



IP43 Building Virtual Infrastructures With NAS

Peter Learmonth, Kim Weller
Consulting Systems Engineers, NetApp



Bud James
Data Center Operations, BEA

- ▶ **A Brief review of the NFS protocol**
- ▶ **Characteristics of ESX NFS Client and VI3 NFS Datastores**
- ▶ **Cost benefits of NFS VI3 Deployments**
- ▶ **Network Design with VI3 and NFS**
- ▶ **Configuring NAS & VI3**
- ▶ **Backup and Recovery**
- ▶ **NFS Performance**
- ▶ **BEA Implementation Profile**

Brief Overview Of The NFS Protocol

▶ NFS Server

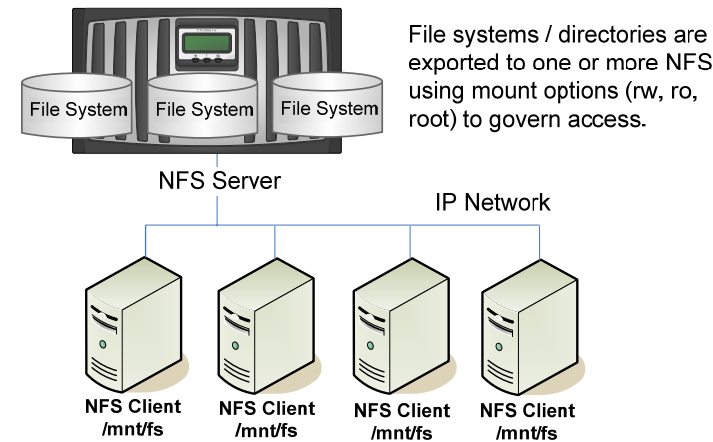
- Implements NFS daemon processes (nfsd) in order to make data generically available to clients
- Administrator exports names and parameters of directories
 - /etc/exports configuration file and exports command
- Server security-administration ensures that it can recognize and approve validated clients

▶ NFS Client

- Requests access to exported data (with mount command)
- Responsible for establishing parameters of mount
 - Transport: TCP/UDP
 - Error Handling: Hard / Soft / Interrupt
 - Write Size: 8k, 32k, etc.

▶ NFS Protocol

- Mature, standardized protocol as established in IETF RFCs 1094 1813 3530 (NFS v2, v3, v4)
- Stateless protocol means that there is no need to do state recovery after a client, server, or network has become unavailable.
 - Clients can be configured to retry I/O to non-responding mounts indefinitely
 - Server can service requests as soon as it begins running.



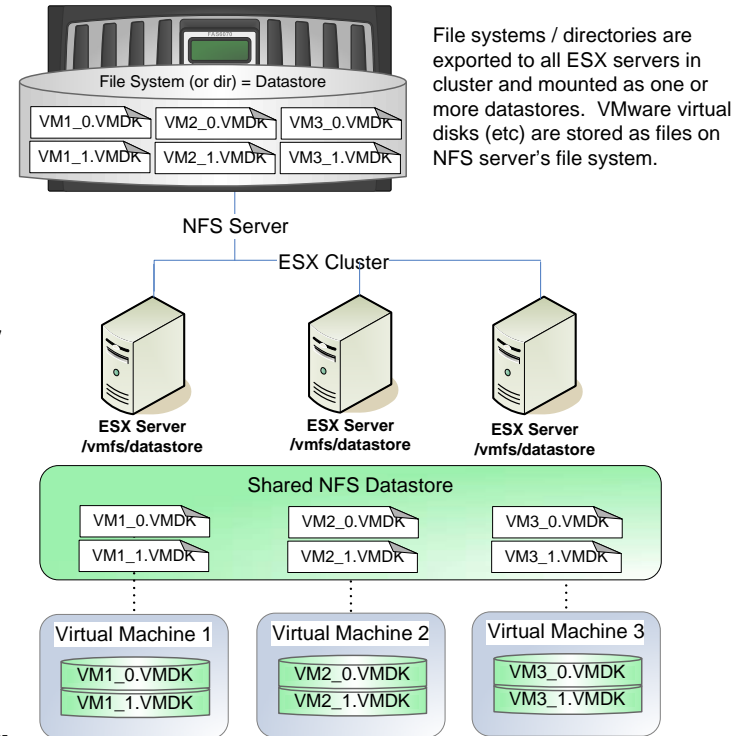
VI3 NFS Implementation: Client and Datastores

▶ Client characteristics:

- NFSv3
- Fixed Mount Options
 - TCP (retransmit only dropped packets)
 - Block Size
- Ability to mount Read-Only datastores
 - Useful for read-only point-in-time copies or replication destination

▶ Datastores

- 8 default, 32 maximum
- Mounted to `/vmfs/volumes/datastore_name`
- Persistent across reboots
- Dynamic Resizing
- Leverages VMware NIC teaming / load balancing for path management



Note: The NFS client for datastore traffic is implemented at the VMKernel and is completely different/separate from the service console NFS client. In the absence of NFS datastores, the service console NFS client may be used to mount administrative exports containing application ISOs.

- ▶ **ISO and Software Repository**
 - Handy way to access single repository from all ESX servers
- ▶ **Backup Target**
 - ESX Ranger and similar used to backup VMFS to NFS
- ▶ **Datstores containing VMs ★**
- ▶ **Other uses out of scope of this talk**
 - Guest OS NFS client (in a VM) directly mounting NFS export
 - Traditional backup server backing up to NFS disk pool

VI3 NFS Implementation: Feature Support With VMs

- ▶ **Shared datastores – YES**
- ▶ **VMotion – YES**
 - VMotion works with VM using VMDK on NFS datastore
 - ISOs on NAS shares prevent VMotion failure due to HW CD-ROM connected
- ▶ **HA – YES**
- ▶ **DRS – YES**
- ▶ **VMware snapshots – YES**
- ▶ **VCB – NO**

Features Of An Enterprise-Class NAS Server

▶ The BASICS

- High Availability
- Advanced cost-effective RAID Protection (High performing RAID-6)
- Ability to resize (grow and shrink) datastores

▶ OPTIMIZING THE VALUE of NFS datastores

- Ability to thin provision datastores
- Storage (NFS server) based SnapShots of datastore
 - Restore individual virtual machine files without network copy
 - Restore datastores without network based data copy
 - Ability to create writable snapshots which may be mounted as non read-only datastores
- Storage (NFS server) based cloning of datastore or VM
 - Ability to thin-provision clones
- Storage (NFS server) based remote replication (DR)
 - Ability to create clones at replication destination
- Deduplication / Single-Instance Storage for primary and backup storage

Cost Benefits Of NFS With VI3

- ▶ **Standard, ubiquitous Ethernet Infrastructure**
 - Switches
 - NICs
- ▶ **Less specialized training (you already know how to do this!)**
- ▶ **Space optimization**
 - One less layer of file system needing space for metadata and free space
 - VMDKs thin provision by default
- ▶ **More flexible space management of datastores**
 - Thin provision datastore *
 - Reclaim unused space by shrinking datastores *

** Not all NAS solutions can do this*

- ▶ **As with VMDK in VMFS, MSCS between VMs or VM and physical is not supported**
- ▶ **VMware Consolidated Backup works only with FCP or iSCSI protocol**
 - Other 'proxy' backup options exist
- ▶ **Maximum 32 NFS datastores**
 - Default is 8

- ▶ **Use Gigabit Ethernet (i.e. not 100Mb)**
 - 10GbE available on Network Appliance storage today (consult other vendors to determine their support)

- ▶ **Build separate networks or VLANs**
 - VM network
 - Storage
 - VMotion

- ▶ **Achieve port redundancy and better throughput with NIC Teaming**
 - Etherchannel (= VIFs on NetApp)
 - Match VMware load balancing and switch load balancing

VI3 Network Design: Virtual Switches / Ports Groups

Summary Virtual Machines Performance **Configuration** Tasks & Events Alarms Permissions Maps

Hardware

- [Processors](#)
- [Memory](#)
- [Storage \(SCSI, SAN, and NFS\)](#)
- ▶ [Networking](#)
- [Storage Adapters](#)
- [Network Adapters](#)

Software

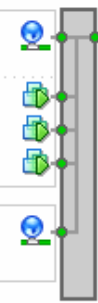
- [Licensed Features](#)
- [DNS and Routing](#)
- [Virtual Machine Startup/Shutdown](#)
- [Security Profile](#)
- [System Resource Allocation](#)
- [Advanced Settings](#)

Networking [Refresh](#) [Add Networking...](#)

Virtual Switch: vSwitch0 [Remove...](#) [Properties...](#)

Virtual Machine Port Group

- VM Network
 - 3 virtual machines | VLAN ID *
 - LnxFNS1
 - WinNFS1
 - WinNFS2
- Service Console Port
 - Service Console
 - vswif0 : 10.41.77.53




Physical Adapters

vmnic1	1000	Full
vmnic0	1000	Full

Virtual Switch: vSwitch1 [Remove...](#) [Properties...](#)

VMkernel Port

- VMkernel backend
- 192.168.42.54
- Service Console Port
 - Service Console iSCSI
 - vswif1 : 192.168.42.53




Physical Adapters

vmnic4	1000	Full
vmnic2	1000	Full

Virtual Switch: vSwitch2 [Remove...](#) [Properties...](#)

VMkernel Port

- VMotion
- 192.168.67.54



Physical Adapters

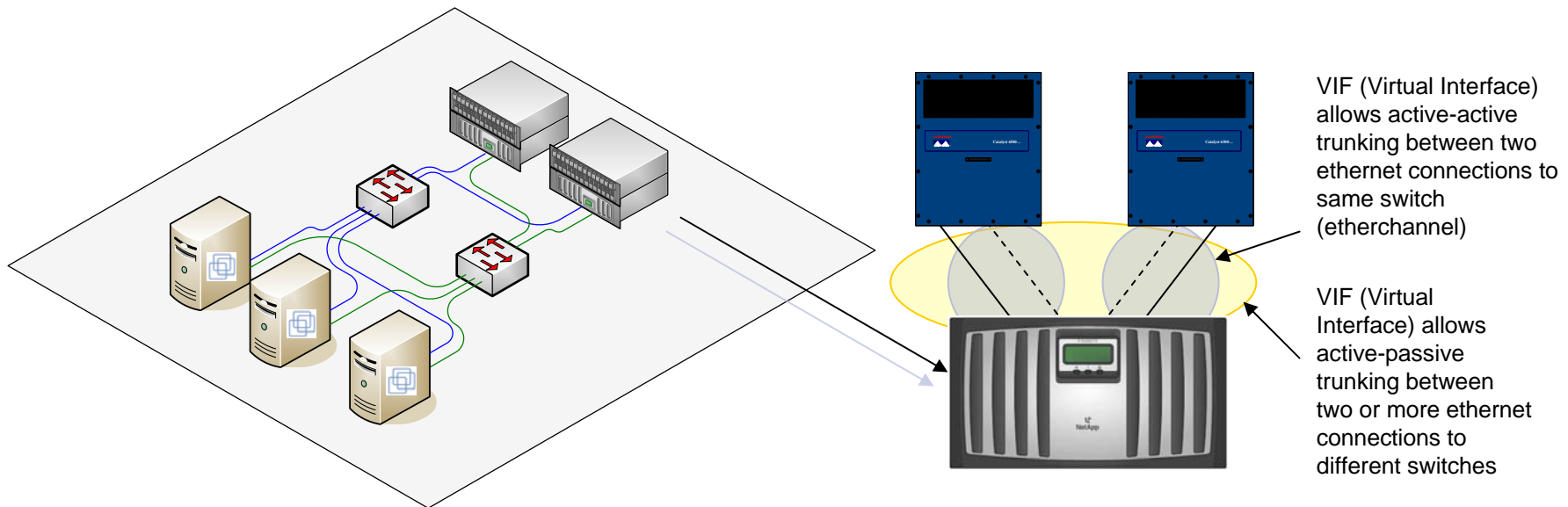
vmnic5	1000	Full
vmnic3	1000	Full

Copyright © 2007 Network Appliance, Inc. All rights reserved.

11

VI3 Network Design For NFS: Redundancy

- ▶ **Switches may be**
 - **Separate switches**
 - **Stackable switches (allows multimode VIF between switches on NetApp)**
 - **Separate blades in a high-end switch (Cisco Catalyst, etc.)**



VI3 Network Design for NFS: Load Balancing

VI3 IP storage networks leverage NIC Teaming and Load Balancing policies

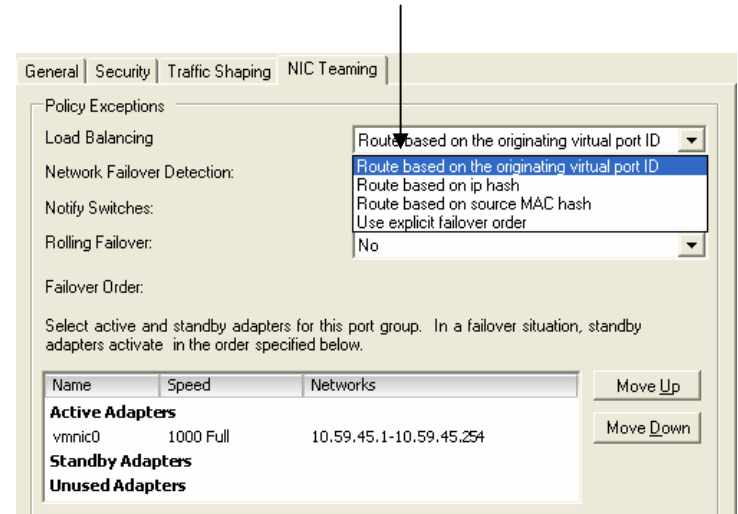
- **Originating virtual port ID:**
 - Choose uplink based on virtual port
- **IP Hash (Source-Destination IP):**
 - Choose uplink based on source+destination IP of each packet
- **Source MAC Hash:**
 - Choose uplink based on source MAC address
- **Explicit Failover Order:**
 - Always use the highest order uplink

NFS traffic uses single VMKernel IP address per vSwitch / set of team NICs

This means that a single uplink will be selected for ALL traffic with:

- Load balancing based only on source IP/MAC/Port
- Load balancing with source IP and a SINGLE DESTINATION IP
- Single datastore

However, a bit of planning—and the right NFS server—can solve the problem of generating NFS traffic over multiple uplinks.



