Reference Architecture for VMware Private Cloud IaaS 1000-5000 VM

WIPRO
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&

vmware®

Contents

1. Solution Theme Background 5

1.1 Private Cloud and Automation – Market Scenario 5

1.2 Joint solution theme introduction 5

1.3 Why Wipro and VMware for Private Cloud 7

1.4 Key Business Outcomes 8

2. Solution Requirement and Scope 9

2.1 Solution Requirement 9

2.2 Scope 12

2.3 Out of Scope 12

2.4 Assumptions and Dependencies 13

2.5 Design Considerations 14

3. Proposed Solution Approach 15

3.1 Solution Architecture 15

3.1.1 Hardware 19

3.1.2 Software 20

3.2 Conceptual Architecture 22

3.3 Logical Architecture 27

3.4 Physical Architecture 29

3.5 Solution Components 30

3.6 Sizing 32

3.6.1 Compute Sizing for 1000 VMs 32

3.6.2 Compute Sizing for 2000 VMs 32

3.6.3 Compute Sizing for 3000 VMs 32

3.6.4 Compute Sizing for 4000 VMs 33

3.6.5 Compute Sizing for 5000 VMs 33

3.6.6 IOPS Sizing for 1000 VMs 34

3.6.7 IOPS Sizing for 2000 VMs 35

3.6.8 IOPS Sizing for 3000 VMs 36

3.6.9 IOPS Sizing for 4000 VMs 37

3.6.10 IOPS Sizing for 5000 VMs 38

3.6.11 Datastore Sizing Estimate 40

3.6.12 VCAC VM Sizing Estimate 41

3.6.13 ITBM VM Sizing estimate 41

3.6.14 SRM Sizing 44

3.6.15 vCenter Operations Sizing 45

3.6.16 Backup-VMware Data Protector sizing 46
3.7 Virtualization 47
3.8 Network 48
3.9 Storage 52
3.10 Access Control 55
3.11 Operations Management 61
3.12 Disaster Recovery 69
3.13 Backup 72
3.14 Automation 73
3.15 Blue Prints 75
3.16 Security Solution 77
3.17 Metering and Chargeback 78
3.18 Private Cloud Solution 79
3.18.1 vCAC Virtual Appliances: 80
3.18.2 Identity Appliance (SSO): 80
3.18.3 Databases: 81
3.18.4 ITBM Standard Edition: 81
3.18.5 vCloud Application Director 81
3.18.6 vCAC IaaS Web tier: 81
3.18.7 vCAC IaaS Manager Service (aka Application Server): 82
3.18.8 Model Manager Service vs. Model Manager Data: 82
3.18.9 vCenter Orchestrator 82
4. Implementation Approach 84
4.1 Phases & Activities 84
4.2 Deliverables 88
4.3 Project Schedule 90
4.4 Roles and Responsibilities 91
4.5 Implementation Methodology 93
4.6 Risk Mitigation Plan 93
4.7 Project Management and Tools 93
4.8 Delivery Model 93
5. Investment 93
5.1 Tools / Software 93
5.2 vCloud Suite Licensing 93
5.3 vCloud Suite Editions 94
6. ROI Analysis 98

7. Joint Case Studies 102
8. Bill of Material of the Reference Architecture 103
8.1 Compute 103
8.2 Network 108
8.3 Storage 109
8.4 VMware 113
9. Reference Documents 114

1. Solution Theme Background

1.1 Private Cloud and Automation – Market Scenario

The transformation journey for enterprise clients has evolved from IT centric model to a service centric model driven by business and the business is looking for next generation cloud platform which gives not only enhanced agility for existing services apart from enabling faster introduction of new products and services.

Also clients are looking at enhanced automation to reduce the cost of running the business estimated to be 66% of the overall spend which will creating funds for innovation.

As per Gartner's survey conducted in 2013, 44% of large enterprises polled have deployed a private cloud service (both Production & Pilot), 45% are planning and only 11% have no plans to do so through 2014. Also while actual hybrid cloud computing deployments are rare, 70% of large enterprises expect to have hybrid deployments by 2015.

To address this key trend, Wipro & VMware have come up with this joint "Private Cloud Automation" solution based on the key trends below of next generation data centers

- Provides a fully customizable self-service portal for end users.
- Provides a service catalog with automation and approval workflows
- Provides logical separation for each business unit with shared service IT
- Provides infrastructure service offerings for virtual machines
- Provides orchestration and policy based placement for infrastructure workloads
- Provides infrastructure cost visibility to the provided services

1.2 Joint solution theme introduction

This Joint solution for Private Cloud is outlines the conceptual, physical, and logical design considerations for vCloud Automation Center core, distributed execution, and integration components to demonstrate the capability of the following concepts and technologies:

- The vCloud Automation Center Self-Service Portal
- Approval workflows
- Automated IaaS Provisioning
- "Showback" of costs for infrastructure services
- Role based Access Controls

Wipro proposes a fully integrated solution along with Design, Implement and Managed Services from Wipro.

Key solution highlights:

1) **Portal Integration and Orchestration**

   - Based on a shared services model, using pools of compute, storage, and network resources
   - As an ideal platform for a cloud infrastructure with VMware Cloud Advanced Suite either running on VBLOCK or HP Converged Infrastructure
   - Infrastructure designed for 1000 to 5000 VMs spread across 2 Active-Active data centers

2) **VMware VCAC**

   VMware VCAC based private cloud which would be designed and implemented by Wipro. The private cloud services are delivered to ease to the customer's Private cloud journey, to simplify the journey the services are delivered as packages. We discuss about the packages and the Private Cloud delivery model in detail in the Implementation section below.

3) **Implementation Services from Wipro**

   - Cloud assessment & design
     - Business case
     - Application profiling
     - Migration plan & design
   - Infrastructure assessment & design
   - Infrastructure procurement
   - DC readiness
   - Set up of Server and Storage
   - Setup of other hardware required in the datacenter

- Configuration & testing
- Images & Templates
- Migration
- Testing
- Implementation of Automation
- Implementation of Self Service Portal
- DR design & implementation
- User Acceptance Testing
- Transition to Managed Services

1.3 Why Wipro and VMware for Private Cloud

Why VMware?

<Please fill it here>

Why Wipro

- # 1 Indian Infrastructure services provider globally with 2.05 Bn $ revenue

- Comprehensive suite of cloud services
  - Cloud advisory services
  - Cloud enabled Infrastructure transformation
  - Cloud enabled application transformation,
  - SaaS based process transformation,
  - PaaS for HR, F&A, Vertical processes,
  - Cloud integration services
- ServiceNXT Operations Center for single pane of glass for managing infrastructure in Private or Public or Hybrid Cloud – recognized by Gartner
- Comprehensive DC Services viz. Consulting, Systems Integration, Run & Operate services
  - 1.1 Billion revenue through large DC services in 2013-14 driven by large transformation deals

- Outcome based engagement model (e.g. Revenue per policy subscribed, Revenue per loan subscribed)

- Hosting services – owned as well as through partners
  - Own DCs in US, Germany, India
  - iStructure IaaS offering with flexible pay per use model (based on VMware Platform)
  - Partner DCs in US, Europe, APAC
- ServiceNXT – Next Generation Integrated Managed Services Offering across Applications , Infrastructure, Cloud, Security leveraging Wipro IPs with respect to automation

1.4 Key Business Outcomes

Following are the key business benefits derived from the private cloud implementation:

- Secure multi-tenancy for lines of business (LOB).
- Leveraging existing investments in both private and public clouds.
- Efficient provisioning, sharing, and management of virtualized resources.
- Self-service user portal with approval workflows.
- Standard catalog of business and IT services that can be created, managed, and maintained.
- Standard catalog of predefined virtual machines and applications with usage metering.
- Linking with other vCloud services within or beyond the boundaries of the enterprise.
- Improved collaboration and asset sharing – enabling a unified environment for developers and testers within client business & IT teams to collaborate seamlessly resulting in transforming from a siloes of infrastructure and processes to an integrated and consolidated "infrastructure /processes"
- Improved operational efficiency as this solution brings together virtualized compute, with analytics-based, simplified operations management to drive greater resource utilization and staff productivity leading to up to 50 percent CapEx and up to 70 percent OpEx savings.
- This solution enables on-demand deployment of IT services in minutes with full control over critical business and IT policies, while automatically matching infrastructure resources to continually changing business demand and workload needs.
- The solution delivers the highest levels of application uptime, through automated business continuity along with virtualization-aware security and compliance, and enables greater control over the cost of, access to, and placement of IT services.

Solution Benefits Summary:

Private Cloud Delivered as a Package: This is a unique business proposition to the customer where the private cloud is delivered to the customer as a packaged solution.

Unique delivery model specifically designed for the cloud era delivering key solution components as bundles.

2. Solution Requirement and Scope

2.1 Solution Requirement

For data center transformation and technology refresh opportunities, system integrators like Wipro can use a highly standardized and repeatable Private Cloud Reference Architecture this joint reference architecture is built for 1000,2000,3000,4000 and 5000 VMs spilt equally across 2 active-active or multiple sites.

Deliverables to be created:

1. Detailed Reference Architecture document with Solution Architecture, Implementation Details and Pricing/TCO-ROI analysis
2. L1 PPT – Strategic and Business Value Proposition of Wipro-VMware Private Cloud solution
3. L2 PPT - Technical Value Proposition of the Wipro-VMware Private Cloud solution with solution details
4. Marketing Brochure
5. White Paper

Detailed Technical Requirement to be considered for the Private Cloud scenario: 1000 VMS

- Two data centers – active-active setup – 30 KM apart. Synchronous replication between the two.
- 500 VM per site
- Break down of the 1000 VMs to four VM types as described below:

VM Sizing Requirement	VM Types ==>	Extra Large	Large	Medium	Small
	vCPU ->	8	4	2	1

	RAM (GB) ->	32	16	8	4
	Storage (GB)	400	200	100	50
Breakdown of VM's		**5%**	**15%**	**40%**	**40%**

- For each site, out of 500 VM: 300VM are in non-production environment and 200VM are in production environment.
- There will be a CPU over commitment of 1:2 in Production Environment and 1:3 in Non-Production Environment
- No memory over-commitment in production environment
- VMware ESX will be the hypervisors to be used.
- The environment will be running common enterprise applications – including web application, Oracle, MS SQL, SAP etc.
- CPU and Memory utilization of production systems should not go beyond 80%
- As this is a cloud environment capacity would be added as and when the utilization reaches 70% or more.
- IOPS per production VMs = 80/150 (for sap's or databases)
- IOPS per non-production VMs = 40.
- Apart from the VM storage, following are additional storage requirement for the environment:
    - File share – 10TB
    - ISO Image – 1TB
    - Templates – 1TB
- Need to include additional infrastructure resources (4 Rack + 1TB Storage) for testing infrastructure software (like VMware) patches.
- Need to include additional infrastructure resources for infrastructure VMs/servers like for monitoring and management applications.
- Replication will happened both ways – only for the 200 production VMs each site
- A unified Service Catalog/Self Service Portal with Multi-Tenancy Capability
- A Single Management Platform capable of handling the Provisioning requests across the environments like Private Cloud, Public Cloud and/or Managed Cloud Environments
- Monitoring/Management system for better service assurance either through in-solution components or through integration to external monitoring/management systems.

- Integration to ITSM for Proper Approval Flows and/or Change and Release Management.
- Capable of Managing Provisioning paths from Infrastructure and expansion capabilities to Application.
- Seamless Automated Provisioning till the application layer (With the ability of adding additional capabilities as part of future expansion).
- Ability to Meet Compliance and configuration requirements based on individual organization policies.
- Ability to manage various approval processes flows depending on the tenant/organization.
- Resource management based on the tenant and the catalog i.e. provisioning from respective resources of the tenant (In a multi-tenant environment)
- Supporting distributed architecture for scalability and manageability.

2.2 Scope

The Private Cloud solution should include the following features

- Automate Provisioning
- Self-Service
- Multi-tenancy and Secure logical separation of business groups
- Workload-optimized storage
- Elasticity and service assurance
- Monitoring
- Metering and chargeback
- Backup and Recovery services

The reference architecture should also include:

- Implementation/Deployment Approach
- Operational Guidelines – how to sustain the solution environment under 'managed services'
- Investment needed and TCO/ROI analysis

2.3 Out of Scope

- Step-by-step implementation and operations guide
- Non-x86 environments
- Any application or database environment is out of scope in Phase 1
- Backup is out of scope in Phase 1
- Load balancers design is out of scope in Phase 1
- vSphere, vCloud Director, Any other third party Provisioning infrastructure design is out of scope
- Integration with ITBM environments is Out of scope in Phase1
- Specific needs of each customer, as well as multiple and varying business needs, with a nature of extensibility.

2.4 Assumptions and Dependencies

- Active Directory Access to Active Directory Server.
- Microsoft and Other operating system licenses would be factor in a customer engagement and based on the requirements
- NTP an NTP service is available or provided for all servers and services.
- Media All required media is provided by Customer in ISO or FLP format.
- Databases: Dedicated database server-to-host vCloud Automation Center database.
- DNS: Name resolution for all servers occurs and FQDNs work as expected.
- Virtual machine templates Virtual machine templates are expected to exist in vSphere
- Network addresses Sufficient number of IP addresses
- Over commitment: Once the compute/storage/network capacity has reached 70% of utilization we have to make sure to order/add additional hardware.
- Compute:
- It is expected that same level of performance would not be required at the DR.
- File share, ISO image template, testing patch and buffer space on NLSAS disks.
- ESX Snapshots will be used.
- A read Write ratio of 70:30 has been considered for the iops calculations.
- Skew is assumed to be 80:20.
- Product licenses

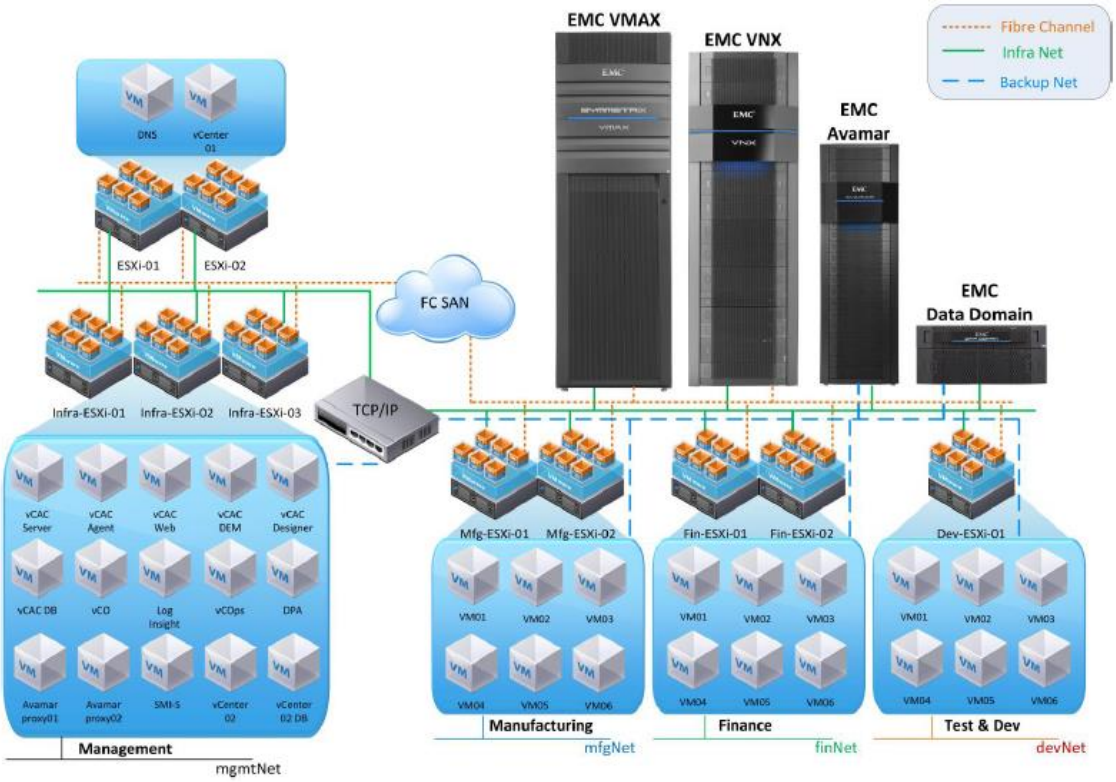
2.5 Design Considerations

- The Private Cloud reference architecture to be created needs to differentiate Wipro from the run-of-the-mill Infrastructure-as-a-Service solutions capable of provisioning and managing only up to the virtual machines layer
-
- 1:1.5x over commitment in production environment
- 1:2.5x over commitment in non-production environment
- Standard backup policy to be considered – for D2D and Tape(Phase 2)
- RPO = 0 for the disaster recovery solution design. RTO to be decided by the end-customer as per the application criticality.
- During a full disaster scenario (when one site is taking the load of both the sites), there will be performance degradation in both compute and storage layer since there is some extra buffer CPU capacity or Storage components have been considered. To counter it and to minimize the performance impact during a disaster scenario is to shut down the non-production environment and to use the freed up resources for production workloads.
- Estimated number of VMs as part of Phase I is 1000 to start with and can be extended to meet the growth through flexible platform architecture and by adding the additional license components upon review.
- The Solution is designed to start with 1000VM requirement with IaaS and also by keeping the future expansion capability requirements to meet the future demand projected.

3. Proposed Solution Approach

3.1 Solution Architecture

The solution is designed for 1000 to 5000 VMs. This reference architecture is based on Cisco UCS servers for compute, Cisco Nexus network infrastructure and EMC VNX /VMAX storage respectively. For 1000 to 2500 VM infrastructure the EMC VNX series of storages could be used and for an environment where we might have to start with more than 2500 virtual machines in a Green field deployment. On a quick note this solution does not depend to be on the above mentioned hardware and can work with any of the vmware certified hardware



ESX Architecture

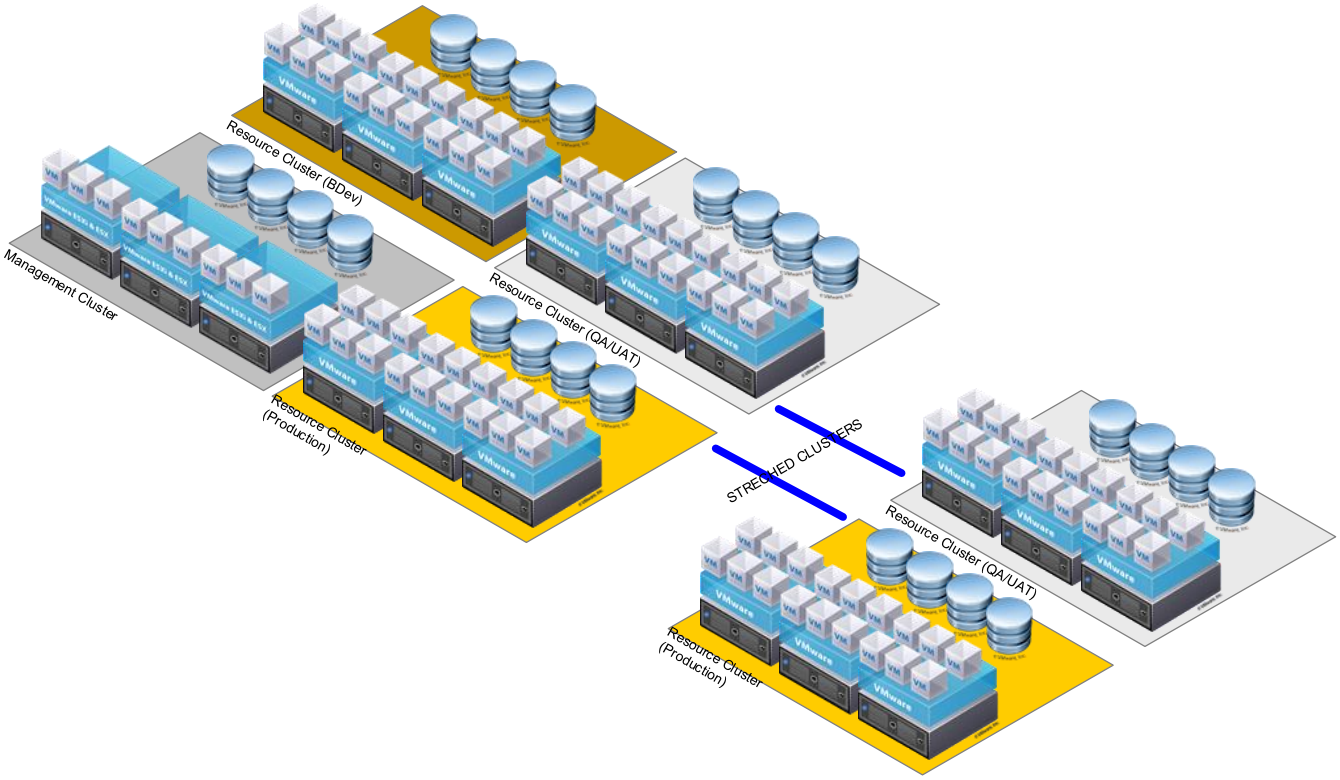
To support a vCloud solution, vSphere is deployed to provide the compute resource. vSphere resources are organized and separated into the management cluster and one or more resource clusters to provide the basis for Provisioning Infrastructure for use with vCAC . The management cluster is a VMware ESXi cluster dedicated to running the servers required to manage a vCloud infrastructure, and a Provisioning Infrastructure is a cluster dedicated to running end user virtual applications, referred to as vApps.

The separation of resources for management functions and end-user functions achieves the following:

- Management components are separate from the resources they are managing.

- Overhead for cloud consumer resources is minimized. Resources allocated for cloud use have little overhead reserved. For example, cloud resource groups do not host VMware vCenter virtual machines.
- Resources are dedicated to the cloud. Resources are consistently and transparently managed and carved up, and scaled horizontally.
- Troubleshooting and problem resolution are quicker as management components are strictly contained in a relatively small and manageable management cluster.

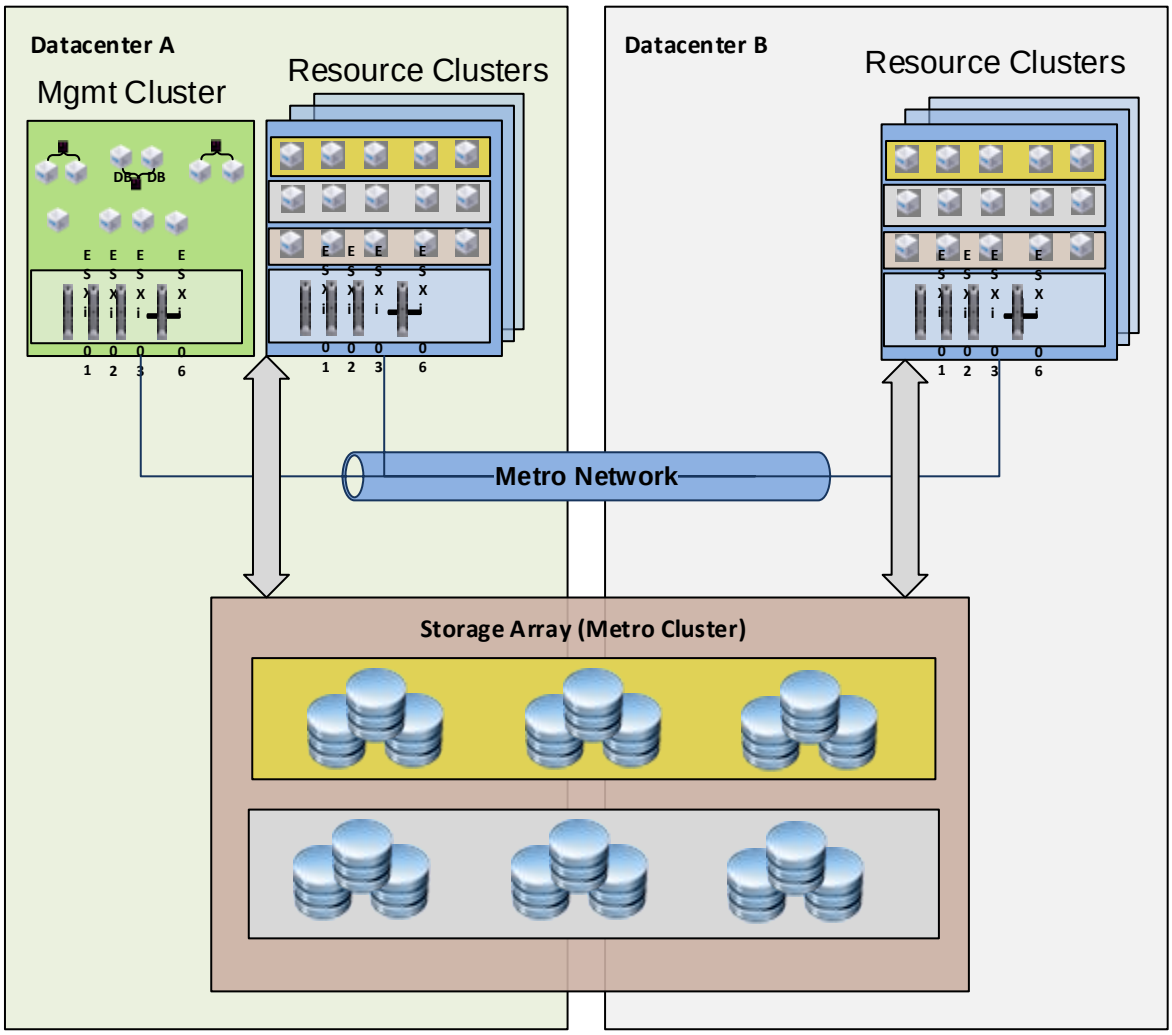
The following figure provides a logical depiction of the vSphere compute resources that are deployed to support the vCloud solution defined in this design.



This design requires four vSphere clusters. This provides compute resources required for a management cluster and three resource clusters, to host different type of Workloads. As shown in the picture above Resource Cluster (Production) & Resource Cluster (QA/UAT) is stretched across two Data Center. Stretched cluster solution enables workload balancing.

This design incorporates two Physical Data Centers. The distance between the Data Centers is 30 kms. Workloads are expected to be distributed across the DCs to form an Active-Active Design. The Management Cluster is a single Management cluster to manage both sites and will be protected using site Recovery Manager (SRM). The Resource Clusters for the PROD and QA/UAT servers will be in a Stretched cluster (Cluster

spanning across two DCs). The workloads in the Resource Cluster will be protected/recovered using Storage Metro Cluster.



Management Cluster

The management cluster hosts the necessary vCloud infrastructure components. Separating infrastructure components from resources used for end-user workloads improves manageability of the vCloud infrastructure.

The management infrastructure for this private cloud solution is critical to the availability of its supporting components. The solution has two management layers, which separate the virtual infrastructure into two tiers of resource management:

The management cluster hosts all virtual machines used for cloud-enabled infrastructure management. This supports the components responsible for functions such as the user portal, automated provisioning, monitoring, networking, security, and

metering. The resource clusters host all systems consumed by different organizations to support the business needs of the enterprise customer.

A vCenter server located in the management cluster manages the resource clusters supporting the various organizations within the enterprise. This vCenter server serves as the vSphere endpoint for vCAC. A separate, higher level vCenter Server instance manages all server and virtual machine components within the management cluster.

This instance can also be located in the management cluster, but, for the highest possible availability, is better located on a separate system.

EMC Avamar provides data protection for all levels of this private cloud solution, with agent-free, image-level backup, and the option of using an EMC Data Domain appliance as the backup target. While the virtual machines within the production resource clusters are automatically protected at provisioning time via customizations between vCAC and Avamar, the virtual machines in the management cluster are manually protected in the more traditional manner, through the Avamar administrative console.

The Management infrastructure would be of the components

- Microsoft Windows Server 2008 Standard R2 SP1 x64
- Cisco C220-A/B server
- VMware vSphere Server Enterprise Plus
- VMware vSphere Hypervisor ESXi, VMware Single Sign-On (SSO) Service, vSphere Web Client, vCenter Server, vCenter Database using Microsoft SQL Server 2008 Standard, vCenter Update Manager, vSphere client, vCenter Server, vSphere Replication appliances
- VMware VDS
- EMC PowerPath/VE License Management Server
- EMC Secure Remote Support (ESRS)
- Array management modules, including but not limited to, EMC Unisphere Client and Server, EMC Unisphere Service Manager, EMC VNX Initialization Utility, EMC VNX Startup Tool, EMC RecoverPoint management software that includes EMC RecoverPoint

3.1.1 Hardware

3.1.1.1. Hardware for 1k

Hardware	Quantity	Configuration	Notes
STORAGE			
EMC VNX5400/5700	1	SAS, NL-SAS, and flash disks	VNX offering unified block and file storage, including FAST VP and FAST Cache
Blade servers	50	• 2 x six-core Intel Xeon 5600 • 256 GB RAM • Converged network adapter	3 x UCS chassis, hosting 10 blades
Network			
Ethernet switch	4	10 GB Ethernet	Infrastructure Ethernet switch
San Switch	2	16/8 GB FC	For dual fiber channel fabric
Backup and Recovery(Validated add-on onto this solution)			
EMC Avamar	2	15 TB Capacity	Backup Appliance
EMC Data Domain	2	21.5 TB Capacity	DE duplication storage system appliance

3.1.2 Software

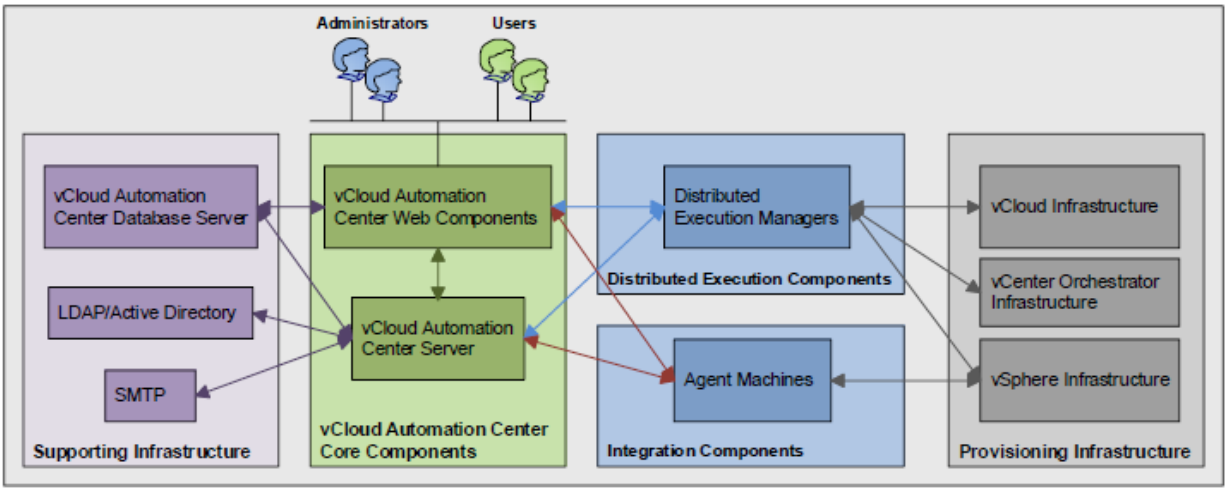
Software	Version	Notes
VMware virtualization and cloud infrastructure		
VMware vSphere ESXi		Virtualization platform providing abstraction of physical infrastructure layer for vCloud. This includes: • vSphere hosts. • VMware vCenter Server. vCenter Server database.
VMware vCenter Server		
VMware vCloud Automation Center		Enables rapid deployment and provisioning of vCloud services across private and public vCloud, physical infrastructures, hypervisors, and public vCloud providers through a secure self-service portal.
VMware vCenter Orchestrator		Enables the automation of provisioning and operational tasks across VMware and third-party applications using an open and flexible plug-in architecture
VMware vCenter Log Insight		
VMware vCloud Network and Security		Decouples network and security from the underlying physical network hardware through software-defined networking and security. This includes: • VXLAN support. • vCloud Networking and Security Edge gateway. • vCloud Networking and Security App and vCloud Networking and Security Data Security. vCloud Networking and Security Manager.
VMware vCenter Operations Management Suite		Provides predictive capacity and performance planning, compliance and configuration management, dynamic resource metering, cost modeling, and report generation using the following components: • vCenter Operations Manager. • vCenter Configuration Manager. vCenter Infrastructure Navigator

Microsoft SQL Server		
Microsoft Windows 2008		
EMC storage		
EMC Unisphere	1.6.0.8	Management software for EMC VMAX and EMC VNX
EMC VNX Operating Environment	Release 32	Operating environment for VNX block
EMC PowerPath®/VE	5.8	Multipathing and load balancing for block access
EMC and VMware integration		
EMC Virtual Storage Integrator (VSI)	5.6	EMC storage plug-in for VMware vSphere client
EMC Storage Analytics	2.0	EMC storage analytics adapter for VMware vCenter Operations Management Suite (storage analytics is a validated but optional component of the solution)
EMC backup and recovery (validated add-on to this solution)		
EMC Avamar	7.0	Avamar system software
EMC Data Domain Operating System (DD OS)	5.3.0.6	Operating system for Data Domain appliance
EMC Data Protection Advisor	6.0.1	Data protection management software
EMC data protection workflows for vCenter Orchestrator	N/A	For automating Avamar and Data Domain protection services

3.2 Conceptual Architecture

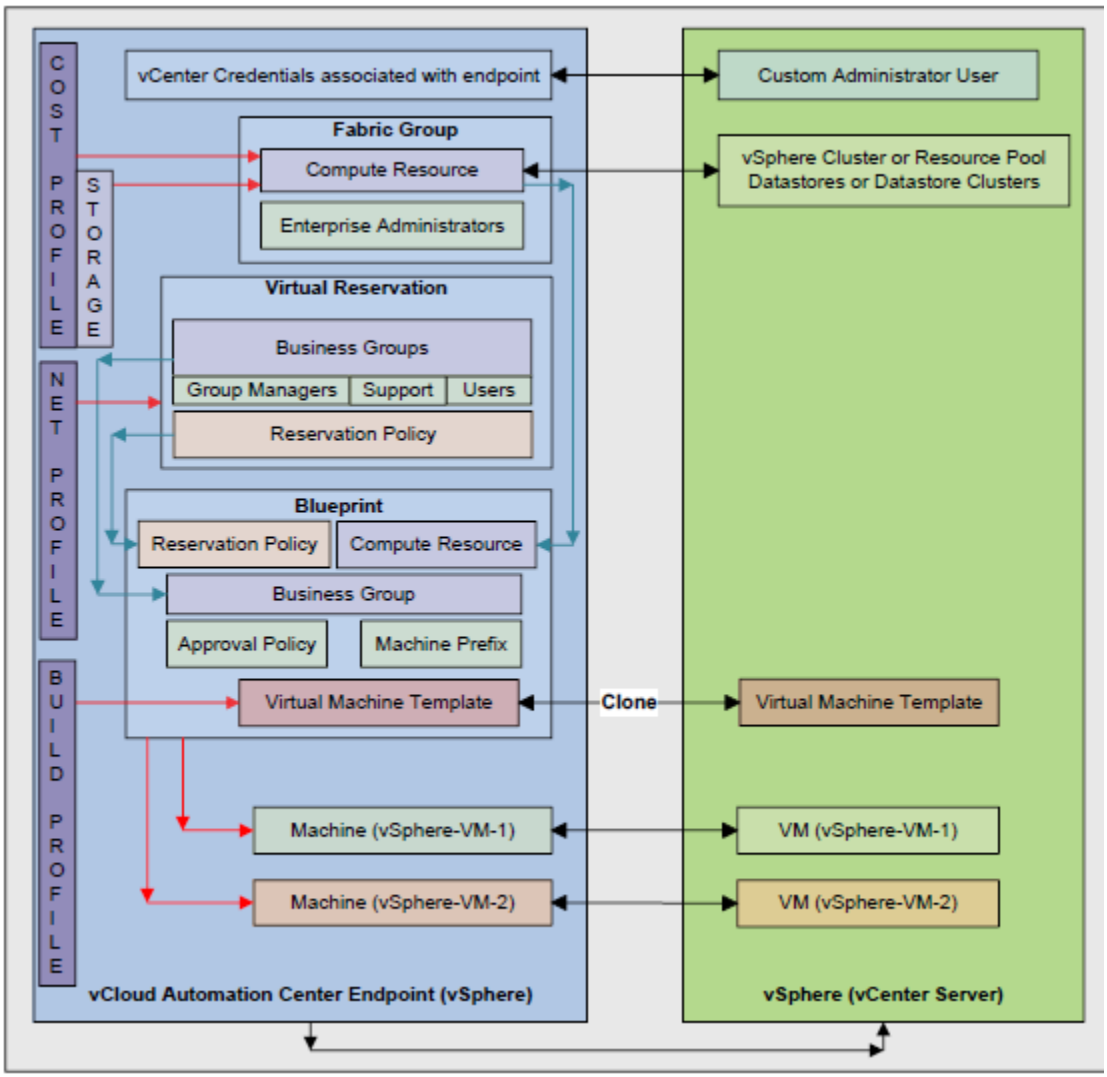
This section contains a high-level conceptual design that shows the Cloud Automation components and their integration with both internal and external systems.

