



# NetBackup for VMware vSphere

## Overview and Best Practices

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# NetBackup for VMware

## *Simple and Comprehensive Protection*

**Agent-less Backup**

Reduces ESX & application impact

**VMDK Incrementals**

Speeds up backup time

**Windows File-level Recovery**

Addresses most common restore requests

**vCenter Integration**

Quick & efficient VM discovery

**NetBackup for**  
 **vmware**

SearchServerVirtualization.com  
**BEST OF vmworld 2010**  
**GOLD AWARD**  
BUSINESS CONTINUITY AND DATA PROTECTION

SearchServerVirtualization.com  
**BEST OF vmworld 2008**

**FINALIST**

SearchServerVirtualization.com  
**BEST OF VMWORLD 2007**

**GOLD**

Reduce backend storage by 95% or more

**VM-optimized Deduplication**

Across physical & virtual machines

**Centralized Deduplication**

At the client, media server or appliance

**Deduplicate Anywhere**

Send only unique data to DR location

**Optimized Replication**

# Agenda

- vStorage API for Data Protection Explained
- VADP – Backup Process
- Performance Baseline Testing
- Backup Application & VADP Perf Considerations
- VMware Intelligent Policy
- Virtual Machine Restore Considerations
- NetBackup for VMware Tips and Tricks
- Customer Implementation Examples
- Q & A

**What's a "VADP"?**

# vStorage API for Data Protection (VADP)

- A family of storage related API's created by VMware
  - vStorage API for Array Integration (VAAI)
  - vStorage API for Data Protection (VADP)
  - vStorage API for Site Recovery Manager (VASRM)
  - vStorage API for Multi-pathing (VAMP)
- Not a backup application – a true API
  - Backup vendors use this API to access advanced VMware backup capabilities
- VADP replacement (not enhancement) of VCB
  - VCB still supported with vSphere 4
  - VCB no longer supported with vSphere 5

# vStorage API for Data Protection (VADP)

- VADP component
  - **NetBackup 7 fully supports all VADP advanced backup capabilities**
  - VDDK – Virtual Disk Development Kit
  - Automatically installed with NetBackup 7 (and later)
- VADP components – VMware side:
  - VADP supported by VMware with ESX 3.5 U2 and later
- VADP provides easier, simpler backup implementation
  - No longer need to download anything (e.g. VCB Framework)
  - No additional disk (holding tank) required



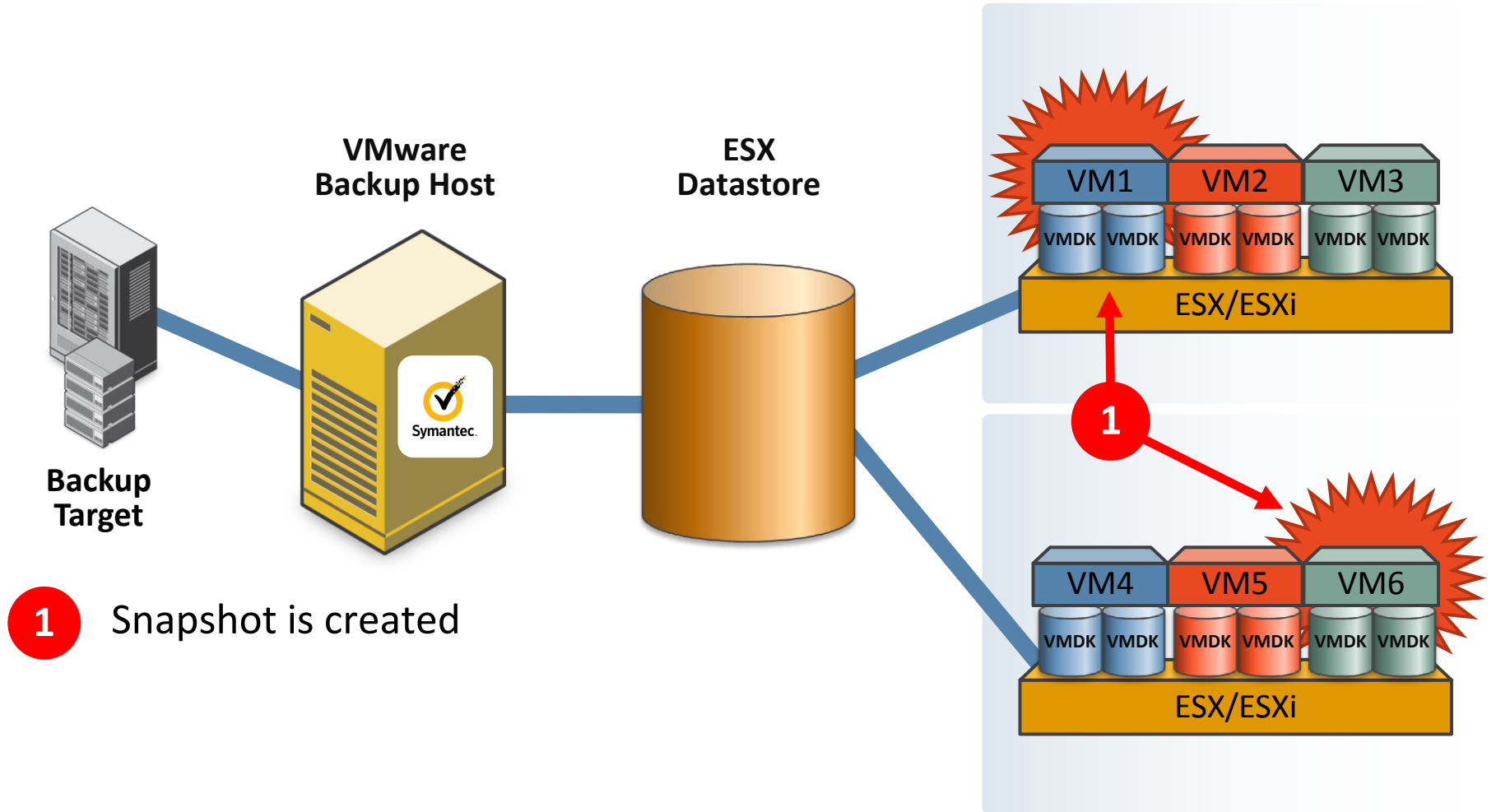
# VADP - Provides Powerful Backup Features

- Changed Block Tracking (CBT)
  - True incremental backups
  - I consider this most important enhancement
  - Image (vmdk) level incremental backup & restore
  - NetBackup uniquely supports single file restores from CBT incremental
- Incremental (CBT) backups are key component of efficient backups
  - Less back end storage required
  - Quicker backups
  - Less snapshot impact (more on this in a minute)

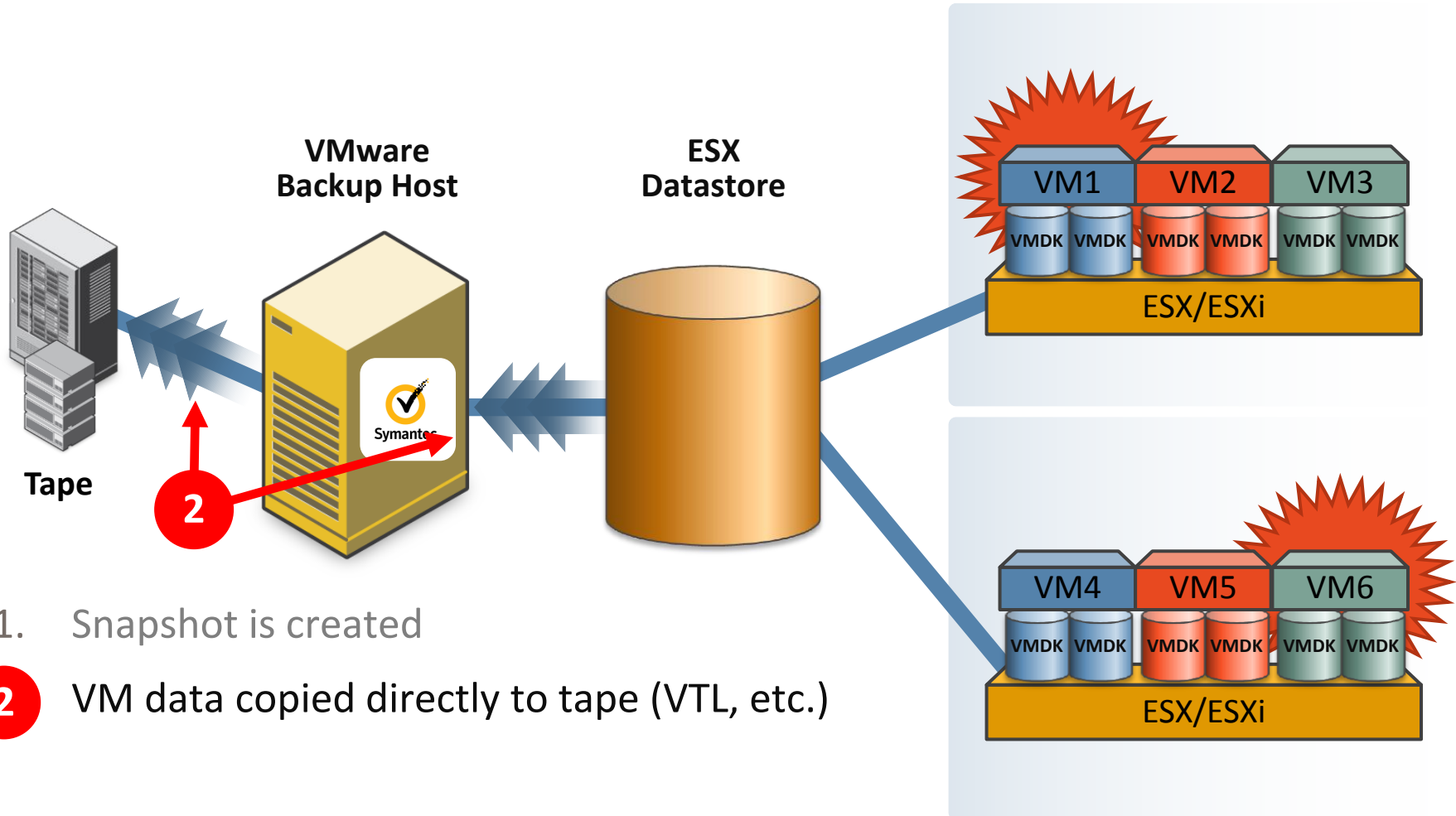
# VADP – Backup Process



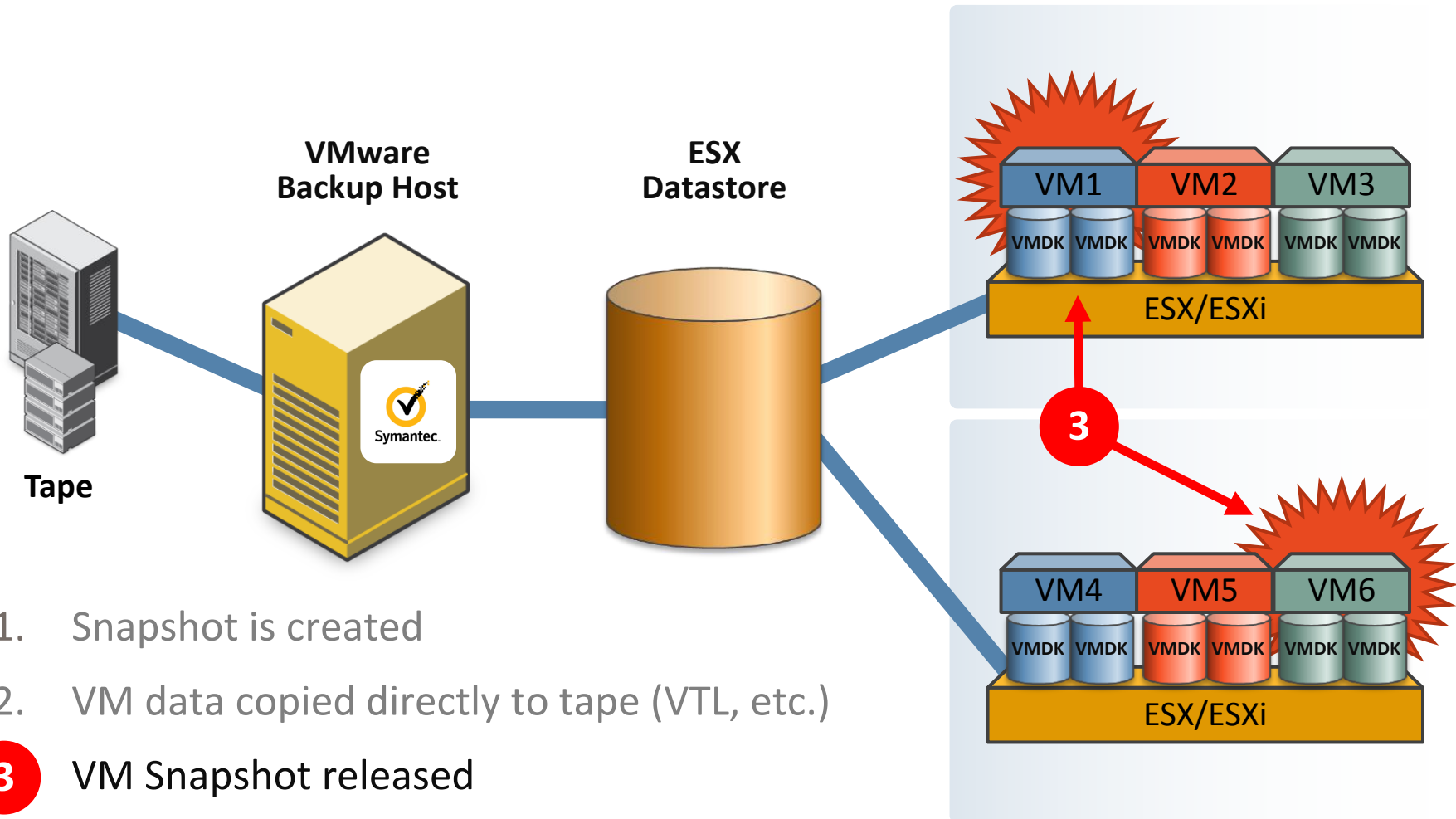
# vStorage API Backup Process



# NetBackup 7 for VMware Backup Process



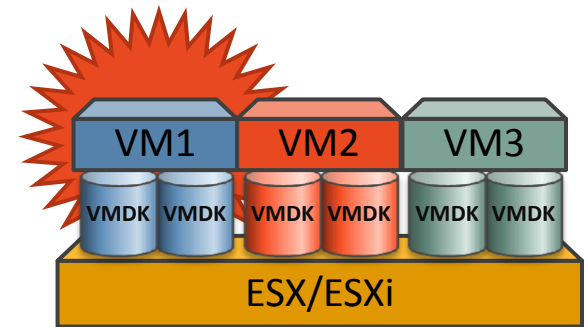
# NetBackup 7 for VMware Backup Process



# A Closer Look - What Happens During a Backup?

## A Detailed Look at the VADP Snapshot Process

- During VM backups, VMware creates temp snapshot of VM. Process is as follows:
  - VSS provider flushes OS buffers in VM
  - Snapshot of VM is taken (vmdk(s) are frozen) (SCSI reservation of LUN)
  - Redo log created – all writes redirected to redo log
  - VM is backed up
  - Redo log data applied to original vmdk(s)
  - Snapshot released - backup completed
- Why does this matter?
  - Every one of these steps involves I/O
  - Reducing I/O impact improves backup perf & reliability
  - Incrementals are quick and can reduce snapshot impact



**Hey! This snapshot stuff takes a lot of time and I/O! Why not just skip it?**

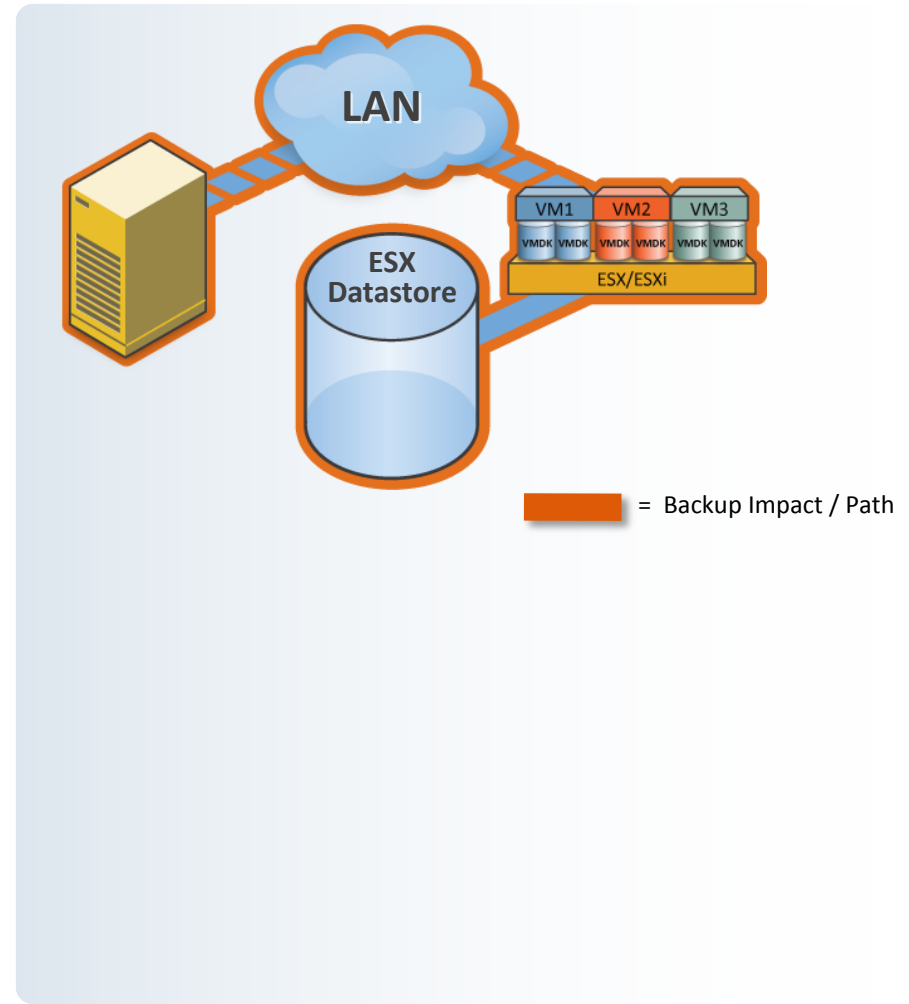
- Some B/U vendors do this. It is called a “crash consistent” backup.
- Crash consistent = data corruption
- We never recommend this. The snapshot process ensures data integrity.
- VIP automatically reduces snapshot load and balances backups (more on this later)

— Incrementals are quick and can reduce snapshot impact



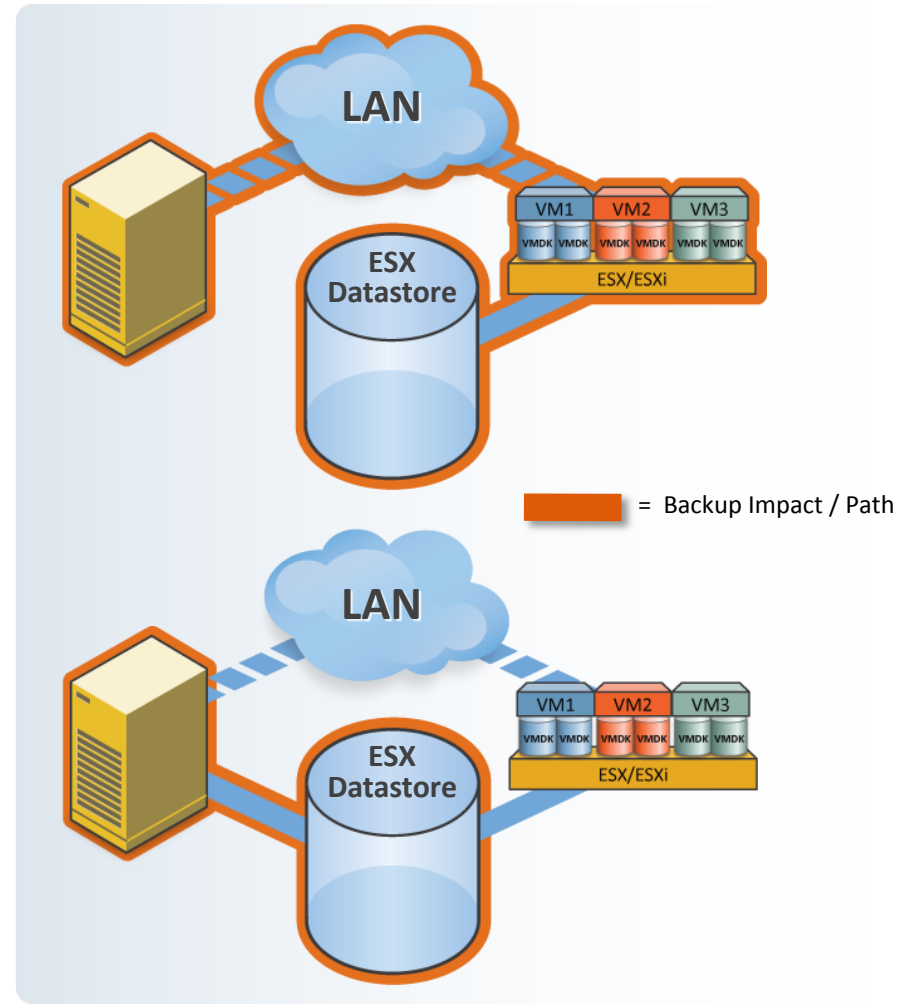
# NetBackup 7 for VMware Backup Data Path

- Network Backups (NBD)
  - NFS or DAS fully supported
  - No loss in backup or restore functionality
  - Direct communication with ESX server required (DNS, etc.)
  - ESX server directly impacted



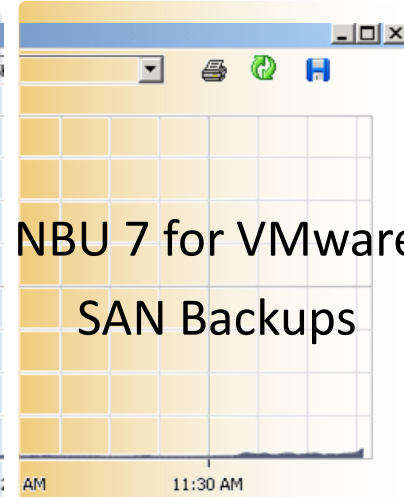
# NetBackup 7 for VMware Backup Data Path

- Network Backups (NBD)
  - NFS or DAS fully supported
  - No loss in backup or restore functionality
  - Direct communication with ESX server required (DNS, etc.)
  - ESX server directly impacted
- Shared storage configuration
  - Fibre or iSCSI
  - Near zero impact on ESX
  - No loss in backup or restore functionality
  - No communication with ESX required
- Hotadd



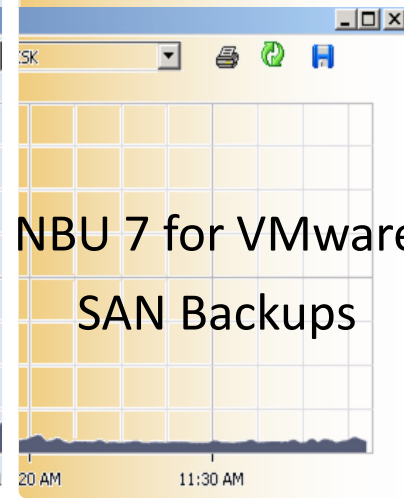
# ESX Server Load – Client Backups vs. VADP

Std Client Backups



NBU 7 for VMware  
SAN Backups

Std Client Backups



NBU 7 for VMware  
SAN Backups



# Hey! Why Are My Backups So Slow??

Performance Baseline Testing

# Performance Baseline Testing Goals

- Determine maximum performance of backup environment
- Tests are designed to simulate VADP backup paths (SAN, Network)
- Verify that hardware configured and working correctly
- Never assume hardware or software working optimally until performance verified

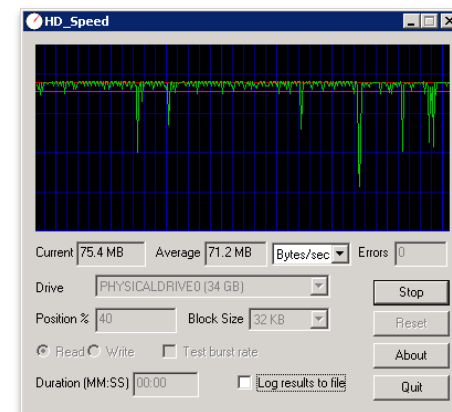


- Cisco UCS, VMware, NetBackup Benchmark:

[http://www.symantec.com/business/products/whitepapers.jsp?pcid=pcat\\_business\\_cont&pvid=2\\_1](http://www.symantec.com/business/products/whitepapers.jsp?pcid=pcat_business_cont&pvid=2_1)

# Performance Baseline Testing Methodology (SAN)

- Isolate performance tests to as few components as possible
- Design performance tests to simulate backup I/O
- Three basic tests run from VMware Backup Host:
  - Read performance from each ESX Datastore
  - Read performance from ESX Datastores simultaneously
  - Write performance of backup destination (disk in this case)
- I/O test utility (Fibre/iSCSI)
  - HD\_Speed ([www.steelbytes.com](http://www.steelbytes.com))
  - Free!
  - Works well from NetBackup (Windows) system
  - Run multiple instances for aggregate performance

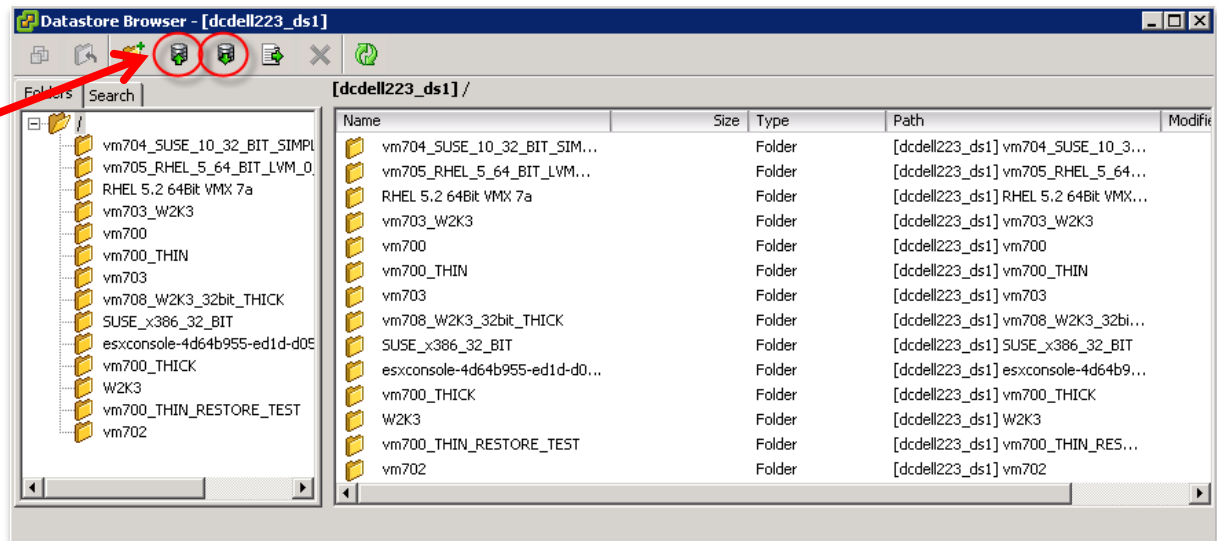


# Performance Baseline Testing Methodology (NBD)

- vSphere Client can test network transfer performance
- “Datastore Browser” sends data over network link
  - Copy file to & from ESX to NetBackup for VMware Backup Host
  - Tests network speeds and I/O of Datastore & Backup Host disk
  - Find and solve network / disk performance issues before tests w/NetBackup