CRITICAL: Ensure that virtual switch and physical switch use same load balancing algorithm :

Ex: IP Hash = Source / Dest IP

VI3 Network Design For NFS: Load Balancing (cont)

▶ Network Configuration

- Single NFS server, separate physical networks
 - This will require more physical NICs and generally the use of additional network segments or VLANs.
- Single NFS server, IP Aliases
 - Advanced feature of NAS storage which allows a single NIC or a group of teamed NICs (Virtual Interface--or VIF--on NetApp platforms) to have multiple IP addresses
 - To generate NFS traffic across multiple uplinks teamed on a single vSwitch, mount more than one NFS datastore using more than one IP addresses.
- Multiple NFS servers
 - Most costly option. Self explanatory.

▶ Datastore Configuration

- Single datastore per exported file system / directory
- Multiple datastores per exported file system / directory
 - VI3 allows the same file system / directory to be mounted as multiple datastores
 - When this capability is leveraged with IP aliasing, physical resources are aggregated / leveraged.

▶ Create Volumes

- GUI or CLI
- Use **UNIX permission/volume/qtree type (check this)**
 - NetApp is multiprotocol which also allows for CIFS access (or NFS access) directly from virtual machine or physical servers

▶ Export

- **rw= and root= to ESX servers.**
 - rw only is OK for read only datastores
 - Export to all servers in the cluster
- **List individual servers by back-end IP or whole back-end subnet**
 - Can use hostnames or FQDN if DNS is properly configured including hostnames for storage network interfaces

▶ FilerView GUI

- Volumes → Add (Follow the wizard)

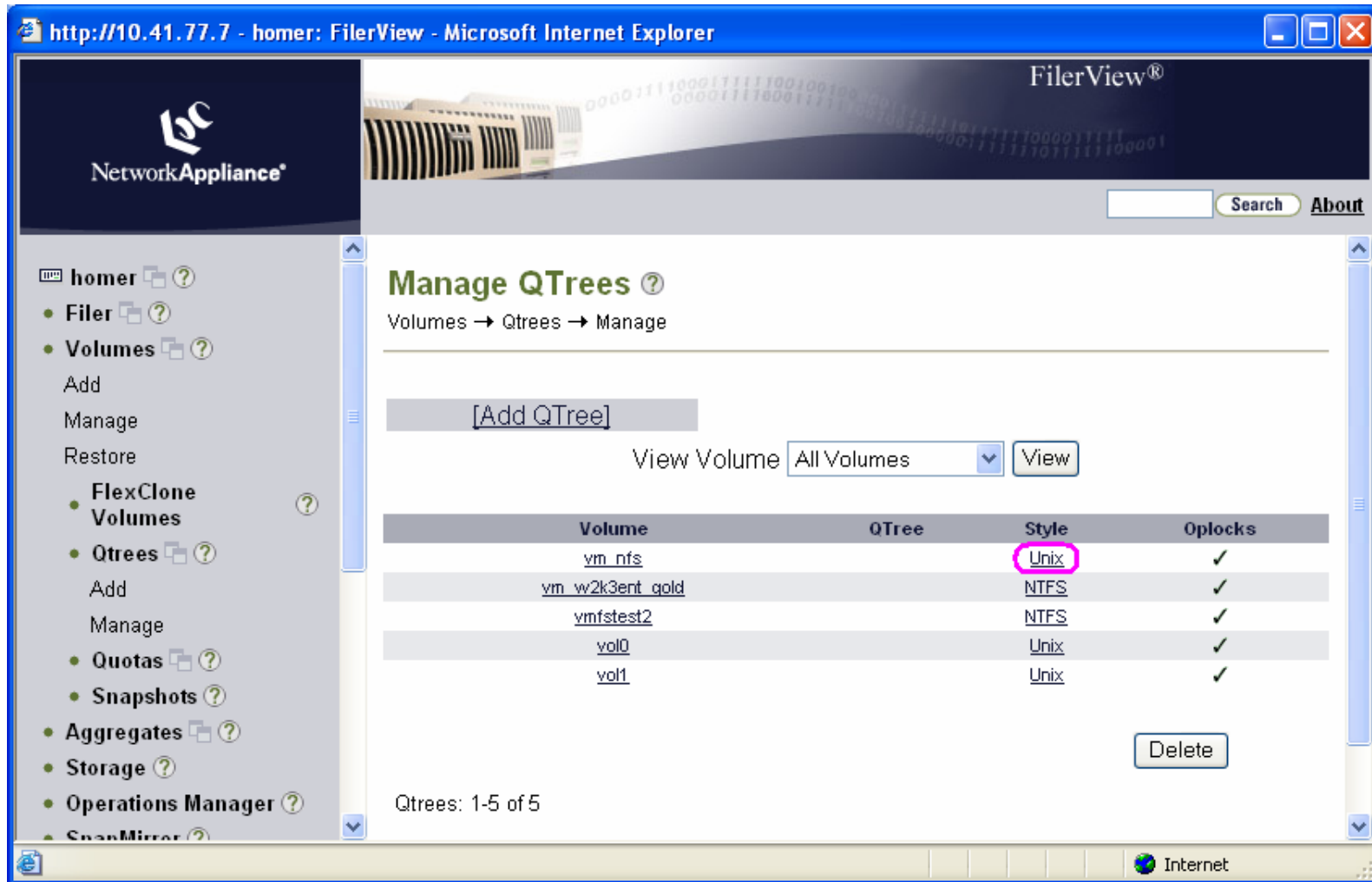
▶ Command Line

```
vol create <vol name> <aggregate> <size>
```

```
homer> vol create vm_nfs aggr0 200g
```

Creation of volume 'vm_nfs' with size 200g on containing aggregate 'aggr0' has completed.

Set UNIX Permission Type



http://10.41.77.7 - homer: FilerView - Microsoft Internet Explorer

NetworkAppliance®

FilerView®

Search About

Manage QTrees ?
Volumes → Qtrees → Manage

[Add QTree]

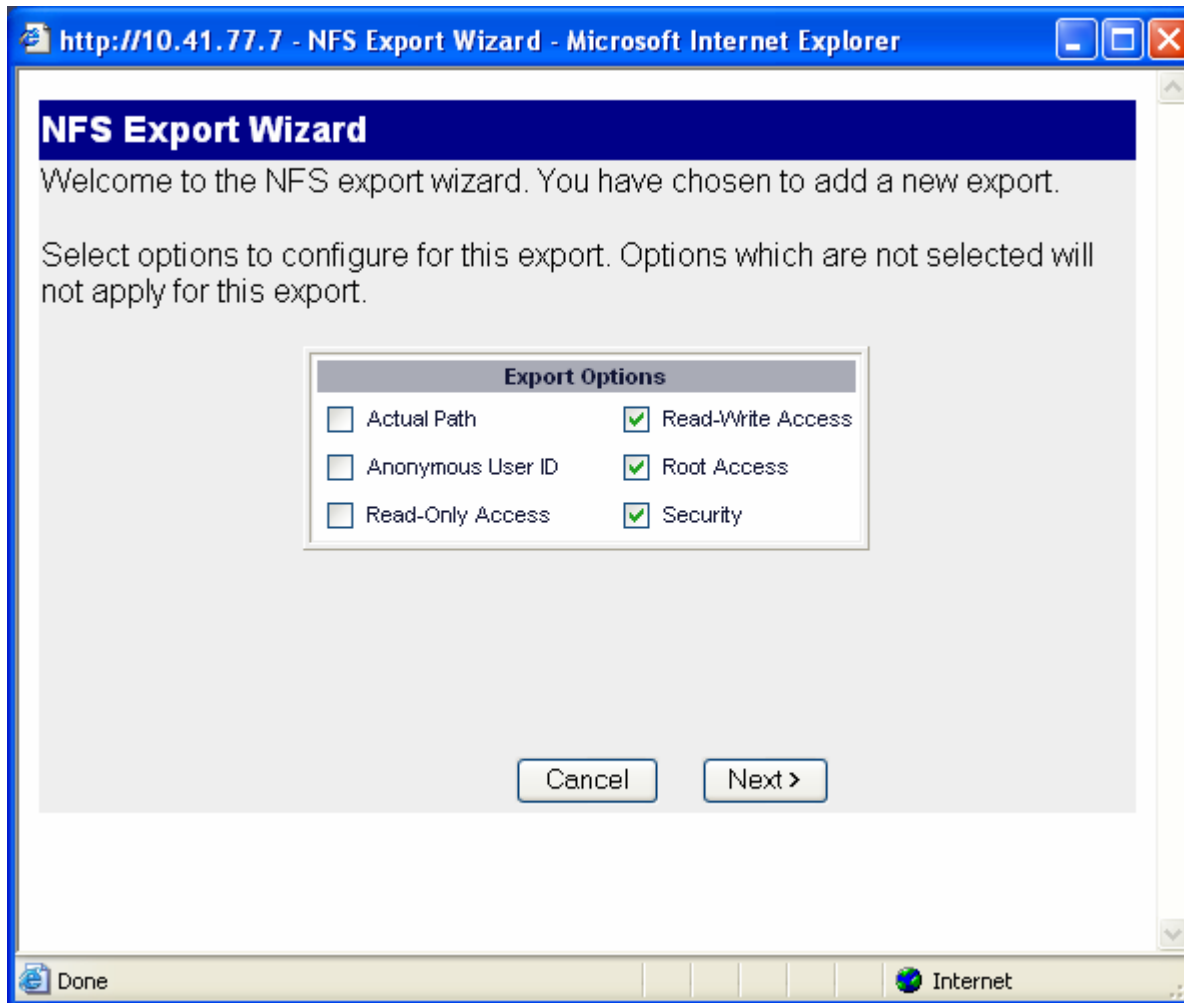
View Volume: All Volumes View

Volume	QTree	Style	Oplocks
vm_nfs		Unix	✓
vm_w2k3ent_gold		NTFS	✓
vmfstest2		NTFS	✓
vol0		Unix	✓
vol1		Unix	✓