The following figure outlines the conceptual design of the Cloud Automation platform components.

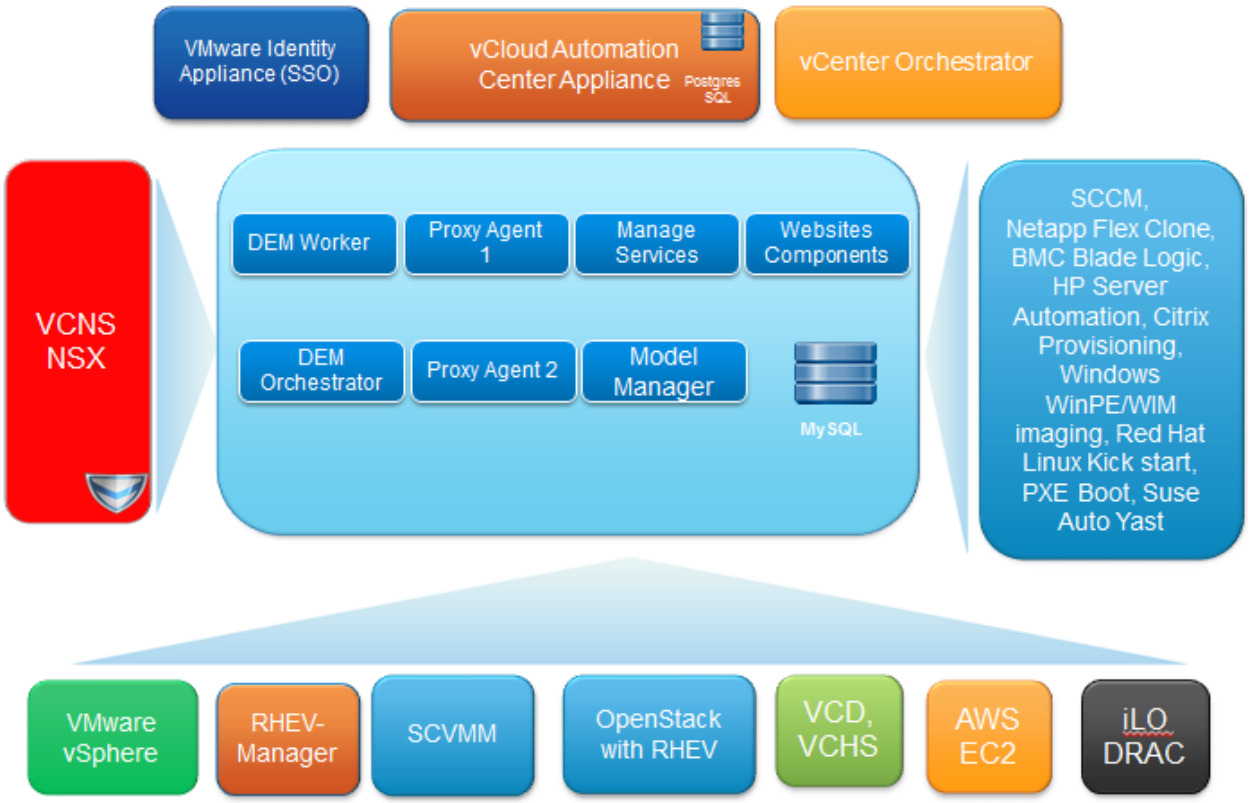


vSphere Logical Design

The following figure shows the logical design constructs discussed in the previous section as they would apply to a deployment of vCloud Automation Center integrated with vSphere.



VCAC Logical Design



Management Cluster Design

Infrastructure/Management Cluster

This design allows us to isolate the infrastructure and the cloud infrastructure. This infra would indeed be running on a dedicated infrastructure.

Management components resiliency considerations

4 Servers

2 Network Switches (for failover)

2 8 port FC Switches

EMC VNXE 3150 /similar storage could be used

Resource Group Logical Design

A fully loaded resource group can contain up to 350 ESXi hosts, giving an average VM consolidation ratio of 26:1 assuming a 5:1 ratio of vCPU:pCPU. To increase this ratio, we could increase the vCPU:pCPU ratio (based on the customer environment). The risk associated with an increase in CPU over commitment is mainly in degraded overall performance that can result in higher than acceptable vCPU ready times. The vCPU:pCPU ratio is based on the amount of CPU over commitment, for the available cores, that customer is comfortable with. For VMs that are not busy this ratio can be increased without any undesirable effect on VM performance. Monitoring of vCPU ready times helps identify if the ratio needs to be increased or decreased on a per cluster basis. A 5:1 ratio is a good starting point for a multi-core system.

vSphere Clusters

A vSphere cluster will scale to 25 hosts, allowing for up to 14 clusters per vCenter Server (the limit is bound by the maximum number of hosts per datacenter possible) and an upper limit of 10,000 VMs (this is a vCenter limit) per resource group.

The cluster would be in a single vCenter datacenter. The management cluster will be comprised of the following vSphere cluster.

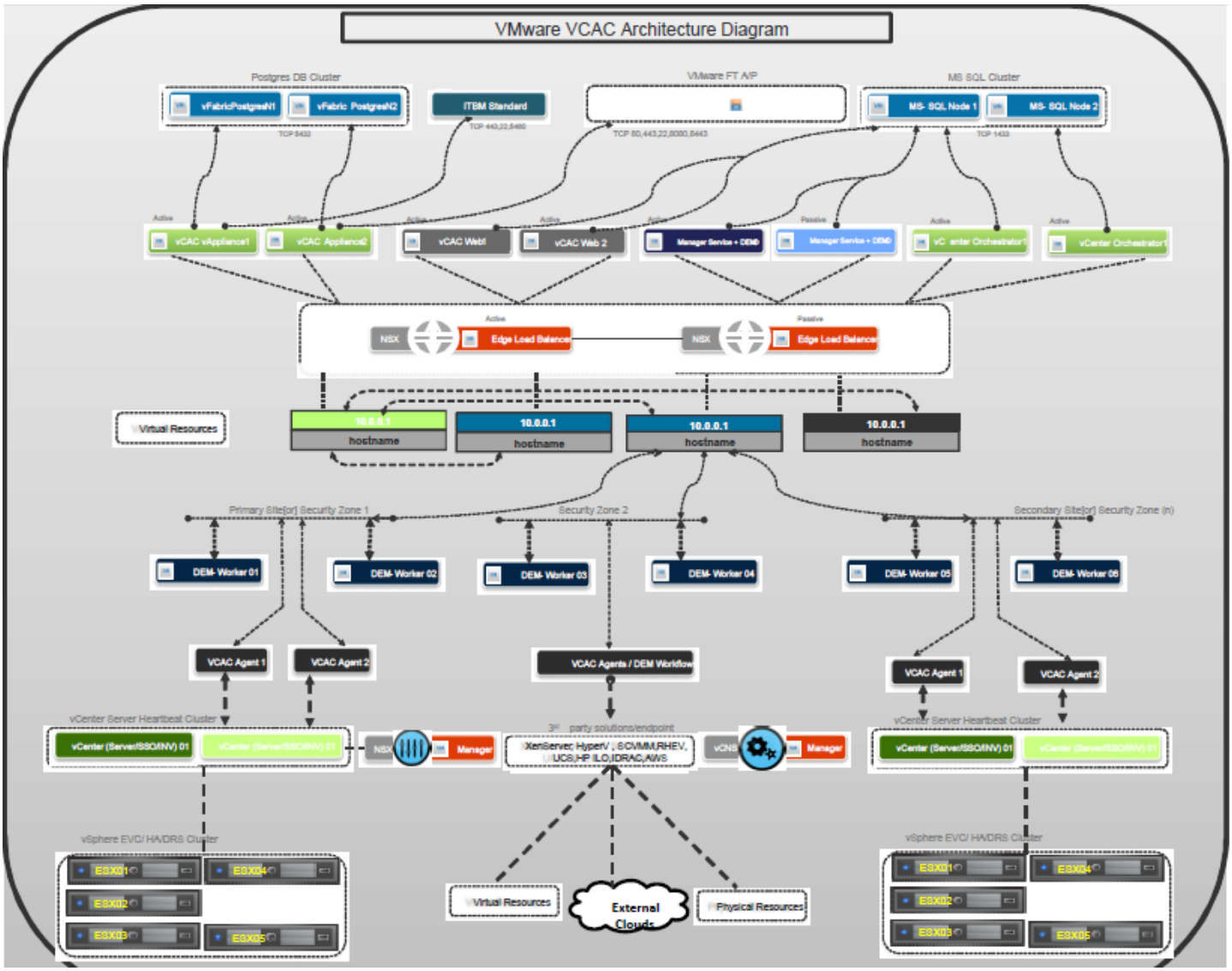
Cloud Cluster

DMZ

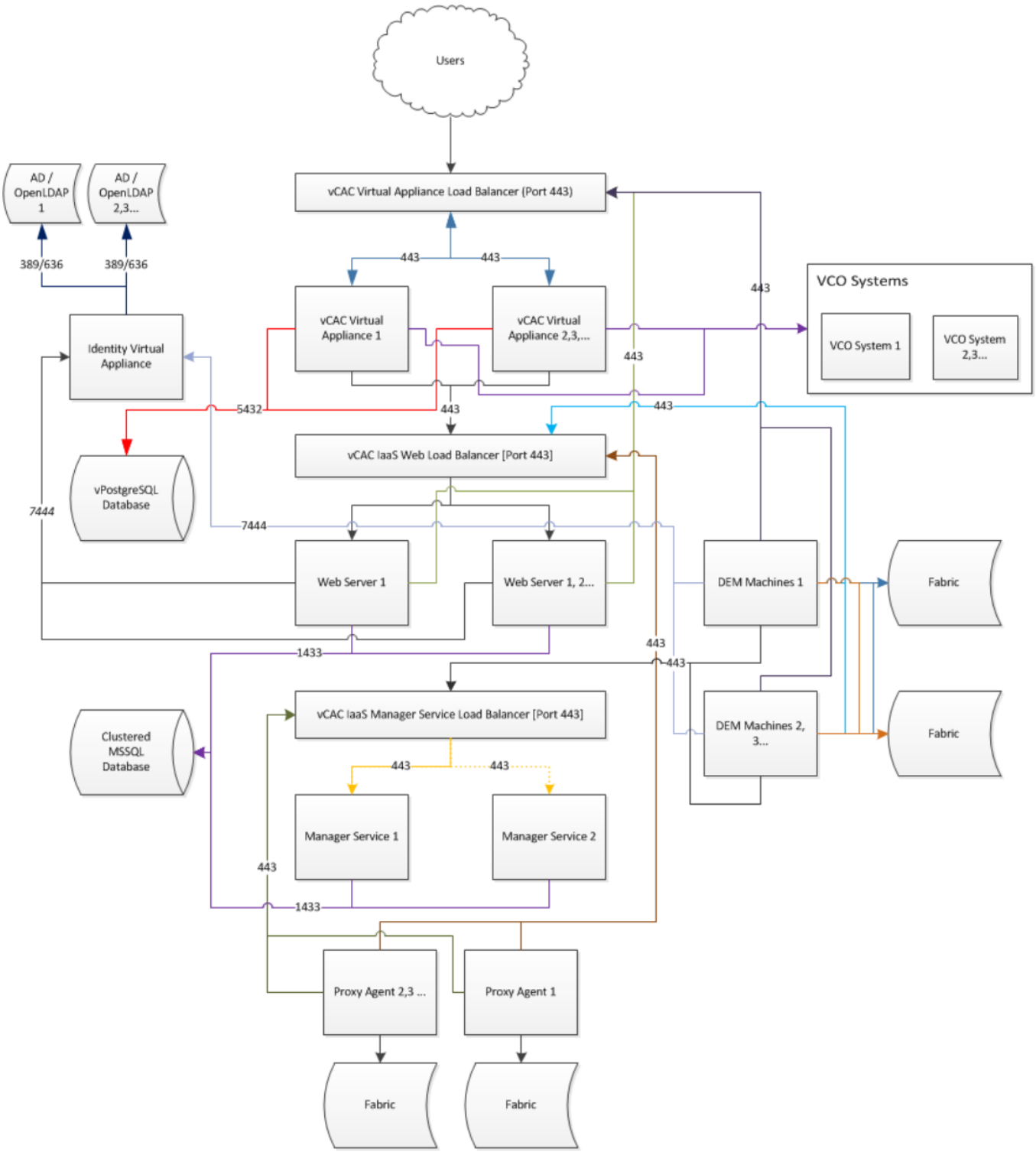
Testing

Architecture	Specification
Number of ESX Hosts	30
VMware DRS Configuration	Fully Automated
VMware DRS Migration Threshold	3 Stars
VMware HA Enable Host Monitoring	Yes
VMware HA Admission Control Policy	Cluster tolerances 2 host failure (percentage based)
VMware HA Percentage	10%
VMware HA Admission Control Response	Prevent VMs from being powered on if they violate availability constraints
Vmware HA Default VM Restart Priority	N/A
VMware HA Host Isolation Response	Leave VM Powered On
VMware HA Enable VM Monitoring	Yes
VMware HA VM Monitoring Sensitivity	Medium

3.3 Logical Architecture



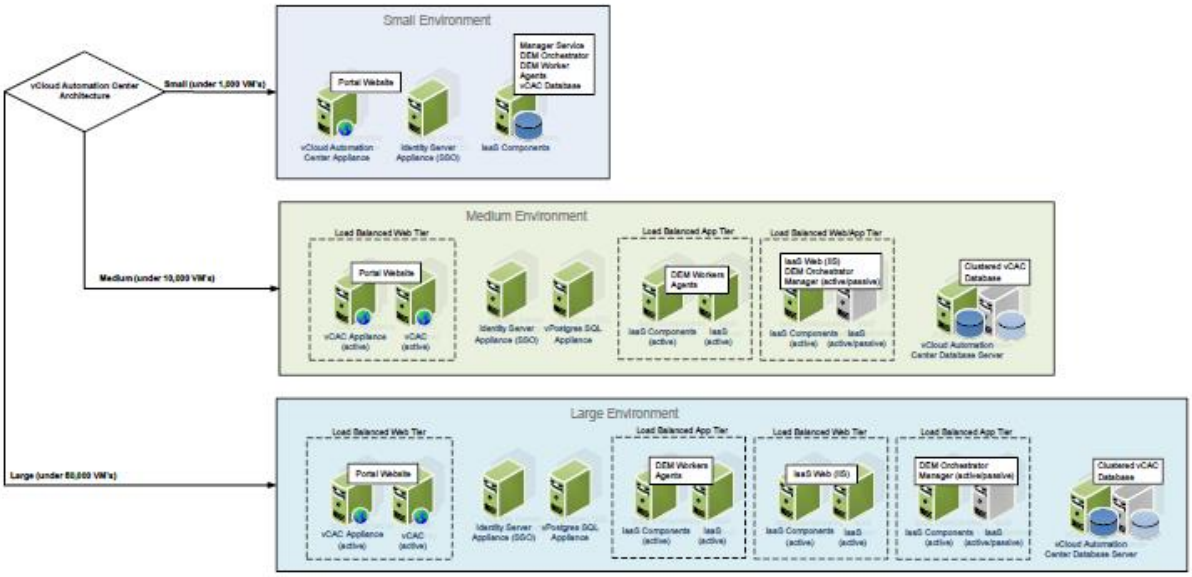
Note: This diagram is completely redrawn from www.hypervizor.com Architected by: Hany Michael


Users
vCAC Virtual Appliance Load Balancer (Port 443)
AD / OpenLDAP 1
AD / OpenLDAP 2,3...
389/636
389/636
443
443
vCAC Virtual Appliance 1
vCAC Virtual Appliance 2,3,...
443
VCO Systems
VCO System 1
VCO System 2,3...
Identity Virtual Appliance
5432
443
443
vCAC IaaS Web Load Balancer [Port 443]
vPostgreSQL Database
7444
7444
Web Server 1
Web Server 1, 2...
DEM Machines 1
Fabric
1433
443
443
vCAC IaaS Manager Service Load Balancer [Port 443]
Clustered MSSQL Database
DEM Machines 2, 3...
Fabric
443
443
Manager Service 1
Manager Service 2
443
1433
Proxy Agent 2,3 ...
Proxy Agent 1
Fabric
Fabric

3.4 Physical Architecture

VCloud Automation Center Physical Deployment Architecture

A distributed installation allows the separation of components best suited to the organization's needs. A medium distributed installation recommends splitting the IaaS SQL database on to an external dedicated server. A large deployment recommends splitting most components and deploying multiple portal appliances, IaaS web site and Model Manager Servers behind a load balancer.



3.5 Solution Components

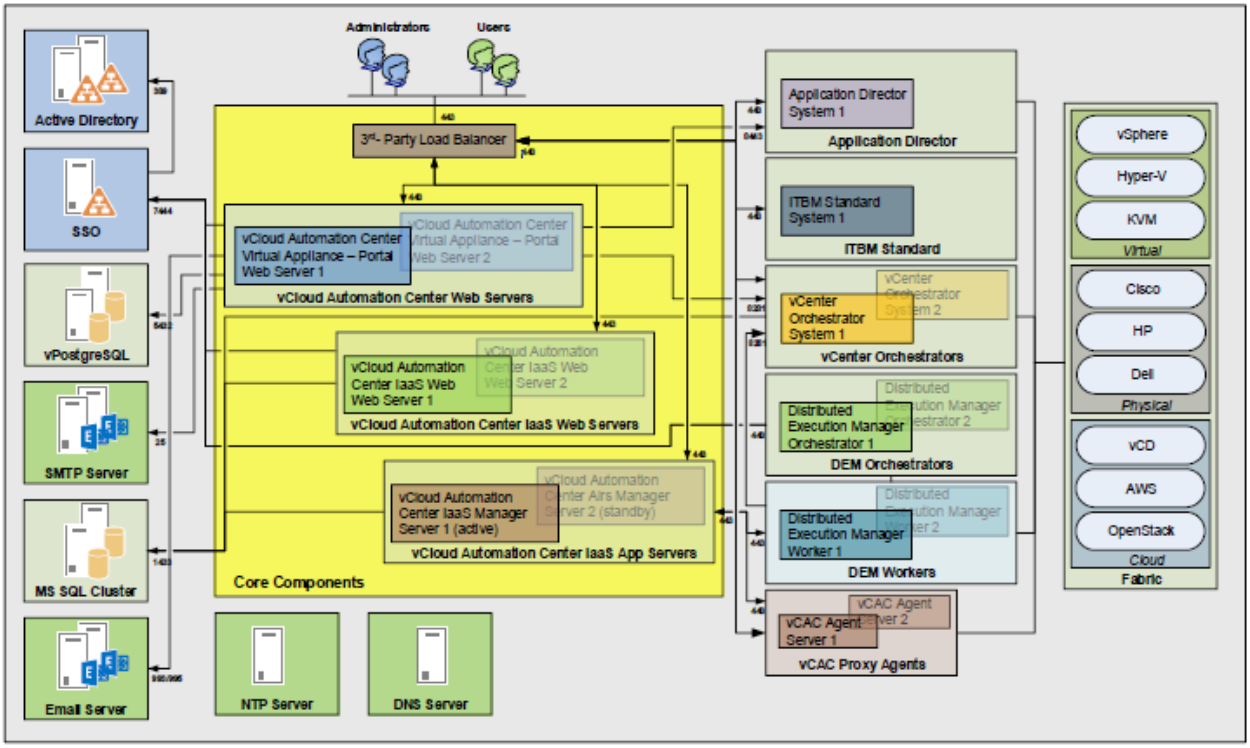
The key solution components include

- VMware VCAC based private cloud
- Compute – x86 based
- Storage – SAN (FC) and NAS
- Data Center Network (VDS)
- Backup – D2D and Tape (VCD/Avamar)
- Virtualization Layer (VMware)
- Disaster Recovery (SRM)
- Monitoring and Management Tools (VCOPS)
- Automation Tools for cloud environment (VCO)
- VMware vCenter Orchestrator
- Security (vShield)
- VMware Log Insight
- Network Virtualization (NSX)
- Storage Virtualization using VMware VSAN (VSAN)
- EMC Avamar & Data domain recovery solutions
- EMC VNX/EMC Symmetrix VMAX Storage platforms
- EMC and VMware integration solutions

Design Sections	Design Components	Requirements
vCloud Automation Center Identity Virtual Appliance	Single Sign-On	
vCloud Automation Center Virtual Appliance	vCloud Automation Center Portal Web Server vCloud Automation Center vPostgreSQL Database	
vCloud Automation Center IaaS Components	• vCloud Automation Center IaaS Web Server • vCloud Automation Center IaaS Manager Services	
Distributed Execution Components	vCloud Automation Center Distributed Execution Managers: o Orchestrator o Workers	
Integration Components	vCloud Automation Center Agent machines	

Provisioning Infrastructure	• VMware vSphere environment • VMware vCloud Director environment • VMware vCenter Orchestrator environment • Other supported physical, virtual, or cloud environments	
Supporting Infrastructure	• Microsoft SQL database environment • vPostgreSQL database environment (if not embedded in VA) • LDAP or Active Directory environment • SMTP and email environment • DNS Server • NTP Server	

The following illustration depicts the Cloud Automation core component logical design.



3.6 Sizing

Sizing is done based on the above defined requirement and we have made sure to consider over

3.6.1 Compute Sizing for 1000 VMs

ESXi Hosts	Cores/Host	RAM per Host
57	16	256
Total IOPS		56000
Total Storage		119680
Total Storage with ThinProvision		89216

3.6.2 Compute Sizing for 2000 VMs

ESXi Hosts	Cores/Host	RAM per Host
112	16	256
Total IOPS		112000
Total Storage		335104
Total Storage with ThinProvision		265472

3.6.3 Compute Sizing for 3000 VMs

ESXi Hosts	Cores/Host	RAM per Host
167	16	256
Total IOPS		168000
Total Storage		502656
Total Storage with ThinProvision		398208

3.6.4 Compute Sizing for 4000 VMs

ESXi Hosts	Cores/Host	RAM per Host
205	16	256
Total IOPS		224000
Total Storage		670208
Total Storage with ThinProvision		530944

3.6.5 Compute Sizing for 5000 VMs

ESXi Hosts	Cores/Host	RAM per Host
277	16	256
Total IOPS		280000
Total Storage		837760
Total Storage with ThinProvision		663680

For the complete list of how the sizing is done, a sizing document is attached as reference below

IOPS sizing estimate

3.6.6 IOPS Sizing for 1000 VMs

IOPS Production	80
Total IOPS Production	32000

VMDK	QTY	VMDK Total	SWAP	Snapshot	Total Storage	Thin Provision	Total Storage
50	160	8000	640	64	8704	5%	8268.8
100	160	16000	1280	128	17408	5%	16537.6
200	60	12000	960	96	13056	10%	11750.4
400	20	8000	640	64	8704	20%	6963.2
Total Storage Production					47872		43520

IOPS Non-Prod	40
Total IOPS Non-Prod	24000

VMDK	QTY	VMDK Total	SWAP	Snapshot	Total Storage	Thin Provision(%)	Total Storage
50	240	12000	960	96	13056	25%	9792
100	240	24000	1920	192	26112	25%	19584
200	90	18000	1440	144	19584	50%	9792
400	30	12000	960	96	13056	50%	6528
Total Storage Non-Production					71808		45696

3.6.7 IOPS Sizing for 2000 VMs

IOPS Production	80
Total IOPS Production	64000

VMDK	QTY	VMDK Total	SWAP	Snapshot	Total Storage	Thin Provision(%)	Total Storage
50	320	16000	1280	128	34816	5%	33075.2
100	320	32000	2560	256	69632	5%	66150.4
200	120	24000	1920	192	52224	10%	47001.6
400	40	16000	1280	128	34816	20%	27852.8
Total Storage Production					191488		174080

IOPS Non-Prod	40
Total IOPS Non-Prod	48000

VMDK	QTY	VMDK Total	SWAP	Snapshot	Total Storage	Thin Provision(%)	Total Storage
50	480	24000	1920	192	26112	25%	19584
100	480	48000	3840	384	52224	25%	39168
200	180	36000	2880	288	39168	50%	19584
400	60	24000	1920	192	26112	50%	13056
Total Storage Non-Production					143616		91392

3.6.8 IOPS Sizing for 3000 VMs

IOPS Production	80
Total IOPS Production	96000

VMDK	QTY	VMDK Total	SWAP	Snapshot	Total Storage	Thin Provision(%)	Total Storage
50	480	24000	1920	192	52224	5%	49612.8
100	480	48000	3840	384	104448	5%	99225.6
200	180	36000	2880	288	78336	10%	70502.4
400	60	24000	1920	192	52224	20%	41779.2
Total Storage Production					287232		261120

IOPS Non-Prod	40
Total IOPS Non-Prod	72000

VMDK	QTY	VMDK Total	SWAP	Snapshot	Total Storage	Thin Provision(%)	Total Storage
50	720	36000	2880	288	39168	25%	29376
100	720	72000	5760	576	78336	25%	58752
200	270	54000	4320	432	58752	50%	29376
400	90	36000	2880	288	39168	50%	19584
Total Storage Non-Production					215424		137088

3.6.9 IOPS Sizing for 4000 VMs

IOPS Production	80
Total IOPS Production	128000

VMDK	QTY	VMDK Total	SWAP	Snapshot	Total Storage	Thin Provision(%)	Total Storage
50	640	32000	2560	256	69632	5%	66150.4
100	640	64000	5120	512	139264	5%	132300.8
200	240	48000	3840	384	104448	10%	94003.2
400	80	32000	2560	256	69632	20%	55705.6
Total Storage Production					382976		348160

IOPS Non-Prod	40
Total IOPS Non-Prod	96000

VMDK	QTY	VMDK Total	SWAP	Snapshot	Total Storage	Thin Provision(%)	Total Storage
50	960	48000	3840	384	52224	25%	39168
100	960	96000	7680	768	104448	25%	78336
200	360	72000	5760	576	78336	50%	39168
400	120	48000	3840	384	52224	50%	26112
Total Storage Non-Production					287232		182784

3.6.10 IOPS Sizing for 5000 VMs

IOPS Production	80
Total IOPS Production	160000

VMDK	QTY	VMDK Total	SWAP	Snapshot	Total Storage	Thin Provision(%)	Total Storage
50	800	40000	3200	320	87040	5%	82688
100	800	80000	6400	640	174080	5%	165376
200	300	60000	4800	480	130560	10%	117504
400	100	40000	3200	320	87040	20%	69632
Total Storage Production					478720		435200

IOPS Non-Prod	40
Total IOPS Non-Prod	120000

VMDK	QTY	VMDK Total	SWAP	Snapshot	Total Storage	Thin Provision(%)	Total Storage
50	1200	60000	4800	480	65280	25%	48960
100	1200	120000	9600	960	130560	25%	97920
200	450	90000	7200	720	97920	50%	48960
400	150	60000	4800	480	65280	50%	32640
Total Storage Non-Production					359040		228480

Storage Sizing

Extra-large VM: 500 x 5/100 = 25 VM
Large VM : 500 X 15/100 = 75 VM
Medium VM : 500 X 40/100 = 200 VM
Small VM : 500 X 40/100 = 200 VM

Space Calculation: Space Required:

Extra-large VM: 25 X 400GB = 10000GB = 10TB
Large VM : 75 X 200GB = 15000GB = 15TB
Medium VM : 200 X 100GB = 20000GB = 20TB
Small VM : 200 X 50GB = 10000GB = 10TB
File Share = 10TB
ISO Image = 1TB
Templates = 1TB
Testing Patches = 1TB

Total 68TB

Replication Space:

EXtralarge + Large + 30% Medium + 20% Small VM = 10+15+6+2 = 33TB
Buffer (5% extra of VM space) = 3TB

Total = 68+33+3= 104TB

IOPS :

NO of Production VM : 200
No of non production VM = 300
IOPS required / production VM = 80
Total IOPS for production VM = 80 X 200 = 16000
IOPS required / non production VM = 40
Total IOPS for production VM = 40 X 300 = 12000

3.6.11 Datastore Sizing Estimate

An estimate of the typical datastore size can be approximated by considering the following factors

Production Variable	**Value**
Maximum VM's Per Datastore	14
Average Size of Virtual Disk(s) per VM	60GB
Average Memory Size per VM	4 GB
Safety Margin	10%

((14 * 60GB) + (15 * 4GB)) + 10% = (840GB + 60) * 1.1 = 858GB

Non-Production Variable	**Value**
Maximum VM's Per Datastore	25
Average Size of Virtual Disk(s) per VM	60GB
Average Memory Size per VM	4 GB
Safety Margin	10%

((25 * 60GB) + (25 * 4GB)) + 10% = (1500 +100) * 1.1 = 1760

3.6.12 VCAC VM Sizing Estimate

vCloud Automation Center Supports

- 50,000 Managed Machines
- 2,500 Catalog Items
- 100 Concurrent Deployments

Virtual Appliances

- Identity Virtual Appliance
- vPostgres Virtual Appliance
- vCloud Automation Center Virtual Appliance x2

Windows Server Virtual Machines

- Infrastructure Web Server x2
- Infrastructure Manager Service x2
- Infrastructure DEM Server x2
- Infrastructure Agent Server x2
- Clustered MSSQL Database Server

Load Balancers

- vCloud Automation Center VA Load Balancer
- Infrastructure Web Load Balancer
- Infrastructure Manager Service Load Balancer

vCloud Application Director

Supports up to 40 concurrent deployments. Each deployment has approximately 3 to 14 VM nodes.

