.4.3 Guest Virtual Machine Storage Interaction

Figure 10 illustrates how the building block virtual machine interact with the shared storage.

**Figure 10. Building Block Virtual Machine Interaction with Shared Storage**



### 4.4.4 Resource Requirements by Server Role

In this example, we increased the number of mailbox servers to four. We also recalculated the number of CAS and Hub Transport virtual machines per Microsoft guidelines.

**Table 20. Exchange Server Role Resource Requirements**

Exchange Role	Physical Resources (per server)
Mailbox Server (4 servers)	<b>CPU:</b> 8 cores <b>Memory:</b> 64GB <b>OS and Application File Storage:</b> 80GB (OS and application files) <b>Database and Log Storage</b> 138 x 300GB/10K RPM FC/SCSI/SAS 3.5" <b>Restore LUN Storage</b> 9 x 300GB/10K RPM FC/SCSI/SAS 3.5" <b>Network:</b> 1Gbps
Client Access Server (4 servers)	<b>CPU:</b> 4 cores <b>Memory:</b> 8GB <b>Storage:</b> 24GB (OS and application files) <b>Network:</b> 1Gbps
Hub Transport Server (2 servers)	<b>CPU:</b> 2 cores <b>Memory:</b> 4GB <b>Storage:</b> 20GB (OS, application, and log files) 32GB (DB, protocol/tracking logs, and temp files) Network: 1Gbps

#### 4.4.5 Virtual Machine Distribution

In this example, we use four ESXi hosts connected to shared storage so that we can use advanced VMware features such as HA and DRS.

To build infrastructure availability into the architecture, we distribute the 10 total virtual machines across four physical VMware ESXi host servers. Initial placement of virtual machines is relatively unimportant, especially if you're using DRS.

**Table 21. Exchange Virtual Machine Distribution**

ESXi host	VM(s)
ESXi host 1	Exchange Mailbox VM 1 (8 vCPU/64GB RAM) Exchange Client Access VM 1 (4 vCPU/8GB RAM) Exchange Hub Transport VM 1 (2 vCPU/4GB RAM)
ESXi host 2	Exchange Mailbox VM 2 (8 vCPU/64GB RAM) Exchange Client Access VM 2 (4 vCPU/8GB RAM) Exchange Hub Transport VM 2 (2 vCPU/4GB RAM)
ESXi host 3	Exchange Mailbox VM 3 (8 vCPU/64GB RAM) Exchange Client Access VM 3 (4 vCPU/8GB RAM)
ESXi host 4	Exchange Mailbox VM 4 (8 vCPU/64GB RAM) Exchange Client Access VM 4 (4 vCPU/8GB RAM)

#### 4.4.6 ESXi host Specifications

Each ESXi host should provide enough physical hardware resources to accommodate the planned workload and provide some headroom in the event of a VMware HA failover or planned vMotion migration of live virtual machines for host hardware maintenance. The following table summarizes the ESXi host hardware configuration based for our example architecture.

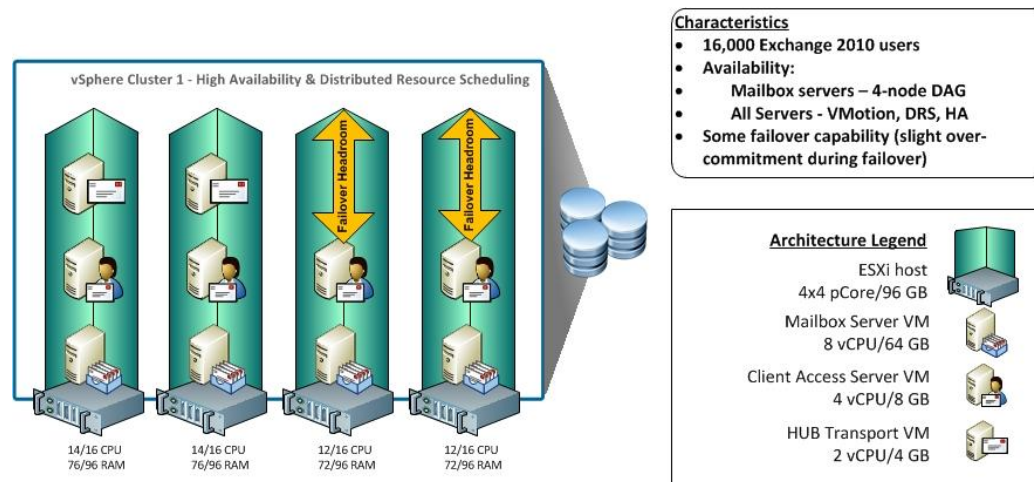
**Table 22. ESXi host Hardware Configuration Table**

