Virtual Infrastructure 3:
Beta to Production

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Agenda

- **Welcome/Introductions**
- **Upgrade Overview**
  - Plan ahead
  - Use a systematic, phased approach
  - A typical upgrade
- **Upgrade Detail**
  - Diving into individual phases
- **New Features**
  - Resource Pools
  - VMware DRS
  - VMware HA
  - VMware Consolidated Backup
- **Q&A**

Welcome / Introduction

- **Doug Baer, Senior Consultant, IT Partners**
  - Based in Phoenix, Arizona
  - Partnerships
    - VMware VIP Enterprise Premier, VAC
    - Microsoft (Gold)
    - Hewlett-Packard

Upgrade Overview

- **Plan ahead**
  - Discovery: know what you are getting into
  - Be prepared to lab activities to verify steps
- **Systematic, phased approach**
  - Break into manageable pieces
  - Have a plan – this is not just a simple software install
- **Typical upgrade tasks**
  - Discovery and pre-upgrade tasks
  - Upgrade VirtualCenter Server and Clients
  - Upgrade ESX Hosts
  - Upgrade Virtual Machines
  - Upgrade VMware Tools
  - Clean up and implement new features

Upgrade Detail – Outline

- **Pre-Upgrade**
  - Licensing
  - Discovery/Validation
  - Upgrade method?
- **Phase I: VirtualCenter**
  - VirtualCenter Server
  - VirtualCenter Database
  - Deploy Virtual Infrastructure Clients
- **Phase II: ESX Hosts and Datastores**
  - VMFS-2 to VMFS-3
- **Phase III: Virtual Machines**
  - New virtual hardware for additional functionality
- **Phase IV: VMware Tools**
- **Post-Upgrade: Clean up and implement new features**

Upgrade order is *very* important: each phase constitutes an *irreversible* process

Pre-Upgrade

- **Backup:** Backup everything prior to any upgrade
- **Licensing:** Acquire all licenses in advance
- **Order:** Complete one phase prior to starting the next phase

- **What makes this upgrade different?**
  - Completely new VMFS partition type, VMFS-3
    - To ESX 3 hosts, VMFS-2 partitions are ***read-only***
    - To ESX 2 hosts, VMFS-3 partitions are ***unreadable***
- **Run `preupgrade.pl` Script on ESX Server 2 host**
  - Script on ESX Server 3 Installation CD-ROM
  - `mount /mnt cdrom`
    `perl /mnt/cdrom/scripts/preupgrade.pl`

- **Notes from the field**
  - Licensing!
  - Commit all VMDK REDO files prior to upgrade
  - Clusters must be migrated from virtual to RDM disks

Risk Mitigation

- **Have a Backup Plan!**
  - VirtualCenter + VirtualCenter database
  - ESX Server host
    - Service Console
      - VMs: all .vmx files
      - Local image files: .iso, .flp, exported .vmdk files
      - Modified configs, **`/etc/passwd`**, **`/etc/groups`**, custom scripts
    - Local VMFS
      - All virtual disk and virtual machine template files
  - SAN-based VMFS
    - Use SAN snapshots or backup/restore software
  - VMs
    - Clone prior to virtual hardware upgrade

Risk Mitigation (continued)

- **Understand and Test Back-Out Procedures!**
  - VirtualCenter
    - Reinstall original VirtualCenter Server
    - Restore full backup of VirtualCenter database
  - ESX Server host
    - Reinstall original ESX host software / reimage
    - Restore Service Console and local VMFS files
  - Shared VMFS
    - Reformat VMFS-2 from ESX 2.x host and files
  - VMs
    - Revert to clone taken prior to upgrade

Upgrade Types

- **In-place:** take down, install, bring up, clean up
  - **Benefits:** Speed, simplicity
  - **Drawbacks**
    - All virtual machines must be powered off simultaneously
    - Upgrade installation requires 2GB root partition w/850MB free
  - **Process**
    - Shut down all virtual machines
    - Boot host from ESX Server 3 Install media
    - Upgrade to ESX 3 and VMFS-3
    - Reboot host, upgrade and power up virtual machines
  - **Candidates**
    - Standalone ESX hosts
    - No SAN connectivity, or HVL aligned (more on this later)
    - Possible to take all virtual machines down at once
    - Downtime is easier to obtain than additional hardware and storage

Upgrade Types

- **Migration:** managed, gradual transition
  - **Benefits**
    - Minimized downtime for critical systems
    - Not an “all or nothing” proposition
  - **Drawbacks**
    - Requires additional resources (ESX host, shared storage)
    - Longer upgrade process = coexistence considerations
  - **Process**
    - Install ESX 3 Server on new host and new VMFS-3 partition
    - Move virtual machines from ESX 2.x host(s) to new host
    - Once ESX 2 host is empty, rebuild as ESX 3 host; Repeat
  - **Candidates**
    - Environments with critical virtual machines (sensitive to downtime)
    - Not possible to shut down all virtual machines simultaneously
    - New hardware and storage is cheaper than downtime

