Executive Summary

The world has been taken over by zombies and they have ravaged nearly everyone on the planet. A billionaire is providing the investment to create a highly scalable and full orchestrated environment which will be the backbone of a manufacturing facility. This facility is building ships to transport what's left of the human race to the moon before sending them to Mars for colonization.

This system will be a lab-based deployment to determine whether the infrastructure is sound to build out for the other sites.

Business Requirements

Number	Item
R01	Deployments must go through Horizon Dashboard

Business Constraints

Number	Item
C01	VMware cluster
C02	Other hypervisor integration
C03	OpenStack
C04	1 Linux VM, 1 Windows VM

Business Assumptions

Number	Item
A01	UPS Power is provided
A02	Air-conditioning is provided
A03	Limited professional support services for environment

Business Risks

Number	Item

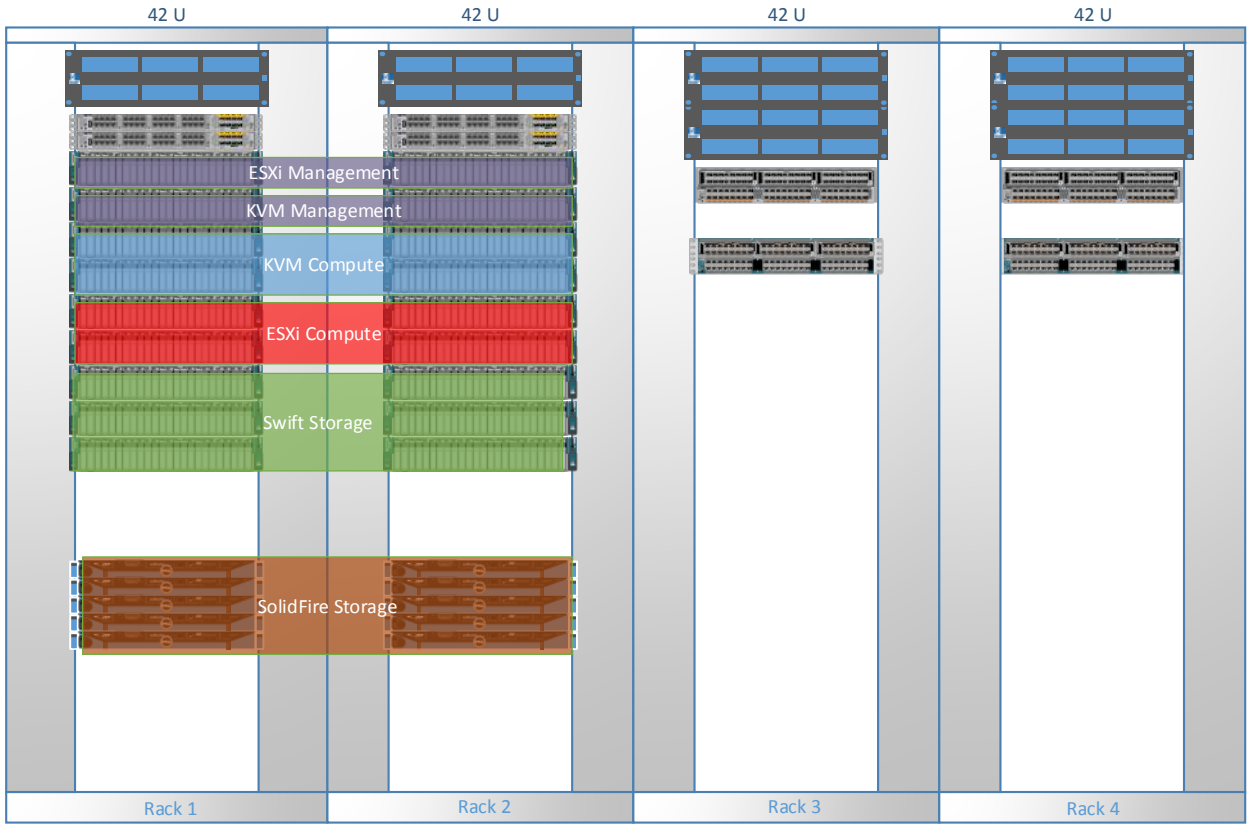
K01	Geoff building and understanding an OpenStack deployment in 5 days
K02	KVM failover is manual

Document Purpose

This document serves as the configuration document to layout the deployment infrastructure and process for the local deployment teams.

Physical Datacenter Overviews

- Datacenter rack layout



The following configuration would allow the best scaling of compute and storage nodes while taking into consideration fault domains within a datacenter.

- Networking
  - Cisco 5548UP – 2
  - Cisco 6248 - 2
- Compute
  - Cisco C240 M3 – 12
- Storage
  - Cisco C240 M3 – 6
  - Solidfire – SF6010

- Power configurations

The installed equipment will draw the following power requirements. Some numbers are obtained from maximums from the vendor websites and some are actual tested numbers based on the vendor's documentation. The racks will consist of two power distribution units that will be connected to separate uninterruptible power supplies. There is an assumption, A01, that the facility will have a generator capable of supplying power in case of main grid failure. The rack will have connections to UPS-A and UPS-B. The numbers are a best representation of the data provided:

Rack	Item	UPS-A Watts	UPS-B Watts
3	Cisco 5548UP	193W	193W
4	Cisco 5548UP	193W	193W
3	Cisco 6248	193W	193W
4	Cisco 6248	193W	193W
1	Cisco C240 M3	375W	375W
1	Cisco C240 M3	375W	375W
1	Cisco C240 M3	375W	375W
1	Cisco C240 M3	375W	375W
1	Cisco C240 M3	375W	375W
1	Cisco C240 M3	375W	375W
1	Cisco C240 M3	375W	375W
1	Cisco C240 M3	375W	375W
2	Cisco C240 M3	375W	375W
2	Cisco C240 M3	375W	375W
2	Cisco C240 M3	375W	375W
2	Cisco C240 M3	375W	375W
2	Cisco C240 M3	375W	375W
2	Cisco C240 M3	375W	375W
2	Cisco C240 M3	375W	375W
2	Cisco C240 M3	375W	375W
2	Cisco C240 M3	375W	375W
2	Cisco C240 M3	375W	375W