ESXi host	VM(s)
All ESXi hosts	16 cores (4x4) 96GB RAM (extra 20GB above requirements for use in failover) 2 Fibre Channel HBAs 4 Gigabit network adapters

#### 4.4.7 Initial VM Placement

Although the workloads migrate automatically with DRS (including the mailbox servers), the following diagram is a useful planning tool for initial placement of virtual machines and calculating host failover capacity. At initial placement, ESXi hosts 3 and 4 have the most failover headroom.

**Figure 11. Initial Virtual Machine Placement for 16,000 Active Users**



#### 4.5 DAG Example 3 – 64,000 Active Mailboxes – 150 Sent/Received

The following example demonstrates the mailbox configuration needed to support 64,000 active users protected by DAG clustering. We use the mailbox calculations to estimate the amount of processing and memory needed for the CAS and Hub Transport Roles. We then translate the estimated resources into virtual machine and host configurations.

##### 4.5.1 Mailbox Server Resource Requirements

The following table summarizes the resource requirements for the mailbox servers running in the DAG. For this example, we've decided to spread our 64,000 users across 12 Mailbox servers in two DAGs. Each server supports approximately 5,333 active users during normal operation and has the capacity to support approximately 6400 active users during failover of one cluster node.

**Note** For maximum consolidation, larger ESXi hosts were used to accommodate two mailbox server virtual machines. When deploying a DAG on vSphere, best practices require no more than a single DAG node per DAG to be hosted on a single physical host. To accommodate two DAG nodes per host the users have been distributed across two DAGs. If using vSphere 5 or later it is also possible to accommodate more users by deploying larger virtual machines.

**Table 23. 64,000 Active Mailboxes (150 Sent/Received) DAG Node Requirements**

Exchange Role	Physical Resources (per server)
Mailbox Server (12 nodes)	<b>CPU:</b> 8 cores <b>Memory:</b> 96GB <b>OS and Application File Storage:</b> 80GB (OS and application files) <b>Database and Log Storage</b> 46 x 2000GB 15K RPM FC/SCSI/SAS 3.5" <b>Restore LUN Storage</b> 3 x 2000GB/15K RPM FC/SCSI/SAS 3.5" <b>Network:</b> 1Gbps

## 4.5.2 Guest Virtual Machine Configuration

**Note** The resource requirements given in Table 23 translated into the virtual machine resources listed in Table 24.

**Table 24. Exchange Virtual Machine Configuration**

Exchange Role	Virtual Hardware (per VM)
Mailbox Server (12 servers)	<b>CPU:</b> 8 vCPU <b>Memory:</b> 96GB <b>Storage:</b> SCSI Controller 0 HDD 1: 80GB (OS and application files) <b>Storage:</b> SCSI Controller 1 HDD 2: 2064GB (DB1) HDD 3: 2064GB (DB2) HDD 4: 2064GB (DB3) HDD 5: 2064GB (DB4) HDD 6: 2064GB (DB5) HDD 7: 2064GB (DB6) HDD 8: 2064GB (DB7) HDD 9: 2064GB (DB8) HDD 10: 2064GB (DB9) <b>Storage:</b> SCSI Controller 2 HDD 11: 2064GB (DB10) HDD 12: 2064GB (DB11) HDD 13: 2064GB (DB12) HDD 14: 2064GB (DB13)