Upgrade Types

- **esxMigrator**
  - **Benefits**
    - Disks migrated while virtual machines are online
    - Cutovers can be scheduled for low-traffic times
    - Single virtual machine reboot accomplishes all upgrade tasks for that VM
  - **Drawbacks**
    - Requires additional ESX host and software purchase
  - **Process**
    - Install esxMigrator on Windows machine (can be virtual)
    - Attach to ESX 2 and ESX 3 hosts from esxMigrator
    - Select per-virtual machine migration options and start sync
    - Once ESX 2 host is empty, rebuild as ESX 3 host; Repeat
  - **Candidates**
    - Software is cheaper than hardware, storage, or downtime
    - ESX 3 host hardware different from ESX 2 (no VMotion)
    - Not possible to shut down all virtual machines simultaneously

Discovery/Validation

- **VirtualCenter Server on a shared server?**
  - Not on a web server – VirtualCenter uses tcp/80 and tcp/443
  - Not on a GSX/VM Server host – VirtualCenter uses tcp/902
- **VirtualCenter Server in a virtual machine?**
  - Do not use same virtual machine as VirtualCenter database
  - VMware License Server should be on a physical server
- **Collect additional information**
  - ESX 2 version and VMFS-2 partition checks (**`pre-upgrade.pl`**)
  - Location of VMDK files for all registered VMs on an ESX host
  - Map running virtual machines to current ESX 2.x hosts
  - Backup **`/home`** to preserve **`.vmx`** files (virtual machine configurations)

Upgradeable Versions

- Minimum versions are VirtualCenter 1.2 and ESX Server 2.1.1
- VirtualCenter versions prior to 1.2 must be upgraded to 1.2 or higher in order to preserve the VirtualCenter database
- Upgrade from VMFS-1 is not supported
- Upgrade from VMFS-2 with >8 MB block size is not supported
- Use migration method instead of in-place upgrades to handle unsupported ESX Server versions

VirtualCenter Version	*Upgrade Support*
Beta release (any)	NO
1.0	Upgrade to 1.2 first
1.1	Upgrade to 1.2 first
1.2	YES
1.3	YES
1.3.1	YES
1.4	YES

ESX Server Version	*Upgrade Support*
Beta release (any)	NO
1.x	NO
2.0.x to 2.1.0	NO
2.1.1, 2.1.2, 2.1.3	YES
2.2.0	YES
2.3.x	NO
2.5.0	NO
2.5.1 or higher, 3.0	YES

Discovery/Validation

- **VirtualCenter Server OS**
  - Windows 2003, any 32-bit release
  - Windows 2000 SP4 + Update Rollup 1 + MDAC 2.6
  - *Windows XP Professional*

- **VirtualCenter Database**
  - Microsoft SQL 2000 SP4
  - Oracle 9iR2, 10gR1 (versions 10.1.0.3 and higher only), and 10gR2
  - *MSDE*

Upgrade Detail – Phase I

- **Preparation**
  - **License file(s)**
  - **Install media**
  - **Database credentials**
- **Expected Downtime**
  - **Virtual Machines: None**
  - **ESX hosts: None**
  - **VC Server: approx. 30 mins, depending on database size**
- **Complete**
  - **VirtualCenter 2.x**
- **Remaining**
  - **ESX 3.x**
  - **VMFS-3**
  - **Virtual Machines**
  - **VMware Tools**

- **Upgrade VirtualCenter**
  - VirtualCenter Server
    - Windows software install, removes VC Server 1.x
  - VirtualCenter Database
    - Save Performance or Events & Tasks logs?
      - Sacrifice historical data to speed upgrade?
      - Significantly faster if not selected
    - Large Databases
      - May time out waiting for ***vpxd*** service to start
      - Does not mean the upgrade has failed!
  - Virtual Infrastructure Clients
    - May be deployed in advance of server upgrade

Templates

- **Options for Handling Templates**
  - Pre-upgrade
    - Deploy each to a virtual machine; clone/upgrade as needed
  - Post-upgrade
    - Import old templates – may be deployed to ESX 2 hosts or ESX 3 hosts as legacy virtual machines only
    - Convert “legacy” templates for use by ESX 3 hosts
      - Template datastore must be upgraded to VMFS-3
  - The approach depends on
    - Extent of template use
    - Duration of coexistence
    - Directives (all new virtual machines provisioned to ESX 3 hosts?)
    - Current datastore for templates (VC server vs. shared storage)

Upgrade Detail – Phase II

- **Preparation**
  - **Phase I complete**
  - **Licenses**
  - **Install media**
- **Expected Downtime**
  - **Virtual Machines: depends on upgrade method**
  - **ESX host: 40-60 minutes per host**
  - **VC Server: None**
- **Complete**
  - **VirtualCenter 2.x**
  - **ESX 3.x**
  - **VMFS-3**
- **Remaining**
  - **Virtual Machines**
  - **VMware Tools**

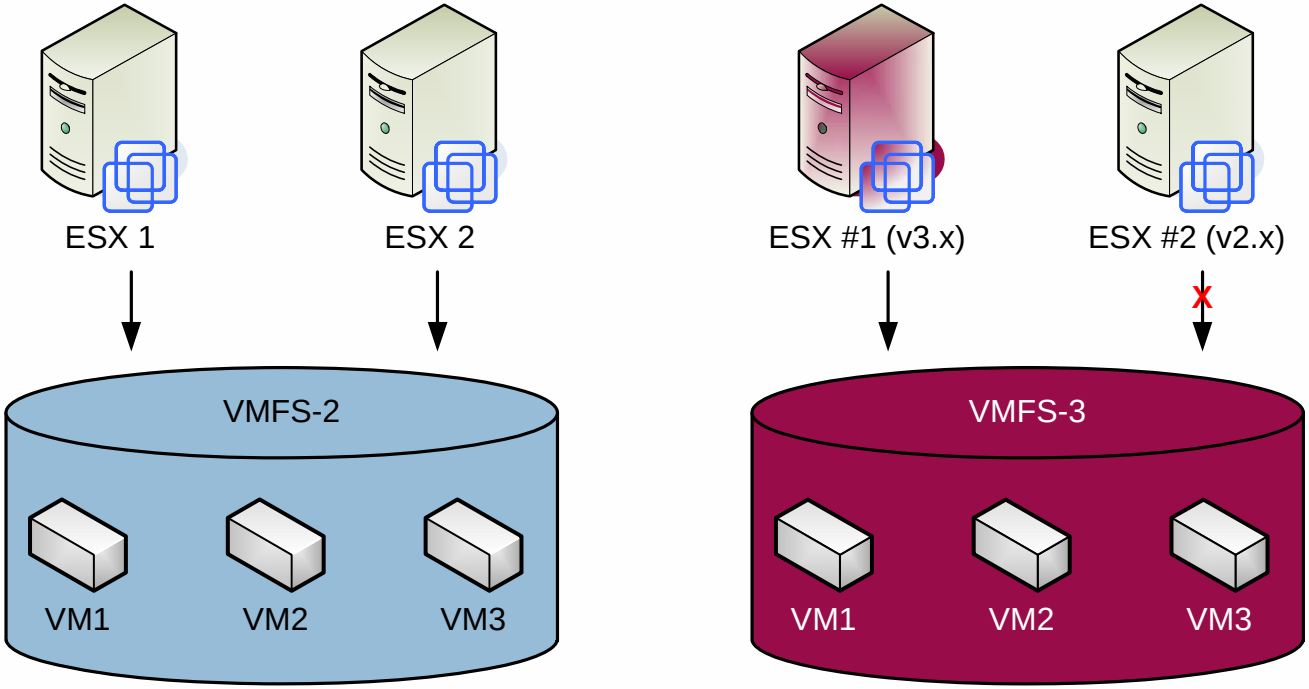
- **Upgrade ESX Hosts and Datastores**
  - **ESX 3 hosts only run VMs from VMFS-3 partitions**
  - In-place Upgrade
    - Downtime incurred from ESX 2.x host down until ESX and VMFS upgraded
  - Traditional Migration (ESX 3.0/VC 2.0)
    - Power off VM
    - Cold migrate to ESX 3.x host and VMFS-3 datastore
  - Enhanced Migration (ESX 3.0.1/VC 2.0.1)
    - Live migrate (VMotion) running VM from ESX 2 host to ESX 3 host ***with datastore relocation***
    - Requires VMotion-compatible hardware
    - ***One-time, one-way operation***
  - Vizioncore esxMigrator

Upgrade Detail – Phase II

- **VMFS-3 Upgrade**
  - VMFS-2 to VMFS-3 upgrade is non-destructive
  - ~1.2 GB free space required for conversion
  - Virtual machine swap files now stored with VMDK and VMX
- **ESX Upgrade**
  - Upgrade options
    - Boot from the ESX Server 3 installation media
      - Select the Upgrade option
      - Perform a clean installation
    - Download the tarball and upgrade similar to patching ESX 2.x hosts
- **DO NOT move to Phase III until all hosts have been upgraded to ESX 3.x and all VMDKs have been moved to VMFS-3 Datastores**

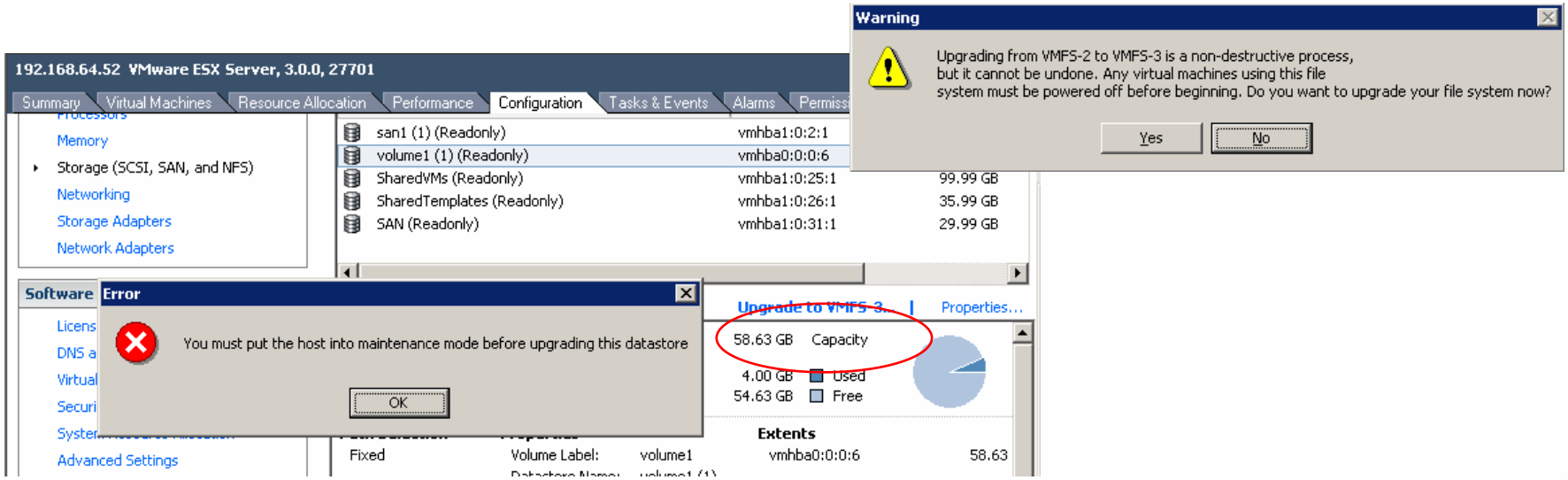
Upgrade Detail – Phase II

- Virtual machines become inaccessible to ESX 2.x hosts as partitions are upgraded to VMFS-3
- Keep this in mind when designing the migration path



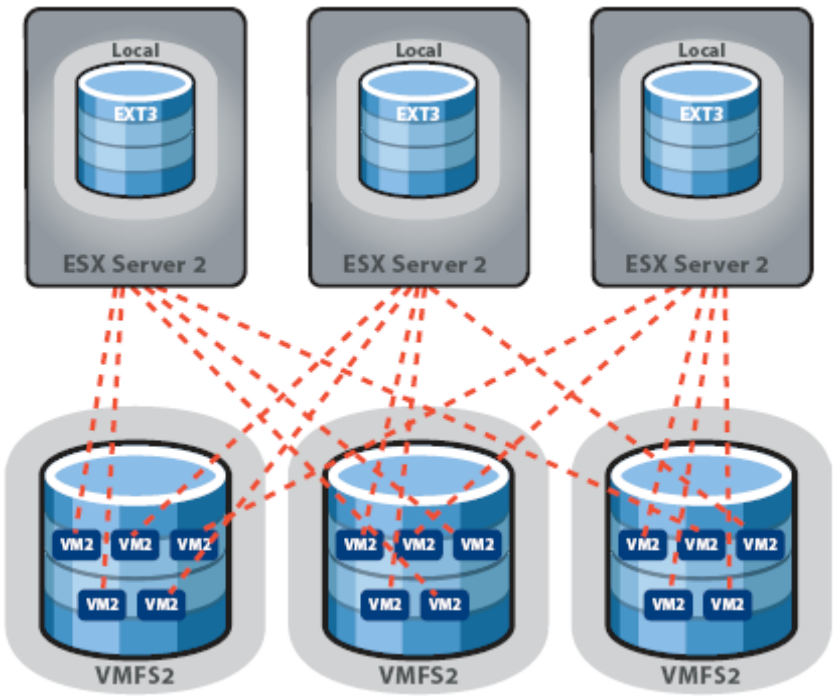
Upgrading VMFS

- **Pre-Upgrade Preparation**
  - Back up files in VMFS datastore
  - Resolve unsupported configurations (clustered VMs, raw disks)
- **Upgrade VMFS**
  - Put host in maintenance mode (requires all VMs be powered off)
  - Upgrade VMFS datastore
  - Take host out of maintenance mode