1	Solidfire SF6010	150W	150W
1	Solidfire SF6010	150W	150W
1	Solidfire SF6010	150W	150W
1	Solidfire SF6010	150W	150W
1	Solidfire SF6010	150W	150W
2	Solidfire SF6010	150W	150W
2	Solidfire SF6010	150W	150W
2	Solidfire SF6010	150W	150W
2	Solidfire SF6010	150W	150W
2	Solidfire SF6010	150W	150W
Total Consumed Power		**9022**	**9022**

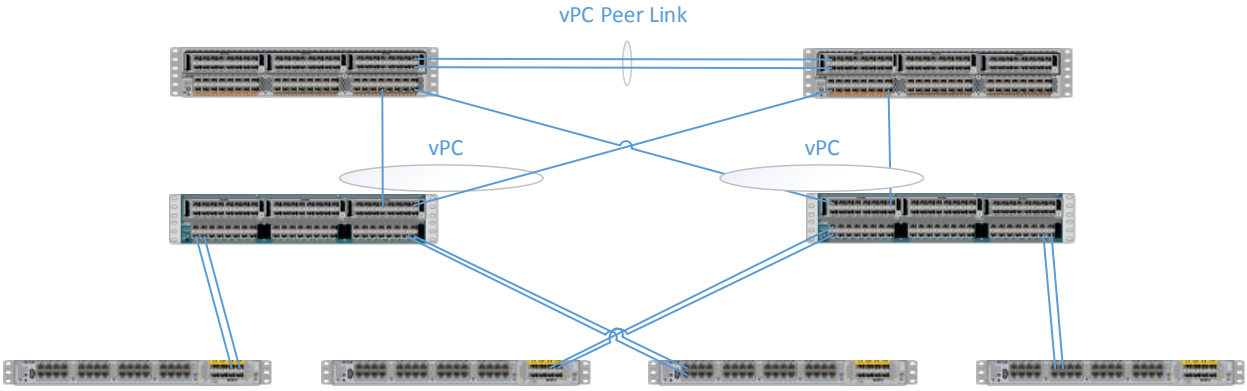
- HVAC configurations

The equipment will need to be cooled during operation. There is an assumption, A02, that the facility will have a room for the datacenter equipment to reside in. Using the Table 1 provided in this document, the amount of AC tonnage required to cool the equipment is as follows:

  - Formula – Total Watts * 0.000283 = Tons
  - Calculation – 18044 * 0.000283 = 5.106452 Tons

Physical Infrastructure Overviews

- Network Infrastructure



The following configuration is composed of a pair of Cisco 5596UP switches. There are Cisco 6296UP Fabric Interconnects that are providing the UCS Manager and Service Profiles for the Cisco C240 M3s.

These machines connect into the fabric extenders which then connects back to the 5596UPs. This configuration provides scale out functions should the need to add more compute nodes be necessary.

- Network Design

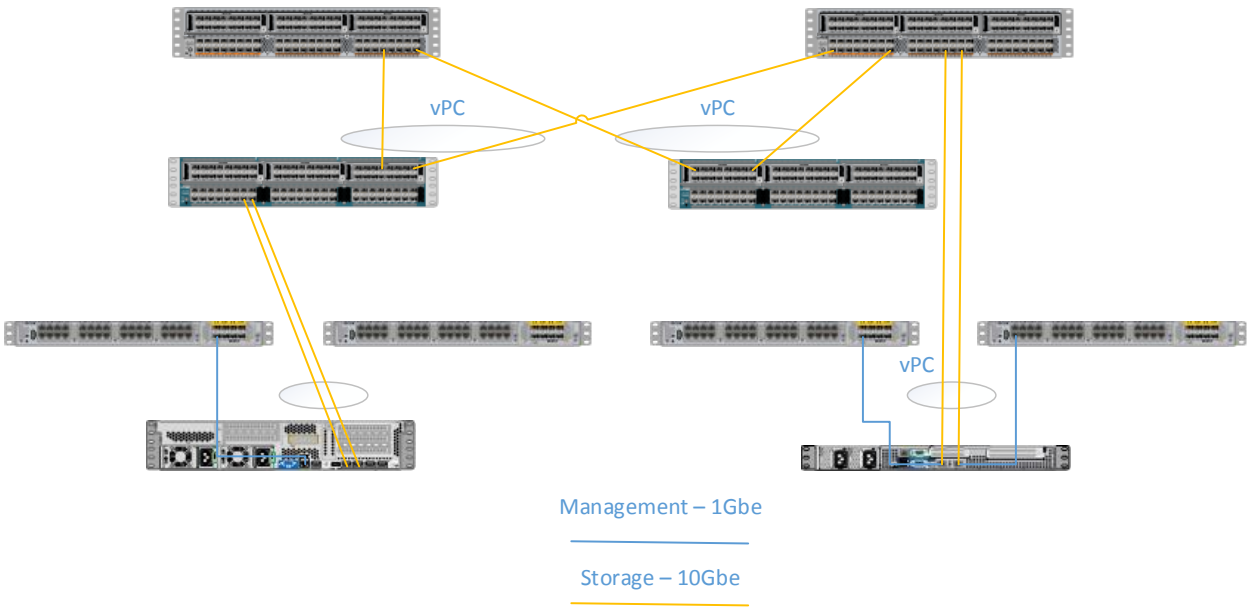
VLAN	Purpose
A	Management Network
B	VM Network
C	vMotion
D	iSCSI
E	Floating IP Network

- Host Infrastructure
  - Cisco C240 M3 x12

CPU	RAM	NIC	Power	Storage
2x2.8Ghz E5-2680	256GB – 1866Mhz	VIC 1225	Dual 750W	Dual SD Card

- Storage Infrastructure – Swift Object Storage
  - Cisco C240 M3 x6

CPU	RAM	NIC	Power	Boot Storage	Internal Storage
2x2.8Ghz E5-2680	256GB – 1866Mhz	VIC 1225	Dual 750W	Dual SD Card	3x Intel S3700 DC 800GB



The storage infrastructure physical layout is shown above. Certain components have been removed for clarity of connectivity. Only one of the Solidfire SF6010's is being shown as the others connect in the same fashion to the 5596UP for 10Gbe storage and the 2232TM for 1Gbe Management. The two 10Gbe connections from each of the SolidFire controllers will be setup in a vPC between the two 5596UPs. The Management network connections will be plugged into both Fabric Extenders to allow connectivity in case of a Fabric Extender or 5596UP device failure. The C240 servers will be plugged into the Fabric Extenders via their VIC 1225 for their 10Gbe uplinks. These will