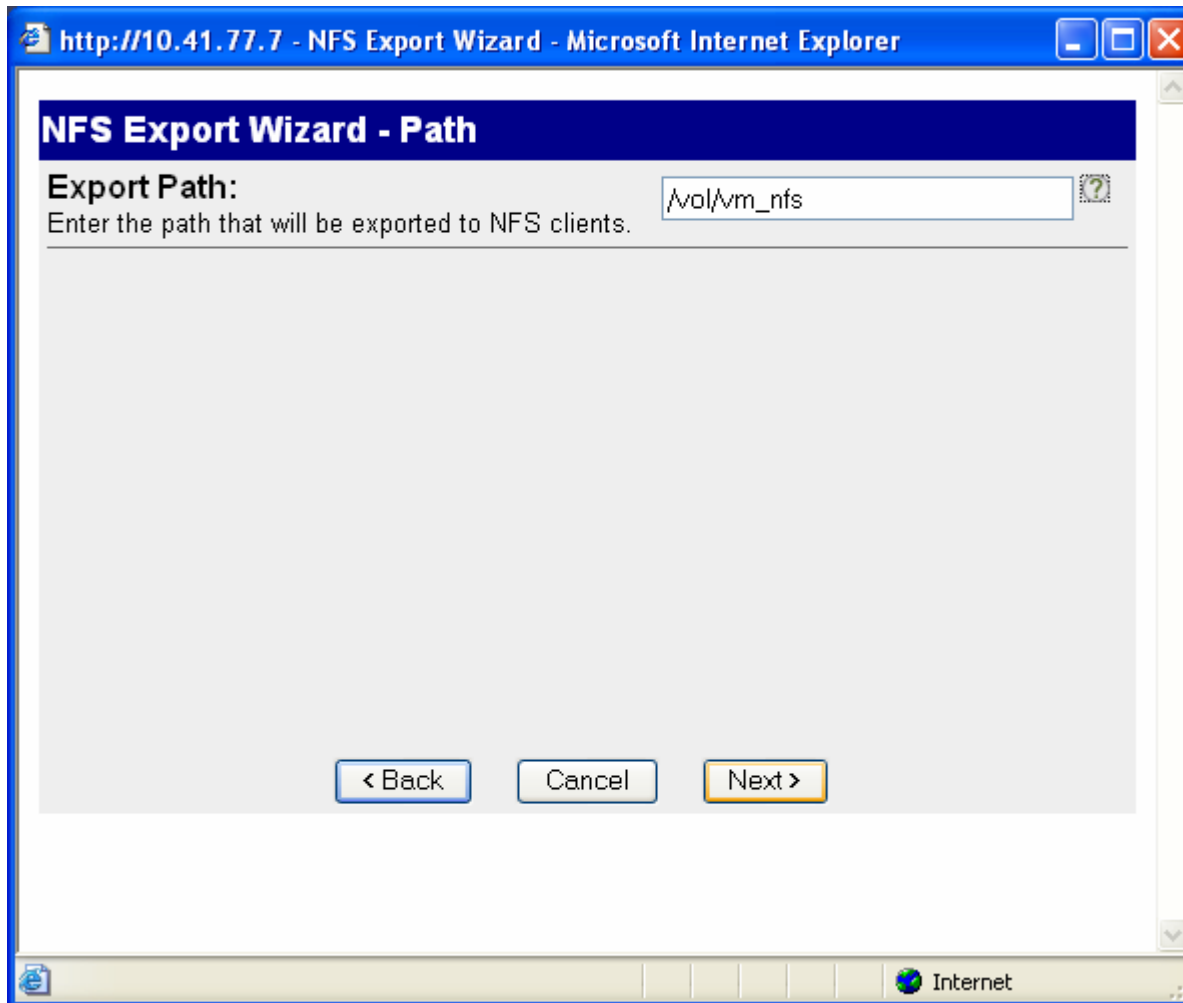
Delete

Qtrees: 1-5 of 5

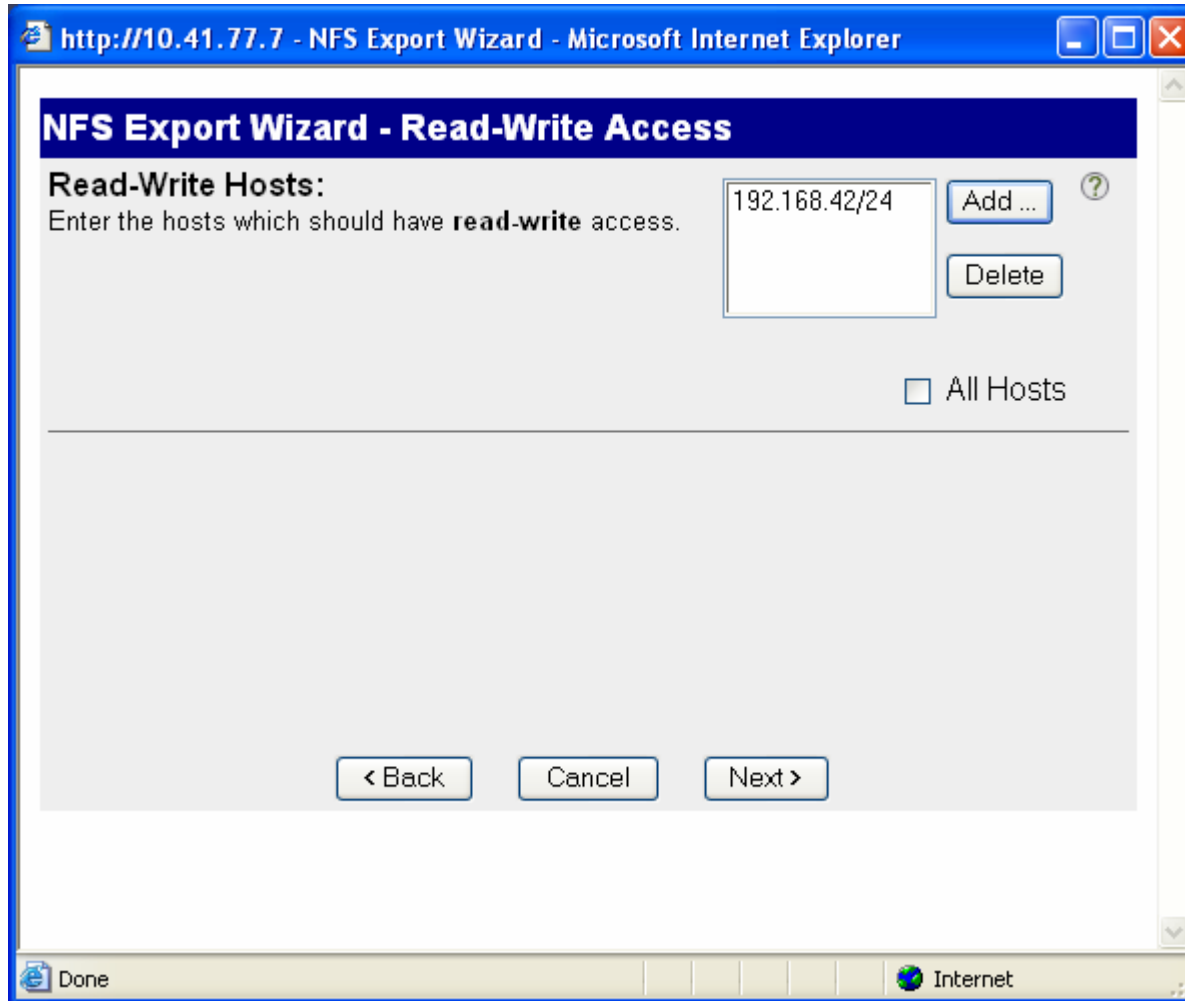
Export The Volume



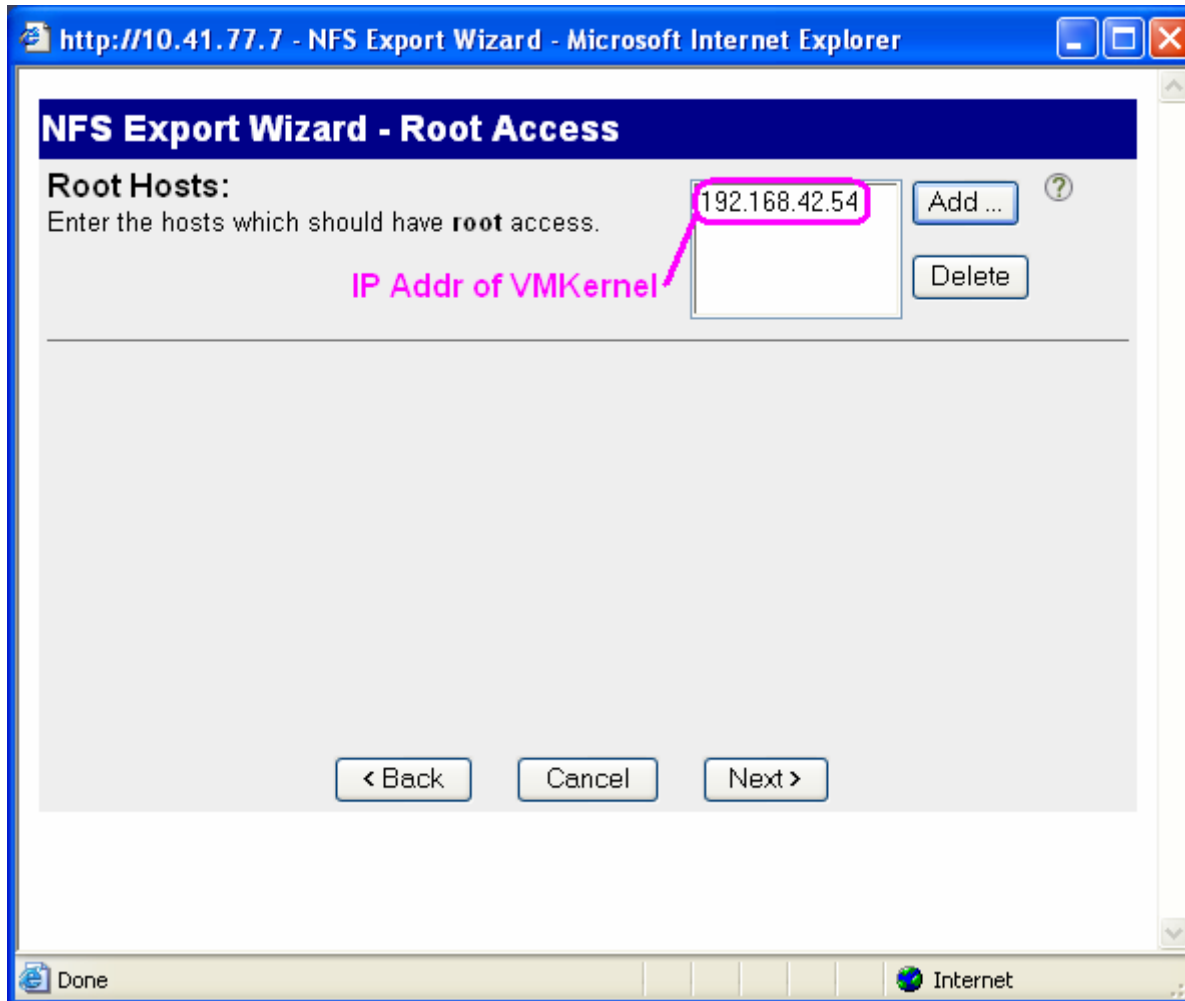
Export The Volume



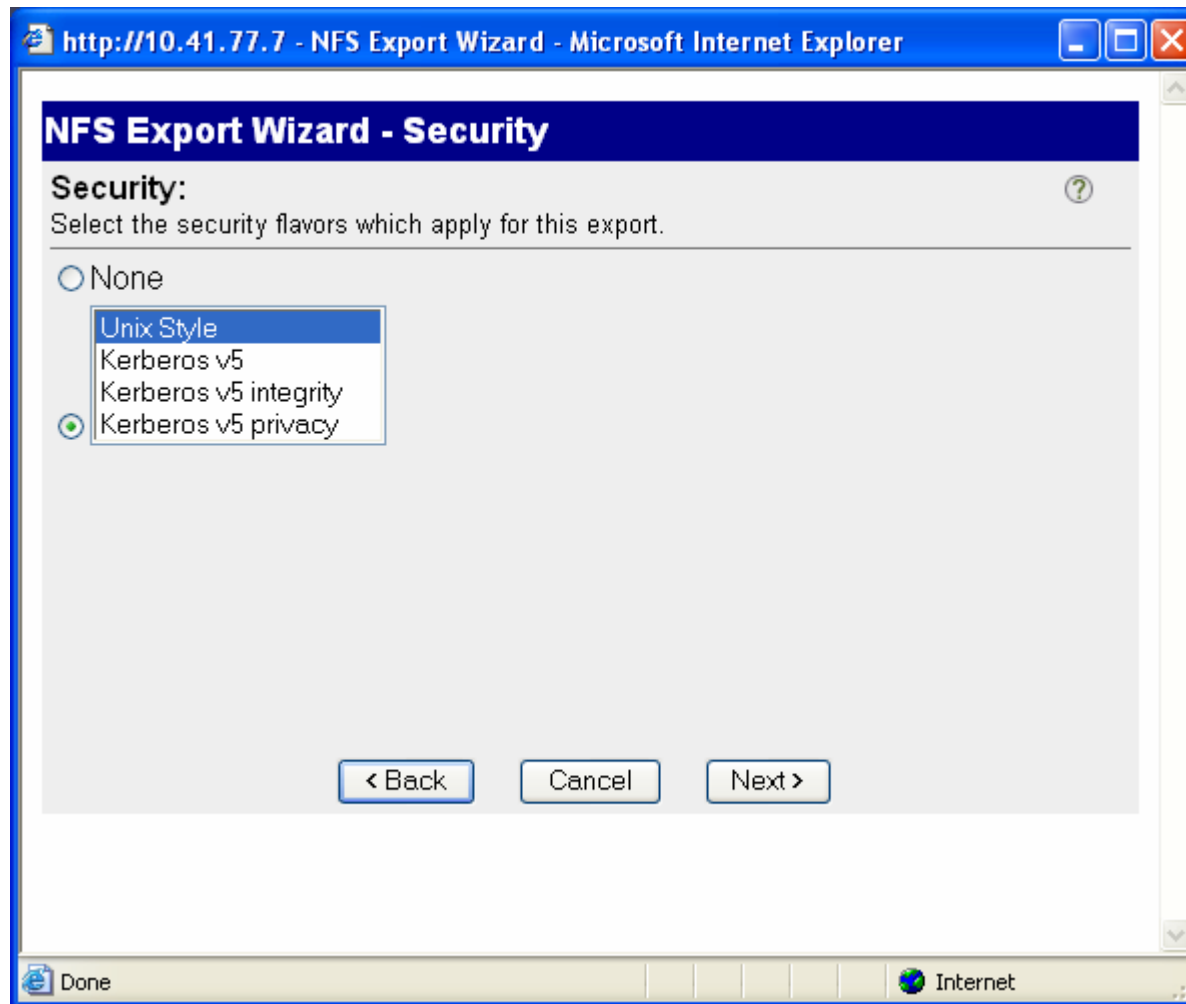
Export The Volume

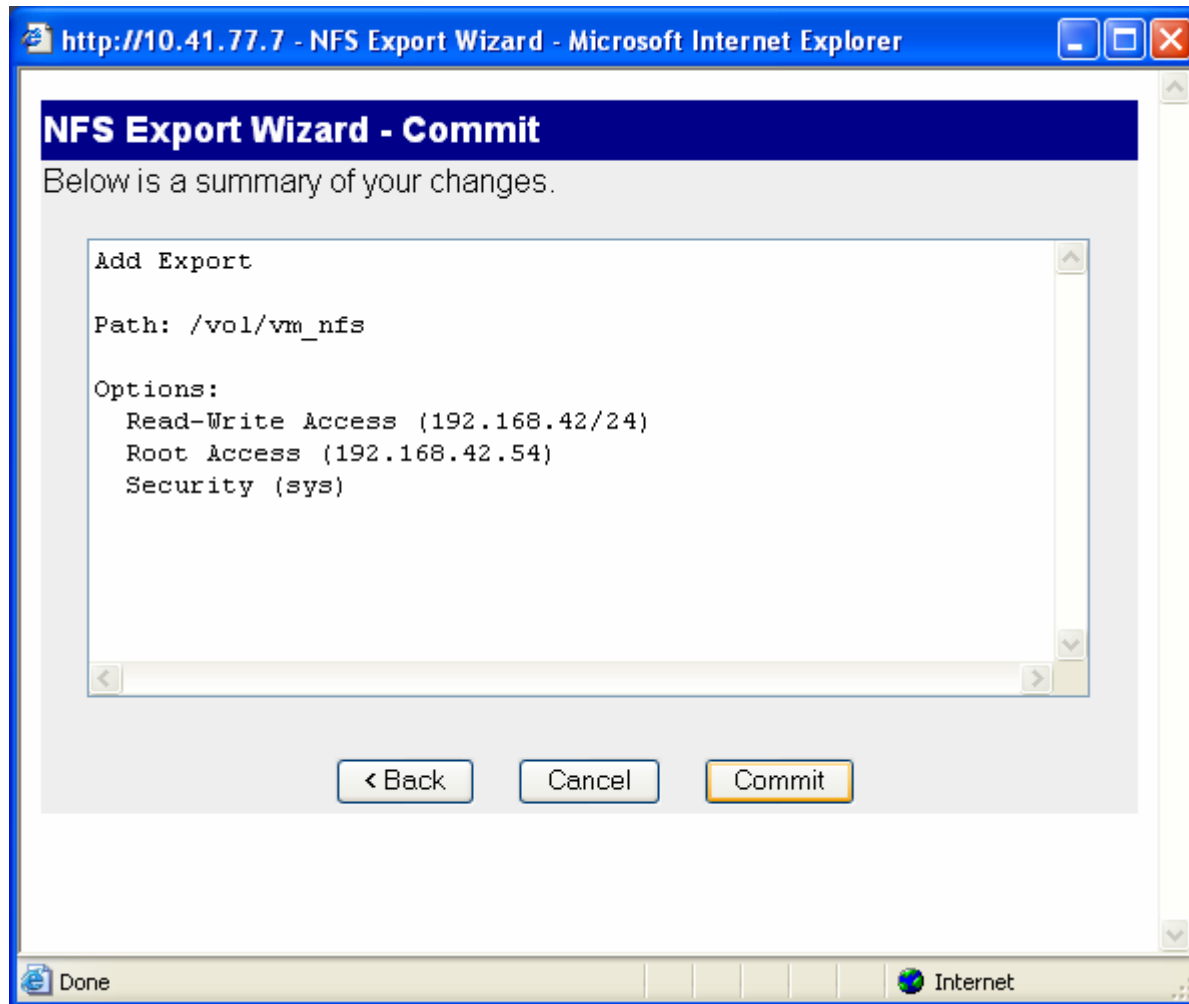


Export The Volume



Export The Volume





- ▶ **Enable the NFS client (through security settings)**
- ▶ **Add VMKernel networking**
- ▶ **Increase NFS Max Volumes if necessary**
- ▶ **Add new NFS datastore**

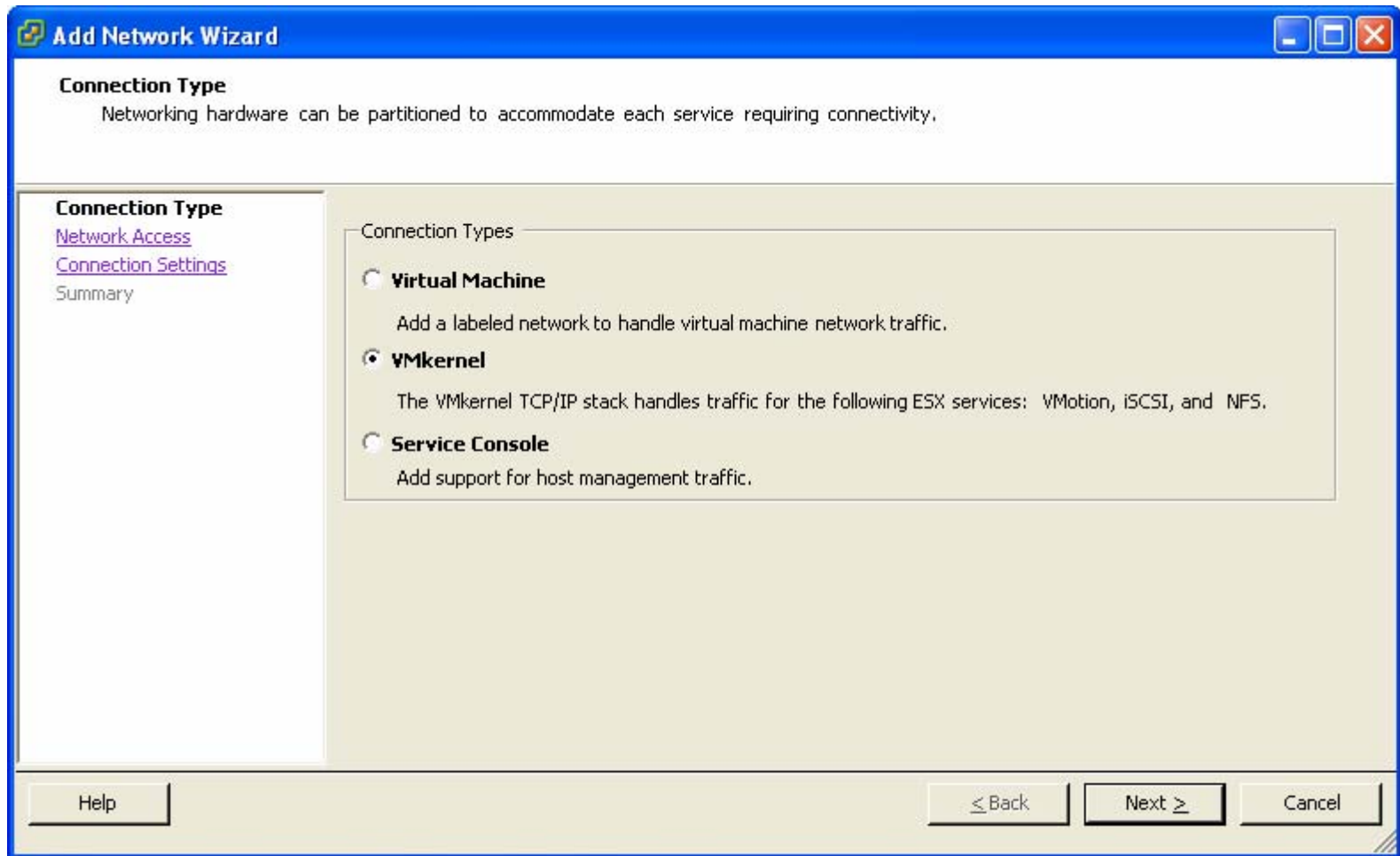
Enabling NFS Client

The screenshot shows the 'Hosts & Clusters' management console. On the left, a tree view lists various hosts under 'DataCenter', including '10.59.45.249'. The right pane shows the configuration for '10.59.45.249 VMware ESX Server, 3.0.0'. The 'Virtual Machines' tab is active, displaying sections for 'Hardware' (Processors, Memory, Storage (SCSI, SAN, and NFS), Networking, Storage Adapters, Network Adapters) and 'Software' (Licensed Features, DNS and Routing, Virtual Machine Startup/Shutdown, Security Profile, System Resource Allocation, Advanced Settings). An arrow points from the 'Virtual Machine Startup/Shutdown' link to the Firewall Properties dialog.

The 'Firewall Properties' dialog box is shown with the 'Remote Access' tab selected. It contains a table of services and their firewall configurations. The 'NFS Client' service is highlighted, and its checkbox is checked, indicating it is enabled.

Label	Incoming Ports	Outgoing Ports	Protocols	Daemon
Required Services				
Secure Shell				
<input type="checkbox"/> SSH Client		22	TCP	N/A
<input checked="" type="checkbox"/> SSH Server	22		TCP	Running
Simple Network Management Protocol				
<input type="checkbox"/> SNMP Server	161	162	UDP	N/A
Ungrouped				
<input checked="" type="checkbox"/> CIM SLP	427	427	UDP, TCP	N/A
<input type="checkbox"/> VNC Server	5900-5964		TCP	N/A
<input checked="" type="checkbox"/> VMware VirtualCenter Agent		902	UDP	N/A
<input type="checkbox"/> CommVault Dynamic	8600-8619	8600-8619	TCP	N/A
<input checked="" type="checkbox"/> NFS Client		111, 2049	UDP, TCP	N/A
<input type="checkbox"/> Tivoli Storage Manager Agent	1500	1500	TCP	N/A
