white paper

Configuring and Troubleshooting VMware VMotion

1.0 Introduction

This white paper describes how to correctly configure and troubleshoot VMotion in VMware ESX Server 3.5 but these principles also apply to vSphere 4.0 environments.

2.0 What is VMotion

VMotion is the ability to seamlessly move a running virtual machine between two physical ESX Hosts without service interuption. It is transparent to the guest OS and applications, able to cope with failures and incurs no downtime of the virtual machine. The term '**migrating**' is used to describe the move from one Host to another however it's important to realise that only the processor and memory state are moving, the virtual hard disk files (.vmdk) do not move but remain on the same shared storage. Moving the virtual hard disk files is referred to as Storage VMotion and is a separate feature not discussed here.

3.0 How does VMotion work?

VMotion can be initialised in a number of ways including using the migration wizard within the virtual infrastructure client, programmatically using the API or by the automated Distributed Resource Scheduling (DRS) load balancing feature.

The process flow of VMotion is as follows:

1. VMotion is initiated.
2. ESX Starts pre-copying the virtual machine memory state to the destination ESX host. The pre-copy repeats until the memory changes in each copy are very small.
3. The source virtual machine stops and is Quiesced. The remaining memory deltas are copied. (This process takes milliseconds).
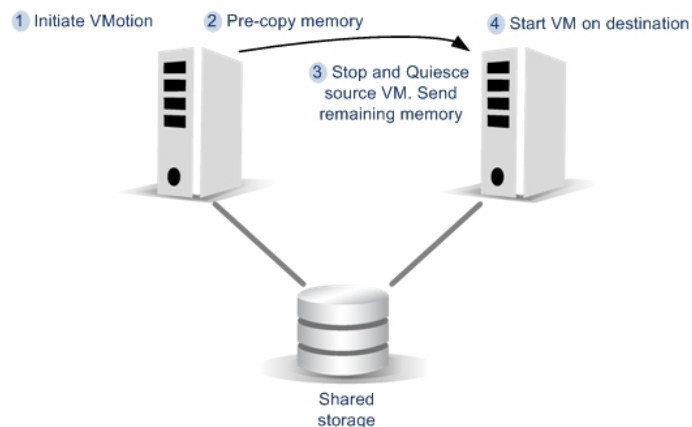4. The destination host starts the virtual machine and assumes control.

Illustration 1-1: Process Overview

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4.0 Prerequisites

The following is an outline of the key prerequisites that must be met for VMotion to work successfully. These will be described in detail in section 6.0 Troubleshooting VMotion.

4.1 VMware Enterprise License

VMotion is a licensed feature of VMware and is only available in the VI Enterprise edition.

If you are evaluating VMware then you will have access to all the enterprise features (including VMotion) for a period of 60 days.

4.2 Shared Storage

The virtual machine files must reside on shared storage that both ESX hosts can access. This can be FC or ISCSI SAN's formatted with VMFS or NFS storage.

4.3 Compatible ESX CPUs

VMotion is only available between ESX hosts within the same CPU family. A live VMotion is not possible between ESX hosts running AMD and Intel CPU's. In addition if the virtual machine is moving between all AMD or all Intel ESX hosts the CPU family must be compatible. Newer CPU's in the same processor/same family may have additional features that previous versions don't support. If a VM is running on one ESX Host and taking advantage of these features then it cannot be seamlessly moved to another Host that doesn't support it.

4.4 Identical Port Group Configuration

The Port Group name on both ESX Hosts must be identical. Likewise the port groups must also present the same IP subnet and VLAN to the virtual machine. This is because the IP addressing of a virtual machine remains the same after a VMotion. As far as the virtual machine operating system is concerned nothing has changed.

4.5 Gigabit Ethernet

1Gbps Ethernet or above is required to reliably VMotion virtual machines. VMotion can be attempted on slower networks for testing and development but not recommended for production networks. Whilst it's possible in theory to VMotion between 2 geographically dispersed sites using stretched VLAN's, the Hosts must still be within the same VMware Cluster and the speed and latency must be fast enough to support it.

