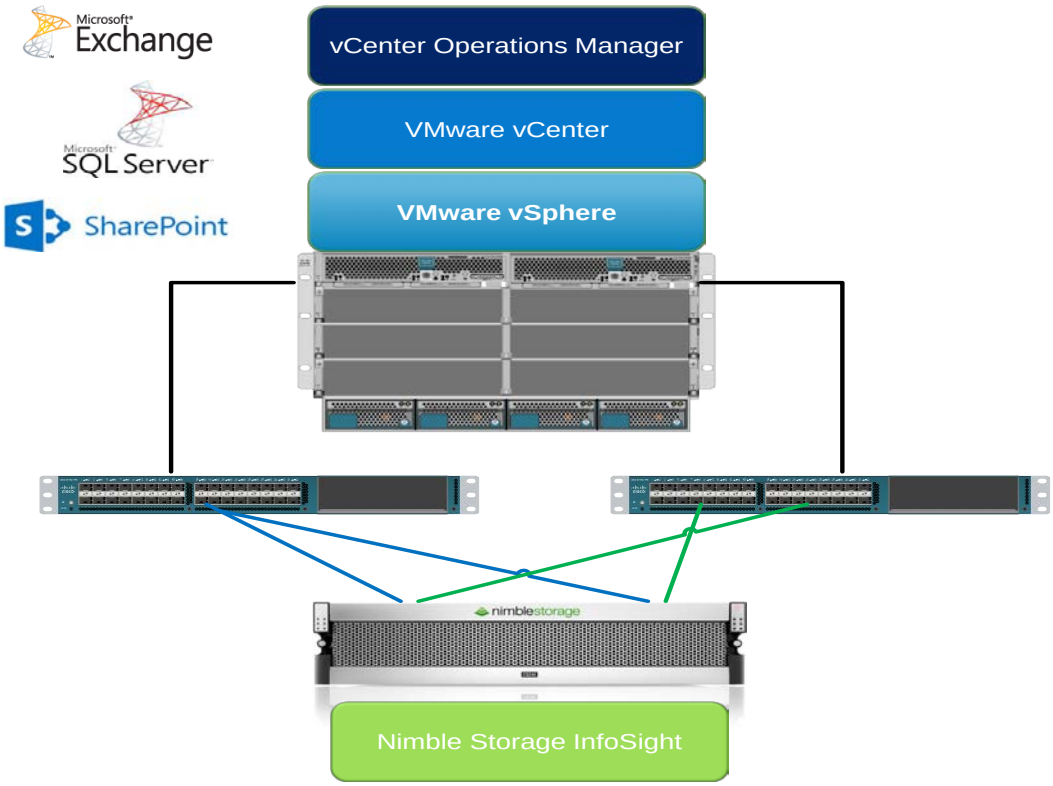
REFERENCE ARCHITECTURE

Virtualizing Business Critical Applications on SmartStack™

Wen Yu, Nimble Storge Alex Fontana, VMware



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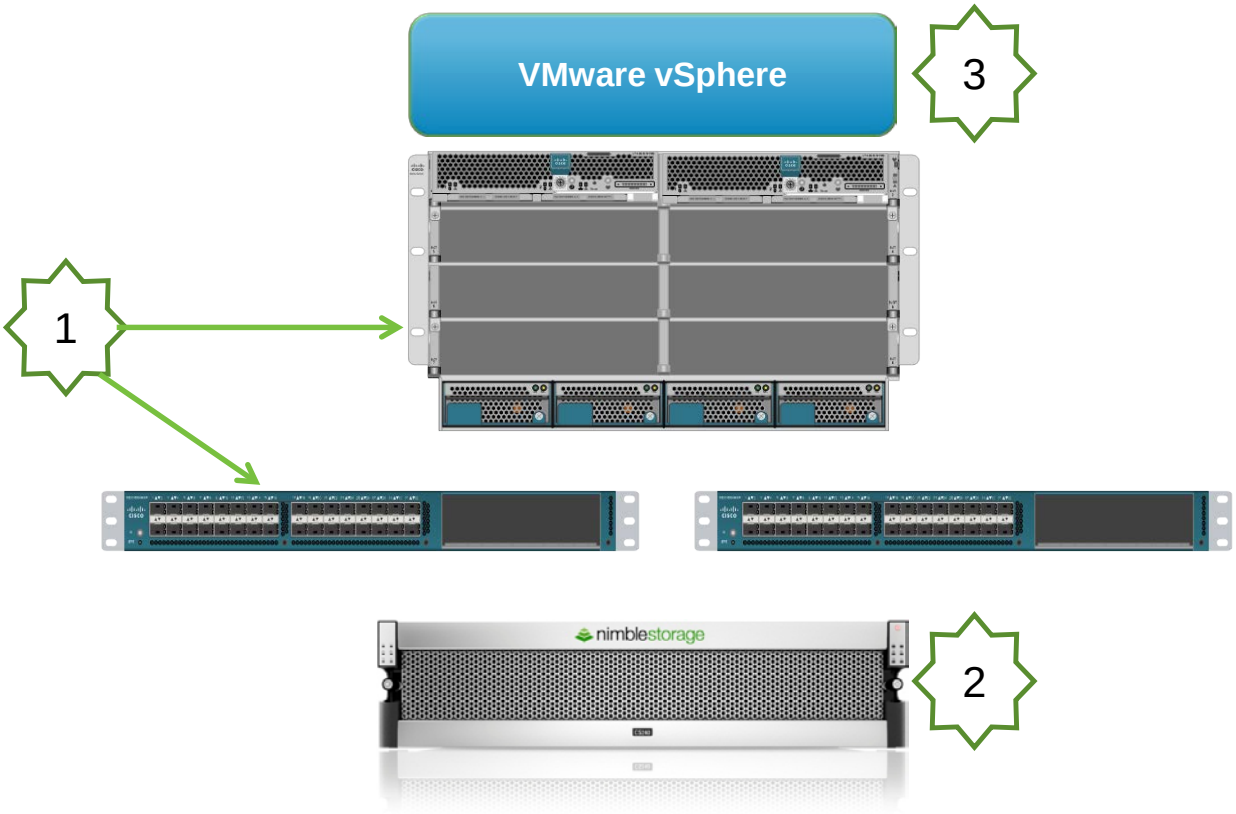
Preface About This Reference Architecture Guide

This document will highlight design best practices for virtualizing business-critical applications on SmartStack, and showcase what was validated jointly by VMware, Cisco, and Nimble Storage. If you want to learn more about Nimble SmartStack, please contact your sales rep or visit this website for links to more resources:

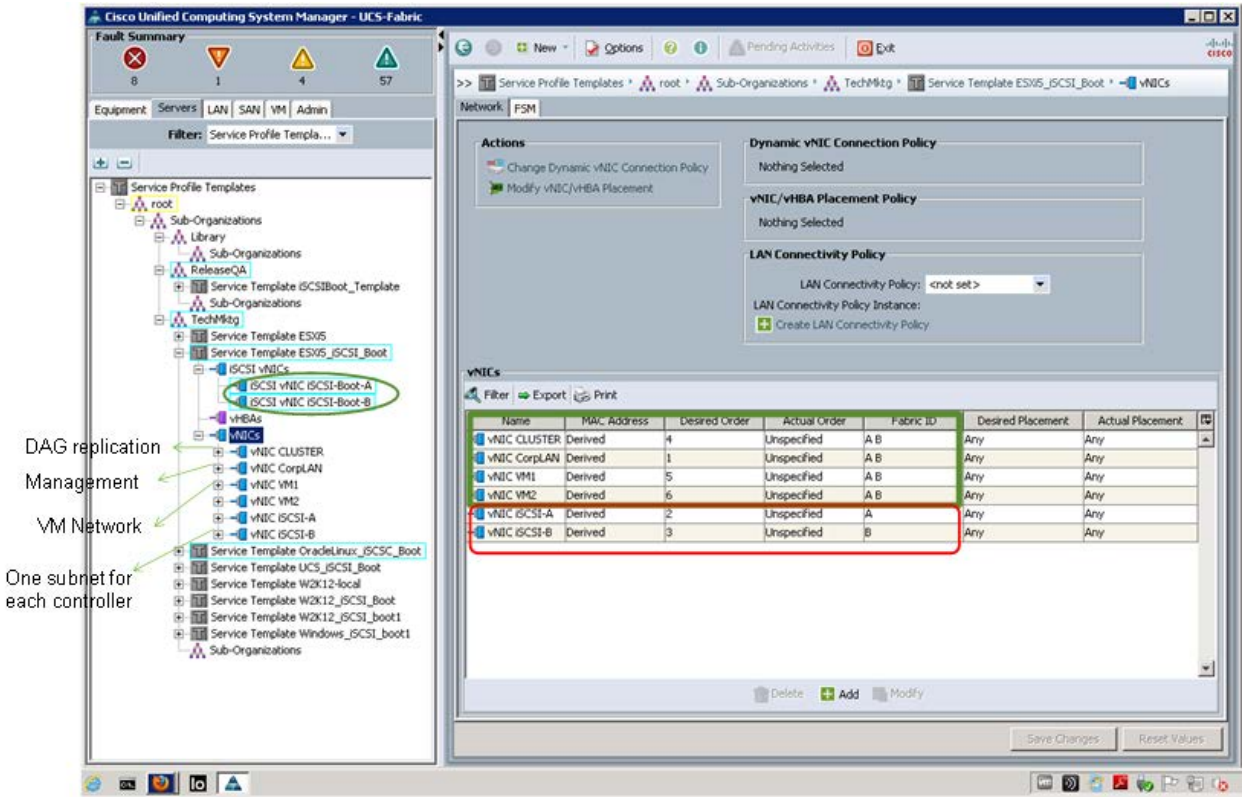
http://www.nimblestorage.com/resources/SmartStack.php

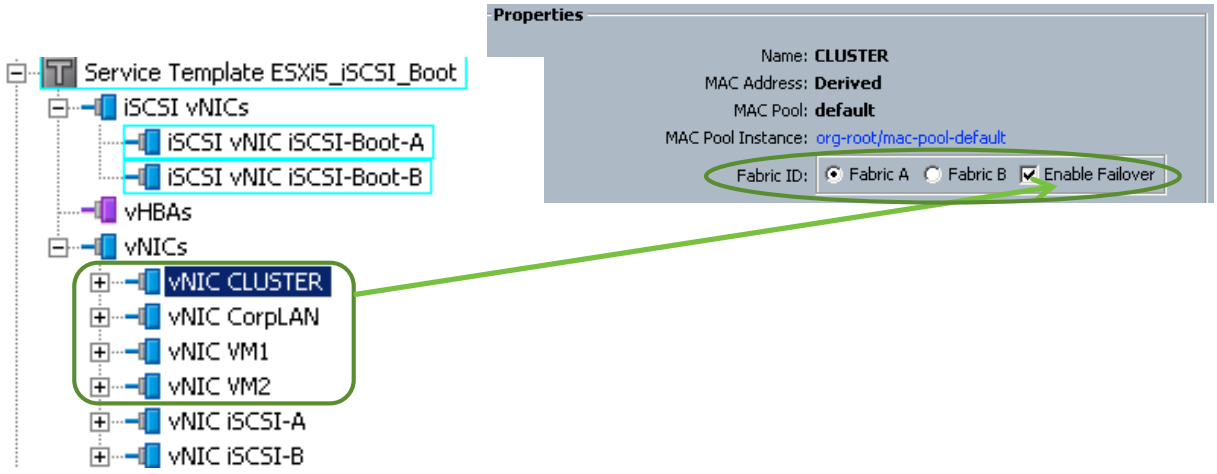
Chapter 1 Availability

When you virtualize business critical applications, you want to ensure the entire infrastructure has no single point of failure, for both hardware and software, across all layers (compute, network, storage, VM and applications). Here is a list of design considerations:

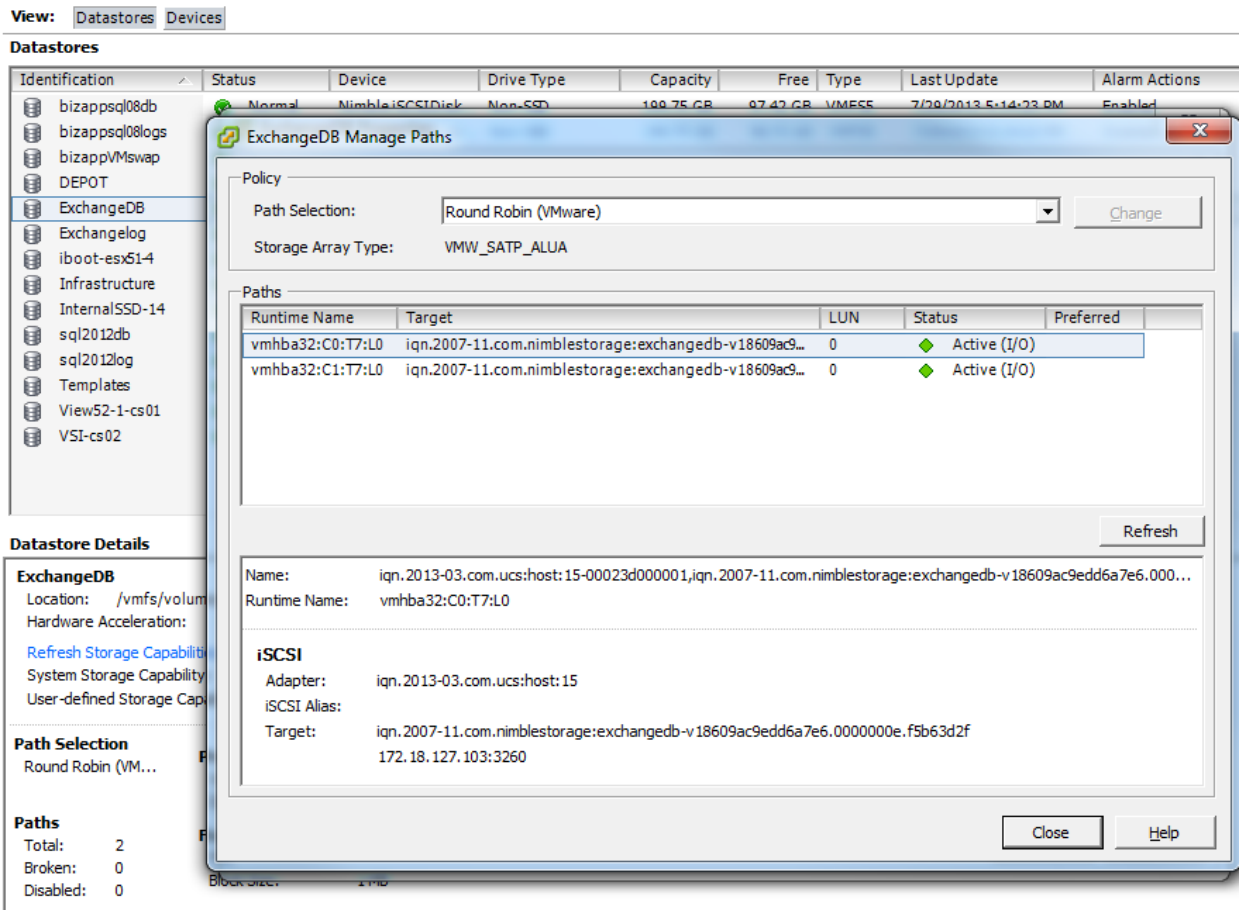


1. UCS
   - Cisco UCS blade chassis has redundancy for all components
   - Two UCS blade servers in case one of them fails
   - Dual UCS Fabric Interconnect configured as a cluster
   - UCS fabric NIC failover is used for management and virtual machine traffic

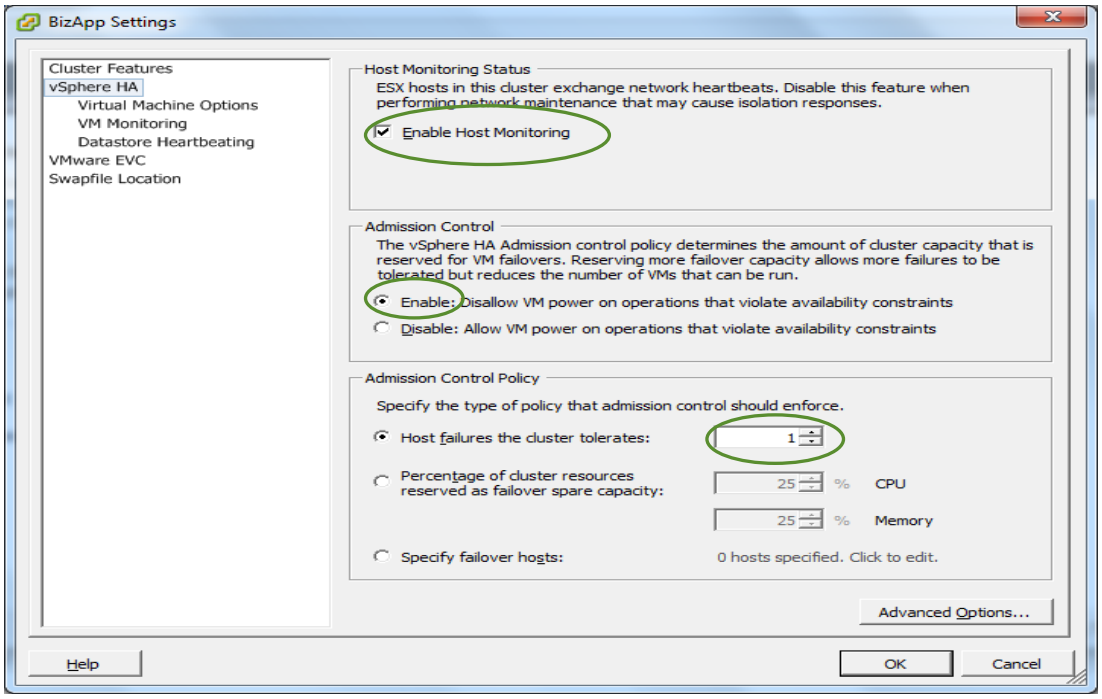




2. Storage
   - Nimble Storage CS-series array has redundancy for all components
   - All volumes provisioned use SATP_ALUA & PSP_RR for path failover and load distribution

