REFERENCE ARCHITECTURE

Virtualizing Business Critical Applications on SmartStack™

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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
- Management
  - Physical Adapters
    - vnic0
    - vmk0: 10.18.127.59
- VMkernel Port
- Management Network
  - vmk0: 10.18.127.59

Standard Switch: vSwitch1
- VMkernel Port
  - iSCSI
    - vmk2: 172.18.128.162
- VMkernel Port
  - iSCSIA
    - vmk1: 172.18.127.162

Standard Switch: vSwitch2
- Virtual Machine Port Group
  - Physical Adapters
    - vnic3
    - 10000

Standard Switch: vSwitch3
- Virtual Machine Port Group
  - Physical Adapters
    - vnic4
    - 10000
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)

   ![Diagram of UCS setup with dual subnet for Nimble to Cisco UCS Fabric Interconnect]

   ```
   Properties
   Name: iSCSI-A
   MAC Address: Derived
   MAC Pool: default
   MAC Pool Instances: mgmt:mac-pool-default
   Fabric ID: A Fabric B Enable Failover
   ```

   ```
   Properties
   Name: iSCSI-B
   MAC Address: Derived
   MAC Pool: default
   MAC Pool Instances: mgmt:mac-pool-default
   Fabric ID: A Fabric B Enable Failover
   ```
2. Storage:
   - Storage Volume layout
     i. Volumes supporting the infrastructure
        - Infrastructure
        - AD
        - vCenter Server
        - vCenter Operations
        - OS VMDK for all VMs
        - VMKD for Sharepoint (web/app tiers)
        - Dedicated datastore for all VM swap (.vswp)
        - bizappVMswap
        - Boot volume (ESXi1)
        - Boot volume (ESXi1)

     ii. Volumes supporting the application
        - ExchangeDB
        - SQL2012DB
        - ExchangeLog
        - SQL2012Log

   - Performance Policy for each storage volume:
For VM .vswp swap
For infrastructure VMs and app VM OS VMDKs

- 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 vmxnet3 as the virtual adapter
  - For Exchange
Separate VMDK for OS, DB, Log

Separate vSCSI HBA for each VMDK

Separate vmnics for MAPI and DAG replication traffic

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 server 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)

![Diagram showing infrastructure boot volumes and Volume Collection]

**Infrastructure**

- ESXi1 boot
- ESXi2 boot

**Infrastructure VolCol (daily snapshot)**
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

vNICs for virtual machine traffic

vNICs for iSCSI
- 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:
### Coverage

#### Legend
- **Not Configured**
- **OK**
- **Replication Partner**

#### Performance Policy
- (A)
- 4K-ac
- archive-32k-ac
- default
- Exchange
- Hyper-V CSV
- Citrix 4K-AC
- K-Meter 6K-AC
- Dell 32G-4C
- ISCSI-Boot
- LoFiles
- Oracle
- netslip-6K-AC
- netslip-AC
- openo-normal
- openslip-2K-nc
- openslip-nc
- sequence2k
- SOL Server 2012
- SOL Server Logs
- SOL Server
- VMware ESX
- VMware ESX 5

#### Array | Volume Collection | Volume
---|---|---
IQMETER
- ISO-Library
- jn-isa-csd8-vol1
- jn-isa-csd11-vol1
- jn-isa-2012-vol1
- Knopp6-Load2-vol1
- LiveDemovol
- MO-cine-00113
- MO-les-1001
- MO-test-1002
- MBA-Jump1-Perf
- MA-VOI-Example
- newOProduction
- NS-AuditLogs
- NS-AuditLogs
- NS-Correlation
- NS-Correlation-Backups
- NS-DB-Delete-Log
- NS-Echo-A
- NS-Echo-DB-VoilTest
- NS-Echo-DC
- NS-Echo-Res-Database...
- NS-Zach-Res-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)

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

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:
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:

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<tr>
<th>Application</th>
<th>Validation Tool</th>
<th>Workload Profile</th>
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<tr>
<td>Microsoft Exchange 2010</td>
<td>LoadGen Version 14.01.0180.003</td>
<td>500 1GB mailboxes (250 in each DAG node with cross replication); Outlook_150</td>
</tr>
</tbody>
</table>
### Microsoft SQL Server 2012
- **Version**: DVDStore Version 2.1
- **Description**: Large DVDStore database with 1 million customers and 2 million DVD products

### Microsoft Sharepoint 2013
- **Employees**: Nimble Storage employees
- **Usage**: 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
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
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 Server 1 Resource Utilization:

![vCenter Operations Manager screenshot with workload details]

- CPU: 35%
- NEN: 5%
- DISK I/O: 4%
- NET I/O: 1.2%

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: