



Migrating to VMware® ESXi™

TECHNICAL WHITE PAPER

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Introduction

With the release of VMware vSphere™ 4.1 (“vSphere”), VMware announced plans to transition away from its classic VMware® ESX® hypervisor architecture, based on a Console Operating System (COS), in favor of its newer lightweight hypervisor architecture, referred to as VMware ESXi™. While functionally equivalent, the VMware ESXi architecture is significantly different from its VMware ESX predecessor (Figure 1). The innovative VMware ESXi architecture operates independently from any general-purpose operating system (OS), offering improved security, increased reliability and simplified management.

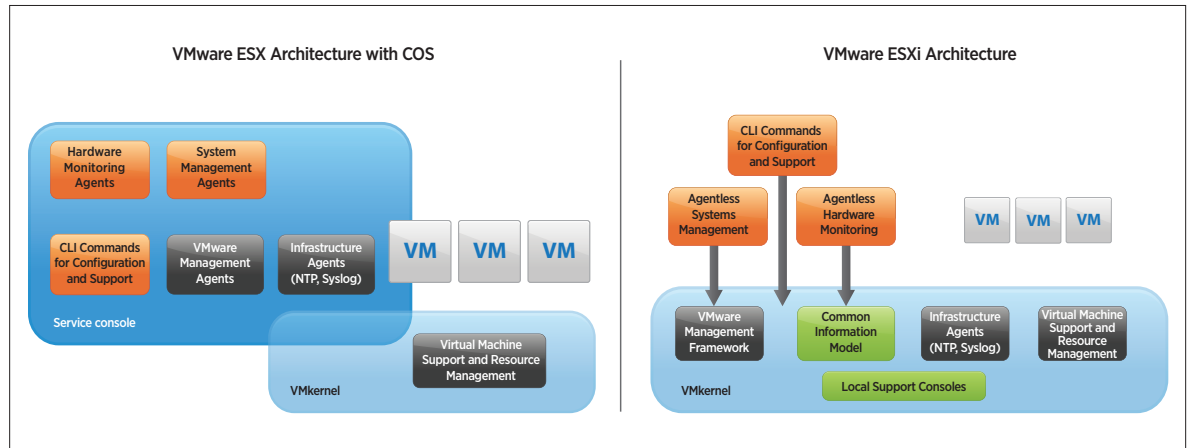


Figure 1. VMware ESX Compared to VMware ESXi

To benefit from the new VMware ESXi architecture, and in order to upgrade to versions of vSphere beyond 4.1, users running the classic VMware ESX architecture must migrate to VMware ESXi. This paper provides guidance on how to make this transition, along with several recommendations to help ensure a timely and seamless migration.

Introduction to VMware ESXi

The classic VMware ESX architecture relies on a Linux-based console OS to bootstrap the server and load the vSphere hypervisor into memory. However, once the OS is bootstrapped and the hypervisor is loaded, there is no longer a need for the COS. Despite its limited role, the COS presents several challenges for both VMware and customers. A significant amount of time and effort is required to secure and maintain the COS properly. In fact, the vast majority of security issues in VMware ESX are due to vulnerabilities in the underlying Linux OS. In addition, vSphere administrators must be disciplined to restrict and closely monitor any third-party agents or other tools enabled to run in the COS, as these things not only introduce potential security risks but will also compete with the hypervisor for valuable system resources.

VMware ESXi, which was first introduced with VMware Virtual Infrastructure 3.5 (VI 3.5), addresses these challenges by eliminating the hypervisor’s reliance on an external OS. With VMware ESXi, the hypervisor is loaded directly into memory from the boot device. Eliminating the COS has many benefits. There are significantly fewer components, allowing for a tightly locked down and highly secure architecture. In addition, it significantly reduces the size of the boot image, helping to provide a more flexible and agile deployment model, especially when deploying large numbers of VMware ESXi hosts.

Planning Your Migration

Migrating to VMware ESXi requires careful planning. The migration procedure will be influenced by several factors, including the version of VMware VirtualCenter/VMware vCenter™ Server, the version of VMware ESX, the supportability of existing hardware, the boot environment, and the type and location of datastores.

- **VMware VirtualCenter/VMware vCenter Server**

The first step in any VMware ESXi migration is to upgrade VMware VirtualCenter/VMware vCenter Server. You must run a version of VMware vCenter Server that is at the same version (or higher) as the target VMware ESXi hypervisor version. For example, if you plan to migrate to VMware ESXi 4.1, you must be running VMware vCenter Server 4.1 or higher.