4.6 Virtual Machine compatibility

The following virtual machine configurations will cause issues:

- Connected physical devices such as CDROM, Floppy, Serial or Parallel Port.

- Virtual CDROM or Floppy devices configured to use ISO image that aren't available to both ESX Hosts.

  Troubleshooting migration compatibility error: Currently connected device uses backing which is not accessible, see **VMotion errors due to connected devices**, http://kb.vmware.com/kb/1003787.

- CPU or Memory Affinity, see **CPU / Memory Affinity and VMotion**, http://kb.vmware.com/kb/1003842.

- Virtual Machines connected to an internal only switch, see **Enable VMotion with internal switches**, http://kb.vmware.com/kb/1006701.
 **Note**: This constraint can be bypassed.

5.0 Configuring VMotion

Once the prerequisites are met, follow these steps in order to configure VMotion. This assumes a fresh installation of VMware and Virtual Center.

5.1 Add Hosts to VMware Cluster

Within vCenter in the **Hosts and Clusters** view create a **Datacenter object** and then a **Cluster Object**. Right click on the cluster, select **Add Hosts** and add 2 or more ESX Hosts.

5.2 Configure Shared Storage

1. Connect your shared storage, add this to each Host and then format.
2. Within Virtual Center in the **Hosts & Clusters** view, select each Host and on the summary tab ensure that you can view the storage from each Host as shown.
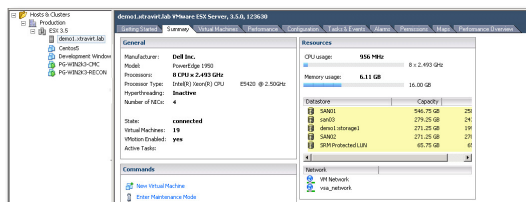

5.3 Configure Virtual Networking

VMotion requires a **VMkernel** port be created on each Host. This port group and its associated Uplink (NIC) will transfer the VMotion traffic between hosts. Each VMKernel port group will have its own IP address and must have the VMotion check box ticked as shown.
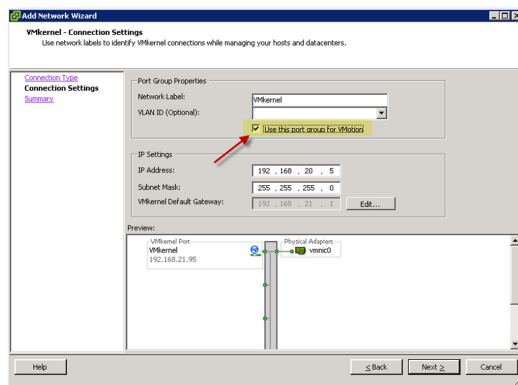
1. Select a **vSwitch** to host the VMkernel port group (or create a new vSwitch). Click on **Properties**.
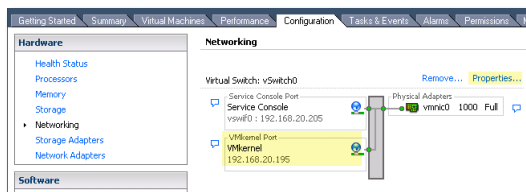
2. Select **Add** and choose a new port group of type **VMkernel**.
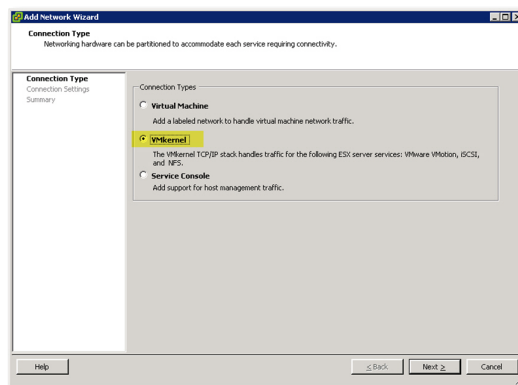
3. Ensure the **VMotion check box** is selected by selecting **Properties**, and then **Edit** the VMkernel port group. Click **Next** and finish the wizard.