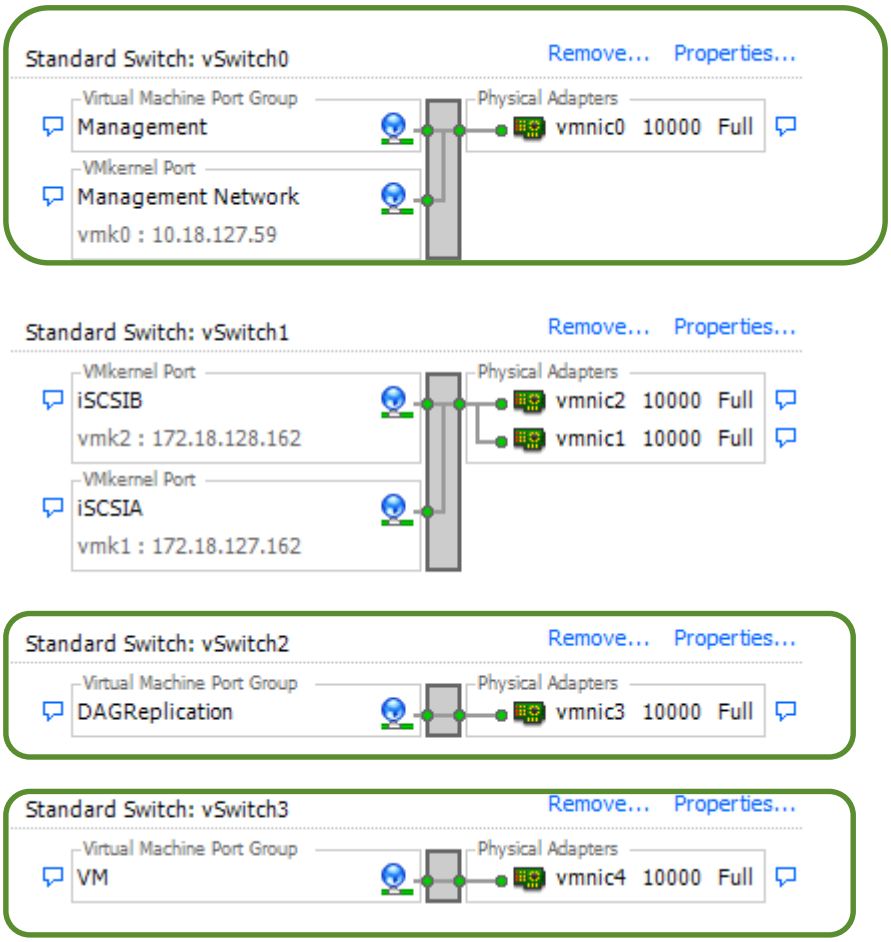


3. vSphere
    a. vSphere HA enabled to auto restart VMs in case ESXi server fails
        i. Host monitoring is enabled to monitor heartbeat of all ESXi hosts in the cluster
        ii. Admission control is enabled to ensure the cluster has enough resources to accommodate a single host failure
        iii. N+1 configuration to tolerate for one ESXi host failure

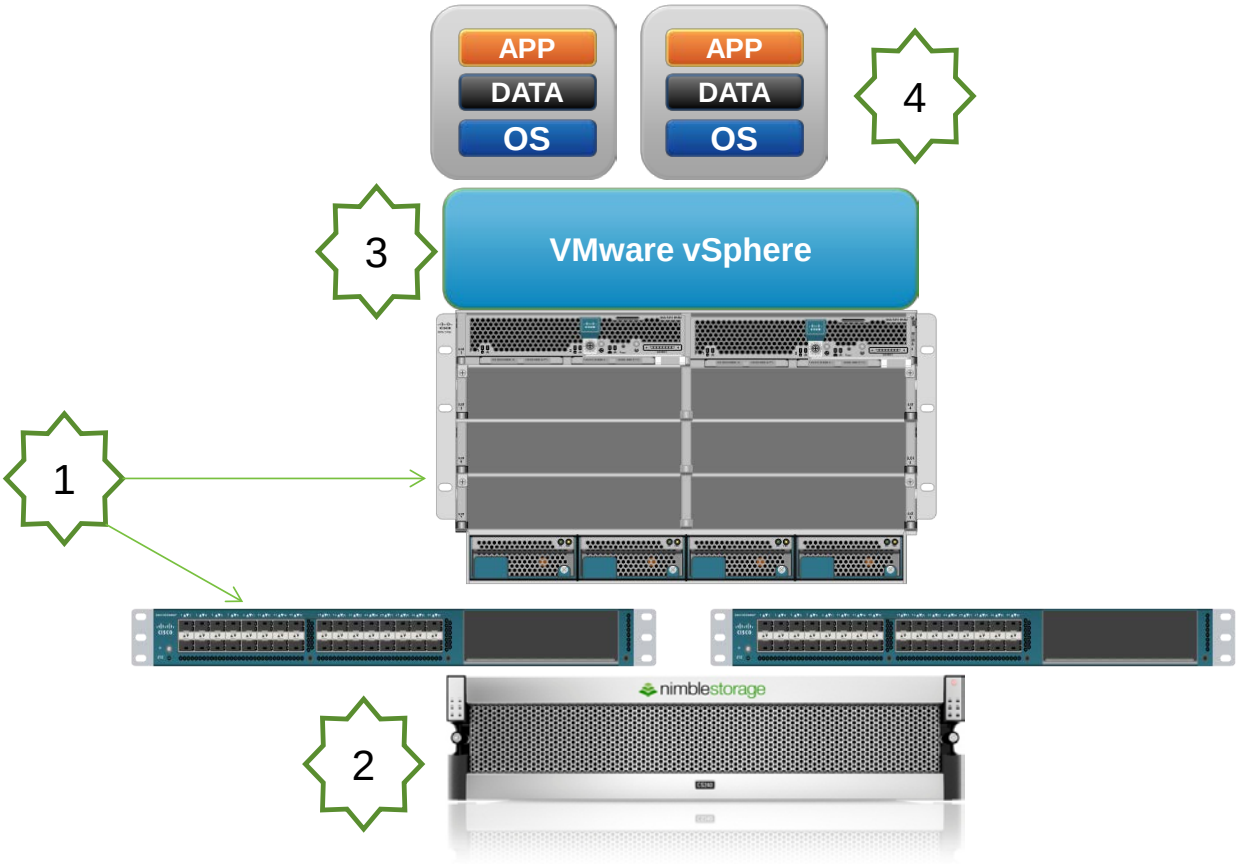


- vSphere Virtual Switch layout (only single vNIC is needed as UCS Fabric failover is enabled for each management and virtual machine traffic vNIC; more on the iSCSI vSwitch later)

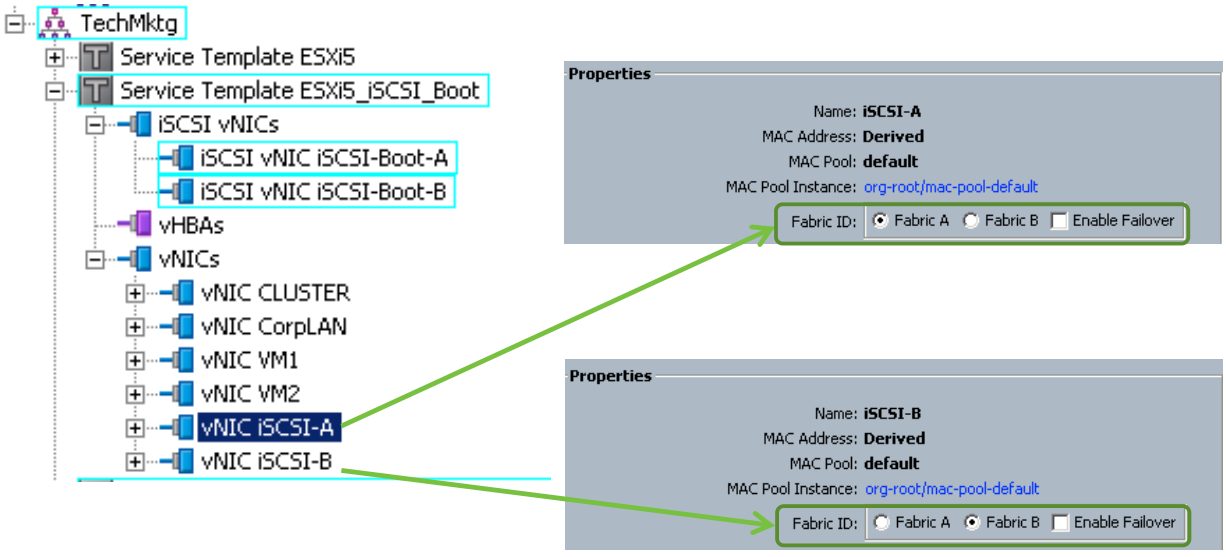
Networking


Standard Switch: vSwitch0
Remove...
Properties...
Virtual Machine Port Group
Management
VMkernel Port
Management Network
vmk0 : 10.18.127.59
Physical Adapters
vmnic0 10000 Full
Standard Switch: vSwitch1
Remove...
Properties...
VMkernel Port
iSCSIB
vmk2 : 172.18.128.162
VMkernel Port
iSCSIA
vmk1 : 172.18.127.162
Physical Adapters
vmnic2 10000 Full
vmnic1 10000 Full
Standard Switch: vSwitch2
Remove...
Properties...
Virtual Machine Port Group
DAGReplication
Physical Adapters
vmnic3 10000 Full
Standard Switch: vSwitch3
Remove...
Properties...
Virtual Machine Port Group
VM
Physical Adapters
vmnic4 10000 Full

Chapter 2 Performance Optimization



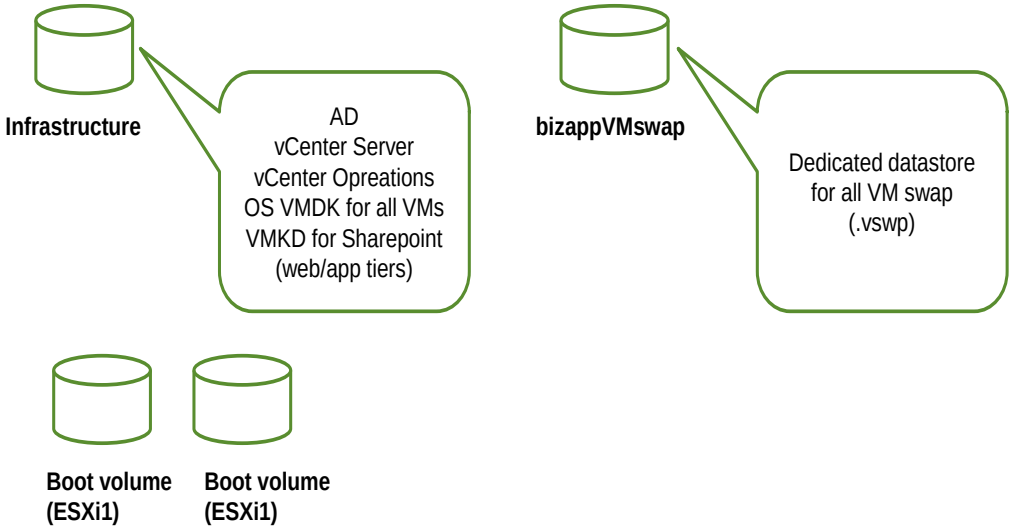
1. **UCS**
   - Dual subnet for directly connecting Nimble to Cisco UCS Fabric Interconnect (without failover of Fabric for the iSCSI vNICs)



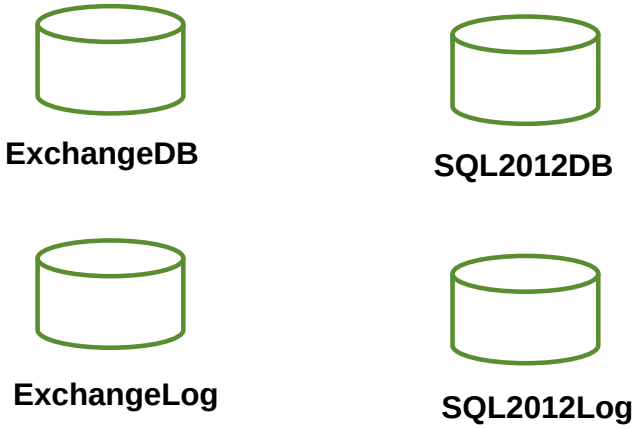
2. **Storage**:

- Storage Volume layout

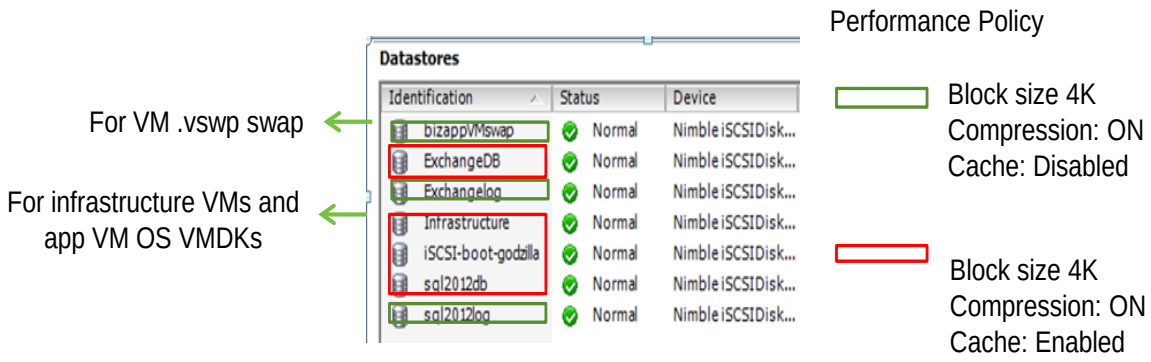
i. Volumes supporting the infrastructure



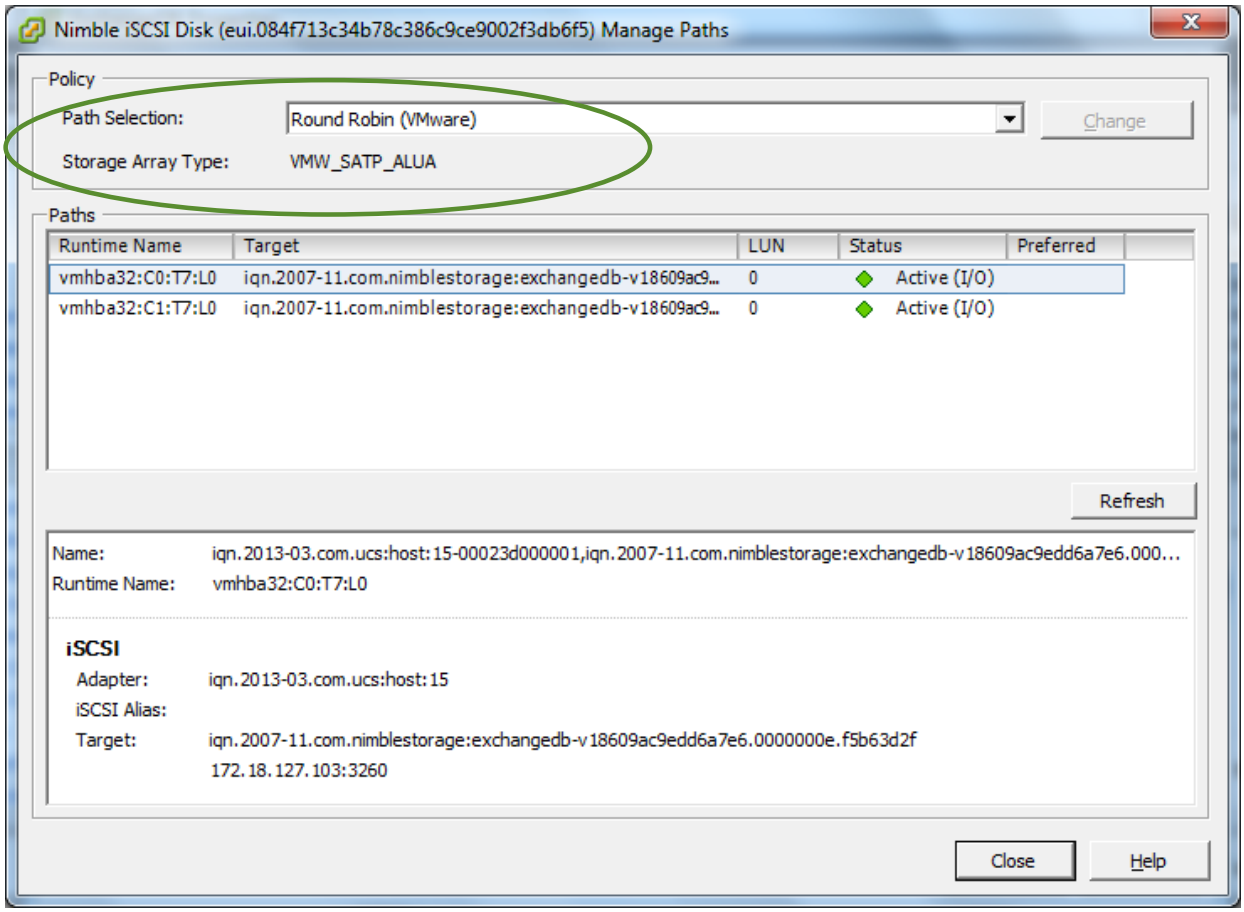
ii. Volumes supporting the application



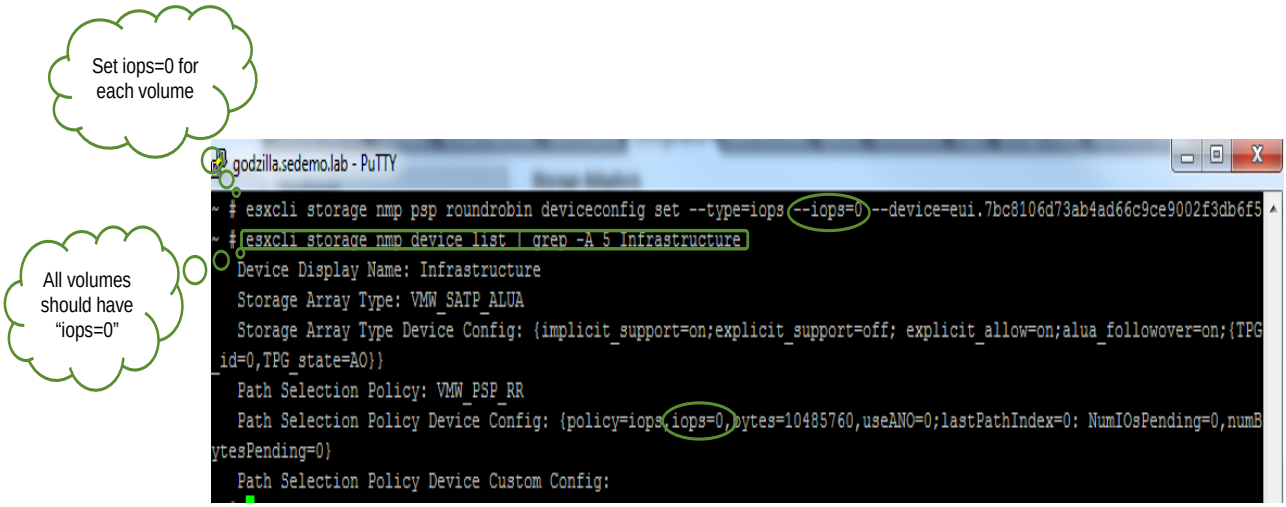
- Performance Policy for each storage volume:



- Use PSP_RR to distribute I/O across both paths

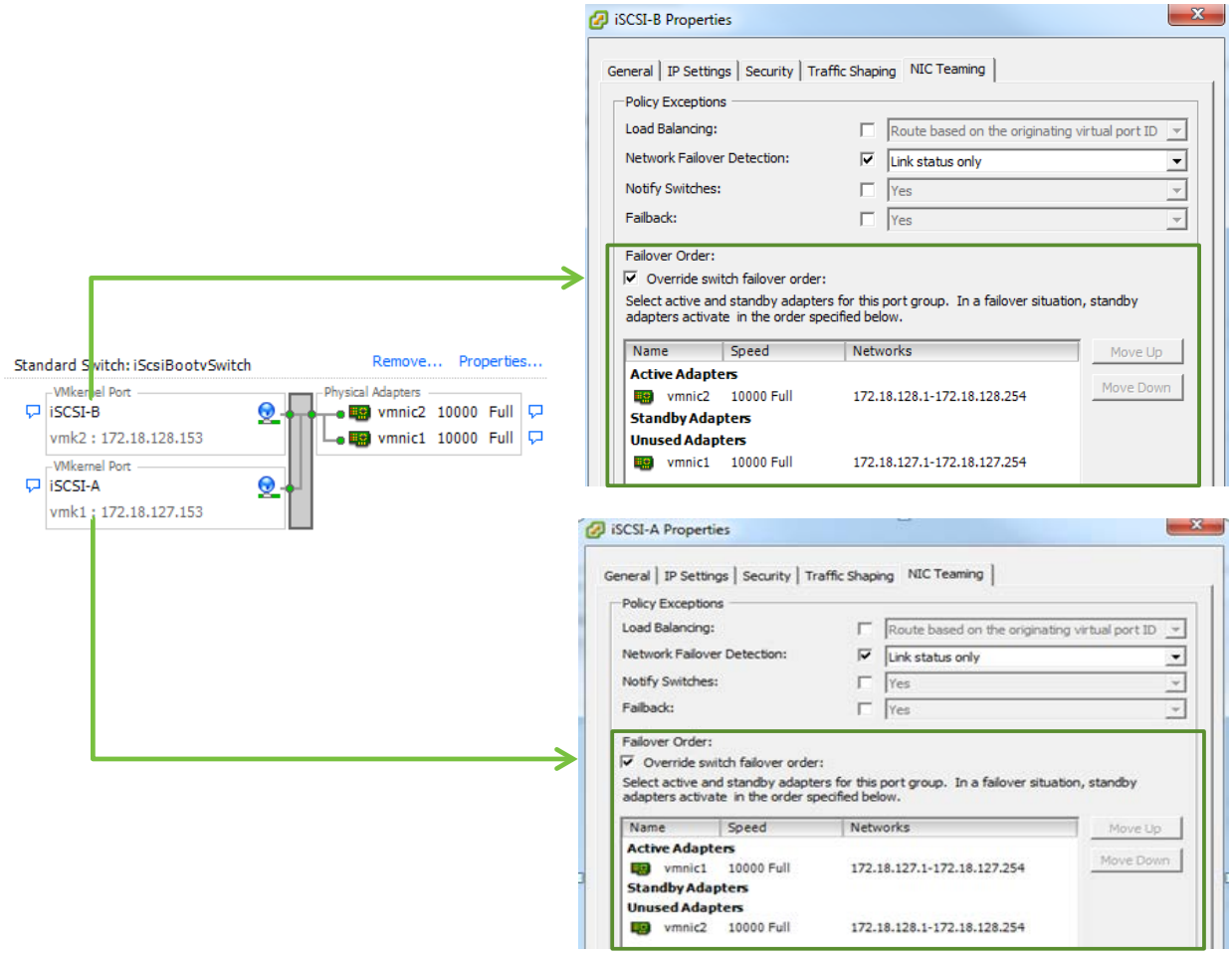


- Change default path IOPS to 0

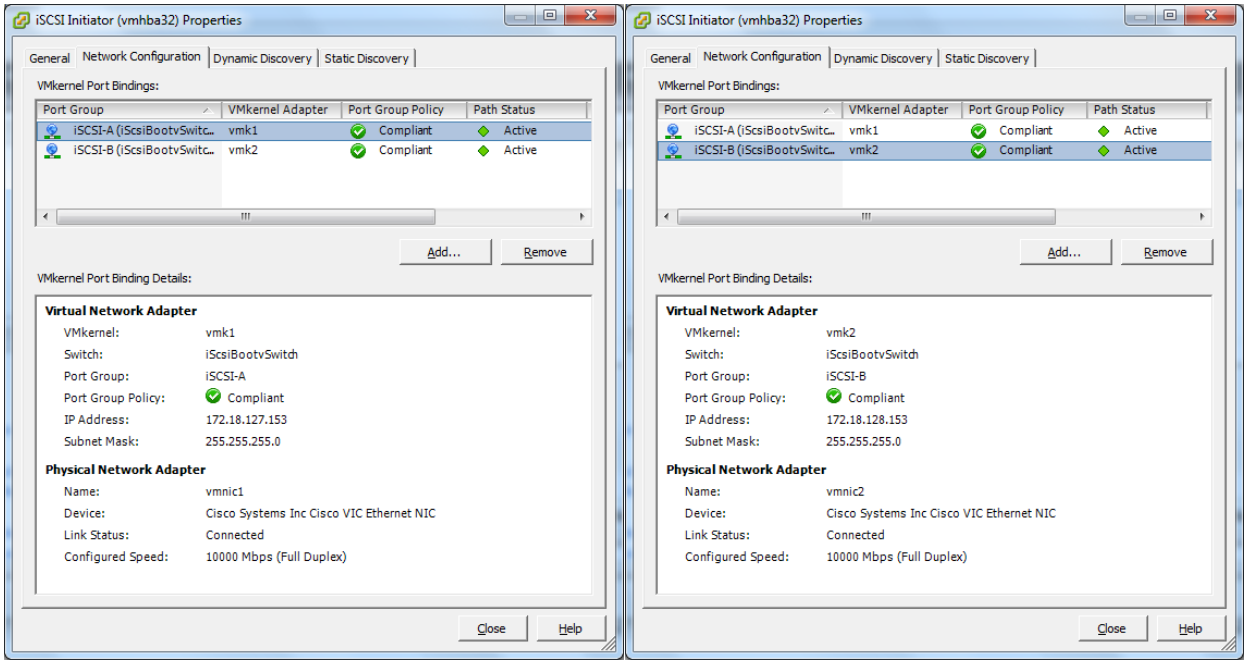


3. vSphere:

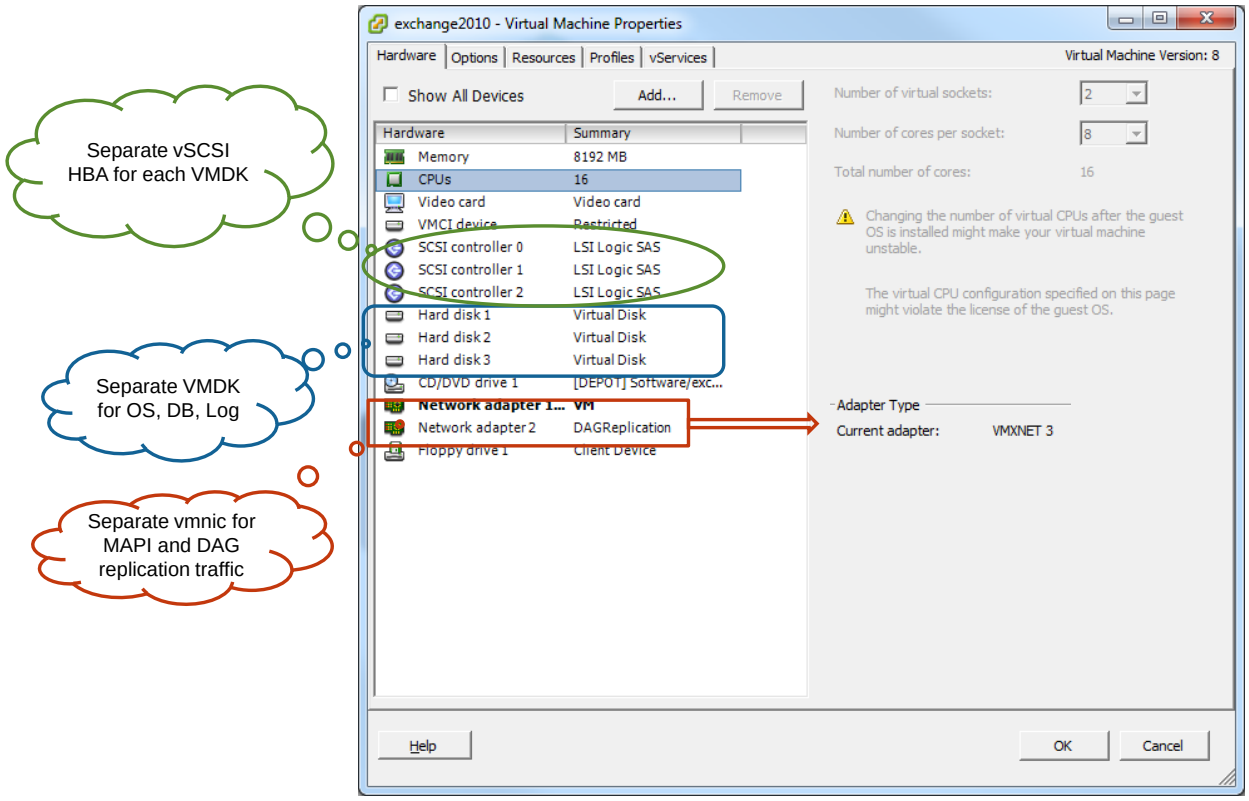
- One VMkernel port for each of the iSCSI vNIC



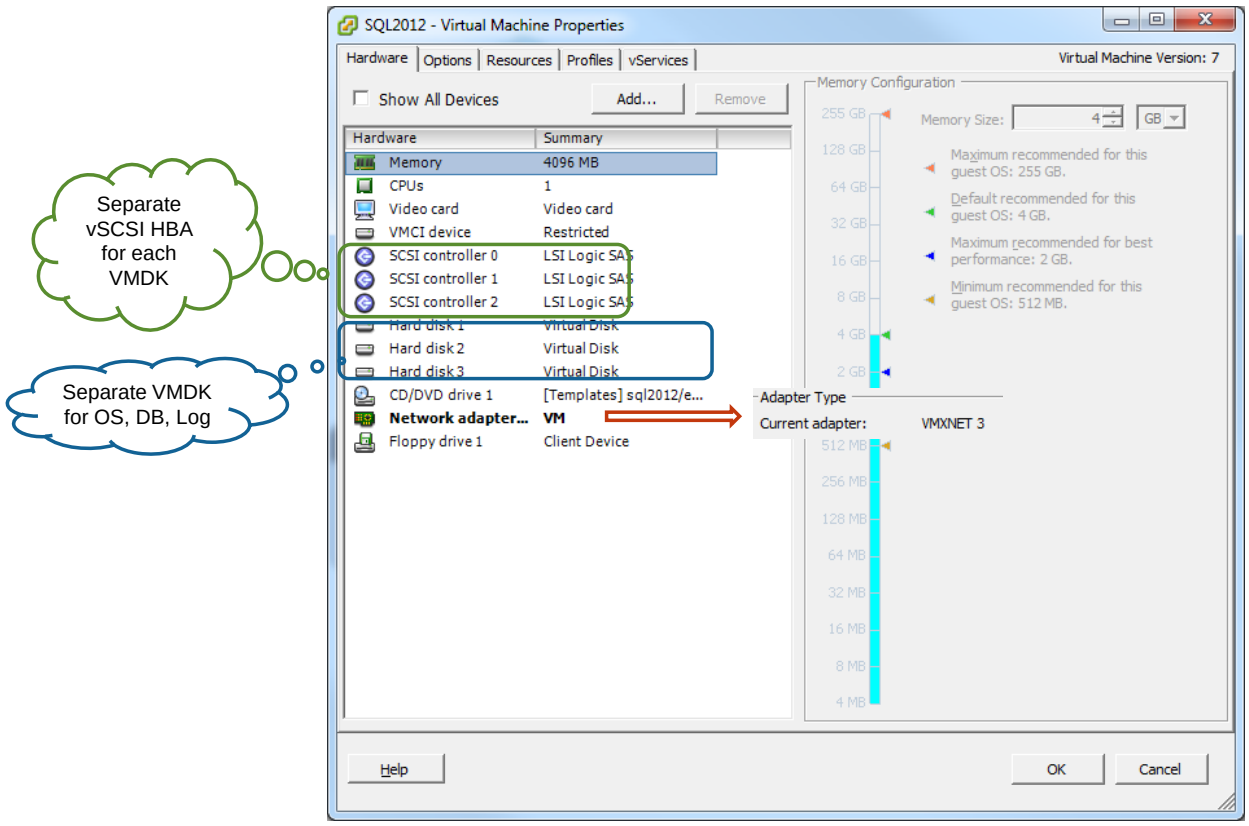
- Software iSCSI initiator binds to two VMkernel ports



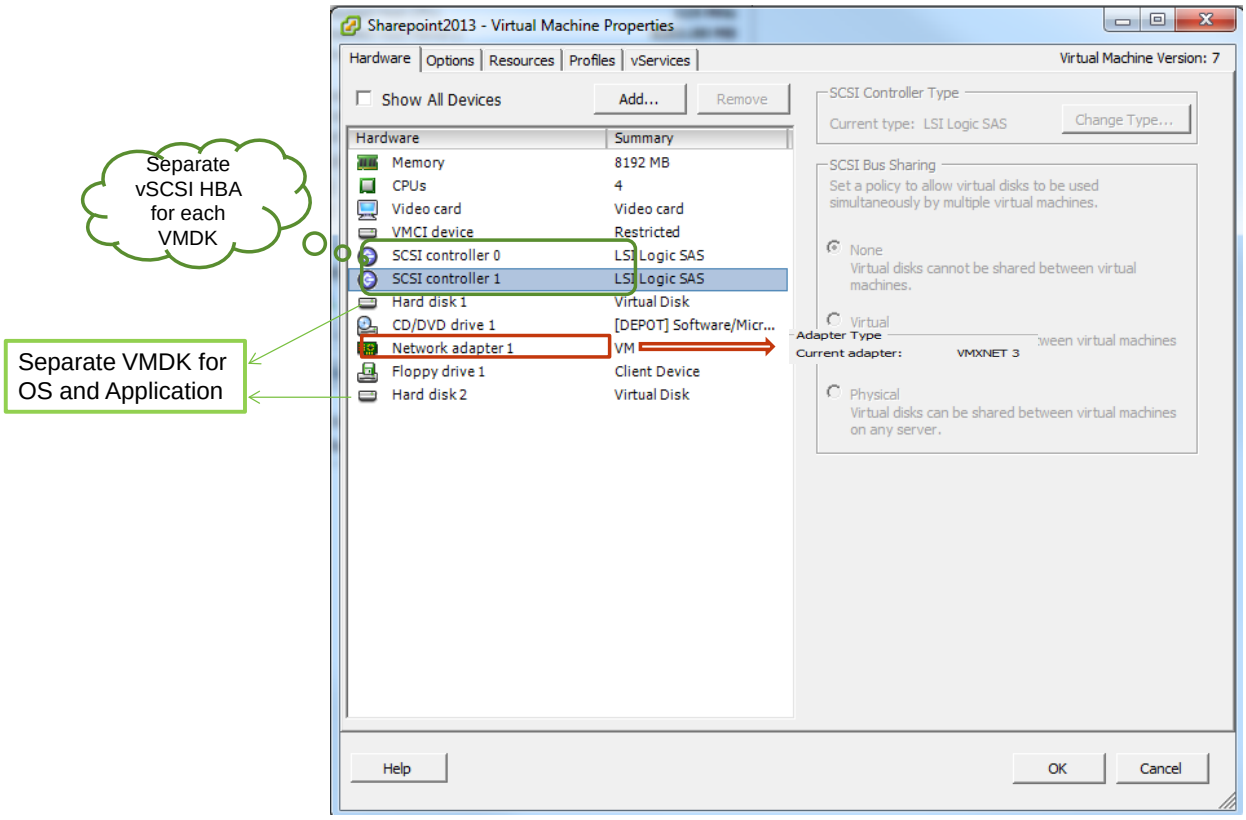
- Separate OS, Data, log into its own VMDK, dedicated virtual SCSI adapter, and use vmnxet3 as the virtual adapter
    i. For Exchange



ii. For SQL Server



iii. For SharePoint



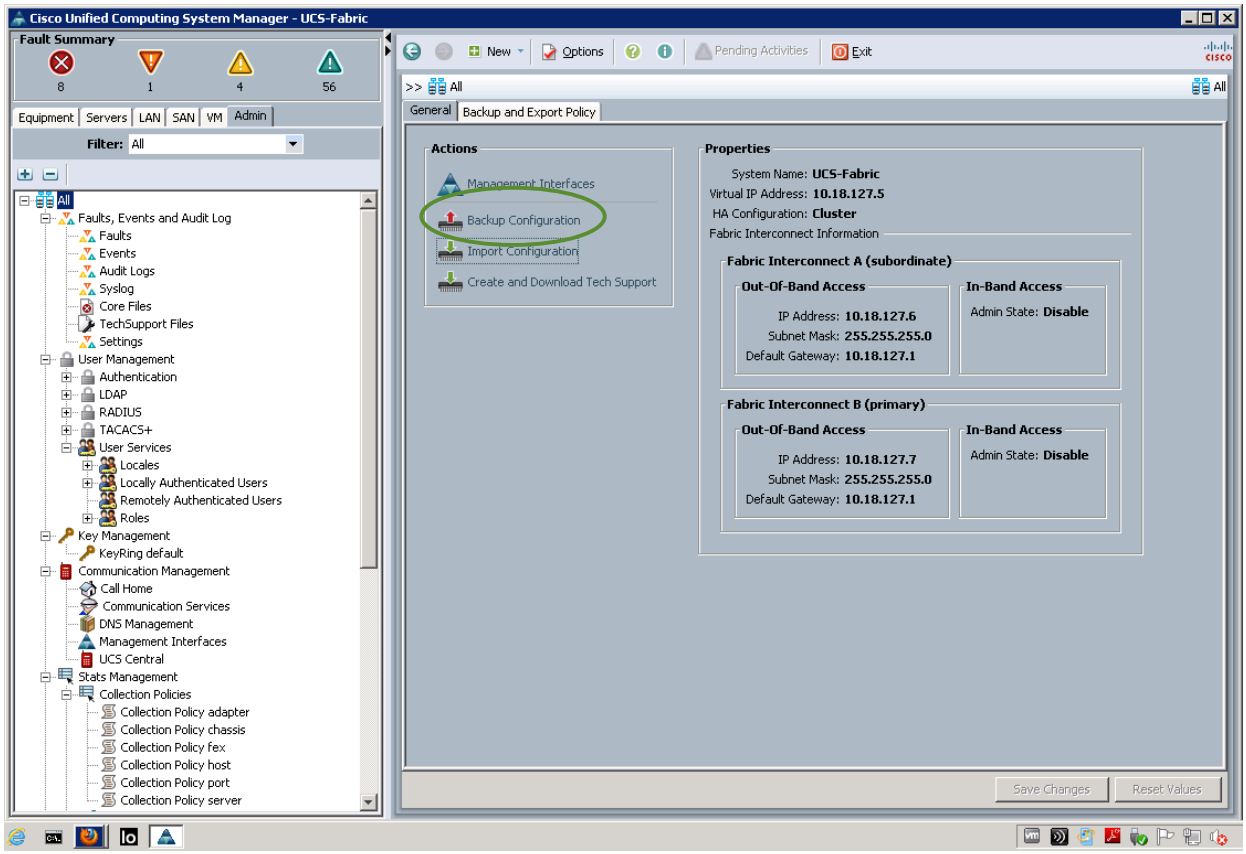
4. VM Guest OS:

- If upgraded from Windows 2003, be sure to align the VM (change partition starting offset to be divisible by 4KB)
- NTFS allocation unit size for data/log partitions should be 64KB

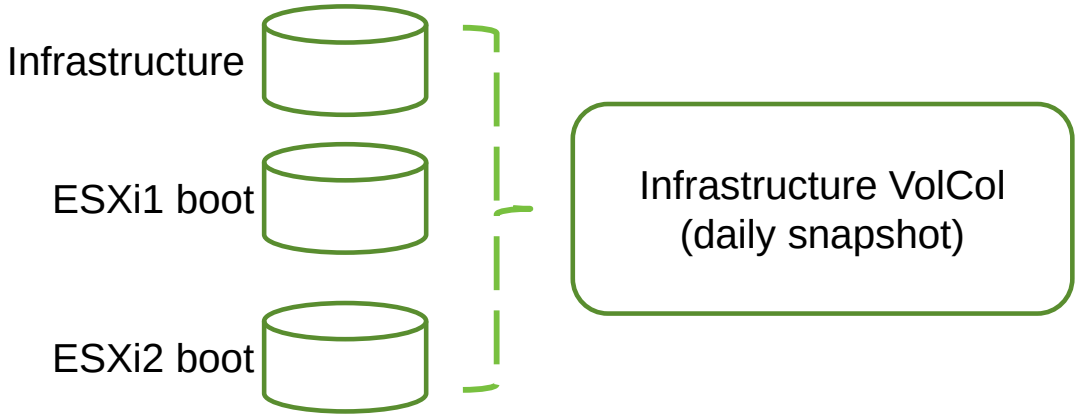
Chapter 3 Data Protection

Infrastructure Protection

- Backup UCSM configuration on a regular basis (service profile templates, service profiles, all environmental configurations for the Fabric Interconnect), especially after changes have been made (for example, modification to service profile, configuration of ports/VLANs in the Fabric Interconnect)



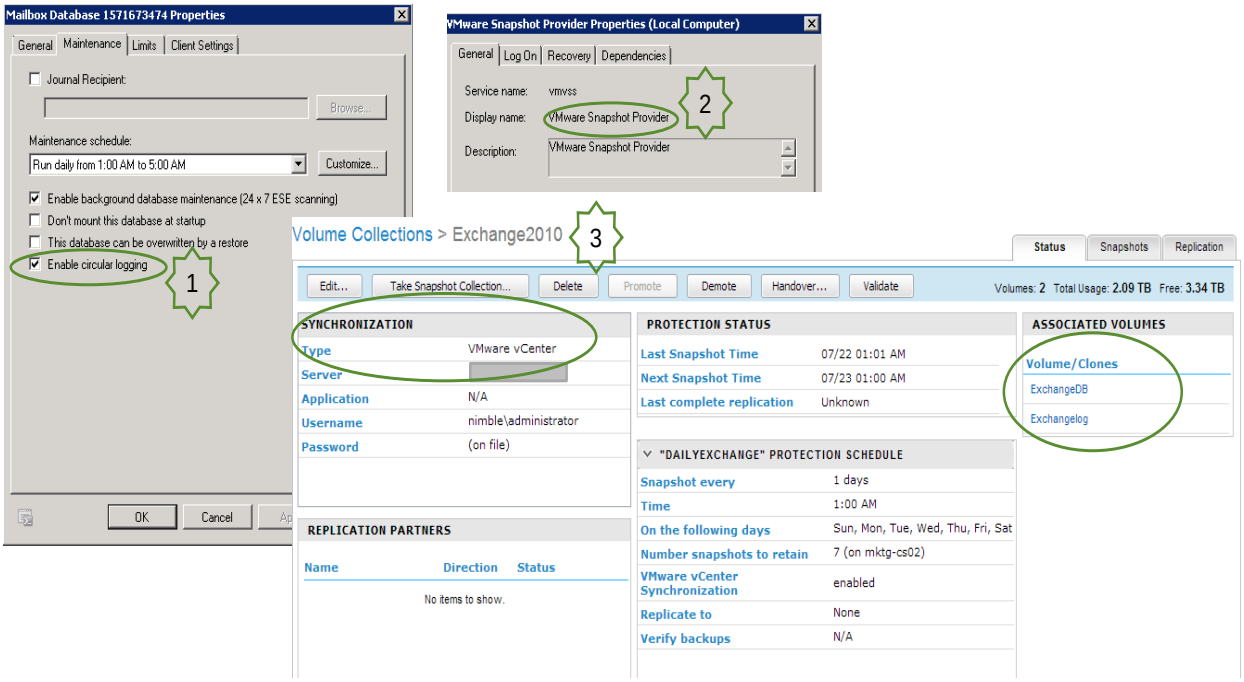
- Backup ESXi sever boot volumes and infrastructure VMs (including Sharepoint Web/App tier) by placing all boot volumes into a single Volume Collection with daily snapshot (NOTE: No snapshot synchronization is needed as crash consistent snapshot is all that's needed)



Application Protection

- Ensure application consistent snapshot can be taken through Nimble and VMware integration

  - Exchange

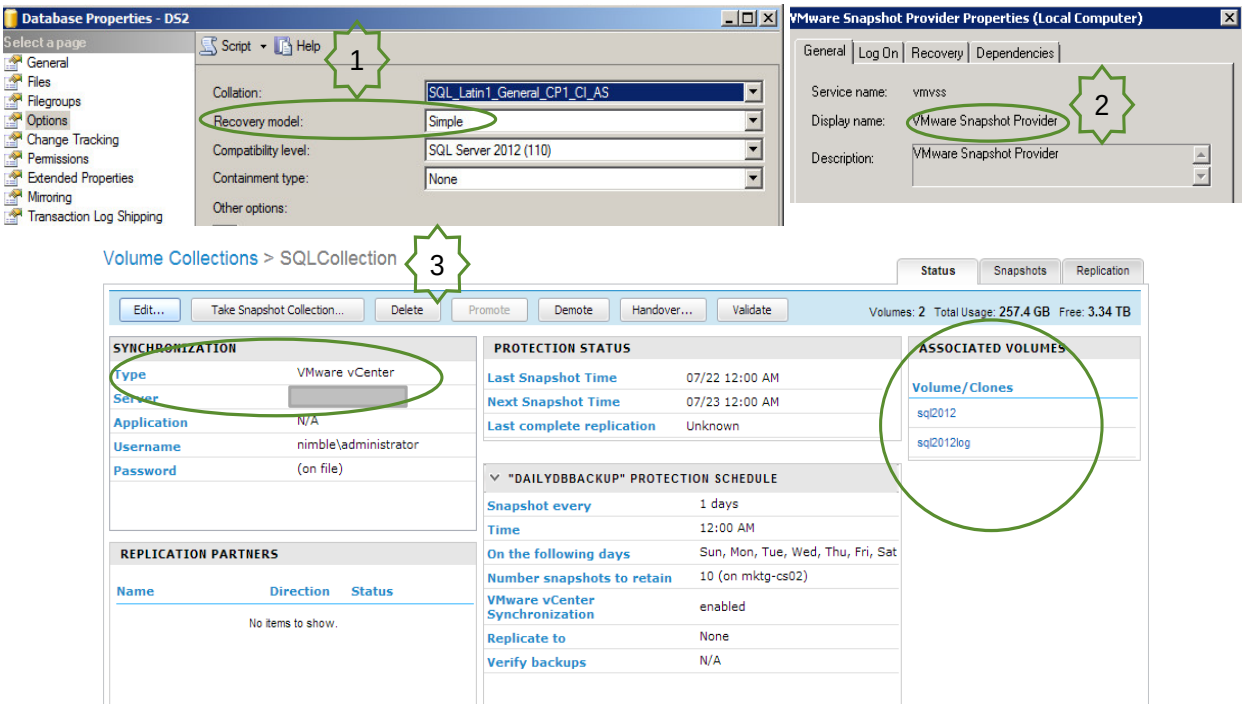


1. For simplicity, each Exchange mailbox database is configured with circular logging

   NOTE: The ability to perform log truncation is provided through add-on products such as Commvault Simpana with Nimble Storage integration or vSphere Data Protection

2. VMware VSS integration is used to properly quiesce Exchange database for application consistent snapshot
3. VMware vCenter Synchronization is used for the Exchange Volume Collection (the volume collection contains both Exchange database and log datastores)

  - SQL Server



1. For simplicity, each SQL database is configured with simple recovery mode

   NOTE: The ability to perform full recovery is provided through add-on products such as Commvault Simpana with Nimble Storage integration or vSphere Data Protection

2. VMware VSS integration is used to properly quiesce SQL database for application consistent snapshot
3. VMware vCenter Synchronization is used for the SQL Volume Collection (the volume collection contains both database and log datastores)

- Sharepoint:

  The Sharepoint Web/Application tier VMDK resides in the Infrastructure volume which is backed up daily. Note the Sharepoint database is backed up through SQL Server volume collection

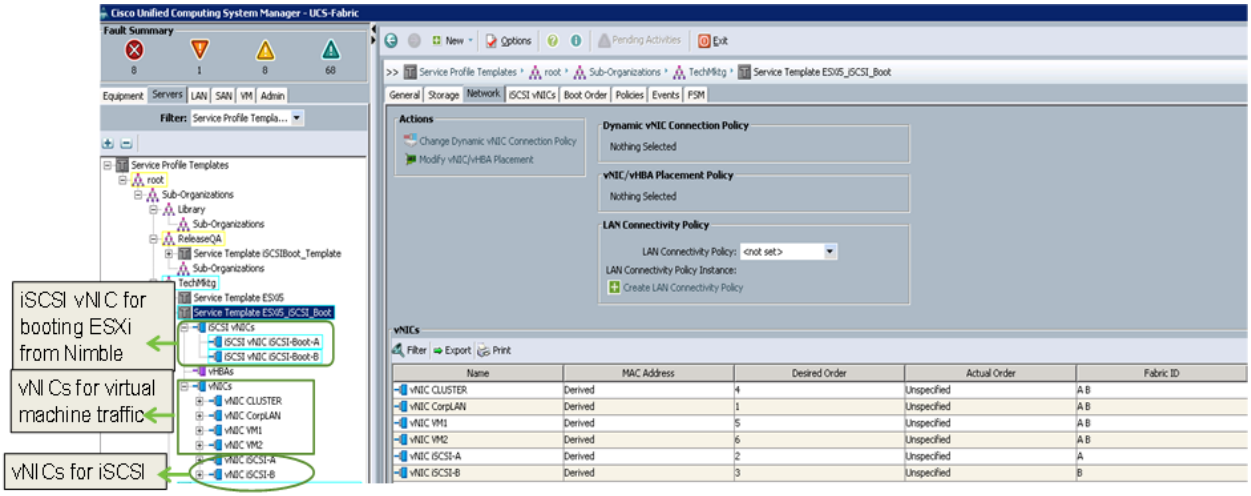
Chapter 4 Operational Management

In this chapter we will highlight tools and integrations that help making deployment and operational management simple and easy.

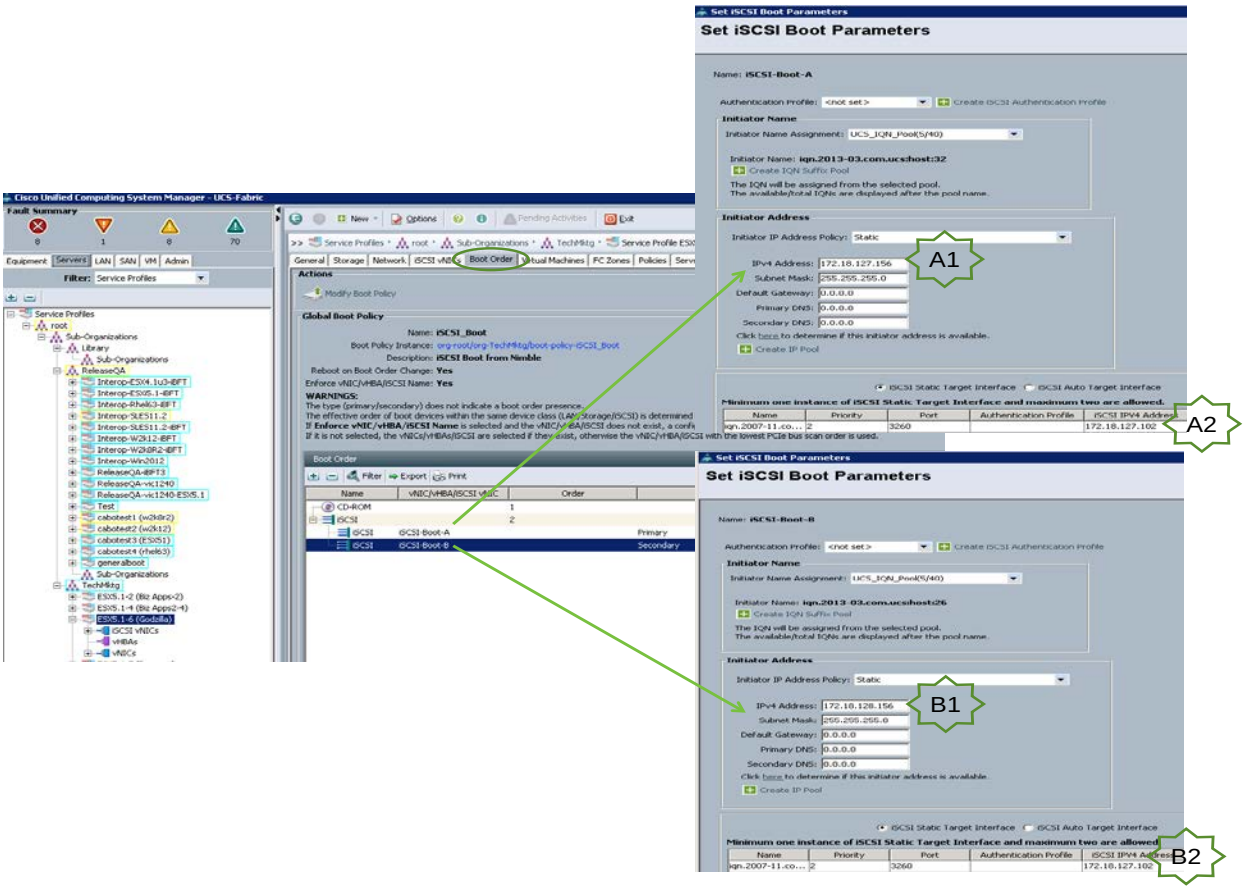
Server Deployment with Cisco UCS Service Profile

A custom UCS Service Profile template was created for vSphere. It creates a standard for deploying the vSphere environment serving business critical applications, and simplifies scalability expansion down the line. We created two service profiles based on this ESXi template, apply it to each blade, and then modify the boot target for each server. That is it – all subsequent servers that will be added to the environment serving business critical applications will follow the same steps. Here's what the service profile template looks like:

For vNIC



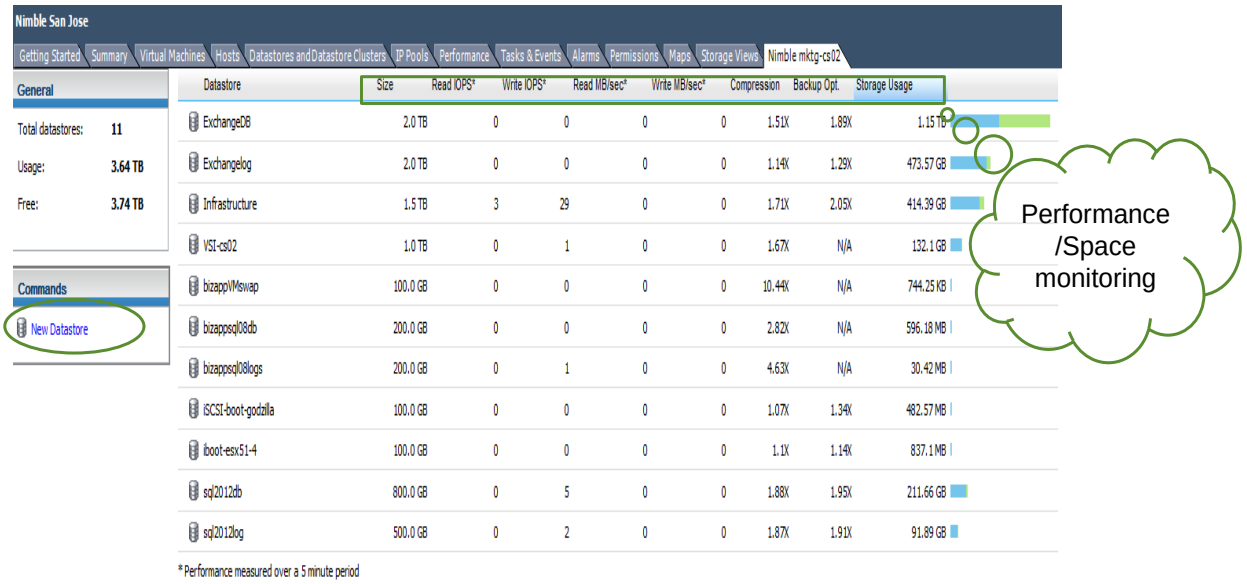
iSCSI vNICs settings for Boot-from-SAN



- A1: subnet A for iSCSI boot vNIC A
- A2: iSCSI Discovery IP address for Nimble Array
- B1: subnet B for iSCSI boot vNIC B
- B2: iSCSI Discovery IP address for Nimble Array