<input type="checkbox"/> SMB Client		137-139, 445	TCP	N/A
<input checked="" type="checkbox"/> CIM Server	5988		TCP	N/A
<input type="checkbox"/> CommVault Static	8400-8403	8400-8403	TCP	N/A
<input checked="" type="checkbox"/> CIM Secure Server	5989		TCP	N/A
<input checked="" type="checkbox"/> VMware License Client		27000, 27010	TCP	N/A
<input type="checkbox"/> Symantec Backup Exec Agent	10000-10200		TCP	N/A
<input checked="" type="checkbox"/> Software iSCSI Client		3260	TCP	N/A
<input type="checkbox"/> Symantec NetBackup Agent	13732, 13783, 1372...		TCP	N/A
<input type="checkbox"/> FTP Client		21	TCP	N/A
<input checked="" type="checkbox"/> EMC AAM Client	2050-5000, 8042-8...	2050-5000, 8042-8045	TCP, UDP	N/A
<input type="checkbox"/> Telnet Client		23	TCP	N/A
<input type="checkbox"/> FTP Server	21		TCP	N/A
<input type="checkbox"/> NIS Client		111, 0-65535	UDP, TCP	N/A
<input type="checkbox"/> NTP Client		123	UDP	Stopped

Add VMKernel Networking



Add VMKernel Networking

Add Network Wizard

VMkernel - Network Access
The VMkernel reaches networks through uplink adapters attached to virtual switches.

[Connection Type](#)
Network Access
[Connection Settings](#)
Summary

Select which virtual switch will handle the network traffic for this connection. You may also create a new virtual switch using the unclaimed network adapters listed below.

Create a virtual switch		Speed	Networks
<input type="checkbox"/>	vmnic1	down	
<input checked="" type="checkbox"/>	vmnic3	1000 Full	10.41.77.1-10.41.77.254
<input checked="" type="checkbox"/>	vmnic5	1000 Full	10.41.77.1-10.41.77.254

Use vSwitch0		Speed	Networks
<input type="checkbox"/>	vmnic0	1000 Full	10.41.77.1-10.41.77.254

Use vSwitch1 Speed Networks

Preview:

The diagram shows a box labeled "VMkernel Port VMkernel 2" connected to a central vertical bar representing a virtual switch. From this bar, two lines connect to boxes labeled "Physical Adapters vmnic3" and "Physical Adapters vmnic5".

Buttons: Help, < Back, Next >, Cancel

Add VMKernel Networking

Add Network Wizard

VMkernel - Network Access
Use network labels to identify VMkernel connections while managing your hosts and datacenters.

[Connection Type](#)
[Network Access](#)
Connection Settings
[Summary](#)

Port Group Properties

Network Label:

VLAN ID (Optional):

Use this port group for VMotion


IP Settings

IP Address:

Subnet Mask:

VMkernel Default Gateway:

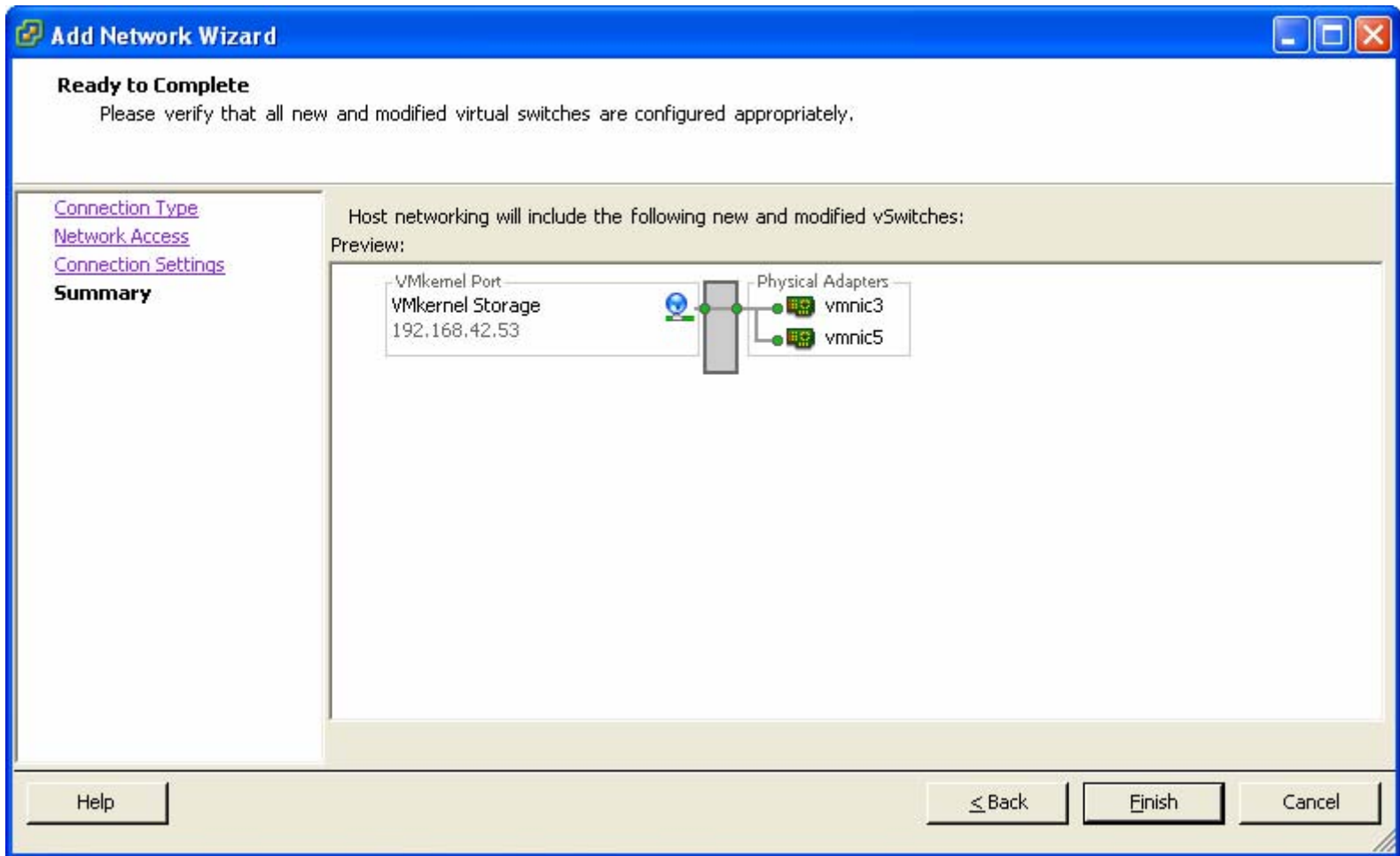
Preview:



VMkernel Port
VMkernel Storage
192.168.42.53

Physical Adapters
vmnic3
vmnic5

Add VMKernel Networking



► Configuration → Advanced Settings → NFS

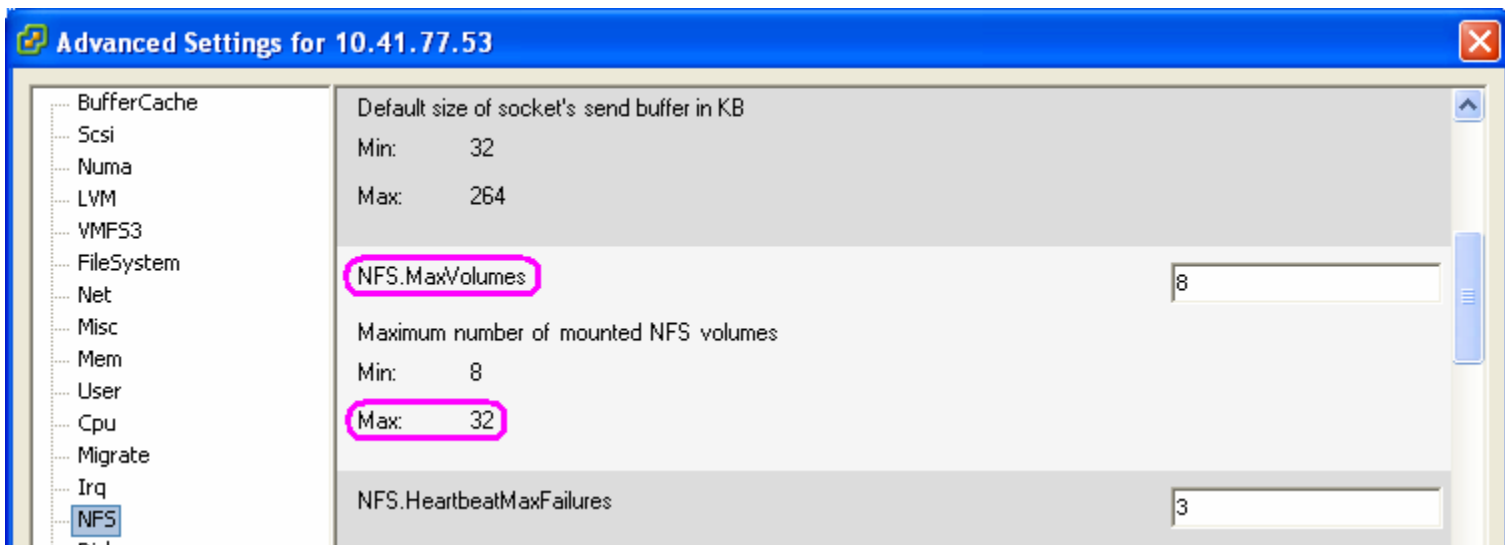
► Command Line

```
# esxcfg-advcfg -g /NFS/MaxVolumes
```

Value of MaxVolumes is 8

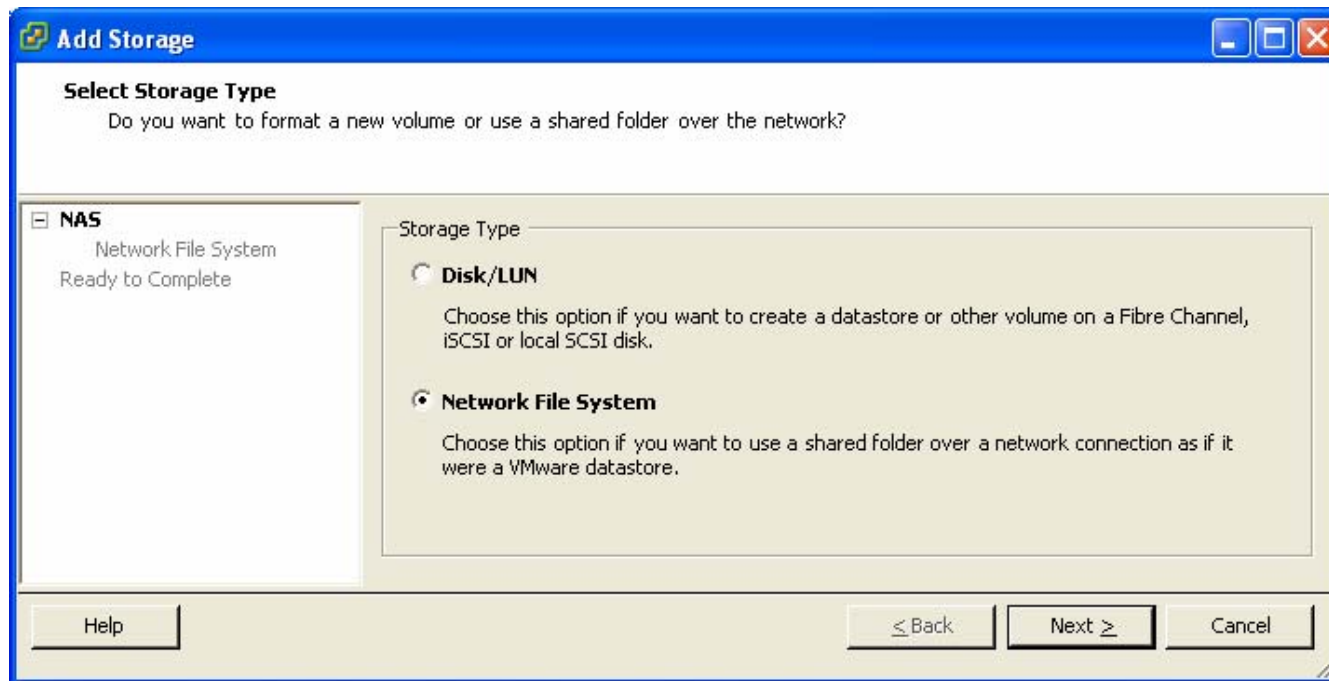
```
# esxcfg-advcfg -s 32 /NFS/MaxVolumes
```

Value of MaxVolumes is 32



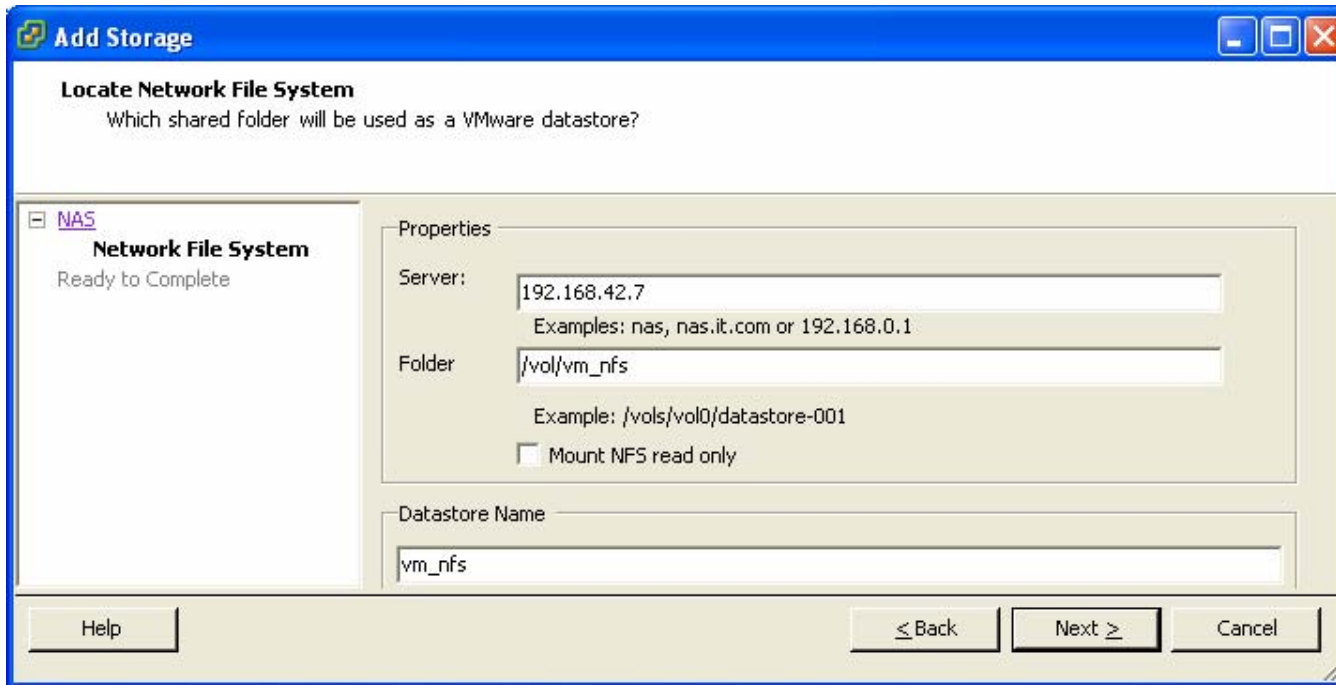
Add New NFS Datastore

- ▶ **Configuration → Storage → Add Storage → NFS**



Add New NFS Datastore

- ▶ **Configuration → Storage → Add Storage → NFS**
- ▶ **Datastore Name (akin to a mount point)**
 - **Must be the same name on all ESX hosts in the cluster (VMotion and HA requirement)**



Add Storage

Locate Network File System
Which shared folder will be used as a VMware datastore?