Virtualization Infrastructure Overviews

- vSphere and Ubuntu KVM Definitions

One of the requirements was to scale down but still use the same software components, R01, with a constraint that the software vendors had to be used, C03.

vSphere Component	Description
VMware vSphere	The core products of the VMware vSphere environment include: • ESXi – 2 instances will compose the management cluster and 6 hosts will comprise the compute cluster for VM consumption • vCenter Server – 1 installed VM instance • vCenter Server Database – 1 VM instance for the single instance of vCenter Server • SSO – Single Sign-on component that is required for connecting to the vSphere Client and vSphere Web Client • vSphere Client – Still needed to manage VMware Update Manager • vSphere Web Client – Used to manager the vSphere environment • vSphere Update Manager – Used to update hosts and virtual machines
Ubuntu KVM 14.04 LTS	• KVM – 2 instances of KVM will provide an HA cluster for an additional copy of the Nova Controller VM • Horizon

- Glance
- Cinder
- Keystone
- RabbitMQ
- MySQL
- HAProxy
- Nova
- Swift Proxy

- vSphere Component Architecture

Design Section	vSphere Components
vSphere Architecture – Management Cluster	• vCenter Server and vCenter Database • vCenter Cluster and ESXi hosts • Single Sign-On • vSphere Update Manager
vSphere Architecture – Compute Cluster	• vCenter Cluster and ESXi hosts

- Ubuntu KVM Component Architecture

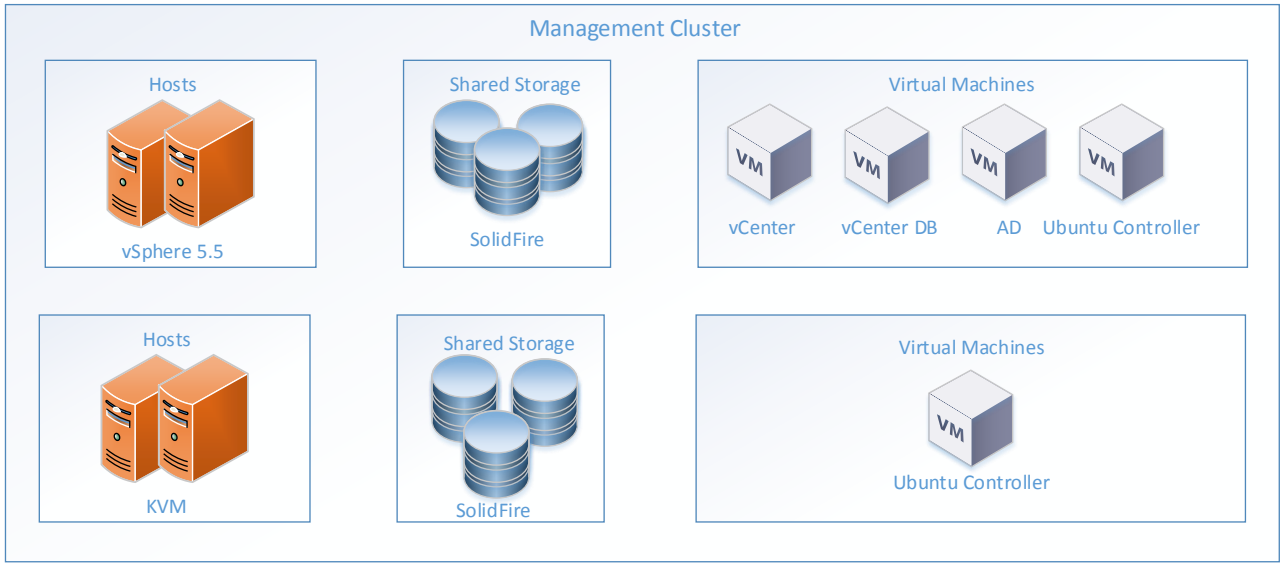
Design Section	vSphere Components
Ubuntu KVM – Management Cluster	• HAProxy • Nova-controller • Keystone • MySQL • RabbitMQ • Horizon • Glance • Cinder • Swift
Ubuntu KVM Architecture – Compute Cluster	• KVM • Nova-compute

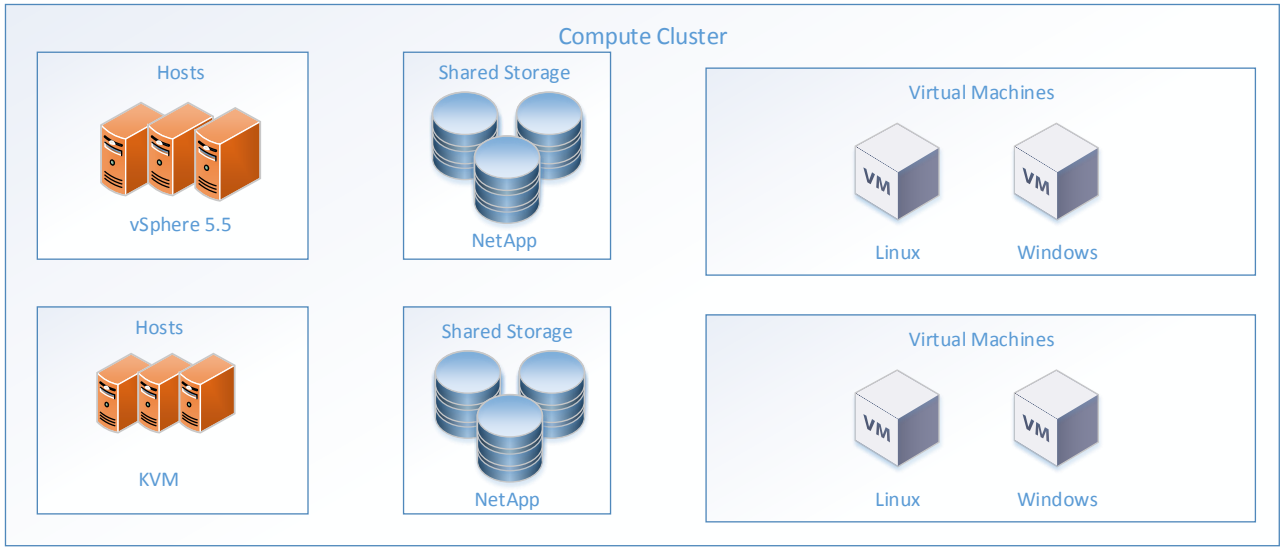
- vSphere and Ubuntu Architecture Design Overview
- High level Architecture