Copy files to/from  
this Datastore

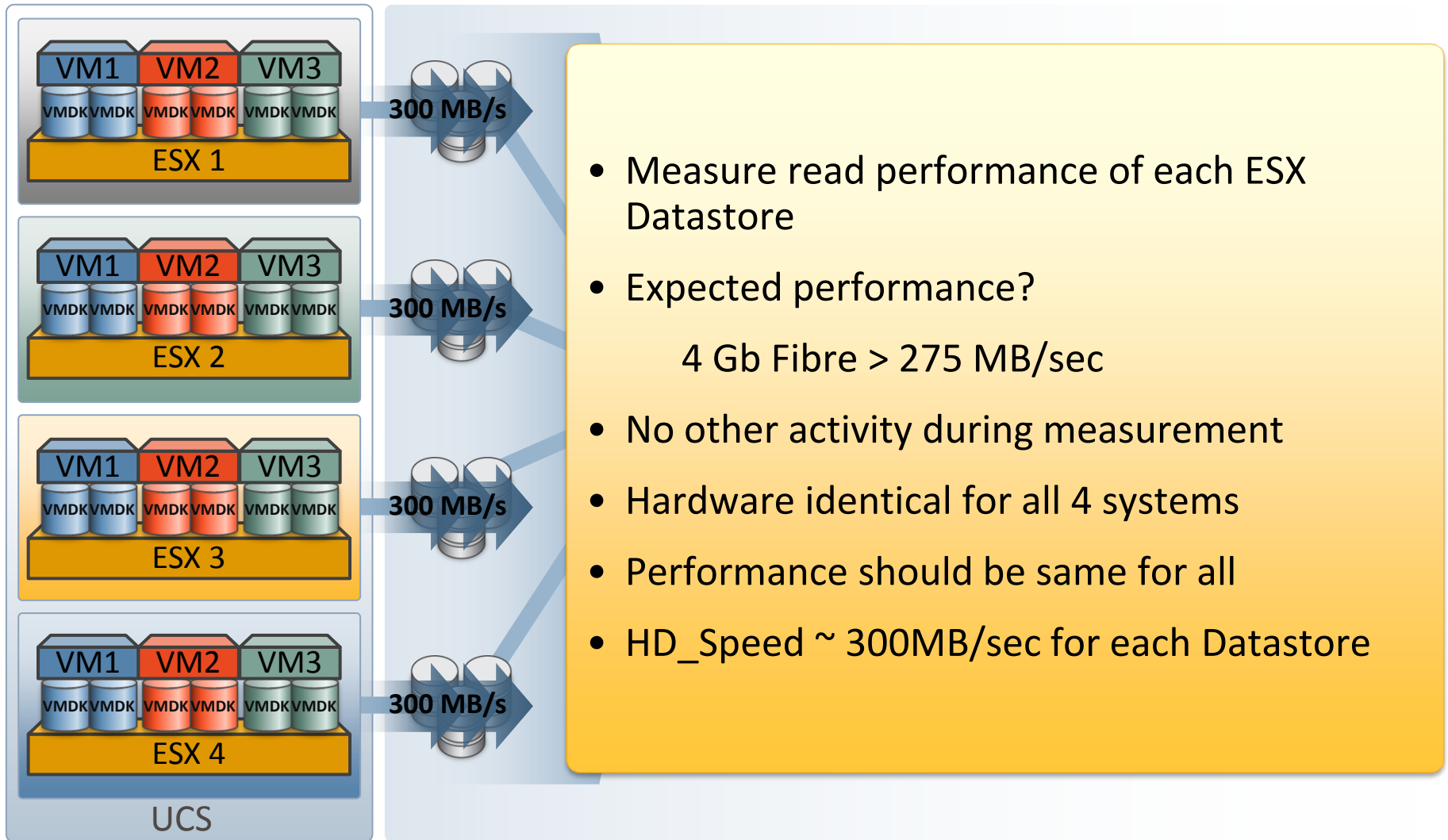
Test all Datastores  
in both directions



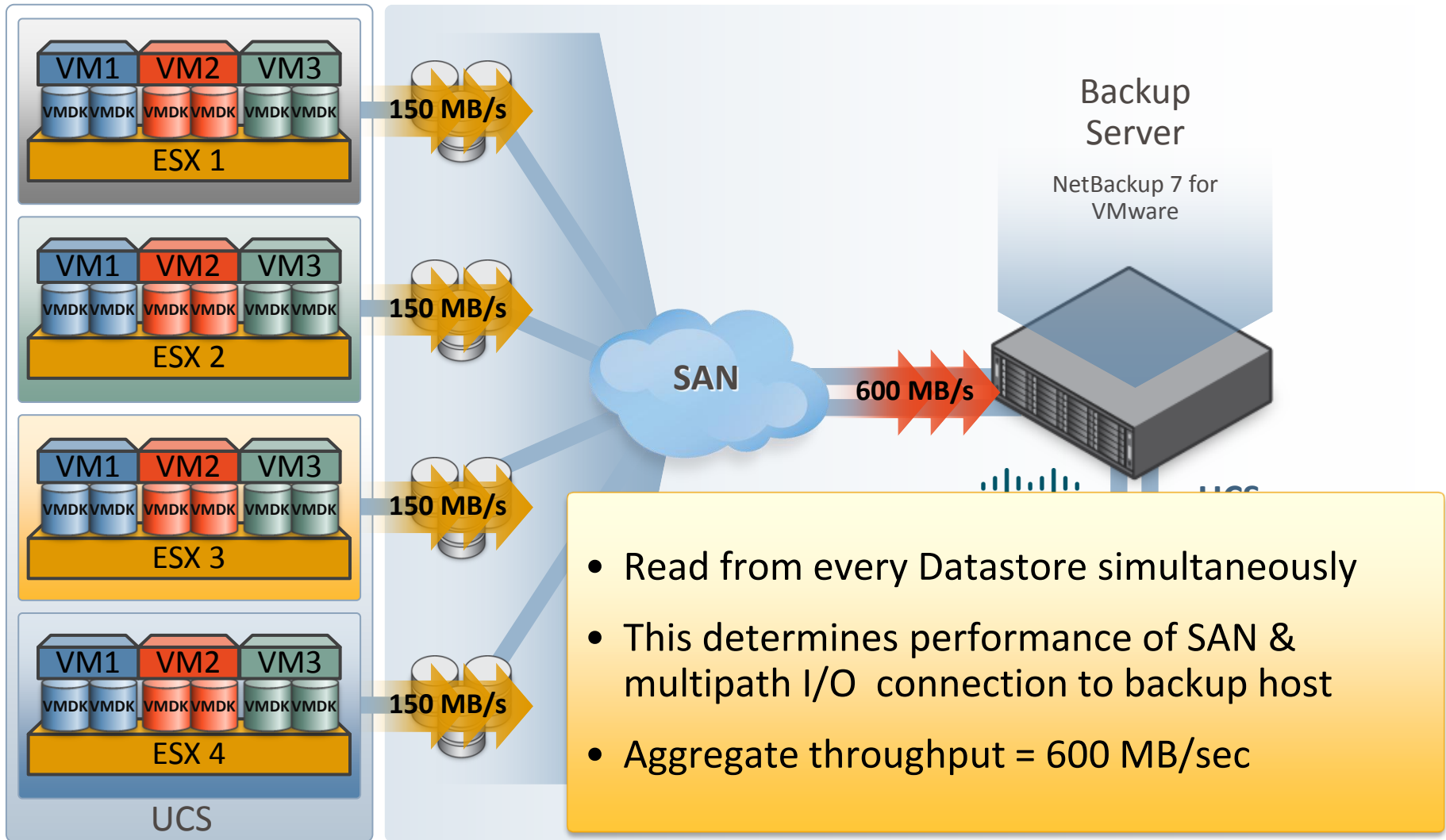
# Cisco / VMware / NetBackup Benchmark Performance Testing Methodology

- Customer environment will dictate testing methods
- Cisco benchmark involved SAN
- HD\_Speed used for SAN tests
- This testing found several HW and SW issues
- Proper RAID configuration was determined
  - Multipathing SW was broken
  - Found bad HBA card
  - Took several days to achieve expected performance numbers

# Perf Test – Datastore Read

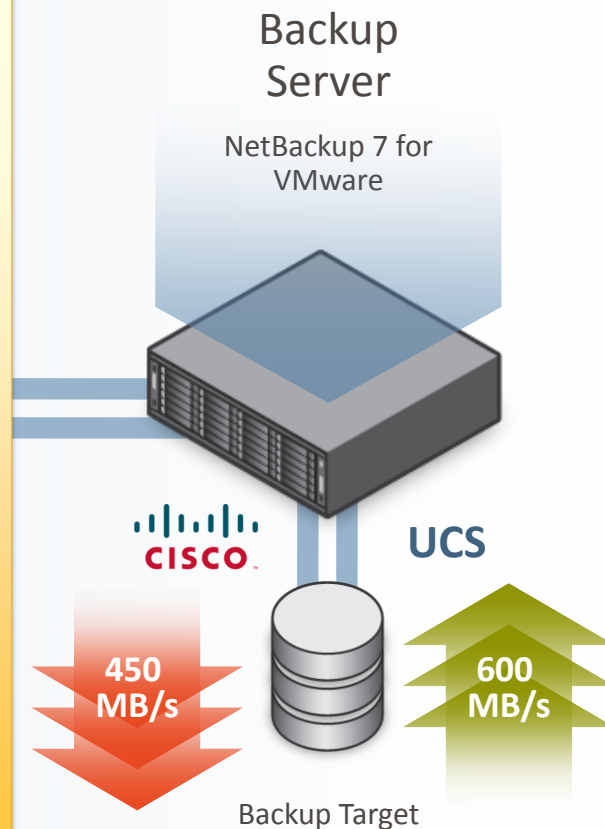


# Perf Test – Simul Datastore Read



# Perf Test – B/U Target Write

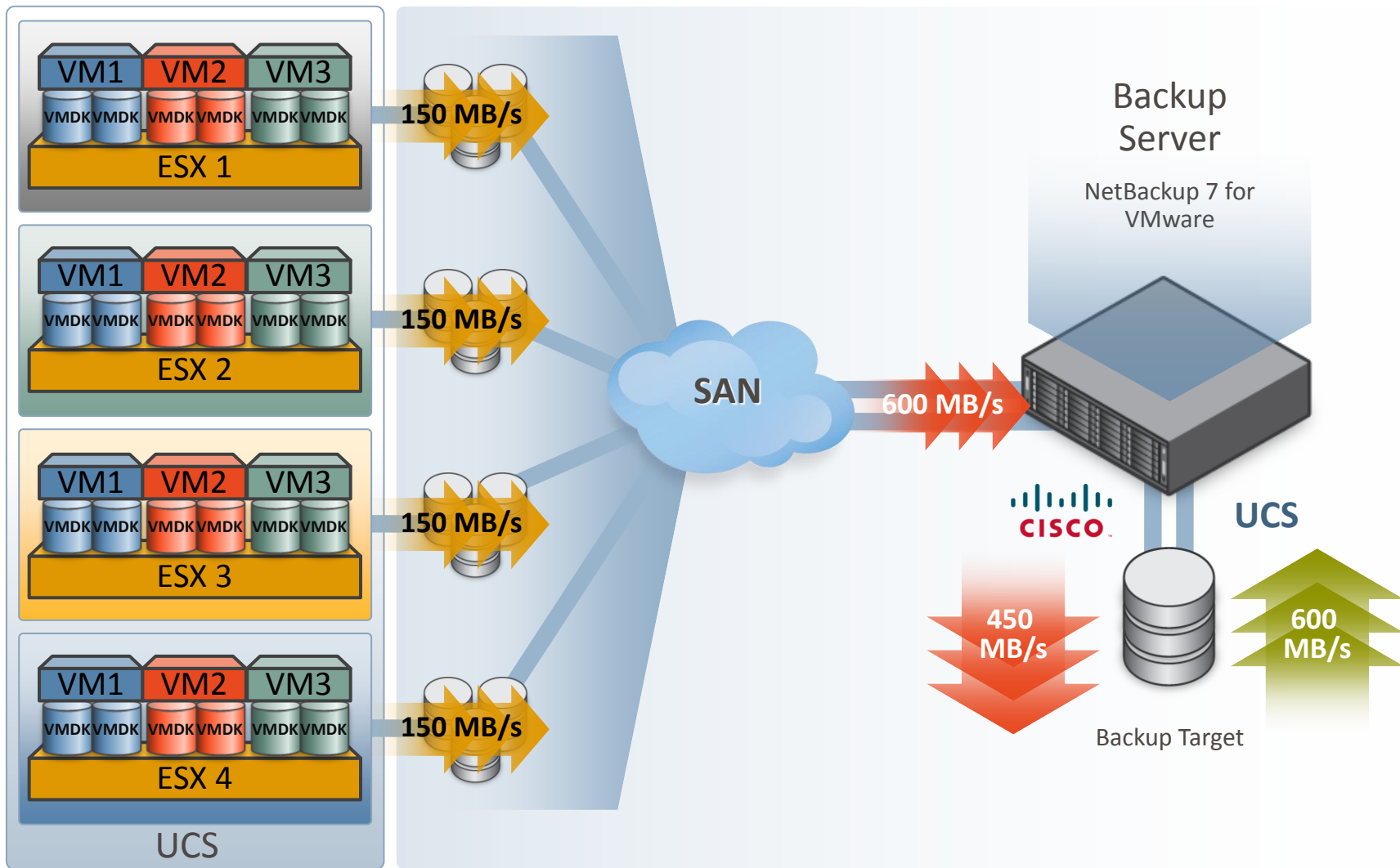
- Backup target performance critical
- Measure read & write performance to stress and characterize:
  - Disk performance
  - RAID configuration
  - Fibre
  - Multipath software
- Read performance = 600 MB/sec
- Write performance = 450 MB/sec
- Why is read perf faster than write?



UCS

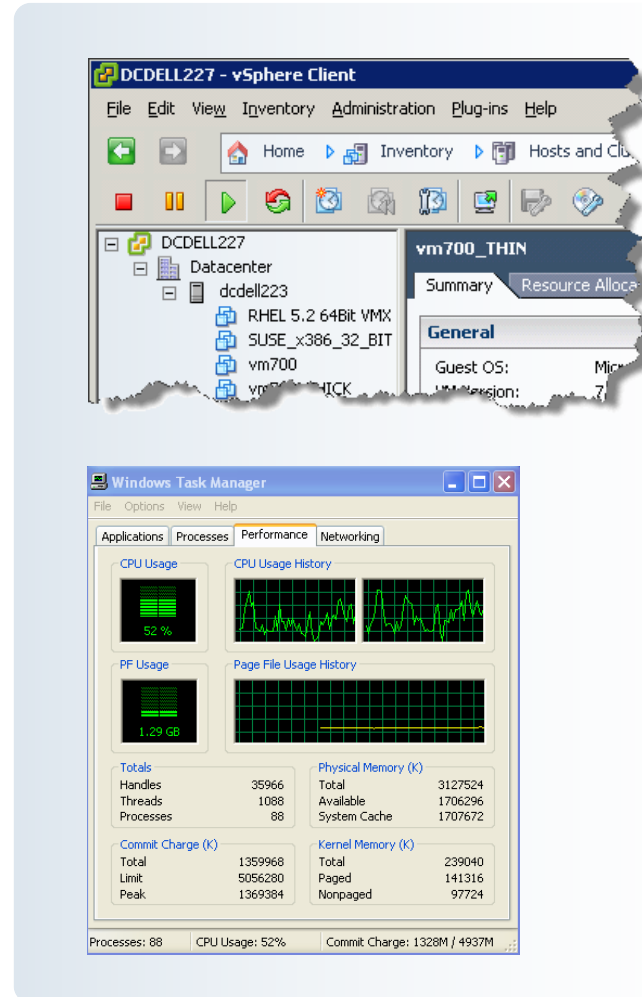


# What Is Overall B/U Throughput?



# Testing vCenter Response Time

- vCenter system can be extremely busy
- Most backup apps periodically contact vCenter
  - This updates VM information, location
  - Required to support VMotion, DRS, Storage VMotion, etc.
  - Slow, unresponsive vCenter can impede entire backup process
  - Backup app unfairly blamed
- Determine vCenter load
  - Windows task manager



# **Backup Application & VADP Performance Settings & Considerations**

# VMware Performance Considerations

- Important to understand the following:
  - Process that occurs during VADP backups
  - Process that occurs during standard client backups (if used)
- Data path of specific backups
  - Network = NBD (Network Block Device)
  - Fibre or iSCSI = SAN (when configured as shared storage)
  - Hotadd
- What part do VMware snapshots play in all this?
  - Understanding snapshot process can help when designing backups

# Reducing Backup I/O Impact – Improve B/U Reliability

- Shorten time backup snapshot is open
  - Backup during periods of low VM activity
  - Use incremental backups (CBT) liberally
  - Limit simultaneous backups per ESX / Datastore
- Configure backup application for optimal performance
  - Design backup policies to evenly balance load across ESX / Datastores
  - Faster backups = shorter open snapshots
  - Tune backup application buffers for optimal performance
- Result:
  - Snapshots more reliable
  - Overall backup processing faster
  - Higher level of backup success

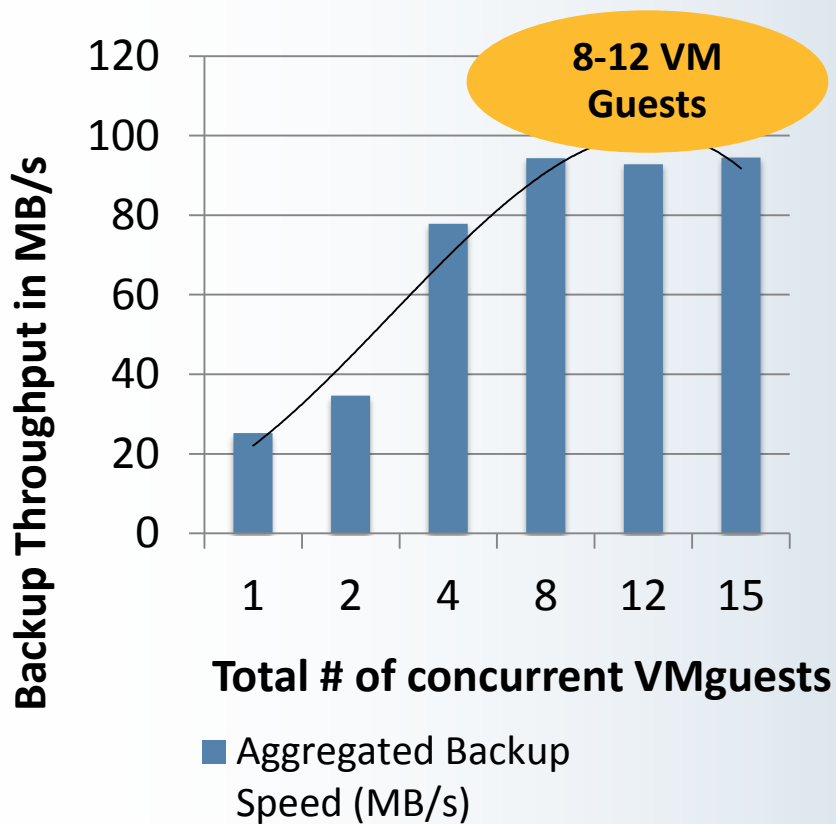


# NetBackup Buffer Tuning – Increase Backup Performance

NUM_DISK_BUFFER	SIZE_DISK_BUFFER	Avg. VM Throughput (MB/Sec)	Total VM Throughput (MB/Sec)
DEFAULT	DEFAULT	24.167	386.7
128	262144	24.034	384.5
256	262144	24.378	390.28
256	524288	28.150	450.41
512	1048576	28.60	457.54
1024	524288	28.31	453.02
1024	1048576	27.47	439.56

# Ensure Optimal Backup Performance

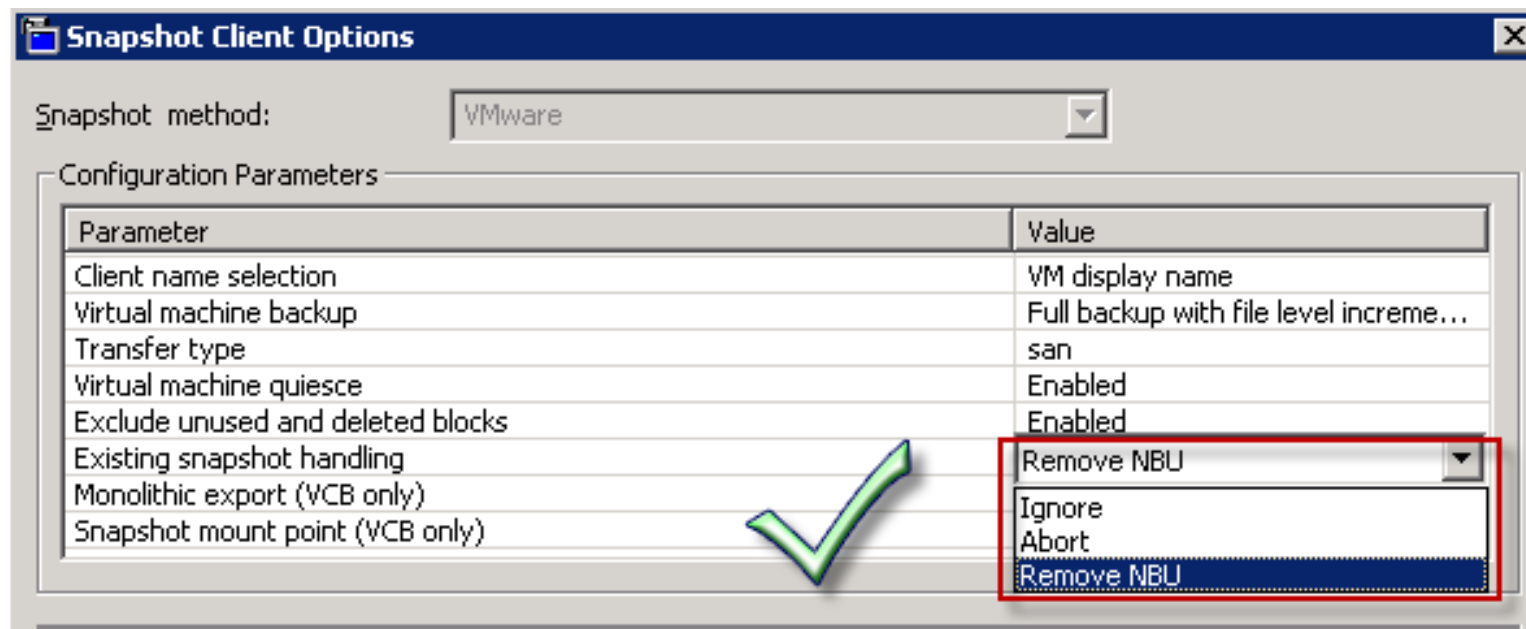
## Number of simultaneous backups?



- Single VADP backup stream typically won't saturate backup path
- Max backup performance achieved by creating simultaneous backup streams
- Design backups so that data is streamed across multiple VMware components (ESX/DS)
- Improve backup speeds, shorten backup window

# NetBackup 7 Policy Configuration

- NetBackup deletes leftover Snapshots to avoid snapshot errors. Enable the **“Remove NBU”** to delete previous snapshots

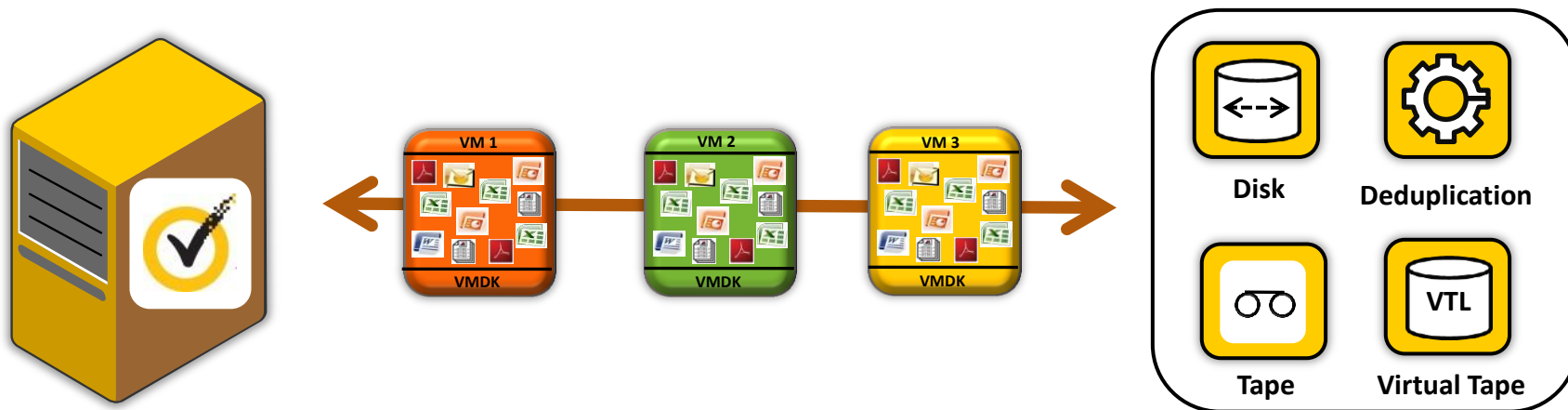


**More reliable backups!**



# V-Ray for Virtual Machine Protection

*Single-pass VM backup with true file-level recovery*

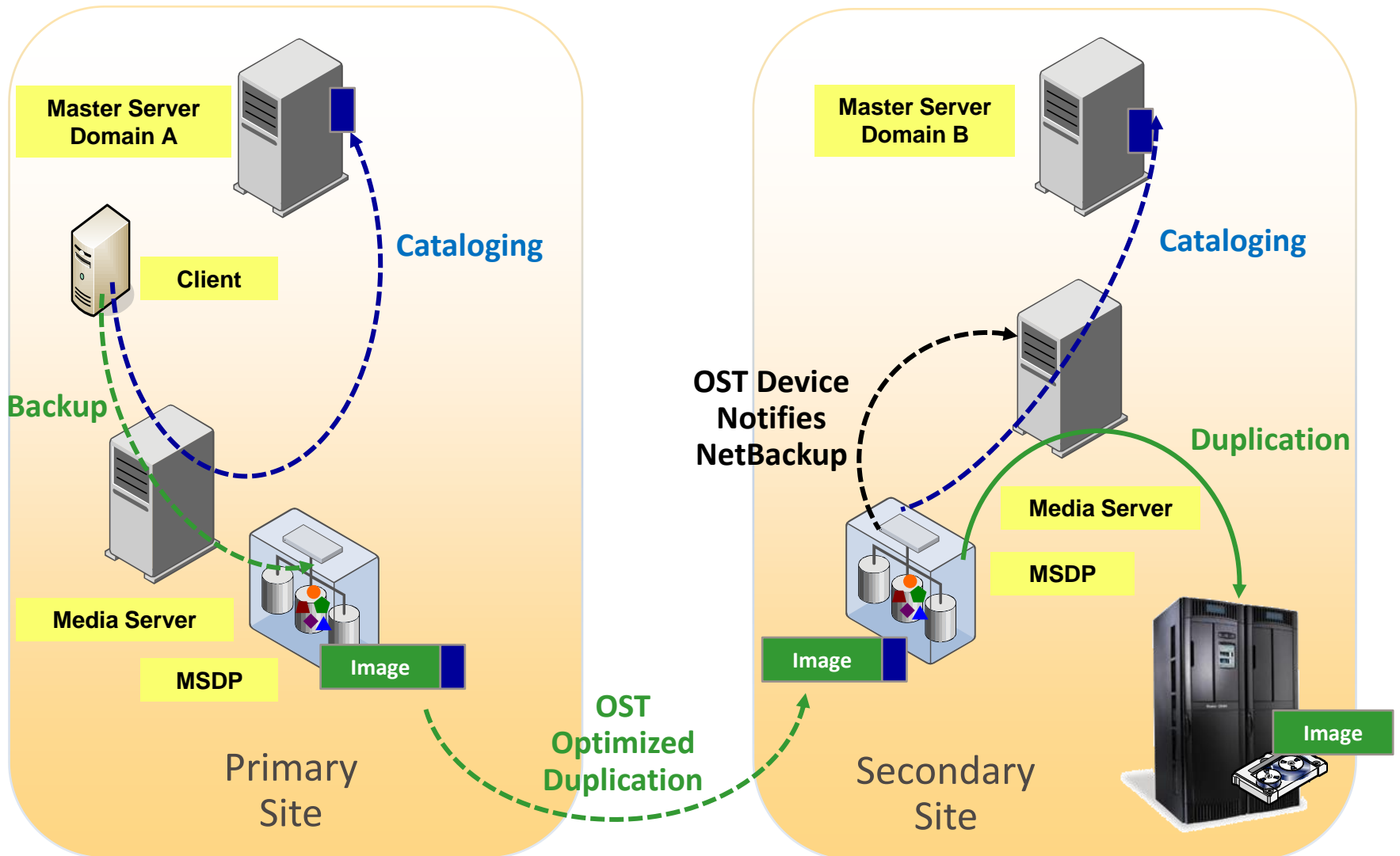


- Don't change your backup environment to suit backup application
  - Backup and restore to any destination
  - Fully compliant with Storage Lifecycle Policies, etc.
- Extract single files from vmdk (V-Ray)
  - **Powerful restore options:** restore single files from full & CBT incremental
  - **Fastest restores:** 100% file data (inside vmdk!) searchable and indexed\*
  - **Secure:** retain original file permissions
  - **Self service restore:** Users can optionally restore own data

\*Windows, RedHat, SuSE

# Fast, Policy-based, Multi-site Disaster Recovery

*Deduplication & Auto Image Replication*



# Is There a Better Way of Selecting VM's for Backup?

# VM admin & Backup admin

**VM admin**



Hi Backup Admin. Somebody in engineering accidentally destroyed VM12, VM18 and VM23. Please restore those VMs from yesterday's backup.

I have no record of VM18 ever being backed up. When did you create that VM?



**Backup admin**

**VM admin**



(Things become very quiet...)