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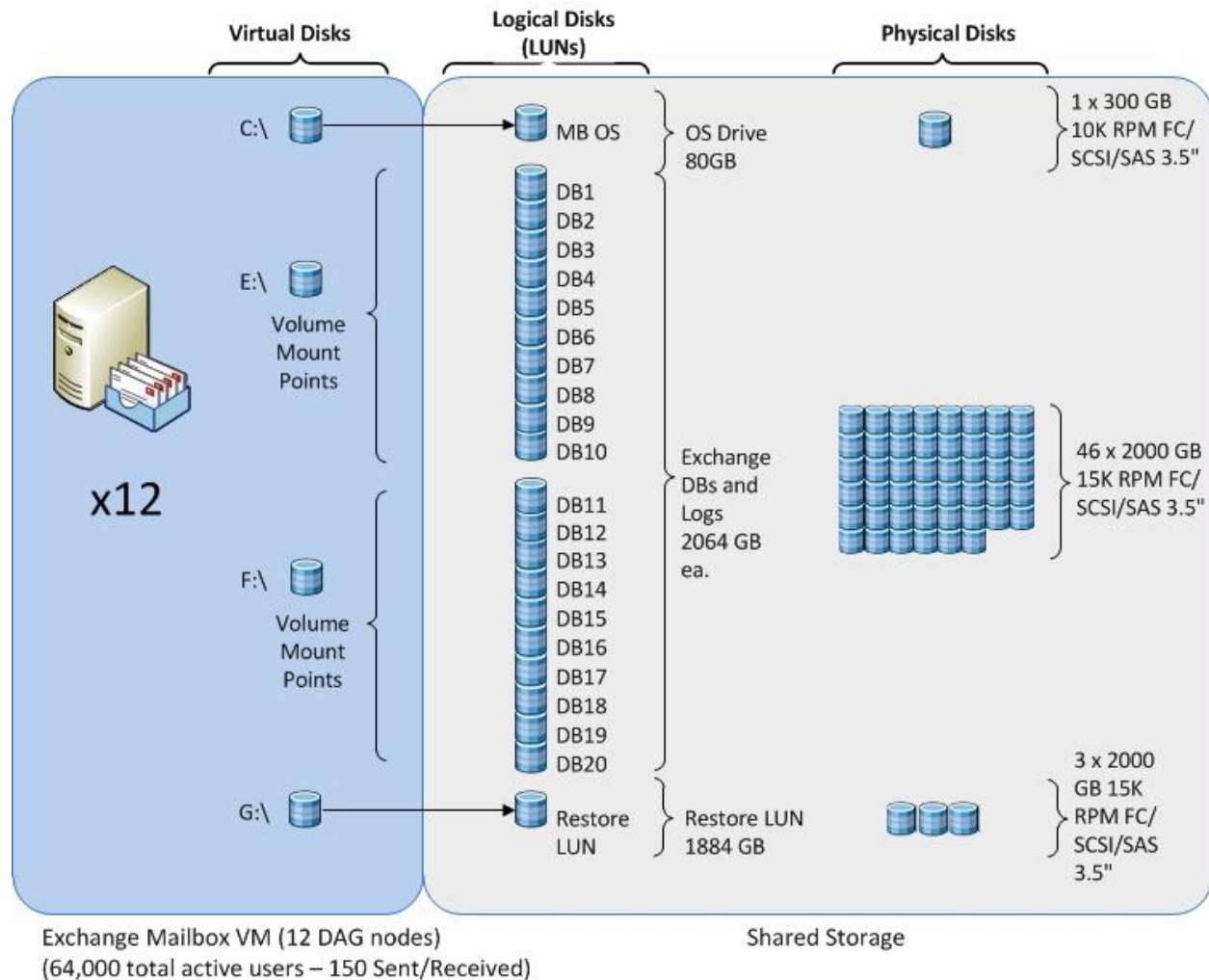
HDD 15: 2064GB (DB14)  
HDD 16: 2064GB (DB15)  
HDD 17: 2064GB (DB16)  
HDD 18: 2064GB (DB17)  
HDD 19: 2064GB (DB18)  
HDD 20: 2064GB (DB19)  
**Storage:** SCSI Controller 3  
HDD 34: 1884GB (Restore LUN)  
**Network:** NIC 1

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### 4.5.3 Guest Virtual Machine Storage Interaction

The following figure illustrates how the building block virtual machine interacts with the shared storage.

**Figure 12. Building Block Virtual Machine Interaction with Shared Storage**



#### 4.5.4 Resource Requirements by Server Role

In this example, we scaled the number of mailbox servers to 16 virtual machines. We also increased the Client Access Server count to 13 and the Hub Transport count to four.