NAS
Network File System
Ready to Complete

Properties

Server: 192.168.42.7
Examples: nas, nas.it.com or 192.168.0.1

Folder: /vol/vm_nfs
Example: /vols/vol0/datastore-001

Mount NFS read only

Datastore Name: vm_nfs

Help < Back Next > Cancel

- ▶ **Snapshot Copies are first defense**
 - Use VMware snapshots to quiesce, then storage snapshots
 - Scripts available to automate

- ▶ **Next, back up off storage**
 - NDMP (Network Data Management Protocol)
 - Back up to tape (and other media) directly from NAS
 - Backup proxy server
 - VCB does not support NFS
 - Same functionality can be provided with Linux backup proxy

Linux– Loopback Mount NTFS

- ▶ **Mount the NFS export on the Linux server.**

```
# mount 10.41.77.76:/vol/vm_nfs /mnt/vm_nfs
```

- ▶ **Mount the VMDK as a loopback mount specifying the starting offset and NTFS file system type.**

```
# mount /mnt/vm_nfs/.snapshot/hourly.0/peternfs/peternfs-flat.vmdk
/mnt/vmdk
-o ro,loop=/dev/loop2,offset=32768 -t ntfs
```

- ▶ **Access NTFS from Linux!**

```
# cd /mnt/vmdk
```

```
# ls -l
```

```
-r----- 1 root root          0 Sep 11 2006 AUTOEXEC.BAT
-r----- 1 root root        210 Dec 18 21:00 boot.ini
-r----- 1 root root          0 Sep 11 2006 CONFIG.SYS
dr-x----- 1 root root      4096 Dec 18 21:10 Documents and Settings
-r----- 1 root root      47772 Mar 25 2005 NTDETECT.COM
-r----- 1 root root    295536 Mar 25 2005 ntl dr
-r----- 1 root root 805306368 Mar 13 16:42 pagefile.sys
dr-x----- 1 root root      4096 Sep 11 2006 Program Files
dr-x----- 1 root root          0 Dec 19 00:35 temp
dr-x----- 1 root root      65536 Mar 13 17:41 WINDOWS
```

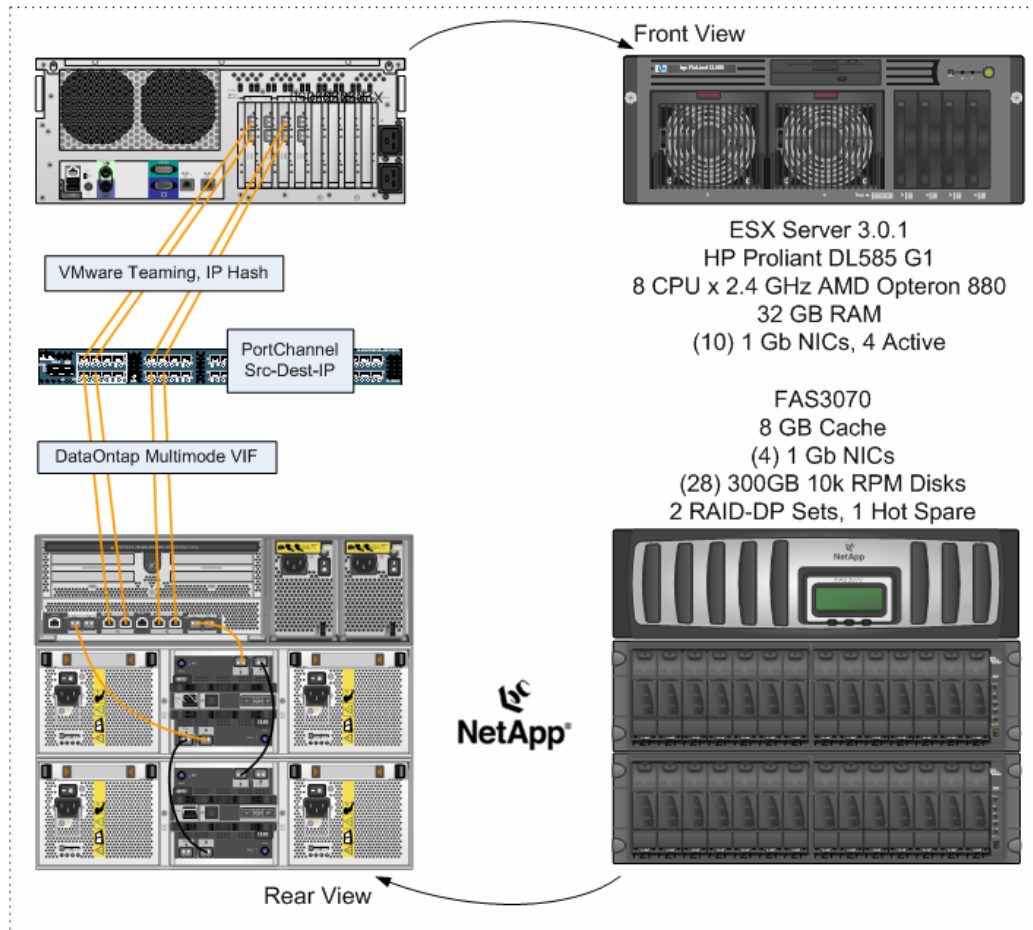
Restore From Snapshot Copies

- ▶ **Copy snapshot vmdk back over corrupted vmdk**
 - Simple and works ...
 - ... but results in I/O and takes time.
- ▶ **Use Instant restore feature (if available)**
 - SnapRestore (single vmdk or whole datastore) on NetApp
- ▶ **Recover individual files from vmdk**
 - Connect snapshot VMDK (or clone) to original VM or recovery VM
 - Copy missing/corrupt files

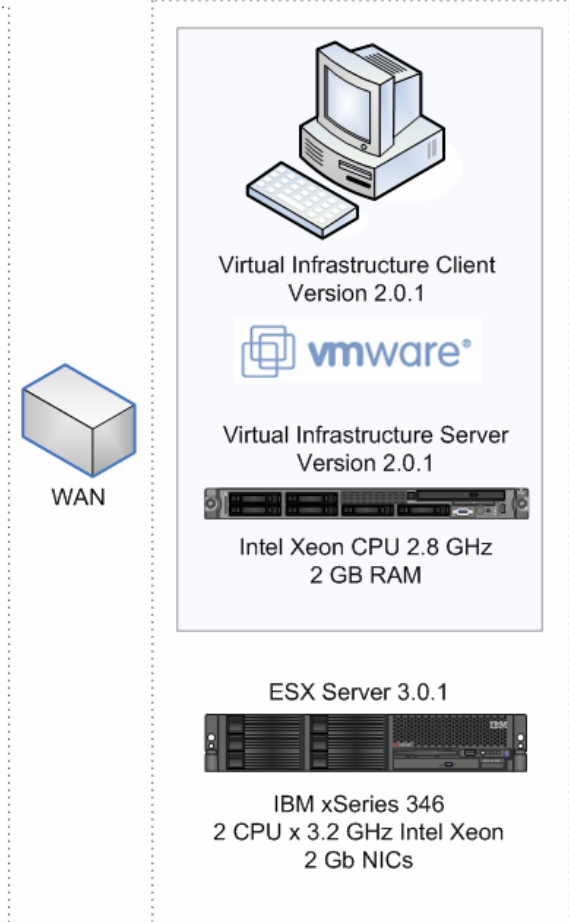
- ▶ **Use NAS server features for replication, D2D, cloning**
- ▶ **NetApp**
 - SnapMirror for DR replication
 - SnapVault for disk to disk backup
 - FlexClone for instant cloning (Smart Copies)
- ▶ **NAS simplicity over LUNs/VMFS**
 - No resignaturing to use datastore snapshot!
 - Just specify different datastore name
 - (You can call it snap-00000001-mynfs if you like!)

Sample Performance Data: POC Design

RTP, North Carolina



Houston, Texas



Sample Performance Data

▶ **Mixed workload generation for single virtual machine on single NFS datastore**

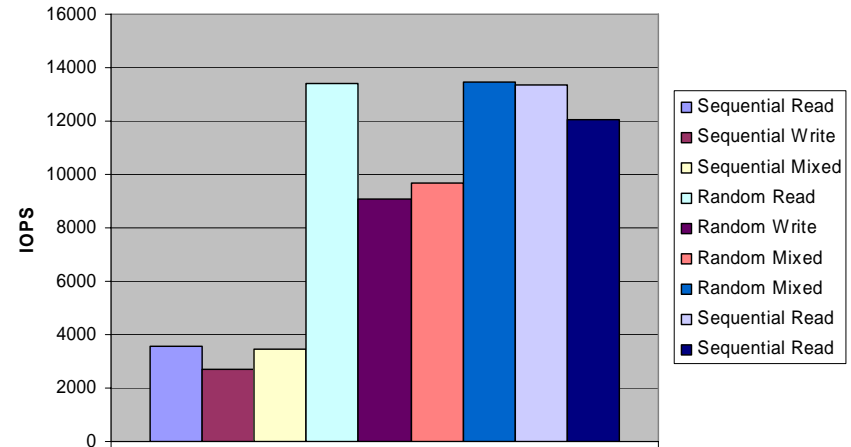
▶ **VM Details**

- Win 2003 SP1
- 4 CPU
- 4096 MB mem

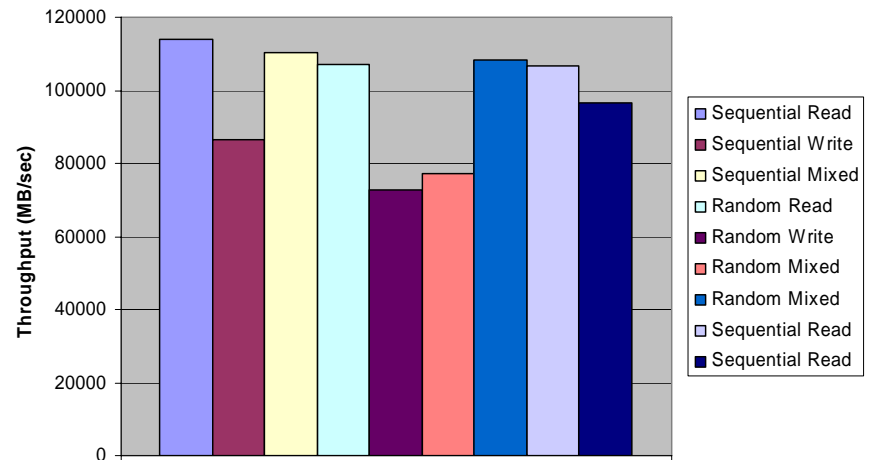
▶ **Workload Details**

- Random: 8K
- Seq: 32K
- 16 Streams

IOPS for Single Windows 2003 Virtual Machine Running SIO on Single NFS Datastore



Throughput for Single Windows 2003 Virtual Machine Running SIO on Single NFS Datastore



▶ **Mixed workload generation for multiple virtual machines residing on multiple NFS datastores.**

▶ **VM Details**

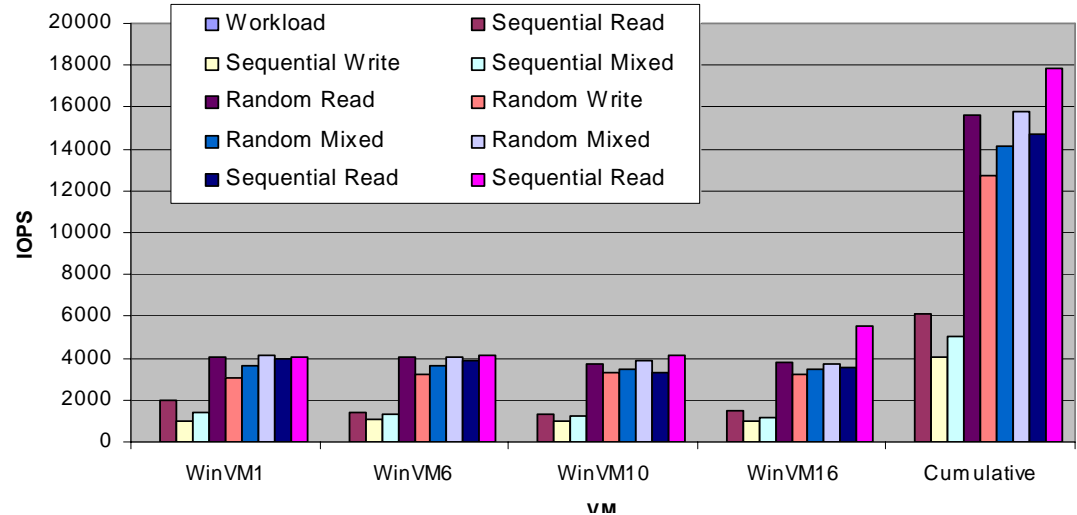
- Win 2003 SP1
- 4 CPU
- 4096 MB mem

▶ **Workload Details**

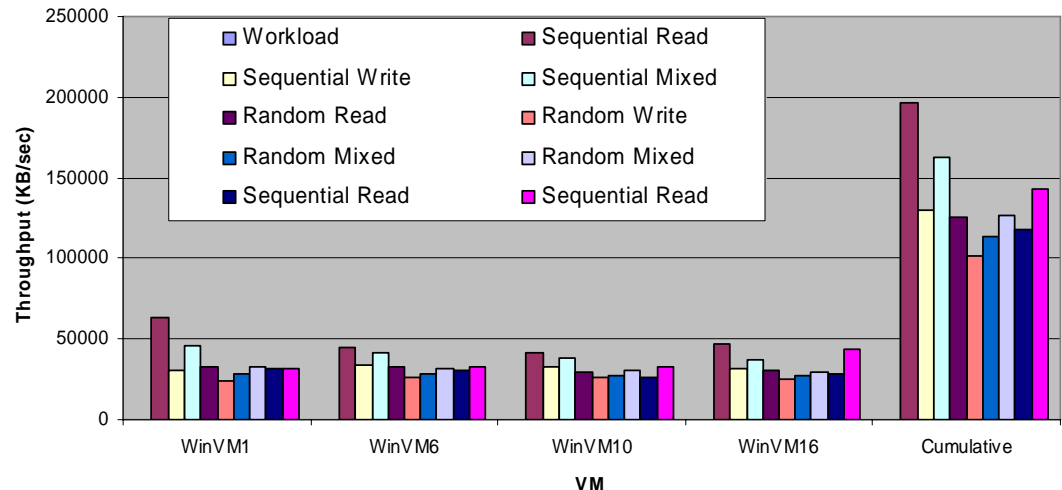
- Random: 8K
- Seq: 32K
- 16 Streams

▶ **Following two slides depict CPU and network utilization on ESX server during these tests**