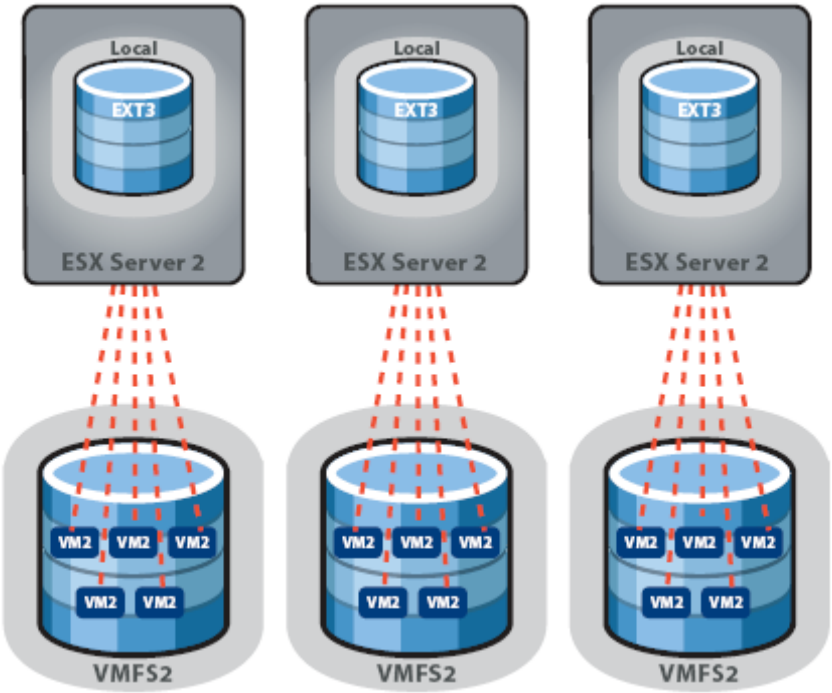
Upgrade Detail – Phase II

- **Example:** SAN access from 4 ESX hosts to 4 SAN-based LUNs
- An upgrade would be difficult without more shared storage available



Upgrade Detail – Phase II

- It is often helpful to align the Hosts, VMDKs and LUNs in a manner that facilitates the upgrade process
- VMware refers to this as HVL alignment (Host/VM/LUN)



Upgrade Detail – Phase III

- Preparation
  - Phase II complete
  - Licenses
  - All datastores VMFS-3
  - All ESX hosts v3
- Expected Downtime
  - Virtual Machines: each must be rebooted
  - ESX hosts: None
  - VC Server: None
- Complete
  - VirtualCenter 2.x
  - ESX 3.x
  - VMFS-3
  - Virtual Machines
- Remaining
  - VMware Tools

- **Upgrade Virtual Machines**
  - Enables new features, expanded capacity
  - Legacy virtual machines will run; cannot be modified
  - Clone VMs prior to virtual hardware upgrade!
  - **Once upgraded, ESX 2 host cannot power it on**
  - Requirements
    - VMDK stored on VMFS-3 or VMkernel NFS datastore
    - No legacy suspend (REDO) files exist
  - May be batched with **`vmware-vmupgrade.exe`**
    - Default operation also upgrades the VMware Tools (this may be disabled with **`-s`**)
    - Supports powered-off Windows 2000+ and Linux virtual machines

Upgrade Detail – Phase IV

- Preparation
  - Phase III complete
  - Licenses
  - All VMs upgraded
  - Supported Guest OS installed
- Expected Downtime
  - Virtual Machines: must be rebooted once
  - ESX hosts: None
  - VC Server: None
- Complete
  - VirtualCenter 2.x
  - ESX 3.x
  - VMFS-3
  - Virtual Machines
  - VMware Tools
- Remaining

- **Upgrade VMware Tools**
  - Install one VM at a time
  - Windows tools are digitally signed; can be installed unattended
  - Downtime is one reboot per virtual machine
    - Can be scheduled as needed: 1-2 minutes per VM + application shutdown time
  - Required to leverage VCB file-level backups

Post-Upgrade Tasks & Notes

- Client-based firewall enabled by default
- Configure **`ntpd`**
  - Open firewall for ntpClient
    - **`esxcfg-firewall –e ntpClient`**
- If SMB/CIFS mounts are used for ISO/floppy images
  - Open firewall for smbClient
    - **`esxcfg-firewall –e smbClient`**
  - Create symlinks of mount points in **`/vmimages`**
    - **`ln –s /mnt/mySMBmount /vmimages/mySMBmount`**

Post-Upgrade Tasks & Notes

- VirtualCenter Server
  - Relocate Microsoft sysprep components
- Virtual Infrastructure Client
  - Can mount local drives (CD-ROM and floppy) and images to virtual machines
- VMkernel owns hardware (no more **`vmkpcidivy`**!)
- Command line management tools (**`esxcfg-*`**) are available
- Bond devices no longer exist
  - Bonds automatically created by assigning multiple physical NICs to a vSwitch
- **`vmkusage`** is gone; use charts in Virtual Infrastructure client
- VirtualCenter Agent
  - **`vmware-serverd`** and **`vmware-ccagent`** are gone
  - **`vmware-hostd`** and **`vmware-vpxa`** are new

Post-Upgrade Tasks & Notes

- SSH
  - Clean installs: **`root`** is not able to login via SSH
    - Create local users on each ESX host
    - Use Vintella Authentication Services to authenticate against AD
  - Default firewall configuration blocks SSH <u>from</u> ESX hosts
    - **`esxcfg-firewall –e sshClient`**
- If ESX 2 Host Upgraded In-place
  - Continues to allow **`root`** to login via SSH – lock it down
    - **`/etc/ssh/sshd_config`** ⇨ **`PermitRootLogin no`**
  - **`/etc/fstab`** replaced with new, old is in **`/etc/fstab.save`**
  - Networking and Storage: Verify and Clean Up as Needed
    - Service Console – check DNS and routing
    - NIC mapping and bonding, vSwitch definition
    - Storage configuration (Paths and Policy: MRU vs. Fixed)