3.6.13 ITBM VM Sizing estimate

- Supports up to 20,000 VMs.
- Requires IT Business Management Virtual Appliance.
- vCloud Application Director heap size is 3GB
- ITBM Virtual Appliance can support up to 20,000 VMs

Server Role	Description	Components	Required Hardware Specification	Recommended Hardware Specification
Identity Appliance	Virtual appliance that provides Single Sign-On (SSO) capabilities for the vCloud Automation Center environment		CPU: 1 vCPU RAM: 2 GB Disk: 10GB Network: 1GB/s	
vCloud Automation Center Appliance	Virtual appliance that deploys the vCloud Automation Center server	tcServer vPostgresSQL VMWARE SLES	CPU: 2 vCPU RAM: 8 GB Disk: 30 GB Network: 1GB/s	CPU: 4 vCPU RAM: 16 GB Disk: 30 GB Network: 1GB/s
Infrastructure Web Server	Website		CPU: 2 vCPU RAM: 2 GB Disk: 40 GB Network: 1GB/s	CPU: 2 vCPU RAM: 4 GB Disk: 40 GB Network: 1GB/s
Infrastructure Manager Server	Manager Service DEM Orchestrator		CPU: 2 vCPU RAM: 2 GB Disk: 40 GB Network: 1GB/s	CPU: 2 vCPU RAM: 4 GB Disk: 40 GB Network: 1GB/s
Infrastructure Web/Manager Server	Infrastructure Web/Manager Server		CPU: 2 vCPU RAM: 4 GB Disk: 40 GB Network: 1GB/s	CPU: 2 vCPU RAM: 8 GB Disk: 40 GB Network:
Infrastructure DEM Server	(one or more) DEM Workers		CPU: 2 vCPU RAM: 2 GB Disk: 40 GB Network: 1GB/s Per DEM Worker	CPU: 2 vCPU RAM: 6 GB Disk: 40 GB Network: 1GB/s Per DEM Worker
Infrastructure Agent Server	(one or more) Proxy Agent		CPU: 2 vCPU RAM: 4 GB Disk: 40 GB Network: 1GB/s	CPU: 2 vCPU RAM: 4 GB Disk: 40 GB Network: 1GB/s
vPostgres Virtual Appliance			CPU: 2 vCPU RAM: 2 GB Disk: 20 GB Network: 1GB/s	CPU: 2 vCPU RAM: 4 GB Disk: 20 GB Network: 1GB/s
MSSQL Database Server	Infrastructure Database		CPU: 2 vCPU RAM: 8 GB	CPU: 8 vCPU RAM: 16 GB

			Disk: 40 GB Network: 1GB/s	Disk: 80 GB Network: 1GB/s
vCloud Application Director	Small deployment	tcServer PostgresSQL VMWARE SLES RabbitMQ		CPU: 2 vCPU RAM: 4GB Disk: 16GB Network: 1 GB/s
	Medium deployment	tcServer PostgresSQL VMWARE SLES RabbitMQ		CPU: 4 vCPU RAM: 8GB Disk: 30GB Network: 1 GB/s
	Large deployment	tcServer PostgresSQL VMWARE SLES RabbitMQ		CPU: 8 vCPU RAM: 16GB Disk: 50GB Network: 1 GB/s
IT Business Management Virtual Appliance		vPostgresSQL tcServer VMWARE SLES	CPU: 2 vCPU RAM: 4GB Disk: 50GB Network: 1 GB/s	CPU: 2 vCPU RAM: 4GB Disk: 50GB Network: 1 GB/s

3.6.14 SRM Sizing

SRM Database Sizing Estimates

PRIMARY SITE			
Resource	Estimated Utilization(MB)		
	Median	+20%	-20%
Database Space Usage	4.73	5.68	3.79
SECONDARY SITE			
Resource	Estimated Utilization(MB)		
	Median	+20%	-20%
Database Space Usage	23.62	28.34	18.89
Incremental Space Usage per month	0.09	0.10	0.07
Incremental Space Usage per year	1.02	1.23	0.82
Additional Transient Space Usage per month	0.20	0.24	0.16

SRM Primary DC 200 VM Storage Replication Sizing

SRM Secondary DC 200 VM Storage Replication Sizing

SRM Primary DC 200 VM vSphere Replication Sizing

SRM Secondary DC 200 VM vSphere Replication Sizing

Sizing for SRM would be primarily based on the below parameters

1) Size of dataset
2) Data change rate ("Churn" for lack of better terminology)
3) Recovery Point Objective ("RPO")
4) Link speed

3.6.15 vCenter Operations Sizing

- One vCenter Operations Standard per vCenter instance
- For VMware environments of 1500 or fewer Virtual Machines
- vCenter Operations Standard is a virtual appliance (.ova)
- SUSE Linux Enterprise Server 11 SP1
- 8GB RAM
- 2 vCPUs
- 124 GB Disk (4 GB system disk + 120 GB data disk)
- OS Support
  - Win Server 2003 R2 (x64)
  - Red Hat Linux RHEL 5 (x64)
- DB Support*
  - SQL Server 2005
  - Oracle 10g R2

		Analytics (Main) Server			DB Server		
Size	Metrics - Collected every 5 min on Avg.	Processors (>2.8Ghz)	Memory	Minimum Initial Disk Space	Processors (>2.8Ghz)	Memory	Minimum Initial Disk Space
Small	<250,00	4 Cores	12GB	500GB	2 Cores	4GB	10GB
Medium	<1,000,000	8 Cores	24GB	500GB	4 Cores	8GB	25GB
Large	<5,000,000	16 Cores	64GB	5TB	8 Cores	16GB	100GB
Very Large	<10,000,000	24 Cores	128GB	10TB	8 Cores	16GB	100GB

3.6.16 Backup-VMware Data Protector sizing

DEDUPLICATED BACKUP DATA	STORAGE CAPACITY	MEMORY
vSphere Data Protection	.5TB	4GB
vSphere Data Protection	1TB	4GB
vSphere Data Protection	2TB	4GB
vSphereData Protection Advanced	2TB	6GB
vSphereData Protection Advanced	4TB	8GB
vSphereData Protection Advanced	6TB	10GB
vSphereData Protection Advanced	8 TB	12 GB

3.7 Virtualization

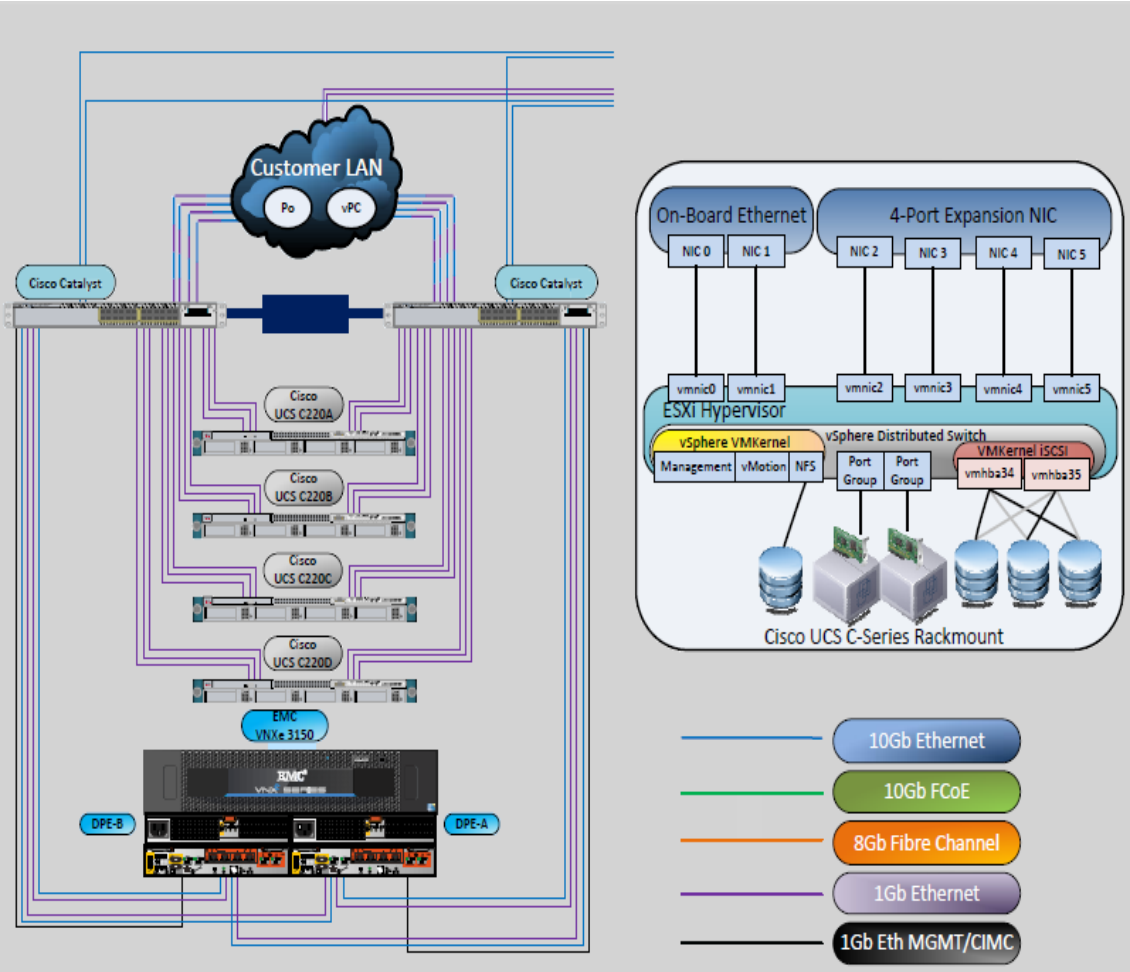
VMware

Hyper-V

KVM

3.8 Network

A Highly available, redundant network architecture is designed for the management infrastructure



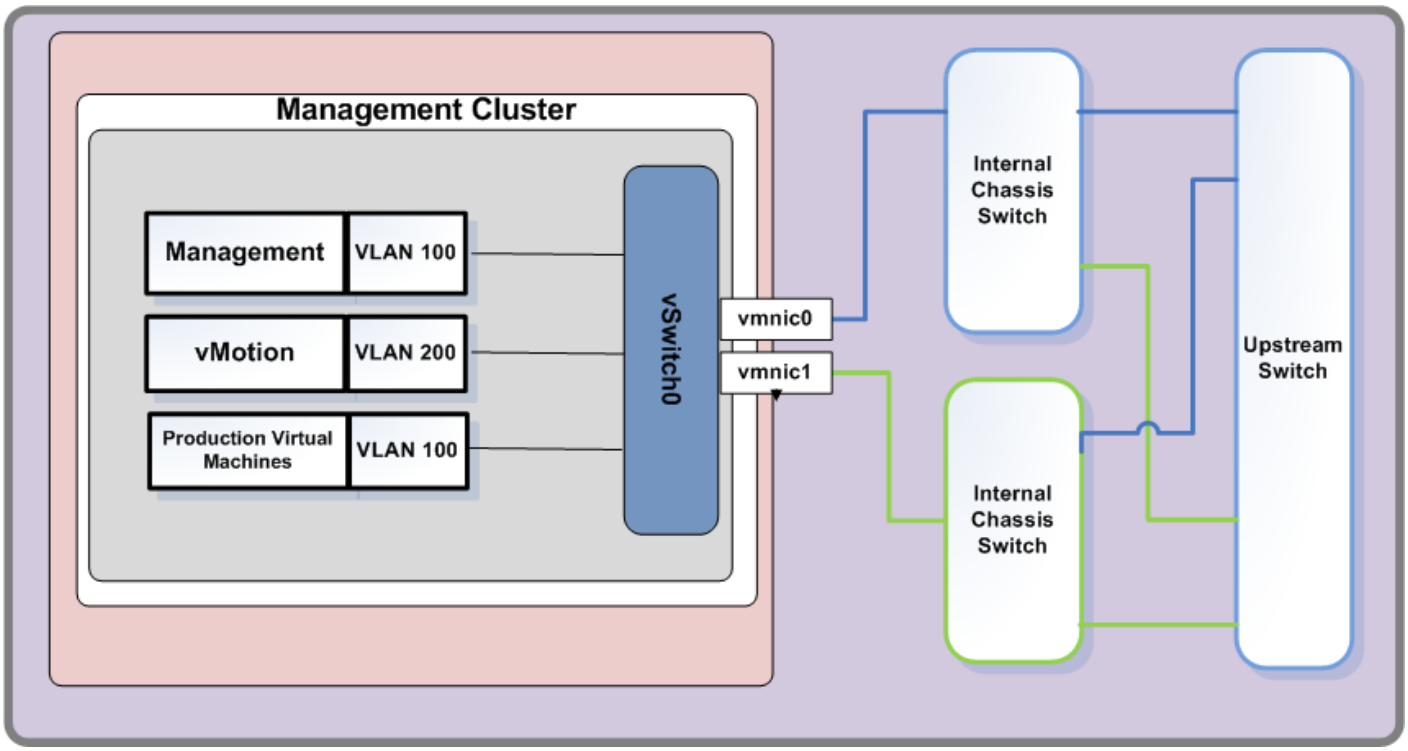
Network Logical Design

The network design section defines how the vSphere virtual networking will be configured.

Following best practices, the network architecture will meet these requirements:

- Separate networks for vSphere management, VM connectivity, and vMotion traffic
- Redundant vSwitches with at least 2 active physical (or vNIC) adapter ports each
- Redundancy across different physical adapters to protect against NIC or PCI slot failure
- Redundancy at the physical switch level

The physical NIC ports will be connected to redundant physical switches. The following diagrams depict the virtual network infrastructure designs:



Parameter	Setting
Load Balancing	Route based on NIC load (For VDS)
Failover Detection	Link Status
Notify Switches	Enabled
Failover Order	All Active except for Management Network Management Console: Active, Standby vMotion: Standby, Active

Teaming

Security

Function	Setting
Promiscuous Mode	Management Cluster – Reject Resource Group - Reject
Mac Address Changes	Management Cluser – Reject Resource Group – Reject
Forget Transmits	Management Cluser – Reject Resource Group – Reject

Failover

Network Pools

External Networks

Internal Networks

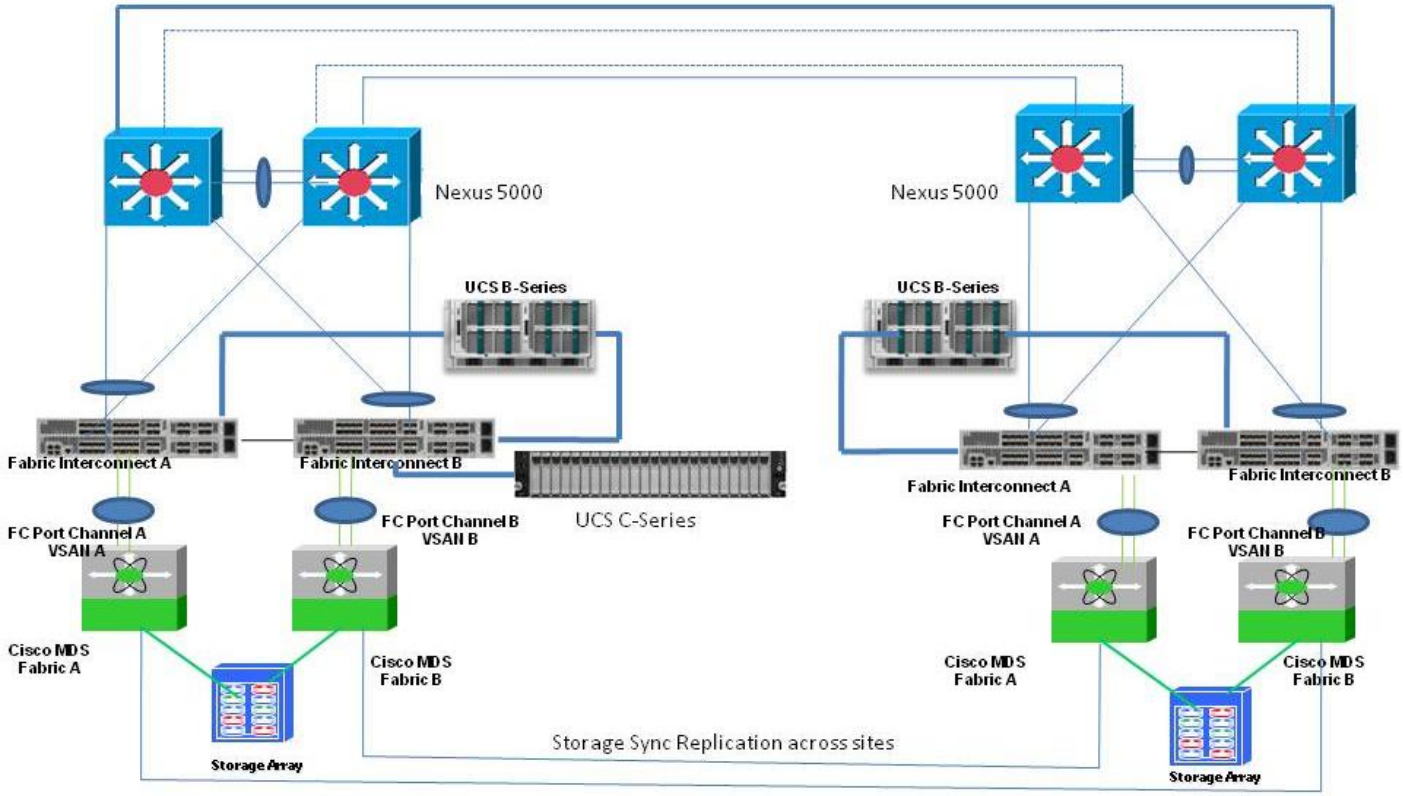
vApp Network

Management Networks

Switch Policies

Securities Policies

Layer 2 and 3 Links Connecting DC



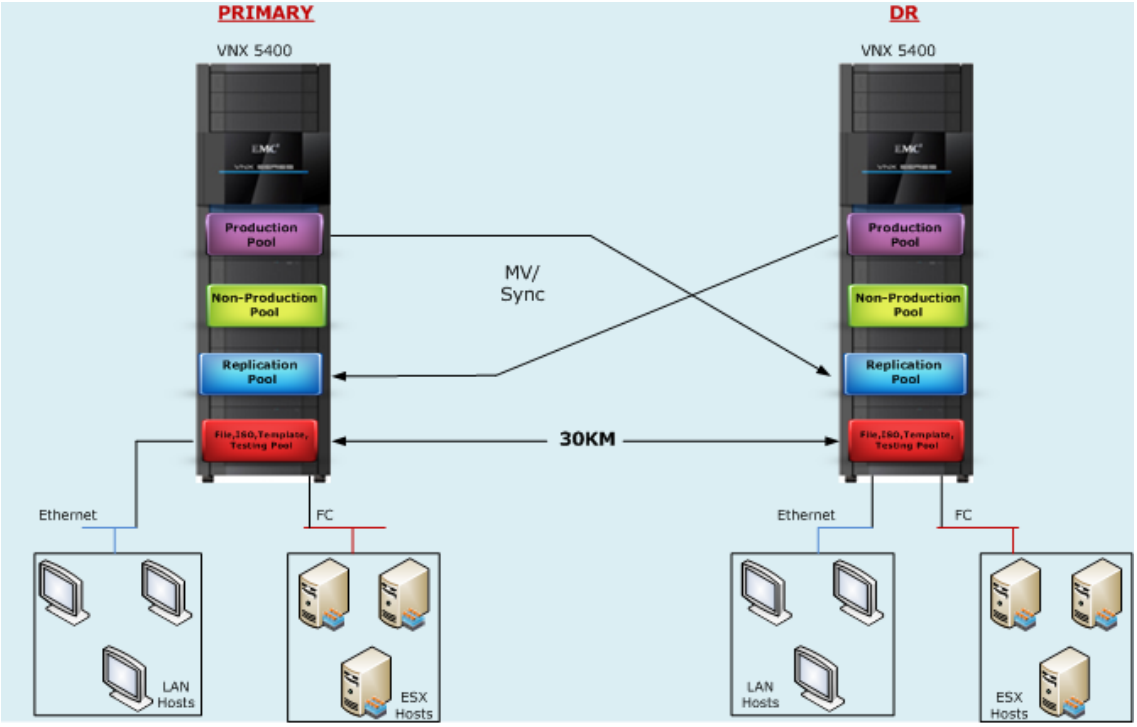
3.9 Storage

Attribute	Specification
Number of Initial Luns **Production** **Non Production** **Staging** **Testing** **DMZ** **Buffer Luns**	 VCAC-Production-01 to VCAC-Production-20 VCAC-Non Production-01 to VCAC-Non Production-24 Staging (250) Testing(250) DMZ(500) Volume 1- Volume 5 (500GB Each)
Lun Size	
Zoning	Single Initiator, Single Target
VMFS Datastore Per Lun	1
VM's Per Lun	13
NFS Volumes	File share – 10TB ISO Image – 1TB Templates – 1TB

Approach :

1. Pools, for Production, and Non-production, one for replicated data and another for Buffer and file shares and ISO images.
2. Production pool to consist of 33TB of pool space consisting of 3% 400GB SSD, 27% 900 Gb 10K and 70% 3TB NLSAS.
3. Non production pool to consist of 1% SSD, 34% 900GB 10K and 65% 3TB NL SAS
4. Replication pool to consist of 600GB 10K disk and 2TB NLSAS disks in 70% and 30% ratio respectively.
4. File pool for Buffer and file shares and ISO image consisting of 3TB NLSAS disks only.
5. FAST cache to be used for the production pool, non-production pool and replication pool..

At the end of the Calculation and keeping the requirements in mind VNX was finalized as the Storage Array. 2 VNX 5400 Arrays, one at the Primary and the other at the DR in Sync replication using MV constitute the solution. The Architecture diagram is as below:



Configuration Details:

2 X VNX5400 Unified New Solution Using 200GB, 600GB 10K, 900GB 10K, 2TB and 3TB Drives - :
- Total Array Capacity = 121.60TB Usable Capacity
- Unified
- EMC Rack and Power Cords
- 1 x Control Station
- 1 x Data Mover
- 5 x 2.5” DAEs(includes DPE and 1 Primary DAE)
- 3 x 3.5” DAEs
- 1 x 1GBase-T DM Module 4 Port
- 2 x 4 port 8G FC IO Module Pair
- Vault: 4 x 600GB 10K 2.5” SAS Drives
- Data Drives:
- 15 x 200GB 2.5” SSD Data Flash Drives RAID5(4+1) = 2.13TB Usable
- 60 x 600GB 10K 2.5” SAS Drives RAID5(4+1) = 25.09TB Usable
- 30 x 900GB 10K 2.5” SAS Drives RAID5(4+1) = 19.20TB Usable
- 8 x 2TB 7.2K 3.5” NL SAS Drives RAID6(6+2) = 10.74TB Usable
- 32 x 3TB 7.2K 3.5” NL SAS Drives RAID6(6+2) = 64.44TB Usable
- 400GB FAST Cache (5 x 200GB 2.5” EFD Drives)
- 2 x 200GB 2.5” Drives – For FAST Cache
- 2 x 200GB 2.5” Drives – for Mirror Protection
- 1 x 200GB 2.5” Drives – Hot Spare
- VNX5400 OE License
- FAST Suite and Remote Protection Suite
- Default Professional Services
- No Customer Education
- 60 Months Premium Hardware Support
- 60 Months Premium Software Support

VNX is Powerful, efficient, protected, and simple are four traits that an array in today's high demand storage environment must have. Storage systems need to be optimized to provide powerful, efficient storage technologies, keeping data protected, all while being simple to use and manage. The new VNX is designed for a wide range of environments that include mid-tier through enterprise. Each new VNX model is offered in file only, block only, and unified (block and file) implementations. The new VNX series is still managed through a simple and intuitive user interface called Unisphere this single pane of glass completes the unified experience.

Features of the new VNX series include:

State-of-the-art hardware:

- PCI-E Gen 3 I/O modules
- 6 Gb/s x 4 lanes SAS back-end infrastructure
- Up to x 8 wide (6 Gb/s x 8 lanes) high-bandwidth connection to 60 drive DAE
- with new 6 Gb SAS I/O module
- Increased memory and core optimization with MCx
- Intel's latest Xeon E5 multicore processors
- Expanded UltraFlex I/O, delivered with denser packaging
- Block functionality that supports the FC, iSCSI, and FCoE protocols
- File functionality that supports the NFS, CIFS, and pNFS protocols
- Support for up to 1,500 drives
- Automated tiering with Fully Automated Storage Tiering for Virtual Pools (FAST VP) for block and file data
- Replication using EMC RecoverPoint for block and file data
- Updated unified management with Unisphere delivers a cohesive, unified user experience

3.10 Access Control

VCenter RBAC

The privileges assigned to a pre-defined role are more comprehensive than described as below, so if you want to know exactly what permissions a role allows to a user, you can view the selected privileges when assigning the role to a user or group.

No Access	**A permanent role that is assigned to new users and groups. Prevents a user or group from viewing or making changes to an object**
Read-Only	A permanent role that allows users to check the state of an object or view its details, but not make changes to it
Administrator	A permanent role that enables a user complete access to all of the objects on the server. The root user is assigned this role by default, as are all of the users who are part of the local Windows Administrators group associated with vCenter Server. At least one user must have administrative permissions in VMware.
Virtual Machine Administrator	A sample role that allows a user complete and total control of a virtual machine or a host, up to and including removing that VM or host
Virtual Machine Power User	A sample role that grants a user access rights only to virtual machines; can alter the virtual hardware or create snapshots of the VM
Virtual Machine User	Grants user access rights exclusively to VMs. The user can power on, power off, and reset the virtual machine, as well as run media from the virtual discs.
Resource Pool Administrator	Allows the user to create resource pools (RAM and CPU reserved for use) and assign these pools to virtual machines
Datacenter Administrator	Permits a user to add new datacenter objects
VMware Consolidated Backup User	Required to allow VMware Consolidated Backup to run
Datastore Consumer	Allows the user to consume space on a datastore
Network Consumer	Allows the user to assign a network to a virtual machine or a host

VCAC

Administrators – Tenant, group, fabric, infrastructure, service and others as defined by business policies and organizational structure.
IaaS users – Those requiring direct access to virtual machine or physical infrastructure to perform OS-level operations provided by vCloud Automation Center IaaS services.
Platform as a Service (PaaS) users – Those requiring automation of application stack management for the purposes of designing, building and deploying custom or packaged applications as provided through the vCloud Application Director platform. These applications can be complex, multi-machine instances, some common examples include web, application, and database blueprints based on standard architecture and organizational practices.

Roles	System-wide roles are typically assigned to an IT system administrator. In some organizations, the IaaS administrator and fabric administrator roles might be the responsibility of a cloud administrator.
System Administrator • Create tenants. • Configure tenant identity stores. • Assign IaaS administrator role. • Assign tenant administrator role. • Configure system default branding. • Configure system default notification providers. • Monitor system event logs. • Configure the vCenter Orchestrator server for use in the Advanced Services Designer.	The system administrator is typically the person who installs vCloud Automation Center and is responsible for ensuring its availability for other users. The system administrator creates tenants and manages the system-wide configuration elements, such as system defaults for branding and notification providers.
IaaS Administrator • Configure IaaS features (global properties). • Manage IaaS licenses. • Create and manage fabric groups. • Create and manage endpoints. • Manage endpoint credentials. • Configure proxy agents. • Monitor IaaS-specific logs.	IaaS administrators manage endpoints and endpoint credentials, create fabric groups, and configure virtualization proxy agents. They manage cloud service accounts as well as physical machines and storage devices.
Fabric Administrator • Manage build profiles. • Manage compute resources • Manage cost profiles • Manage network profiles • Manage machine prefixes • Manage property dictionary • Manage reservations and reservation policies	A fabric administrator is the administrator of one or more fabric groups. Fabric administrators manage physical machines and compute resources within their groups, along with the reservations and reservation policies associated with those resources

Cloud Administrator	In some organizations, the IaaS administrator and fabric administrator roles might be the responsibility of a cloud administrator.
Tenant administrator • Manage tenant identity stores • Manage user and group roles • Create custom groups • Customize tenant branding • Manage notification providers • Enable notification scenarios for tenant users • Create and manage approval policies • Manage catalog services • Manage catalog items • Manage actions • Manage entitlements • Monitor tenant machines and send reclamation requests • Configure vCenter Orchestrator servers, plug-ins and workflows for use in the Advanced • Services Designer • Create and publish shared machine blueprints from IaaS	The system administrator designates a tenant administrator when creating a tenant. Tenant administrators can assign the role to other users in the tenant.
Service architect • Define custom resource types • Create and publish service blueprints in the Advanced Services Designer • Create and publish custom actions.	The tenant administrator can assign this role to give a user or group the rights to create custom services in the Advanced Service Designer.
Business group manager • Create and publish business group-specific machine blueprints from IaaS. • Manage business group-specific catalog items and entitlements	The tenant administrator designates the business group manager when creating or editing

3.10.1 Comparison of Single-Tenant and Multitenant Deployments

vCloud Automation Center supports deployments with a default single tenant and then single or multiple tenants deployed inside that default tenant. The configuration can vary depending on how many tenants are in your deployment.

System-wide configuration is always performed in the default tenant and can apply to one or more tenants. For example, system-wide configuration might specify defaults for branding and notification providers.

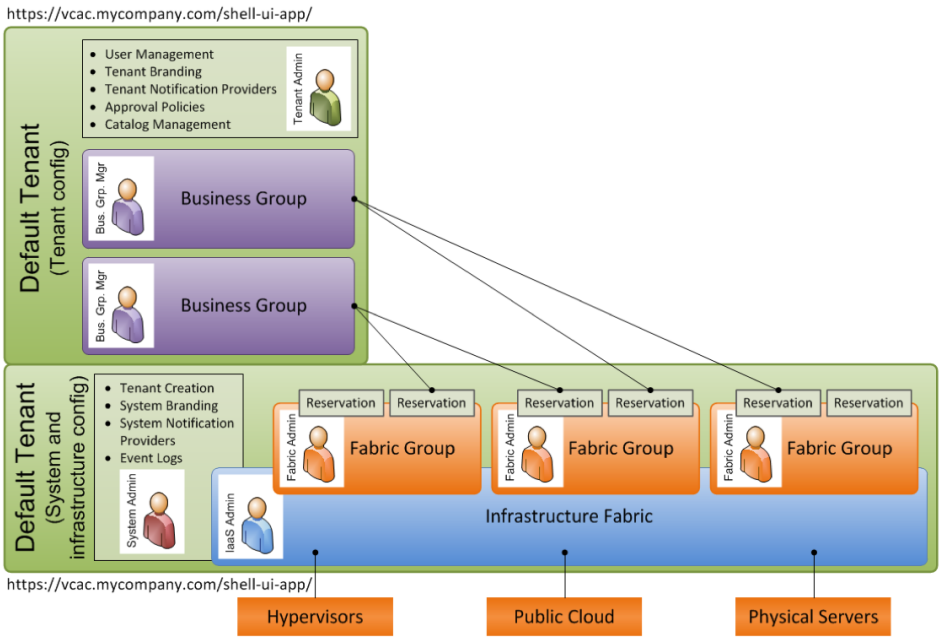
Infrastructure configuration, including the infrastructure sources that are available for provisioning, can be configured in any tenant and is shared among all tenants. The infrastructure resources, such as cloud or virtual compute resources or physical machines, can be divided into fabric groups managed by fabric administrators. The

resources in each fabric group can be allocated to business groups within each tenant by using reservations.

Single-Tenant Deployment

In a single-tenant deployment, all configuration can occur in the default tenant. Tenant administrators can manage users and groups, configure tenant-specific branding, notifications, business policies, and catalog offerings. All users log in to the vCloud Automation Center console at the same URL, but the features available to them are determined by their roles.

vCloud Automation Center Default Tenant Example



Multitenant Deployment

In a multitenant environment, the system administrator creates new tenants for each organization that uses the same vCloud Automation Center instance. Tenant users log in to the vCloud Automation Center console at a URL specific to their tenant. Tenant-level configuration is segregated from other tenants as well as from the default tenant, although users with system-wide roles can view and manage configuration across multiple tenants.