The vSphere components are being split out to facilitate ease of troubleshooting of the management components without disruption of the resource components. They are split out as follows:

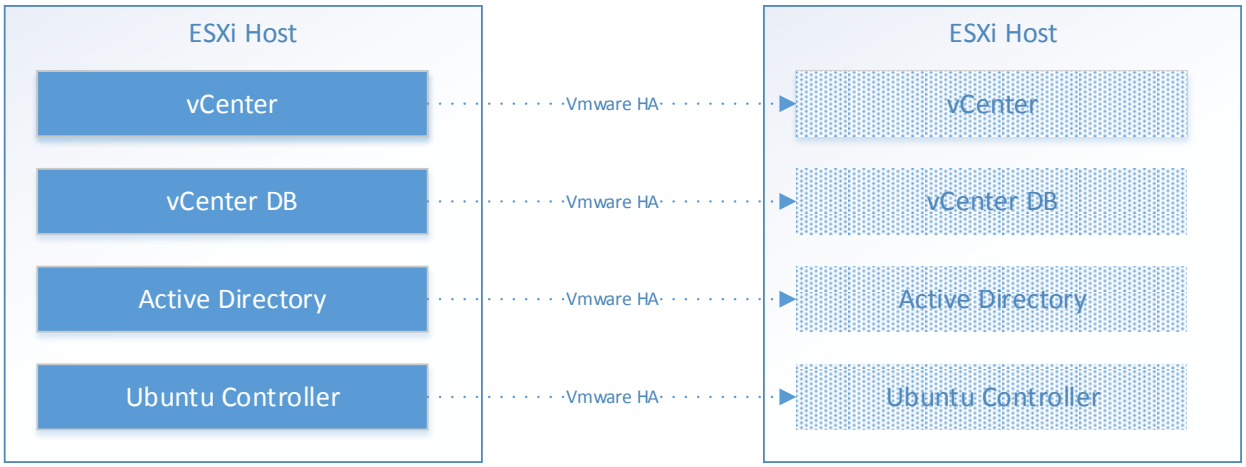
Management cluster that will host the management components of the vSphere infrastructure as well as one of the redundant Ubuntu Nova Controller VMs. They are split out to ensure they have dedicated resources in which to consume. The Ubuntu Nova Controller VMs will be split across the hypervisors in an active/active configuration. In case of VMware host failure, VMware HA will restart the controller on the other ESXi host. In case of full failure of the VMware management cluster, the Ubuntu KVM nodes will take over servicing the compute nodes.

Compute cluster that will host the virtual machines for OpenStack to spawn up on.

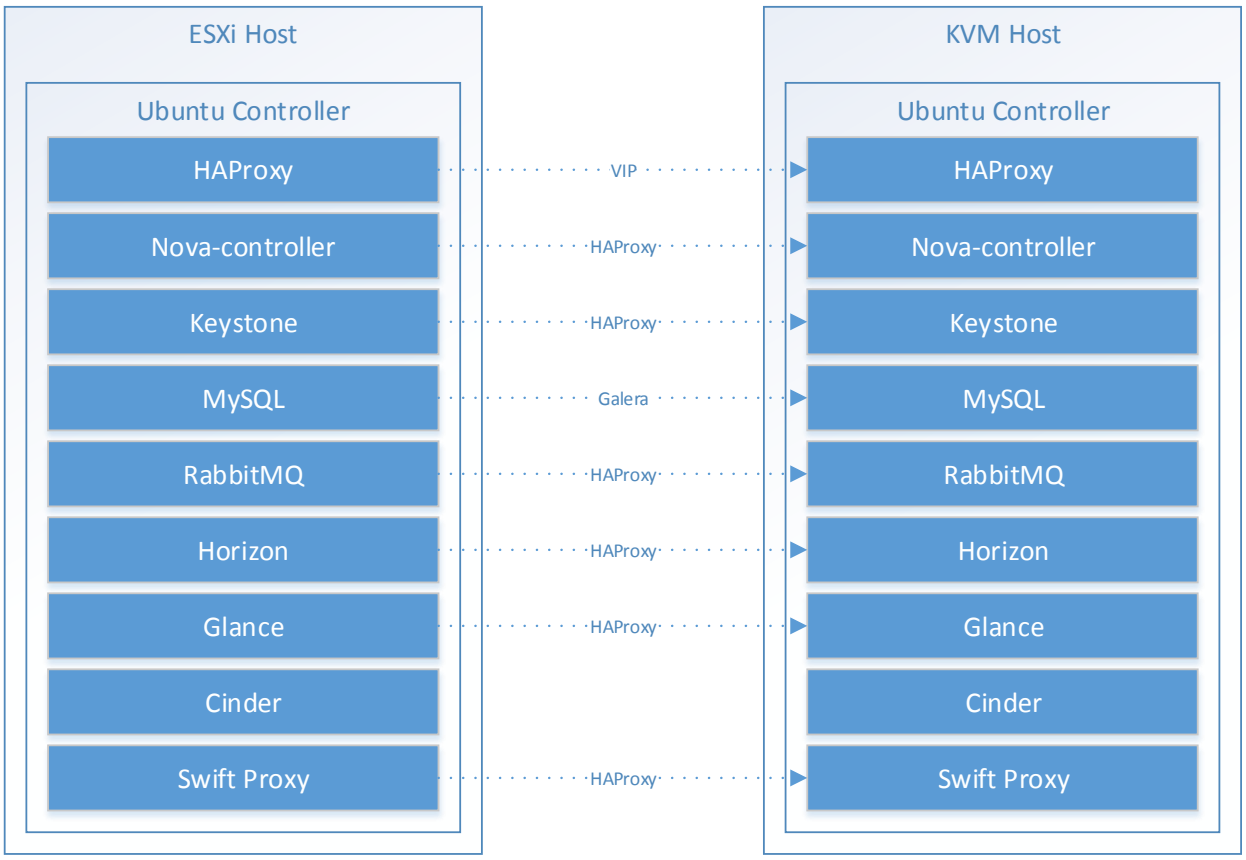




vSphere HA



OpenStack HA



- Site Considerations

The vSphere management and compute clusters are both residing within the same facility. This will provide the lowest latency for management as well as a consistent datacenter in which to manage the clusters.

There are no other sites that are in scope for this project.

    - Design Specifications
- vSphere Architecture Design – Management Cluster
    - Computer Logical Design
        - Datacenter

One vCenter datacenter will be built to house the two clusters for the vSphere environment.