New Features – Resource Pools

- Boundaries around groups of VMs to guarantee or restrict resources
- Only CPU and Memory resources
- May be subdivided
- Created at ESX host, Cluster, or Resource Pool level
- Examples
  - Chargeback
    - Charge departments for reserved CPU and Memory capacity
  - Priority/Criticality/SLAs
    - Configure Resource Pools based on performance needs
    - Prevent Test machines from affecting Production
  - “Security”
    - Shares assigned are relative to Resource Pool, not ESX host

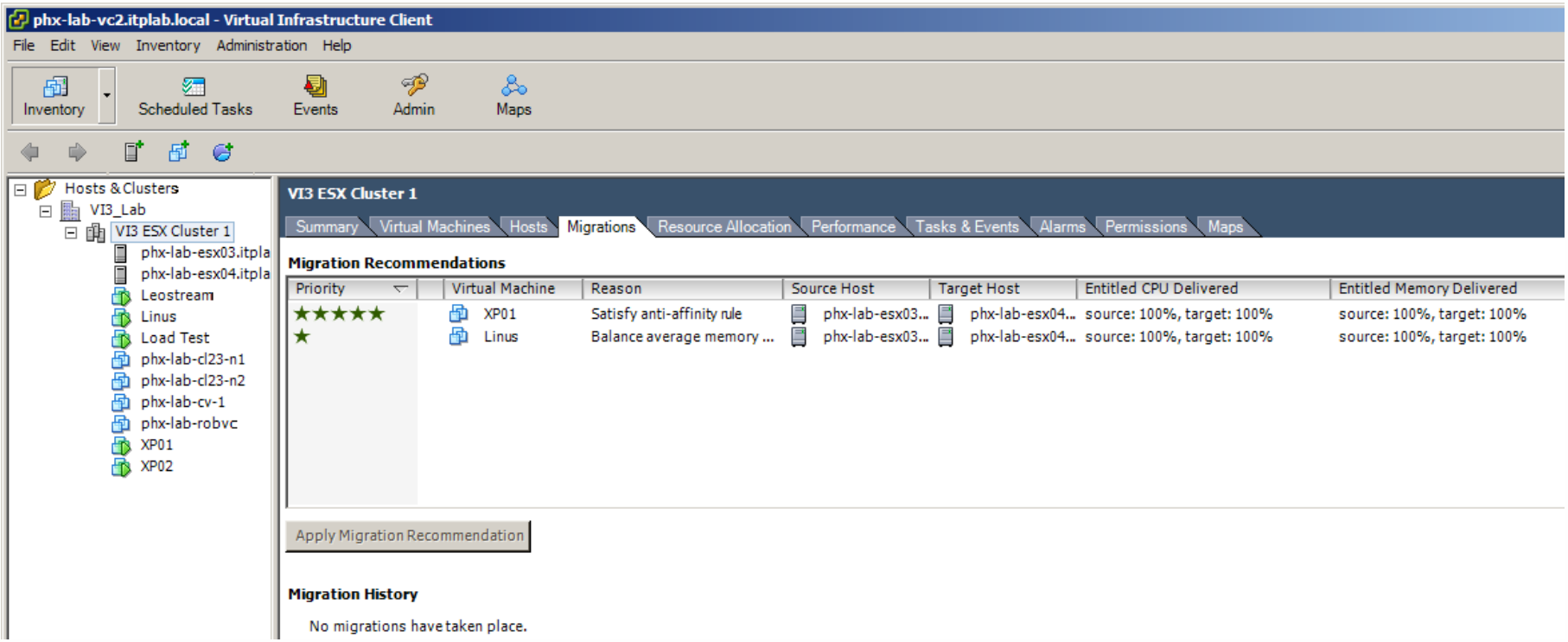
New Features – VMware DRS

- **Leverages VMotion**
  - Create clusters based on VMotion groups
- Start with Partially Automated mode
  - Manual mode requires a decision for **each** power-on operation
- Balances load across the cluster; honors resource pool constraints

- **Cool Feature**
  - Enable Fully Automated DRS (Aggressive) and put a host into Maintenance Mode to have it automatically evacuate the host for maintenance

