

Managing the Virtual Information Infrastructure

Technology Concepts and Business Considerations

EMC Global Solutions

Abstract

A well-managed virtual information infrastructure allows organizations to manage their information while making the most of their data center environment by sharing computing, network, and storage resources across the data center or across the world. A virtualized infrastructure can be more complex to manage than a comparable physical infrastructure to ensure that the environment can deliver the robust visibility, change control, and policy enforcement required in today's business environment. EMC's virtual information infrastructure solution provides management advantages by automating and streamlining IT services.

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Contents

Executive summary.....	4
Introduction.....	6
The well-managed virtual information infrastructure data center environment.....	7
Introduction.....	7
Elements of a virtual information infrastructure.....	7
Managing a virtual information infrastructure.....	7
Management architecture.....	8
Architecture diagram.....	8
Infrastructure environment.....	9
Hardware elements.....	9
Software elements.....	10
Managing the storage environment.....	11
Storage environment management.....	11
EMC Ionix ControlCenter.....	12
Managing the server environment.....	13
Server management.....	13
EMC Ionix Server Configuration Manager.....	13
VMware vCenter CapacityIQ.....	14
Managing the hypervisor environment.....	15
Managing a VMware vSphere environment.....	15
VMware vSphere 4 Update 1.....	15
Managing a Hyper-V environment.....	16
Managing the unified computing environment.....	17
Unified computing management.....	17
Cisco Unified Computing System.....	17
EMC Ionix Unified Infrastructure Manager.....	17
Managing the network environment.....	18
Network environment management.....	18
EMC Ionix Network Configuration Manager.....	18
Cisco Fabric Manager.....	18
Managing the application environment.....	19
Application environment management.....	19
EMC Ionix Application Discovery Manager.....	19
VMware vCenter Appspeed.....	20
Technology resource cost distribution.....	21
Distributing resource costs.....	21
VMware vCenter Chargeback.....	21
Conclusion.....	22

Executive summary

Business case As more companies adopt virtualization for their data centers, many IT organizations are unsure how to approach managing their virtual infrastructure as they have primarily managed a physical environment to date. This white paper explores the technologies and practices that enable administrators to feel confident in managing their virtual information infrastructure so they can leverage the benefits and cost savings that virtualization offers.

EMC® Ionix™ and other third-party management software provide the building blocks to manage the virtual information infrastructure. They provide visibility into the physical and virtual elements that comprise the virtual information infrastructure across multiple domains, and the relationships between them.

By simplifying the management of the virtual infrastructure and automating common time-consuming tasks, these tools greatly streamline and improve overall IT services. Additionally, IT resources now have the bandwidth to focus on revenue-generating projects for the business.

Business environment Managing a virtualized information infrastructure requires an IT organization to manage the physical devices and the virtual machines. To maintain complete control of their infrastructure, administrators must be able to:

- Discover and map dependencies of mission-critical applications in a manner that doesn't impact application performance
 - Identify the relationship and topology of physical and virtual elements
 - Manage multiple hypervisors and guest virtual machines
 - Manage multiple unified computing elements across multiple domains
 - Manage multi-vendor network hardware within a single instance
 - Automate server and network compliance across physical and virtual infrastructure within multi-vendor hardware and platforms
 - Simplify storage provisioning, monitoring, and reporting within a multi-vendor storage environment
-

Technical solution

A multi-site virtual information infrastructure must include:

- Architecture elements that support active/active and data recovery capabilities
- Security elements that guarantees data confidentiality, availability, integrity, and compliance.
- Management elements that enable quick identification of physical dependencies and provide configuration management, change management, and compliance management throughout the data center

A comprehensive virtual information infrastructure management policy must be able to provide consistency, efficiency and scalability across all components:

- Networking
- Computing
- Application
- Storage

EMC's solution for virtual information infrastructure management provides components that enable strict control across these and all layers of the infrastructure.

Architecture elements

A multi-site virtual information infrastructure architecture that supports active/active and data recovery capabilities includes the following elements:

- Secure virtual desktops
- Unified computing
- Resource pooling
- Distributed networking
- Business continuity and disaster recovery for remote and local users
- Tiered storage

EMC's Ionix Management Suite, as well as applications from VMware, Cisco and Microsoft, integrates tightly with the virtualization technologies needed to support the virtual information infrastructure and provide visibility to the storage platform as well as multi-tenancy and other resource sharing.

Introduction

Purpose

This white paper explores the elements and features required to effectively manage a virtual information infrastructure data center environment.

The elements of the virtual information infrastructure in this white paper include:

- EMC Ionix applications such as ControlCenter[®], Server Configuration Manager, Network Configuration Manager, Unified Infrastructure Manager and Application Discovery Manager
- VMware applications such as vCenter, AppSpeed, CapacityIQ, and Chargeback
- Cisco applications such as Unified Computing System (UCS) Manager and Fabric Manager
- Microsoft applications such as Virtual Machine Manager

The features and advantages of an efficiently managed virtual information infrastructure include:

- Visibility into all layers of the environment and into infrastructure components such as storage arrays, routers, switches, firewalls, and virtual server hypervisors
- Efficient management across platforms and layers of the infrastructure
- Resource monitoring for capacity and optimization planning as well as chargeback for resource usage
- Effective leverage of virtualization to realize cost savings, flexibility and agility while maintaining control and compliance

Audience

This white paper is intended for EMC employees, partners, and customers including IT planners, virtualization architects and administrators, and any others involved in evaluating, acquiring, managing, operating, or designing a virtual information infrastructure environment leveraging EMC and VMware technologies.