        - vSphere Cluster

Below is the cluster configuration for the management cluster for the environment.

Attributes	Specification
Number of ESXi Hosts	2
DRS Configuration	Fully Automated
DRS Migration Threshold	Level 3
HA Enable Host Monitoring	Enabled
HA Admission Control Policy	Disabled
VM restart priority	Medium – vCenter and vCenter DB set High priority
Host Isolation response	Leave powered on
VM Monitoring	Disabled

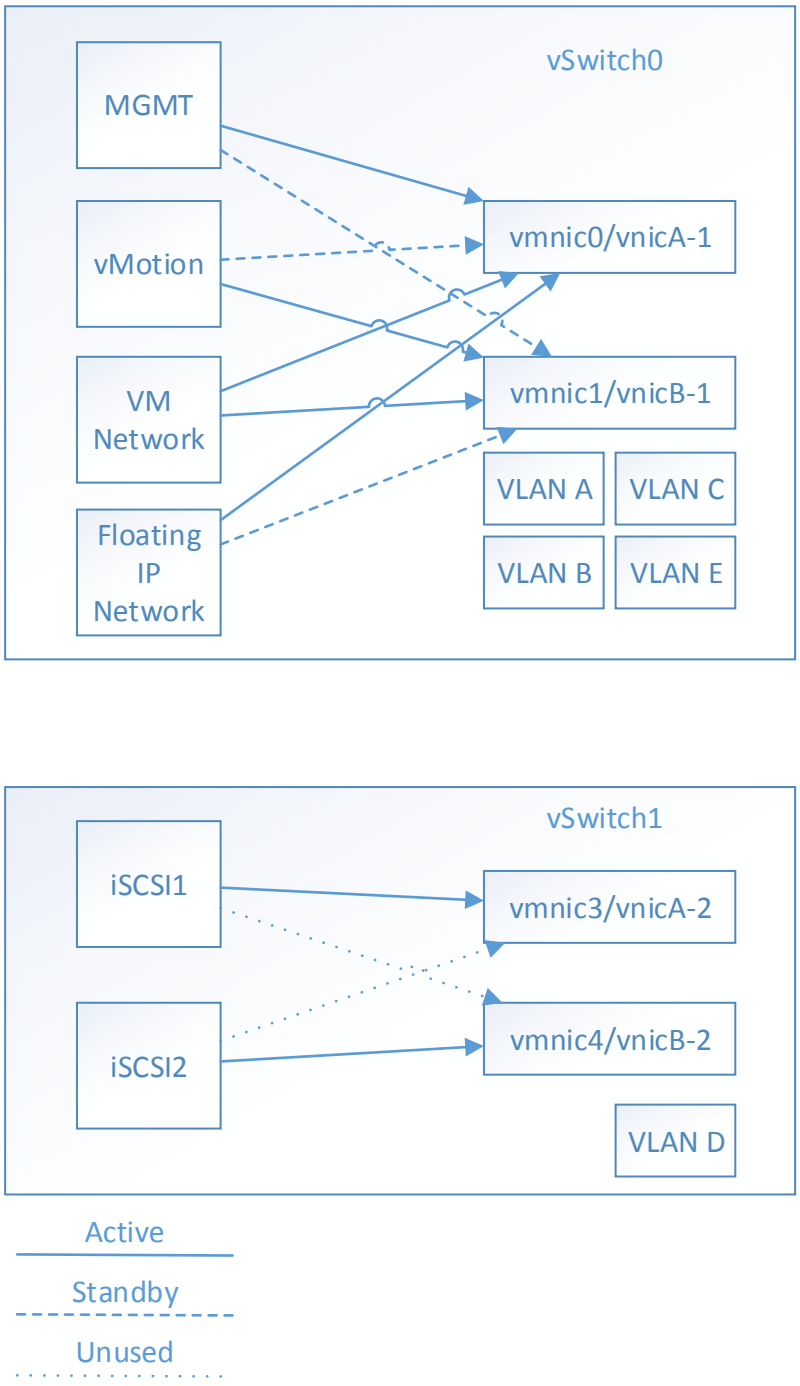
        - Host logical Design

Attribute	Specification
Host Type and Version	VMware ESXi Installable
Processors	X86 Compatible
Storage	FlexFlash SD for local ESXi install, shared storage for VMs
Networking	Connectivity to all needed VLANS
Memory	Sized for workloads

        - Network Logical Design

Switch Name	Switch Type	Function	# of Physical Ports
vSwitch0	Standard	Management vMotion VM Network Floating IP Network	2x10Gbe
vSwitch1	Standard	iSCSI	2x10Gbe

The VIC 1225 in the Cisco C240 M3 allows the ability to split out 2 10Gbe Network connections into 256 vnics. The configuration is to create 4 vnics through the Service Profile, 2 with bindings to Fabric Interconnect A and Fabric Interconnect B. A pair of vnics, one going to either Fabric Interconnect, will compose the port group uplinks necessary for failover purposes and redundancy within the vSphere environment. This is illustrated below:



Port group configurations

Attribute	Setting
Load balancing	Route based on originating virtual port ID
Failover Detection	Link Status Only
Notify Switches	Yes
Failover Order	MGMT – Active vmnic0/Standby vmnic1 vMotion – Standby vmnic0/Active vmnic1 VM Network – Active vmnic3/Active vmnic4 Floating IP Network – Active vmnic0/Standby vmnic1 iSCSI1 – Active vmnic3/Unused vmnic4 iSCSI2 – Active vmnic4/Unused vmnic3

- Shared Storage Logical Design

Attribute	Specification
Number of LUNs to start	1
LUN Size	1TB
VMFS Datastores per LUN	1
VMs per LUN	4

- Management Components

This is the list of Management components that will be running on the management cluster:

- vCenter Server
- vCenter Database
- Active Directory
- Ubuntu Controller

- Management Components Resiliency Considerations

Component	HA Enabled?
vCenter Server	Yes
vCenter Database	Yes
Active Directory	Yes
Ubuntu Controller	Yes

- Management Server Configurations

VM	vCPUs	RAM	Disk1	Disk2	Disk3	Controller	Quantity
vCenter Server	2	16GB	40GB	200GB	N/A	LSI Logic SAS	1
vCenter Database	2	16GB	40GB	100GB	N/A	LSI Logic SAS	1
Active Directory	2	8GB	30GB	N/A	N/A	LSI Logic SAS	1

Ubuntu Controller	4	16GB	100GB	N/A	N/A	LSI Logic SAS	1

- vSphere Architecture Design – Compute Cluster
  - Computer Logical Design
    - Datacenter

One datacenter will be built to house the two clusters for the environment.