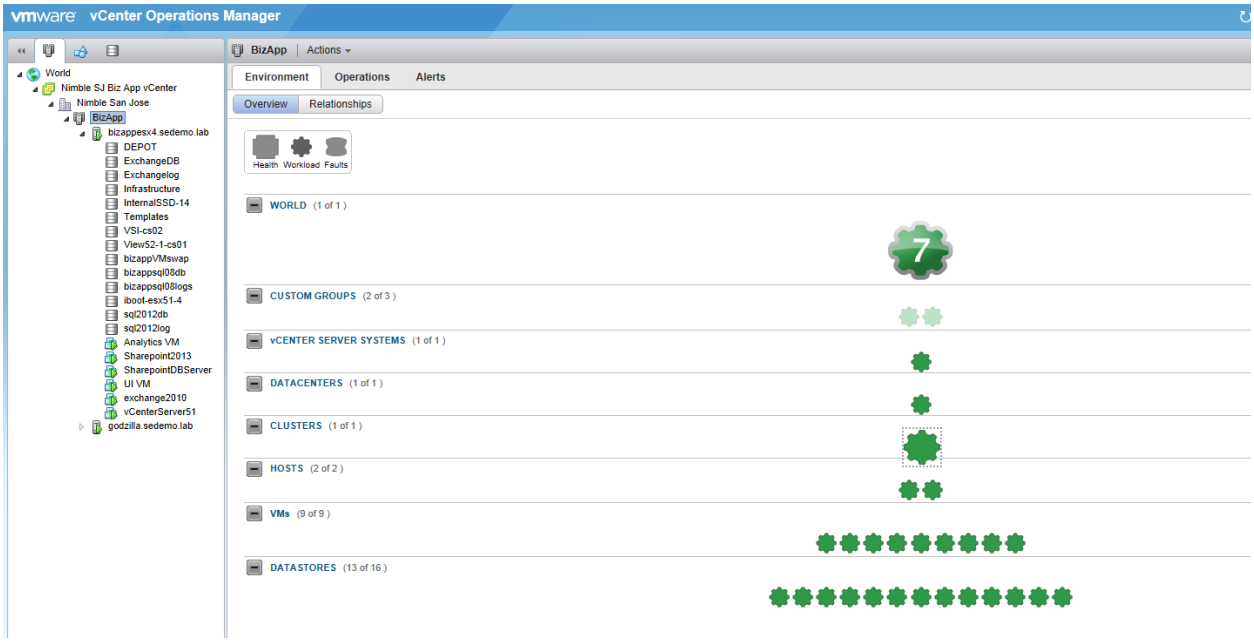
Storage Management with Nimble Storage vCenter plugin

Don't want to toggle between different UIs to perform storage related tasks? Just stay in vCenter Server. Nimble Storage plugin allows for new datastore provisioning, cloning, resizing, snapshotting, and monitoring performance statistics, space usage, and compression savings:



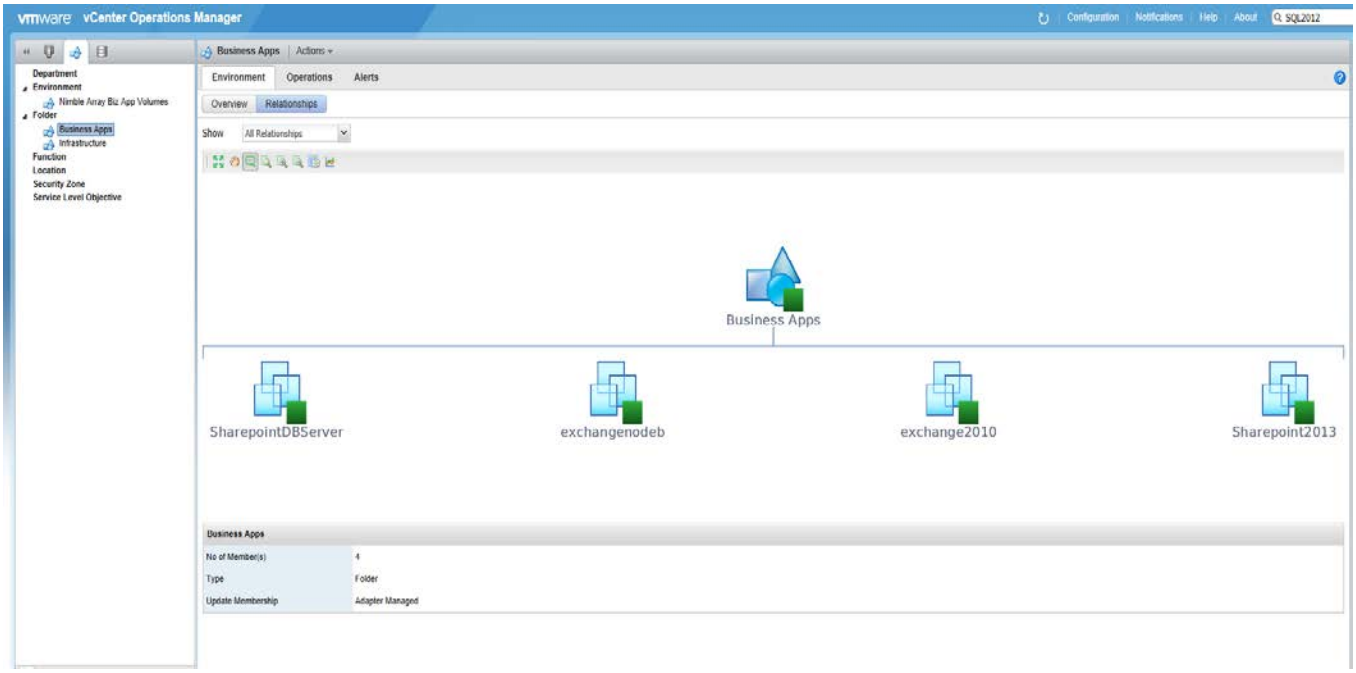
Operational Management with vCenter Operations Manager

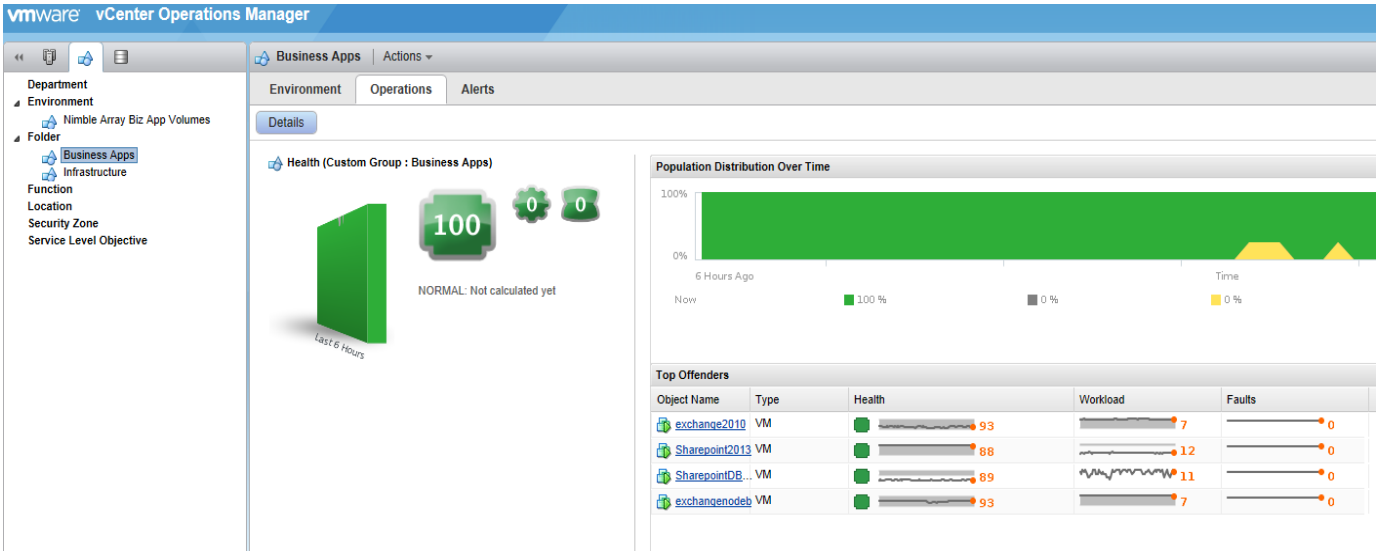
After the environment has been deployed, use vCenter Operations Manager to monitor health, workload and faults in the infrastructure. Good practice is to pay attention to any red icon(s) for Health, Workload and Fault badges, as well as “Alerts”:



You could also leverage the Group view functionality to look at the current health and workload status of all the VMs by their grouping folder:

NOTE: It is recommended to create a custom group with all Nimble Storage datastores. Doing so allows for quick overview of the health and workload status of the Nimble array volumes. Nimble InfoSight could then be used to look at deeper statistics based on heartbeats sent from the array.

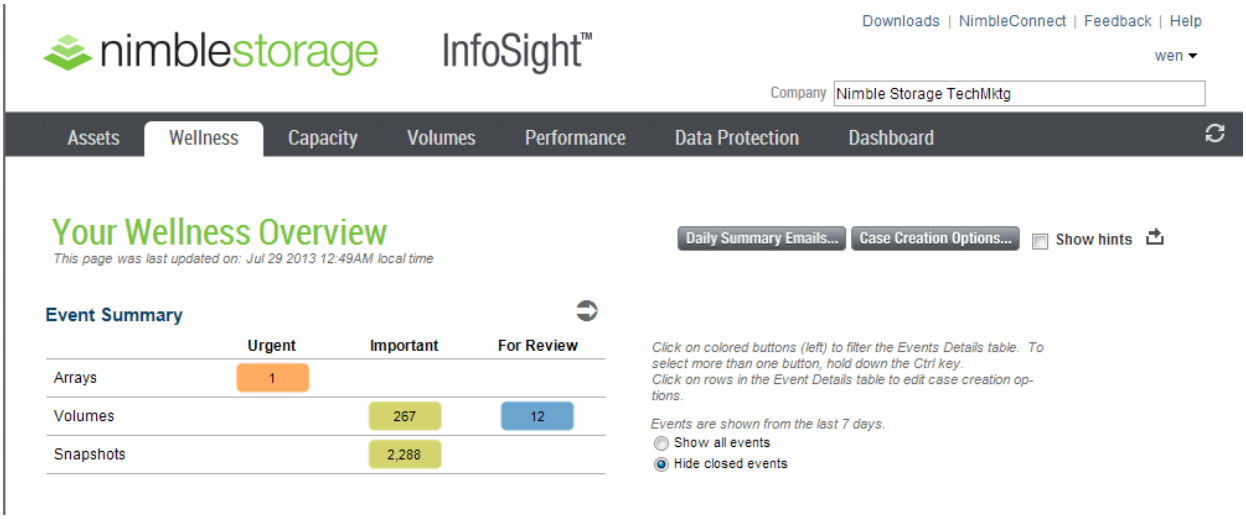




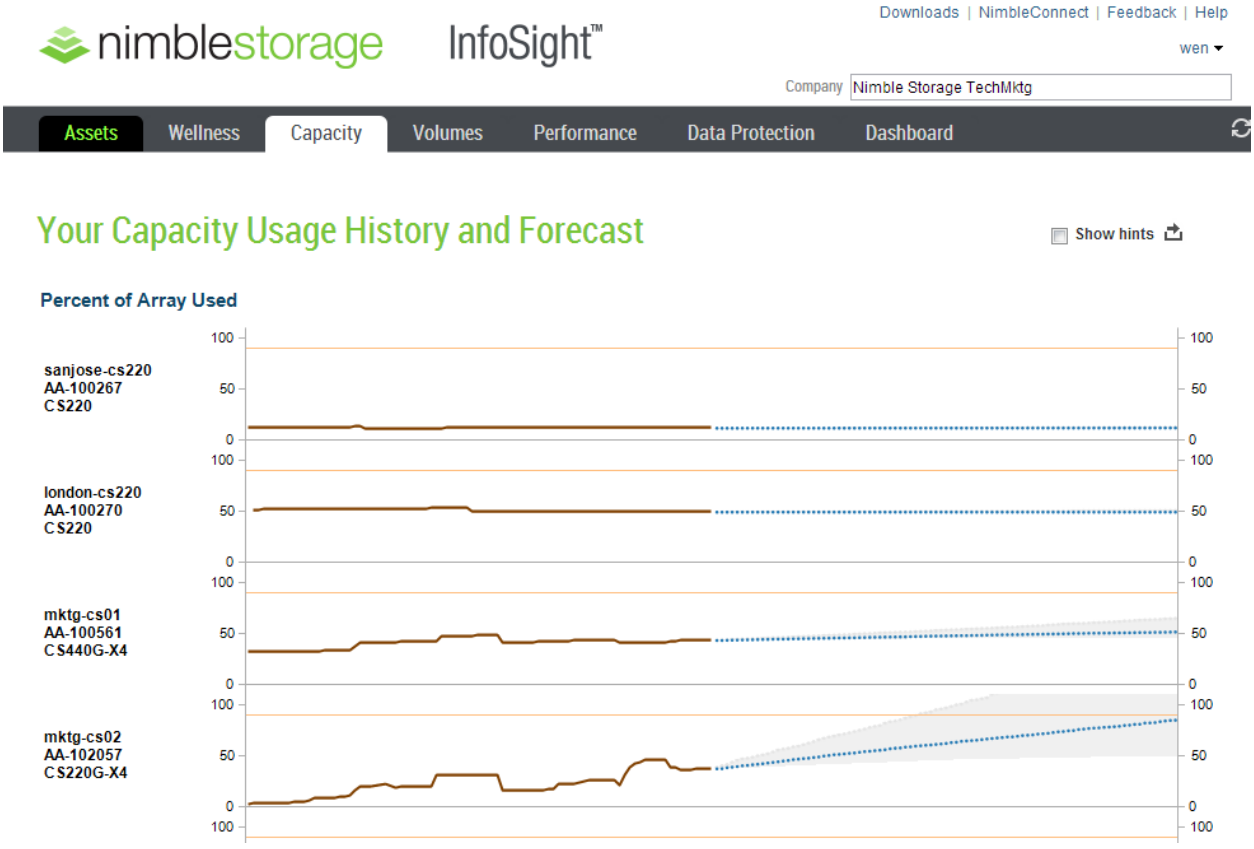
Deep Data Analytics with Nimble InfoSight

It is a good practice to regularly monitor Nimble InfoSight for storage health, availability, performance, data protection reports based on heartbeats from the array:

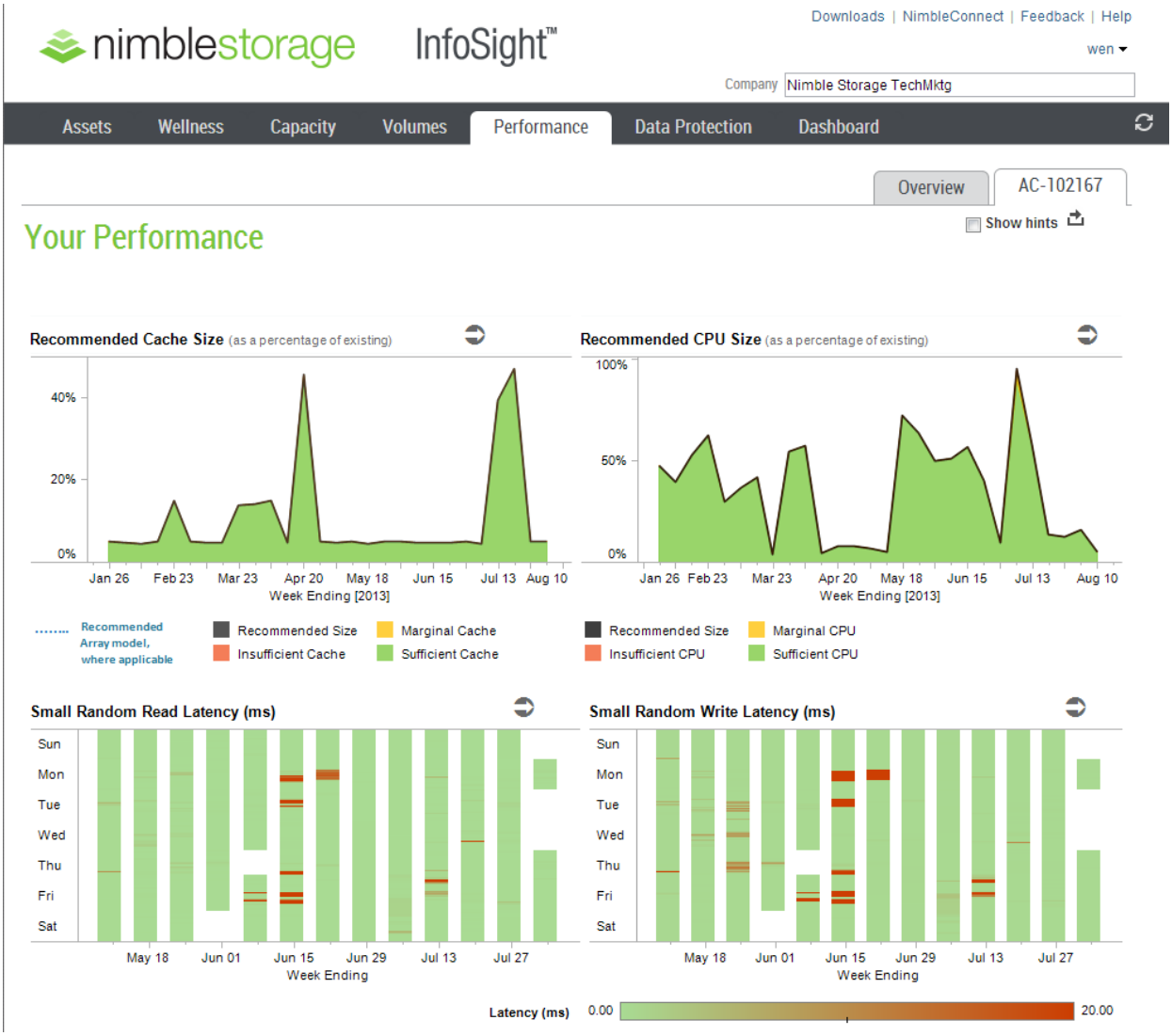
Wellness tab shows alerts from the array (both hardware and software), as well as support cases that have been open automatically based on criticality of the alerts:



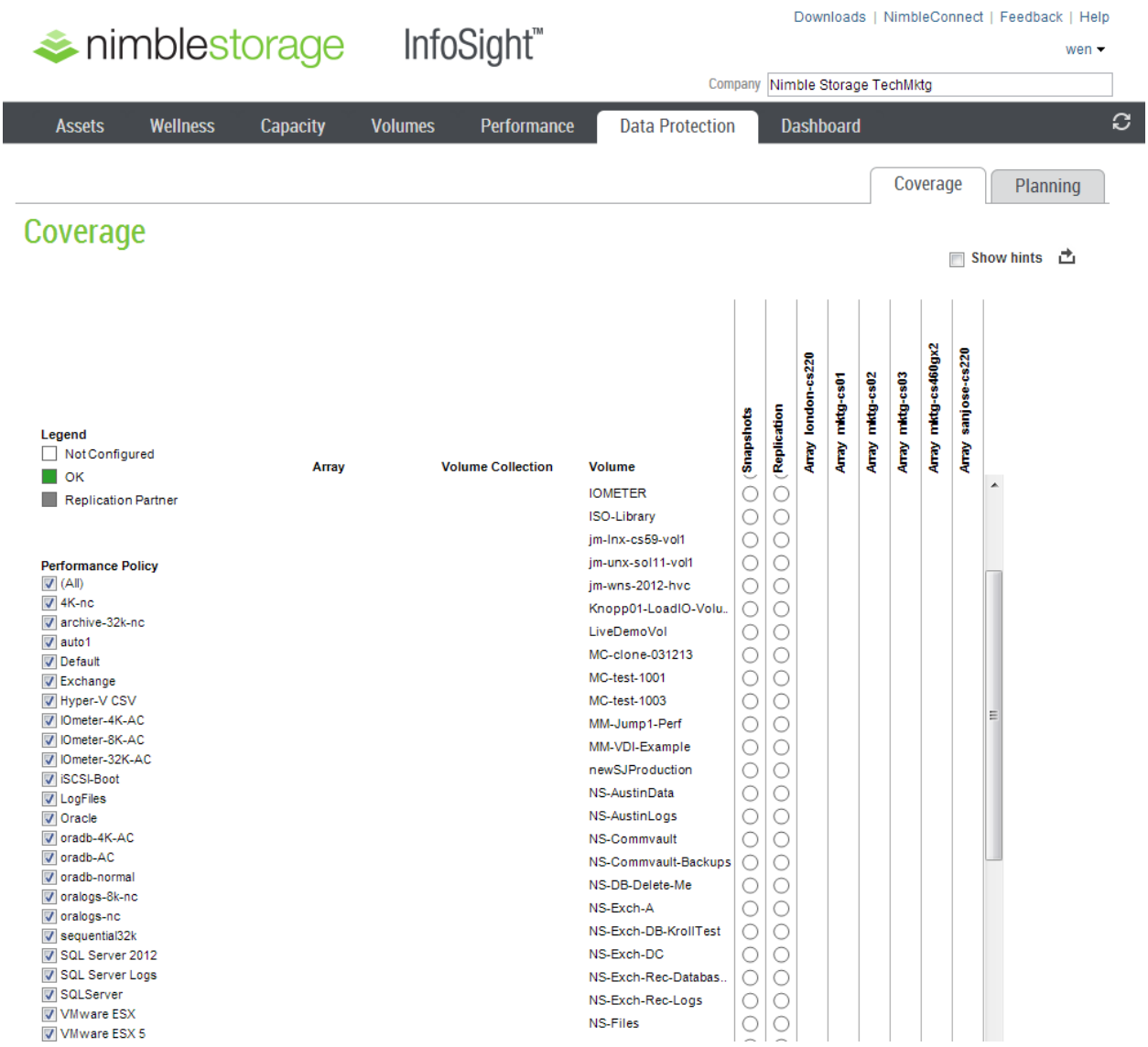
Capacity tab shows current array space utilization, as well as projection of when the array would run out of capacity:



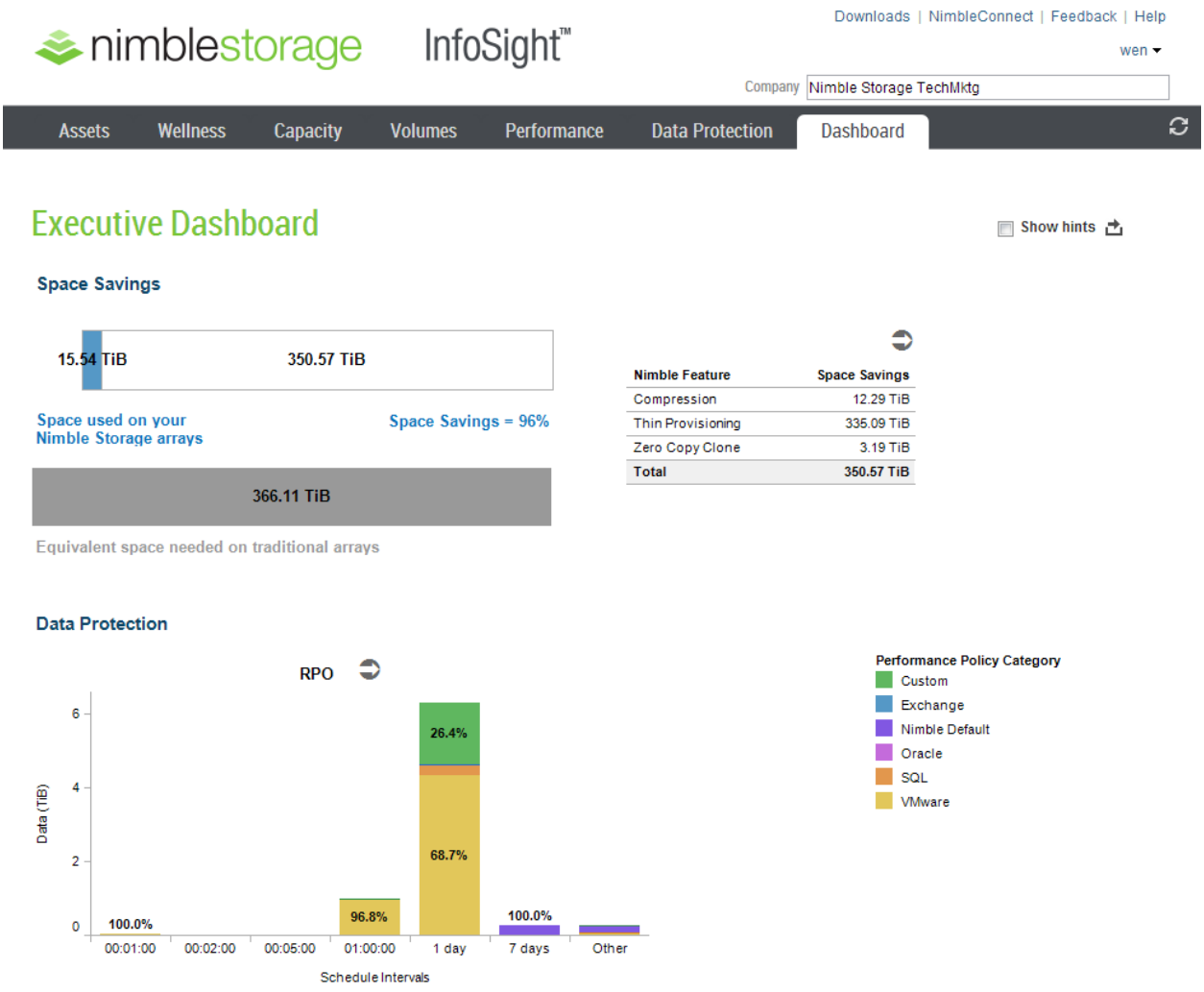
Performance tab shows CPU and cache utilization of the array, as well as average read and write latency based on heartbeat sent by the array:



Data Protection tab shows snapshot/replication configuration for each volume within the Nimble array:


nimblestorage InfoSight™
Downloads | NimbleConnect | Feedback | Help
wen
Company Nimble Storage TechMktg
Assets Wellness Capacity Volumes Performance Data Protection Dashboard
Coverage Planning
Coverage
Show hints
Legend
Not Configured
OK
Replication Partner
Performance Policy
(All)
4K-nc
archive-32k-nc
auto1
Default
Exchange
Hyper-V CSV
IOmeter-4K-AC
IOmeter-8K-AC
IOmeter-32K-AC
iSCSI-Boot
LogFiles
Oracle
oradb-4K-AC
oradb-AC
oradb-normal
oralogs-8k-nc
oralogs-nc
sequential32k
SQL Server 2012
SQL Server Logs
SQLServer
VMware ESX
VMware ESX 5
Array
Volume Collection
Volume
Snapshots
Replication
Array london-cs220
Array mktg-cs01
Array mktg-cs02
Array mktg-cs03
Array mktg-cs460gx2
Array sanjose-cs220
IOMETER
ISO-Library
jm-lnx-cs59-vol1
jm-unx-sol11-vol1
jm-wns-2012-hvc
Knopp01-LoadIO-Volu..
LiveDemoVol
MC-clone-031213
MC-test-1001
MC-test-1003
MM-Jump1-Perf
MM-VDI-Example
newSJProduction
NS-AustinData
NS-AustinLogs
NS-Commvault
NS-Commvault-Backups
NS-DB-Delete-Me
NS-Exch-A
NS-Exch-DB-KrollTest
NS-Exch-DC
NS-Exch-Rec-Databas..
NS-Exch-Rec-Logs
NS-Files

Dashboard tab shows summary reports of space savings through compression, data protection level for each volume, snapshot retention duration as well as upgrade recommendations based on workload



Summary

When you virtualize business critical applications such as Microsoft Exchange, SQL and SharePoint, be sure to design the architecture with the four key pillars of requirements in mind: availability, performance, data protection and operational management. This document highlights the key design principles and best practices that address the requirements from all four pillars. Virtualize with confidence using SmartStack, powered by Cisco, VMware and Nimble Storage.

Appendix A: Build of Materials (B.O.M)

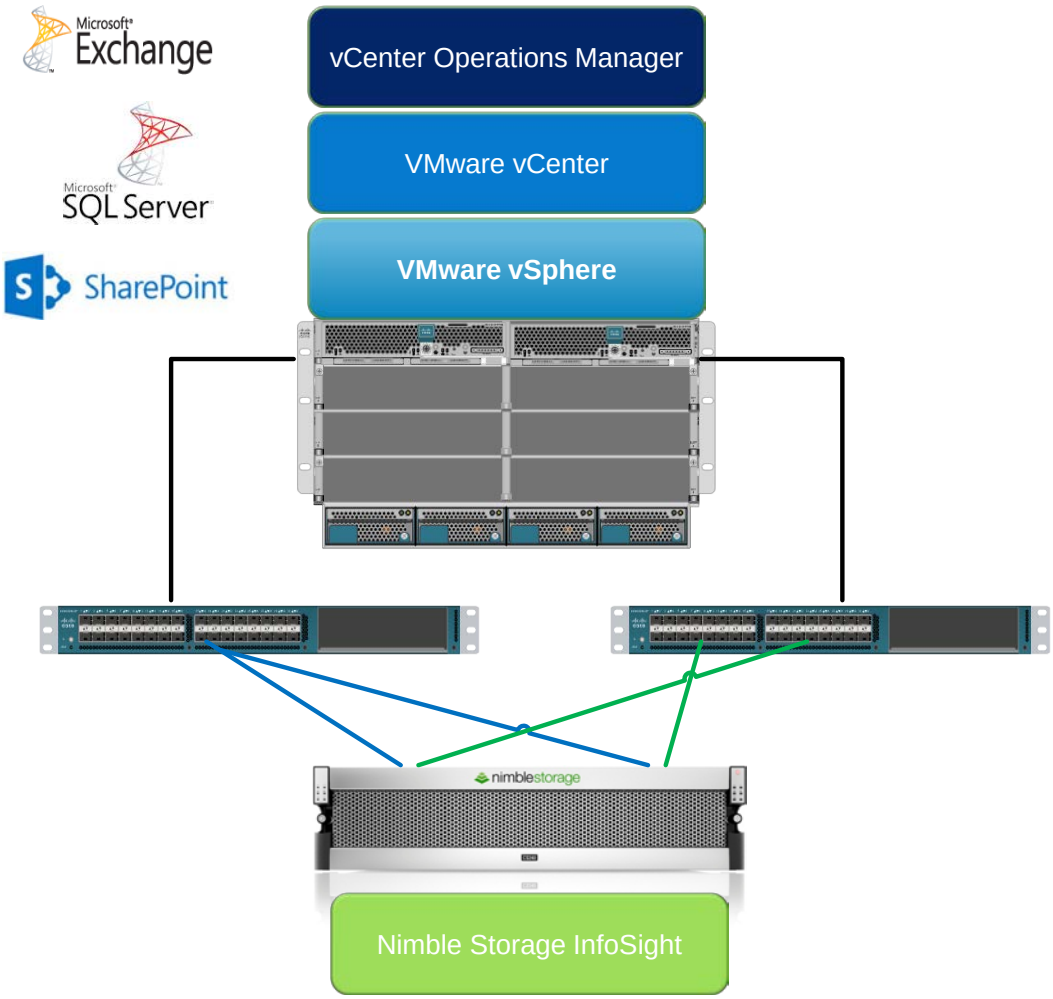
Vendor	Component Model(Quantity)	Software/OS Version
Cisco	UCS B200 M3 Blade Server(x2)	2.1(1e)
	UCS Fabric Interconnect 6248(x2)	
Nimble	CS220G(x1)	1.4.6
VMware	vSphere ESXi (Standard)	5.1
	vSphere vCenter Server (Standard)	5.1
	vCenter Operations Manager	5.7

Note:

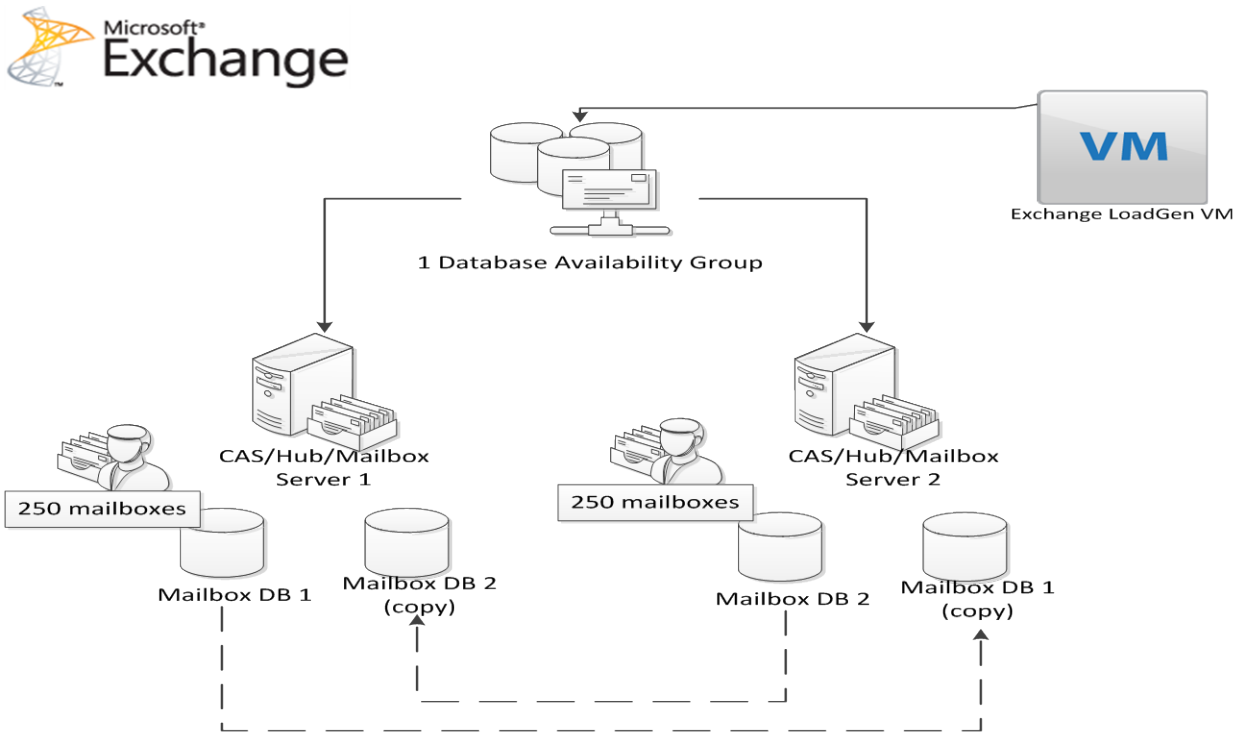
The B.O.M listed above is a reference design of an environment capable of supporting 500+ users with business critical applications. Customers and partners are welcome to use different models of equipment from Cisco for compute, and Nimble for Storage. For example, Cisco UCS C-series rack mountable servers or other blade models, and a Nimble CS400 series could be used in place of the CS200 series, depending on the workload and capacity needs.

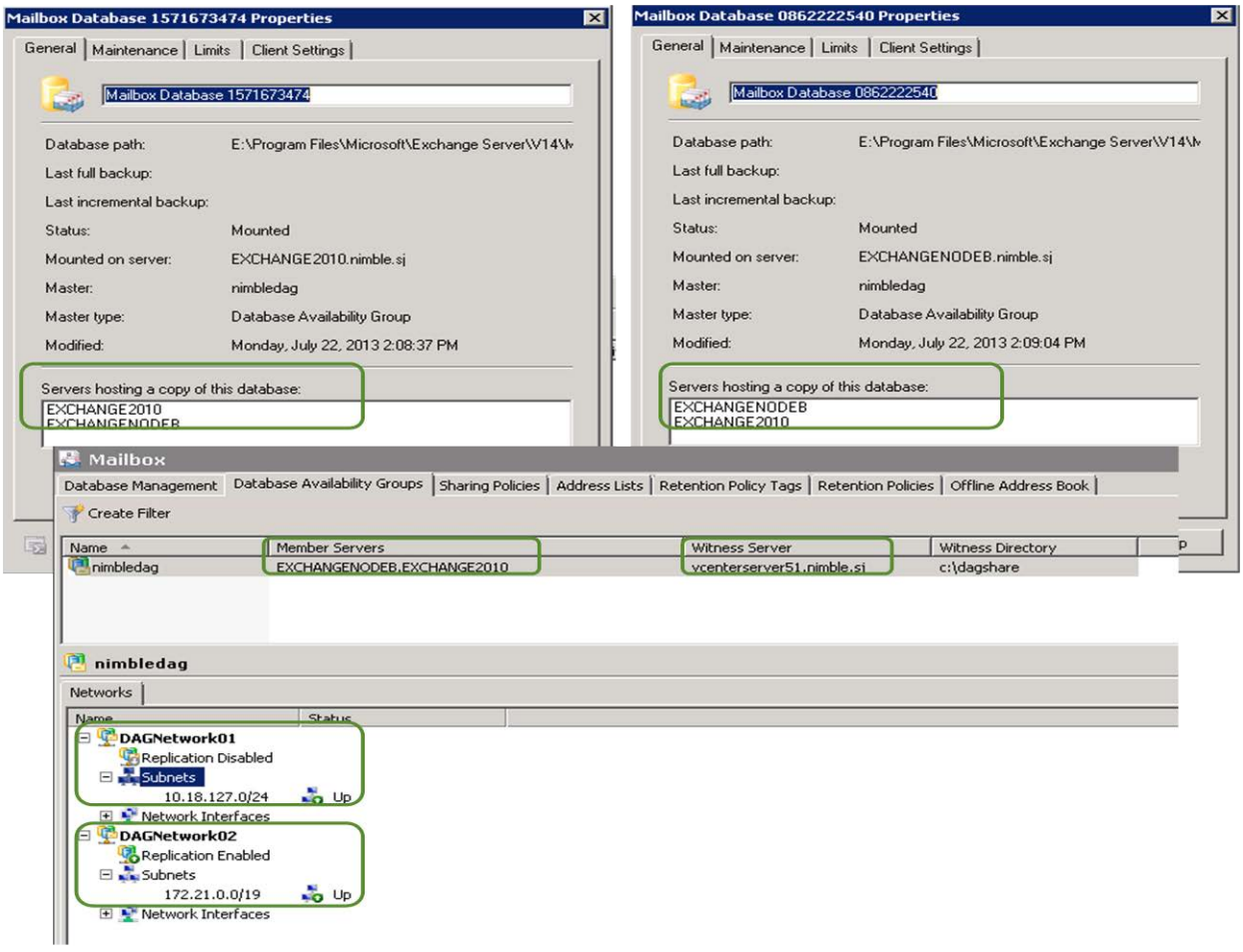
Appendix B: Validation for 500-User Business Critical Applications Environment

High Level Environment Overview:

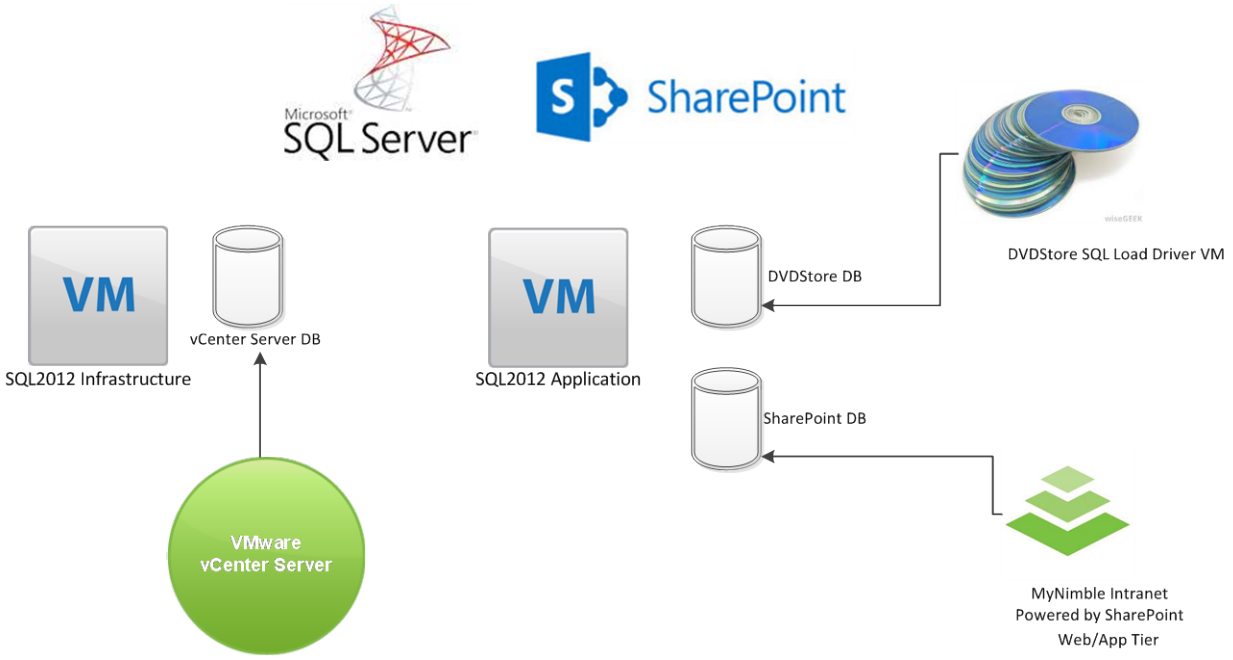


Exchange 2010:


Microsoft
Exchange
VM
Exchange LoadGen VM
1 Database Availability Group
CAS/Hub/Mailbox
Server 1
CAS/Hub/Mailbox
Server 2
250 mailboxes
250 mailboxes
Mailbox DB 1
Mailbox DB 2
(copy)
Mailbox DB 2
Mailbox DB 1
(copy)


Mailbox Database 1571673474 Properties
General
Maintenance
Limits
Client Settings
Mailbox Database 1571673474
Database path:
E:\Program Files\Microsoft\Exchange Server\V14\M
Last full backup:
Last incremental backup:
Status:
Mounted
Mounted on server:
EXCHANGE2010.nimble.sj
Master:
nimbledag
Master type:
Database Availability Group
Modified:
Monday, July 22, 2013 2:08:37 PM
Servers hosting a copy of this database:
EXCHANGE2010
EXCHANGENODEB
Mailbox Database 0862222540 Properties
General
Maintenance
Limits
Client Settings
Mailbox Database 0862222540
Database path:
E:\Program Files\Microsoft\Exchange Server\V14\M
Last full backup:
Last incremental backup:
Status:
Mounted
Mounted on server:
EXCHANGENODEB.nimble.sj
Master:
nimbledag
Master type:
Database Availability Group
Modified:
Monday, July 22, 2013 2:09:04 PM
Servers hosting a copy of this database:
EXCHANGENODEB
EXCHANGE2010
Mailbox
Database Management
Database Availability Groups
Sharing Policies
Address Lists
Retention Policy Tags
Retention Policies
Offline Address Book
Create Filter
Name
Member Servers
Witness Server
Witness Directory
nimbledag
EXCHANGENODEB,EXCHANGE2010
vcenterserver51.nimble.sj
c:\dagshare
nimbledag
Networks
Name
Status
DAGNetwork01
Replication Disabled
Subnets
10.18.127.0/24
Up
Network Interfaces
DAGNetwork02
Replication Enabled
Subnets
172.21.0.0/19
Up
Network Interfaces

SQL 2012 and SharePoint 2013:



In case you are wondering how the SmartStack solution performs with real applications, here are the details of the validation:

In short, the physical servers, VMs hosting the applications, and the Nimble CS220G array did not show any signs of resource starvation. The environment could definitely take on additional workload. We leverage vCenter Operations Manager to determine the impact of running all workloads simultaneously, and here are the results:

Summary of observations:

- Mixture of Exchange, SQL and Sharepoint workload shows both random and sequential read and write, with bursts of up to 15000 IOPS
- The SmartStack architecture is well equipped to handle the mixture of workloads without signs of resource starvation for CPU, memory, network or storage (as shown in vCenter Operations charts below)
- Nimble CS220G array shows average latency of under 2 ms for both read and write IO

Details:

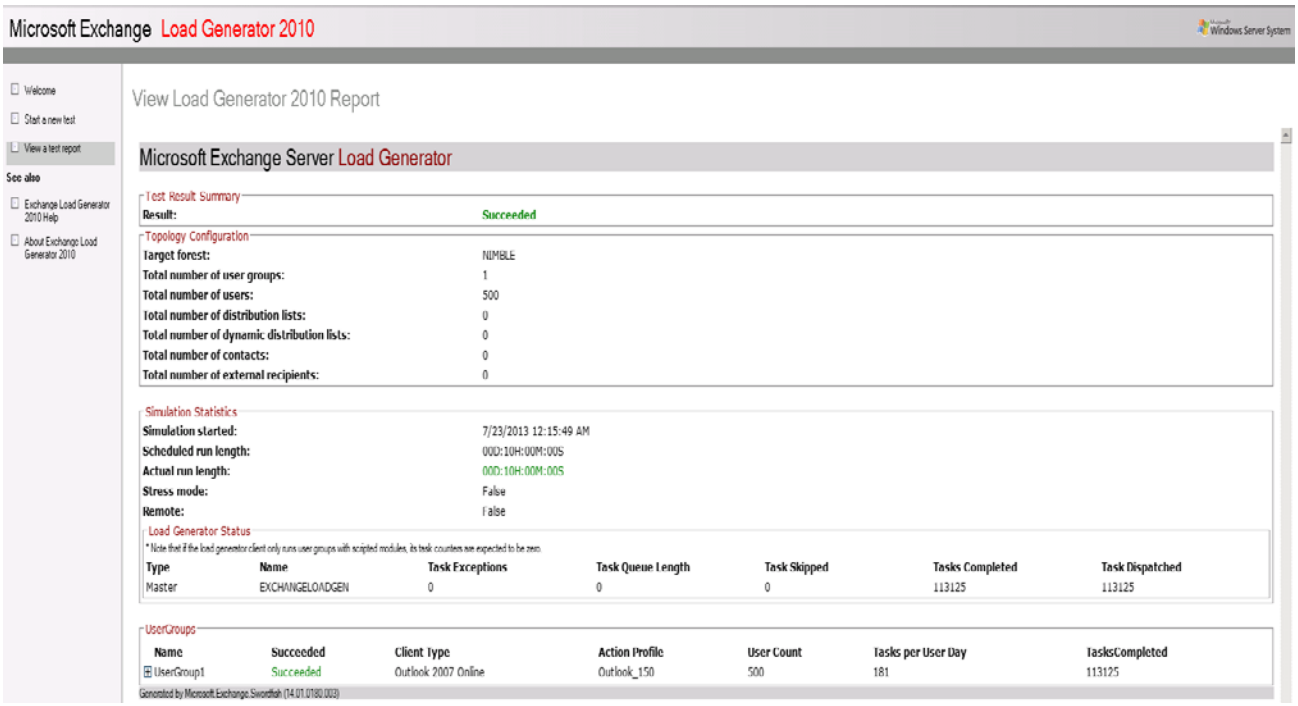
Application	Validation Tool	Workload Profile
Microsoft Exchange 2010	LoadGen Version 14.01.0180.003	500 1GB mailboxes (250 in each DAG node with cross replication); Outlook_150

		action profile (150 messages/day); total of 10 hour test simulating 8 hour busy work day
Microsoft SQL Server 2012	DVDStore Version 2.1	Large DVDStore database with 1 million customers and 2 million DVD products
Microsoft Sharepoint 2013	Nimble Storage employees	Day-to-day cross functional usage of Sharepoint farms for page creation, modification, file upload and sharing

NOTE: Validation was conducted with all three workloads running simultaneously

Results:

Exchange LoadGen Test Report



Expanding on the Usage tasks completed

View Load Generator 2010 Report

UserGroups

Name	Succeeded	Client Type	Action Profile	User Count	Tasks per User Day	TasksCompleted
UserGroup1	Succeeded	Outlook 2007 Online	Outlook_150	500	181	113125

Active Users Statistics

Active User Count	Duration
500	10:00:00

Task Execution Statistics

Task Name	Count	Actual Distribution(%)	Configured Distribution(%)
AddPublicDelegateTask	0	0	0
BrowseAddressBookTask	0	0	0
BrowseCalendarTask	8159	7	7
BrowseContactsTask	6899	6	6
BrowsePublicFolderTask	0	0	0
BrowseTasksTask	581	0	0
CreateContactTask	646	0	0
CreateFolderTask	0	0	0
CreateTaskTask	630	0	0
DeleteMailTask	0	0	0
DownloadOabTask	606	0	0
EditRulesTask	0	0	0
EditSmartFoldersTask	602	0	0
ExportMailTask	0	0	0
InitializeMailboxTask	0	0	0
LogoffTask	1898	1	1
LogonTask	0	0	0
MakeAppointmentTask	655	0	0
ModuleInitTask	1	0	0
MoveMailTask	0	0	0
PostFreeBusyTask	2486	2	2
PublicFolderPostTask	0	0	0
PublishCertificatesTask	0	0	0
ReadAndProcessMessagesTask	74964	66	66
RequestMeetingTask	1890	1	1
SearchTask	0	0	0
SendMailTask	13108	11	11
ViewContactDetailsTask	0	0	0

DVDStore Results

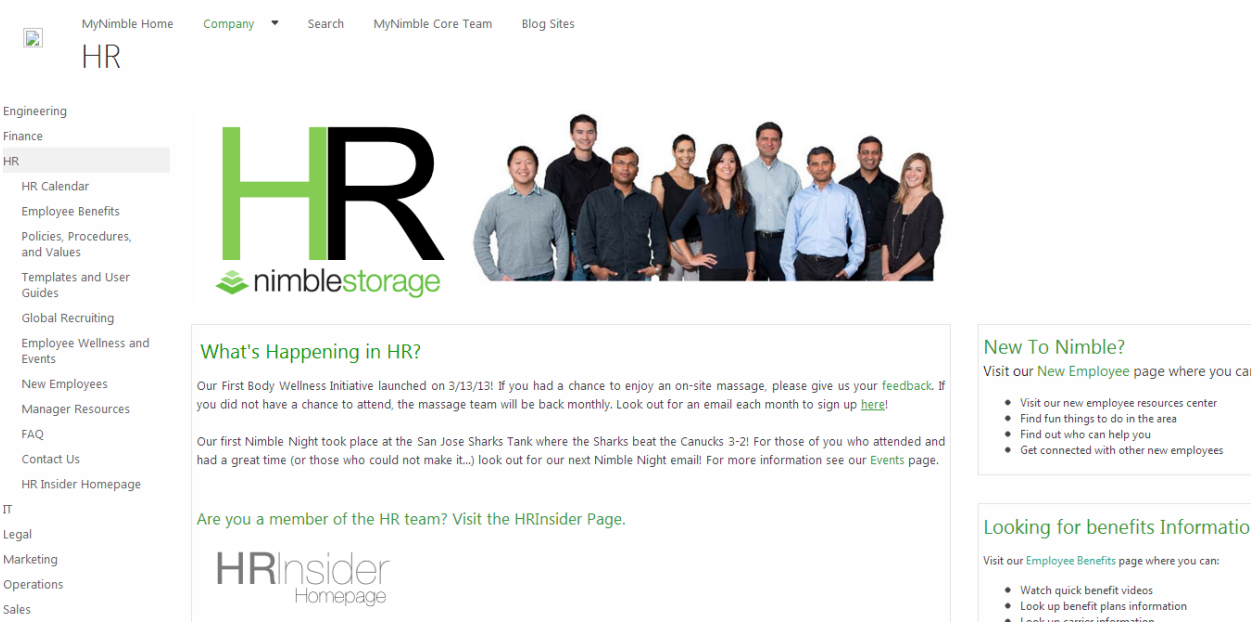
- Total test run duration: 36018 minutes (~10 hours)
- Total transactions completed: 1892280 orders
- Total new customers added: 378376
- Total number of browse during run: 5677543
- Total number of purchases: 1892280
- Average latency per second to login to DVDStore: 6 millisecond
- Average latency to add new customer: 1 millisecond
- Average latency to browse catalog: 1 millisecond
- Average latency to purchase: 9 millisecond

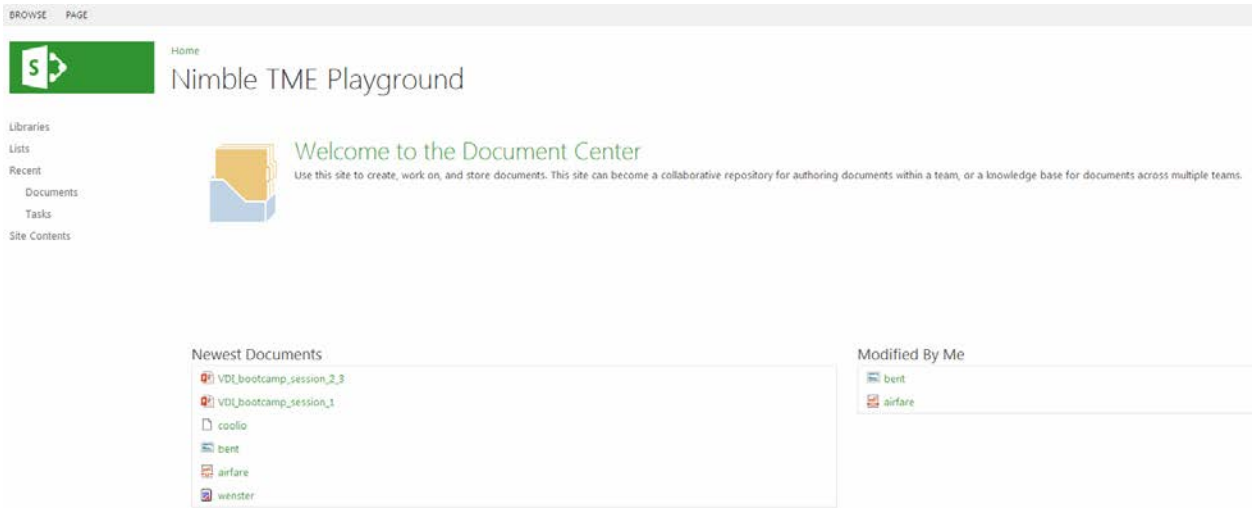
```
Final (7/23/2013 10:22:10 AM): et=36018.9 n_overall=1892280 opm=3152 rt_tot_last
n_max=220 rt_tot_avg=18 n_login_overall=1513904 n_newcust_overall=378376 n_brows
e_overall=5677543 n_purchase_overall=1892280 rt_login_avg_msec=6 rt_newcust_avg_
msec=1 rt_browse_avg_msec=1 rt_purchase_avg_msec=9 rt_tot_sampled=16 n_rollbacks
_overall=511 rollback_rate =    0.0%

Thread 0: exiting
Controller (7/23/2013 10:22:11 AM): all threads stopped, exiting
n_purchase_from_start= 1894362 n_rollbacks_from_start= 511
Run over
```

Sharepoint Access

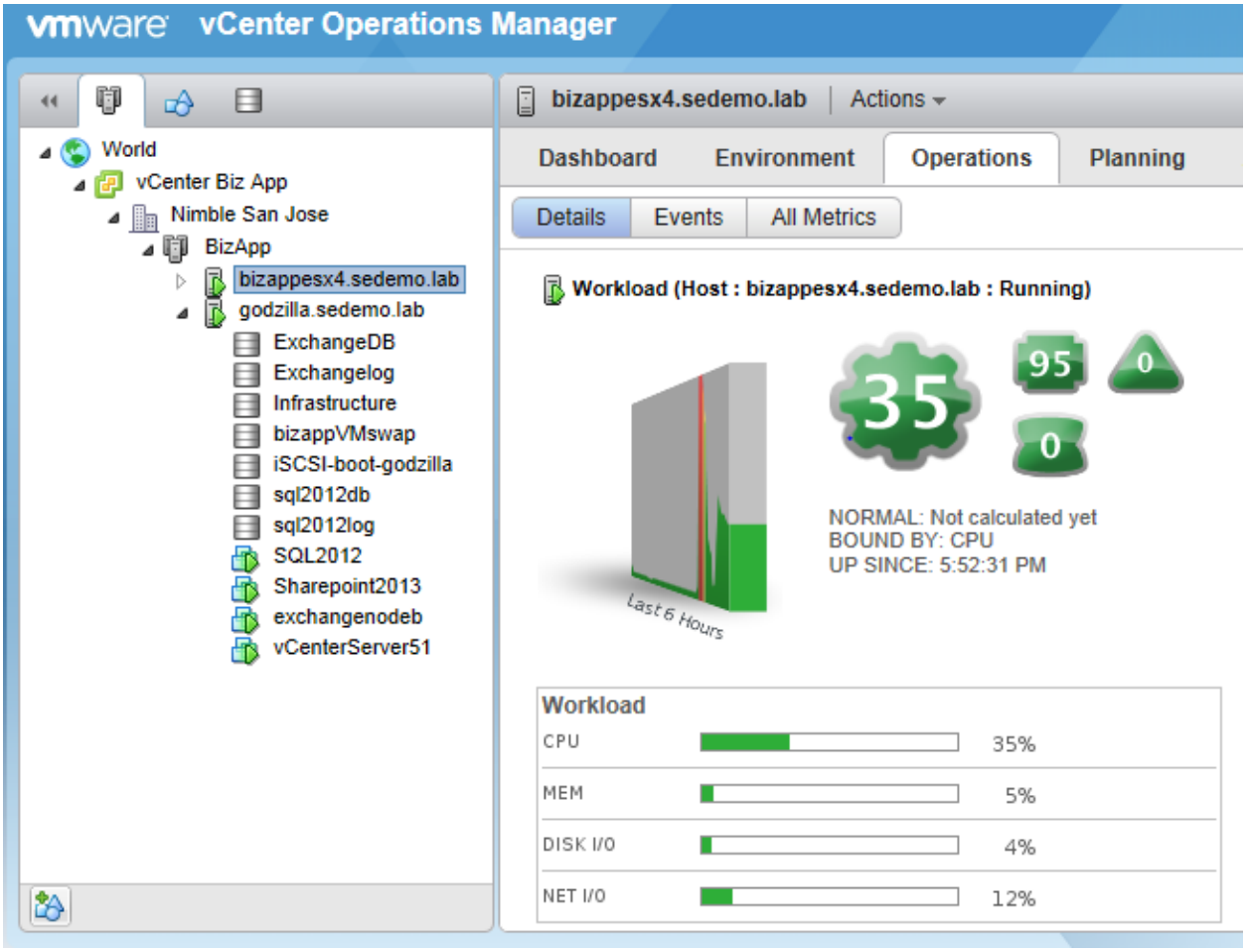
Nimble employees across HR, Engineering, QA, Product Management, Marketing, IT and Sales all had access to “MyNimble” (Nimble’s intranet backed by Sharepoint 2013 with SQL 2012 back-end). All team members were able to access various intranet pages, upload and edit shared documents, while Exchange Loadgen and DVDStore workloads were running on the SmartStack.