There are two main scenarios for configuring a multitenant deployment.

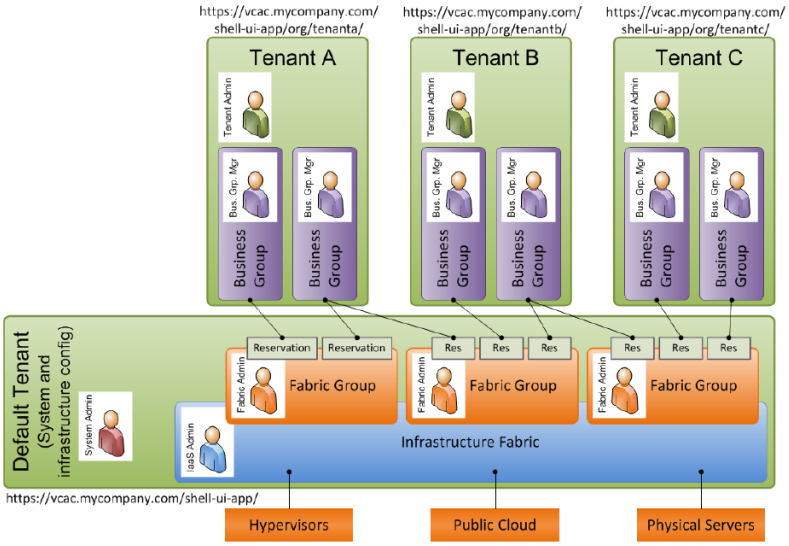
Multitenant Deployment Scenarios

Characteristic	Description

Characteristic	Description
Manage infrastructure configuration only in the default tenant	In this scenario, all infrastructures are centrally managed by IaaS administrators and fabric administrators in the default tenant. The shared infrastructure resources are assigned to the users in each tenant by using reservations.
Manage infrastructure configuration in each tenant	In this scenario, each tenant manages its own infrastructure and has its own IaaS administrators and fabric administrators. Each tenant may provide its own infrastructure sources or may share a common set of infrastructure. Fabric administrators manage reservations only for the users within their own tenant.

The following diagram shows a multitenant deployment with a centrally-managed infrastructure. The IaaS administrator in the default tenant configures all infrastructure sources that are available for all tenants. The IaaS administrator can organize the infrastructure into fabric groups according to type and intended purpose. For example, a fabric group may contain all virtual resources, or all Tier 1 resources. The fabric administrator for each group can allocate resources from their fabric groups. Although the fabric administrators exist only in the default tenant, they can assign resources to business groups in any tenant.

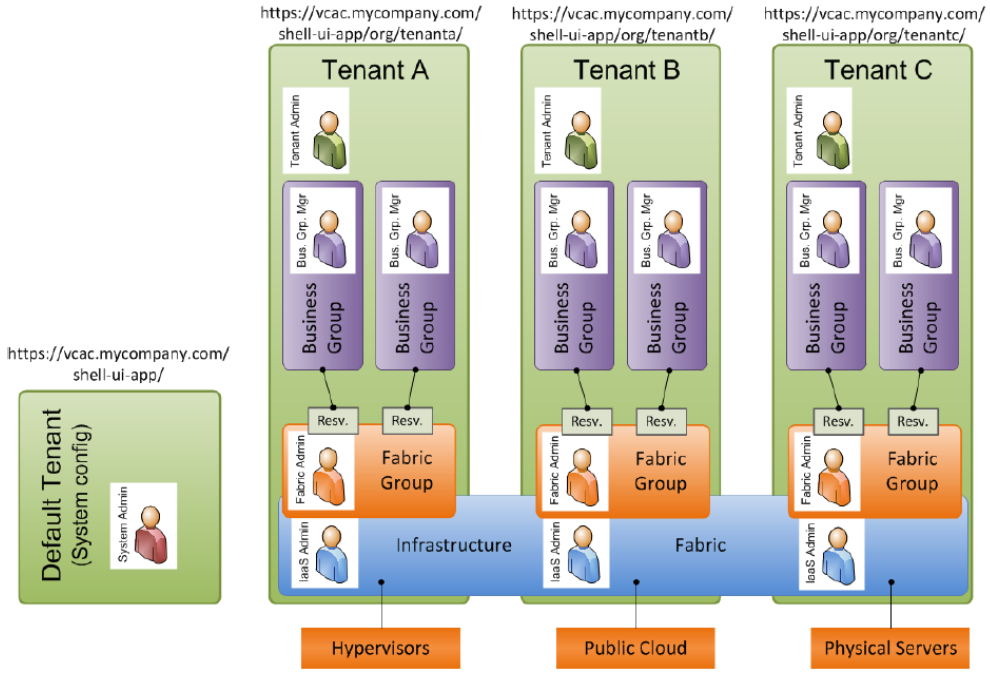
Multitenant Example with Infrastructure Configuration Only in Default Tenant

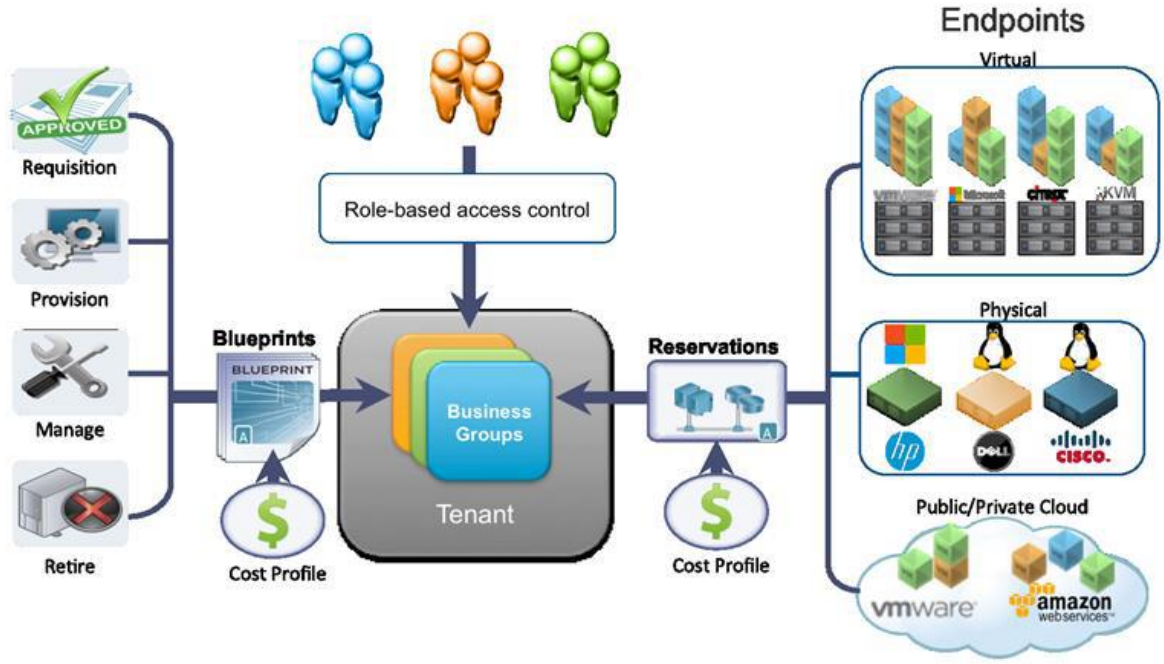


The following diagram shows a multitenant deployment where each tenant manages their own infrastructure. The system administrator is the only user who logs in to the default tenant to manage system-wide configuration and create new tenants.

Each tenant has an IaaS administrator, who can create fabric groups and appoint fabric administrators with their respective tenants. Although fabric administrators can create reservations for business groups in any tenant, in this scenario they typically create and manage reservations within their own tenants. If the same identity store is configured in multiple tenants, the same users can be designated as IaaS administrators or fabric administrators in each tenant.

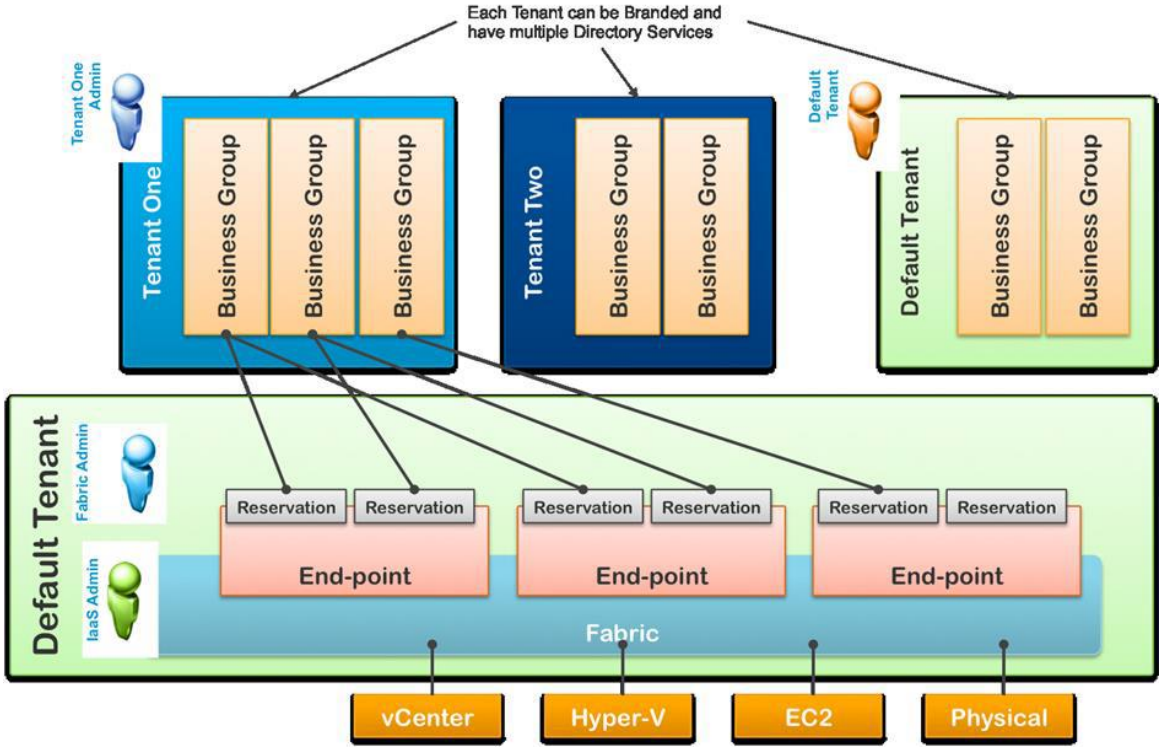
Multitenant Example with Infrastructure Configuration in Each Tenant





The following figure introduces key constructs of the vCloud Automation Center design and how the compute resources and business groups are mapped to each other.

Compute Resources to Business Group Mapping



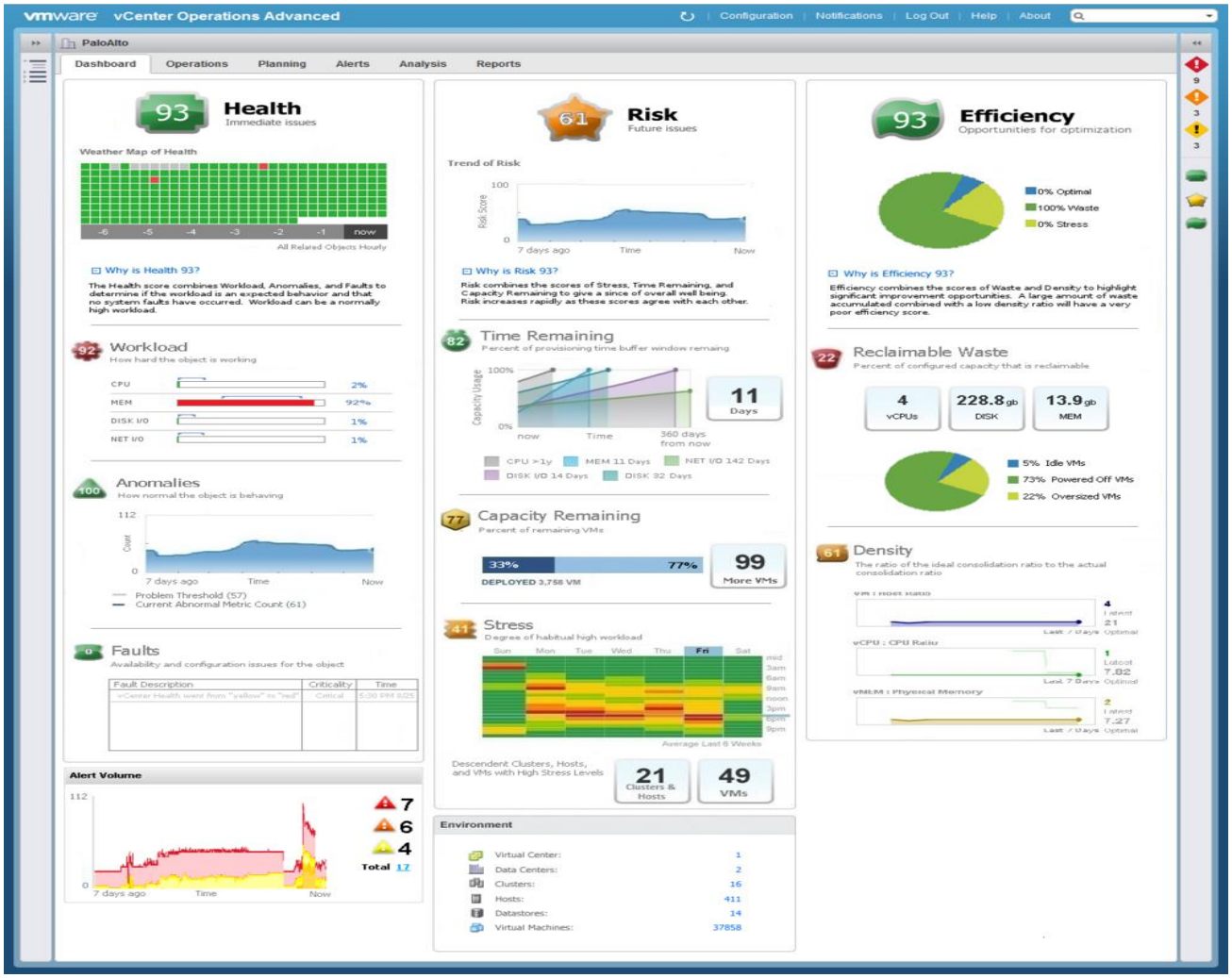
3.11 Operations Management

VMware VCenter Operations

It shows the 3 major indicator or score, or badge as we call it. Within each badge, there are details that you can see. In this one screen, you can see all the critical indicators of your entire private cloud.

It's a daily update, so not suitable for live dashboard that changes every minute. Use the Operations tab for that. Perhaps we can write a small Windows automation program that simply toggle between the following tabs: Dashboard (vSphere UI), Operations, Alerts, Dashboard (custom UI)

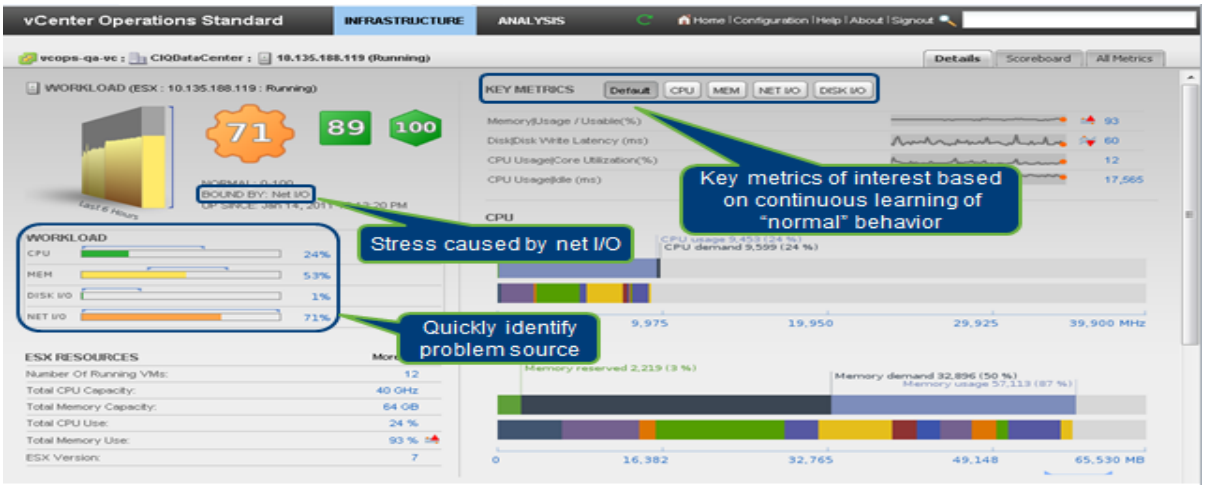
Relationship between Major Badge and its Minor Badges is rather sophisticated. It is not a simple max or average. The minor badges can be all green, and the major badge is yellow. Or vice versa. As a result, I think it is best to look at all badges individually instead of assuming "if major is fine, then all its minor is fine".


vmware vCenter Operations Advanced
Configuration | Notifications | Log Out | Help | About
PaloAlto
Dashboard
Operations
Planning
Alerts
Analysis
Reports
93 Health
Immediate issues
Weather Map of Health
-6 -5 -4 -3 -2 -1 now
All Related Objects Hourly
Why is Health 93?
The Health score combines Workload, Anomalies, and Faults to determine if the workload is an expected behavior and that no system faults have occurred. Workload can be a normally high workload.
92 Workload
How hard the object is working
CPU 2%
MEM 92%
DISK I/O 1%
NET I/O 1%
100 Anomalies
How normal the object is behaving
112
Count
0
7 days ago
Time
Now
Problem Threshold (57)
Current Abnormal Metric Count (61)
0 Faults
Availability and configuration issues for the object
Fault Description
Criticality
Time
vCenter Health went from "yellow" to "red"
Critical
5:30 PM 8/25
Alert Volume
112
0
7 days ago
Time
Now
7
6
4
Total 17
61 Risk
Future issues
Trend of Risk
100
Risk Score
0
7 days ago
Time
Now
Why is Risk 93?
Risk combines the scores of Stress, Time Remaining, and Capacity Remaining to give a since of overall well being. Risk increases rapidly as these scores agree with each other.
82 Time Remaining
Percent of provisioning time buffer window remaing
100%
Capacity Usage
0%
now
Time
360 days from now
11 Days
CPU >1y
MEM 11 Days
NET I/O 142 Days
DISK I/O 14 Days
DISK 32 Days
77 Capacity Remaining
Percent of remaining VMs
33%
77%
DEPLOYED 3,758 VM
99 More VMs
41 Stress
Degree of habitual high workload
Sun Mon Tue Wed Thu Fri Sat
Average Last 6 Weeks
Descendent Clusters, Hosts, and VMs with High Stress Levels
21 Clusters & Hosts
49 VMs
Environment
Virtual Center: 1
Data Centers: 2
Clusters: 16
Hosts: 411
Datastores: 14
Virtual Machines: 37858
93 Efficiency
Opportunities for optimization
0% Optimal
100% Waste
0% Stress
Why is Efficiency 93?
Efficiency combines the scores of Waste and Density to highlight significant improvement opportunities. A large amount of waste accumulated combined with a low density ratio will have a very poor efficiency score.
22 Reclaimable Waste
Percent of configured capacity that is reclaimable
4 vCPUs
228.8 gb DISK
13.9 gb MEM
5% Idle VMs
73% Powered Off VMs
22% Oversized VMs
61 Density
The ratio of the ideal consolidation ratio to the actual consolidation ratio
vCPU : CPU Ratio
vMEM : Physical Memory

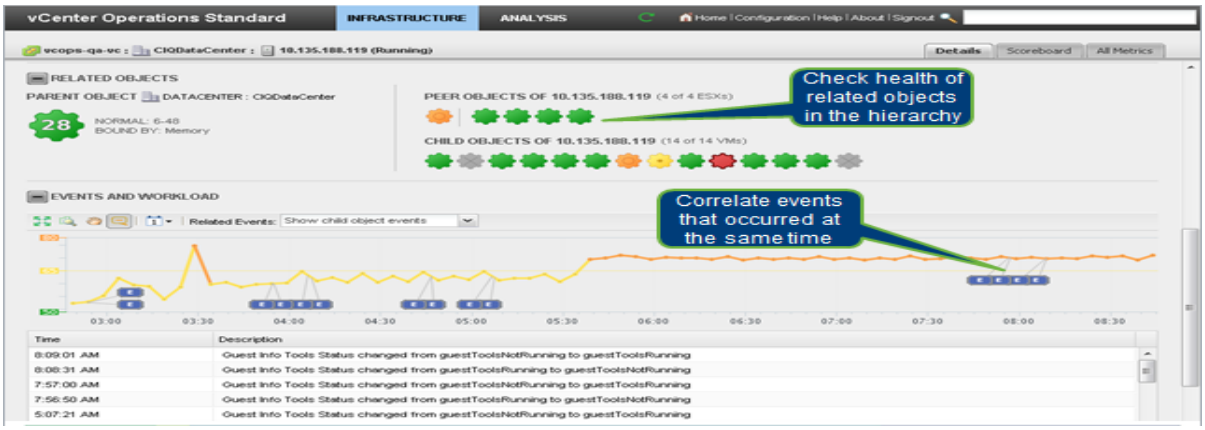
VCOPS could be used to

Find Bottlenecks

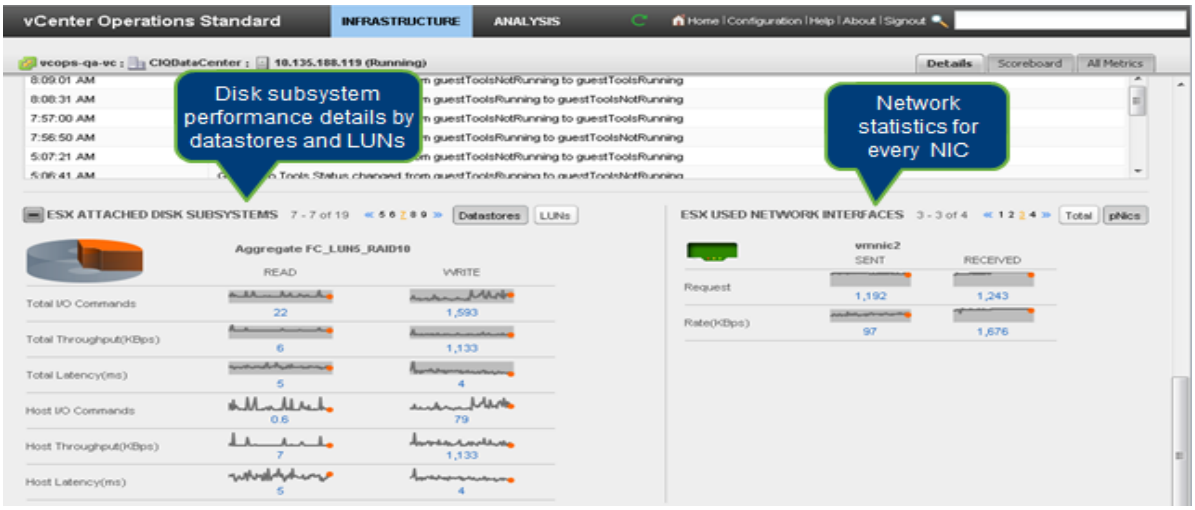
Drill down into problem source



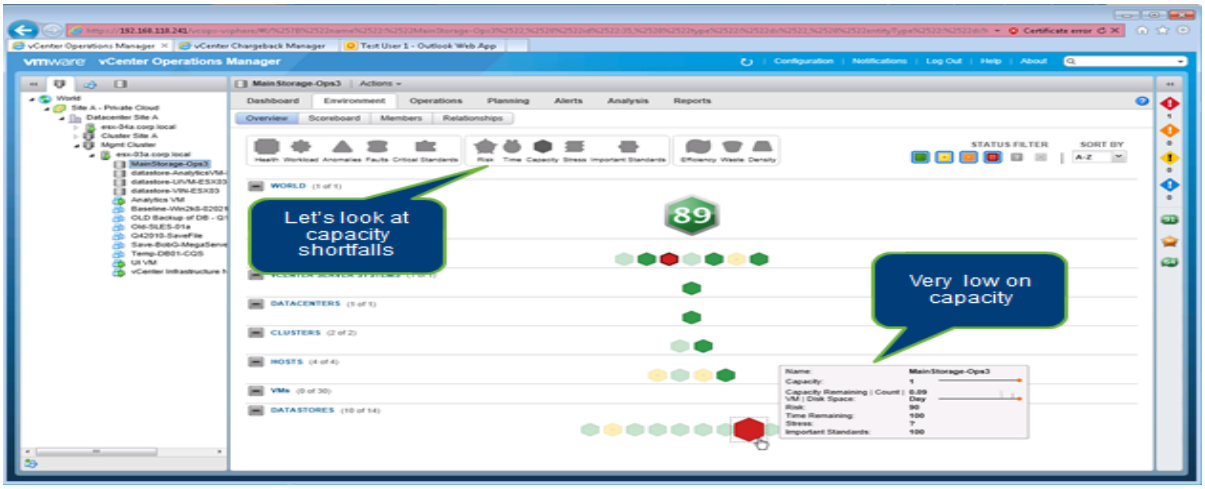
Correlate cause and effect of a problem



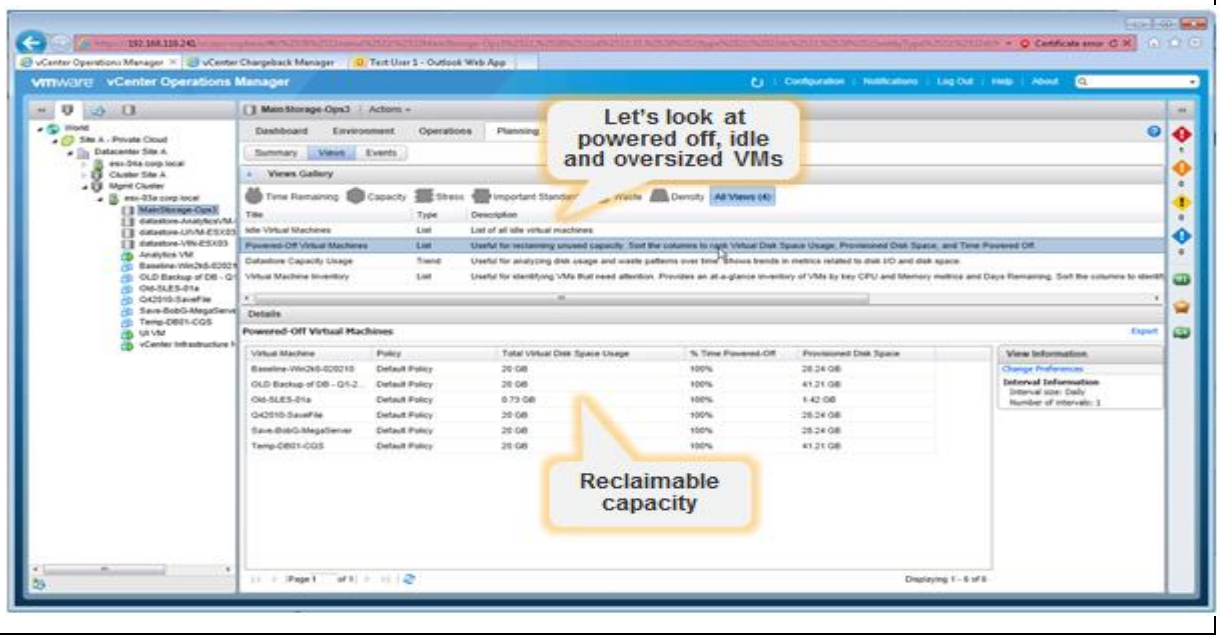
Deep Dive into Disk and Network IO performance



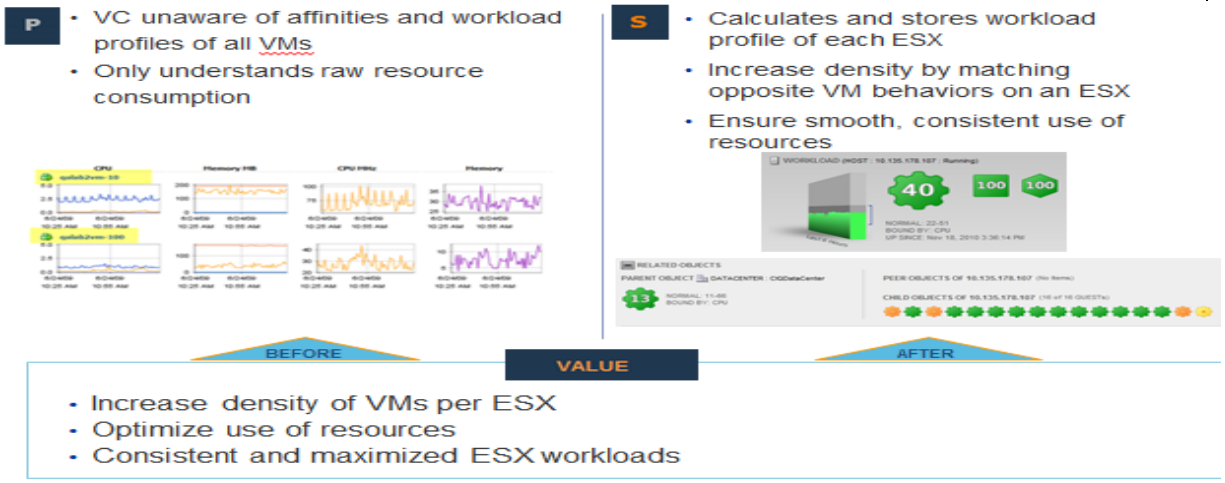
Monitor and Plan capacity utilization



View Opportunities to optimize



Workload Optimization

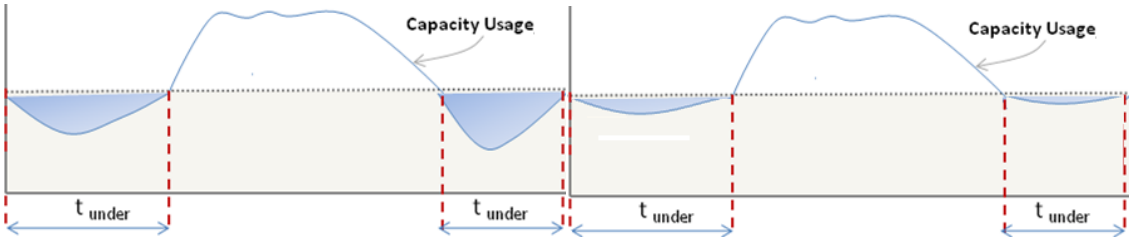


Reclaim waste capacity

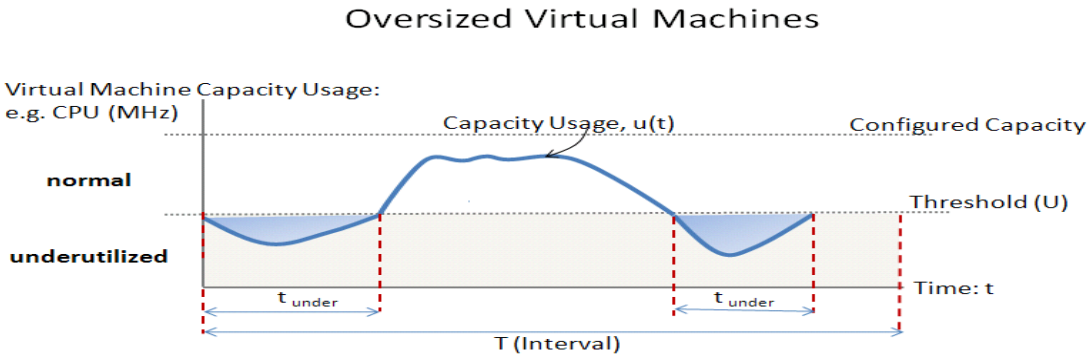
World: World

Virtual Machine	vCenter Server	Configured vCPU	Recommended vCPU	Optimal of Recommended(%)	Configured Memory	Recommended Memory
AdminClient-Iwan	vCloud	2 vCPUs	1 vCPUs	23%	2 GB	896 MB
AdminClient-Vishal	vCloud	2 vCPUs	1 vCPUs	4.3%	2 GB	480 MB
Analytics VM	MGMT-VC	2 vCPUs	1 vCPUs	77%	9 GB	5,120 MB
Analytics VM	MGMT-VC	2 vCPUs	1 vCPUs	29%	9 GB	2,272 MB
CapacityIQ	MGMT-VC	4 vCPUs	1 vCPUs	10%	4 GB	448 MB
Chargeback 2.0	MGMT-VC	1 vCPUs	1 vCPUs	15%	4 GB	512 MB
CMPCONV001	vCloud	2 vCPUs	1 vCPUs	1.2%	2 GB	256 MB
CMPDBS001	vCloud	2 vCPUs	1 vCPUs	2.6%	2 GB	256 MB
CMPESXI001	vCloud	4 vCPUs	1 vCPUs	5%	4 GB	288 MB
CMPESXI002	vCloud	4 vCPUs	1 vCPUs	5.6%	4 GB	288 MB
CMPESXI003	vCloud	4 vCPUs	1 vCPUs	17%	4 GB	576 MB

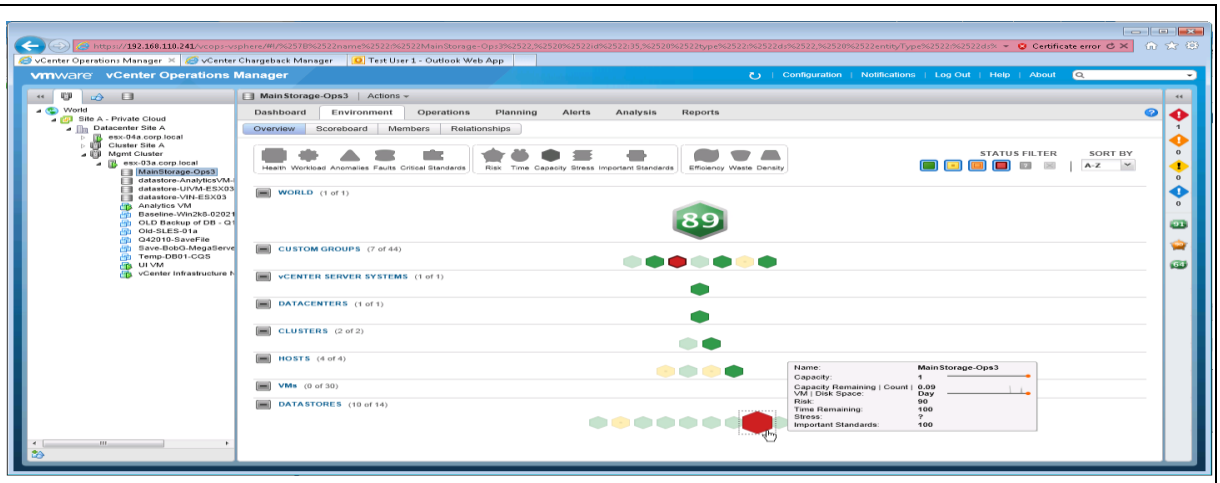
Capacity Planning: Is the VM sized properly



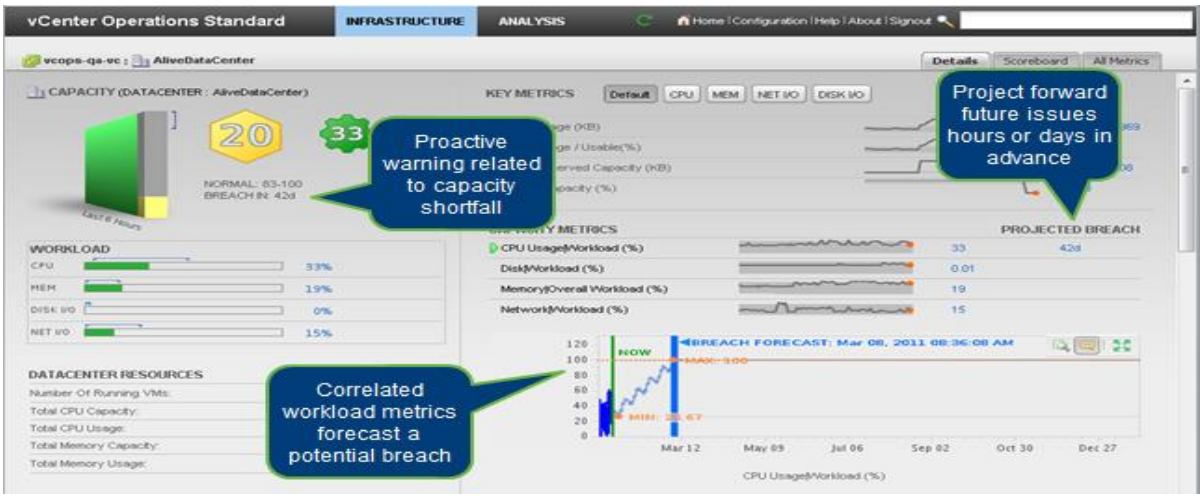
Oversized VM Calculation



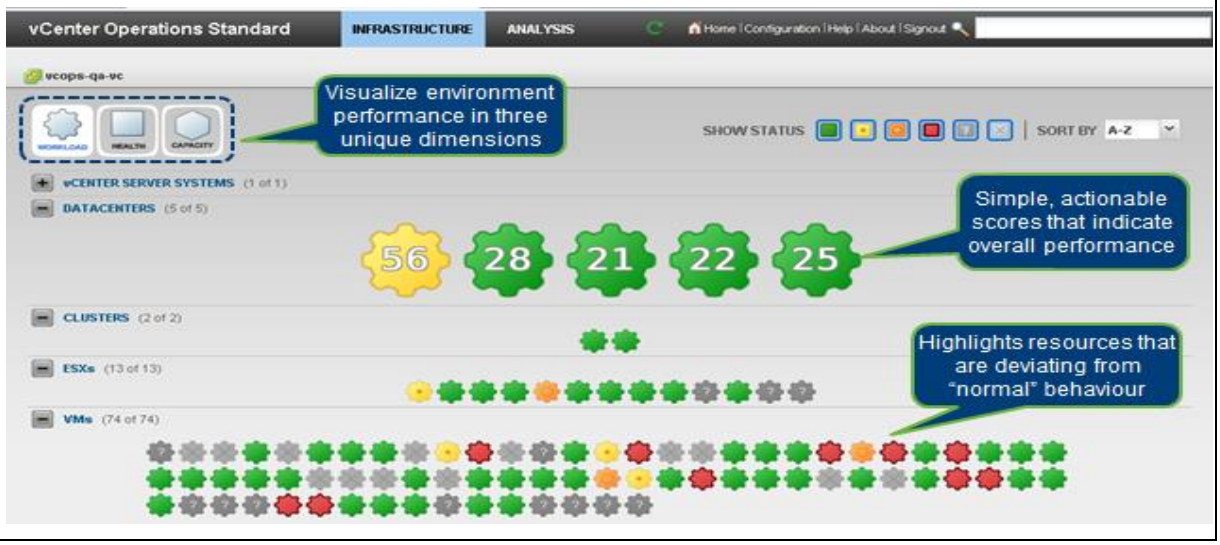
Analyze : Monitor and Plan Capacity Utilization



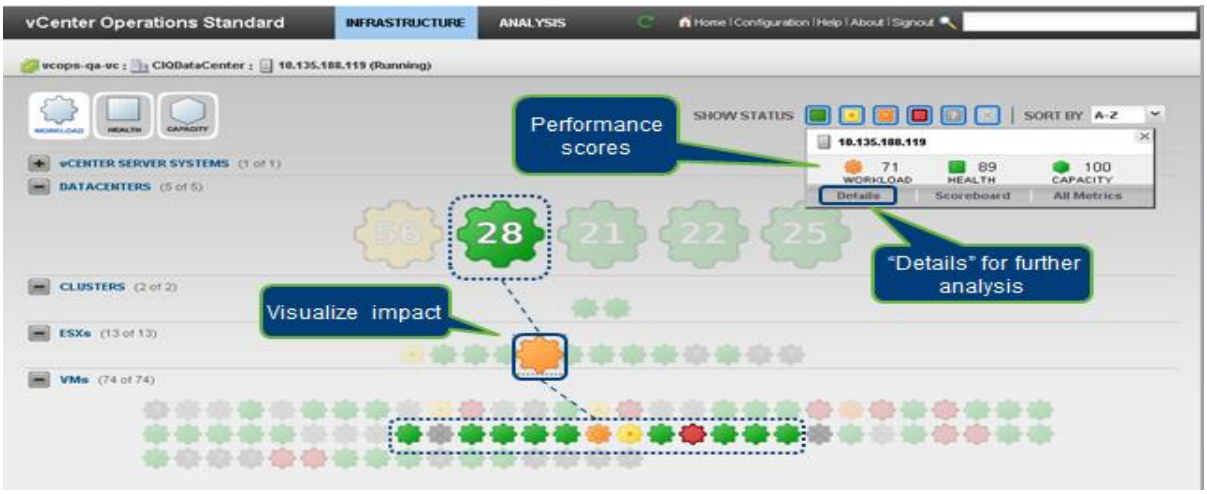
Anticipate Capacity Issues Before They Happen



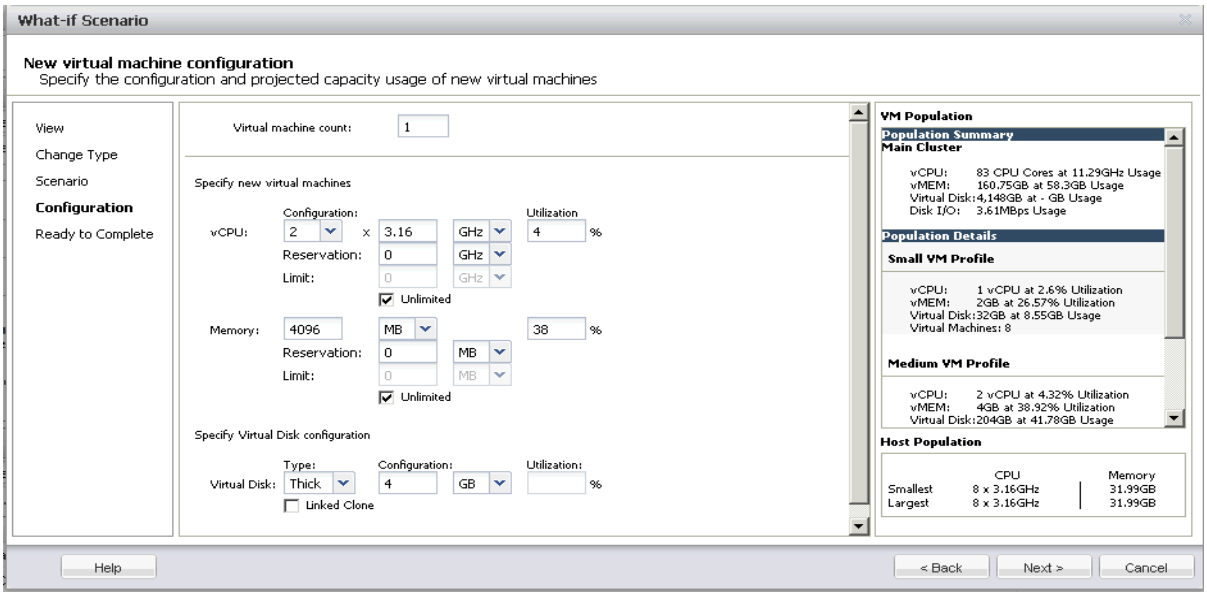
Performance Dashboard based on self-learning analytics



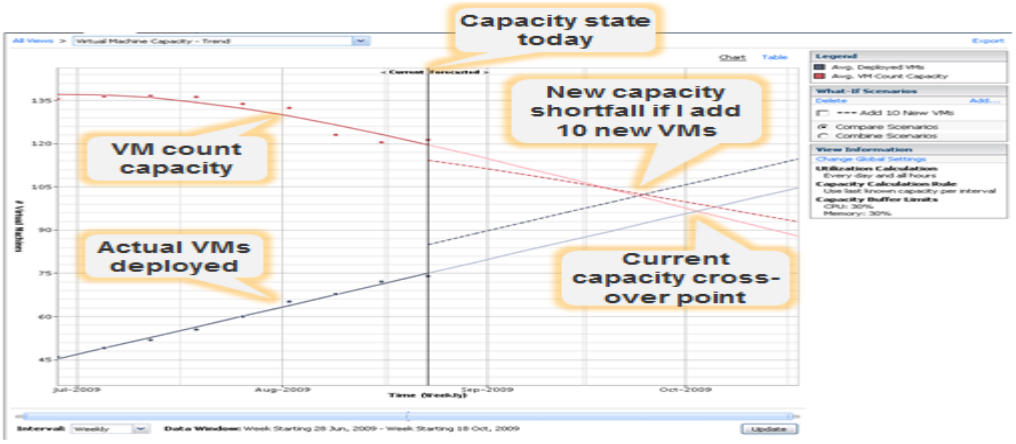
Get "At-a-glance" insights into performance issues



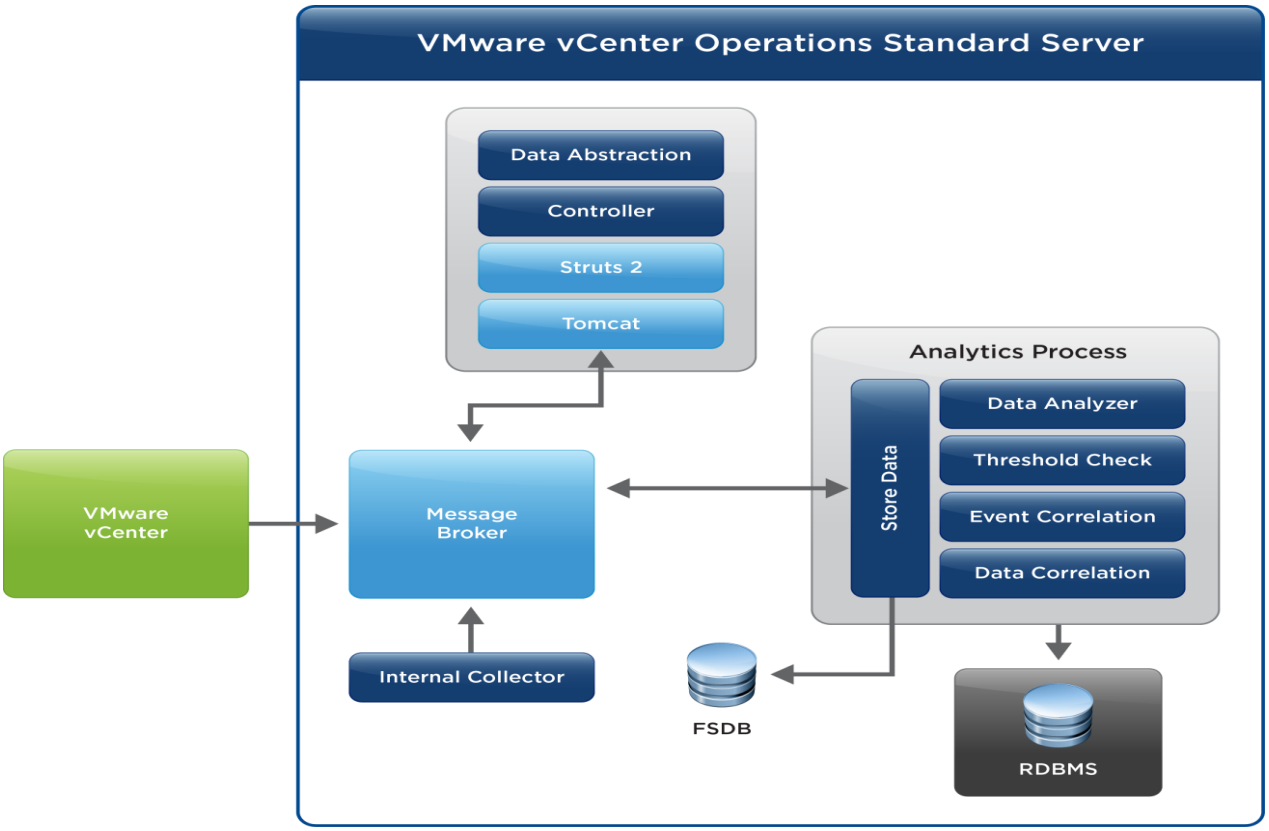
Modeling a What-if Scenario



Forecast: What-If Analysis



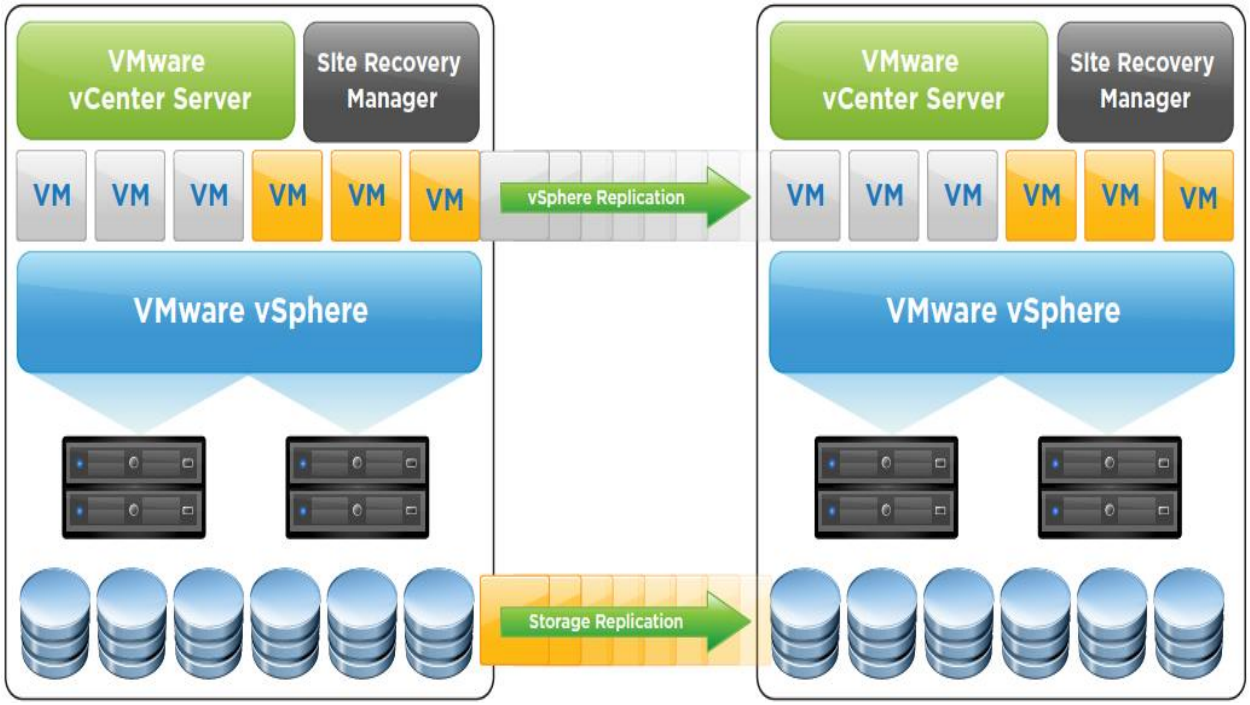
- Architecture includes
  - PostgresSQL DB
  - File-based DB (FSDB) for raw metric storage
- Single Collector for vCenter embedded in appliance



- **Simplified implementation – 15 mins**
  - Deploy the appliance – Deploy OVF Template
  - Change passwords and set Timezone
  - Set up network configurations (Optional)
  - Connect to vCenter Server
    - IP, Admin User Name, Admin Password, Collector User Name, Collector Password
  - Apply your license
- **Polling and analytics start automatically**
  - Polling set to every 5 mins
  - **Accessing the UI**
  - Supported browsers include: Internet Explorer 7 or 8, or Firefox 3.6.x
  - Internet Explorer 7 is required on the machine where vSphere Client runs

3.12 Disaster Recovery

SRM is an automation product that runs on vSphere that eases the setup of disaster recovery for virtualized workloads. SRM facilitates non-disruptive testing of recovery plans and provides automation when it is needed most – during a disaster. Last, but not least, SRM creates a history report every time a recovery plan is tested or ran providing documentation for troubleshooting and auditing purposes.

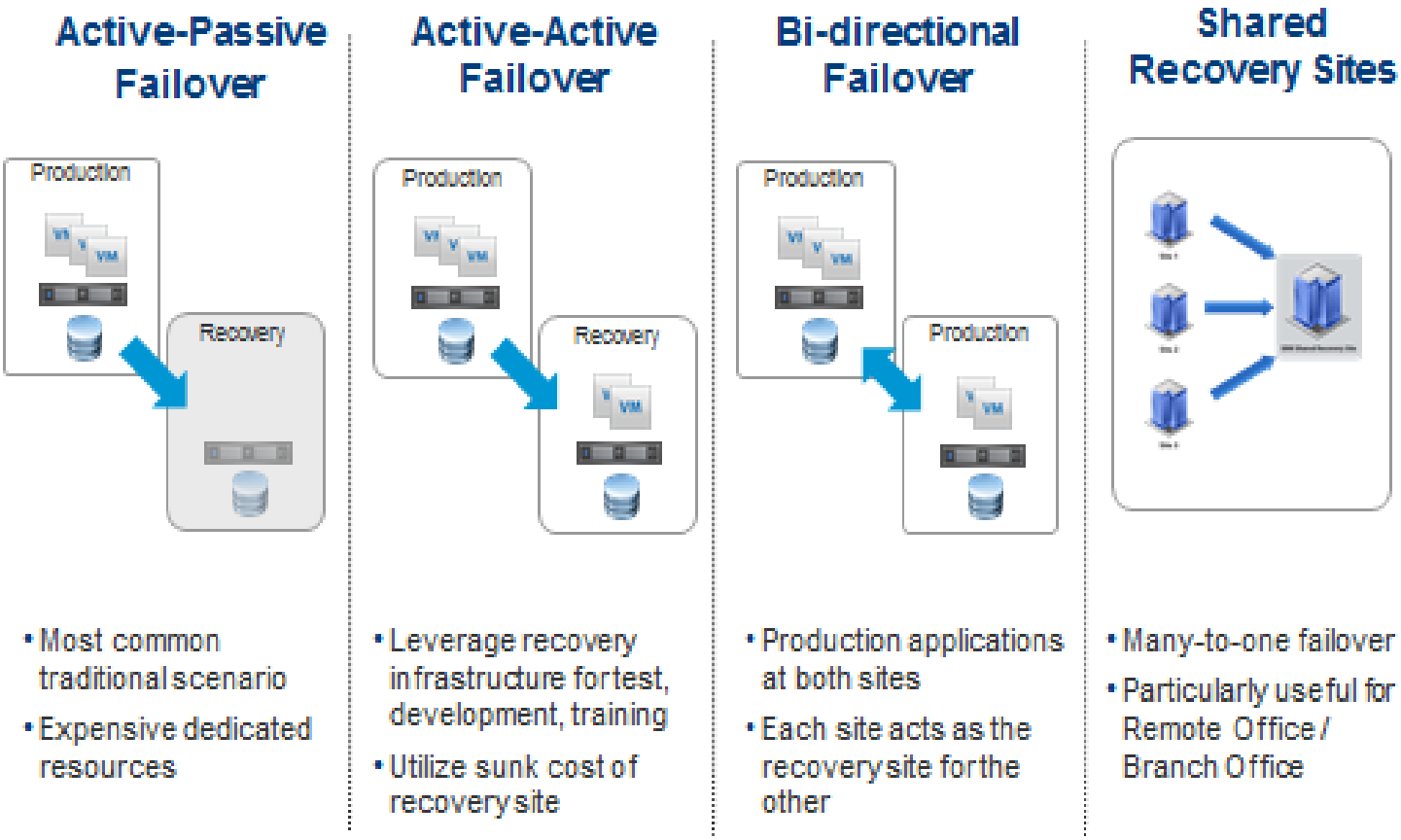


SRM can be used in a number of different failover scenarios

- **Active-Passive:** Site Recovery Manager absolutely supports the traditional active-passive DR scenario, where a production site running applications is recovered at a second site that is idle until failover is required. Although the most common configuration, this scenario also means that you are paying a lot of money for a DR site that is idle most of the time.
- **Active-Active:** To make better use of the recovery site, Site Recovery Manager also enables you to leverage your recovery site for other workloads when you aren't using it for DR. Site Recovery Manager can be configured to automatically shut down or suspend VMs at the recovery site as part of the failover process so that you can easily free up compute capacity for the workloads being recovered.
- **Bidirectional:** Site Recovery Manager can also provide bidirectional failover protection so that you can run active production workloads at both sites and

failover to the other site in either direction. The spare capacity at the other site will be used to run the VMs that are failed over.

- **Local Failover:** Although less common, some of our customers need to be able to failover within a given "site" or campus, for example when a storage array failure occurs or when building maintenance forces you to move workloads to a different campus building. These customers are leveraging Site Recovery Manager to perform these failovers.



SRM Quick Steps

Activity	Descriptioin
ESX Install	ESX has to be installed and configured on both the sites
vCenter Install	Install VMware Virtual Center Management Server on both sites
SRM Install	Install SRM on both the VC at the production site and the VC at the DR site needs to be confirmed.
ODBC	Create and configure ODBC either to SQL or Oracle database for SRM at both the Production and DR sites.
Databases	Create a database in either Oracle or SQL at both the Production and DR sites. Create an empty database, with similar naming structure as VC and VUM, and make the owner of it the same account as will be used in the ODBC connection. Obtain Valid VMware licenses to cover all components – These can either be purchased licenses or evaluation keys. SRM has a built in 60 license. TCP/IP connectivity and forward, reverse, short, long DNS resolution between VC, ESX, and SRM servers in each site. Create a list of Virtual Machine(s) to be protected by SRM along with their underlying storage. As discussed earlier in this document. Identify storage vendor and array replication and snapshot software to be used. Verify storage is supported:
Storage Replication	Storage has to be replicated from one site to another site.
SRA configuration	With customer, contact storage vendor and make sure the storage vendor follows their Storage Replication Agent (SRA) documentation to prepare for the environment.
Recovery Group	Create Recovery Groups
Protection Group	Create Protections Group
VM Customization	Identify and define VM Customization.
Dry Run	Test if the environment work as expected

3.13 Backup

Based on EMC Avamar

To be taken up in Phase 2

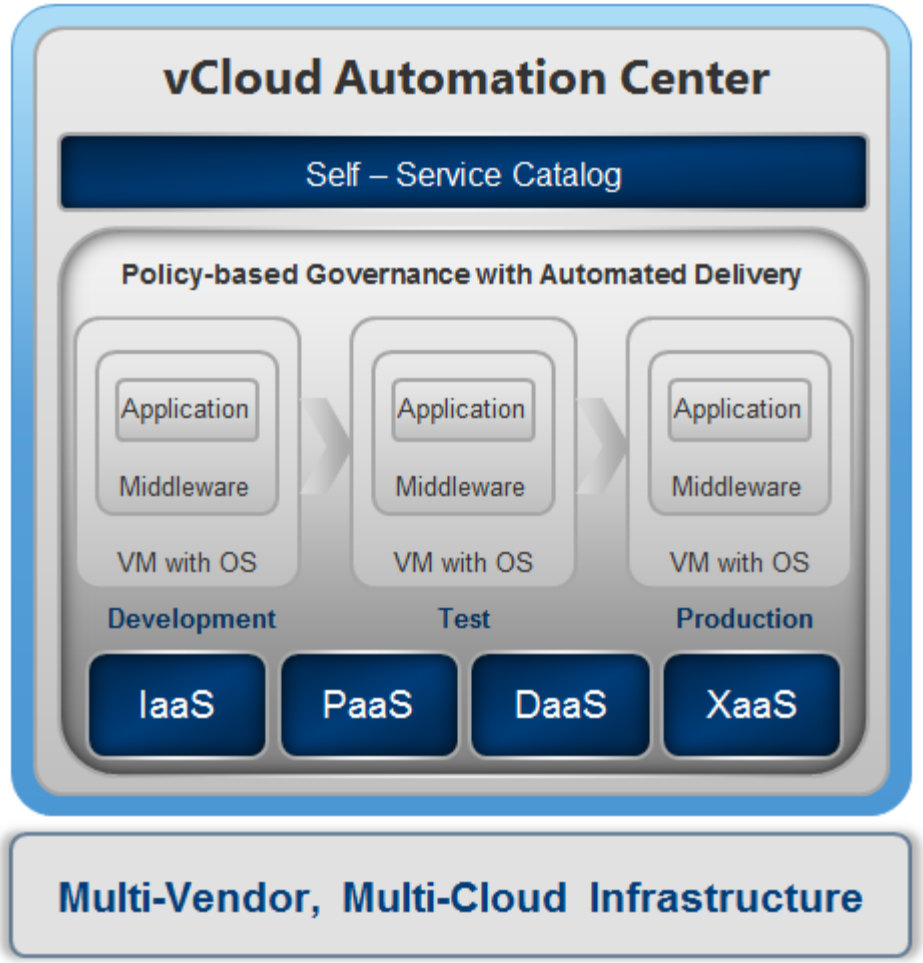
3.14 Automation

VMware vCloud Automation helps IT accelerate the delivery of personalized application and infrastructure services. Through a single self-service catalog, users request and manage a wide range of multi-vendor, multi-cloud applications, infrastructure, and custom services.

New Capabilities
This release continues to enhance VMware's cloud automation management capabilities with the following new capabilities:

- **Unified IT Service Catalog**
  Empower users to request and manage a variety of IT services that seamlessly span multi-vendor, multi-cloud platforms.

- **Deliver Anything as a Service**
  Wizard-driven service designer that allows administrators to define service request forms, configure governance policies and automate the delivery workflow of custom IT services. These services can be published in the vCloud Automation Center catalog along with other application and infrastructure services.
- **Accelerated Application Deployment**
  Single solution for application release automation that supports various DevOps automation tools.
- **Additional Cloud Support**
  vCloud Automation Center 6.0 continues to expand it multi-vendor, multi-cloud support with the addition of VMware vCloud Hybrid Services and OpenStack Cloud Environments
- **Dynamic configuring of NSX Network Services**
  New in this release, vCloud Automation Center can dynamically configure and tear down NSX logical services as needed to deliver a secure and scalable application infrastructure on demand.
- **Simplified Business Management**
  Integration with VMware IT Business Management Standard Edition automatically populates vCloud automation Center cost profiles from an extensive reference database of Infrastructure cost information. Administrators can then compare the cost of their private cloud services to public cloud offerings.