# VM admin & Backup admin

VM admin



# NetBackup VIP to the Rescue!

Designed Specifically for VMware Protection

# NetBackup VMware Intelligent Policy (VIP) VMware Protection on Autopilot

**Never miss a virtual machine backup again!**

- An alternate method of selecting VMware virtual machines for backup
- New and moved VM's automatically detected and protected
- Designed specifically for dynamic nature of VMware environments
  - VMotion, Storage VMotion, DRS, Storage DRS
- VIP updates VM location and information before and during backup run
- Powerful query engine can be tailored to protect any VMware configuration



# NetBackup VMware Intelligent Policy (VIP)

- Customize backups for optimal performance in your environment
- Reduce backup hardware requirement
  - Use backup hardware more efficiently
- vSphere aware resource limits
  - Less backup impact on ESX servers and ESX Datastores
- Automatically balances backup processing across entire vSphere environment
  - Minimize backup impact on every vSphere component



# VIP – Flexible VM Selection Criteria

- VMs protected based on physical location
  - ESX server
  - ESX Datastore
  - VMware cluster
  
- VMs protected based on logical attributes
  - vCenter folder
  - Resource pool
  - vApp

# VIP – Flexible VM Selection Criteria

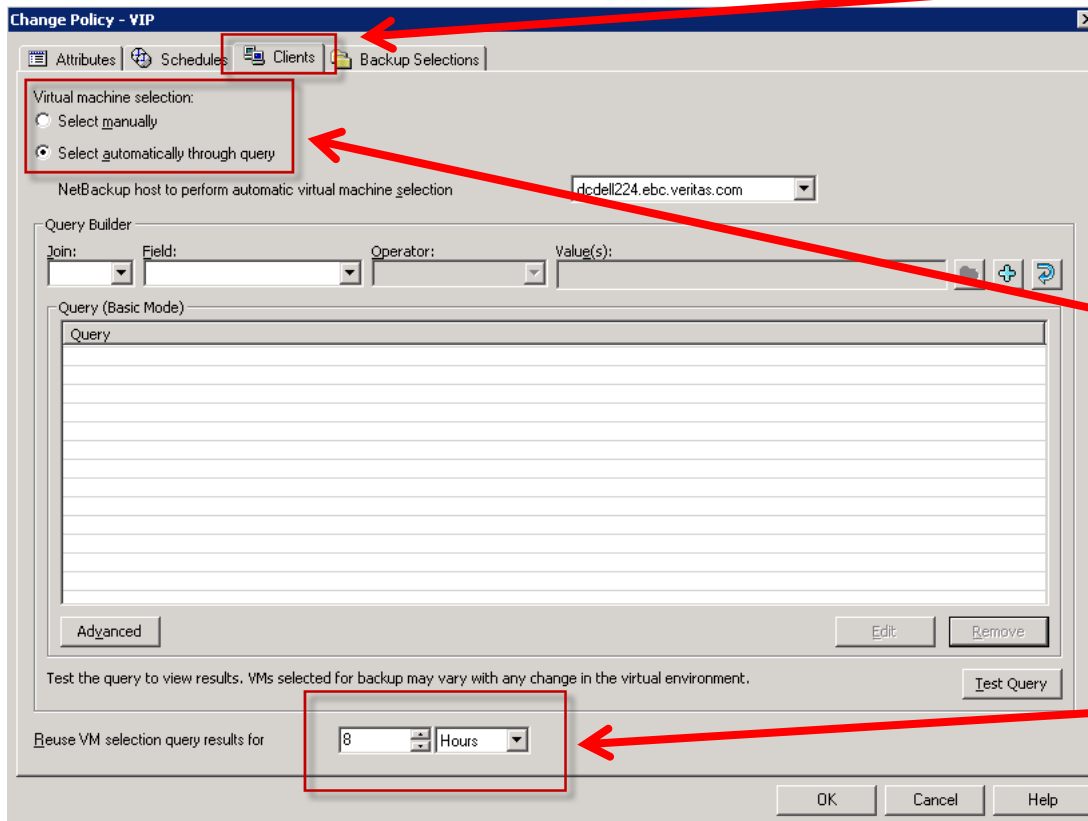
- VMs protected based on VM attribute
  - Display name, hostname, UUID
  - Power state
  - Annotation
  - OS version
- Explicitly exclude any VM or group of VMs
- Use combination of any criteria to further pinpoint VM protection

# VMware Intelligent Policy

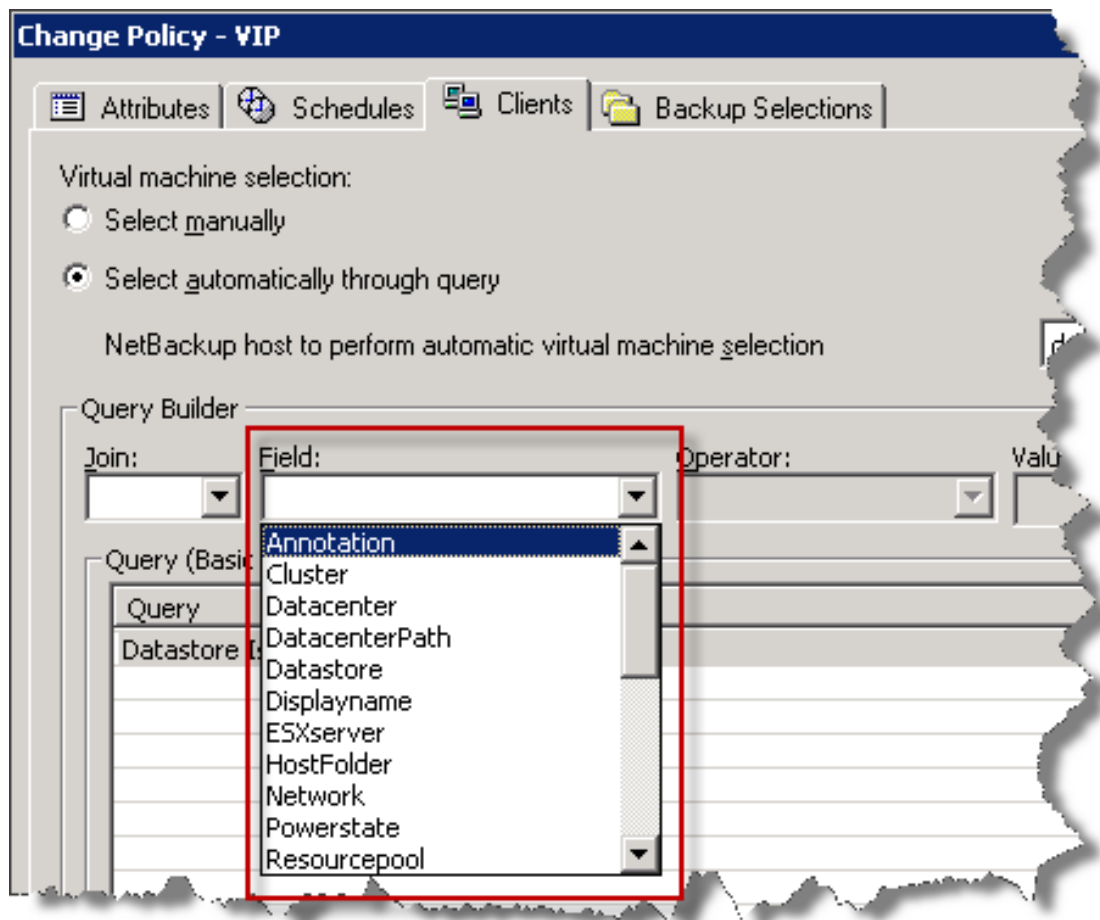
## Technical Overview

# VIP Query Generator Overview

- VIP is selected via standard NetBackup policy client tab
- Traditional static or automatic (VIP) VM selection can be used
- VIP cache automatic update can be defined to minimize impact on vCenter server

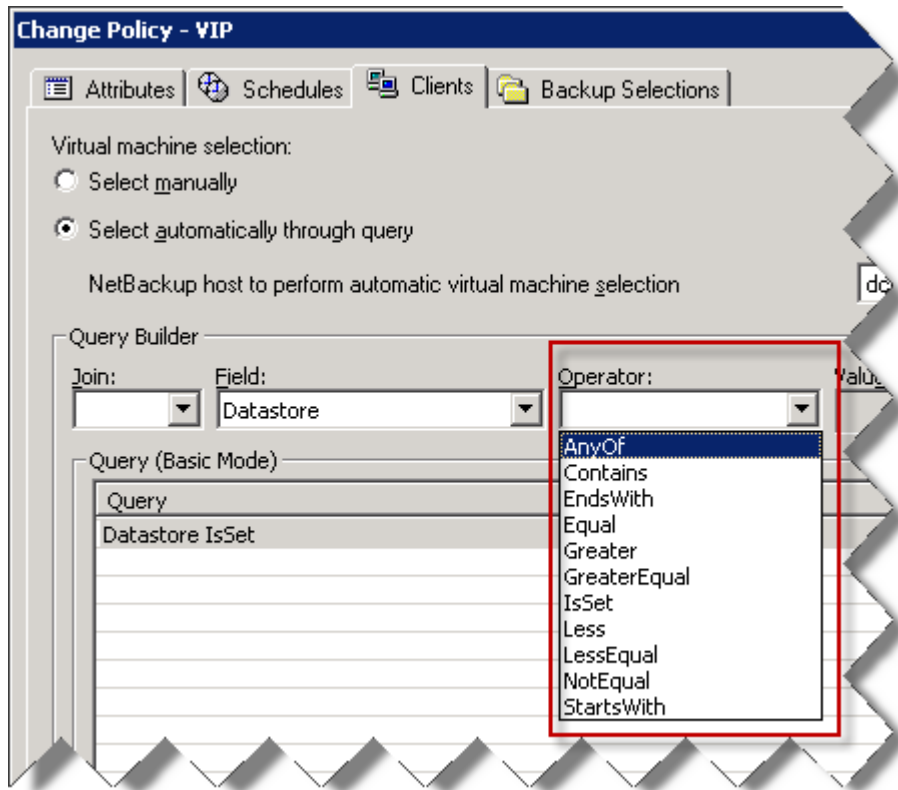


# VIP vCenter Selection Criteria



- VMs can be selected based on **26** vCenter attributes including:
  - **Annotation:** backup all VMs with specific keyword in annotation field
  - **Cluster:** all VMs in VMware cluster selected for backup
  - **ESXserver:** any VM located on an ESX server
  - **Datastore:** VM located on specified storage

# VIP Search Operators



- Powerful Boolean style search operators
- Selection based on specific resource name or portion of name (i.e. wildcards)
- Multiple queries can be combined to narrow focus of VM selection

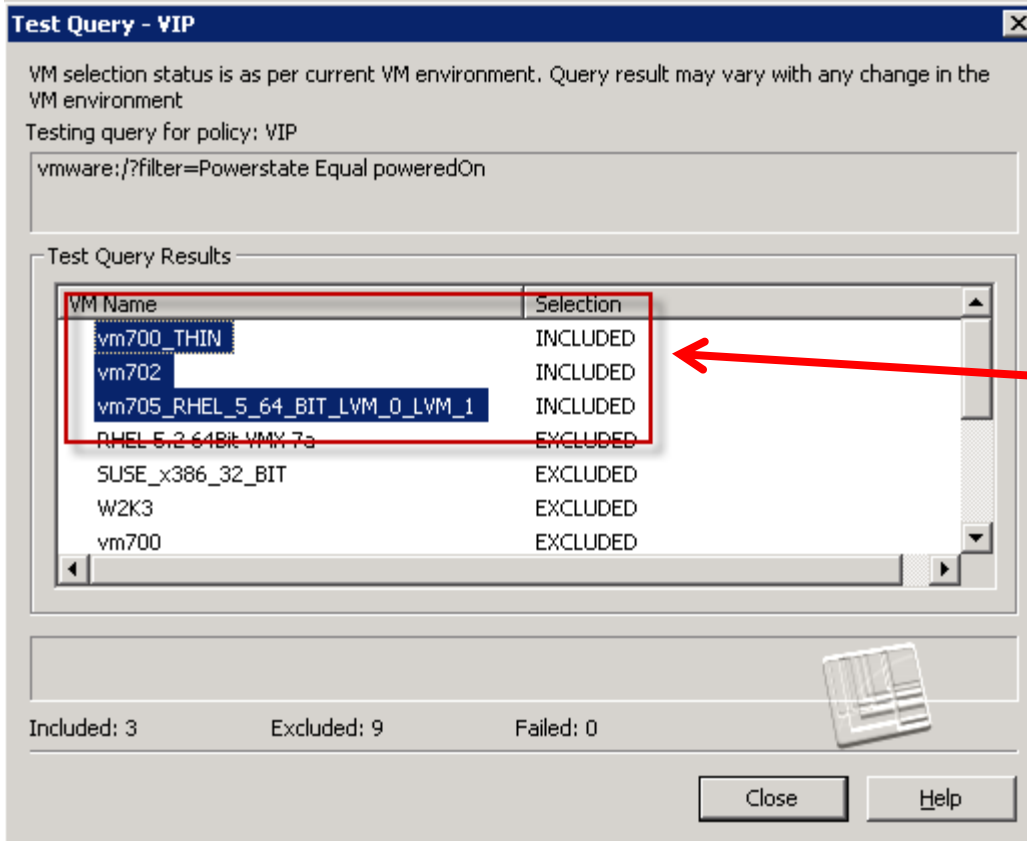
# VIP Query Results

- Resulting query will dynamically select VMs for backup
- Example: Any new or “vMotioned” VMs will be protected on every existing or new ESX server with word “Engineering” in name

The screenshot shows the 'Change Policy - VIP' window with the following configuration:

- Virtual machine selection:  Select automatically through query
- NetBackup host to perform automatic virtual machine selection: dcdell224.ebc.veritas.com
- Query Builder: Join: [dropdown], Field: [dropdown], Operator: [dropdown], Value(s): [text box]
- Query (Basic Mode):
  - Query
  - ESXserver Contains "Engineering"

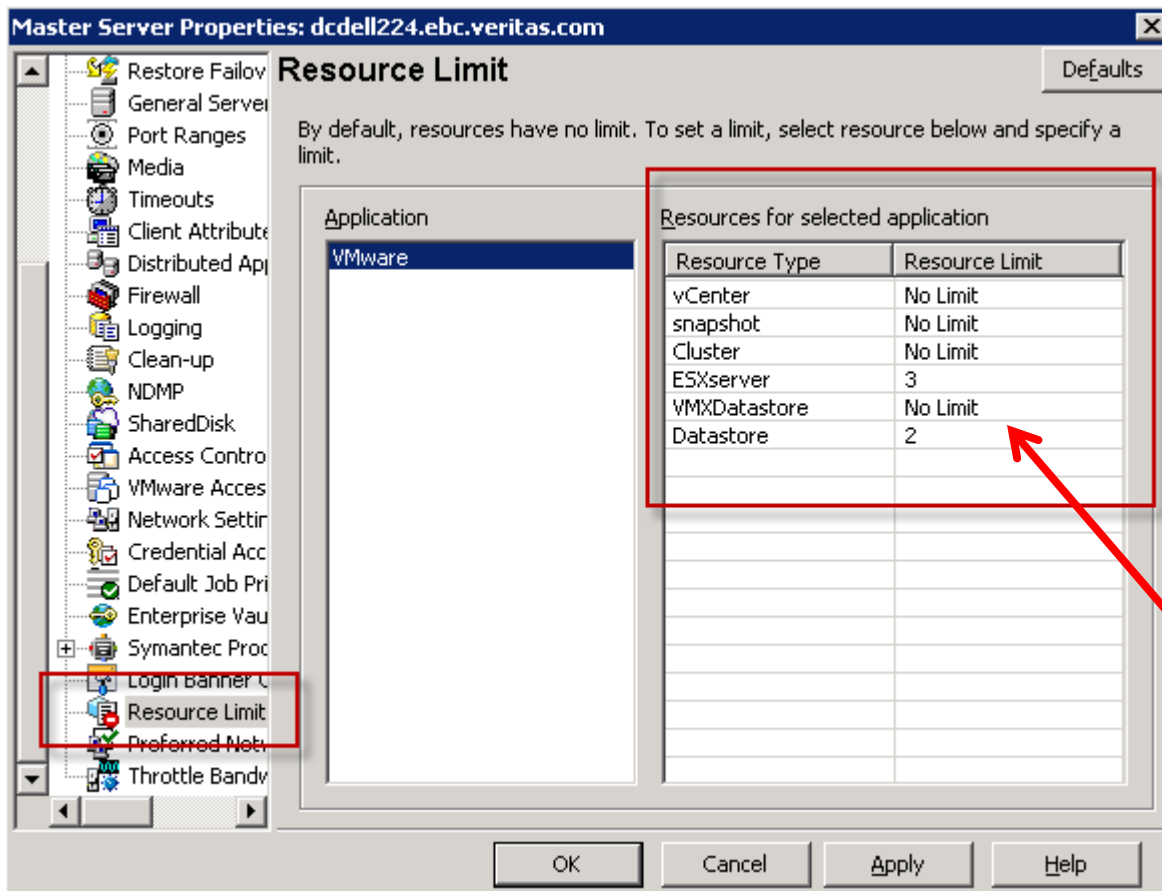
# Test the VIP Query



- The “Test Query” button can help to ensure the query will select the desired VMs