Upgrading VMware vCenter Server involves upgrading the VMware vCenter Server machine, its accompanying database, and any configured plug-ins, including VMware vCenter Update Manager (Update Manager). As of vSphere 4.1, VMware vCenter Server requires a 64-bit server running a 64-bit OS. If you are currently running VMware vCenter Server on a 32-bit server or with a 32-bit OS, you will need to upgrade to the 64-bit architecture. With the 64-bit VMware vCenter Server you will also need to use a 64-bit DSN for the VMware vCenter database. With the 64-bit VMware vCenter Server, you can continue to run a 32-bit database, although you might want to consider upgrading to a 64-bit database to better accommodate future growth and scalability. Consult the *vSphere Upgrade Guide* for information on upgrading VMware vCenter Server.

NOTE: Following the VMware vCenter Server upgrade, you are entitled to a free 60-day trial period, in which you have unlimited access to all of the Enterprise+ features and capabilities. The 60-day trial license is automatically installed as part of the VMware vCenter Server upgrade. If your vSphere license does not include advanced features such as VMware High Availability (VMware HA), VMware Distributed Resource Scheduler (VMware DRS), VMware vMotion™, VMware Storage vMotion and host profiles, you can leverage this 60-day evaluation period to use these tools to help with your VMware ESXi migration.

Recommendation: Take advantage of the vSphere 60-day evaluation period to use tools such as VMware vMotion and VMware Storage vMotion to help with your migration and eliminate downtime.

- **VMware ESX Versions**

VMware ESX versions prior to 3.5 cannot be migrated directly to VMware ESXi. If you are running versions of VMware ESX prior to 3.5, you should weigh the cost of having to upgrade these hosts to 3.5 in order to migrate them to VMware ESXi against the benefits of phasing out the older VMware ESX hosts and replacing them with new servers.

Recommendation: Replace older VMware ESX hosts running versions of VMware ESX prior to 3.5.

- **Hardware Compatibility**

When migrating to VMware ESXi, you can choose to deploy new servers or upgrade existing servers. In either case, it's important to verify that the server and its associated devices (network adaptors, HBAs, and so on) are supported using the vSphere Hardware Compatibility List (HCL).

Recommendation: Verify all hardware against the vSphere HCL prior to migrating to VMware ESXi.

Boot Environment

If you plan to install VMware ESXi on an existing VMware ESX boot device, the installation will overwrite the VMware ESX boot image and reformat any VMware vStorage Virtual Machine File System (VMware vStorage VMFS) volumes on the disk. As such, it is important to identify any templates or virtual machines on the VMware ESX boot disk and use VMware Storage vMotion or cold migration to migrate them to an alternate datastore prior to installing VMware ESXi. Any virtual machines that cannot be migrated off the boot disk must be shut down and backed up prior to installing VMware ESXi, and restored when the migration is complete.

Recommendation: Identify virtual machines and templates on the boot disk datastore and identify an alternate datastore to which they can be moved. If no alternate datastore is available, identify a reliable backup method to protect them during the migration.

• **Storage Considerations**

Whether you are running SAN, NAS, or iSCSI can impact your migration. Although Fibre Channel devices will be rediscovered following your migration, iSCSI and NAS storage must be reconfigured. Verify the storage device against the vSphere HCL and ensure that the correct and supported PSP (path selection plug-in; in other words, fixed, MRU or round robin) is used. It's important to save your iSCSI and NAS configurations and have this information available to facilitate reconfiguring your VMware ESXi host following the installation.

Recommendation: Document details about your storage architecture prior to migrating.

Choosing a Migration Path

The culmination of the migration planning process is to identify a migration path. It is important to choose the correct migration path for your environment. Figure 2 provides a graphic illustration of the decision tree used to identify your migration path.

