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DEFY CONVENTION

VAPP5618

Virtualize Active Directory – The Right Way!

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Agenda

- Active Directory Overview
- Why virtualize Active Directory?
- Best Practices
- New Features

Active Directory Overview

- **This is not an Active Directory class**
- **Windows Active Directory Multi-master Replication Conundrum**
  - Write Originates from any Domain Controller
    - RODC is "special"
    - Schema Update is "special"
  - Selective Partnership
    - The Case for Optimal Replication Topology
  - Changes MUST Converge
    - Eventually
    - Preferably On-Time
- **The Additional Complexity of Multi-Domain Infrastructure**
  - The Infrastructure Master
  - The Global Catalog

Active Directory Overview

- **How Do They Do That? – Overview of AD Replication**
  - The Directory Service Agent GUID
    - Unique to a Domain Controller
    - Persistent over the life of a Domain Controller
    - Used in USNs to track DC's originating updates
  - The InvocationID
    - Used by DSA to identify a DC's instance of the AD database
    - Can change over time (e.g. during a DC restore operation)
  - Update Sequence Number (USN), aka "Logical Clock"
    - Used by DCs to track updates sent or received
    - Increases per write transaction on each DC
    - Globally unique in Forest
  - USN + InvocationID => Replicable Transactions
- **What about Timestamps?**
  - Conflict Resolution – Check the Stamps
    - Stamp = Version + Originating Time + Originating DSA

Why Virtualize Active Directory?

Why Virtualize AD?

Virtualization is main-stream	"Virtualize First" – the new normal No longer a "black magic"
Active Directory virtualization is FULLY supported	All roles are suitable candidates Can't spell "Cloud" w/o "Virtual"
Active Directory characteristics are virtualization-friendly	Distributed, Multi-master Low I/O and resource requirements
Domain Controllers are inter-changeable	OK, maybe not the RODC ☺ Facilitates rapid provisioning
Why not to virtualize Active Directory?	The fear of the "stolen vmdk" How about the "stolen server"? Privilege Escalation*

Best Practices

Best Practices for Virtualizing Domain Controllers

Design for Resilience

The "low-hanging fruits"

Deploy across multiple datacenters

Multiple geographical locations and AD Sites

Distribute the FSMO roles

Use EFFECTIVE Role-Based Access Control

Enforce Well-Defined Administrative Practices

Leverage VMware Availability Features

VMware HA

VMware DRS Rules

- Use Anti-affinity rules to keep DCs separated
- Use Host-Guest affinity rules to keep DCs on specific Hosts

vMotion

What's in a Name?

~ 75% of AD-related support calls attributable to DNS "issues"

AD DEPENDS on effective name resolution

- Clients and DCs reference objects by name/GUID
- Internal AD processes depend on DNS

The "Repl Perform Initial Synchronizations = 0" Curse Word

DNS on DC or IPAM?

- Physical IPAM complicates failover and recovery
- Avoid pointing DC to ONLY itself for DNS
- Distribute DNS servers across multiple sites
- Include loopback address in DNS list
- Include ALL Suffixes – or use GloblaNames