# Setting Resource Limits on vCenter Objects



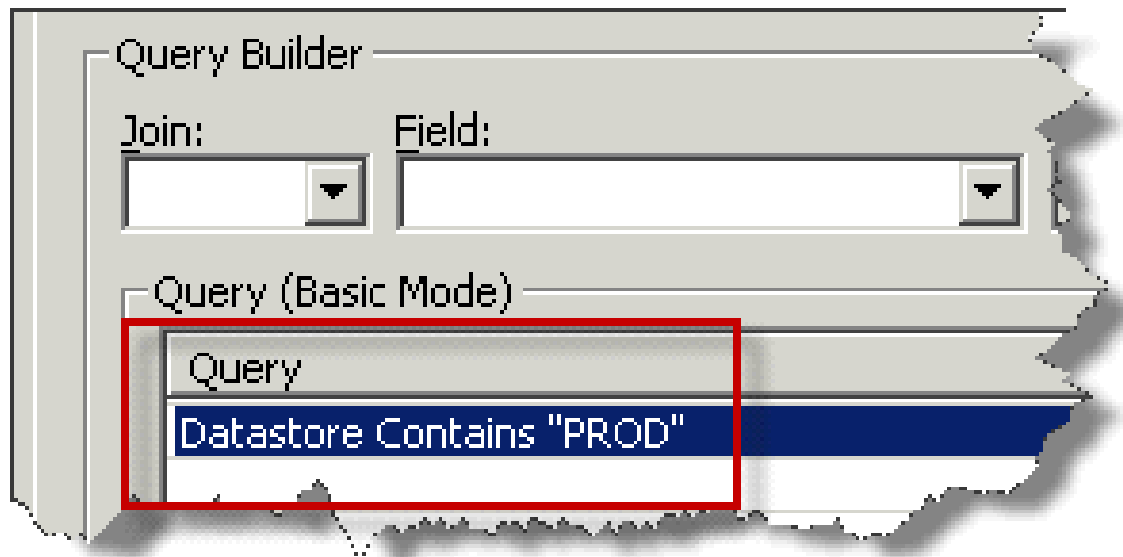
- No more backup “hot spots”!
- Automatically spread backup load across entire ESX farm
- Faster backups while controlling backup load on every ESX system
- **Example:** No more than 2 active backups per Datastore with no more than 3 active backups per ESX

# **VMware Intelligent Policy Use Cases**

**Improve Backup Performance & Reliability**

# Problem: Equalize Backup Load in SAN Environment

- Manage SAN (iSCSI - shared storage) backups at Datastore level
- Managing backups at ESX server does not balance load at storage level

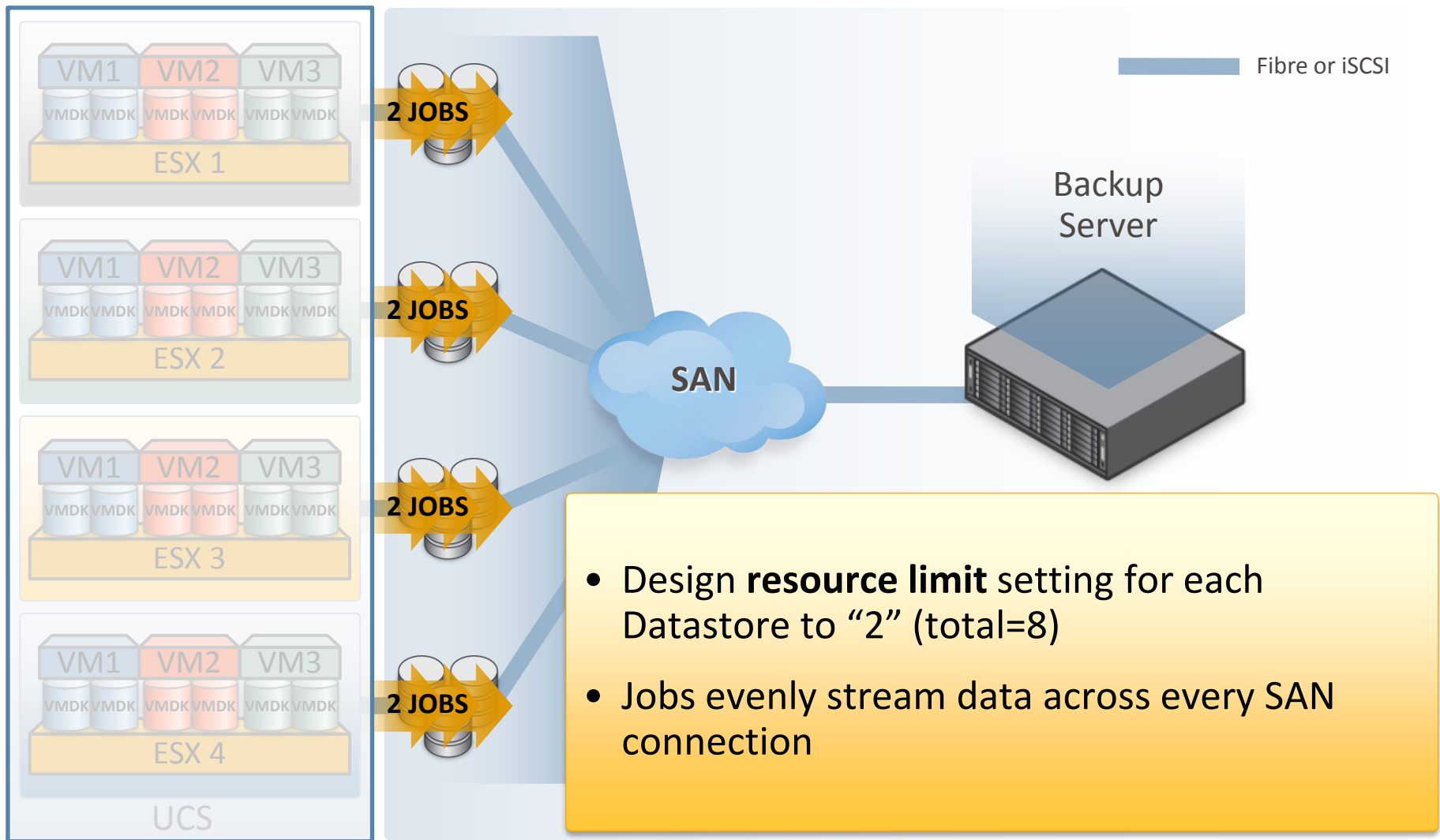


**Solution:** Will protect every existing and new VM on any Datastore with "PROD" in name

Fully compliant with Storage vMotion

Set "Datastore" resource limit to balance backup load across all Datastores

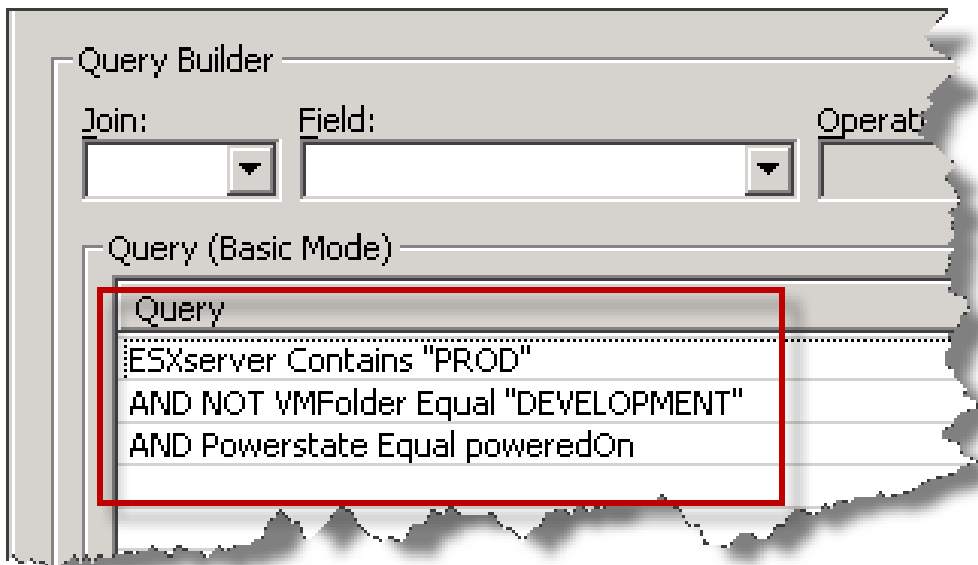
# SAN Backups - Equalize Load at Datastore



# Problem: Network backups – Equalize Load at ESX NIC

- All backup traffic over network – no shared storage available
- Don't want to saturate ESX network interface

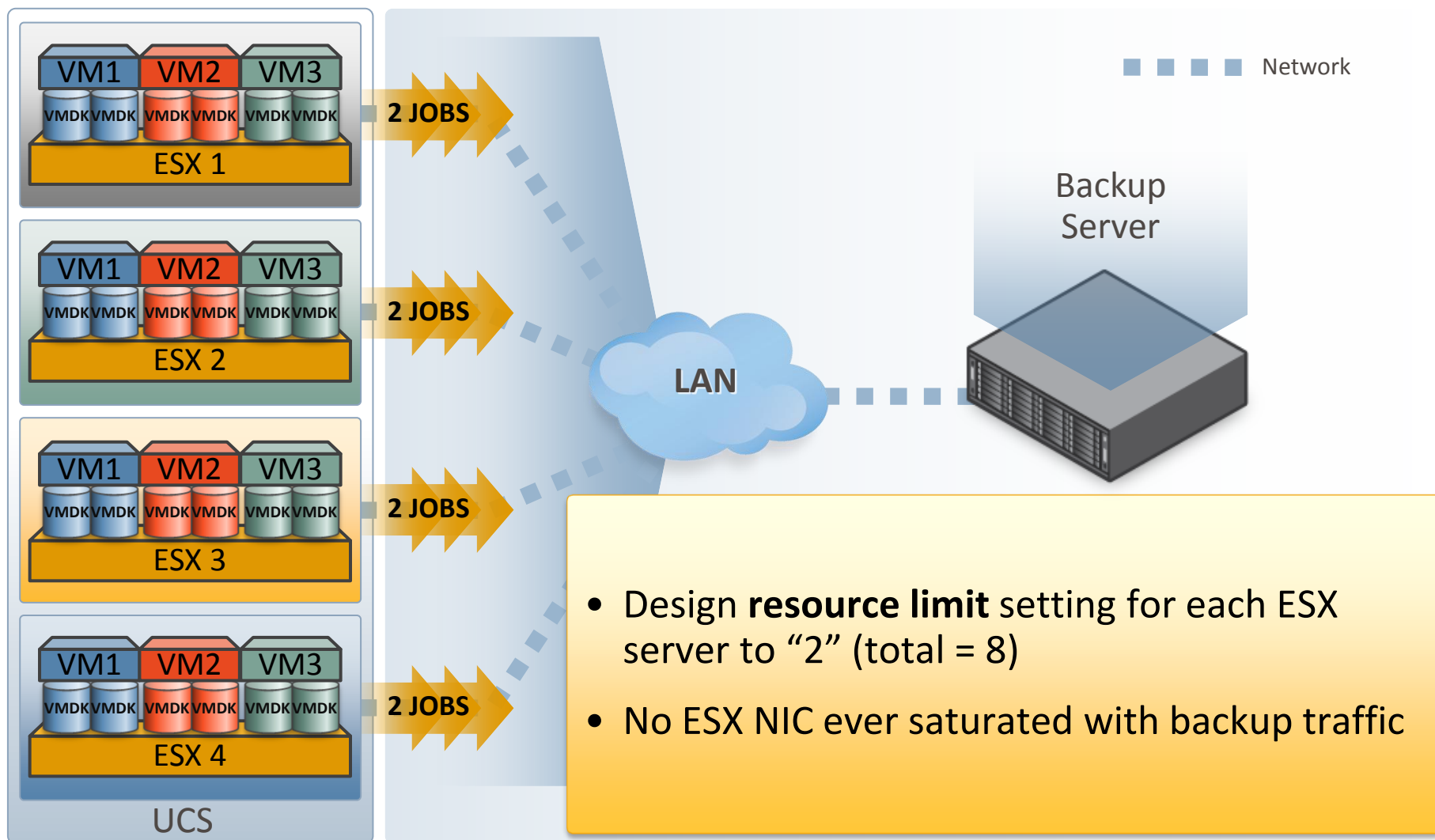
**Solution:** All powered on VMs on any ESX server in “Production” will be protected.