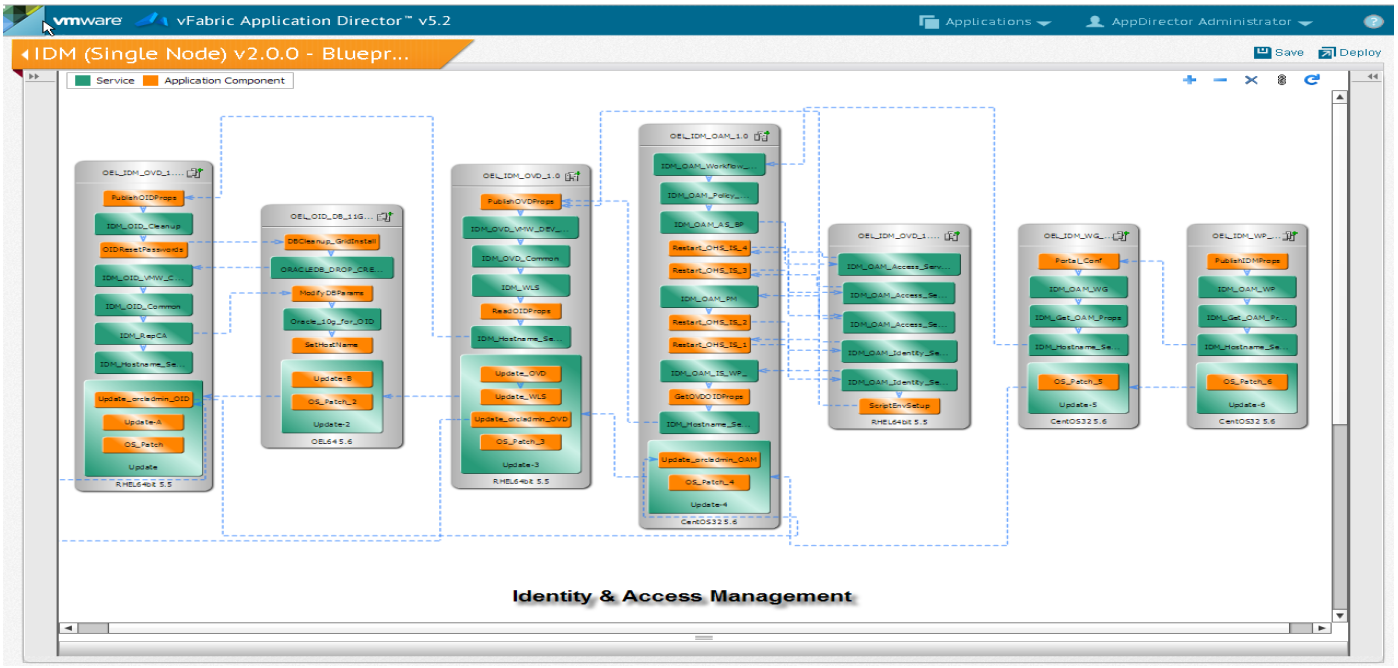

vCloud Automation Center
Self – Service Catalog
Policy-based Governance with Automated Delivery
Application
Middleware
VM with OS
Development
Application
Middleware
VM with OS
Test
Application
Middleware
VM with OS
Production
IaaS
PaaS
DaaS
XaaS
Multi-Vendor, Multi-Cloud Infrastructure

3.15 Blue Prints

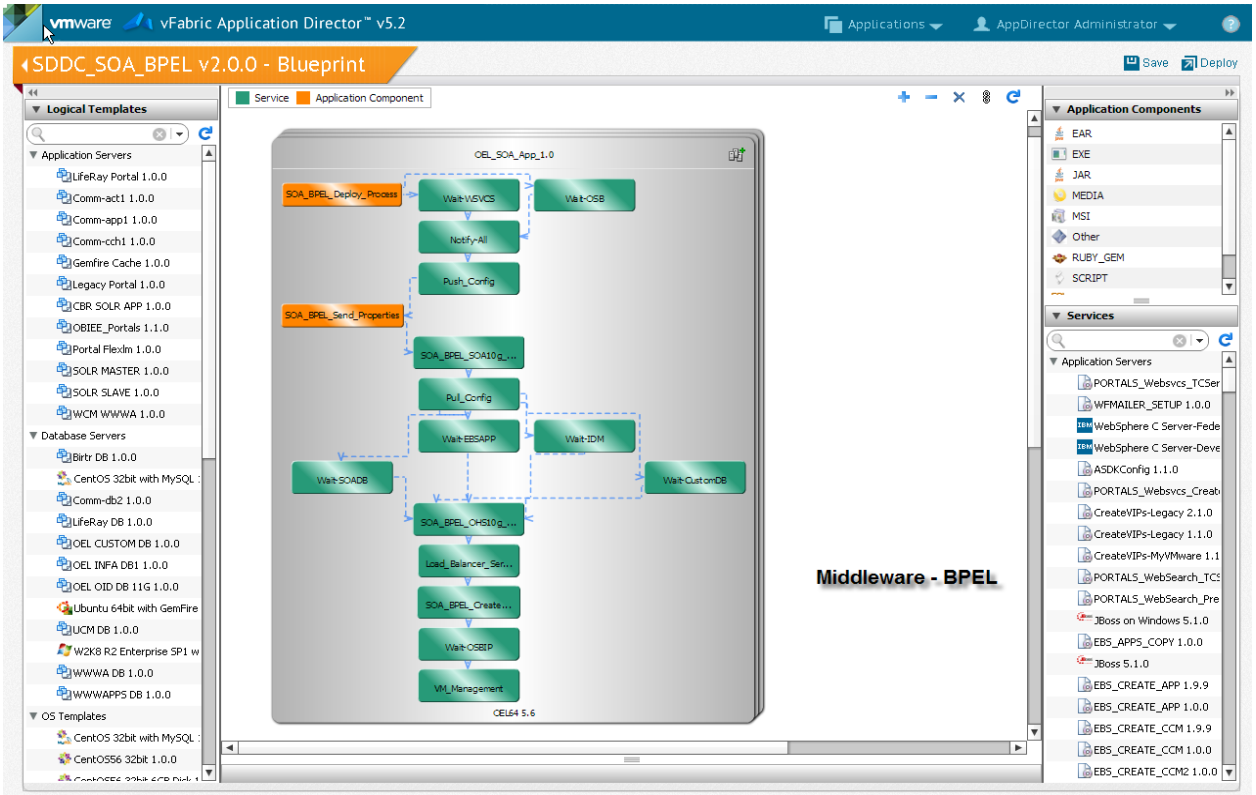
A *blueprint* is the complete specification for a virtual, cloud or physical machine, determining the machine's attributes, the manner in which it is provisioned, and its policy and management settings. When a user requests a machine, she must select the blueprint from which it will be created. For example, a virtual blueprint might specify a Windows XP Professional developer workstation with one CPU, 2 GB of memory and a 30 GB hard disk. A cloud blueprint might specify a Red Hat Linux web server image in a small instance type with 1 CPU, 2 GB of memory and 160 GB of storage. A physical blueprint might specify Windows Server 2008 R2 installed on a server with exactly two CPUs and at least 4 GB of memory. Blueprints specify the workflow used to provision a machine and additional provisioning information as needed, such as the locations of required disk images or virtualization platform objects. Finally, blueprints set the policies that apply to a machine, such as the approvals required provisioning it, when it expires, which operations its owner can perform on it, and so on. When a blueprint is created, some information is specified using controls in the console and some using *custom properties*.
A *local* virtual or physical blueprint is created by a provisioning group manager for a single provisioning group and is available only to that group's members. A g*lobal* virtual or physical blueprint is created by an Enterprise Administrator and/or Provisioning Group Manager can be selected for inclusion among a provisioning group's local blueprints by the Provisioning Group Manager.

Examples of VCAC Blue Prints

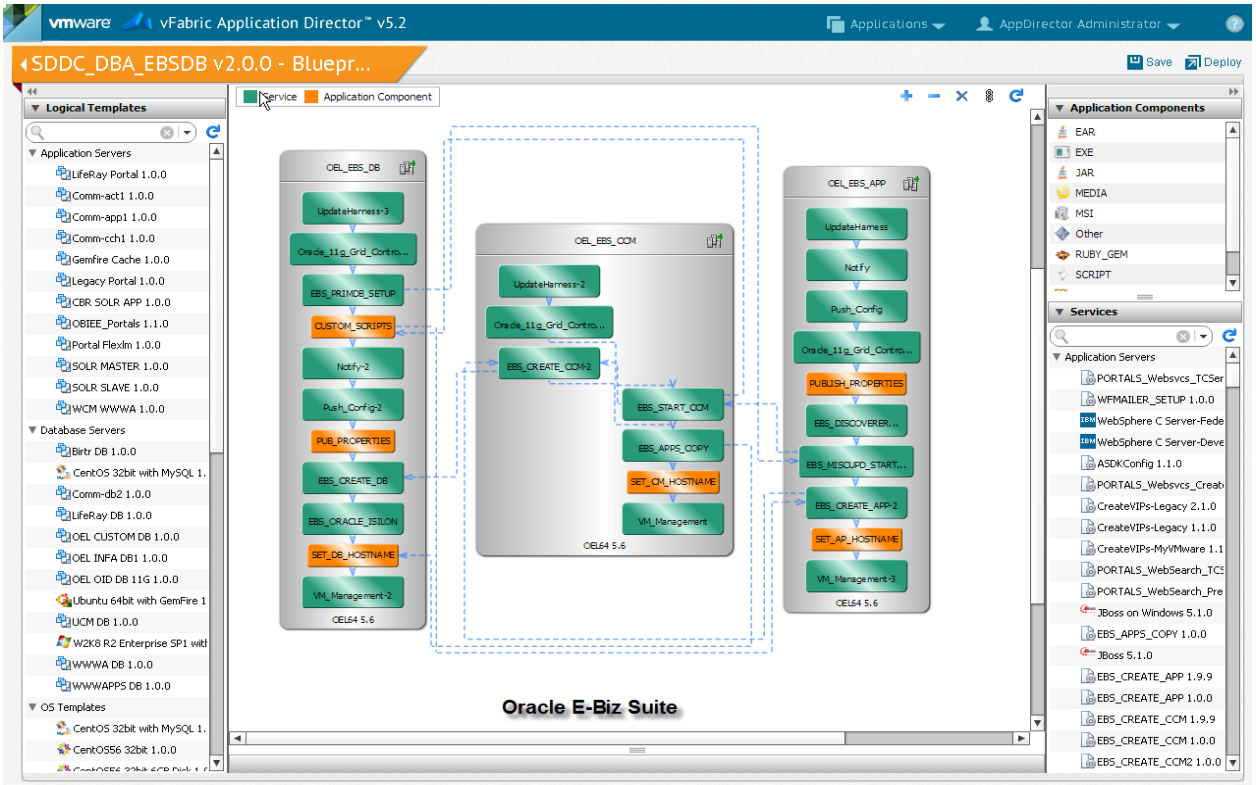
Single Node Blue Print



Middleware – BPEL



Oracle EBIZ Suite Blue Print



3.16 Security Solution

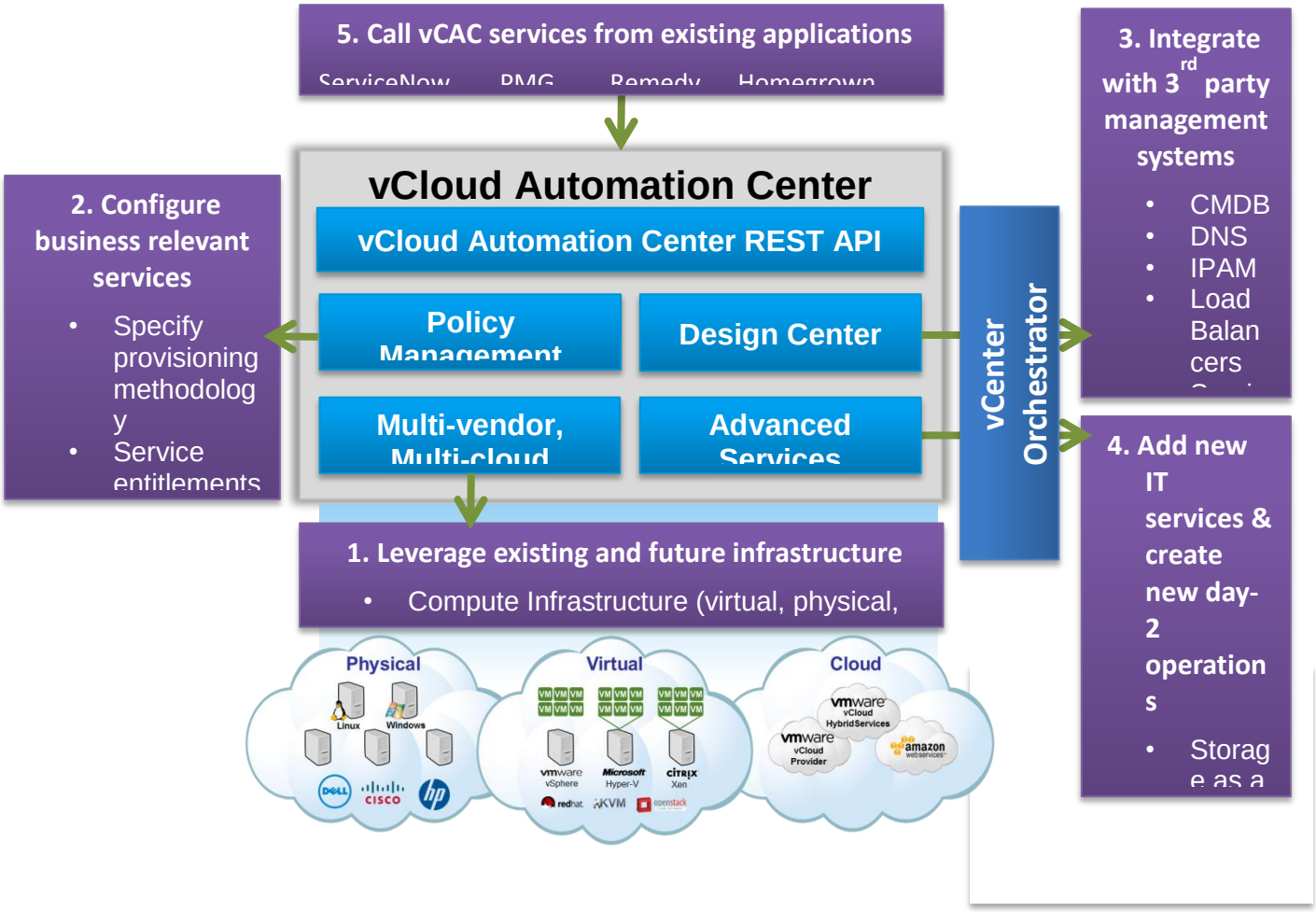
To be completed

3.17 Metering and Chargeback

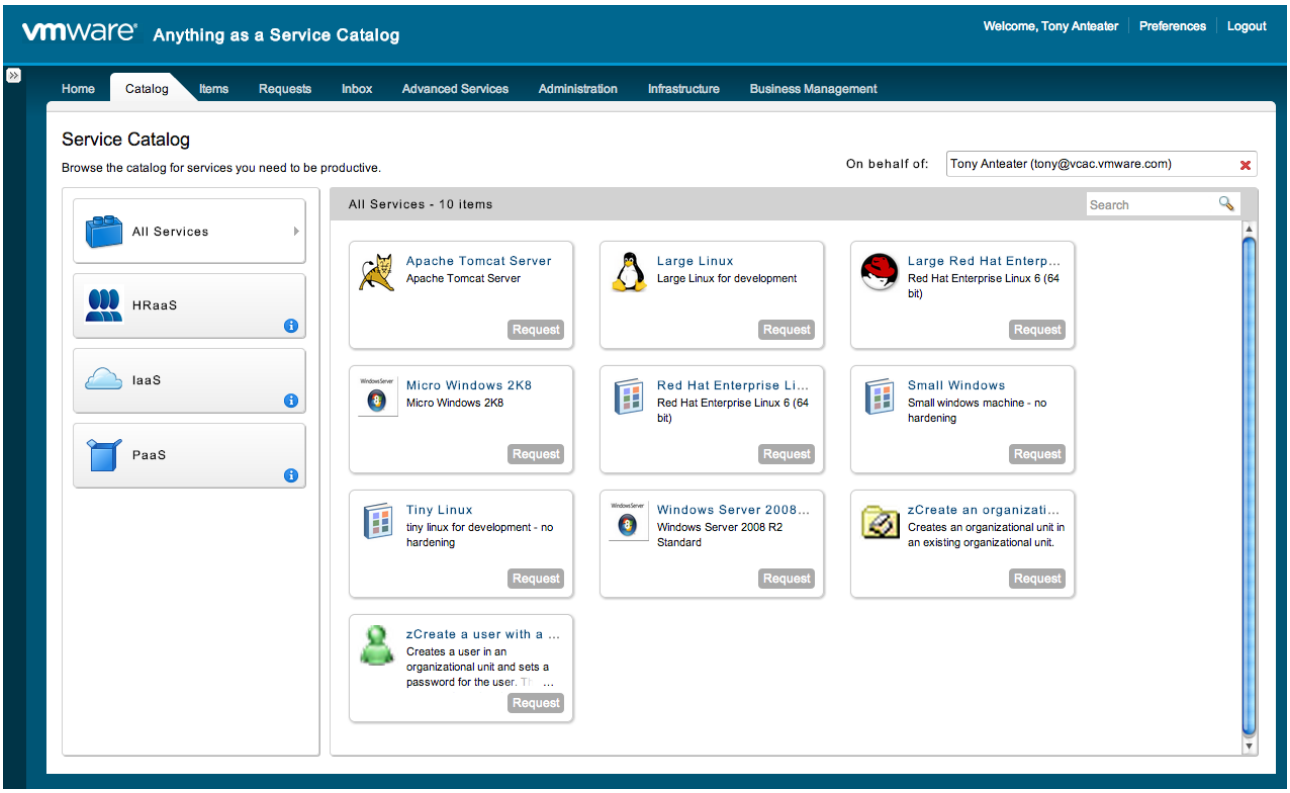
To be completed

3.18 Private Cloud Solution

vCAC Architecture



VCAC Portal



3.18.1 vCAC Virtual Appliances:

In vCAC 6.0 VMware has introduced a new web tier to the architecture. In our case here, two nodes are deployed for high availability and load balancing. Those appliances are completely stateless which means that all the configurations are stored on the database tier We could have a load balancer in front of those appliances to load balance the end-user traffic to the portal and to monitor also the connection in case one node goes down. In such a case, the LoadBalancer should automatically switch the traffic to the active node. In our appliances configuration also, you must have your Load balancer hostname set there, not the actual vCAC VA node hostname

3.18.2 Identity Appliance (SSO):

We used the vCenter SSO 5.5.0b for the solution. This is a virtual appliance that was released with vCAC 6.0 and Unlike what most of us know, this is **NOT** a mandatory components anymore after the vCenter SSO 5.50b was release. The latter is compatible with vCAC 6.0 and can be used instead of the identity appliance.

3.18.3 Databases:

There are two kind of databases required in this distributed architecture:

1) MS-SQL database: this will host the DBs for the vCenter Server (and relevant components) as well as the vCAC IaaS components and the vCenter Orchestrator. We would use Windows Failover Cluster (aka MSCS) for the high availability of that database tier.

2) PostgresSQL database: would be the database for vCAC appliances. Please note that you only need this external DB if you are clustering your vCAC virtual appliances for load balancing and high availability as explained above. In this case, you can still have high availability using the native vSphere HA. In this architecture PostgresSQL DB is clustered as well.

3.18.4 ITBM Standard Edition:

This is a standalone appliance and integrated with vCAC to collect all the statistics from either vCenter Server, vCloud Director and/or external clouds (as end-points). When installed, the ITBM registers itself with vCAC and we get new tab in vCAC portal under a new tab called "Business Management". This is a standalone appliance and would be deployed inside the management cluster. Standard vSphere HA should is used for 100% uptime. A single ITBM appliance can support 20,000 VMs.

3.18.5 vCloud Application Director

This is another standalone appliance would be deployed inside the management cluster and then registers it with your vCAC environment. Application blueprint Please note that, in this 6.0 release, you will still need to manage your configurations and application blueprints from AppD directly, not from within the vCAC 6.0 portal as ITBM. In the official product documentation, the minimum configuration required for this appliance is 1vCPU and 2GB memory

3.18.6 vCAC IaaS Web tier:

This is the traditional web tier that was inherited from the old DynamicOps acquisition. It still has the same characteristics and recommendations as it was back in the vCAC 5.x days. The only difference here is that the IIS pages of this web tier are actually "framed" within the vCAC VA front-end portal. For example, when you want to add a new Endpoint to your cloud environment, you will navigate through the vCAC VA portal menus until you click on the Endpoints button. At that point, we are actually grabbing an IIS page and framing it for you within the vCAC portal. That way, we are providing a consistent experience to the cloud admins for all the configuration wizards and panels that they have been doing from the old days of vCAC 4.x/5.x. Back to the architecture, this web tier is active/active and stateless as it has always been. Like the vCAC VAs, you will need a load-balancer virtual IP for these web nodes as illustrated in the diagram.

3.18.7 vCAC IaaS Manager Service (aka Application Server):

This is another IaaS component that is ported from the old DynamicOps architecture. It is still an Active/Passive application tier that requires a manual intervention to start the service in case the first active node goes down. You will still need also to use a load balancer with a virtual IP to pass the traffic to the active node. If that node went down, the load-balancer can switch over to the other node but, again, the service has to be started manually. It is recommended also to stop the service on the LB before enabling it on the actual Manager Service node and then do the switch over.

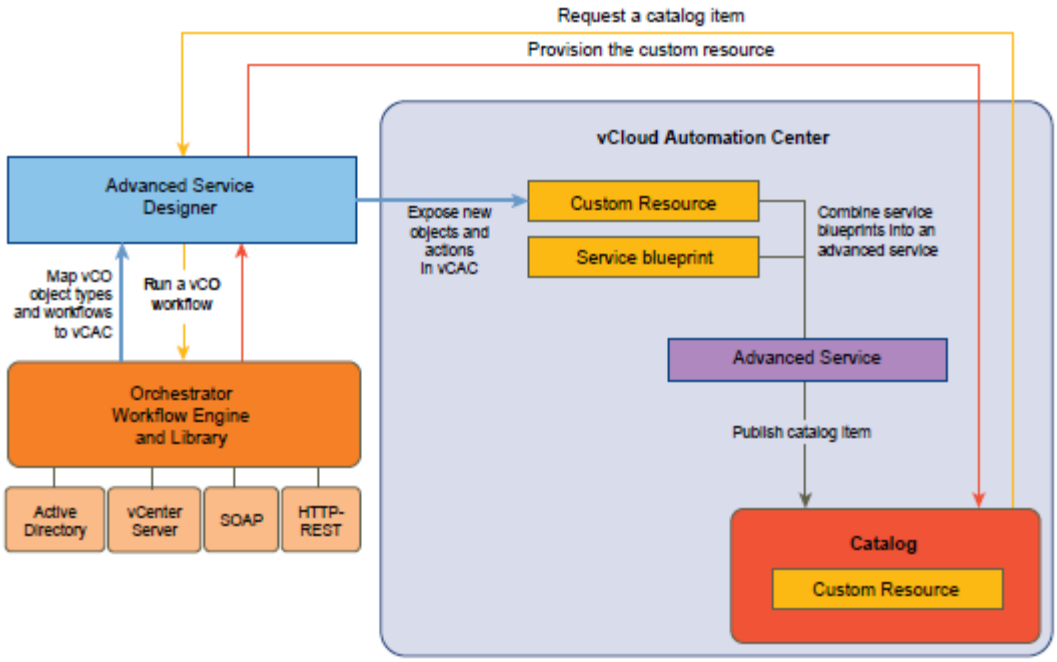
Since this is an active/passive configuration, I like also to place the DEM-Orchestrator along with it. Two reasons for that. Firstly, the DEM-O is also an active/passive in functionality. If you have two DEM-O nodes, both will be active on the network (to monitor each others) but only one will be actually doing the work. The failover process is automated though, unlike the Manager Service. Secondly, the DEM-O should be as close as possible to the Manager Service for best performance. You can definitely use another dedicated VMs for your DEM Orchestrator nodes if you are worried about the performance of the VMs or if you like to completely segregate all your management workloads.

3.18.8 Model Manager Service vs. Model Manager Data:

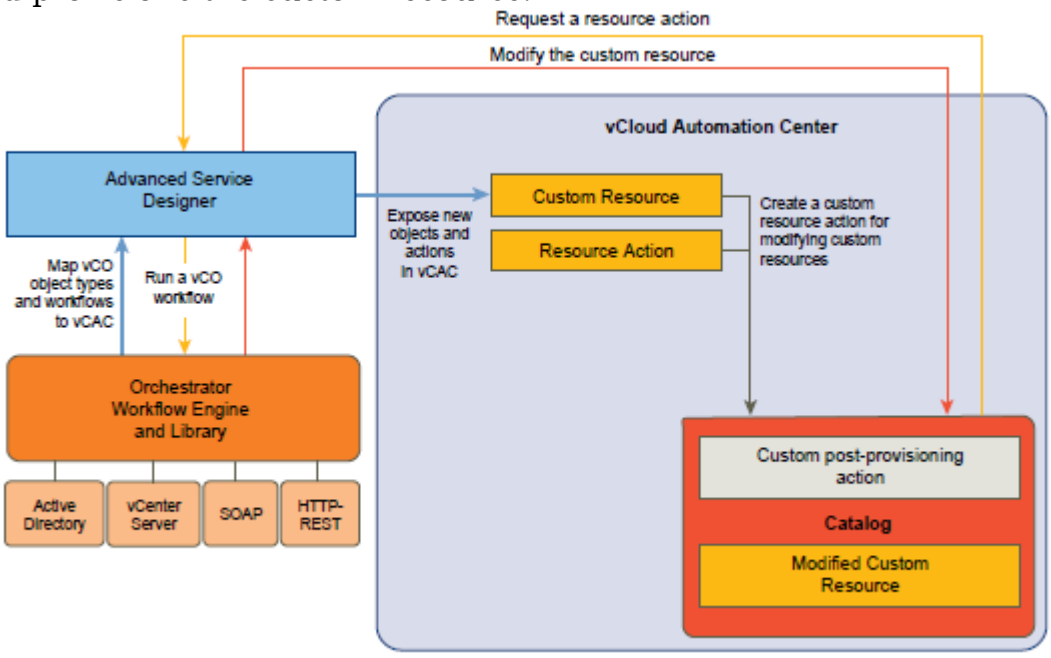
. This ModelManagerData gets installed only once. It is basically to populate the database (the MS-SQL DB) with the default model data.

3.18.9 vCenter Orchestrator

The vCenter Orchestrator server distributed with vCloud Automation Center is preconfigured, and therefore when your system administrator deploys the vCloud Automation Center Appliance, the vCenter Orchestrator server is up and running.



Service architects can map vCenter Orchestrator objects to custom resources and vCenter Orchestrator workflows to service blueprints in vCloud Automation Center. They can then publish the service blueprints as catalog items and combine the items into an advanced service. Tenant administrators or business group managers can display the service to the catalog of the consumers by creating an entitlement. When the consumers request a catalog item, vCloud Automation Center runs a vCenter Orchestrator workflow and provisions the custom resource.



4. Implementation Approach

4.1 Phases & Activities

VMware VCAC based private is delivered by Wipro in 6 Phases and the phases are listed as below

Phase 1: Design

The Wipro design team would understand the customer requirement and deliver the below listed services

- Business Requirement Assessment

  Assess the customer requirement and identify and design an appropriate solution.

- Application Migration Assessment

  Assess what application could be migrated to the cloud environment. Design and give a project plan based on the state of the applications. Involve Wipro BAS team based on the requirement.

- High Level Design

  High level design document

- Low Level Design

  Low level design document

- Network Logical Design
- Storage Logical Design
- Shared Storage Logical Design
- HA Design
- DR Design
- Security Design
- Backup Design

Phase 2: Setup Cloud Environment

- Setup the VMware virtualization environment

  Datacenters

  Clusters

  Resource Pools

  RBAC

  Network

  Storage

- Setup Datacenters, Clusters, Pools, RBAC
- Install and configure
  - Install and configure MS-SQL Cluster
  - Install and configure vCenter (vCenter)
  - Install and configure ESXi (ESX)
  - Install and Configure SSO (SSO)
  - Install vCenter Operations (VCOPS)
  - Install vSphere Replication (VR)
  - Install VMware SRM (SRM)
  - Install VMware Update Manager
  - Install Auto Deploy
  - Install Operations Orchestrator (OO)
  - Install Chargeback Manager (VCM)
  - Install ITBM Suite(ITBM)
  - Install VDP(VDP)
  - Install (vSAN)
  - Install vCloud Network and Security (VCNS)
  - Install NSX
  - Install and configure PostgressSQL
  - Install and configure vCloud Application Director
  - Install VCAC Appliances (VAPPS)
  - Install VCAC Web (VAPPS)
  - Install VCAC Manager Services

    - Install DEM
    - Install DEM-Workers
    - Install VCAC Agents
    - Physical Network configuration
    - Physical Storage Configuration
    - VMware LogInsight configuration
- Configure the environment
    - vMotion
    - Fault Tolerance
    - High Availability
    - Load Balancing
    - Failover
    - Alerts and Notifications
    - Logging VMware Loginsight
    - Storage Multipath configuration
    - Snapshot configuration
    - DRS Configuration
    - HA Configuration
    - App HA configuration
    - Resource Pools
    - Associate pools to organizations
    - Prices for Pools
    - Report on Resource utilization and subscription
    - vCenter Resource Pools
    - Resource Pool Dashboard
    - Server Resource Pool
    - Network Resource Pool
    - Storage Resource Pool
    - IP Address Resource Pool
    - Host Security
    - vCenter Security
    - Network Security

- Network Security Manager
- Edge Gateway

Phase 3: Test the setup

Clustered Services (HA, DRS, FT, etc.)

Virtual Machine

Migration (Storage, vMotion, Network)

Network (VDS, NSX, Standard, Multipathing)

Storage

Security

Performance (Throughput, Latency etc)

Disaster Recovery

User acceptance testing

Phase 4: Migration

Migrate a batch of 100 Virtual Machines

Migrate rest of the virtual machines as a batch of 100 subsequently

Phase 5: VCAC Implementation

- Self Service Portals
- Catalogs
- Blue Prints
- Provision Groups
- Reservations Policies
- Profiles
- Customization
- Dashboards

Phase 6: Report and Billing

- Executive Reporting
- Intelligent Resource Utilization

- Executive Scorecard and Dashboards
- Executive Business Reporting
- Deployment Costing Breakdown
- Usage Insights
- Service profitability (Wipro deliverable)
- Cost and Usage by provider with scoring
- On Premises with Off Premises comparison
- License Usage
- Software procurement and contract management
- Customized reporting
- Cloud Subscriptions Across departments, across service contracts
- Asset management reporting

4.2 Deliverables

Phase 1: Cloud Design Document

Phase 2:

- Entire hardware configuration to be delivered to the software team.
- Infrastructure Topology and Configuration document
- VMware Private Cloud installed and configured
- Installation and configuration document specifically documenting the database size, LDAP/AD integration, Single SignON configuration.

Phase 3:

- Test Plan
- Test Results
- Recommendations and Suggestions
- Sign off at this phase

Phase 4:

- Migration Approach Document
- Migration best practices

Phase 5:

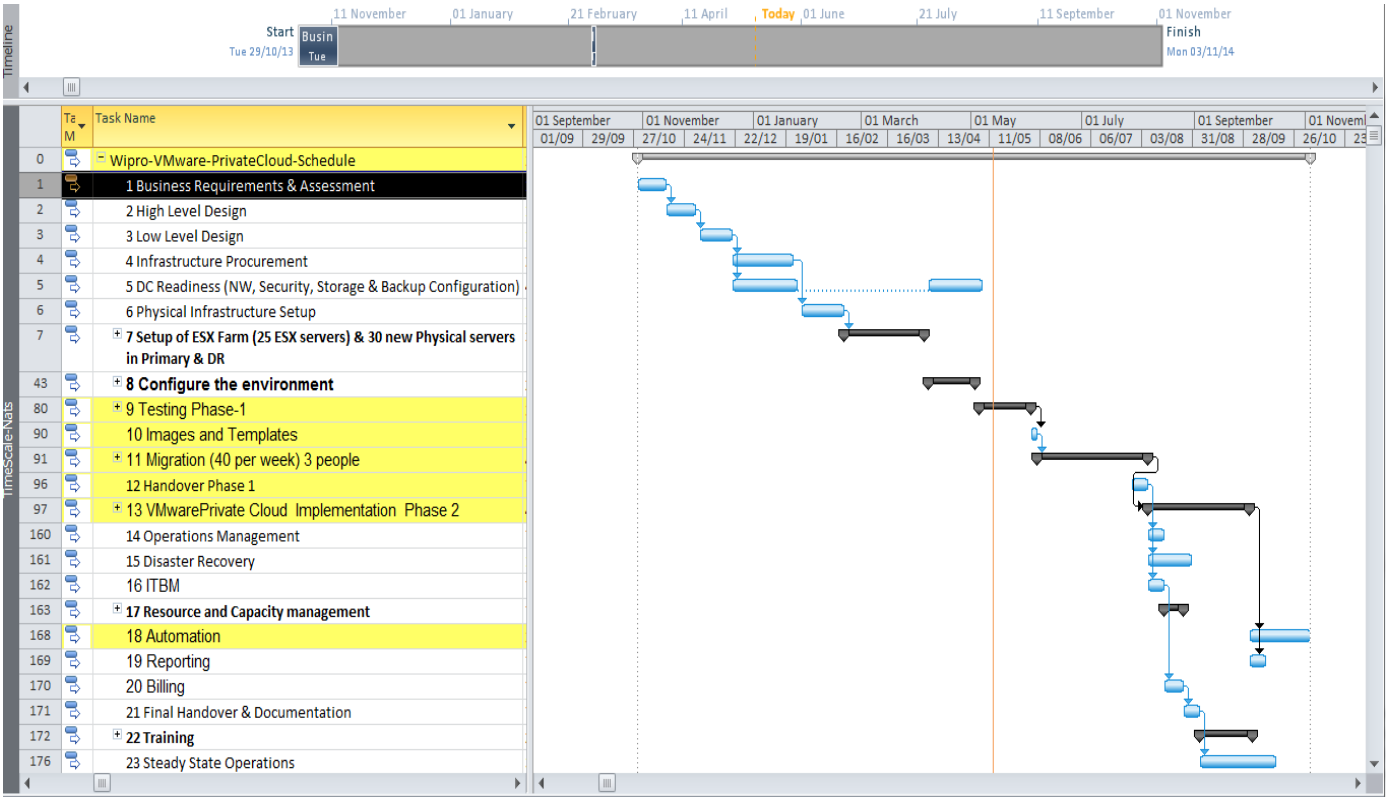
- VCAC based private cloud

Phase 6:

- Executive Reporting
- Intelligent Resource Utilization
- Executive Scorecard and Dashboards
- Executive Business Reporting
- Deployment Costing Breakdown
- Usage Insights
- Service profitability (wipro deliverable)
- Cost and Usage by provider with scoring
- On Premises with Off Premises comparison
- License Usage
- Software procurement and contract management
- Customized reporting
- Cloud Subscriptions Across departments, across service contracts
- Asset management reporting
- Customized reports as per requirements

4.3 Project Schedule

The private cloud implementation is done across 6 phases and the 6 phases would be completed over a period of 265 days person months



Note: Would revise the numbers or days once we have the people and the budgeting for the resource

4.4 Roles and Responsibilities

Role	Responsibility
Project Manager	Would drive the Project Would get involved in all of the project entry and exit objectives Would govern the project Would execute the project to from inception to completion Would make sure to carry all the group members as a team. Would be the point of contact for the project to the customer.
Cloud Infrastructure Architect	VMware VCAC/VCD Cloud Solution Expert Would drive and manage the VMware Cloud solution from design, install, configure, manage to document the solution. Post documentation would train the executives and would hand over the project smoothly to the respective individual
VMware ESX architect	An ESX Architect would understands all the VMware ESX and it's solutions Would be the key player for the project execution
Automation Consultant	Would drive automation end to end independently From Scripting to blue print to designs the solution would be done by this expert
VMware Infrastructure Consultant	VMware Infrastructure who has the big picture while implementing vmware solutions
VMware Consultant	The go to guy for implementing vmware solution
VMware Network Consultant	The Physical/Virtual network expert VDS Administrator NSX consultant
VMware Security Consultant	
VMware DR Consultant	The DR expert DR Solution expert(EMC mirrorview/recoverpoint/etc.etc) Would be comfortable implementing metro clustering solution on any of the

	given storages (EMC/Netapp/HP 3PAR/Hitachi)
VMware Backup Consultant	Backup consultant
VMware Windows Engineer	Windows Engineer
VMware Linux Engineer	Linux Engineer

4.5 Implementation Methodology

4.6 Risk Mitigation Plan

4.7 Project Management and Tools

4.8 Delivery Model

5. Investment

5.1 Tools / Software

5.2 vCloud Suite Licensing

vCloud Suite 5.5 is licensed on a per-processor basis. This is the same licensing basis used for vSphere 5.x Enterprise Plus, which is included in all editions of vCloud Suite. All virtual machines running on processors properly licensed by vCloud Suite 5.5 editions are entitled to all suite components.