Additional information

This white paper discusses the management aspects of a virtual information infrastructure. For more detailed information about the architecture of a virtual information infrastructure, as well as how to secure the virtual information infrastructure, refer to the following documents:

- *Building the Virtual Information Infrastructure — Technology Concepts and Business Considerations*
 - *Securing the Virtual Information Infrastructure — Technology Concepts and Business Considerations*
-

The well-managed virtual information infrastructure data center environment

Introduction

Management is a critical component of a virtualized information infrastructure that allows an organization to:

- Gain comprehensive visibility to resources
- More efficiently maintain the environment to make changes in the best way possible
- Track configuration changes regardless of where they occur in the computing environment
- Implement a chargeback policy to internal or external organizations based on resource usage
- Understand the relationship between components to preempt issues
- Monitor compliance with service level agreements (SLAs)

All resources within a computing infrastructure must be tracked and correlated with usage activities. They must be managed in a way that makes the best use of those resources, while minimizing complexity and making use of automation to maximize administrator efficiency. In a virtualized infrastructure, maintaining visibility of all components in the environment, and all changes to those components:

- Ensures compliance to management policies and SLAs
 - Enables root-cause analysis and simplifies troubleshooting
-

Elements of a virtual information infrastructure

A virtual information infrastructure is a fully virtualized data center composed of shared resource pools for:

- Computing resources including desktops and servers
 - Network resources including switching and transmission
 - Storage resources including tiered storage and business continuity (recovery)
-

Managing a virtual information infrastructure

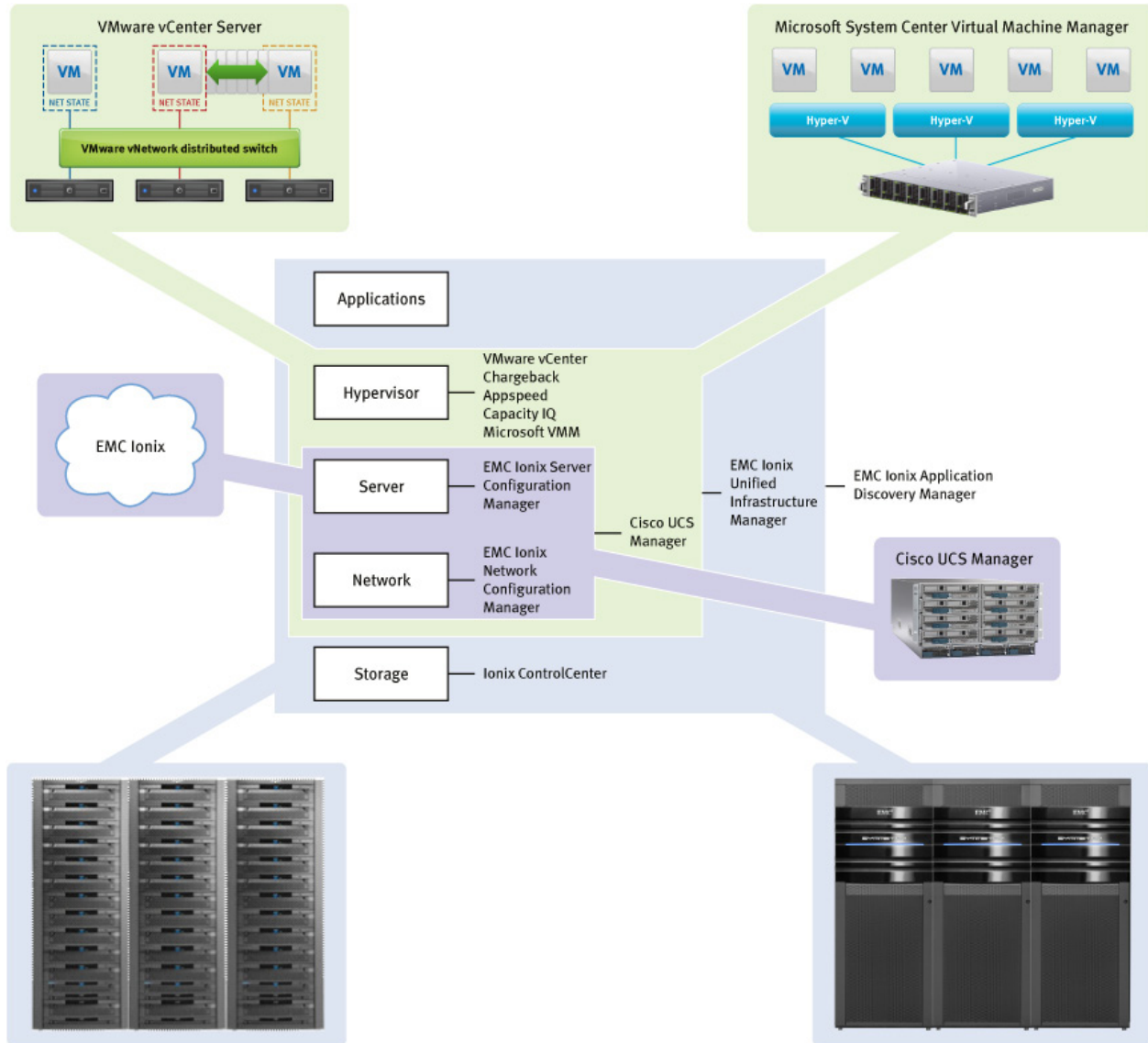
Visibility into each component of your virtual environment is critical in successfully managing each layer of your virtual information infrastructure. This ensures complete control of all aspects including storage, network, host, virtual machines, and the applications that reside within them by:

- Providing storage provisioning, host connectivity, monitoring and reporting
 - Providing compliance across unified compute systems, networking, server hardware and virtualized guest systems that run on the hypervisor
 - Providing application dependency and mapping
-

Management architecture

Architecture diagram

The following illustration depicts the overall management architecture of the virtual information infrastructure environment.