Unimportant VMs in the “DEVELOPMENT” folder (only used for development) will be skipped

Set “ESX” resource limit to balance backup load across all ESX NICs

# Network backups – Equalize Load at ESX NIC



# NetBackup for VMware

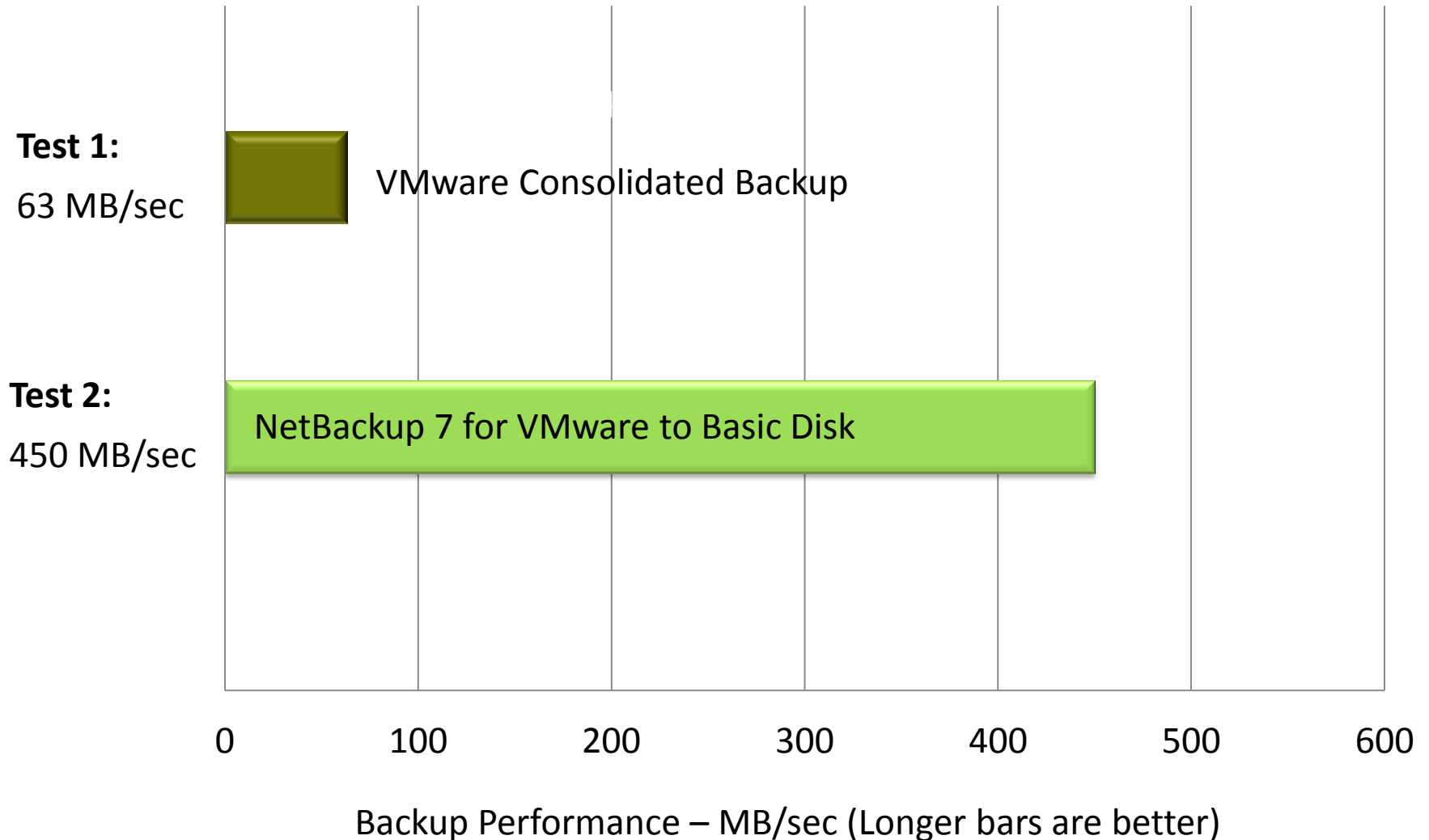
## Built-in Performance Enhancements

# So, How Fast Can I Backup?

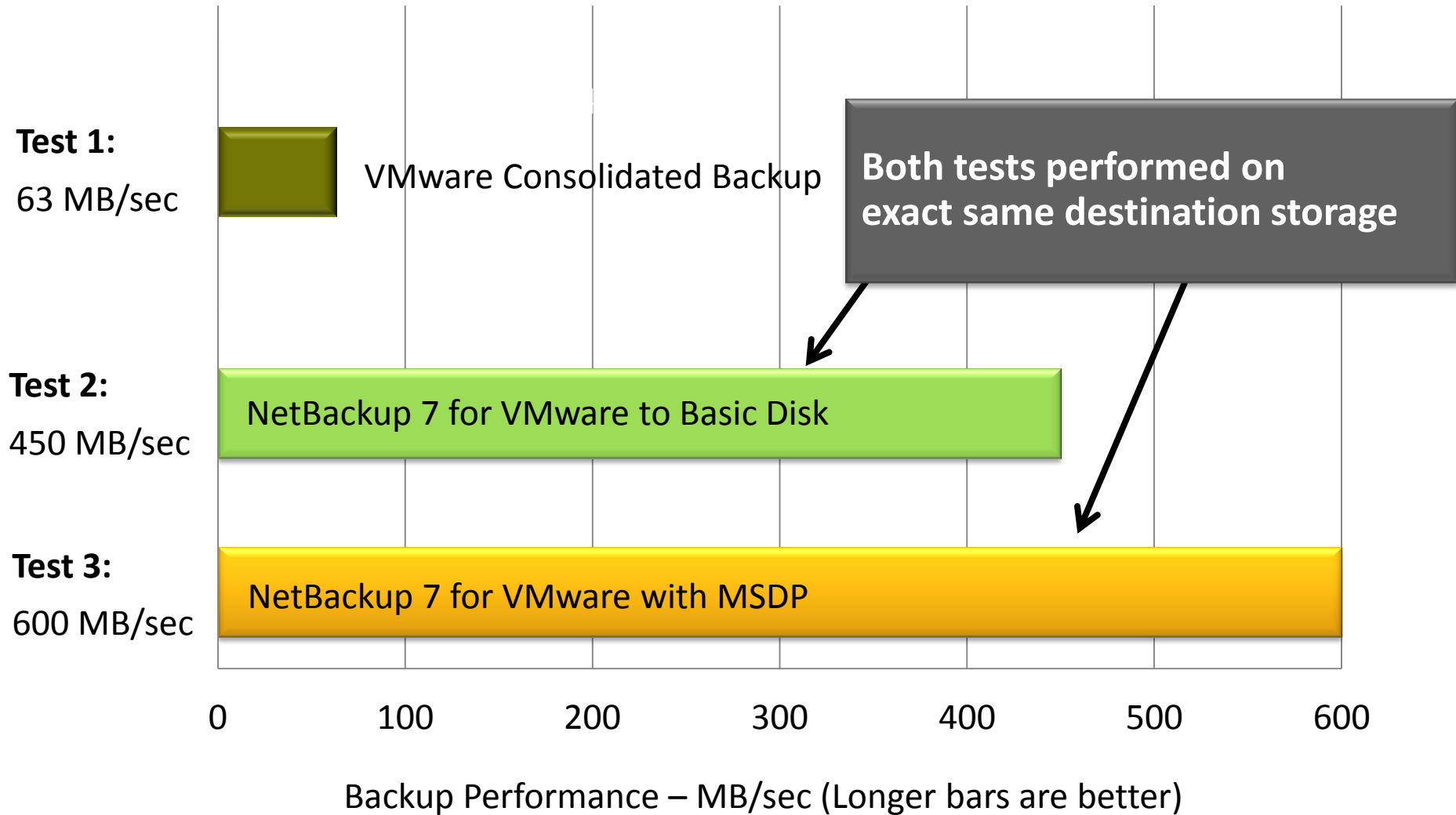
Where's the beef?



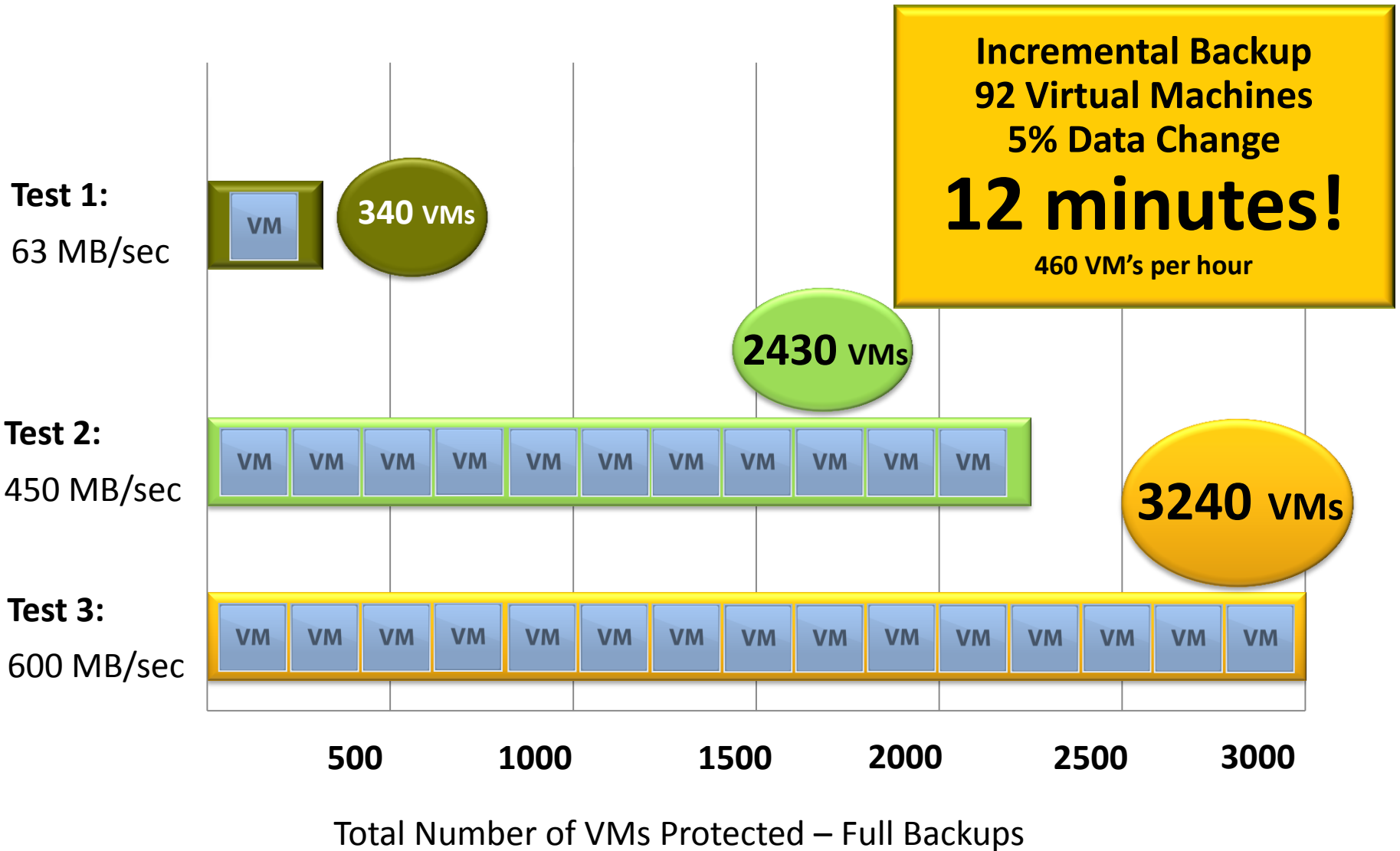
# NetBackup 7 for VMware Performance Advantage



# NetBackup 7 for VMware Performance Advantage

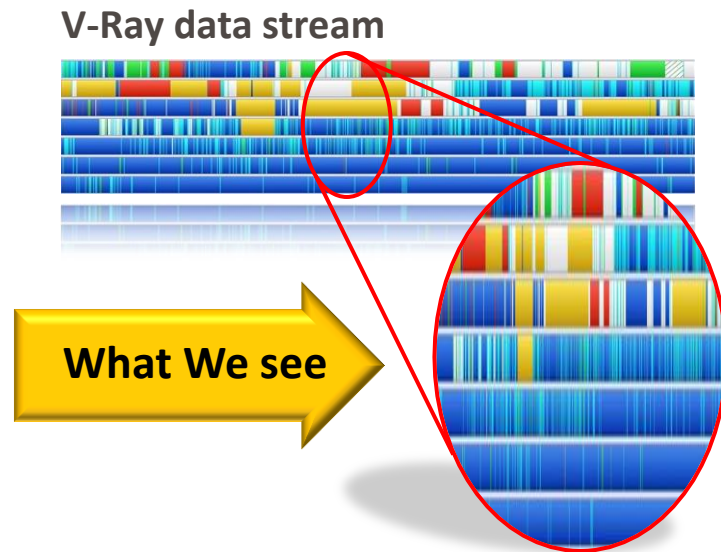


# Translate Performance Into Protection



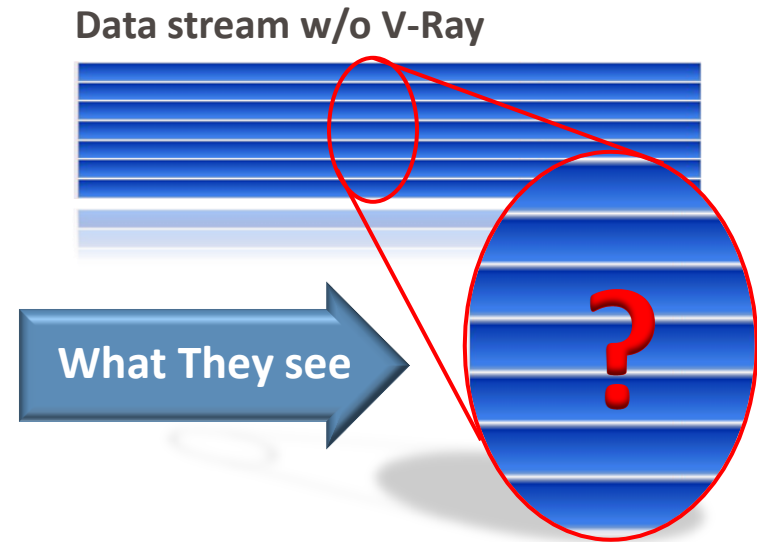
# V-Ray Visibility for Global Deduplication

*Combines off-host VM deduplication with physical machine deduplication*



## What We Can Do –

- “Single-Pass” Backup and Recovery → Fast
- “Intelligent” Deduplication → Data Aware

