EMC HYBRID CLOUD 2.5 WITH VMWARE
Foundation Infrastructure Reference Architecture

- Infrastructure as a service
- Automated provisioning and monitoring
- Service-driven IT operations

EMC Solutions

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**EMC Hybrid Cloud 2.5 with VMware: Foundation Infrastructure Reference Architecture**

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Executive summary

Document purpose
This document describes the reference architecture of an EMC Hybrid Cloud solution that enables IT organizations to quickly deploy an on-premises hybrid cloud delivering infrastructure as a service (IaaS) to their business. The document introduces the main features and functionality of the solution, the solution architecture and key components, and the validated hardware and software environment. The companion *EMC Hybrid Cloud 2.5 with VMware: Foundation Infrastructure Solution Guide* is an enablement reference to begin the planning and design of your hybrid cloud and to prepare for a successful implementation.

The following documents provide further information about how to implement specific capabilities or enable specific use cases within the EMC Hybrid Cloud solution with VMware:

- *EMC Hybrid Cloud 2.5 with VMware: Hadoop Applications Solution Guide*
- *EMC Hybrid Cloud 2.5 with VMware: Pivotal CF Platform as a Service Solution Guide*
- *EMC Hybrid Cloud 2.5 with VMware: Data Protection Continuous Availability Solution Guide*
- *EMC Hybrid Cloud 2.5 with VMware: Data Protection Disaster Recovery Solution Guide*
- *EMC Hybrid Cloud 2.5 with VMware: Data Protection Backup Solution Guide*
- *EMC Hybrid Cloud 2.5 with VMware: Security Management Solution Guide*
- *EMC Hybrid Cloud 2.5 with VMware: Public Cloud Integration Guide*

Audience
This document is intended for executives, managers, architects, cloud administrators, and technical administrators of IT environments who want to implement a hybrid cloud IaaS platform. Readers should be familiar with the VMware vCloud Suite, storage technologies, and general IT functions and requirements, and how a hybrid cloud infrastructure accommodates these technologies and requirements.

Solution purpose
This EMC Hybrid Cloud solution enables EMC customers to build an enterprise-class, scalable, multitenant infrastructure that enables:

- Complete management of the infrastructure service lifecycle
- On-demand access to and control of network bandwidth, servers, storage, and security
- Provisioning, monitoring, and management of the infrastructure services by the line-of-business end users, without IT administrator involvement
- Maximum asset utilization
- Access to application services from a single platform for both business-critical and next-generation cloud applications
This solution provides a reference architecture and the best practice guidance that are necessary to integrate all the key components and functionality of a hybrid cloud, as shown in Figure 1.

Figure 1. Hybrid cloud solution stack

Business leaders typically demand that their organization addresses the following fundamental challenges:

- Providing shareholder value by increasing revenues
- Improving competitiveness by driving business agility
- Increasing investment by lowering operational costs

While many organizations have successfully introduced virtualization as a core technology within their data center, the benefits of virtualization have largely been restricted to the IT infrastructure owners. End users and business units within customer organizations have not experienced many of the benefits of virtualization, such as increased agility, mobility, and control.

Transforming from the traditional IT model to an IaaS model involves overcoming the challenges of legacy infrastructure and processes, such as:

- Inefficiency and inflexibility
- Slow, reactive responses to customer requests
- Inadequate visibility of the requested infrastructure cost
- Limited choice of availability and protection services

The difficulty in overcoming these challenges has given rise to public cloud providers who have built technology and business models specifically catering to the requirements of end-user agility and control. Many organizations are under pressure to provide these same service levels within the secure and compliant confines of the
on-premises data center. As a result, IT departments need to create cost-effective alternatives to public cloud services, alternatives that do not compromise enterprise features such as data protection, disaster recovery (DR), and guaranteed service levels.

As IT organizations implement a hybrid cloud, they must consider the following factors:

- The infrastructure must be quick to deploy so that business value can be recognized quickly.
- The hybrid cloud infrastructure and operations must be designed to reduce costs through higher utilization and higher staff productivity.
- Risk of downtime must be controlled through disciplined change control and careful management of component compatibility.
- Support agreements must be established for all elements of the solution.

This solution integrates the best of EMC and VMware products and services, and empowers IT organizations to accelerate implementation and adoption of the hybrid cloud while enabling customer choice for the compute and networking infrastructure within the data center. The solution caters to both customers who want to further use their existing infrastructure and to those who want to build out new infrastructures dedicated to the hybrid cloud.

This solution takes advantage of the strong integration between EMC technologies and the VMware vCloud Suite. The solution, developed by EMC and VMware product and services teams, includes using EMC scalable storage arrays and integrated EMC and VMware monitoring and data protection suites to provide the foundation for enabling IaaS.