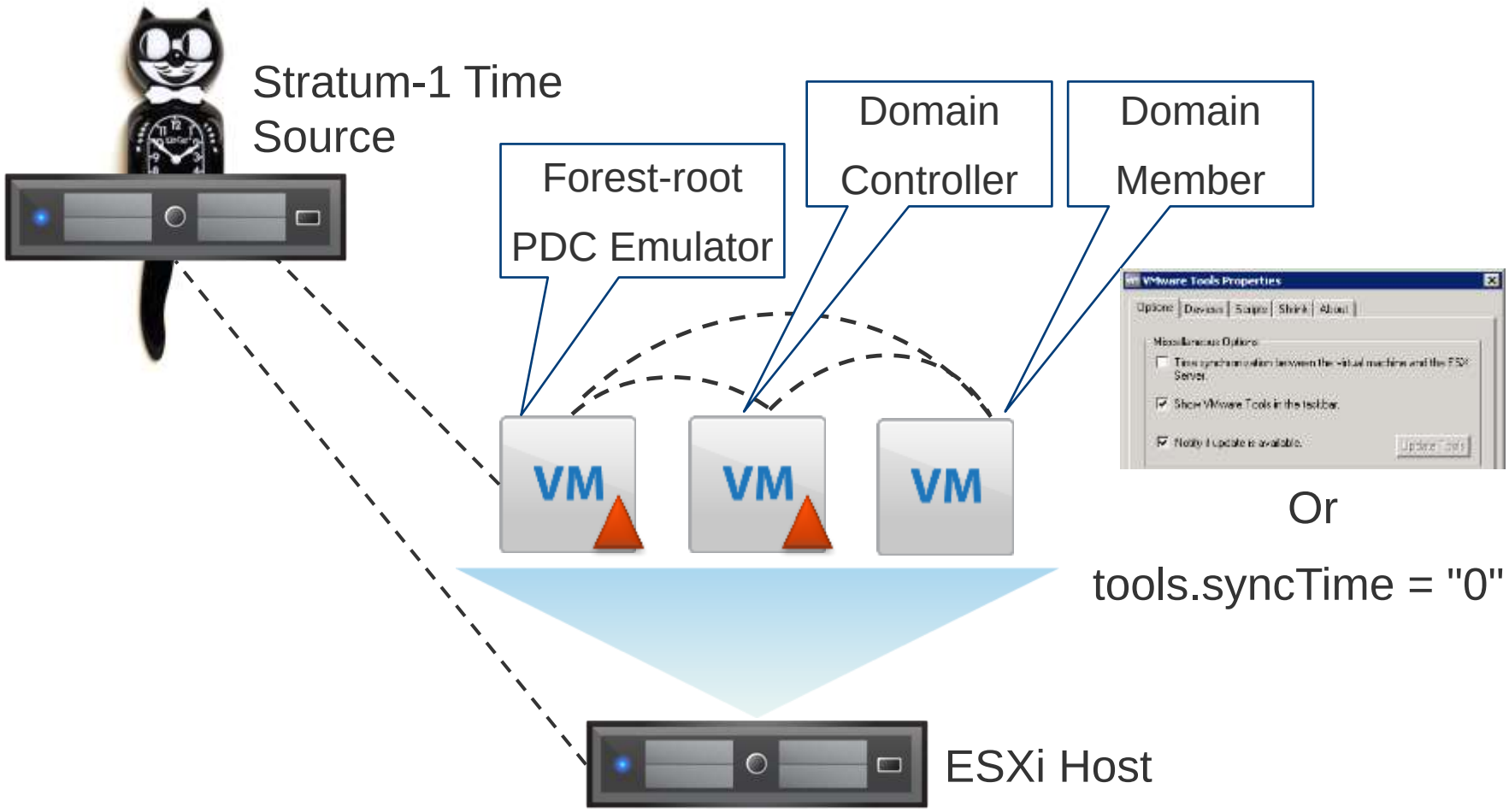
Time Keeping

- **ACCURATE timekeeping is essential to AD**
  - Conflict resolution “tie breaker”
  - Kerberos authentication
  - W32Time is “good enough”
- **Operating Systems use timer interrupts (ticks) to track elapsed time**
  - Relies on CPU availability for accuracy
- **Tickless timekeeping avoids problem of CPU saturation**
  - Uses units of elapsed time since boot-up
  - Depends on fast, reliable “hardware counter”
- **Host resource over-allocation will lead to contention**
  - Guest may be idle and not schedule timer interrupts
  - Guest unable to schedule CPU time for interrupts
  - This leads to interrupt backlogs – and clock “drift”
  - Guest may over-compensate for “drift” by discarding backlogs – Ping-Pong!

Time Keeping – The Proper Way

- **vSphere includes time-keeping mechanism**
- **VMware Tools is the delivery vehicle**
  - Resets Guest's clock to match Host's on boot-up
    - Even if Guest-Host clock synchronization is disabled
  - Reset Guest's clock when resuming from suspension or snapshot restore
    - This behavior can be disabled
- **Synch with Host or Use Windows domain time hierarchy?**
  - We have had a change of heart
    - Default guest time synchronization option changed in vSphere
    - Domain-joined Windows guests should use native time sync option
    - Domain Controllers should NOT be synced with vSphere hosts *
      - Unless when running VMKernel-hosted NTP daemon in vSphere (ESXi)
    - vSphere hosts should NOT be synced with virtualized DCs
    - Follow Microsoft's time sync configuration best practices
- **VMware Tools STILL performs on-startup guest time correction ***

Proper Time Keeping – For Visual Learners



http://support.microsoft.com/kb/816042

http://kb.vmware.com/kb/1318

http://www.vmware.com/files/pdf/techpaper/Timekeeping-In-VirtualMachines.pdf

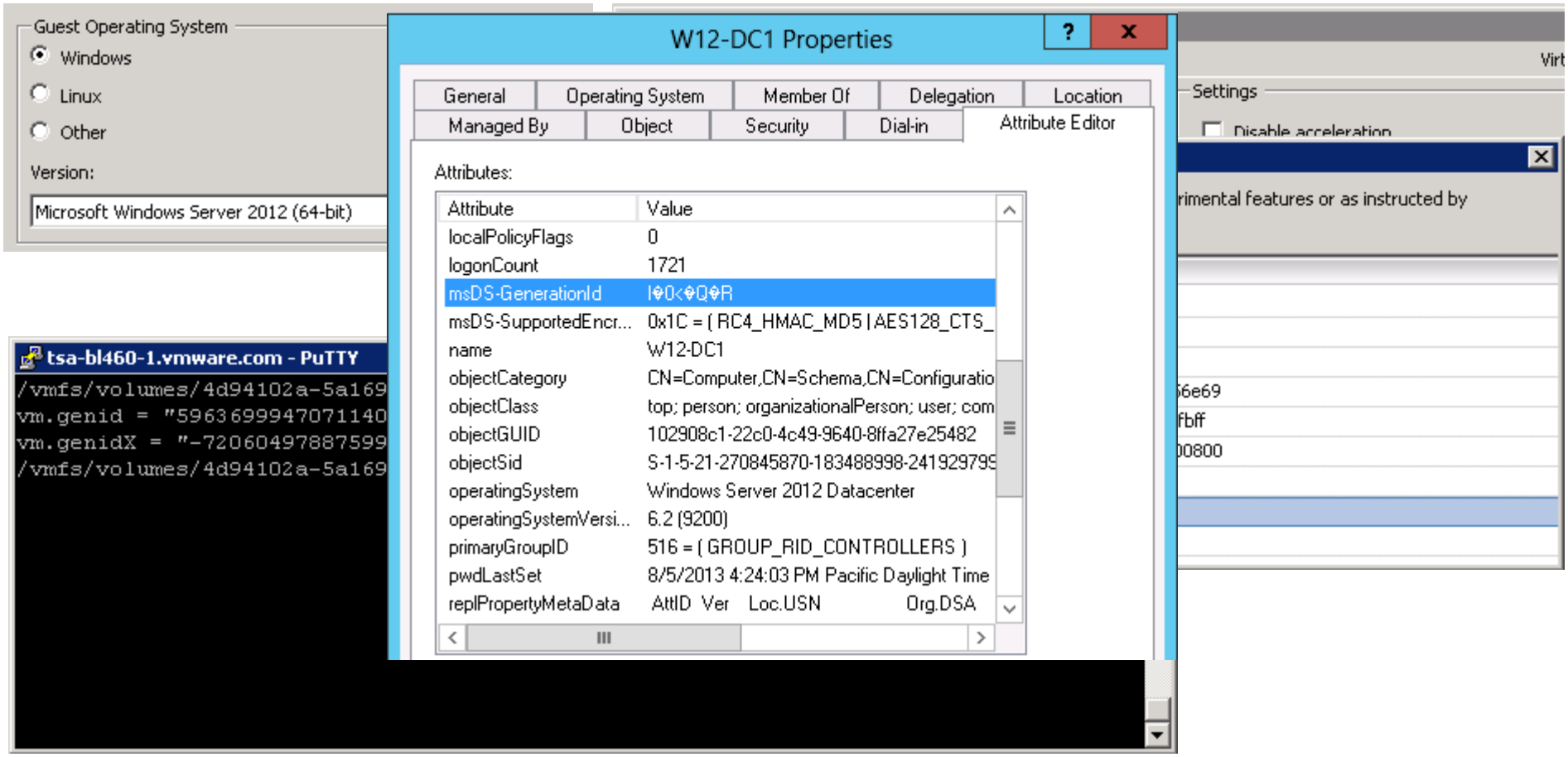
Historical Problems with Virtualizing Domain Controllers

- **Virtual Disk – To cache or not to cache?**
  - Not ~~our problem~~ a vSphere issue ☺
  - Force Unit Access – http://support.microsoft.com/kb/888794/en-us
  - Virtual Disk Corruption in Hyper-V – http://support.microsoft.com/kb/2853952
- **AD is a distributed directory service that relies on a clock-based replication scheme**
  - Each domain controller keeps track of its own transactions and the transactions of every other domain controller via Update Sequence Numbers and InvocationIDs
  - A domain controller which has been reverted to a previously taken snapshot, or restored from a VM level backup will attempt to reuse USNs for new transactions – USN Rollback
  - The local DC will believe its transactions are legit, while other domain controllers know they are not and refuse to allow incoming replication
- **The fix? VM GenerationID**