**IOPS for 4 Windows 2003 Virtual Machines
Running Concurrent SIO Workloads to 4 NFS Datastores**

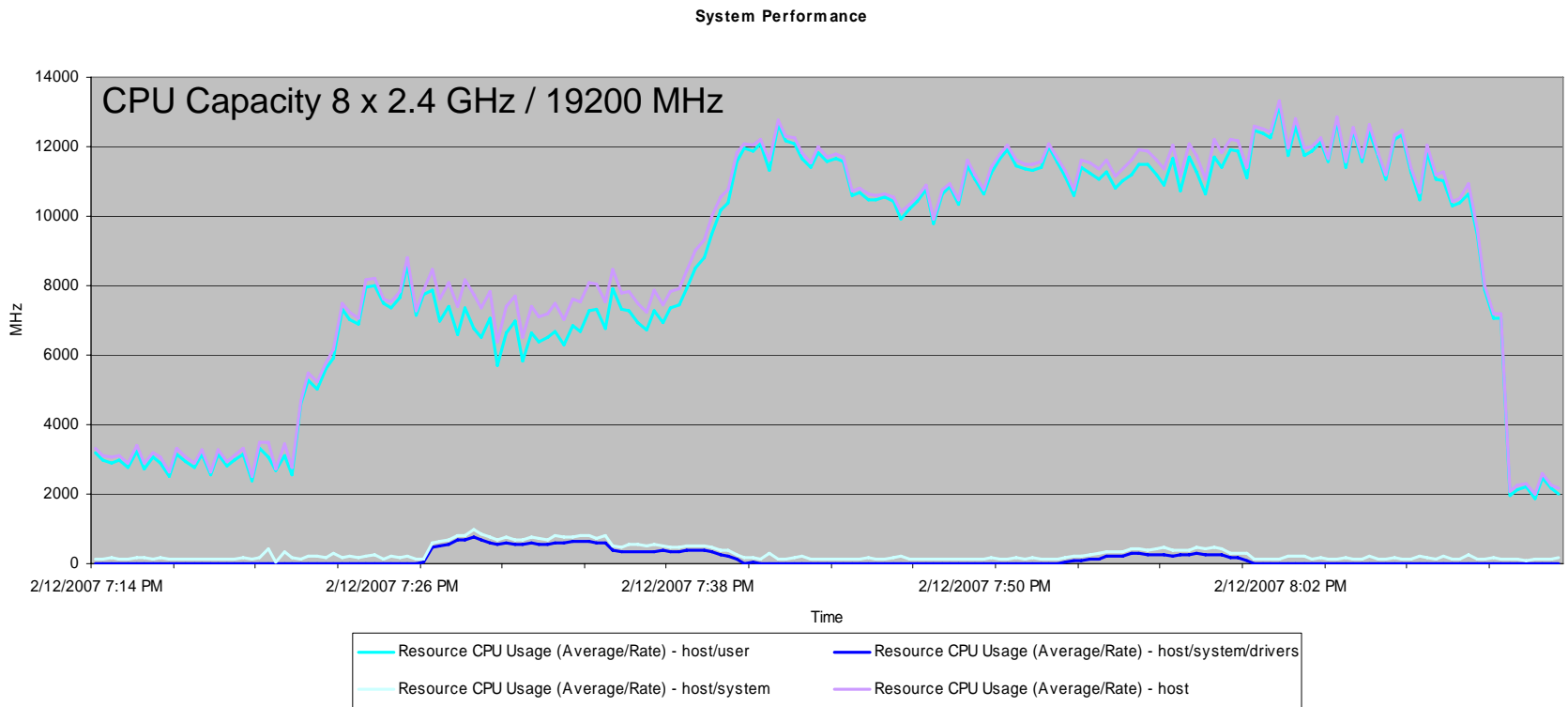


**Throughput for 4 Windows 2003 Virtual Machines
Running Concurrent SIO Workloads to 4 NFS Datastores**



Comparison Of Protocols For VMware 3.0.1 4 Virtual Machines Running On 4 NFS Datastores*

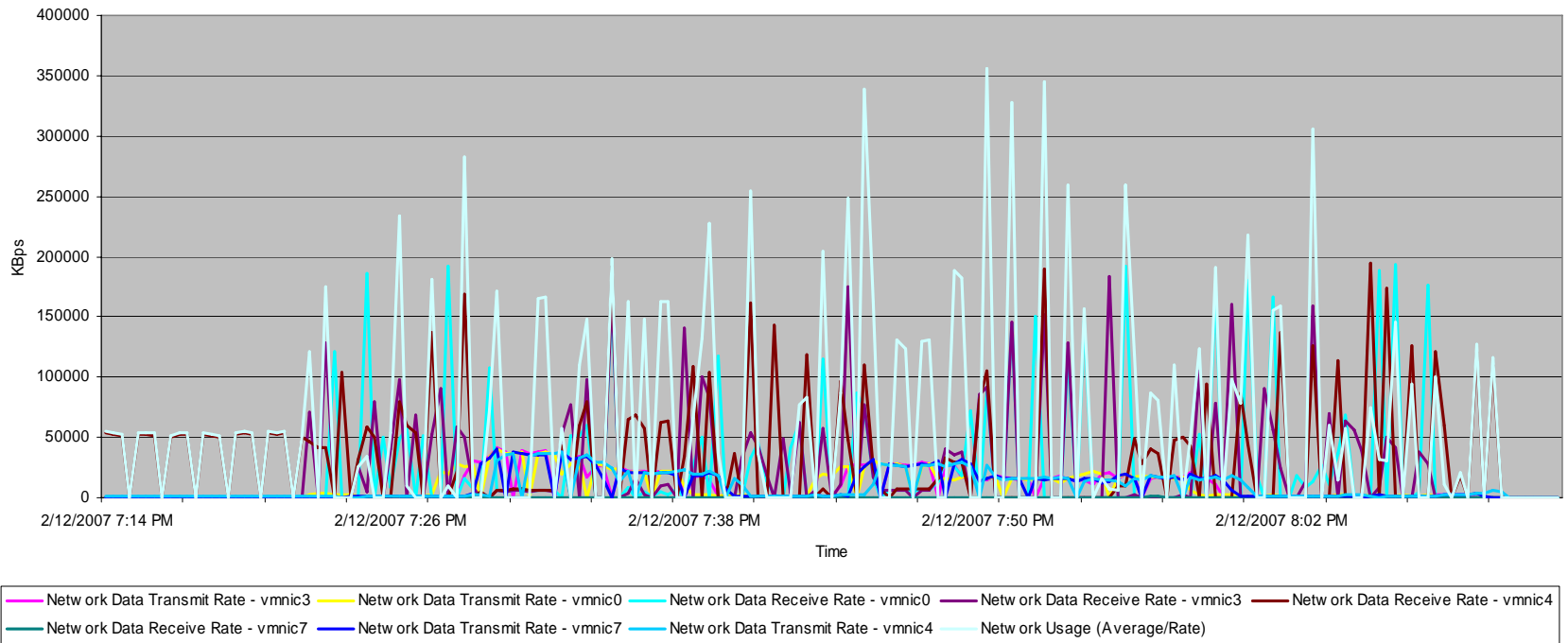
*Single NFS mount point mounted across 4 IP addresses



Comparison Of Protocols For VMware 3.0.1 4 Virtual Machines Running On 4 NFS Datastores*

*Single NFS mount point mounted across 4 IP addresses

Network Performance





BEA Implementation

Bud James

BEA Sr. Manager

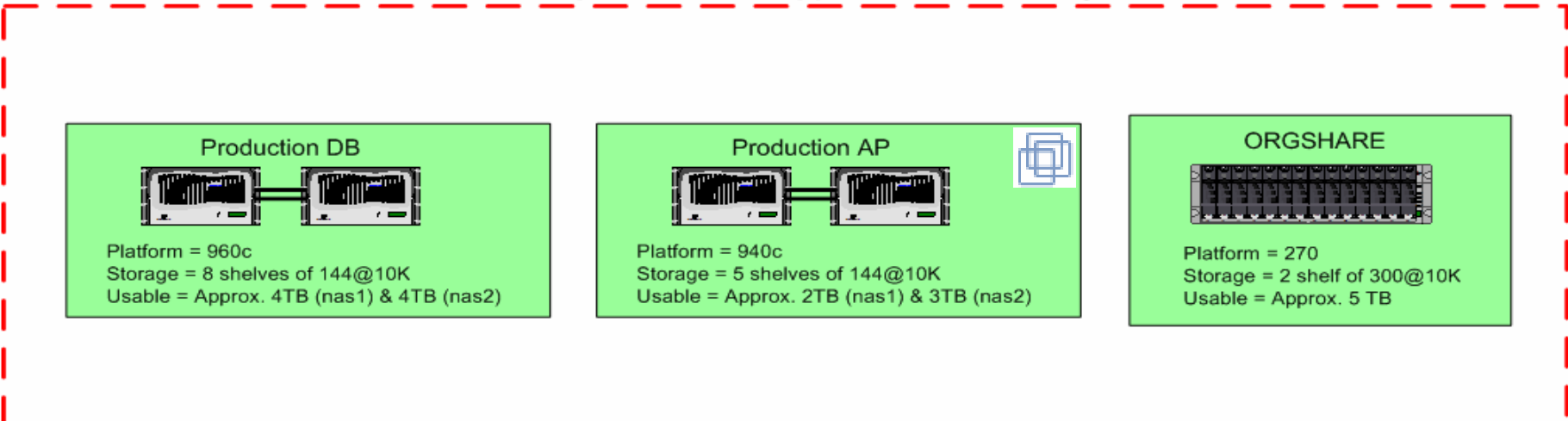
Data Center Operations Team

Collaboration Team

▶ Reno Data Center

- 13 ESX hosts (growing to 50 in the next 12 months)
- 48 Virtual Machines (growing to well over 250)
- 25 Virtual Desktops (VDI) (Also planned for growth)
- Storage is NetApp FAS940c (Clustered)
- Storage network is done via dedicated Cisco 6506's (Fiber) with dual ethernet connections from each server to the switches

BEA Core Data Center Implemented NetApp Architecture – May 2007



Production DB

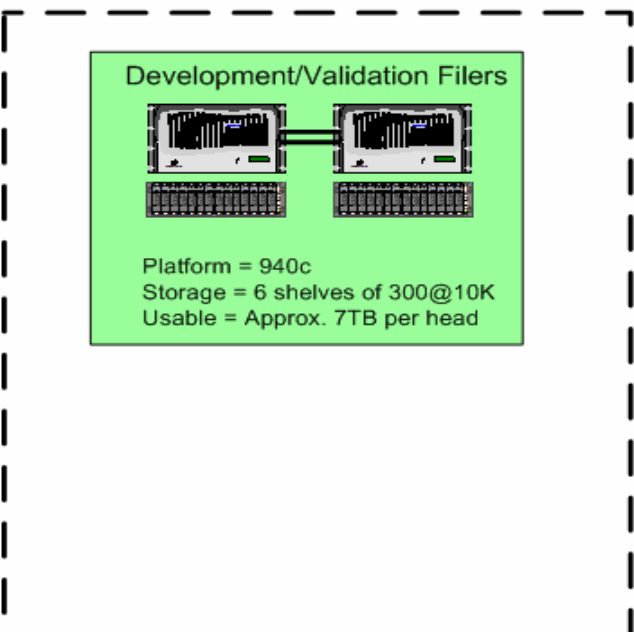
Platform = 960c
Storage = 8 shelves of 144@10K
Usable = Approx. 4TB (nas1) & 4TB (nas2)

Production AP

Platform = 940c
Storage = 5 shelves of 144@10K
Usable = Approx. 2TB (nas1) & 3TB (nas2)

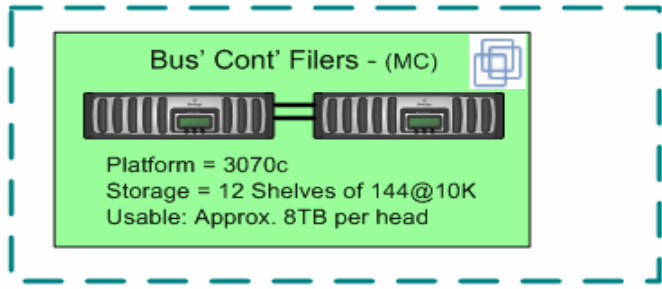
ORGSHARE

Platform = 270
Storage = 2 shelf of 300@10K
Usable = Approx. 5 TB



Development/Validation Filers

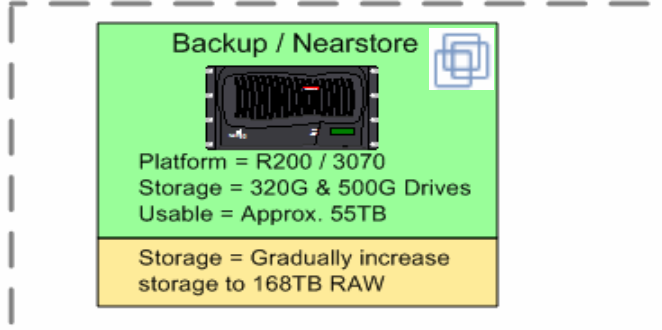
Platform = 940c
Storage = 6 shelves of 300@10K
Usable = Approx. 7TB per head