GEN-00135:

Infrastructure environment

As the architecture diagram illustrates, a comprehensively managed virtual information infrastructure includes:

- Visibility of storage resources
 - Visibility of network resources
 - Visibility of computing resources including the server and virtualization hypervisor
 - Application visibility
-

Hardware elements

The following table summarizes the hardware used in this secure virtual information infrastructure.

Equipment	Configuration
Dell rackmount servers	R710s, Intel Nehalem processors R900s, Intel Xeon processors
Cisco blade servers	UCS blade servers, Nexus 6120 switches
Cisco switches	Nexus 1000v, 5010, 5020, 7010, 2148T fabric extenders
Cisco fabric switches – director class	MDS 9509
EMC CLARiON® CX4-480	FC connectivity, 300 GB/15k FC drives
EMC Symmetrix® VMAX™	FC connectivity, 300 GB/15k FC drives
Cisco firewalls	ASA 5500

Software elements

The following table summarizes the software used in this secure virtual information infrastructure.

Software	Version
VMware vSphere	4 Update 1 Build 208167
VMware vCenter Server	4 Update 1 Build 208111
VMware Appspeed	1.2.0 Build 41671
VMware CapacityIQ	1.0.2 Build 232321
VMware Chargeback	1.0.1
Cisco Fabric Manager	4.2(1b)
Cisco Unified Computing System Manager	1.0.(1e)
Microsoft System Center Virtual Machine Manager 2008	R2
Microsoft Windows 2008	Enterprise Edition 64-bit
Microsoft Windows 2003	Enterprise Edition 32-bit
Microsoft Windows XP Professional	32-bit
Microsoft SQL Server 2005	9.0.3042
EMC Solutions Enabler	7.1.0.0
Ionix ControlCenter	6.1.0.7.289
Ionix Application Discovery Manager	6.0.1
Ionix Network Configuration Manager	4.1.0.863
Ionix Server Configuration Manager	5.2.11.143
Ionix Unified Infrastructure Manager	1.0
PowerPath®/VE	5.4 SP1 Build 33

Managing the storage environment

Storage environment management

In today's complex multi-protocol storage environments, it is more important than ever to ensure that administrators are able to effectively control the storage environment in order to maintain stability, consistency, and ease of use all while making sure resources are used in the most efficient way possible. Whether the view is from the hypervisor out to the storage or from the storage out to the hypervisor, a consistent yet simple view of the data path is critical.

Depending on how the IT organization is laid out, and how responsibilities are spilt up, it's possible that the Storage administrator may have previously had no visibility into the server environment. The same can be said of the server administrator with regard to the storage. Through VMware storage plug-ins such as EMC's Storage Viewer, server administrators can see how storage is allocated from end to end, which greatly simplifies planning, troubleshooting, and overall resource utilization.

The screenshot shows the EMC Storage Views interface. On the left, there is a navigation pane with 'Storage' selected, containing 'Datastores', 'LUNs', and 'Targets'. Below it are 'Options' and a checkbox for 'Hide PowerPath Details'. The main area displays a table titled 'EMC Storage LUNs: Show all LUNs'. The table has columns for Product, Model, Array, Device, RAID, Group, Capacity, Paths, Owner, and Datastore. There are 7 rows of data.

Product	Model	Array	Device	RAID	Group	Capacity	Paths	Owner	Datastore
PERC 5/i	Unkno...	Unknown	Unknown			67.75 GB	1	NMP	Storage1 (S)
CLARiON	CX4_480	Fabric_A_CX4-1647	SCM_RAI	RAID_1	Pcloud-Infrastruc...	268.37 GB	14	NMP	Ionix_SCM_RAID1_LUN1
CLARiON	CX4_480	Fabric_A_CX4-1647	Ionix_UI	RAID_5	Pcloud-Infrastruc...	1.00 TB	14	NMP	Ionix_UIM-ADM
CLARiON	CX4_480	Fabric_A_CX4-1647	Ionix_SC	RAID_1	Pcloud-Infrastruc...	268.37 GB	14	NMP	Ionix_SCM_RAID1_LUN2
CLARiON	CX4_480	Fabric_A_CX4-1647	SCM_RAI	RAID_1_0	Pcloud-Infrastruc...	500.00 GB	14	NMP	Ionix_SCM_RAID10
CLARiON	CX4_480	Fabric_A_CX4-1647	Pcloud_I	RAID_5	Pcloud-Infrastruc...	1.00 TB	14	NMP	Infrastructure_Datastore
CLARiON	CX4_480	Fabric_A_CX4-1647	LUN 154	RAID_5	Pcloud-Infrastruc...	1.00 TB	14	NMP	Ionix_NCM_R5_1T

Conversely, storage administrators can greatly benefit from knowing how the LUNs on an array correlate to virtual machines. EMC Navisphere® software for the CLARiON array enables a storage administrator to see into the virtualization environment to map LUN information to a particular virtual machine and application.

The screenshot shows a window titled 'Pcloud-Infrastructure-02.pcloud.emc.net - Host Properties'. The 'Virtual Machines' tab is selected. It displays a table of virtual machine information.

Virtual Machine Name	Guest Hostname	...	Guest Operating S...
AuthenticationMgr	authmgr	...	Microsoft Windows Server 2003,
RAWC-EmailServer	viewemail	...	Other 2.6x Linux (32-bit)
DLP ICAP	Unknown	...	Unknown
DLP Network Controller	Unknown	...	Unknown
RAWC-sI02	RAWC-sI02	...	Microsoft Windows Server 2003,
RAWC-sI01	RAWC-sI01	...	Microsoft Windows Server 2003,
Windows2003	windows2003	...	Microsoft Windows Server 2003,
DLP Interceptor	Unknown	...	Unknown
RAWC-Ctrl	RAWC-Ctrl	...	Microsoft Windows Server 2003,
DLP Enterprise Manger	RSA-DLP	...	Microsoft Windows Server 2003,

EMC Ionix ControlCenter

EMC Ionix ControlCenter enables IT organizations to ensure the availability of virtual information infrastructure through visibility and control across the entire infrastructure. This includes storage, network, server, and application resources.