Best Practices:

•   Provide a dedicated network / VLAN for VMotion traffic to keep the memory state secure as well as provide best performance.
•   At least one dedicated physical NIC.
•   Also configure a standby NIC.
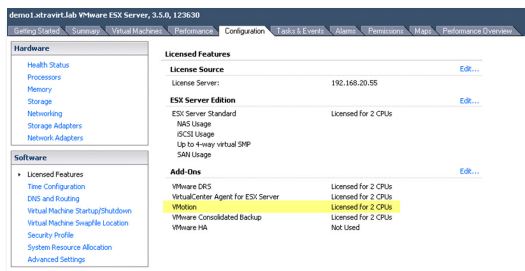
6.0 Troubleshooting VMotion

VMotion issues are typically caused by:

- Misconfiguration within VMware Virtual Center
- Incompatible CPU's
- Incompatible virtual machine configurations

6.1 Troubleshooting Steps

Licensing

a. Ensure that the Virtual Infrastructure is licensed by checking the **Licensed Feature** tab within Virtual Center.

Virtual Center Networking

b. **VMKernel** – Ensure a VMkernel port is created on each host and the **Use this port group for VMotion** is selected.

c. **Port Group Names** – Ensure the names of the port groups are exactly identical

d. **VLAN and IP networks** – Ensure each Host is connected to the same VLAN / network

e. **VM connected to an Internal only vSwitch** – VM's connected to an internal only vSwitch (that is one with no assigned physical uplink) will fail a VMotion. This can be enabled, see **Enable VMotion with internal switches**, http://kb.vmware.com/kb/1006701.

Shared Datastore not accessible to both ESX Hosts

f. Check that each Host can access the datastore which holds the virtual machine files, see **Section 5.2 Configure Shared Storage**.

CPU compatibility

g. Using one of the following tools to check CPU compatibility:

- **VMware CPU Host Info** by Run-Virtual, http://www.run-virtual.com/files/cpuinfo_201.zip

- **CPU-Z** by Franck Delattre at CPUID, http://www.cpuid.com/cpuz.php

h. Enable **Enhanced VMotion Compatibility** – EVC. Only supported in Virtual Center 2.5 U2 and above. Right click on the **VMware Cluster**, select **Edit Settings**, select **VMware EVC** and **Enable for AMD or Intel Hosts**. This will disable the necessary CPU features that are not common throughout all ESX Hosts in the cluster.

Note: To enable VMware EVC:
- All VM's in the cluster must be powered off.
- CPU's must support 'Flex migration' (Intel) or AMD-V Extended Migration (AMD).
- The VT and 'No execute bit' must be enabled in the BIOS of the ESX Hosts.

Right-click on the cluster object within virtual center and select **Edit Settings**.
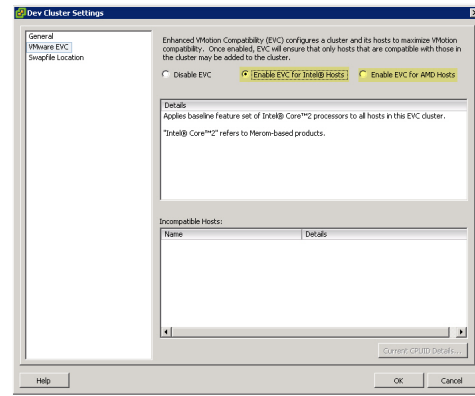
Virtual Machine Configuration

i. Check the virtual machine does not have any of the following devices connected:

- CD ROM Drive
- Floppy Drive
- Serial Port
- Parallel Port

j. **CPU Affinity** – Ensure CPU affinity is not set.
To check the CPU affinity:

I. **Log in** to the Virtual Center as an administrator from the Virtual Infrastructure client.

II. Right-click on the **Virtual Machine**.

III. Click **Edit Settings**.

IV. Click the **Resources** tab.

V. Click the **Advanced CPU** option.

- See **CPU / Memory Affinity and VMotion**, http://kb.vmware.com/kb/1003842.

k. Check the VM is not attached to an Internal only switch, that is one with no physical network adapter.