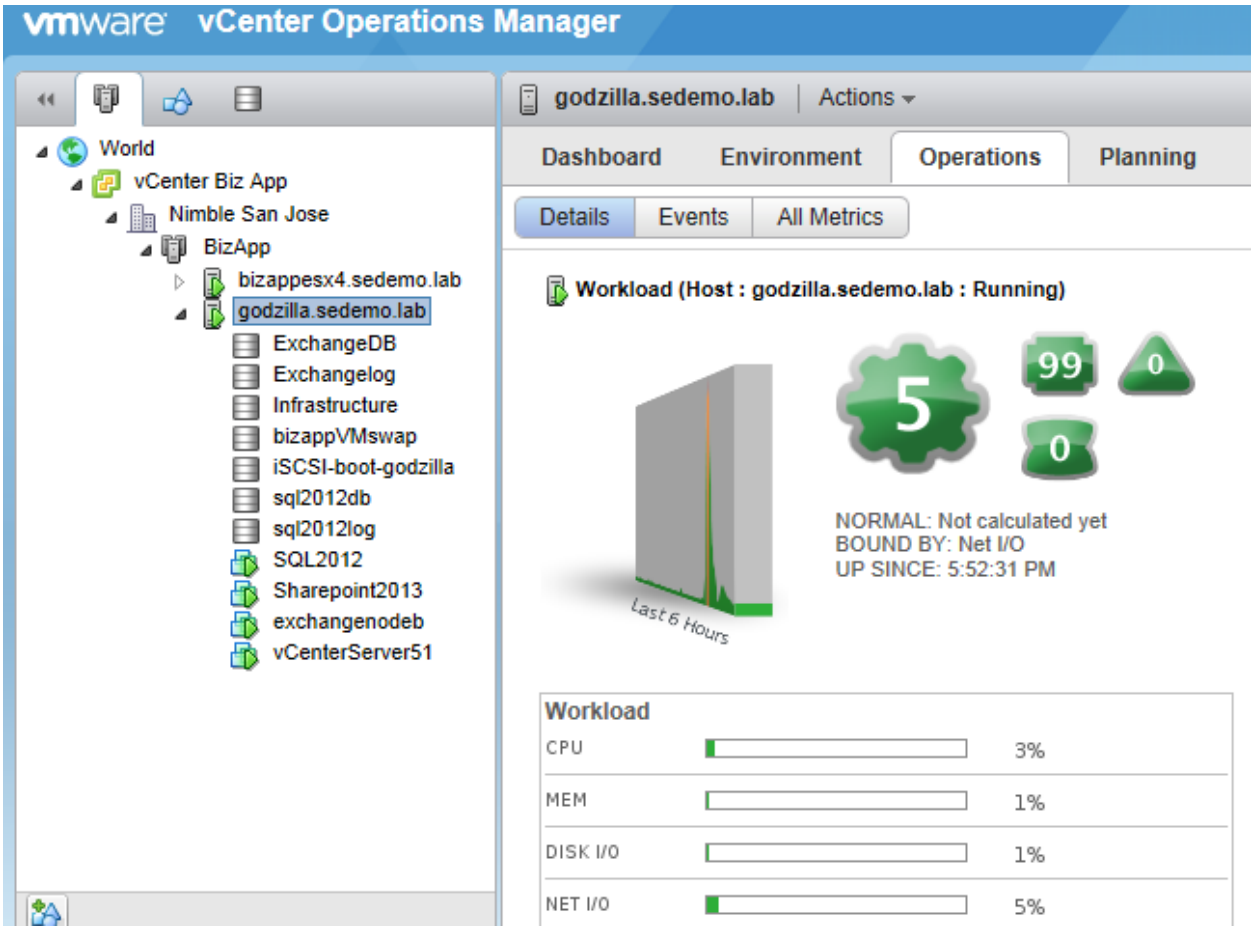


Resource Utilization

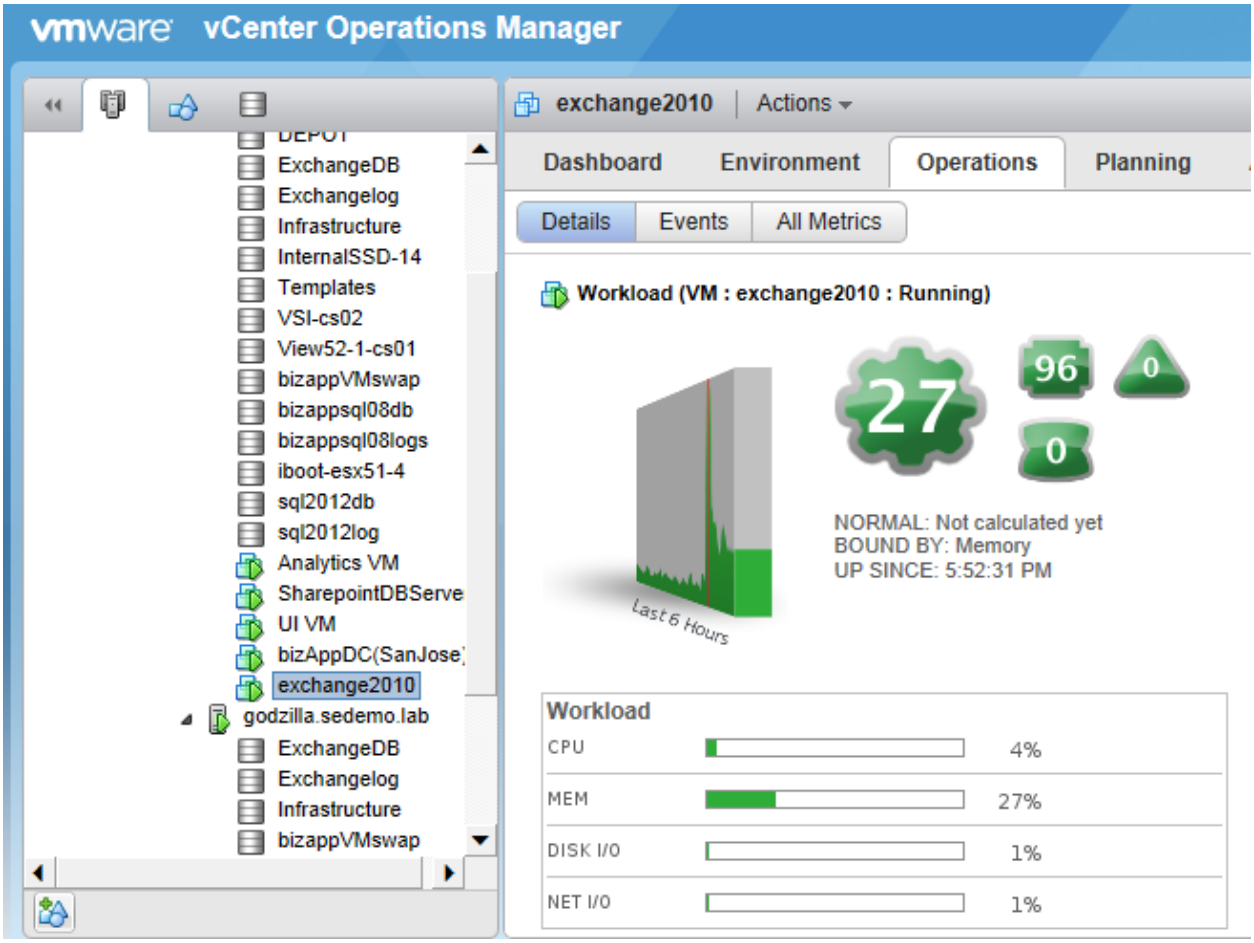
ESXi Server1 Resource Utilization:



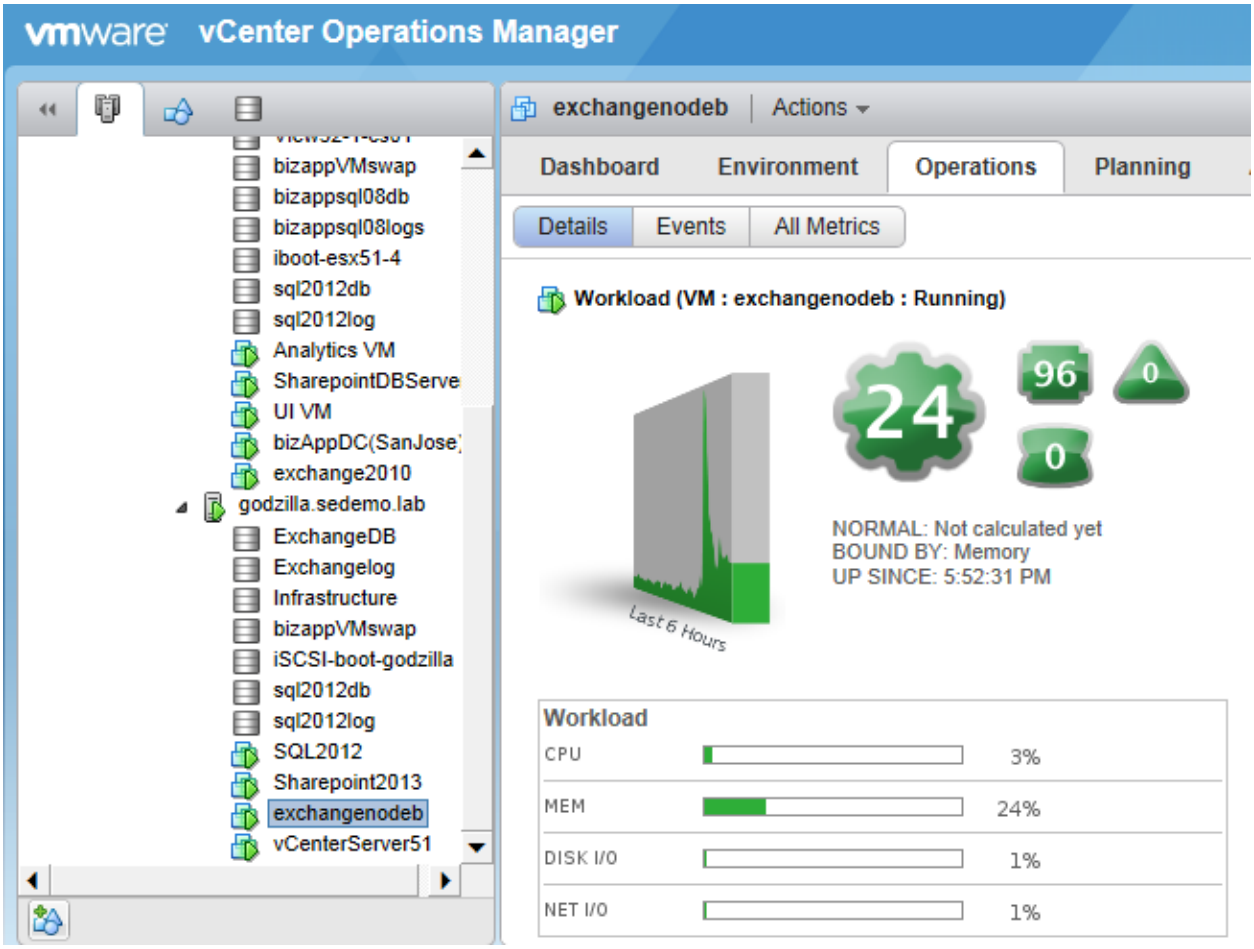
ESXi Server 2 Resource Utilization:



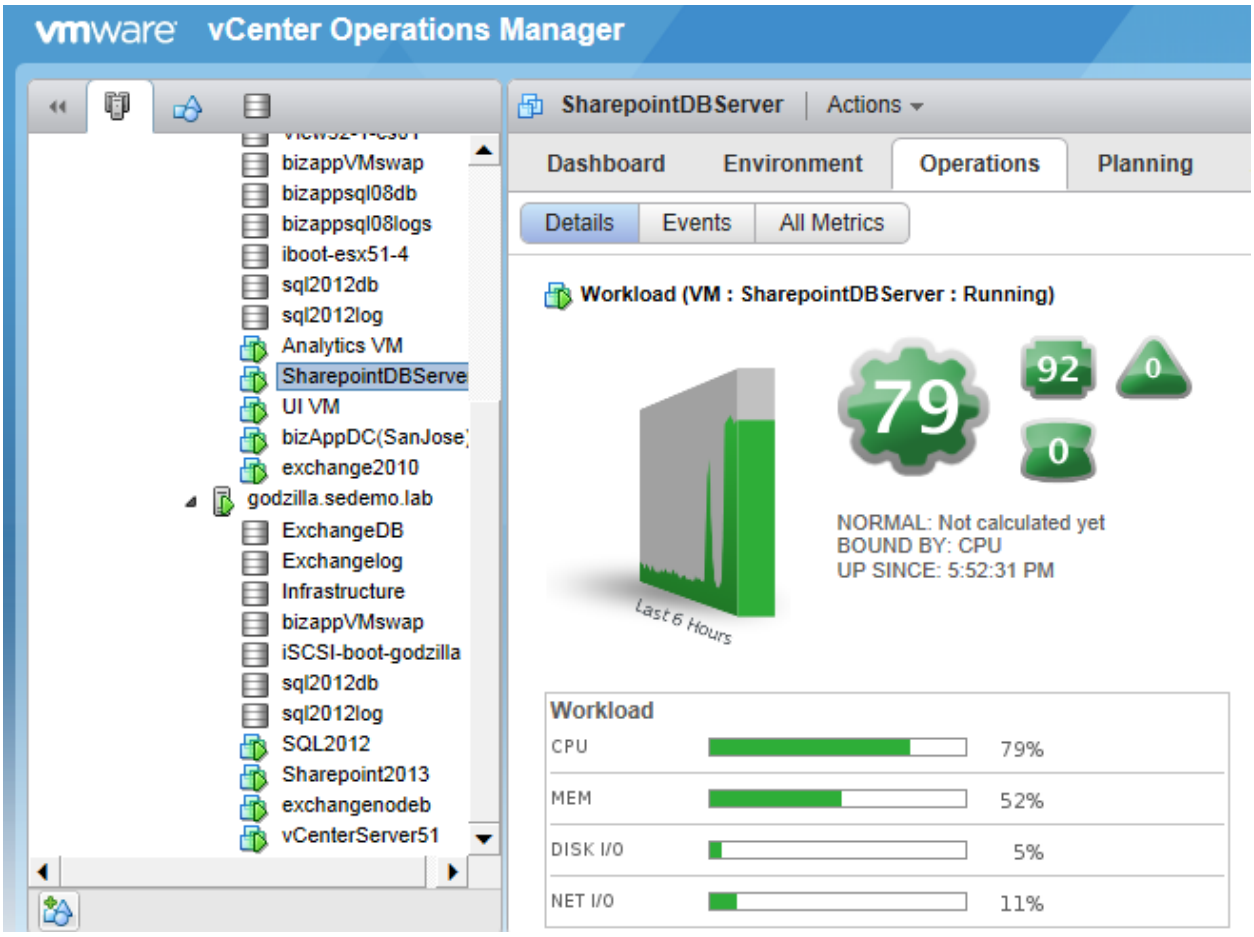
Exchange DAG node 1 Resource Utilization:



Exchange DAG group node 2 Resource Utilization:

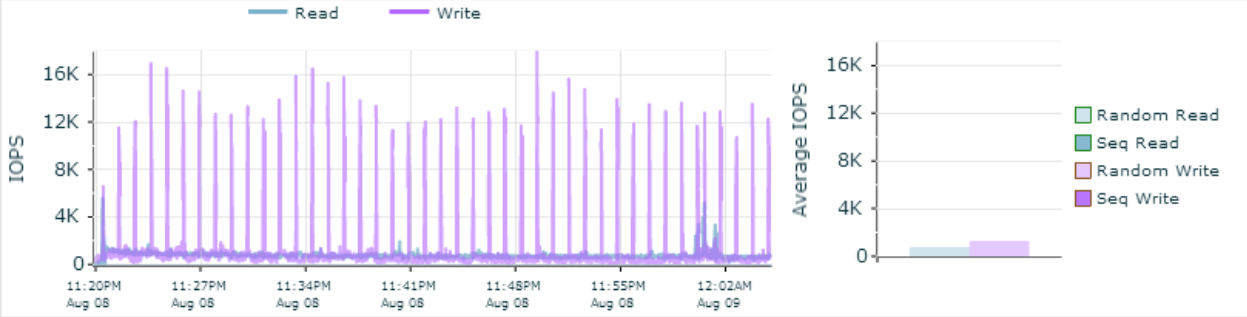


SQL DB serving DVDStore and Sharepoint databases Resource Utilization:

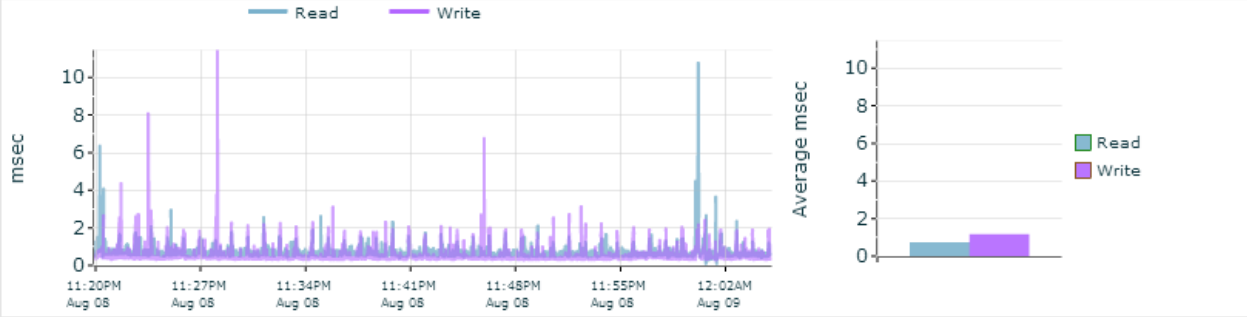


Nimble Storage CS220G Array IOPS and Latency chart:

IOPS



AVERAGE LATENCY



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