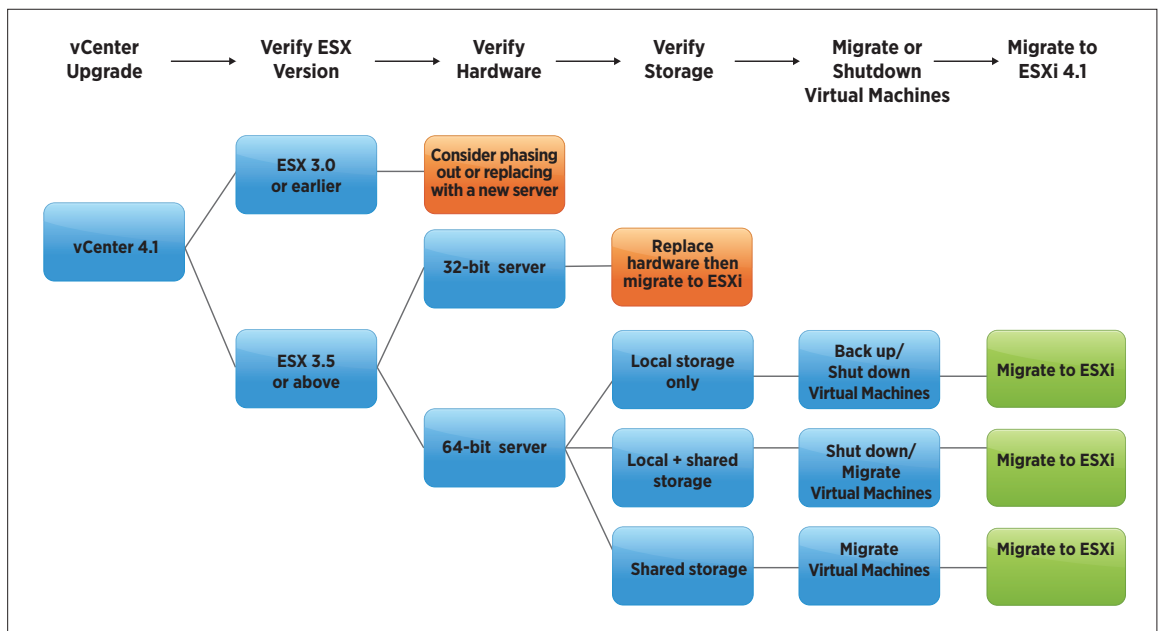


Figure 2. VMware ESX to VMware ESXi 4.1 Migration Paths

Pre-Migration Tasks

Once you have upgraded the VMware vCenter Server and identified a migration path, you are ready to proceed with the VMware ESXi migration. The actual migration comprises three distinct phases: pre-migration, migration, and post-migration. During the migration it is recommended that you migrate one host at a time. The estimated migration time is approximately 30 minutes per host.

Pre-Migration

To help with the pre-migration activities and to assist you in tracking your progress as you work through the migration, VMware provides helpful information and tools on the VMware ESXi Info Center Web site located at: <http://www.vmware.com/products/vsphere/esxi-and-esx>. Consult this Web site for the latest information available, to assist in your migration.

The following pre-migration tasks should be performed prior to installing VMware ESXi on the host:

1. Validate that all prerequisites are complete and verify that hardware requirements are met.
2. Document the existing VMware ESX host configuration.
3. Evacuate virtual machines and templates and put the host into Maintenance Mode.
4. If running in a VMware HA/VMware DRS cluster, remove the host from the cluster.

Validate Prerequisites and Verify Host Requirements

Confirm that VMware vCenter Server is running at the same version (or higher) as your target VMware ESXi version. Verify that both the VMware ESX hosts and associated storage meet the minimum requirements for VMware ESXi. As of VMware ESXi 4.1, only 64-bit servers are supported. Consult the appropriate vSphere HCL.

Document the Host Configuration

When VMware ESXi is installed, the VMware ESX host settings are lost and will need to be restored. Document the host settings and have this information readily available to assist with reconfiguring the host after the migration. Consult the VMware ESXi Info Center for tools that might help with this step.

Host Profiles (available since vSphere 4.0) can be used to help restore the host's configuration during your VMware ESXi migration. After the first host has been migrated to VMware ESXi, and after you have completed its configuration, you can use this host as a template to create a Host Profile that contains the common configuration settings shared across all the remaining hosts (in other words, vSwitches, port groups, storage policies, and so on). With the Host Profile, after you migrate the remaining hosts and after you reconnect them in VMware vCenter, simply attach and apply it, to configure the host settings. Refer to the *VMware ESXi Configuration Guide* for more information on using host profiles.

Evacuate Virtual Machines and Templates and Put the Host into Maintenance Mode

The steps for evacuating virtual machines and templates and placing the host into maintenance mode will vary depending on your environment and whether or not you have virtual machines and templates on the boot disk datastore, whether you use local datastores, and whether or not the hosts are part of a VMware DRS cluster.