Licensing Unit: Per-Processor (CPU)

A vCloud Suite 5.5 edition license activates all components (e.g., vSphere Enterprise Plus, vCloud Director) included in that vCloud Suite edition. Each physical processor in a server must have at least one assigned vCloud Suite 5.5 processor license key to run vCloud Suite. All physical processors in a server must be licensed with the same vCloud Suite edition. vCloud Suite 5.5 license keys can be deployed and managed in the same way as vSphere 5.x license keys.

No Limits on Physical Resources

There are no restrictions on physical cores or physical RAM with vCloud Suite 5.5. No Limits on Number of Virtual Machines There are no restrictions on the number of virtual machines that can run on each properly licensed vCloud Suite processor. All virtual machines can use all suite components included in the licensed vCloud Suite edition.

Multiple Components Under a Single License

VMware vCloud Suite 5.5 combines multiple components (vSphere Enterprise Plus, vCloud Director, vCloud Networking and Security, etc.) into a single product with a single license. Many of these components are also available as standalone products licensed on a per–virtual machine basis. However

PRODUCT TITLE	License Price	1 Year Support & Subscription	
VMware vCloud Suite Standard Foundational solution with infrastrucure provisioning, health and capacity, security and extensiblity to public clouds	USD 4,995.00	Basic	USD 1,049.00
		Production	USD 1,249.00
VMware vCloud Suite Advanced Solution for governed, enterprise cloud, with capacity management, cloud management extensibility and increased automation	USD 7,495.00	Basic	USD 1,574.00
		Production	USD 1,874.00
VMware vCloud Suite Enterprise Comprehensive solution for resilient, compliant and secure private cloud with disaster recovery automation, visbility into application performance, and regulatory compliance	USD 11,495.00	Basic	USD 2,414.00
		Production	USD 2,874.00

5.3 vCloud Suite Editions

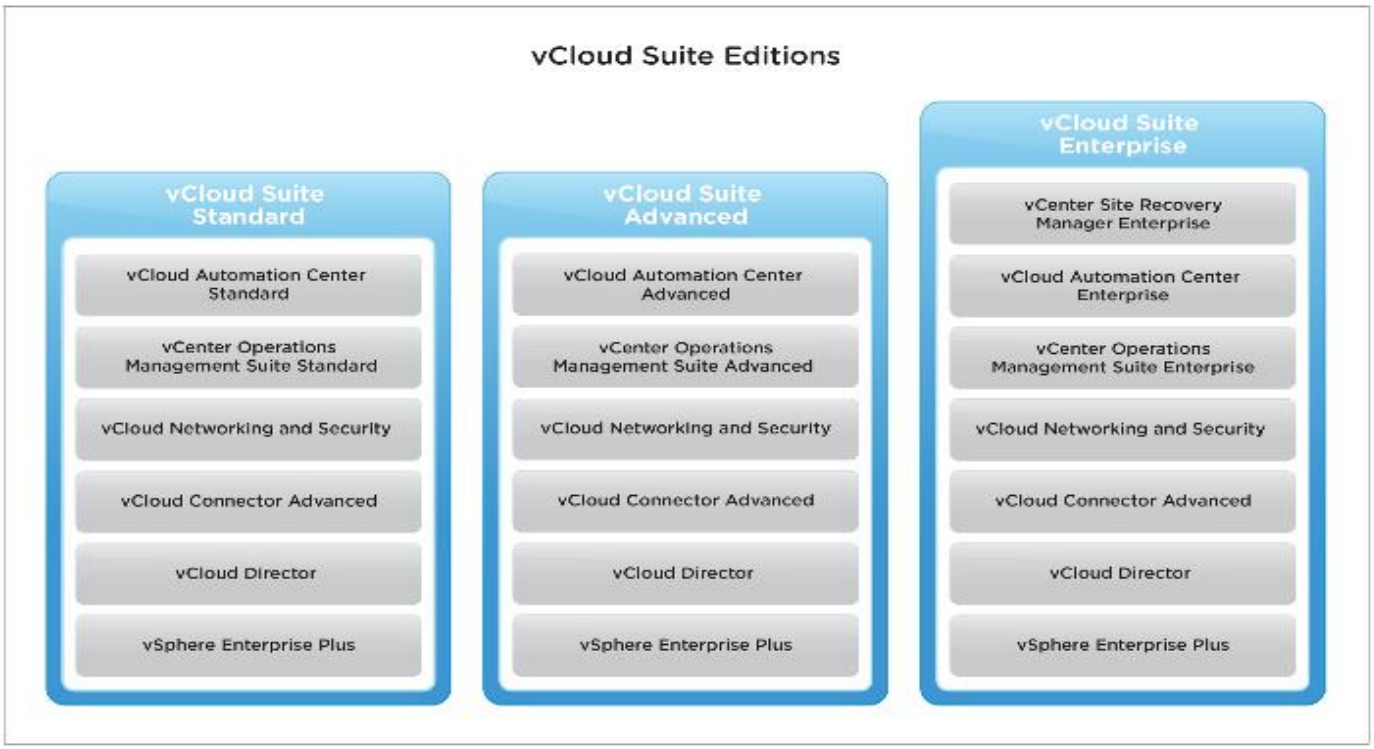
VMware offers three vCloud Suite editions that provide different functionality at different price points, making it easy to license VMware vCloud Suite to meet specific requirements and use cases. A support and subscription (SnS) contract is required for every vCloud Suite purchase

vCloud Suite 5.5 is composed of the following integrated products:

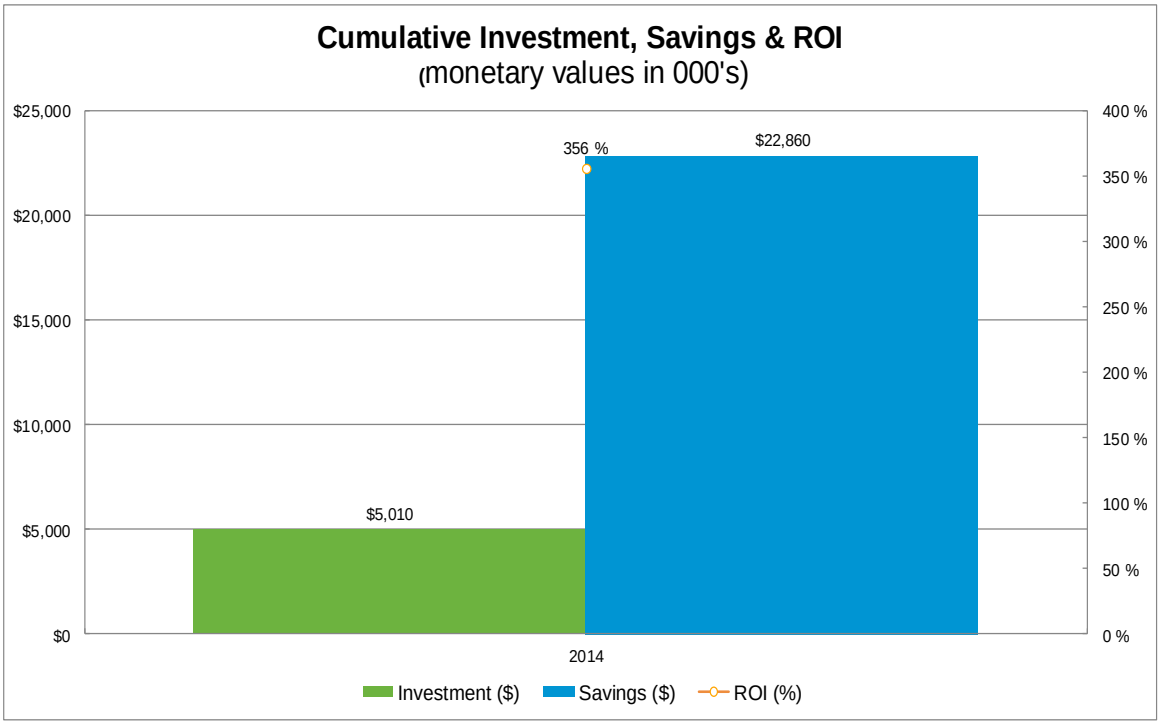
- VMware vSphere: Compute virtualization platform with policy-based automation
- VMware vCenter Site Recovery Manage: Automated disaster recovery planning, testing, and execution
- VMware vCloud Networking and Security: Networking and security with ecosystem integration for a virtualized compute environment
- VMware vCloud Automation Center: Self-service and policy enabled cloud service provisioning, multi-tier application service catalog publishing and provisioning
- VMware vCenter Operations Management Suite™: Integrated, proactive performance, capacity, and configuration management for dynamic cloud environments
- VMware vCloud Director: Virtualized data centers with multitenancy and public cloud extensibility
- VMware vCloud Connector: Integrated viewing and dynamic transfer of workloads between private and public clouds

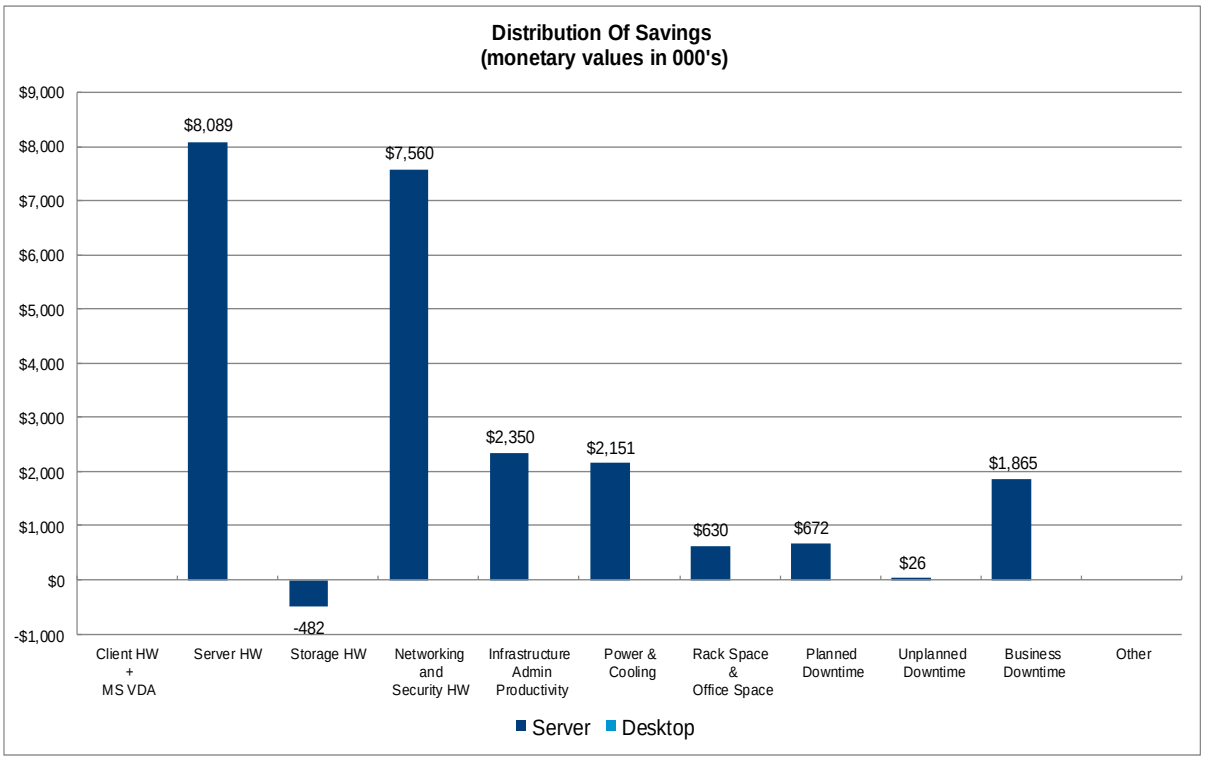
	Standard	Advanced	Enterprise
Cloud Management			
Cloud Automation	vCAC Std	vCAC Adv	vCAC Ent
Application and data services – Application provisioning, changes and data			Yes
Governance – Approvals, reclamation, cost profile and transparency		Yes	Yes
Extensibility – Infrastructure integrations, workflows and customizations	Yes	Yes	Yes
Infrastructure provisioning and management	Yes	Yes	Yes
Operations management	vCOPS Standard	vCOPS Advanced	vCOPS Enterprise
Application Monitoring – OS, middleware, databases			Yes
OS-level change, configuration and regulatory compliance management			Yes
Extensibility – Adapters for third-party OS and application monitoring tools			Yes
Extensibility – Adapters for third-party infrastructure monitoring tools		Yes	Yes
vSphere® hardening, change and configuration management		Yes	Yes
Application awareness – Discovery dependency mapping		Yes	Yes
Chargeback – Cost metering and reporting		Yes	Yes
Operations dashboard – Health	Yes	Yes	Yes

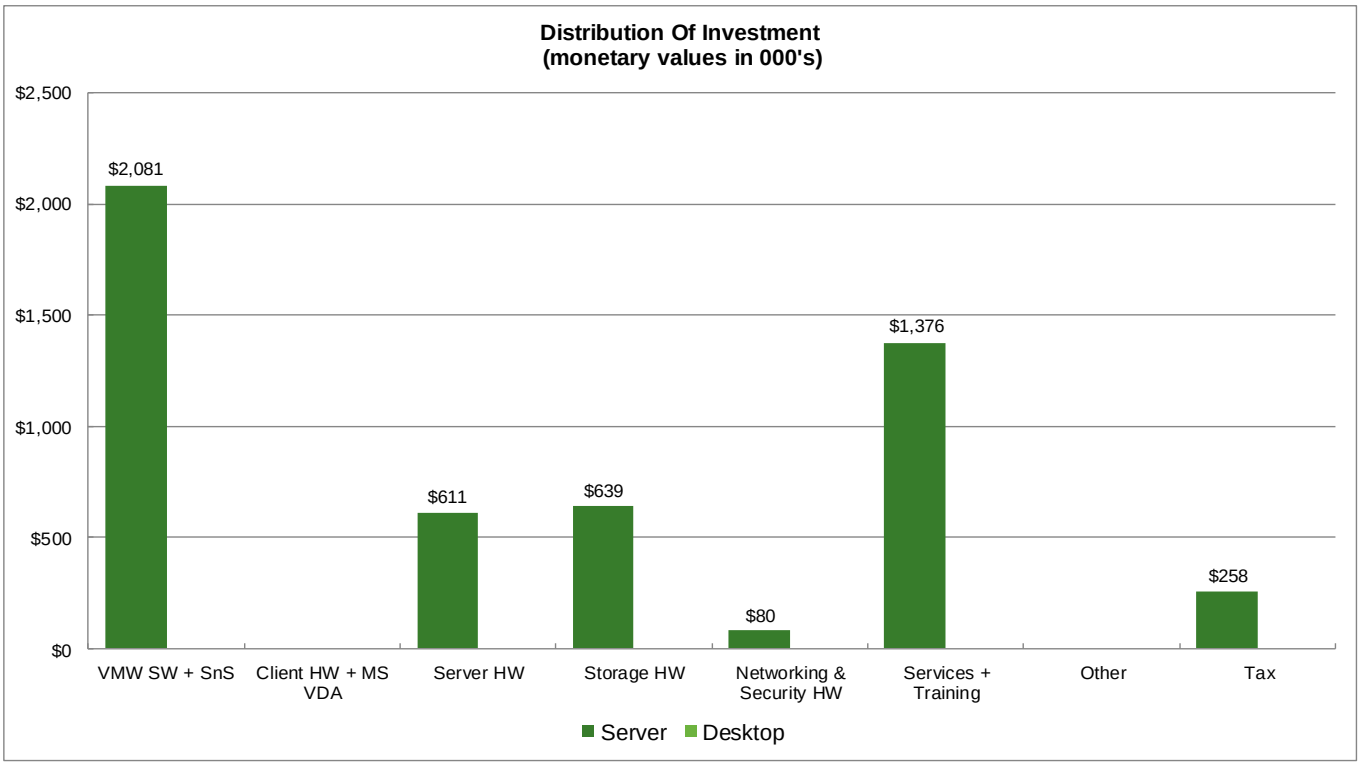
Monitoring and Performance Analytics			
Capacity management – Planning and optimization	Yes	Yes	Yes
Cloud Infrastructure			
Disaster Recovery Automation Automated disaster recovery planning, testing and execution			SRM Enterprise
Networking and Security Scalable networking and virtualization-aware security	vCloud Net & Sec	vCloud Net & Sec	vCloud Net & Sec
Virtualized Data Centers Virtualized data centers and public cloud extensibility	vCD,vCC	vCD,vCC	vCD,vCC
vSphere Enterprise Plus Virtualized infrastructure with policy-based automation	vSphere Enterprise Plus	vSphere Enterprise Plus	vSphere Enterprise Plus

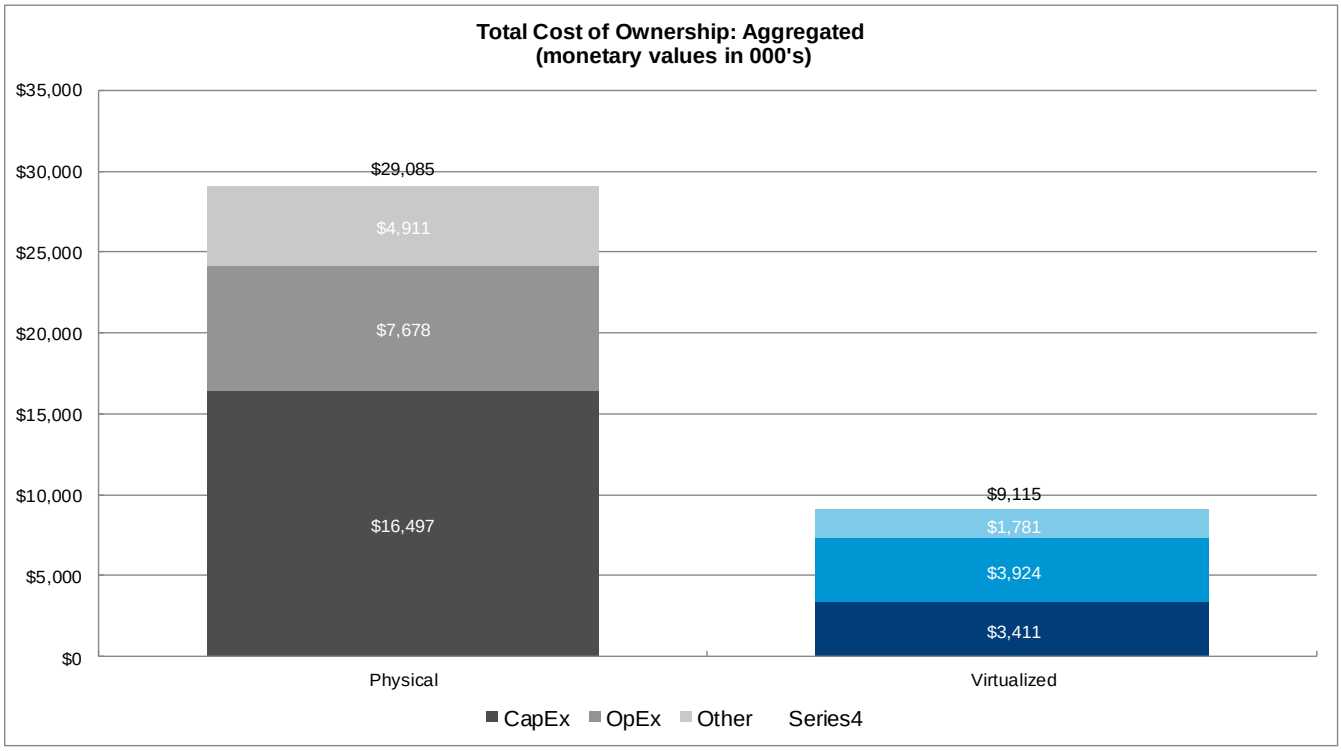

vCloud Suite Editions
vCloud Suite Standard
vCloud Automation Center Standard
vCenter Operations Management Suite Standard
vCloud Networking and Security
vCloud Connector Advanced
vCloud Director
vSphere Enterprise Plus
vCloud Suite Advanced
vCloud Automation Center Advanced
vCenter Operations Management Suite Advanced
vCloud Networking and Security
vCloud Connector Advanced
vCloud Director
vSphere Enterprise Plus
vCloud Suite Enterprise
vCenter Site Recovery Manager Enterprise
vCloud Automation Center Enterprise
vCenter Operations Management Suite Enterprise
vCloud Networking and Security
vCloud Connector Advanced
vCloud Director
vSphere Enterprise Plus

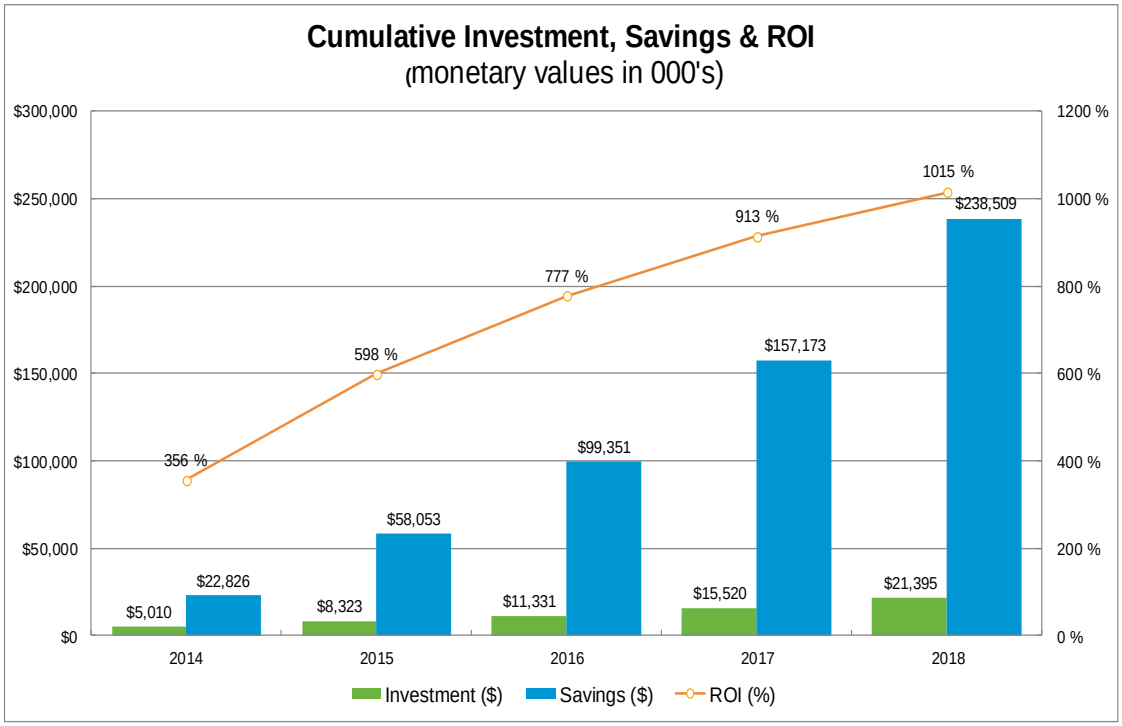
6. ROI Analysis

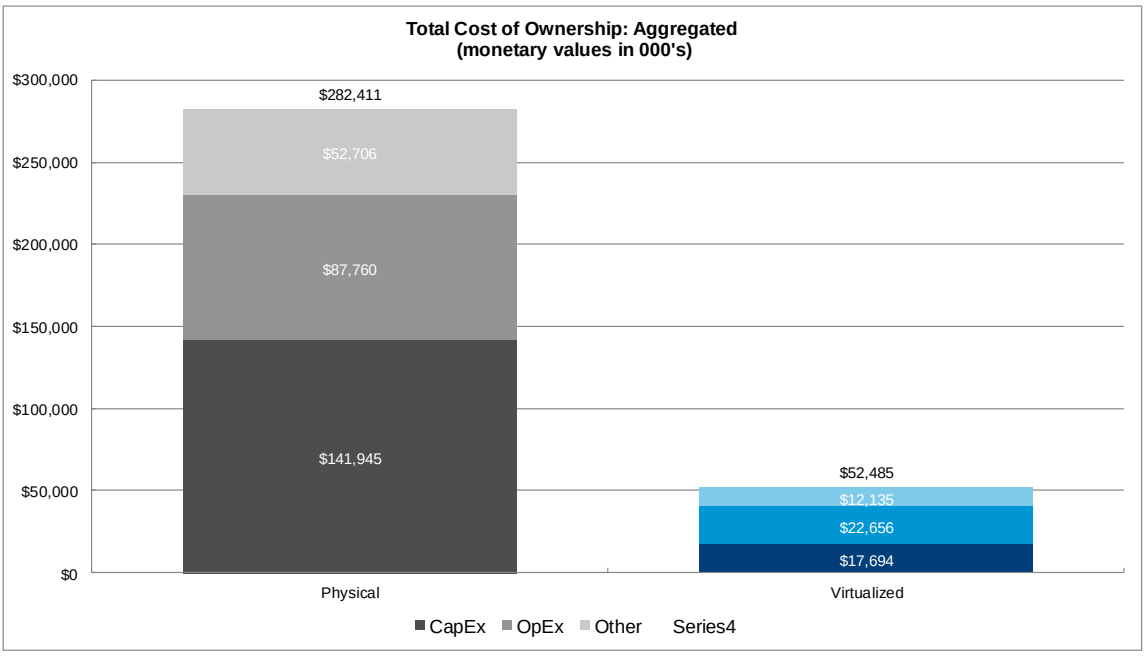


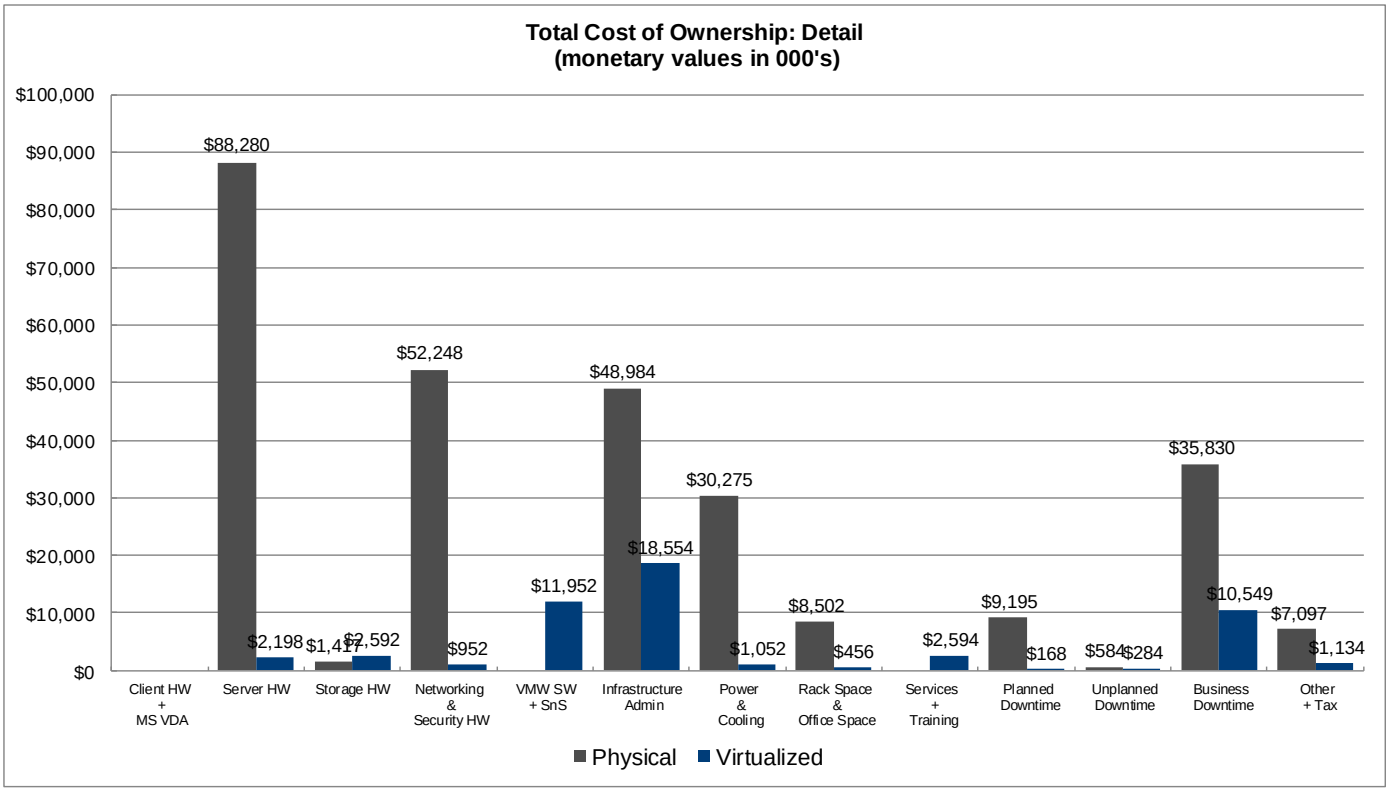


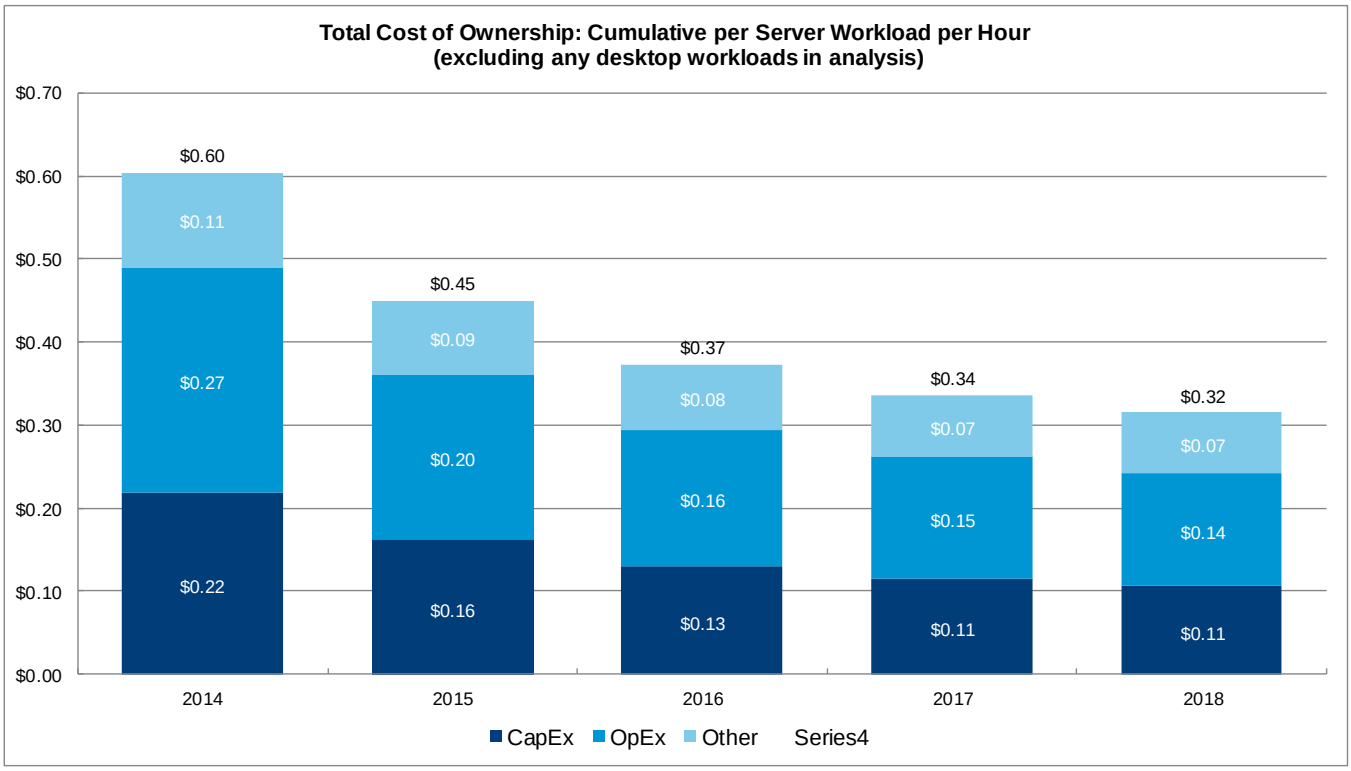

Distribution Of Investment
(monetary values in 000's)
$2,500
$2,000
$1,500
$1,000
$500
$0
$2,081
$611
$639
$80
$1,376
$258
VMW SW + SnS
Client HW + MS VDA
Server HW
Storage HW
Networking & Security HW
Services + Training
Other
Tax
Server
Desktop