As a storage resource and device management solution, ControlCenter uses a single, consistent, information-centric approach to enable administrators to simplify and automate common time consuming task such as:

- Planning
- Provisioning
- Zoning
- Reporting

This allows administrators to implement an information lifecycle management strategy of tiered and multi-vendor storage infrastructure.

The screenshot displays the EMC Ionix ControlCenter interface. The top pane, titled "1 Relationship - Hosts - Ionix ECC", shows a search for "LUN" and a diagram of a relationship between a host and a LUN. The host is labeled "pcloud-infra-04" and is connected to a LUN labeled "Ionix_SCM_RAID1_LUN2". The LUN is associated with the CLARiiON ID "APM00093801647". The bottom pane, titled "2 Properties", shows the details of the LUN.

CLARiiON	LUN Name	LUN ID	UID	Configuration
APM00093801647	Ionix_SCM_RAID1_LUN2	0147	60:06:01:60:67:40:26:00:5E:23:DE:D5:18:2B:DF:11	RAID1

Managing the server environment

Server management

Although virtualization greatly increases the utilization of server resources, and therefore makes it possible to run IT applications on fewer servers, management of the server environment is even more critical than ever. Whether they are blade servers, rack-mounted servers, or unified computing environments such as Cisco's UCS platform, maintaining a strong control over those resources is key. Fortunately, as server technology advances, so do the tools to manage those resources. Not only is visibility important, but ease of deployment, management, and repair are important criteria for selecting a management package.

EMC Ionix provides many tools which have been designed specifically for managing complex virtualized data center environments in order to maximize efficiency, maximize control over configuration changes, and maximize manageability.

EMC Ionix Server Configuration Manager

Today the constant and ongoing change in system configuration, compliance, and security vulnerability continues to evolve. In the past change management has been a tedious and manual process done periodically; leaving you with an environment that is not fully secure or compliant. Managing physical and virtual server environments adds yet another layer of complexity to the problem.

With EMC Ionix Server Configuration Manager IT organizations can track change across their information infrastructure and automate common but critical IT processes. By collecting and storing thousands of asset, security, and configuration settings across Windows, UNIX, and Linux platforms into a centralized repository, you have business-aligned system delivering unified configuration insight.

Feature	Benefit
Unparalleled visibility	Discovers configuration across the IT environment and tracks changes automatically.
Remediation	Detects and fixes configuration problems and security vulnerabilities automatically across multiple systems.
Patch management	Accesses the status of a patch, deploys a new patch, and verifies correct deployment of a patch.
Compliance toolkits	Ensures compliance with various industry and regulatory standards and requirements.
Scalable, secure data collection	Discovers and collects more than 80,000 configuration settings and securely transmits data using encryption.
Multiplatform support	Supports Windows desktops and servers, UNIX and Linux servers, and virtualization platforms.
Active directory integration	Manages user accounts, enforces organization standards for user accounts, and monitors change.

EMC Ionix Server Configuration Manager Collector: IONIXSCM User: pcloud\administrator, Admin

Machine Group: All Machines Filter: Define

Console
Compliance
Active Directory
Reports
Server Advisor
Administration
Settings
Collection Filters
Certificates

Licensed VM Hosts
License Unlicense Change Settings

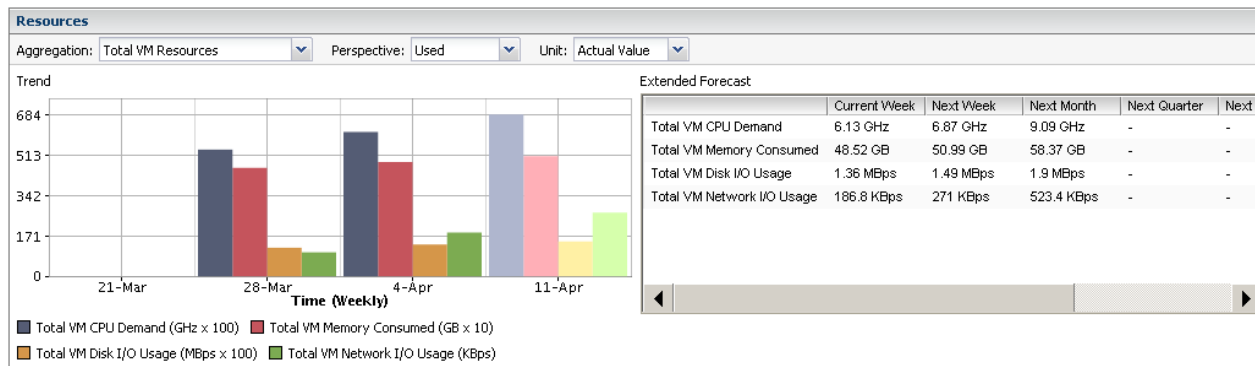
Column Grouping

Row	Machine Name	Machine Description	VMM Type	VMM Version	Protocol	Agent Proxy
1	pcloud-infra-03		ESX	VMware ESX 4.0	HTTP	PCLLOUD-VC-01
2	pcloud-infra-04		ESX	VMware ESX 4.0	HTTP	PCLLOUD-VC-01
3	pcloud-infrastructure-01		ESX	VMware ESX 4.0	HTTP	PCLLOUD-VC-01
4	pcloud-infrastructure-02		ESX	VMware ESX 4.0	HTTP	PCLLOUD-VC-01
5	pcloud-vspheredus01-01		ESX	VMware ESX 4.0	HTTP	PCLLOUD-VC-01

VMware vCenter CapacityIQ

VMware vCenter CapacityIQ continuously profiles, analyzes, and tracks an IT organization's capacity needs at multiple levels: VM, host, cluster, and data center. Based on historical capacity consumption patterns it can trend and forecast current and future capacity needs to meet service levels.