- vSphere Cluster

Attributes	Specification
Number of ESXi Hosts	3
DRS Configuration	Fully Automated
DRS Migration Threshold	Level 3
HA Enable Host Monitoring	Enabled
HA Admission Control Policy	Disabled
VM restart priority	Medium -
Host Isolation response	Leave powered on
VM Monitoring	Disabled

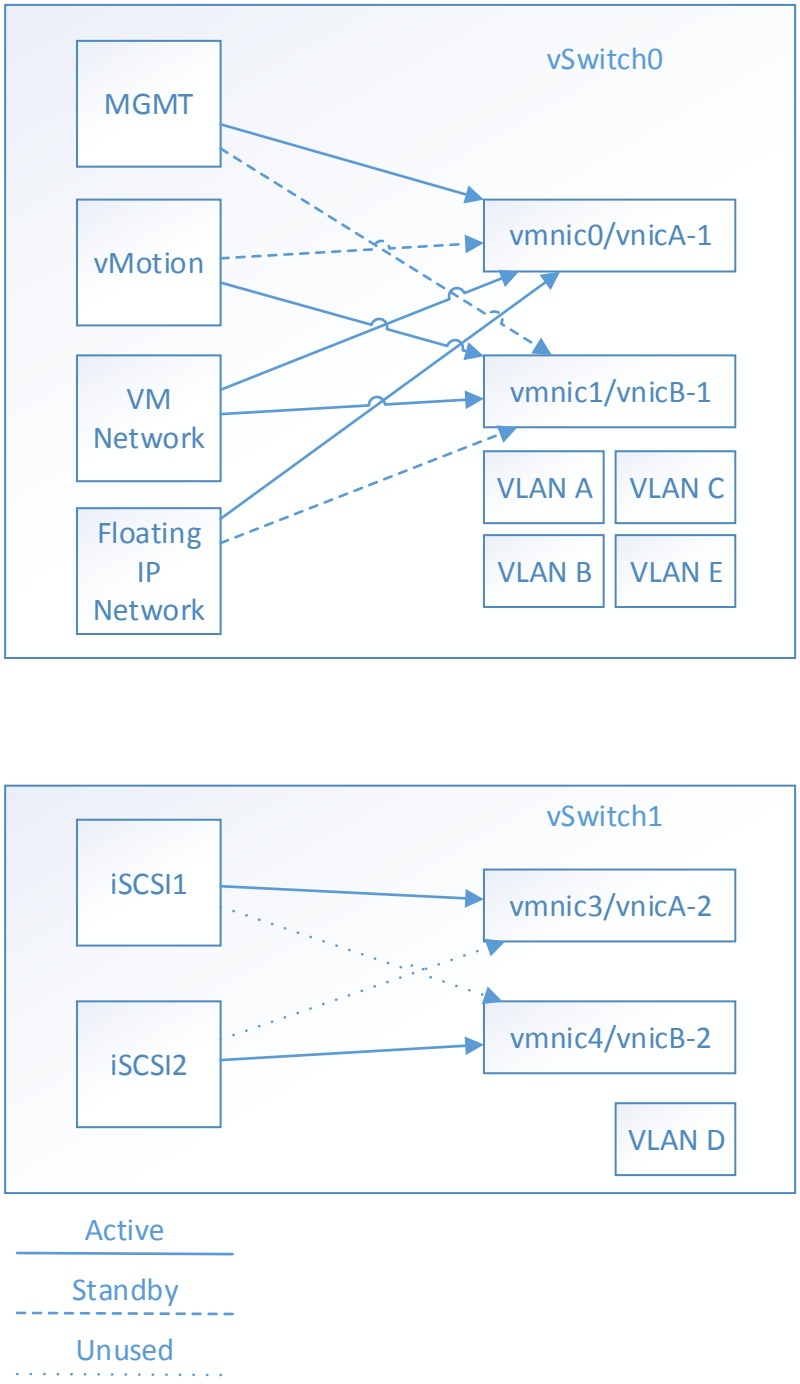
- Host Logical Design

Attribute	Specification
Host Type and Version	VMware ESXi Installable
Processors	X86 Compatible
Storage	FlexFlash SD for local ESXi install, shared storage for VMs
Networking	Connectivity to all needed VLANS
Memory	Sized for workloads

- Network Logical Design

Switch Name	Switch Type	Function	# of Physical Ports
vSwitch0	Standard	Management vMotion VM Network Floating IP Network	2x10Gbe
vSwitch1	Standard	iSCSI	2x10Gbe

The network configuration for the Compute Cluster follows the exact same pattern as that of the Management cluster for simplicity.



Port group configurations

Attribute	Setting
Load balancing	Route based on originating virtual port ID
Failover Detection	Link Status Only
Notify Switches	Yes
Failover Order	MGMT – Active vmnic0/Standby vmnic1 vMotion – Standby vmnic0/Active vmnic1

	VM Network – Active vmnic3/Active vmnic4 Floating IP Network – Active vmnic0/Standby vmnic1 iSCSI1 – Active vmnic3/Unused vmnic4 iSCSI2 – Active vmnic4/Unused vmnic3