VM Generation ID

- **Windows Server 2012 provides a way for hypervisor vendors to expose a 128-bit generation ID counter to the VM guest**
  - Generation ID is communicated from the hypervisor to the guest through the VM GenerationID Counter Driver (not VMware Tools)
- **VM GenerationID supported in vSphere 5.0 Update 2 and later**
  - Exposed in VMX file as *vm.genid*
  - Added to all VMs configured as Windows Server 2012
- **VM GenerationID is updated by the hypervisor**
  - VM clone, new VM from copied VMDK, snapshot revert, restore from VM-level backup, replicated VM (vSphere Replication or Array-based)
- **VM GenerationID tracked via new Active Directory attribute on domain controller objects – *msDS-GenerationId***
  - Attribute is not replicated to other domain controllers

VM GenerationID Screenshots



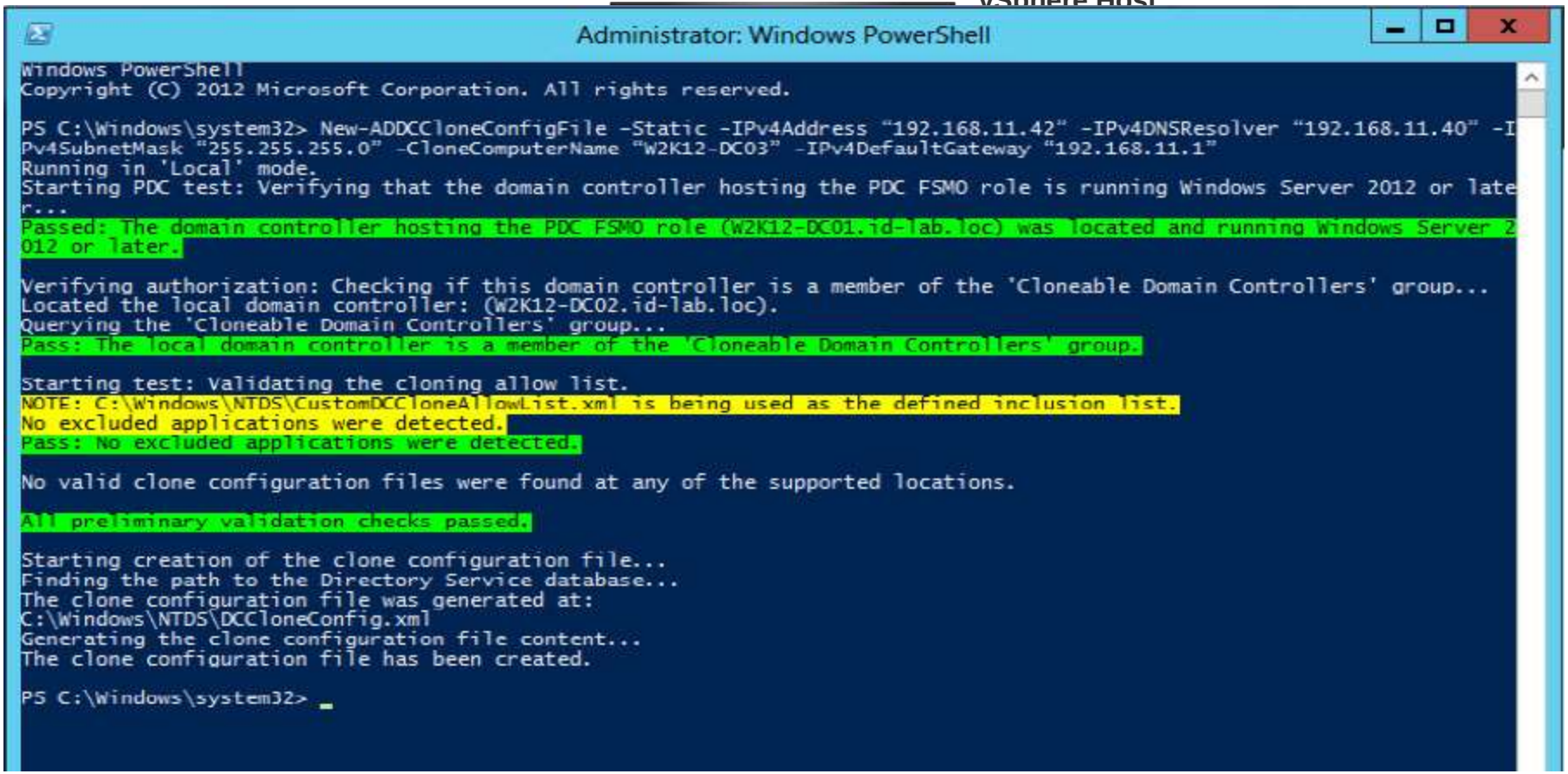
- VM GenerationID allows for two new features: domain controller cloning and domain controller safeguard

Domain Controller Cloning

- **DC Cloning allows fast, safe deployment of new domain controllers using hypervisor based cloning techniques**
  - Includes clone and copy VMDK
- **DC Cloning Sequence**
  - Source DC is prepared for cloning, this includes adding the DC to the cloneable domain controllers AD group, checking for non-cloneable software and creating the DCCloneConfig.xml
  - Source DC is shut down
  - Source DC VM is cloned using hypervisor based cloning operations
  - New DC is powered on and VM GenerationID is evaluated
  - New VM GenerationID triggers DC Safeguard – RID Pool discard, invocationID reset
  - New VM checks for existence of file DCCloneConfig.xml
  - If exists, the cloning process proceeds and new DC is promoted using the existing AD database and SYSVOL contents

Domain Controller Cloning Example

vSphere Host

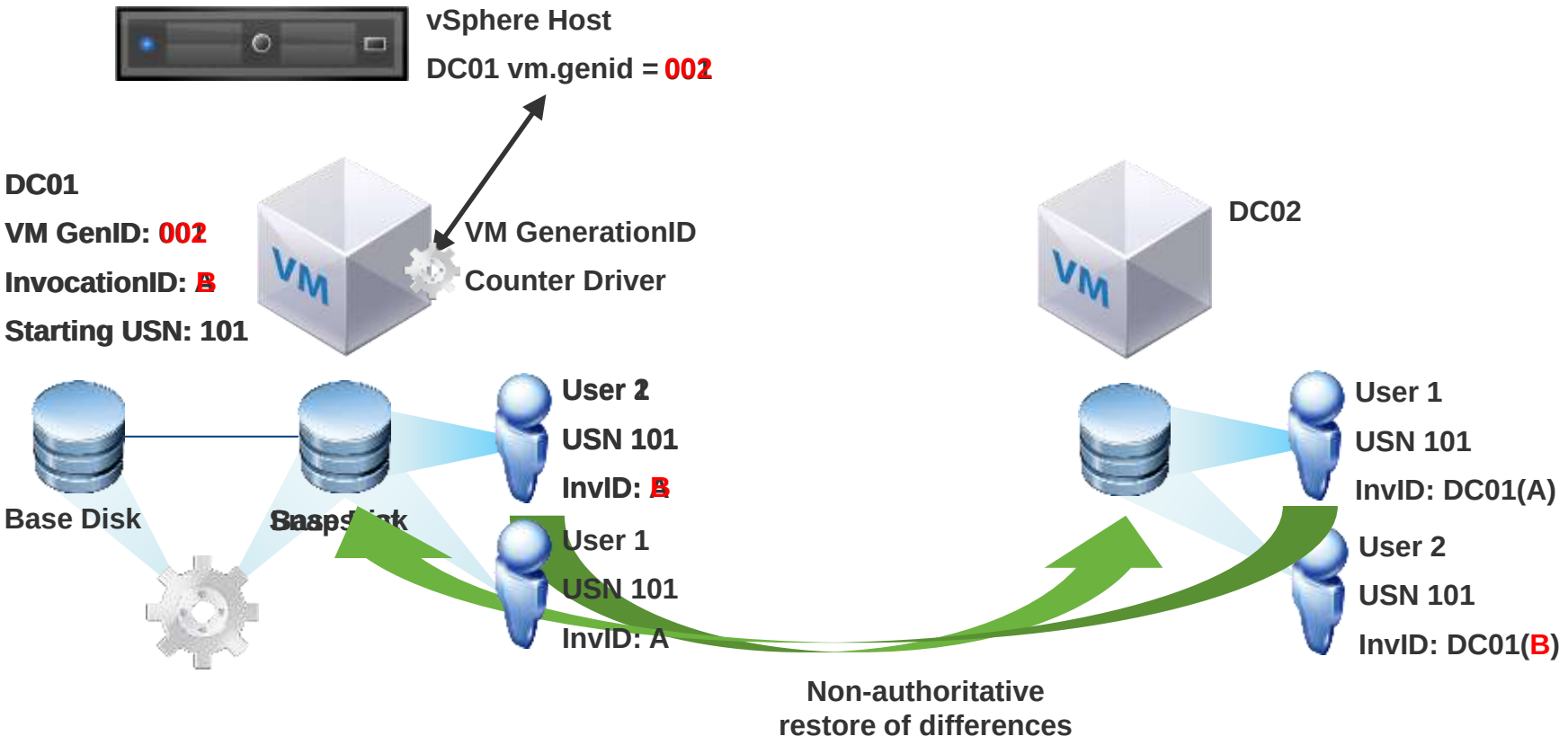


Domain Controller Cloning Demo

Domain Controller Safeguard

- **DC Safeguard allows a DC that has been reverted from a snapshot, or restored from VM backup to continue to function as a member of the directory service**
  - VM GenerationID is evaluated during boot sequence and before updates are committed to active directory
- **After revert/restore:**
  - Boot-up or new AD update triggers VM GenerationID to be compared to value of msDS-GenerationId in local AD database
  - If the values differ:
    - The local RID pool is invalidated
    - New invocationID is set for the local AD database
  - New changes can be committed to the database and synchronized outbound
  - Changes lost due to revert/restore and synchronized back inbound
- **After VM Clone or Copy (without proper prep)**
  - DC is rebooted into directory service restore mode (DSRM)

DC Safeguard Example



DC Safegaurd Demo