VMware vCenter CapacityIQ allows IT organization to forecast the growth in order to avoid virtual machine performance degradation and bottlenecks. It also provides insight allowing for proactive plan changes to meet VMware capacity needs.



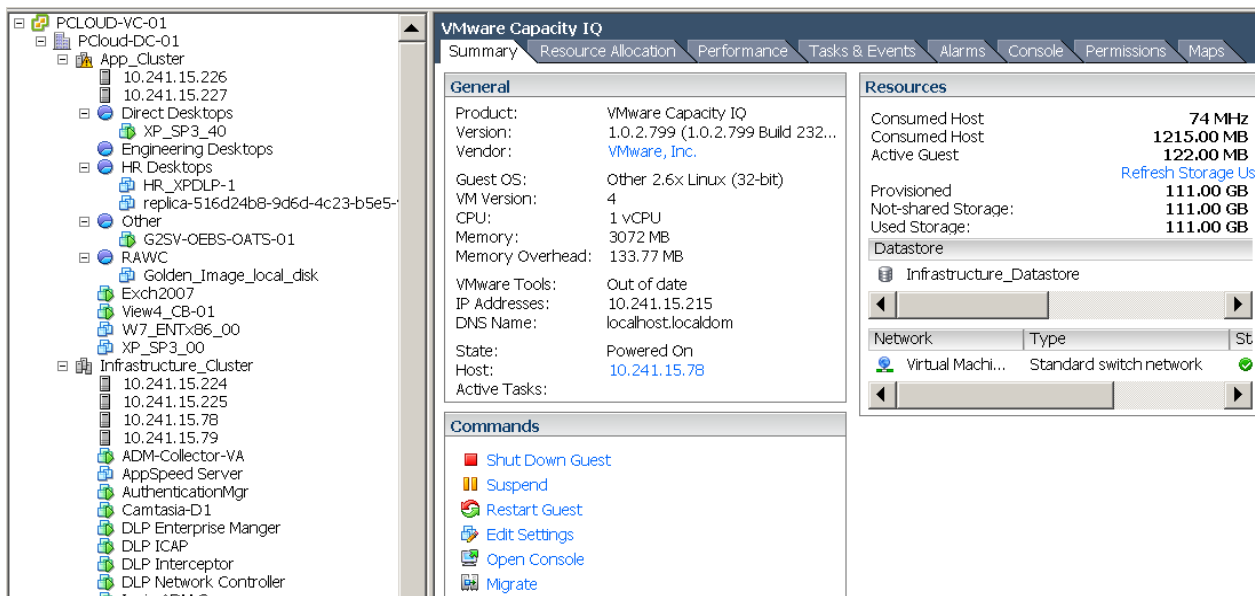
Managing the hypervisor environment

Managing a VMware vSphere environment

The VMware vSphere hypervisor is the core of virtualization technology that abstracts the physical layer hardware from the guest operating system. The industry's first cloud operating system transforms data centers into the next generation of flexible, reliable IT environments.

VMware vCenter Server is a scalable platform that forms the foundation for virtualization management. It centrally manages servers running vSphere and the guest virtual machines allowing IT administrators to dramatically improve control over their virtual environments and reduce server sprawl. VMware vCenter:

- Simplifies management
- Helps to better forecast future growth of resources
- Analyzes application performance
- Maps IT costs to business units



VMware vSphere 4 Update 1

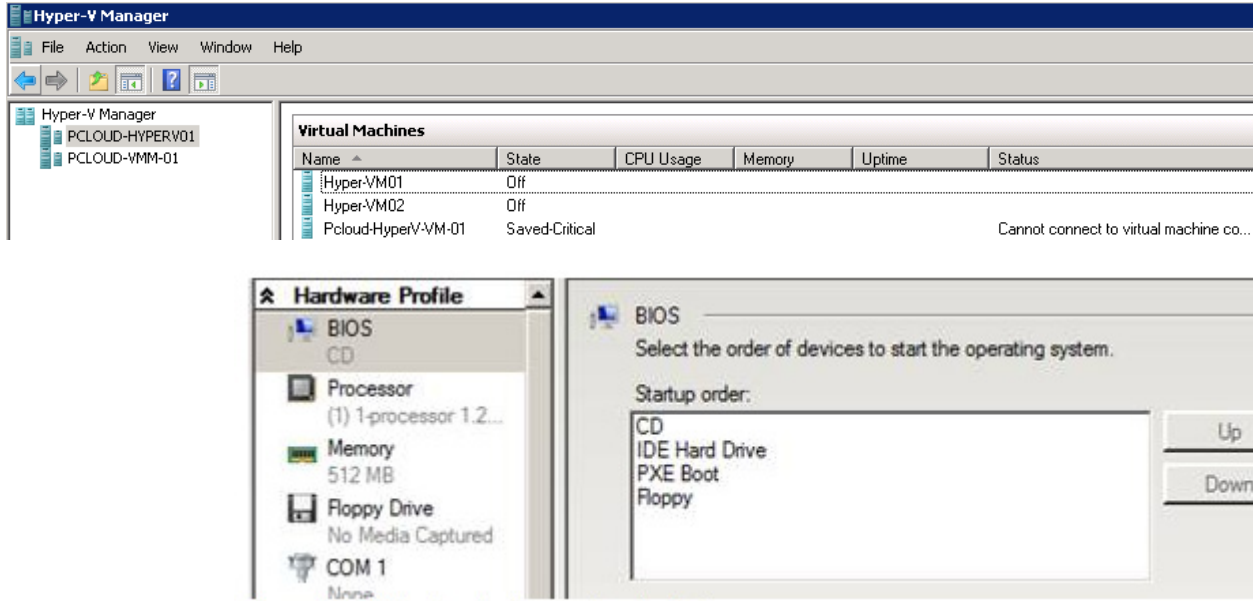
VMware vSphere is the next-generation data center operating system that virtualizes the entire IT infrastructure. It enables the most scalable and efficient use of server hardware in a robust fault-tolerant environment. VMware vSphere Server:

- Abstracts server processor, memory, storage, and networking resources into multiple virtual machines, forming the foundation of the VMware Infrastructure 3 suite.
 - Is a “bare metal” platform that partitions physical servers in multiple virtual machines. Each virtual machine represents a complete system, with processors, memory, networking, storage, and BIOS.
 - Can share single server resources across multiple virtual machines, and cluster ESX servers for further sharing of resources.
-

Managing a Hyper-V environment

The Hyper-V Manager MMC snap-in provides management access to servers that are running Hyper-V

To facilitate remote Hyper-V administration from systems that are not running Hyper-V, the snap-in may also be installed as a stand-alone tool on Windows Server 2008 and Windows Vista SP1 Enterprise and Ultimate editions.



Managing the unified computing environment

Unified computing management

Unified computing is a concept that is becoming much more prevalent as vendors further explore ways of realizing the benefit of resource abstraction and virtualization. The best example of this is Cisco's Unified Computing System (UCS).

Cisco Unified Computing System

The Cisco Unified Computing System (UCS) manager provides centralized management for Cisco UCS. It offers role-based management to make more efficient use of limited administrator resources, templating to simplify and standardize server deployment and management, and alerting to maintain tight control over the computing and network environment. The Cisco Unified Computing System:

- Streamlines data center resources to reduce total cost of ownership
 - Scales service delivery to increase business agility
 - Radically reduces the number of devices requiring setup, management, power, cooling, and cabling
-

EMC Ionix Unified Infrastructure Manager

EMC Ionix Unified Infrastructure Manager manages all elements of the unified computing environment and can scale beyond a single domain. Unified Infrastructure Manager is purpose-built for Vblock Infrastructure Packages allowing management of these elements as a single entity. This simplifies change management, configuration, integrated provisioning, compliance and reporting for Vblock Infrastructure.

Device Name	Device Class	Compliance Severity	Model
10.241.15.250	Cisco UCSM		CAM-NSK
MDS3A	Cisco Nexus		MDS 9509
MDS3B	Cisco Nexus		MDS 9509
pcloud-5010-01-03	Cisco Nexus		Nexus5010
pcloud-5010-01-04	Cisco Nexus		Nexus5010
pcloud-5010-02-03	Cisco Nexus		Nexus5010
pcloud-5010-02-04	Cisco Nexus		Nexus5010
pcloud-5020-01-05	Cisco Nexus		Nexus5020
pcloud-7010-01-06	Cisco Nexus		C7010

Data Center VII / All Devices (view) - Editor

Data Center VII / All Devices (view) x

Devices shown in editor:

- pcloud-5010-... CISCO Nexus5010
- pcloud-5010-... CISCO Nexus5010
- MDS3A CISCO MDS 9509
- pcloud-5010-... CISCO Nexus5010
- pcloud-5020-... CISCO Nexus5020
- pcloud-5010-... CISCO Nexus5010
- MDS3B CISCO MDS 9509
- 10.241.15.250 CISCO SYSTEMS CAM-NSK
- pcloud-7010-... CISCO C7010

Managing the network environment

Network environment management

Networking is the backbone of the virtual information infrastructure, providing a foundation upon which resources can be deployed to meet end-user requirements. As bandwidth needs expand, the backbone must expand with it. High-speed resilient networks that can support application requirements, regardless of protocols, are a critical component to an IT infrastructure.

Networks require complex equipment, with complex configurations, to make it all come together in an efficient way to meet application SLAs. That complex equipment needs to be managed in a way that promotes ease of use and efficiency while allowing an organization to meet its strict SLAs.

Each networking vendor has its own tools to enable configuration and problem management, but having a tool that monitors all of that as well as integrates it into an overall management configuration requires an application that can tie all aspects together.

EMC Ionix Network Configuration Manager

EMC Ionix Network Configuration Manager (NCM) is a model-based, automated compliance change and configuration management solution for network devices. NCM provides industry-recognized best practices and verifies controlled change processes to ensure compliance with corporate and regulatory requirements

NCM automates support for all facets of the network infrastructure by seamlessly integrating critical design, change, and compliance management requirements into a simple and easy-to-use interface. NCM dramatically reduces the time needed to implement new or configure existing devices throughout the network by centrally managing the entire network environment including:

- Planning
 - Allocation
 - Security
 - Deployment
 - Configuration
 - Template creation for new device deployment
-

Cisco Fabric Manager

Cisco Fabric Manager is a web-based Java application that simplifies management of Cisco MDS Fibre Channel switches. It enables users to easily configure advanced multi-protocol and long-distance communication in a SAN environment.