• Virtual Machines and Templates on Boot Disk Datastores

Start by evacuating any virtual machines and templates off the boot disk datastore. Depending on your environment, you might use a combination of Storage vMotion and/or cold migration to complete this step. With Storage vMotion, the virtual machines can be moved to an alternate datastore while the virtual machine is running. Cold migration, on the other hand, requires the virtual machines to be shut down during the move. You can leverage the free 60-day trial period to access Storage vMotion if that feature is not normally available.

Any virtual machines or templates that are not migrated off the boot disk datastore will be lost when VMware ESXi is installed.

• Virtual Machines on Local Datastores

If you have virtual machines on any local storage, they can either be shut down during the migration or migrated to another datastore in the same way you migrated the virtual machines off the boot disk datastore. Any virtual machines on local storage that are not migrated to another datastore must be shut down during the migration and reregistered on the VMware ESXi host after the migration. However, unlike the virtual machines residing on the boot disk datastore, the virtual machines on local datastores will not be lost during the migration.

• Hosts in a VMware DRS-Enabled Cluster

If the host is in a fully automated VMware DRS cluster, and if the virtual machines are on shared storage, VMware DRS will automatically migrate the virtual machines to other hosts in the cluster when the host is placed into Maintenance Mode.

- **Hosts Not in a VMware DRS-Enabled Cluster**

If the host is not in a fully automated VMware DRS cluster, you must manually migrate or shut down the virtual machines prior to placing the host into Maintenance Mode. You can use a combination of VMware vMotion, Storage vMotion, and cold migration to accomplish this.

Once you have migrated all the virtual machines off your host, put the host into Maintenance Mode.

- **Remove the Host from the VMware HA/VMware DRS Cluster**

It is recommended that you remove the host from the VMware HA/VMware DRS cluster. This is a precautionary step done to avoid any potential conflicts with VMware HA during the migration.

Migration

After the pre-migration tasks are complete, you are ready to install VMware ESXi and perform the migration. The actual migration involves six steps:

1. Installing VMware ESXi
2. Configuring the management network
3. Reconnecting the host in VMware vCenter Server
4. Restoring host-specific configuration settings
5. Test/validate the upgraded host
6. Move the host back into the VMware HA/VMware DRS cluster

Install VMware ESXi

To install VMware ESXi, you simply boot the host off the installation media. The installer will launch and guide you through the installation. Once it is installed, you will be prompted to remove the installation media and reboot the hosts.

Configure Management Network

After the VMware ESXi installation, log in to the VMware ESXi Direct Console User Interface (DCUI) to set the password, host name, and management network to include DNS settings. Verify the settings using the “Test Management Network” option in the DCUI.

Connect in VMware vCenter Server

Once the host is configured and accessible on your management network, you are ready to reconnect it in VMware vCenter Server. From the vSphere Client, right-click the disconnected host and select “Connect.” VMware vCenter Server will detect that the host’s credentials have changed and reprompt for the username and password.

NOTE: When you reconnect the host in VMware vCenter Server, the host’s pre-migration statistics stored in the VMware vCenter database are retained. Do not remove the host from the vCenter Server inventory prior to the migration, because this will cause all event and performance statistics for that host to be deleted

Restore Host Configuration

At this point, you must restore any host-specific configuration settings. Using the data captured during the pre-migration step, reconfigure the host by adding the required network (vSwitches) and storage (NAS/iSCSI) objects along with any other required objects.

As mentioned in the pre-migration steps, after you migrate the first host, you can simplify the configuration of the remaining hosts by using the first host’s configuration as a template that can be applied to the other hosts using host profiles.

Test/Validate

After restoring the host configuration, it's recommended to test the VMware ESXi host by migrating or booting a noncritical virtual machine on the host and monitoring the alarms, alerts, and log files for any anomalies. This is also a good time to apply any host updates or patches using the Update Manager. It is also recommended that you validate the working of features, such as NIC Teaming, Storage Resiliency, VMware HA and VMware DRS, when applicable.

Move Host Back into Cluster

Once the host has been tested, you are ready to move it back into the VMware HA/VMware DRS cluster. From the vSphere Client, simply drag the host into the vSphere cluster. At this time the VMware HA agent will be pushed to the host and VMware HA will be configured. Monitor the status to ensure that this completes successfully. If VMware DRS is enabled in fully automated mode, it will detect the host has been added back to the cluster and begin migrating virtual machines. Depending on the cluster load, this might or might not happen right away. Alternatively, you can manually migrate virtual machines back onto the hosts.