Considerations When Using DC Safeguard Features

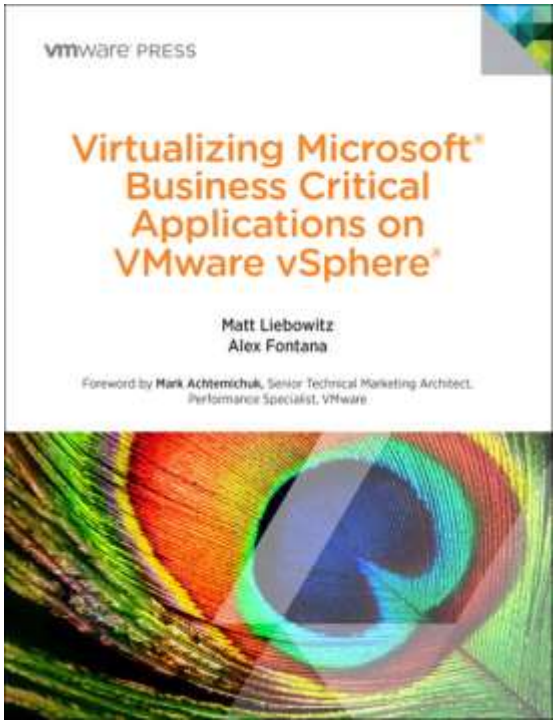
- **Minimum vSphere/vCenter/ESXi version: 5.0 Update 2**
- **Always shutdown source domain controller prior to cloning**
  - No Hot-clone! Besides, it's not supported.
- **If cloning or safeguard is not working as expected, make sure the guest operating system setting on the VM is set to Windows Server 2012**
- **Remember to validate all software (think management/backup agents) for cloning**
- **Leave Cloneable Domain Controllers group empty in between clone operations**
- **If using Windows Backup make sure to delete the history on the clone, and take a fresh backup ASAP**

Key Take Aways…

- Dangers which were once present when virtualizing DCs have mostly been resolved in Windows Server 2012
- Domain Controller virtualization is 100% supported
- The Multi-master, distributed, and low resource utilization characteristics of Active Directory make domain controllers virtualization-friendly
- Most of the best practices for virtualizing Active Directory, are not specific to VMware or virtualization at all, i.e. DNS, time keeping, etc.
- Active Directory is natively highly available, combine with vSphere High Availability to mitigate hardware failures
- Upgrade to Windows Server 2012 to bring domain controller safeguard and cloning to the party.

Shameless Plug

- **New book available for VMworld 2013**
- **Topics include:**
  - Virtualizing business critical apps
  - Active Directory
  - Windows Failover Clustering
  - Exchange 2013
  - SQL 2012
  - SharePoint 2013
- **Available on-site at the VMworld Book Store**
- **Available online at Amazon and Pearson (pearsonitcertification.com)**
- **Book signing Wednesday 12:30-1:30pm**



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