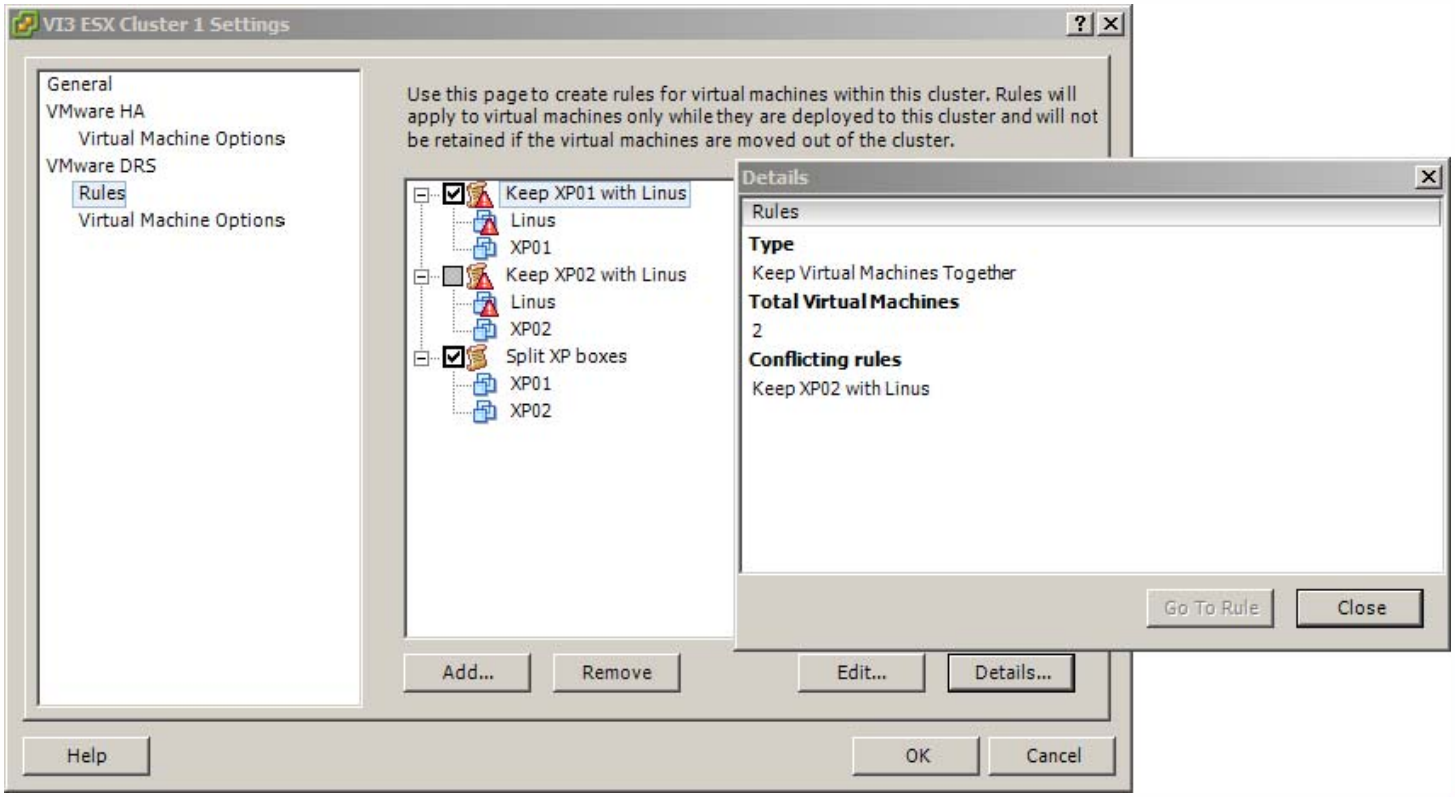
New Features – VMware DRS

- Recommendations assigned a ‘star rating’ (1-5 stars)
  - Displayed on the Migrations tab of the Cluster object



New Features – VMware DRS

- Affinity/Anti-Affinity Rules
  - Virtual machines that should or should not be on the same ESX host
  - Logic issues (A+B, B-C, A-C) are flagged



New Features – VMware HA

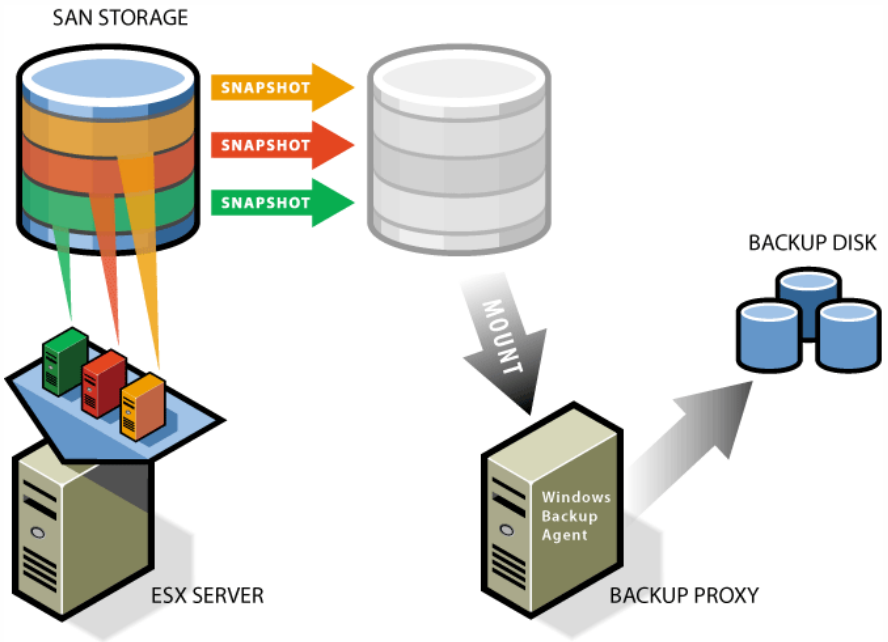
- **What is it?**
  - If an ESX host fails, its hosted virtual machines are **powered up** on another host in the cluster
  - Failures are detected by heartbeats on Service Console NICs
    - Failure to receive heartbeats triggers isolation detection
  - Uses Legato AAM engine on Service Console
- **What isn't it?**
  - **Does not use VMotion**
  - Virtual machines **become temporarily unavailable**
  - **Does not** protect against failures within VMs
  - **Does not** work between Clusters or Datacenters
  - **Should not** be considered your DR solution