Follow the same procedures to migrate all your hosts. You can choose to migrate all your VMware ESX hosts during a single maintenance window, or over the course of several maintenance windows. If you choose to migrate your hosts over several maintenance windows, keep in mind that the VMware vCenter evaluation period is only 60 days. Also, although running mixed versions of VMware ESX and VMware ESXi in a cluster is supported, it is important that you avoid deploying new virtual machines or upgrading VMware tools and virtual machine hardware versions for any existing virtual machines while running in a mixed cluster.

Recommendation: *Minimize the time spent running mixed versions of VMware ESX and VMware ESXi in a VMware HA/VMware DRS cluster. Clusters running a combination of VMware ESX and VMware ESXi hosts of the same version are fully supported and will not present any issues.*

Post-Migration Tasks

Following the upgrade to VMware ESXi, there are several post-migration tasks you should perform.

Direct Console User Interface (DCUI)

For users who are new to VMware ESXi, take time to become familiar with the VMware ESXi DCUI. The DCUI is accessed from the VMware ESXi host's console. It was the interface you used to configure the password and management network following the VMware ESXi installation, prior to reconnecting the host in VMware vCenter. In addition to setting the password, host name and management network, the DCUI can be used to enable Lockdown Mode and to enable and access the VMware ESXi Tech Support Mode shell.

- **Lockdown Mode**

Lockdown Mode enables you to disable access to the VMware ESXi console for all non-root users. When Lockdown Mode is enabled, access to the host is restricted and the only way a non-root user can access or manage the host is through the vSphere Client.

Recommendation: *Enable Lockdown Mode to limit access to the VMware ESXi console.*

- **Tech Support Mode**

The local Tech Support Mode (available under troubleshooting options) provides an interactive shell for performing troubleshooting tasks. There are a limited number of commands that can be executed inside the Tech Support Mode shell. Refer to the *VMware ESXi Configuration Guide* for a list of these commands. You can access the Tech Support Mode shell directly from the console or you can enable remote Technical Support Mode by enabling the SSH service on the host.

Recommendation: *Avoid enabling Technical Support Mode except when needed to assist with diagnosing and troubleshooting.*

Scratch Partition

On the boot disk where VMware ESXi was installed, a special 4GB “scratch” partition was automatically created during the installation. The scratch partition is used to store files needed to troubleshoot and diagnose problems (typically generated at the request of VMware global support staff by running the “vm-support” command). If you wish to move the scratch partition to another disk, you can manually (re)configure the VMware ESXi host scratch partition.

To (re)configure your scratch, log in to the vSphere Client, select the host and choose “Configuration.” Under “Software,” choose “Advanced Settings → ScratchConfig” and enter the VMware vStorage VMFS volume where you want to place the scratch partition in the *ScratchConfig.ConfiguredScratchLocation* field. The VMware ESXi host must be rebooted for the change to take effect.

Alternatively, you can (re)configure the scratch partition using the vSphere Command-Line Interface (vCLI) and VMware vSphere 4 PowerCLI:

- vCLI

```
# vicfg-advcfg.pl --server <hostname> --username root -s /vmfs/volumes/storage1/<unique-name> ScratchConfig.ConfiguredScratchLocation
```

- PowerCLI

```
# Set-VMHostAdvancedConfiguration -VMHost (Get-VMHost <fqdn-hostname>) -Name "ScratchConfig.ConfiguredScratchLocation" -Value "/vmfs/volumes/storage1/<unique-name>"
```

Active Directory

You can join your VMware ESXi host to an Active Directory domain and use Active Directory to authenticate users and manage access.

To add a VMware ESXi host to Active Directory domain, log in to the vSphere Client, select the VMware ESXi host and choose “Configuration → Authentication → Services → Properties.” For more information, refer to chapter 13 of the *VMware ESXi Configuration Guide*.

Configure a Logging Host

By default, the VMware ESXi logs are stored in memory and are reset each time the host is rebooted. This can complicate auditing and troubleshooting. Therefore, it is recommended that you identify and configure a persistent datastore for saving the VMware ESXi logs. Even better, set up a central syslog host in your environment.

To configure VMware ESXi to log to a persistent datastore, log in to the vSphere Client, select the host and choose “Configuration → Advanced → Settings → Syslog.” Enter the datastore path where you want to save the VMware ESXi logs. For more information, refer to chapter 6 of the *VMware vCenter Server Setup Guide*.