Bus' Cont' Filers - (MC)

Platform = 3070c
Storage = 12 Shelves of 144@10K
Usable: Approx. 8TB per head

Total NetApp Storage
Currently ~103TB
To grow well over
~250TB



Backup / Nearstore

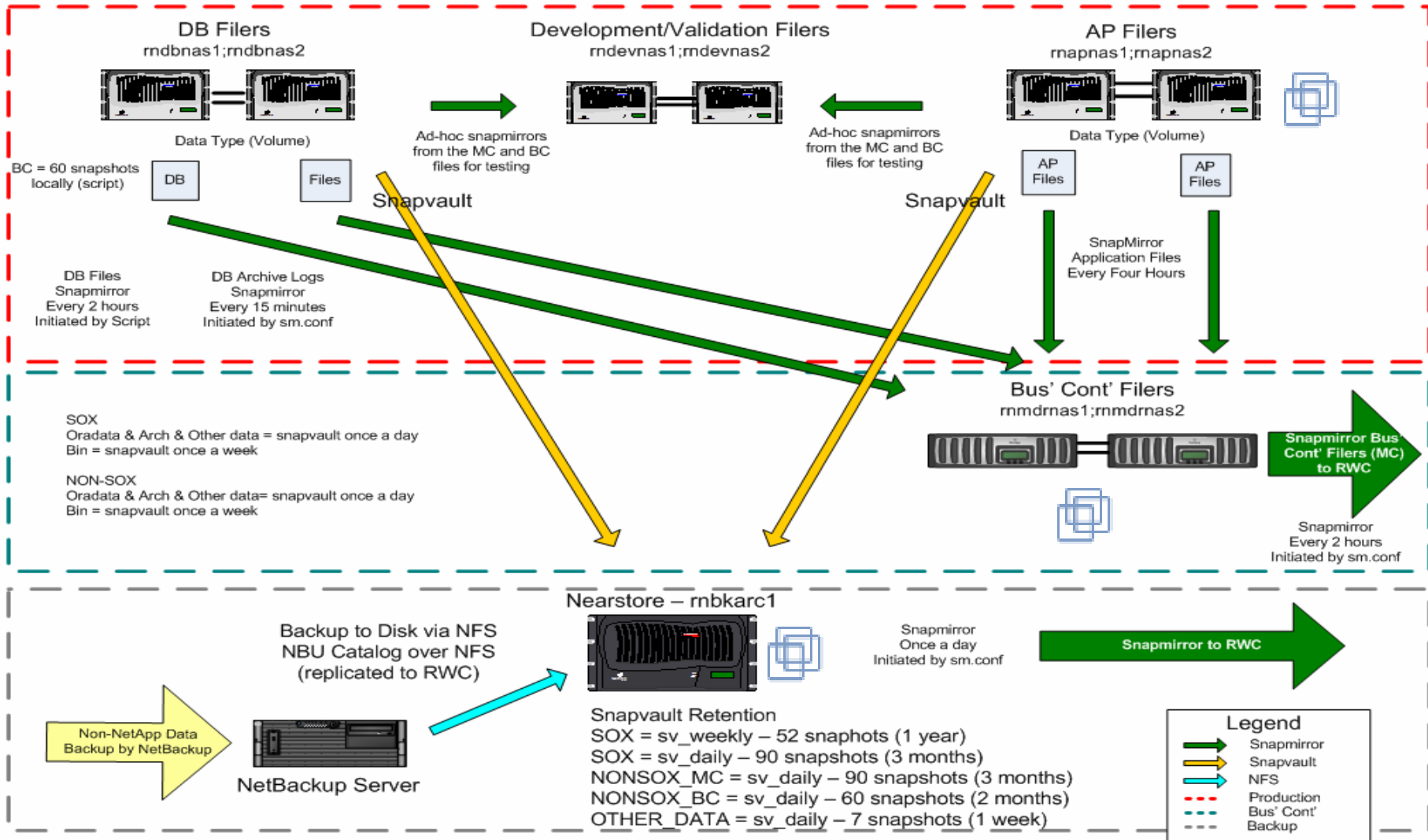
Platform = R200 / 3070
Storage = 320G & 500G Drives
Usable = Approx. 55TB

Storage = Gradually increase storage to 168TB RAW

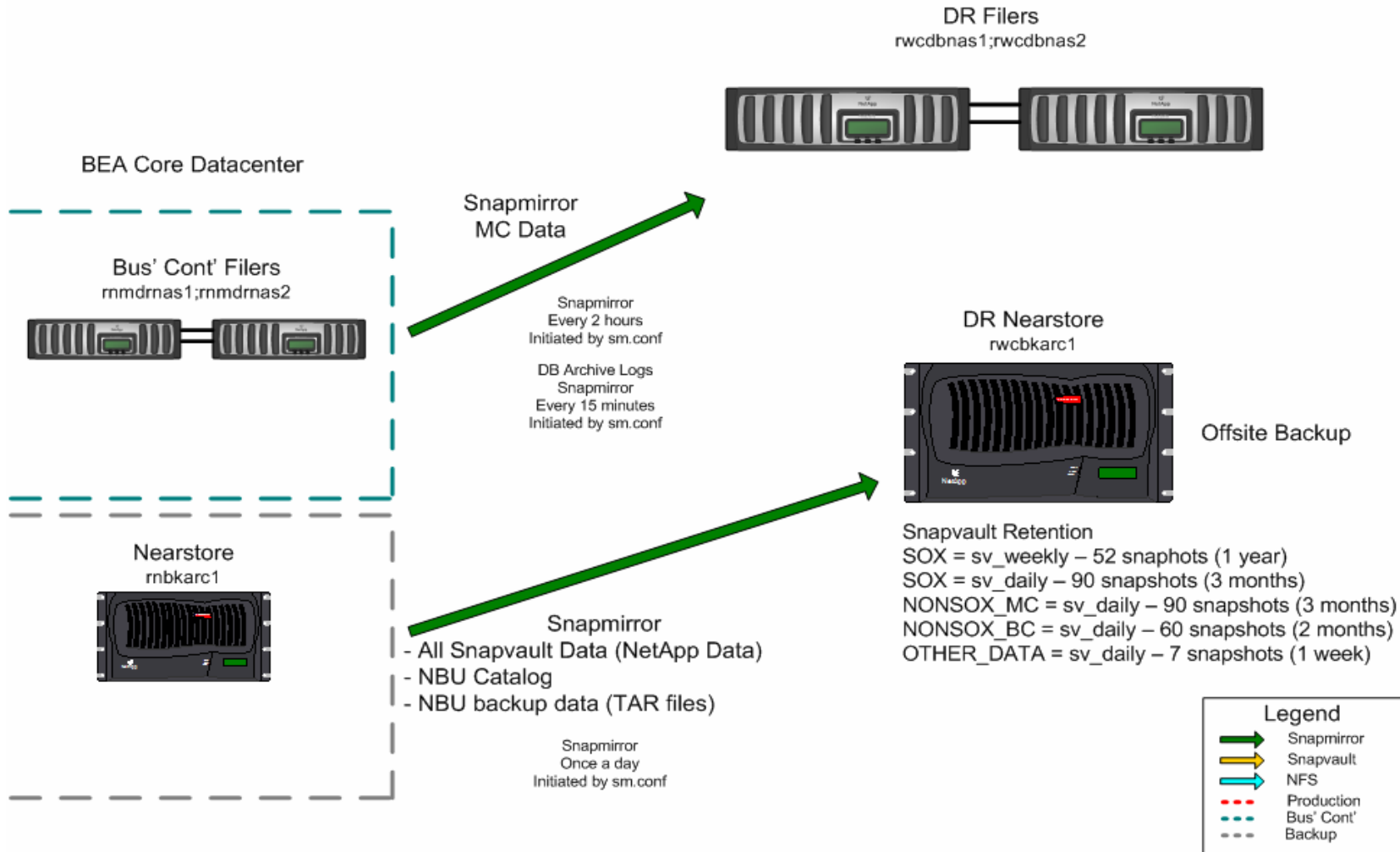
Legend

- New Hardware
- Existing Hardware
- Production
- Bus' Cont'
- Backup
- IT Test / Burn in

BEA Core Datacenter Snapmirror/Snapvault Flow Chart As Implemented – May 2007



BEA RWC DATACENTER Snapmirror/Snapvault Flow Chart As Implemented – May 2007



reisap11 - Virtual Infrastructure Client

File Edit View Inventory Administration Help

Inventory Scheduled Tasks Events Admin Maps

← → ↗ ↻

Datcenters

- BEA
 - Non-Prod Environments (AMD)
 - Non-Prod Environments (Intel Quad Core)
 - Non-Prod Environments (Intel)
 - Production Environments (AMD)
 - reimvx01.bea.com
 - reimvx02.bea.com
 - reimvx03.bea.com
 - reimvx04.bea.com
 - Production
 - Staging
 - VDI Environments (AMD)

reimvx01.bea.com VMware ESX Server, 3.0.1, 42829

Summary Virtual Machines Performance Configuration Tasks & Events Alarms Permissions Maps

Hardware

- Processors
- Memory
- Storage (SCSI, SAN, and NFS)
- Networking
- Storage Adapters
- Network Adapters

Software

- Licensed Features
- DNS and Routing
- Virtual Machine Startup/Shutdown
- Security Profile
- System Resource Allocation
- Advanced Settings

Storage Refresh

Identification	Device	Capacity	Free	Type
vmware_stg	10.160.100.13:/vol/vmware_stg	160.00 GB	42.83 GB	nfs
reibvx01_local	vmhba0:0:0:7	120.25 GB	119.64 GB	vmfs3
vmware_prod	10.160.100.13:/vol/vmware_prod	280.00 GB	165.00 GB	nfs

Details

vmware_stg 160.00 GB Capacity

Server: 10.160.100.13

Folder: /vol/vmware_stg

117.17 GB Used
42.83 GB Free

Copyright © 2007 Network Appliance, Inc. All rights reserved.

47

▶ Hardware:

- **Make sure your ESX server hosts are certified per the VMware Hardware Compatibility List (HCL)**
- **Use the same chipset architecture (i.e. all AMD or all Intel) in the cluster for VMotion compatibility**
- **When using NIC teaming, be sure that physical connections are on separate switches and the standby NIC provides hardware layer redundancy**
- **Be sure not to over commit resource allocations across VM's**
- **Size CPU, memory and disk conservatively for the initial rollout and 'tune-down' based upon 'real-world' workloads**
- **Use SAN/NAS Mass Storage for all VM's**

▶ Network:

- Implement VLAN tagging and trunk physical network switches
- Make sure your network switching infrastructure has enough capacity (e.g., uplinks, GigE) given collapsed workloads

▶ Virtual Center:

- Use Virtual Center for virtual machine administration and capacity planning benefits
- Make sure Virtual Center uses a 'mission-critical' RDBMS (SQL, Oracle, etc) during installation since VMware doesn't provide easy porting tools for the embedded MSDE database
- Use Centralized License server for ease of license administration

▶ **Training & Support:**

- **Purchase VMware Platinum Edition for the VMotion feature set (no downtime for scheduled outages, DRS resource scheduling benefits, etc)**
- **Commit to either direct VMware support or ISV indirect VMware support - - you don't want to have a mixture of both**
- **Really read the technical whitepapers on the VMware web site**
- **Use Technical Support for troubleshooting problems**
- **Send your System Administrators to official VMware training**
- **Educate business and technical personnel on virtualization benefits to remove organizational obstacles/boundaries**

- ▶ **Quickly take a consistent point in time copy of the ‘quiesced’ guest OS using NetApp Snapshot copies**
(NOTE: takes just a few seconds for tens of gigabytes of data)
- ▶ **Support for both iSCSI & NFS on the same NetApp storage system**
- ▶ **Lower Storage Administration & Network support costs using IP-based protocols**
- ▶ **Improve Guest OS application recovery point objectives using NetApp SnapMirror for off-site disaster recovery**
- ▶ **Mass storage enables the use of VMotion for ‘zero-outage’ scheduled hardware maintenance**
- ▶ **Tapeless Back-up Rocks!**

- ▶ **NFS is a viable shared storage protocol for VI3 environments**
 - **Flexible**
 - **High-performance**
 - **Reliable**
 - **Scalable**
 - **Simple**
 - **Cost-effective**

- ▶ **VMWorld 2006 Storage presentations**
 - http://en.wikipedia.org/wiki/Network_File_System_%28protocol%29

- ▶ **O'Reilly *Managing NFS and NIS***

- ▶ **Technical Report: Using the Linux® NFS Client with Network Appliance™ Storage**
 - <http://www.netapp.com/library/tr/3183.pdf>

- ▶ **Network Appliance™ and VMware ESX Server 3.0 Storage Best Practices**
 - <http://www.netapp.com/library/tr/3428.pdf>

- ▶ **NetApp stencils are on VisioCafe.Ca**

- ▶ **Session ID: IP43**
- ▶ **Session Title: Building Virtual Infrastructures with Network Attached Storage**
- ▶ **Speaker Name: Peter Learmonth and Kim Weller**
- ▶ **Speaker Company: Network Appliance**
- ▶ **Special Guest: Bud James, BEA**
- ▶ **For more information ... visit the NetApp booth or <http://www.netapp.com/solutions/infrastructure/server-virtualization/vmware.html>**