New Features – VMware HA

- **Requirements**
  - **Name resolution is required**
  - ESX hosts must be able to resolve each other's names
  - ESX hosts must be able to ping their default gateway(s)*
  - `/etc/hosts` files may be used, but DNS is preferred
- **Notes from the field**
  - **Ensure that the Service Console has redundancy**
    - Prevents a switch failure from triggering Isolation Response (split-brain prevention) and powering off all virtual machines
  - To reduce false positives
    - Enable portfast on physical switch ports
    - Enable "Rolling Failover" vSwitch policy
  - Do not use with Beacon Probing network failure detection (BUG!)

New Features – VMware Consolidated Backup

- Virtual machines backed up from a centralized Windows 2003 Server (Backup Proxy) rather than from the ESX host
- Reduces load on ESX host and network
- Uses VMware Tools inside Guest OS to quiesce file system prior backup
- Single backup agent in a proxy server instead of per-VM agents
- File-level backups within Guest OS (Windows only)
- Full VM snapshot backup (Any Guest OS)



Q&A

- **Questions?**
- **Assistance**
  - VI Upgrade Workshop
    - This presentation highlights best practices from the detailed workshop
  - http://www.vmware.com/pdf/vi_upgrade.pdf
  - Contact VMware Professional Services or a VAC partner

Q&A

- **Questions?**
- **Online Resources**
  - Planning an Upgrade to VMware Infrastructure 3
    - http://www.vmware.com/vmtn/resources/539
  - VMware documentation:
    - http://www.vmware.com/support/pubs/
  - Licensing
    - http://www.vmware.com/download/licensing.html
  - Mike Laverick's (RTFM) Site:
    - http://www.rtfm-ed.co.uk/
  - VMTN Forums
    - http://www.vmware.com/community

More Resources

- Vintella Authentication Services
  - http://www.quest.com/Vintela_Authentication_Services/
- Vizioncore esxMigrator
  - http://www.vizioncore.com/esxMigrator.html
- Microsoft Windows 2000 SP4 Update Rollup 1
  - http://www.microsoft.com/windows2000/server/evaluation/news/bulletins/rollup.mspx

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EXTRA SLIDES

Updating ESX 3.0

- **esxupdate**: a new way to patch ESX hosts
  - How?
    - Download update package (`3.0.1-32039-full.tgz`)
    - Copy to ESX server or host on NFS/SMB share and mount
    - Migrate virtual machines; put host into Maintenance Mode
  - Unpack a tarball and perform update with esxupdate
    - `tar xfz 3.0.1-32039-full.tgz`
    - `cd 32039`
    - `esxupdate -n update`
  - Tracks installed updates
    - `esxupdate query`

```
Installed software bundles:
------ Name ------ --- Install Date --- --- Summary ---
   3.0.0-27701    14:54:27 07/28/06
   3.0.1-30353    09:43:50 08/29/06 Full 3.0.1 release of VMware ESX Server
   3.0.1-32039    10:25:54 10/06/06 Full 3.0.1 release of VMware ESX Server
```

Scripts and Snippets

- Location of VMDK files for all registered VMs on an ESX host
  - ```
    vmware-cmd -l | while read vm; do ID=`vmware-cmd "$vm" getconfig displayname`; ID=${ID/*= /}; DISK=`grep -i VMDK "$vm"`; DISK=${DISK/*= /}; printf "$ID\t$DISK\n"; done
    ```
    ```

Storage Changes

- VMFS-3 supports directories and small file storage
- VI3 virtual machines store configuration files virtual disks, and per-machine swap files on VMFS-3
- Memory overcommitment relies on per-virtual machine swap files, not per-host swap files
- VI2 virtual machines with raw disks will fail on VI3 hosts
  - ESX Server 2.5.x VMs: convert a raw disk to a raw device mapping (RDM) prior to running on ESX Server 3.0
  - ESX Server 2.1.x VMs: remove a raw disk and add the disk back as a raw device mapping (RDM) when running on ESX Server 3.0