To configure VMware ESXi to log to a central logging host, log in to the vSphere Client, select the host and choose “Configuration → Advanced → Settings → Syslog.” Enter the name of your remote logging host. For more information, refer to chapter 6 of the *VMware vCenter Server Setup Guide*.

Set up a Remote Management Host

The majority of VMware ESXi administration will be done through VMware vCenter Server using the vSphere Client, but there will be occasions when remote command-line access is beneficial, such as for scripting, troubleshooting, and some advanced configuration. VMware ESXi provides a rich set of APIs that are accessible using vCLI or Windows-based vSphere PowerCLI.

- vCLI/VMware vSphere 4.1 Management Assistant (vSphere Management Assistant)

The vCLI is available for both Linux and Windows platforms and can be downloaded from www.vmware.com/downloads. Download and install the applicable version of vCLI inside a Windows or Linux virtual machine of your choice. VMware also provides the vCLI as part of the vSphere Management Assistant, which is distributed

as an Open Virtualization Format (OVF) image. To deploy the vSphere Management Assistant, log in to the vSphere Client, choose “File → Deploy OVF Template” and provide either the URL or file name for the OVF descriptor file. For more information on the vCLI and the vSphere Management Assistant, refer to the vSphere Management Assistant home page: <https://www.vmware.com/support/developer/vima>.

- PowerCLI

PowerCLI is available in Windows environments only. To install PowerCLI, download the executable file from www.vmware.com/downloads and install inside your management virtual machine. For more information on PowerCLI, refer to the PowerCLI home page: <https://www.vmware.com/support/developer/PowerCLI/index.html>.

Back Up the VMware ESXi Host Configuration

Once you have finished configuring the VMware ESXi host, it is recommended you back up the configuration. In vSphere 4.1, the VMware ESXi host backup is performed using either vCLI or PowerCLI.

- vCLI

```
# vicfg-cfgbackup --server <FQHN> -s <file name>
```

- PowerCLI

```
# Connect-VIServer <vCenter Server>
```

```
# Get-VMHost <ESXi host> | Get-VMHostFirmware -BackupConfiguration -DestinationPath <path>
```

Virtual Machine Upgrades

Once all the hosts in the cluster have been migrated, the final step in the migration is to update the virtual machines running in the cluster. To fully benefit from the latest features and capabilities, VMware Tools and the virtual machine virtual hardware version should be updated for each virtual machine. Upgrading VMware Tools can be done while the virtual machine is running, however virtual machines running a Windows OS will require a reboot after the upgrade completes. All virtual machines must be powered down prior to upgrading each virtual machine’s virtual hardware.

NOTE: Upgrade the virtual machine tools and hardware version only after all the hosts in a VMware HA/VMware DRS cluster have been migrated to VMware ESXi.

- VMware Tools

The VMware Tools package used to upgrade the virtual machines is bundled with the VMware ESXi host. To perform an unattended upgrade of VMware Tools, ensure that the virtual machine is running on a VMware ESXi 4.1 host, log in to the vSphere Client, right-click the virtual machine, and choose “Guest → Install/Upgrade VMtools.” After VMware Tools has been upgraded, virtual machines running Windows operating systems will automatically reboot.

- Virtual Hardware

Prior to upgrading the virtual machine’s virtual hardware, it is recommended you first upgrade VMware Tools. To upgrade the virtual hardware, shut down the virtual machine, and from the vSphere Client right-click the virtual machine and choose “Upgrade Virtual Hardware.” After the upgrade, simply power the virtual machine on.

NOTE: After upgrading the virtual hardware and rebooting the virtual machine, if the guest OS detects any new devices, it might prompt for a second reboot of the virtual machine.

Conclusion

With the release of vSphere 4.1, VMware announced plans to converge to a single lightweight hypervisor referred to as VMware ESXi. While functionally equivalent to its VMware ESX predecessor, the VMware ESXi architecture provides many benefits, including no external operating system, improved security, increased reliability and simplified management.

To benefit from the new VMware ESXi architecture, and to prepare for the future release of vSphere, it's important that you complete your VMware ESXi migration today. Migrating to VMware ESXi is easy and can be done with no virtual machine downtime, however it does require planning and coordination.

The migration procedure that is best for you will be influenced by many factors. This paper provides guidance on the best way to plan and execute your VMware ESXi migration to ensure a seamless transition.

References

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