Total Cost of Ownership: Aggregated
(monetary values in 000's)
$35,000
$30,000
$25,000
$20,000
$15,000
$10,000
$5,000
$0
$29,085
$4,911
$7,678
$16,497
$9,115
$1,781
$3,924
$3,411
Physical
Virtualized
CapEx
OpEx
Other
Series4


Cumulative Investment, Savings & ROI
(monetary values in 000's)
$300,000
$250,000
$200,000
$150,000
$100,000
$50,000
$0
1200 %
1000 %
800 %
600 %
400 %
200 %
0 %
356 %
598 %
777 %
913 %
1015 %
$5,010
$22,826
$8,323
$58,053
$11,331
$99,351
$15,520
$157,173
$21,395
$238,509
2014
2015
2016
2017
2018
Investment ($)
Savings ($)
ROI (%)


Total Cost of Ownership: Aggregated
(monetary values in 000's)
$300,000
$250,000
$200,000
$150,000
$100,000
$50,000
$0
$282,411
$52,706
$87,760
$141,945
$52,485
$12,135
$22,656
$17,694
Physical
Virtualized
CapEx
OpEx
Other
Series4


Total Cost of Ownership: Detail
(monetary values in 000's)
$100,000
$90,000
$80,000
$70,000
$60,000
$50,000
$40,000
$30,000
$20,000
$10,000
$0
$88,280
$2,198
$1,417
$2,592
$52,248
$952
$11,952
$48,984
$18,554
$30,275
$1,052
$8,502
$456
$2,594
$9,195
$168
$584
$284
$35,830
$10,549
$7,097
$1,134
Client HW + MS VDA
Server HW
Storage HW
Networking & Security HW
VMW SW + SnS
Infrastructure Admin
Power & Cooling
Rack Space & Office Space
Services + Training
Planned Downtime
Unplanned Downtime
Business Downtime
Other + Tax
Physical
Virtualized


Total Cost of Ownership: Cumulative per Server Workload per Hour
(excluding any desktop workloads in analysis)
$0.70
$0.60
$0.50
$0.40
$0.30
$0.20
$0.10
$0.00
$0.60
$0.11
$0.27
$0.22
$0.45
$0.09
$0.20
$0.16
$0.37
$0.08
$0.16
$0.13
$0.34
$0.07
$0.15
$0.11
$0.32
$0.07
$0.14
$0.11
2014
2015
2016
2017
2018
CapEx
OpEx
Other
Series4

7. Joint Case Studies

8. Bill of Material of the Reference Architecture

8.1 Compute

Primary BD and DC

Part Number	Description	Service Duration	Lead Time	Unit List Price	Qty	Unit Net Price	Disc(%)	Extended Net Price
UCSB-B200-M3-U	UCS B200 M3 Blade Server w/o CPU, mem, HDD, mLOM/mezz (UPG)	---	10	3,154.00	30	3,154.00	0.00	94,620.00
UCS-CPU-E52667B	3.30 GHz E5-2667 v2/130W 8C/25MB Cache/DDR3 1866MHz	---	10	6,090.00	60	6,090.00	0.00	365,400.00
UCS-MR-1X162RY-A=	16GB DDR3-1600-MHz RDIMM/PC3-12800/dual rank/1.35v	---	10	698.00	480	698.00	0.00	335,040.00
A03-D600GA2	600GB 6Gb SAS 10K RPM SFF HDD/hot plug/drive sled mounted	---	10	1,086.00	60	1,086.00	0.00	65,160.00
UCS-VIC-M82-8P	Cisco UCS VIC 1280 dual 40Gb capable Virtual Interface Card	---	10	1,699.00	30	1,699.00	0.00	50,970.00
UCSB-MLOM-40G-01	Cisco UCS VIC 1240 modular LOM for M3 blade servers	---	10	1,499.00	30	1,499.00	0.00	44,970.00
UCSB-HS-01-EP	CPU Heat Sink for UCS B200 M3 and B420 M3	---	10	0.00	60	0.00	0.00	0.00
CON-NC4P-B200M3CH	SNTC 24X7X4OS DISTI Only: UCS B20	36	N/A	921.00	30	921.00	0.00	27,630.00
UCSC-C240-M3S	UCS C240 M3 SFF w/o CPU, mem, HD, PCIe, w/ rail kit, expdr	---	10	3,600.00	4	3,600.00	0.00	14,400.00
UCS-CPU-E5-2650	2.00 GHz E5-2650/95W 8C/20MB Cache/DDR3 1600MHz	---	10	3,220.00	8	3,220.00	0.00	25,760.00
UCS-MR-1X162RY-A	16GB DDR3-1600-MHz RDIMM/PC3-12800/dual rank/1.35v	---	10	698.00	32	698.00	0.00	22,336.00
A03-D600GA2	600GB 6Gb SAS 10K RPM SFF HDD/hot plug/drive sled mounted	---	10	1,086.00	8	1,086.00	0.00	8,688.00
UCSC-RAID-MZ-240	2008 Mezz Card for UCS C240 server, HW TSOC For RAID 0/1/10	---	10	654.00	4	654.00	0.00	2,616.00
N2XX-AEPCI05	Emulex LPe 12002 Dual Port 8Gb Fibre Channel HBA	---	10	3,467.00	4	3,467.00	0.00	13,868.00
UCSC-PCIE-CSC-02	Cisco VIC 1225 Dual Port 10Gb SFP+ CNA	---	10	1,594.00	4	1,594.00	0.00	6,376.00
CAB-9K12A-NA	Power Cord, 125VAC 13A NEMA 5-15 Plug, North America	---	8	0.00	8	0.00	0.00	0.00
UCSC-PSU-650W	650W power supply for C-series rack servers	---	10	630.00	8	630.00	0.00	5,040.00
UCSC-RAIL-2U	2U Rail Kit for UCS C-Series servers	---	10	0.00	4	0.00	0.00	0.00
N20-BBLKD	UCS 2.5 inch HDD blanking panel	---	10	0.00	88	0.00	0.00	0.00
UCSC-HS-C240M3	Heat Sink for UCS C240 M3 Rack Server	---	10	0.00	8	0.00	0.00	0.00
UCSC-PCIF-01F	Full height PCIe filler for C-Series	---	10	0.00	8	0.00	0.00	0.00
UCSC-PCIF-01H	Half height PCIe filler for UCS	---	10	0.00	4	0.00	0.00	0.00

N20-C6508-UPG	UCS 5108 Blade Svr AC Chassis/0 PSU/8 fans/0 fabric extender	---	10	5,999.00	4	5,999.00	0.00	23,996.00
CON-SCUN-2C6508	SC UCS ADV 8X5XNBD 5108 Blade Server Chassis	12	N/A	112.75	4	112.75	0.00	451.00
UCS-IOM-2208XP	UCS 2208XP I/O Module (8 External, 32 Internal 10Gb Ports)	---	10	10,000.00	8	10,000.00	0.00	80,000.00
UCSB-PSU-2500ACPL	2500W Platinum AC Hot Plug Power Supply for UCS 5108 Chassis	---	10	936.00	16	936.00	0.00	14,976.00
CAB-AC-2500W-US1	Power Cord, 250Vac 16A, straight blade NEMA 6-20 plug, US	---	21	0.00	16	0.00	0.00	0.00
N01-UAC1	Single phase AC power module for UCS 5108	---	10	0.00	4	0.00	0.00	0.00
N20-CAK	Accessory kit for UCS 5108 Blade Server Chassis	---	10	0.00	4	0.00	0.00	0.00
N20-CBLKB1	Blade slot blanking panel for UCS 5108/single slot	---	10	0.00	32	0.00	0.00	0.00
N20-FAN5	Fan module for UCS 5108	---	10	0.00	32	0.00	0.00	0.00
UCSB-5108-PKG-HW	UCS 5108 Packaging for chassis with half width blades.	---	10	0.00	4	0.00	0.00	0.00
UCS-FI-6248UP-UPG	UCS 6248UP 1RU Fabric Int/No PSU/32 UP/ 12p LIC	---	10	32,000.00	2	32,000.00	0.00	64,000.00
CON-SCUN-FI6248UP	SC UCS ADV 8X5XNBD UCS 6248UP 1RU Fabrc Intercnnct/2 PSU/2	12	N/A	941.88	2	941.88	0.00	1,883.76
UCS-ACC-6248UP	UCS 6248UP Chassis Accessory Kit	---	10	0.00	2	0.00	0.00	0.00
SFP-H10GB-CU5M	10GBASE-CU SFP+ Cable 5 Meter	---	38	260.00	32	260.00	0.00	8,320.00
N10-MGT012	UCS Manager v2.2	---	10	0.00	2	0.00	0.00	0.00
UCS-PSU-6248UP-AC	UCS 6248UP Power Supply/100-240VAC	---	10	1,400.00	4	1,400.00	0.00	5,600.00
CAB-N5K6A-NA	Power Cord, 200/240V 6A North America	---	14	0.00	4	0.00	0.00	0.00
UCS-BLKE-6200	UCS 6200 Series Expansion Module Blank	---	10	0.00	2	0.00	0.00	0.00
UCS-FAN-6248UP	UCS 6248UP Fan Module	---	10	0.00	4	0.00	0.00	0.00
UCS-FI-DL2	UCS 6248 Layer 2 Daughter Card	---	10	0.00	2	0.00	0.00	0.00
CON-NC4P-2C6508	SNTC 24X7X4OS 5108 Blade Server Chassis	36	N/A	780.00	4	780.00	0.00	3,120.00
CON-NC4P-FI6248UP	SNTC 24X7X4OS UCS 6248UP 1RU Fabrc Intercnnct/2 PSU/2	36	N/A	2,892.00	2	2,892.00	0.00	5,784.00
CON-NC4P-C240M3SF	SNTC 24X7X4OS UCS C240 M3 SFF w/o	36	N/A	1,704.00	1	1,704.00	0.00	1,704.00

Valid through:

FOB Point: None

Product Total :	1,055,244.00
Service Total :	29,334.00
Total Price:	**1,084,578.00**

Primary Chassis and FI

Part Number	Description	Service Duration	Lead Time	Unit List Price	Qty	Unit Net Price	Disc(%)	Extended Net Price
N20-C6508-UPG	UCS 5108 Blade Svr AC Chassis/0 PSU/8 fans/0 fabric extender	---	10	5,999.00	4	5,999.00	0.00	23,996.00
CON-SCUN-2C6508	SC UCS ADV 8X5XNBD 5108 Blade Server Chassis	12	N/A	112.75	4	112.75	0.00	451.00
UCS-IOM-2204XP	UCS 2204XP I/O Module (4 External, 16 Internal 10Gb Ports)	---	10	5,000.00	8	5,000.00	0.00	40,000.00
UCSB-PSU-2500ACPL	2500W Platinum AC Hot Plug Power Supply for UCS 5108 Chassis	---	10	936.00	16	936.00	0.00	14,976.00
CAB-AC-2500W-US1	Power Cord, 250Vac 16A, straight blade NEMA 6-20 plug, US	---	21	0.00	16	0.00	0.00	0.00
N01-UAC1	Single phase AC power module for UCS 5108	---	10	0.00	4	0.00	0.00	0.00
N20-CAK	Accessory kit for UCS 5108 Blade Server Chassis	---	10	0.00	4	0.00	0.00	0.00
N20-CBLKB1	Blade slot blanking panel for UCS 5108/single slot	---	10	0.00	32	0.00	0.00	0.00
N20-FAN5	Fan module for UCS 5108	---	10	0.00	32	0.00	0.00	0.00
UCSB-5108-PKG-HW	UCS 5108 Packaging for chassis with half width blades.	---	10	0.00	4	0.00	0.00	0.00
UCS-FI-6248UP-UPG	UCS 6248UP 1RU Fabric Int/No PSU/32 UP/ 12p LIC	---	10	32,000.00	2	32,000.00	0.00	64,000.00
CON-SCUN-FI6248UP	SC UCS ADV 8X5XNBD UCS 6248UP 1RU Fabrc Intercnnct/2 PSU/2	12	N/A	941.88	2	941.88	0.00	1,883.76
UCS-ACC-6248UP	UCS 6248UP Chassis Accessory Kit	---	10	0.00	2	0.00	0.00	0.00
SFP-H10GB-CU5M	10GBASE-CU SFP+ Cable 5 Meter	---	38	260.00	32	260.00	0.00	8,320.00
N10-MGT012	UCS Manager v2.2	---	10	0.00	2	0.00	0.00	0.00
UCS-PSU-6248UP-AC	UCS 6248UP Power Supply/100-240VAC	---	10	1,400.00	4	1,400.00	0.00	5,600.00
CAB-N5K6A-NA	Power Cord, 200/240V 6A North America	---	14	0.00	4	0.00	0.00	0.00
UCS-BLKE-6200	UCS 6200 Series Expansion Module Blank	---	10	0.00	2	0.00	0.00	0.00
UCS-FAN-6248UP	UCS 6248UP Fan Module	---	10	0.00	4	0.00	0.00	0.00
UCS-FI-DL2	UCS 6248 Layer 2 Daughter Card	---	10	0.00	2	0.00	0.00	0.00
CON-NC4P-2C6508	SNTC 24X7X4OS 5108 Blade Server Chassis	36	N/A	780.00	4	780.00	0.00	3,120.00
CON-NC4P-FI6248UP	SNTC 24X7X4OS UCS 6248UP 1RU Fabrc Intercnnct/2 PSU/2	36	N/A	2,892.00	2	2,892.00	0.00	5,784.00

Valid through:

FOB Point: None

Product Total :	156,892.00
Service Total :	11,238.76
Total Price:	**168,130.76**

Part Number	Description	Service Duration	Lead Time	Unit List Price	Qty	Unit Net Price	Disc(%)	Extended Net Price
UCSB-B200-M3-U	UCS B200 M3 Blade Server w/o CPU, mem, HDD, mLOM/mezz (UPG)	---	10	3,154.00	30	3,154.00	0.00	94,620.00
UCS-CPU-E52667B	3.30 GHz E5-2667 v2/130W 8C/25MB Cache/DDR3 1866MHz	---	10	6,090.00	60	6,090.00	0.00	365,400.00
UCS-MR-1X162RY-A=	16GB DDR3-1600-MHz RDIMM/PC3-12800/dual rank/1.35v	---	10	698.00	480	698.00	0.00	335,040.00
A03-D600GA2	600GB 6Gb SAS 10K RPM SFF HDD/hot plug/drive sled mounted	---	10	1,086.00	60	1,086.00	0.00	65,160.00
UCS-VIC-M82-8P	Cisco UCS VIC 1280 dual 40Gb capable Virtual Interface Card	---	10	1,699.00	30	1,699.00	0.00	50,970.00
UCSB-MLOM-40G-01	Cisco UCS VIC 1240 modular LOM for M3 blade servers	---	10	1,499.00	30	1,499.00	0.00	44,970.00
UCSB-HS-01-EP	CPU Heat Sink for UCS B200 M3 and B420 M3	---	10	0.00	60	0.00	0.00	0.00
CON-NC4P-B200M3CH	SNTC 24X7X4OS DISTI Only: UCS B20	36	N/A	921.00	30	921.00	0.00	27,630.00

Valid through:

FOB Point: None

Product Total :	956,160.00
Service Total :	27,630.00
Total Price:	**983,790.00**

Part Number	Description	Service Duration	Lead Time	Unit List Price	Qty	Unit Net Price	Disc(%)	Extended Net Price
N20-C6508-UPG	UCS 5108 Blade Svr AC Chassis/0 PSU/8 fans/0 fabric extender	---	10	5,999.00	4	5,999.00	0.00	23,996.00
CON-SCUN-2C6508	SC UCS ADV 8X5XNBD 5108 Blade Server Chassis	12	N/A	112.75	4	112.75	0.00	451.00
UCS-IOM-2204XP	UCS 2204XP I/O Module (4 External, 16 Internal 10Gb Ports)	---	10	5,000.00	8	5,000.00	0.00	40,000.00
UCSB-PSU-2500ACPL	2500W Platinum AC Hot Plug Power Supply for UCS 5108 Chassis	---	10	936.00	16	936.00	0.00	14,976.00
CAB-AC-2500W-US1	Power Cord, 250Vac 16A, straight blade NEMA 6-20 plug, US	---	21	0.00	16	0.00	0.00	0.00
N01-UAC1	Single phase AC power module for UCS 5108	---	10	0.00	4	0.00	0.00	0.00
N20-CAK	Accessory kit for UCS 5108 Blade Server Chassis	---	10	0.00	4	0.00	0.00	0.00
N20-CBLKB1	Blade slot blanking panel for UCS 5108/single slot	---	10	0.00	32	0.00	0.00	0.00
N20-FAN5	Fan module for UCS 5108	---	10	0.00	32	0.00	0.00	0.00
UCSB-5108-PKG-HW	UCS 5108 Packaging for chassis with half width blades.	---	10	0.00	4	0.00	0.00	0.00
UCS-FI-6248UP-UPG	UCS 6248UP 1RU Fabric Int/No PSU/32 UP/ 12p LIC	---	10	32,000.00	2	32,000.00	0.00	64,000.00
CON-SCUN-FI6248UP	SC UCS ADV 8X5XNBD UCS 6248UP 1RU Fabrc Intercnnct/2 PSU/2	12	N/A	941.88	2	941.88	0.00	1,883.76
UCS-ACC-6248UP	UCS 6248UP Chassis Accessory Kit	---	10	0.00	2	0.00	0.00	0.00
SFP-H10GB-CU5M	10GBASE-CU SFP+ Cable 5 Meter	---	38	260.00	32	260.00	0.00	8,320.00
N10-MGT012	UCS Manager v2.2	---	10	0.00	2	0.00	0.00	0.00
UCS-PSU-6248UP-AC	UCS 6248UP Power Supply/100-240VAC	---	10	1,400.00	4	1,400.00	0.00	5,600.00
CAB-N5K6A-NA	Power Cord, 200/240V 6A North America	---	14	0.00	4	0.00	0.00	0.00
UCS-BLKE-6200	UCS 6200 Series Expansion Module Blank	---	10	0.00	2	0.00	0.00	0.00
UCS-FAN-6248UP	UCS 6248UP Fan Module	---	10	0.00	4	0.00	0.00	0.00
UCS-FI-DL2	UCS 6248 Layer 2 Daughter Card	---	10	0.00	2	0.00	0.00	0.00
CON-NC4P-2C6508	SNTC 24X7X4OS 5108 Blade Server Chassis	36	N/A	780.00	4	780.00	0.00	3,120.00
CON-NC4P-FI6248UP	SNTC 24X7X4OS UCS 6248UP 1RU Fabrc Intercnnct/2 PSU/2	36	N/A	2,892.00	2	2,892.00	0.00	5,784.00

Valid through:

FOB Point: None

Product Total :	156,892.00
Service Total :	11,238.76
Total Price:	**168,130.76**

CPU AND Supported RAM

All prices are shown in USD

Part Number	Description	Service Duration	Lead Time	Unit List Price	Qty	Unit Net Price	Disc(%)	Extended Net Price
UCS-CPU-E5-2690=	2.90 GHz E5-2690/135W 8C/20MB Cache/DDR3 1600MHz/NoHeatSink	---	10	6,103.12	1	6,103.12	0.00	6,103.12
UCS-CPU-E5-2680=	2.70 GHz E5-2680 130W 8C/20MB Cache/DDR3 1600MHz/NoHeatSink	---	10	4,787.99	1	4,787.99	0.00	4,787.99
UCS-CPU-E5-2670=	2.60 GHz E5-2670 115W 8C/20MB Cache/DDR3 1600MHz/NoHeatSink	---	10	4,275.00	1	4,275.00	0.00	4,275.00
UCS-CPU-E52650B=	2.60 GHz E5-2650 v2/95W 8C/20MB Cache/DDR3 1866MHz (Spare)	---	10	3,500.00	1	3,500.00	0.00	3,500.00
UCS-MR-1X162RY-A=	16GB DDR3-1600-MHz RDIMM/PC3-12800/dual rank/1.35v	---	10	698.00	1	698.00	0.00	698.00

Valid through:

FOB Point: None

Product Total :	19,364.11
Service Total :	0.00
Total Price:	**19,364.11**

8.2 Network

Part Number	Description	Service Duration	Lead Time	Unit List Price	Qty	Unit Net Price	Disc(%)	Extended Net Price
N5K-C5672UP	Nexus 5672UP 1RU, 32x10G SFP+, 16pxUP SFP+, 6x40G QSFP+	---	N/A	32,000.00	4	32,000.00	0.00	128,000.00
SFP-H10GB-CU5M	10GBASE-CU SFP+ Cable 5 Meter	---	38	260.00	60	260.00	0.00	15,600.00
N6KUK9-702N1.1	Nexus 5600/6000 Base OS Software Rel 7.0(2)N1(1)	---	N/A	0.00	4	0.00	0.00	0.00

N56-VMFEX9	Nexus 5600 VM-FEX license	---	14	0.00	4	0.00	0.00	0.00
N56-BAS1K9	Nexus 5600 Series LAN Base License	---	14	0.00	4	0.00	0.00	0.00
N5672-ACC-KIT	Nexus 5672 Chassis Accessory Kit	---	14	0.00	4	0.00	0.00	0.00
N6K-C6001-FAN-F	Nexus 6001 Fan for Port Side exhaust (Front to Back) airflow	---	14	0.00	12	0.00	0.00	0.00
CAB-N5K6A-NA	Power Cord, 200/240V 6A North America	---	14	0.00	8	0.00	0.00	0.00
NXA-PAC-1100W	Nexus 1100W Platinum PS, Port side Exhaust airflow	---	14	0.00	8	0.00	0.00	0.00
CON-NC4P-C5548P	SNTC 24X7X4OS Nexus 5548P 1RU Chassis2 PS2 Fan32	36	N/A	8,730.00	4	8,730.00	0.00	34,920.00

8.3 Storage

Line #	Qty	Product ID	Description	Units
		VNX5400 Unified New Solution Using 200GB, 600GB 10K, 900GB 10K, 2TB and 3TB Drives - 1		
		SYSTEM	**PSI FOR VNX 5400**	
1	1	VNXB54DP25	VNX5400 DPE 25X2.5" DRIVE SLOTS-EMC RA	EA
2	1	VNXBRACK-40U	VNXB 40U RACK WITH FRONT PANEL	EA
3	3	VNXB6GSDAE15	VNXB 15X3.5 6G SAS EXP DAE-EMC RACK	EA
4	3	VNXB6GSDAE25	VNXB 25X2.5 6G SAS EXP DAE-EMC RACK	EA
5	1	VNXB6GSDAE25P	VNXB 25X2.5 6G SAS PRI DAE-EMC RACK	EA
6	1	VNXBCS	VNXB CONTROL STATION-EMC RACK	EA
7	1	VNXB54DME	VNX5400 DME: 1 DM+FC SLIC-EMC RACK	EA
8	63	V4-2S10-600	VNX 600GB 10K SAS 25X2.5 DPE/DAE	EA
9	31	V4-2S10-900	VNX 900GB 10K SAS 25X2.5 DPE/DAE	EA
10	9	V4-VS07-020	VNX 2TB NL SAS 15X3.5 DAE	EA
11	16	V4-2S6F-200	VNX 200GB SSD 25X2.5 DPE/DAE	EA
12	34	V4-VS07-030	VNX 3TB NL SAS 15X3.5 DAE	EA
13	1	V-V4-260010	VNX 600GB 10K VAULT 25X2.5 DPE/DAE	EA
14	5	FLV42S6F-200	VNX 200GB FAST CACHE 25X2.5 DPE/DAE	EA
15	1	VBPW40U-US	CAB QUAD POWER CORD US TWISTLOCK	EA
16	1	VNX54-KIT	VNX5400 Documentation Kit=IC	EA

17	1	VDMBM1GCUA	VNXB 1GBASE-T DM MODULE 4 PORT	EA
18	2	VSPBM8GFFEA	VNXB 4 PORT 8G FC IO MODULE PAIR	EA
1	1	ESRS-GW-200	EMC SECURE REMOTE SUPPORT GATEWAY CLIENT	EA
2	1	RP-LS	RECOVERPOINT LICENSE SOLUTION	EA
3	1	456-104-620	RP/SE REM FOR RPS V53 V54=IC	EA
4	120	VNXBOECAPTB	VNXB OE PER TB HI CAPACITY	EA
5	71	VNXBOEPERFTB	VNXB OE PER TB PERFORMANCE	EA
6	1	VNXOE-5400	VNX5400 Operating Environment	EA
7	1	FSTS-VNX5400	VNX5400 FAST Suite=IC	EA
8	1	UNISU-VNX5400	VNX5400 Unisphere Unified Suite=IC	EA
9	1	RPS-VNX5400	VNX5400 Remote Protection Suite=IC	EA
1	1	PSINST-ESRS	ZERO DOLLAR ESRS INSTALL	EA
2	1	PS-PKG-IMFSU	FAST IMPLEMENT	EA
3	1	PS-PKG-IMRPU	VNX - MIRRORVIEW REPLICATOR IMP	EA
4	3	PS-BAS-ADDAE	RACK & STACK OF UPTO 2 DAE	EA
5	1	PS-PKG-IMMGTU	IMPLEMENT USM SUITE	EA
6	1	PS-PKG-MRUDE	INSTALL IMPLEMENT VNX ENHANCED	EA
1	1	M-PRESWE-001	PREMIUM SW SUPPORT See Maintenance Schedule for more details	EA
2	1	WU-PREHWE-01	PREMIUM HW SUPPORT-WARR UPG	EA
3	1		HW MAINTENANCE Includes months 37-60 @ $ 0/mo.	EA

Configuration Sub-total		
Hardware Sub-total		**$ 165,000**
Software Sub-total		**$ 62,664**
Services Sub-total		**$ 28,319**
Maintenance and Warranty Upgrade Sub-total		**$ 37,592**
Configuration Total		**$ 293,575**

		SYSTEM	PSI FOR VNX 5400	
1	1	VNXB54DP25	VNX5400 DPE 25X2.5" DRIVE SLOTS-EMC RA	EA
2	1	VNXBRACK-40U	VNXB 40U RACK WITH FRONT PANEL	EA
3	3	VNXB6GSDAE15	VNXB 15X3.5 6G SAS EXP DAE-EMC RACK	EA
4	3	VNXB6GSDAE25	VNXB 25X2.5 6G SAS EXP DAE-EMC RACK	EA
5	1	VNXB6GSDAE25P	VNXB 25X2.5 6G SAS PRI DAE-EMC RACK	EA
6	1	VNXBCS	VNXB CONTROL STATION-EMC RACK	EA
7	1	VNXB54DME	VNX5400 DME: 1 DM+FC SLIC-EMC RACK	EA
8	63	V4-2S10-600	VNX 600GB 10K SAS 25X2.5 DPE/DAE	EA
9	31	V4-2S10-900	VNX 900GB 10K SAS 25X2.5 DPE/DAE	EA
10	9	V4-VS07-020	VNX 2TB NL SAS 15X3.5 DAE	EA
11	16	V4-2S6F-200	VNX 200GB SSD 25X2.5 DPE/DAE	EA
12	34	V4-VS07-030	VNX 3TB NL SAS 15X3.5 DAE	EA
13	1	V-V4-260010	VNX 600GB 10K VAULT 25X2.5 DPE/DAE	EA
14	5	FLV42S6F-200	VNX 200GB FAST CACHE 25X2.5 DPE/DAE	EA
15	1	VBPW40U-US	CAB QUAD POWER CORD US TWISTLOCK	EA
16	1	VNX54-KIT	VNX5400 Documentation Kit=IC	EA
17	1	VDMBM1GCUA	VNXB 1GBASE-T DM MODULE 4 PORT	EA
18	2	VSPBM8GFFEA	VNXB 4 PORT 8G FC IO MODULE PAIR	EA
1	1	ESRS-GW-200	EMC SECURE REMOTE SUPPORT GATEWAY CLIENT	EA
2	1	RP-LS	RECOVERPOINT LICENSE SOLUTION	EA
3	1	456-104-620	RP/SE REM FOR RPS V53 V54=IC	EA
4	120	VNXBOECAPTB	VNXB OE PER TB HI CAPACITY	EA
5	71	VNXBOEPERFTB	VNXB OE PER TB PERFORMANCE	EA
6	1	VNXOE-5400	VNX5400 Operating Environment	EA
7	1	FSTS-VNX5400	VNX5400 FAST Suite=IC	EA
8	1	UNISU-VNX5400	VNX5400 Unisphere Unified Suite=IC	EA
9	1	RPS-VNX5400	VNX5400 Remote Protection Suite=IC	EA
1	1	PSINST-ESRS	ZERO DOLLAR ESRS INSTALL	EA
2	1	PS-PKG-IMFSU	FAST IMPLEMENT	EA
3	1	PS-PKG-IMRPU	VNX - MIRRORVIEW REPLICATOR IMP	EA
4	3	PS-BAS-ADDAE	RACK & STACK OF UPTO 2 DAE	EA
5	1	PS-PKG-IMMGTU	IMPLEMENT USM SUITE	EA
6	1	PS-PKG-MRUDE	INSTALL IMPLEMENT VNX ENHANCED	EA

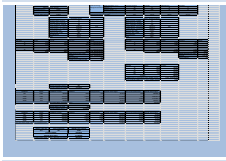
1	1	M-PRESWE-001	PREMIUM SW SUPPORT See Maintenance Schedule for more details	EA
2	1	WU-PREHWE-01	PREMIUM HW SUPPORT-WARR UPG	EA
3	1		HW MAINTENANCE Includes months 37-60 @ $ 0/mo.	EA

Configuration Sub-total		
Hardware Sub-total		**$ 165,000**
Software Sub-total		**$ 62,664**
Services Sub-total		**$ 28,319**
Maintenance and Warranty Upgrade Sub-total		**$ 37,592**
Configuration Total		**$ 293,575**

8.4 VMware

VMware BOM & Price to be added

9. Reference Documents

SLNo	Document Name	By Whom	Attachments
1	Private Cloud 1000VM over 1 year Presentation	Nataraj	
2	Private Cloud 1000 VM over 5 years Presentation	Nataraj	
3	Private Cloud 1000VM over 1 year pdf document	Nataraj	
4	Private Cloud 1000 VM over 5 years pdf document	Nataraj	
5	Sizing Document	Nataraj	
6			
7			
8			

10. Change History

VerNo	Description	Name	Date&Time
1	Version 1 of this document	Nataraj	01/03/2014
2	Initial Sizing by VMware	Sanjaya	22/04/2014
3	Version 3 of this document Updated the section 3 of this document including all the architectural details	Nataraj	30/04/2014
4	Version 4 Wipro Implementation Services Project Plan	Nataraj	13/05/2014
5	Version 5 Sizing for 1000, 2000,3000,4000,5000 Updated Over commitment ratios Updated Thin Provisioning Updated Section 3 of document Updated Section 8 of the document BOM BY EMC BOM BY CISCO	Nataraj	05/06/2014
6	Version 6 BOM For Compute, Network, Storage	Nataraj	06/06/2014
7	Version 7 Revised Solution Document Updated the below sections Conceptual architecture Logical Architecture Sizing Network Storage Access Control Disaster Recovery	Nataraj	07/06/2014
8	Version 8 Updated the Sizing Updated section 3.18 Private Cloud Blue Prints Dropped VDP from the solution and sticking with EMC Avamar Updated Operations Management	Nataraj	09/06/2014
9	Version 9 Review comments by Sanjaya	VMware	23/06/2014