**Table 25. Exchange Server Role Resource Requirements**

Exchange Role	Physical Resources (per server)
Mailbox Server (12 servers)	<b>CPU:</b> 8 cores (82% max utilization) <b>Memory:</b> 96GB <b>OS and Application File Storage:</b> 80GB (OS and application files) <b>Database and Log Storage</b> 46 x 2000GB 15K RPM FC/SCSI/SAS 3.5" <b>Restore LUN Storage</b> 3 x 2000GB/15K RPM FC/SCSI/SAS 3.5" <b>Network:</b> 1Gbps
Client Access Server (13 servers)	<b>CPU:</b> 4 cores <b>Memory:</b> 8GB <b>Storage:</b> 24GB (OS and application files) <b>Network:</b> 1Gbps
Hub Transport Server (4 servers)	<b>CPU:</b> 4 cores <b>Memory:</b> 4GB <b>Storage:</b> 20GB (OS, application, and log files) 32GB (DB, protocol/tracking logs, and temp files) <b>Network:</b> 1Gbps

### 4.5.5 Exchange Virtual Machine Distribution

In this example, we've increased the physical server count to six ESXi hosts and evenly balanced the initial virtual machine placement across them.

**Table 26. Exchange Virtual Machine Distribution**

ESXi host	VM(s)
ESXi host 1	Exchange Mailbox VM 1 (8 vCPU/96GB RAM) Exchange Mailbox VM 2 (8 vCPU/96GB RAM) Exchange Client Access VM 1 (4 vCPU/8GB RAM) Exchange Client Access VM 2 (4 vCPU/8GB RAM) Exchange Hub Transport VM 1 (4 vCPU/4GB RAM)
ESXi host 2	Exchange Mailbox VM 3 (8 vCPU/96GB RAM) Exchange Mailbox VM 4 (8 vCPU/96GB RAM) Exchange Client Access VM 3 (4 vCPU/8GB RAM) Exchange Client Access VM 4 (4 vCPU/8GB RAM) Exchange Hub Transport VM 2 (4 vCPU/4GB RAM)
ESXi host 3	Exchange Mailbox VM 5 (8 vCPU/96GB RAM) Exchange Mailbox VM 6 (8 vCPU/96GB RAM) Exchange Client Access VM 5 (4 vCPU/8GB RAM) Exchange Client Access VM 6 (4 vCPU/8GB RAM) Exchange Hub Transport VM 3 (4 vCPU/4GB RAM)
ESXi host 4	Exchange Mailbox VM 7 (8 vCPU/96GB RAM) Exchange Mailbox VM 8 (8 vCPU/96GB RAM) Exchange Client Access VM 7 (4 vCPU/8GB RAM) Exchange Client Access VM 8 (4 vCPU/8GB RAM) Exchange Hub Transport VM 4 (4 vCPU/4GB RAM)
ESXi host 5	Exchange Mailbox VM 9 (8 vCPU/96GB RAM) Exchange Mailbox VM 10 (8 vCPU/96GB RAM) Exchange Client Access VM 9 (4 vCPU/8GB RAM) Exchange Client Access VM 10 (4 vCPU/8GB RAM) Exchange Client Access VM 11 (4 vCPU/8GB RAM)
ESXi host 6	Exchange Mailbox VM 11 (8 vCPU/96GB RAM) Exchange Mailbox VM 12 (8 vCPU/96GB RAM) Exchange Client Access VM 12 (4 vCPU/8GB RAM) Exchange Client Access VM 13 (4 vCPU/8GB RAM)

## 4.5.6 ESXi host Specifications

Each ESXi host should provide enough physical hardware resources to accommodate the planned workload and provide some headroom in the event of a VMware HA failover or planned vMotion migration of live virtual machines for host hardware maintenance. Table 27 summarizes the ESXi host hardware configuration based on our example architecture.

To get the most out of our hardware consolidation, we chose to implement 32-core hosts for this configuration.