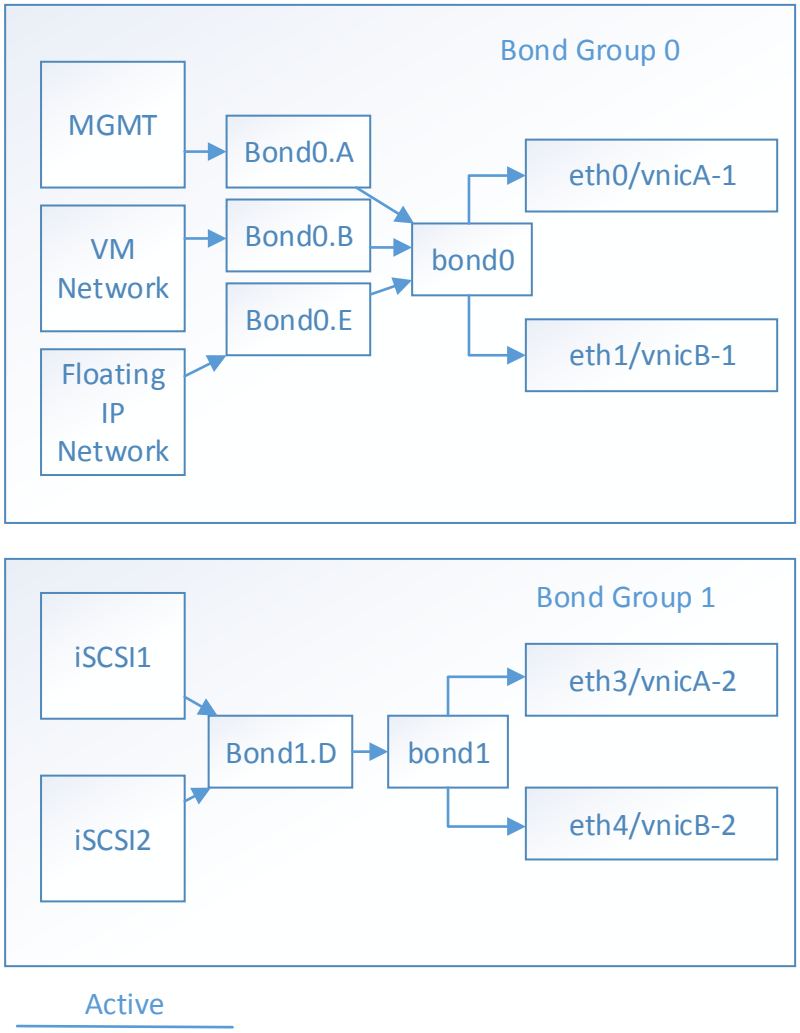
- KVM Architecture Design – Management Cluster
  - Host logical Design

Attribute	Specification
Host Type and Version	Ubuntu 14.04 LTS
Processors	X86 Compatible
Storage	FlexFlash SD for local KVM install, shared storage for VMs
Networking	Connectivity to all needed VLANS
Memory	Sized for workloads

    - Network Logical Design

Switch Name	vBonds	Function	# of Physical Ports
Bond Group1	Bond0.A Bond0.B Bond0.D	Management vMotion VM Network Floating IP Network	2x10Gbe
Bond Group2	Bond1.E	iSCSI	2x10Gbe

The VIC 1225 in the Cisco C240 M3 allows the ability to split out 2 10Gbe Network connections into 256 vnics. The configuration is to create 4 vnics through the Service Profile, 2 with bindings to Fabric Interconnect A and Fabric Interconnect B. A pair of vnics, one going to either Fabric Interconnect, will compose the port group uplinks necessary for failover purposes and redundancy within the KVM environment. This is illustrated below:



KVM uses a uniquely different type of connection binding called a bond. A Bond is split into a bond per VLAN necessary.

- Shared Storage Logical Design

Attribute	Specification
Number of LUNs to start	1
LUN Size	200GB
VMs per LUN	1

- Management Components

This is the list of Management components that will be running on the management cluster:

- Ubuntu Controller
  - HAProxy
  - Nova-controller
  - Keystone

- MySQL
- RabbitMQ
- Horizon
- Glance
- Cinder
- Swift Proxy

- Management Components Resiliency Considerations

Component	Live Migration
Ubuntu Controller	Yes

The KVM hypervisor supports Live Migration, however the process is a manual one, K02.

- Management Server Configurations

VM	vCPUs	RAM	Disk1	Disk2	Disk3	Controller	Quantity
Ubuntu Controller	4	16GB	100GB	N/A	N/A	LSI Logic SAS	1

- KVM Architecture Design – Compute Cluster

Attributes	Specification
Number of KVM Hosts	3

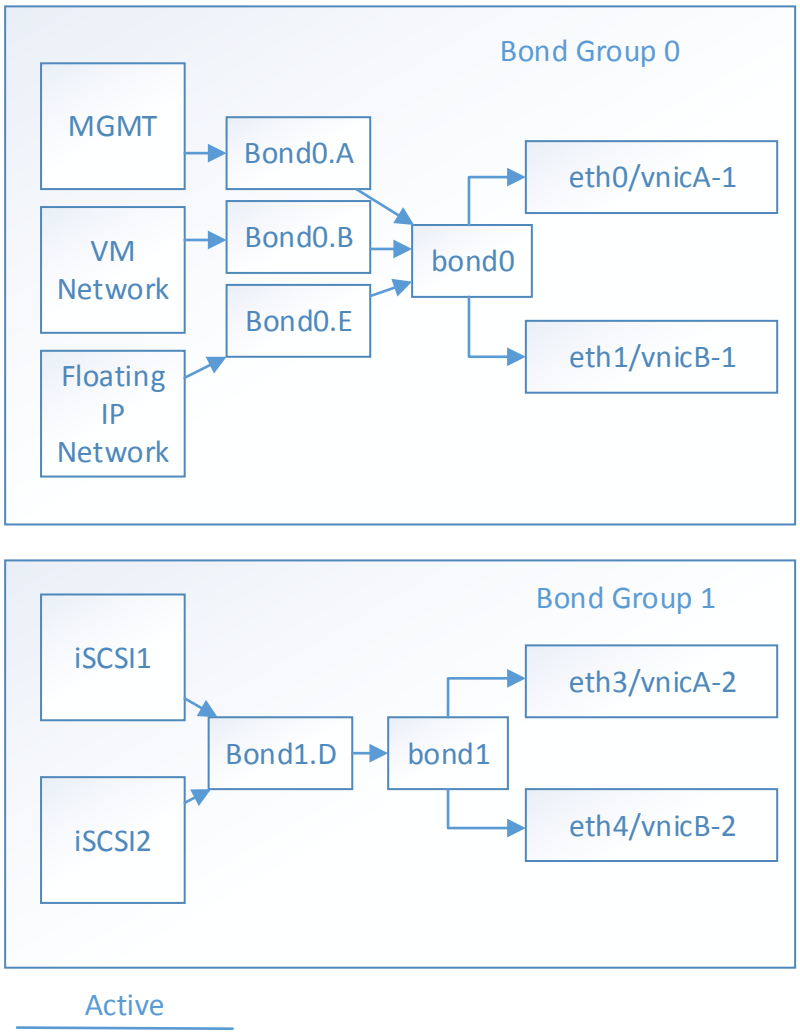
- Host Logical Design

Attribute	Specification
Host Type and Version	Ubuntu 14.04 LTS
Processors	X86 Compatible
Storage	FlexFlash SD for local KVM install, shared storage for VMs
Networking	Connectivity to all needed VLANS
Memory	Sized for workloads

- Network Logical Design

Switch Name	vBonds	Function	# of Physical Ports
Bond Group1	Bond0.A Bond0.B Bond0.D	Management vMotion VM Network Floating IP Network	2x10Gbe
Bond Group2	Bond1.E	iSCSI	2x10Gbe

The network configuration for the Compute Cluster follows the exact same pattern as that of the Management cluster for simplicity.