Managing the application environment

Application environment management

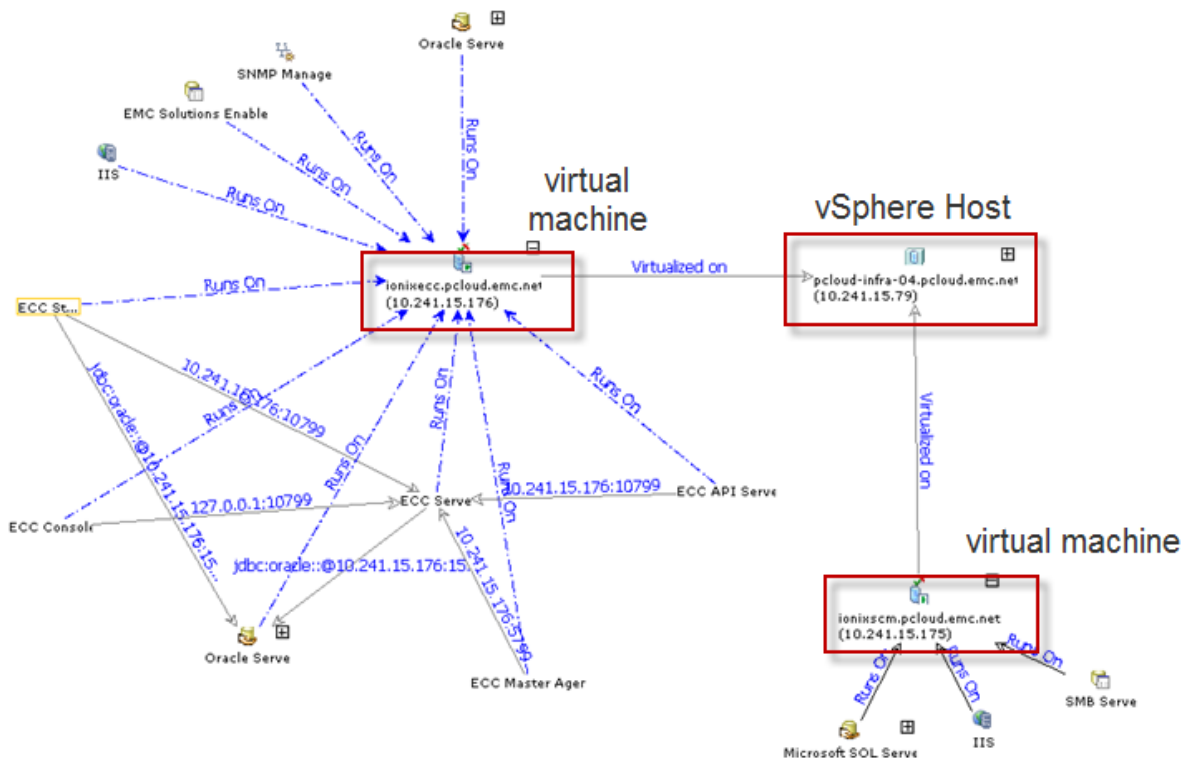
As applications become more complex and SLAs for those applications become more stringent, it is critical that problems that adversely affect performance be identified and fixed as quickly as possible. Key to the ability to do that is:

- Have visibility to all layers of the infrastructure that impact an application
- Monitor application performance in real time

Whether it is a network configuration setting, a storage array problem, a virtualization hypervisor issue or a singular problem that impacts all of those layers, application visibility is crucial to identifying and fixing problems so that SLAs are not affected and user experience is not degraded.

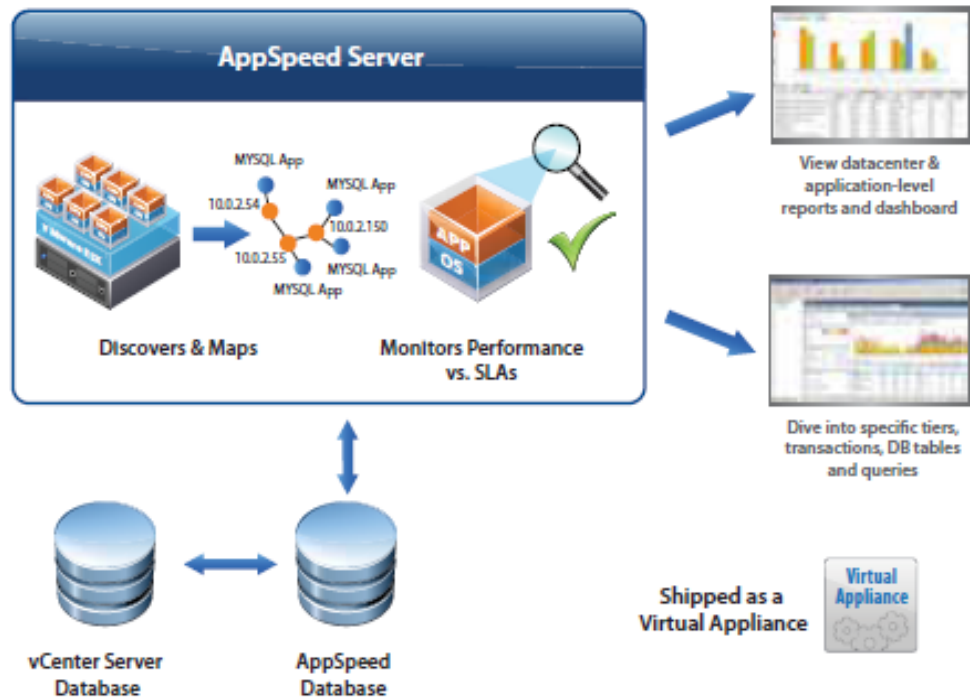
EMC Ionix Application Discovery Manager

EMC Ionix Application Discovery Manager (ADM) provides automated, realtime application discovery and dependency mapping with respect to the underlying physical and virtual infrastructure, without the need for intrusive host agents. It continuously and passively tracks application usage, demand, service levels, and change events. Ionix ADM then creates an impact analysis.