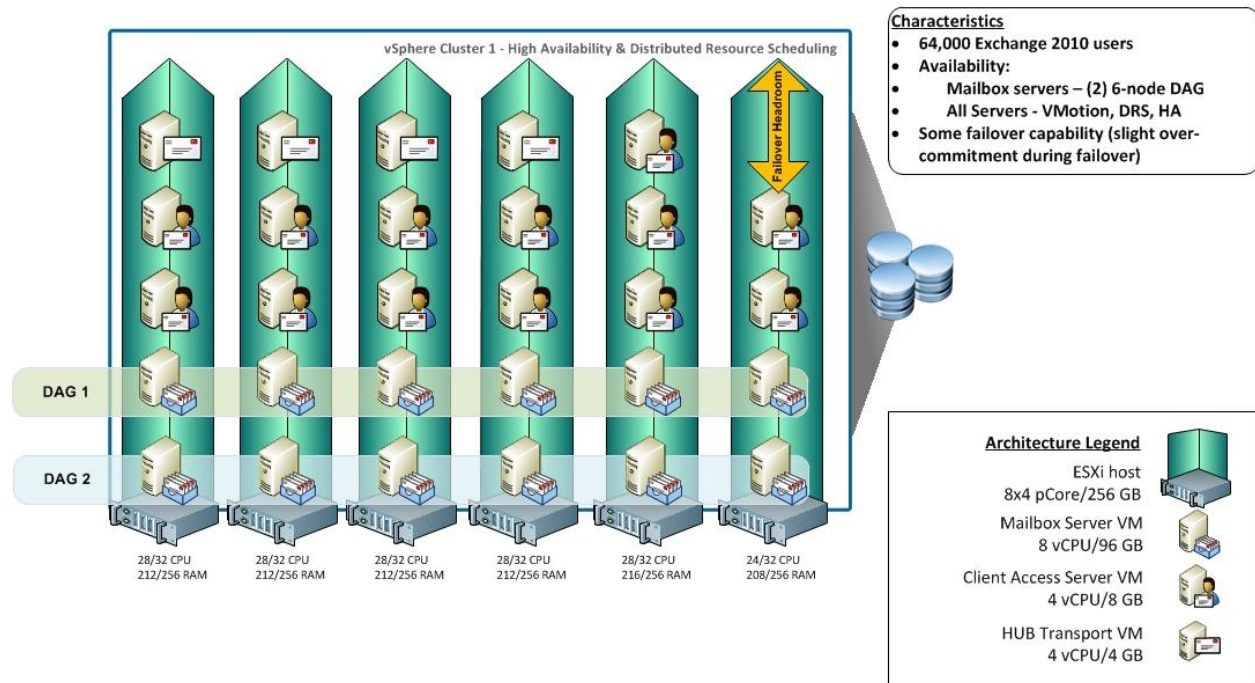
**Table 27. ESXi Host Hardware Configuration Table**

ESXi host	Specification
All ESXi hosts	32 cores (8x4)
	256GB RAM (extra 40GB above requirements for use in failover)
	2 Fibre Channel HBAs
	4 Gigabit network adapters

## 4.5.7 Initial Virtual Machine Placement

Although the workloads migrate automatically with DRS (including the mailbox servers), the following diagram is a useful planning tool for initial placement of virtual machines and for calculating host failover capacity. At initial placement, ESXi host 6 has most of the failover headroom.

**Figure 13. Initial Virtual Machine Placement for 64,000 Active Users**



## 5. Design and Deployment Considerations

Exchange aggressively utilizes all of the memory provided to it in a guest OS. vSphere can support higher levels of memory over-commitment if virtual machines share the same OS and application code pages. Even with page sharing, over-commitment should be attempted with caution to avoid performance impacts due to resource contention. VMware recommends setting Memory Reservation to the amount of memory configured for the virtual machine.

Follow Microsoft Guidelines for storage sizing using the *Exchange 2010 Mailbox Server Role Requirements Calculator* (<http://blogs.technet.com/b/exchange/archive/2009/11/09/3408737.aspx>).

Use the latest processor generations for their enhanced virtualization support.

If deploying on larger hardware and pre-vSphere 5 consider deploying multiple DAGs to accommodate multiple mailbox server virtual machines on the same server hardware.

VMware recommends at least four NIC ports per ESXi host machine to address network traffic, virtual machine security and isolation, vMotion, and Management (service console).

VMware recommends at least two HBA ports per ESXi host for redundancy.

The NIC/HBA ports are minimum recommendations for each ESXi host. More ports may be needed depending on the number of virtual machines and customer-specific network and storage requirements. The number should be determined by a detailed sizing analysis with the infrastructure vendor.

## 6. Summary

This guide shows example configurations of Exchange 2010 on VMware. These examples provide only high-level guidance and are not intended to reflect customer-specific workloads. Customers need to work with their infrastructure vendors to build a detailed sizing and architecture design that meets their individual requirements.