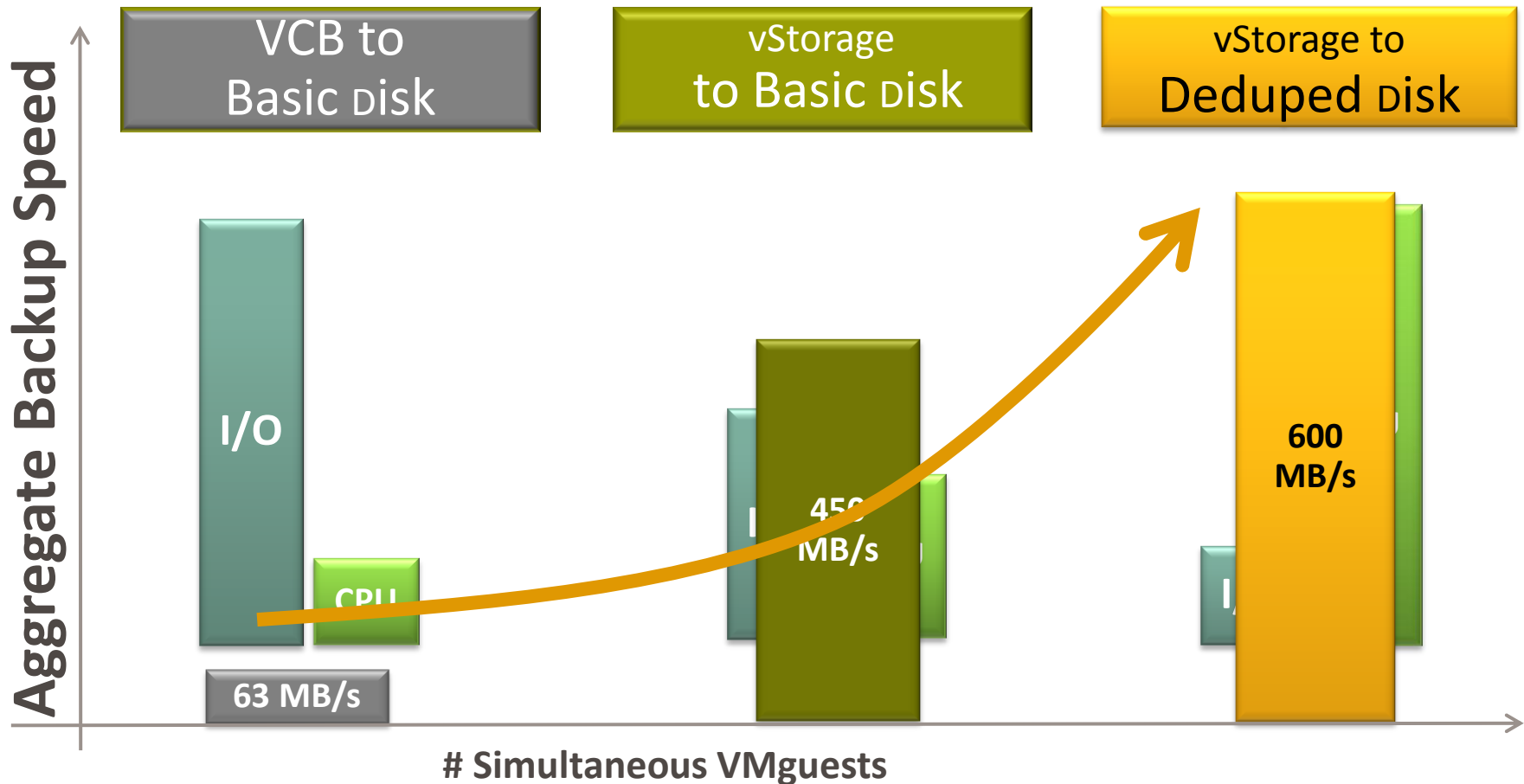


## Without V-Ray –

- “Multi-Step” Backup and Recovery → Slow
- “Guess” at Optimized deduplication

# Media Server Deduplication Advantage

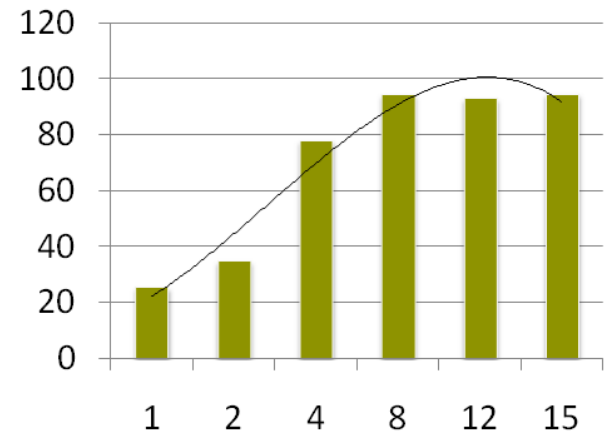
“Trade CPU cycles for faster Backup I/O”



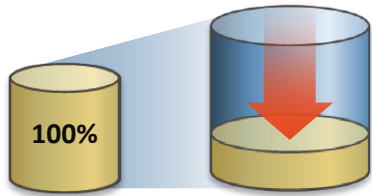
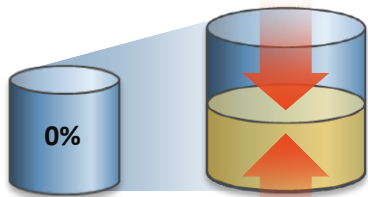
# Virtual Machine Restore Considerations

# General Restore Considerations

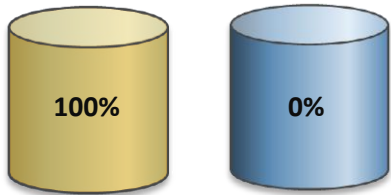
- Restore process involves more I/O than backup process
  - Disks (vmdk's) must be first created as target of restore
  - Type of vmdk can impact restore speed and I/O required
- Single restore typically won't saturate restore path
  - DR – create simultaneous restore jobs
  - As with backup – balance restores across ESX or Datastore
- Slow vCenter can also cause restore perf issues
  - Optional: bypass vCenter by restoring directly to ESX(i) server
  - Known to significantly improve restore perf in some cases



# VMDK Type Can Impact Restore Speeds



- thin
  - Space not allocated during creation
  - Space is supplied then zeroed out – on demand
  - Creation slow if vmdk turns out to be full
- zeroedthick
  - 100% of space allocated during creation
  - Zeroed out on demand
  - Can be faster than “thin” – especially if vmdk is nearly full
- eagerzeroedthick
  - 100% of space allocated during creation
  - 100% of disk zeroed out during creation
  - Could take long time (and create lots of I/O) to complete entire process





# Simple and Powerful Virtual Machine Restores



- Simplified disaster recovery process
  - Entire VM restored with 4 mouse clicks
  - Wizard walks you through entire restore process
  - Restore, clone, replicate, rename VM to original or alternate location
- Optional user directed (self service) single file restores

**Virtual Machine Recovery**

**Recovery Destination**  
Select the original or alternate destination for the virtual machine recovery.

**Original settings of the virtual machine when it was backed up**

Display Name : moneevm4      vCenter Server : galago  
UUID : 420a5601-1855-71f6-9fca-b52369118d6      Datacenter : 2100  
Host name :      ESX Server : monee.min.veritas.com  
Backup Reference : Displayname      Datastore : d9500\_I2  
Folder : /2100/vm/  
Resource Pool : /2100/host/dev systems/32 bit systems/monee.min.veritas.com/Resources

**Recover virtual machine to**

**Original location**  
Select this option to apply the original settings while recovering the virtual machine.

**Alternate location**  
Select this option to change the settings while recovering the virtual machine.

< Back    Next >    Cancel

**Backup, Archive, and Restore Wizard** [Restore: Server: hiebeck Source Client: moneevm4 Destination Client: hiebeck]

Time Backed Up    Time Expires    Files    Size    Compressed    Schedule Type    Policy Name    Keyword Phrase

Time Backed Up	Time Expires	Files	Size	Compressed	Schedule Type	Policy Name	Keyword Phrase
10/8/2009 4:12:45 PM	10/22/2009	307	651597	N	Cumulative Incremental...	Incree	
10/8/2009 3:27:35 PM	10/22/2009	24376	5209824	N	Full Backup	Incree	
10/8/2009 1:20:09 PM	10/22/2009	7	5209981	N	Cumulative Incremental...	Incree	
10/8/2009 11:44:46 AM	10/22/2009	7	5209981	N	Differential Incremental...	Incree	
10/8/2009 11:23:50 AM	10/22/2009	24375	5205334	N	Full Backup	Incree	
10/8/2009 1:42:44 PM	10/20/2009	24375	5205335	N	Full Backup	Incree	

**All Folders**

- monееvm4
  - add50958b8e62157f1a2a15a0c
  - d51d6d983050a8290c4ed134
  - Program Files
  - RECYCLER
  - System Volume Information
  - WINDDWS
  - wmpub

**Contents of 'C:\Program Files'**

Name	Time Backed Up	A...	S	Time Modified
Adobe	10/8/2009 3:27:35 PM	dirv	0	6/24/2008 2:19:31 PM
asmb	10/8/2009 3:27:35 PM	dirv	0	6/24/2008 2:22:29 PM
Common Files	10/8/2009 3:27:35 PM	dirv	0	6/5/2009 8:32:15 PM
ComPlus Applications	10/8/2009 3:27:35 PM	dirv	0	6/24/2008 6:45:38 AM
Internet Explorer	10/8/2009 3:27:35 PM	dirv	0	2/12/2009 9:02:49 AM
Mozilla Firefox	10/8/2009 3:27:35 PM	dirv	0	6/24/2008 2:18:41 PM
MSBuild	10/8/2009 3:27:35 PM	dirv	0	6/24/2008 2:30:23 PM
MSDN4_6.0	10/8/2009 3:27:35 PM	dirv	0	2/12/2009 9:52:27 AM
MSDN4_6.0	10/8/2009 3:27:35 PM	dirv	0	2/12/2009 9:52:30 AM
NetMeeting	10/8/2009 3:27:35 PM	dirv	0	6/24/2008 7:18:34 AM
Outlook Express	10/8/2009 3:27:35 PM	dirv	0	6/24/2008 7:18:29 AM
Reference Assemblies	10/8/2009 3:27:35 PM	dirv	0	6/24/2008 8:28:13 PM
Symantec	10/8/2009 3:27:35 PM	dirv	0	6/5/2009 8:44:39 PM
Universal Information	10/8/2009 3:27:35 PM	dirv	0	2/12/2009 9:59:31 AM
Wheave	10/8/2009 3:27:35 PM	dirv	0	6/5/2009 11:20:09 AM
Windows Media Player	10/8/2009 3:27:35 PM	dirv	0	6/24/2008 12:22:09 PM
Windows NT	10/8/2009 3:27:35 PM	dirv	0	6/24/2008 6:44:37 AM
WindowsUpdate	10/8/2009 3:27:35 PM	dirv	0	6/24/2008 1:07:26 AM
WinZip	10/8/2009 3:27:35 PM	dirv	0	6/24/2008 2:19:00 PM

# Additional Performance Tips and Tricks

# NetBackup has Linux quiesce & verify! See Admin Guide

## Appendix

# D

## SYMCquiesce utility for Linux virtual machines

This appendix includes the following topics:

- [About the SYMCquiesce utility](#)
- [Requirements for the SYMCquiesce utility](#)
- [Installing the SYMCquiesce utility](#)
- [Configuration options for the SYMCquiesce utility](#)
- [SYMCquiesce logging and troubleshooting](#)

# Tips and Tricks

- For VM discovery use “Display name or “UUID”
  - Hostname can easily if DNS not working correctly
- Create separate temporary policy to test basic functionality
  - Once testing is completed, expire images associated with this policy
- For shared storage backups, try network (NBD) backups first then SAN/iSCSI
- Get basic backup/snapshot functionality working
  - Turn off all advanced functionality (mapping, quiesce, etc.)
  - Power off VM if possible
  - Once basic backups are working, start turning on stuff

# Troubleshooting: Suggested Logs

- **bpvmutil:**

  - VM discovery fails

  - vCenter credentials are incorrect

  - vCenter discovery timeout

- **bpbkar:**

  - standard backup processes

- **bpfis –**

  - Logs snapshot process

  - Troubleshoot snapshot (156) errors

  - Restore issues - does all interaction with vCenter during restore

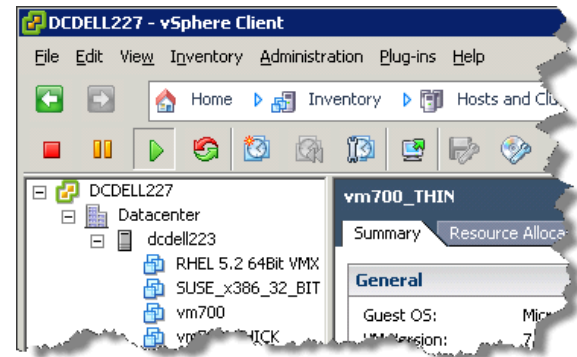
# Testing vCenter Response Time

- NetBackup periodically contacts vCenter
  - This updates VM information, location
  - Required to support VMotion, DRS, Storage VMotion, etc.
  - Slow, unresponsive vCenter can impede entire backup process
  - NetBackup unfairly blamed
- Test vCenter response
  - Time command using CLI from NBU Windows B/U host
  - This can point to oversubscribed vCenter server (common problem)
- Standard backups:

**bpvmutil 0 NOCACHE 0**

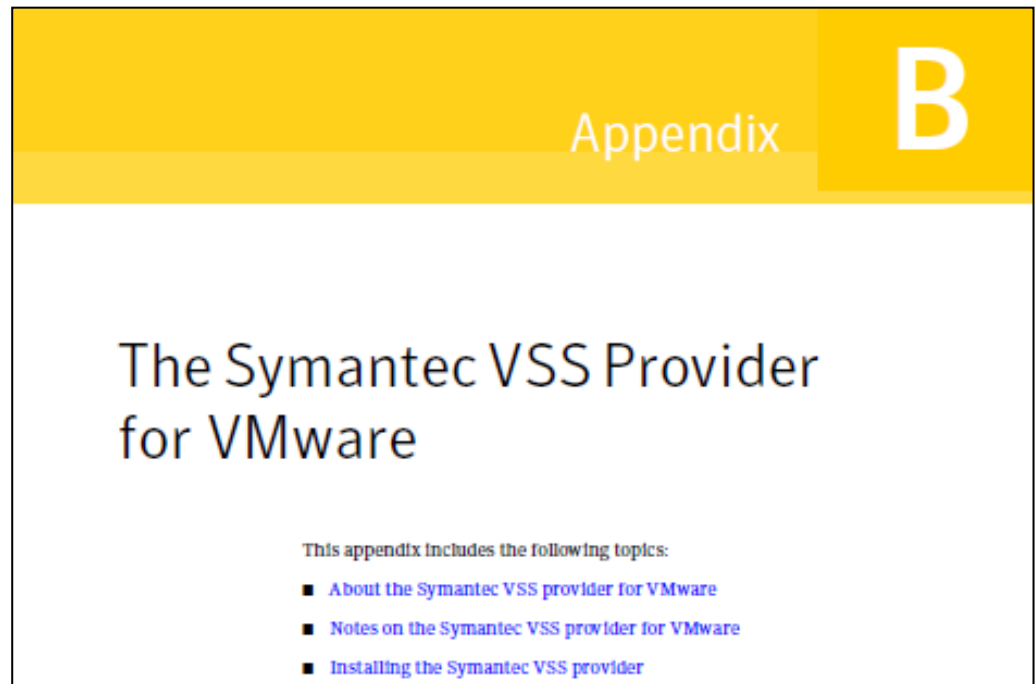
- VIP backups:

**nbdiscover vmware:**



# Enhanced VSS Support for VMware – By Symantec

- Optional resource created by Symantec Engineering
- Improved VSS performance
- Supports newer OS'es (W2K8 R2)
- Application aware
  - Truncate EXCH logs
- Try this if you are experiencing snapshot issues that go away when “quiesce” is disabled (NBU policy options)



# VM Protection Criteria

- Simple and scalable, minimal impact to ESX servers
- Disaster Recovery: Legal offsite Requirements
  - Backup and restore locally
  - Offsite = replication and tape
- Occasional restore of entire VM
  - Restore entire environment if necessary
- Single file restore – Linux and Windows
  - Most common restore request



# Customer Experiences: Backups Failing

- Too many paths showing up on backup server
  - Multipathing Software not installed
- Able to connect to virtual center but backups keep failing with snapshot error
  - Not given proper credentials even though we were told they were equivalent to administrator
- Could connect to virtual center but backups were failing and customer would not give us access to view vCenter
  - ESX Server was in Maintenance Mode
- Backup over network worked but would fail over SAN we see the LUNS
  - They were the wrong LUNS and change request took 1 day, SAN team did not verify the LUNS

# Customer Experiences: Slow Performance

- Backup Target to disk
  - USB Hard Drive on Server as Disk Storage Target
- VMWare Datastore hosted on iSCSI
  - iSCSI connected to server via 10 MB Hub, 10 MB



# Thank you!

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