- See **Enable VMotion with internal switches**, http://kb.vmware.com/kb/1006701.

Miscellaneous

l. Virtual Network security policies may conflict
It is possible to configure different Security and Traffic shaping policies on ESX Hosts which will cause VMotion to fail. Ensure the security policies match:

   • See **Troubleshooting Migration compatibility error**, http://kb.vmware.com/kb/1003834.

   Workarounds:
   VMotion referes to the live migration of running virtual machines from one ESX host to another. If machines are powered off they can be moved between Hosts even without many of the VMotion requirements being met including CPU compatibility and virtual machine configuration settings. This is referred to as Cold Migration.

7.0 Summary

Once configured correctly VMotion is a reliable feature of VMware vCenter which is used in many production datacenters.

VMotion is a licensed feature only available with ESX 3.x Enterprise edition or vSphere Advanced Edition +.

7.1 Useful References and KB articles

1. Diagnosing VMware VMotion failure at 10%, http://kb.vmware.com/kb/1003734

2. Troubleshooting Migration compatibility error: Currently connected network interface uses network, which is configured for different offload or security policies, http://kb.vmware.com/kb/1003834

3. VMotion failure, error message: problem detected at CPUID level 0x80000001 register 'edx', http://kb.vmware.com/kb/1001131

4. VMotion Fails When the Virtual Machine's Parallel Port Is Set to Write to an Output File, http://kb.vmware.com/kb/2284

5. Troubleshooting Migration compatibility error: VMotion from source host to destination host is unsupported because of VMotion protocol differences, http://kb.vmware.com/kb/1003828

6. VMotion Error: Destination Host Not on Same Networks as Virtual Machine You Are Trying to Migrate, http://kb.vmware.com/kb/1723

7. Troubleshooting migration compatibility error: Unable to access the virtual machine configuration: Unable to access file, http://kb.vmware.com/kb/1003795

8. Troubleshooting migration compatibility error: Currently connected device uses backing which is not accessible, http://kb.vmware.com/kb/1003787

9. Troubleshooting Migration compatibility error: The VMotion interface is not configured (or is misconfigured) on the destination host, http://kb.vmware.com/kb/1003827

10. VMware vMotion and CPU Compatibility, http://www.vmware.com/files/pdf/vmotion_info_guide.pdf

11. Troubleshooting Migration compatibility error: Virtual machine has CPU and/or memory affinities configured, preventing VMotion, http://kb.vmware.com/kb/1003842

12. VMotion times out at 10%, http://kb.vmware.com/kb/1002567

13. Troubleshooting VMotion CPU feature requirement error messages, http://kb.vmware.com/kb/1003718

14. Overview of Migration Compatibility Error Messages, http://kb.vmware.com/kb/1003684

15. Troubleshooting migration compatibility error: Device is a connected device with a remote backing, http://kb.vmware.com/kb/1003780

16. Enabling VMotion on internal vswitch behind bridged-mode firewalls and other network appliances, http://kb.vmware.com/kb/1006701

17. Configuring a Duplicate IP Address for VMotion Causes an Error, http://kb.vmware.com/kb/2224

This concludes the white paper.

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For more information contact:

Dorset House, Regent Park
297 Kingston Road, Leatherhead
Surrey KT22 7PL
t   +44 (0) 1372 824 296
f   +44 (0) 1372 824 576
e   information@xtravirt.com
w   www.xtravirt.com

Additional References
1.   Nil.

Useful Links
1.   Nil.

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