**VMware
vCenter
Appspeed**

In addition to overall application performance, monitoring a virtual application environment can improve performance and allow for quicker problem resolution. VMware vCenter Appspeed provides non-intrusive monitoring and realtime view of actual end-user application performance and monitors against SLAs and dramatically reduce troubleshooting time and finger pointing.



AppSpeed collects and stores application, latency, and usage data in one location, enabling users to monitor application and transaction performance as well as root-cause performance issues. Further, Appspeed assures performance before and after migration to a virtualized environment.

Technology resource cost distribution

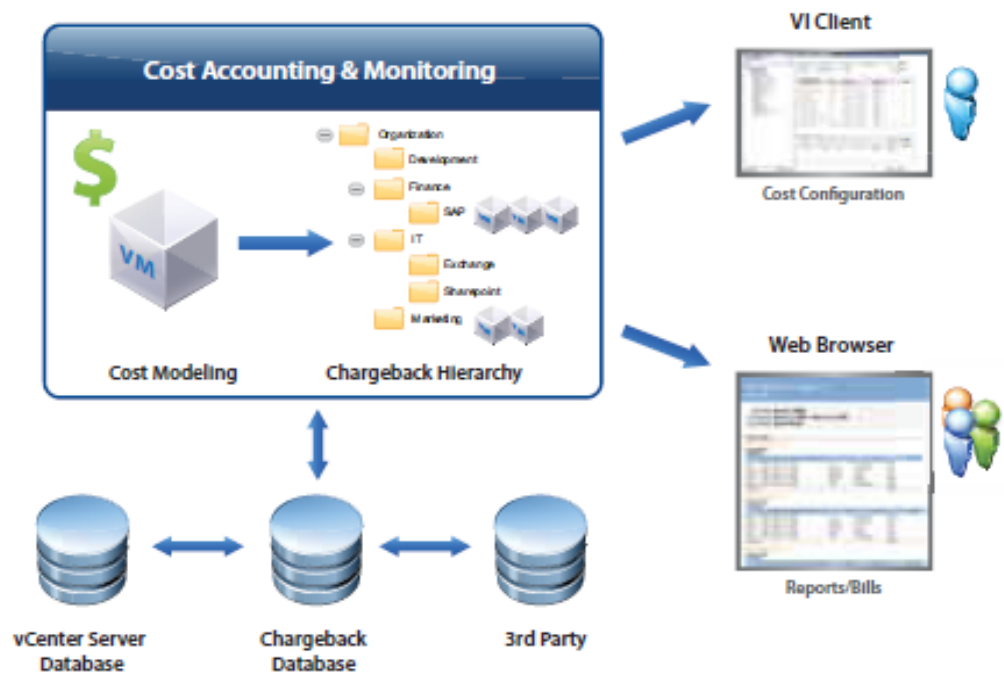
Distributing resource costs

Whether it's a company whose IT organization allocates its operating costs to the internal departments that use them, or a service provider that bills out charges to external customers on a monthly basis, having visibility into resources and the costs of those resources, is essential to ensuring resources are tied to the right end user application.

VMware vCenter Chargeback

VMware vCenter Chargeback enables accurate cost management, analysis, and reporting to create cost transparency and accountability. This allows IT staff to understand the actual cost of virtual infrastructure required to support business services and bill those charges out according to the IT resource billing policy.

VMware vCenter Chargeback enables IT organization to accurately report and give insight into the true costs of provisioning systems. Taking into account the different factors that range from CPU, memory, storage, and additional elements such as power and cooling, Chargeback can incorporate all of these variables to provide a comprehensive cost analysis for a virtual environment.



VMware vCenter Chargeback is based on a flexible hierarchy and cost models that can be customized to the organization's requirements.

Conclusion

Summary

A well-managed virtual information infrastructure must provide visibility and control across all levels of the infrastructure, including:

- Computing resources
- Storage resources
- Networking resources
- Desktop resources
- Application resources

EMC Ionix and the other third-party management software detailed in this white paper provide the following key management capabilities:

- Simplified remediation and configuration change management
- Automated policy enforcement to rectify issues within the physical and virtual environment to reduce user errors

The virtual information infrastructure must be able to provide the benefits of transportability inherent in virtualized environments, while still allowing for management and visibility into the physical and virtual elements that comprise the virtual information infrastructure across multiple domains.

Key points

The table below summarizes the key points that this solution addresses.

Key point	Solution objective
To effectively manage a virtual environment, you must understand the relationship between the physical and virtual components.	Leveraging EMC Ionix and other applications, you can easily determine the interdependencies of the virtual infrastructure to successfully support service level agreements.
To fully realize the benefits of virtualization, the physical infrastructure must be optimized.	Virtualization provides the means to manage change and enforce policies throughout the data center, from the virtual environment to the physical environment.
A single, correlated view across all layers of the infrastructure is needed for root-cause analysis and effective problem resolution.	EMC Ionix provides consistency, efficiency, and scalability across the networking, computing, application, and storage elements for fast problem resolution.
Tools must simplify the management of the virtual information infrastructure.	EMC Ionix and other third-party management software provide the building blocks to provide visibility into the physical and virtual elements that comprise the virtual information infrastructure across multiple domains.

Learn more

The following references are useful sources of more information about the topics discussed in this white paper.

- EMC white paper: *[Building the Virtual Information Infrastructure - Technology Concepts and Business Considerations](#)*
- EMC white paper: *[Securing the Virtual Information Infrastructure – Technology Concepts and Business Considerations](#)*

Also, visit these websites:

- [EMC.com](#)
 - [VMware.com](#)
 - [EMCIsionix.com](#)
-