Attribute	Specification
Number of LUNs to start	1
LUN Size	1TB
VMFS Datastores per LUN	1
VMs per LUN	4

SolidFire storage will be used for block storage. Swift is not able to produce block based storage. Also, vSphere needs block-based access that only SolidFire can provide. Use of SolidFire storage alleviates this problem.

- Compute Components

This is a list of the components that will be running on the compute cluster for the environment:

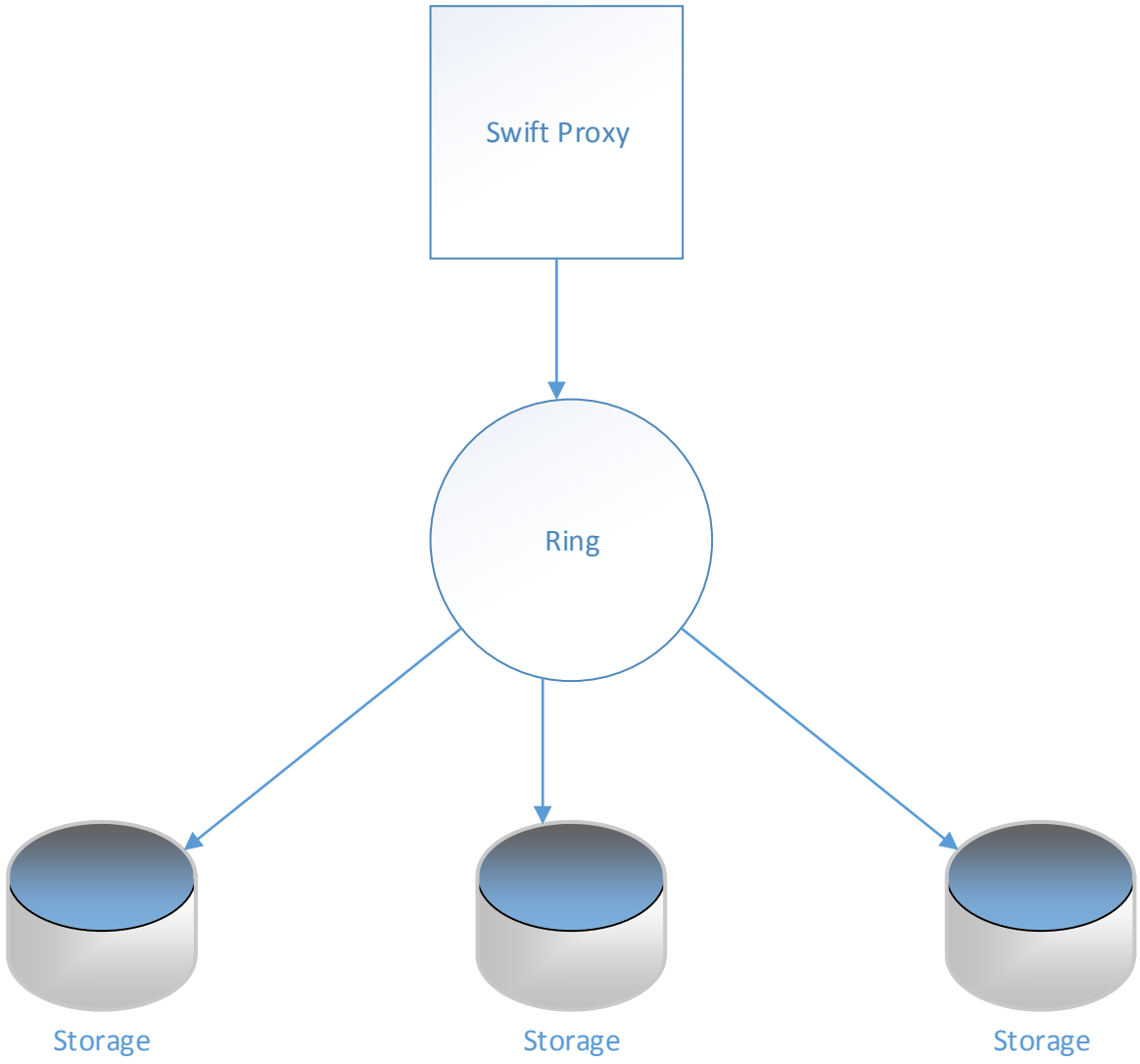
- Nova-compute

    - Storage Components
        - Swift – Object Storage Design

The Swift Object Storage access is controlled by the Swift Proxy. These proxies broker connections into the store. Each Swift Storage node is composed of six the following servers:

CPU	RAM	NIC	Power	Boot Storage	Internal Storage
2x2.8Ghz E5-2680	256GB – 1866Mhz	VIC 1225	Dual 750W	Dual SD Card	3x Intel S3700 DC 800GB

The SSDs provide the storage space necessary to provide the distributed storage. The SSDs are not put into any form of RAID and are made resilient through Swift rings.



- vSphere Security
    - Host Security

Hosts will be placed into lockdown mode to prevent root access. This would ensure that only access can be done through the DCUI.

    - Network Security

All virtual switches will have the following settings:

Attribute	Setting
Promiscuous Mode	Management Cluster – Reject Compute Cluster - Reject
MAC Address Changes	Management Cluster – Reject

	Compute Cluster – Reject
Forged Transmits	Management Cluster – Reject Compute Cluster - Reject

- vCenter Security

By default when vCenter is added to an Active Directory domain, the Domain Administrators group is granted local administrator permissions to the vCenter Server. A new vCenter Admins group will be created, appropriate users will be added to the group and that group will become the new local administrators on the vCenter Server. The Domain Administrators group will be removed.

Appendix A – Bill of Materials

Equipment	Quantity
Cisco 5596UP	2
Cisco 6296UP	2
Cisco C240 M3	18
SolidFire SF6010	10
Racks	4
PDUs	8