The key solution components include:

- EMC ViPR® software-defined storage platform
- EMC VNX® and/or EMC Symmetrix® VMAX® storage platforms
- EMC Avamar® and/or EMC Data Domain® backup and recovery solutions
- EMC and VMware integrated workflows
- VMware vCloud Suite
- VMware vCloud Networking and Security (vCNS) or VMware NSX virtual networking technologies
- VMware vCenter Log Insight
- VMware IT Business Management Suite
Hybrid cloud features and functionality

**Introduction**

The EMC Hybrid Cloud solution enables a well-run hybrid cloud by bringing new functionality to IT organizations, developers, end users, and line-of-business owners. Beyond delivering baseline infrastructure as a service (IaaS), built on the software-defined data center (SDDC) architecture, the EMC Hybrid Cloud also delivers feature-rich capabilities to expand from IaaS to business-enabling IT as a service (ITaaS).

Backup as a service (BaaS) and disaster recovery as a service are now policies that can be enabled with just a few clicks. End users and developers can quickly gain access to a marketplace of application resources, from Microsoft, Oracle, SAP, EMC Syncplicity, Pivotal, you can also add third-party packages as needed. All of these resources can be deployed on private cloud or public cloud services from EMC-powered cloud service providers, including VMware vCloud Air.

This solution includes the following features and functionality:

- **Automation and self-service provisioning**
- **Multitenancy and secure separation**
- **Workload-optimized storage**
- **Elasticity and service assurance**
- **Monitoring**
- **Metering and chargeback**
- **Modular add-on components**
- **Public cloud services**

**Automation and self-service provisioning**

This EMC Hybrid Cloud solution provides self-service provisioning of automated cloud services to both users and infrastructure administrators. The solution uses VMware vCloud Automation Center (vCAC), integrated with EMC ViPR and VMware NSX, to provide the compute, storage, network, and security virtualization platforms for the SDDC. These platforms enable you to rapidly deploy and provision business-relevant cloud services across your hybrid cloud and physical infrastructure.

Cloud users can request and manage their applications and compute resources within established operational policies. This can reduce IT service delivery times from days or weeks to minutes. Features include:

- **Cross-cloud storefront**: Acts as a service governor that provisions workloads based on business and IT policies.
- **Role-based self-service portal**: Delivers a user-appropriate catalog of IT services.
- **Resource reservations**: Enable resources to be allocated for use by a specific group and ensure that those resources are inaccessible to other groups.
- **Service levels**: Define the amount and type of resources that a given service can receive either during initial provisioning or as part of any configuration changes.
• **Build specifications**: Contain the automation policies that specify the process for building or reconfiguring compute resources.

In this solution, vCAC provides lines of business with the ability to rapidly deploy and provision both applications and services to the cloud platform when required. vCAC provides the ability to take a shared infrastructure and divide the resources into logical units and capacities that can be assigned to different business units. Using role-based entitlements, business users can choose from their own self-service catalog of custom-defined services and blueprints. Each user’s catalog presents only the virtual machine, application, or service blueprints appropriate to their role within the business.

Service blueprints enable cloud infrastructure administrators to add services created by EMC that use ViPR for automated storage services, and Avamar and Data Domain for backup and restore services.

Virtual machine and application blueprints can be single or multimachine deployments. Multitier enterprise applications requiring multiple components (application, database, and web) and service levels can be deployed easily from predefined blueprints.

Figure 2 shows the EMC Hybrid Cloud self-service portal in VMware vCAC.

![Figure 2. Self-service provisioning via the vCAC self-service portal](image)

Data protection policies can be applied to virtual machine resources at provisioning time, which later enables users to request on-demand backups and restores of their virtual machines, as well as requesting generation of backup reports, all from the vCAC self-service portal.
This solution is built to work with both new and existing infrastructures. It supports the differing requirements of an enterprise’s many business units and integrates with a wide variety of existing IT systems and best practices.

**Multitenancy and secure separation**

Multitenancy requirements in a cloud environment can range from shared, open resources to completely isolated resources, secure from any access. It depends on what the organization needs for their specific end users. The EMC Hybrid Cloud provides the ability to enforce physical and virtual separation for multitenancy, to the level required by the administrator. This separation can encompass network, compute, and storage resources to ensure appropriate security and performance for each tenant.

The solution supports secure multitenancy through vCAC role-based access control (RBAC), which enables vCAC roles to be mapped to Active Directory groups. vCAC uses existing authentication and business groupings. The self-service portal restricts access for cloud users based on their role.

Physical resource separation can be used to isolate tenant resources or to isolate and contain compute resources for licensing purposes, for example, Oracle. Virtual resource separation can be enforced between and within resource groups, depending on the level of separation required.

Compute resources can be configured at the vSphere layer to ensure physical and logical separation of resources between functional environments such as Production and Test/Dev.

Valid concerns exist around information leakage and “nosy neighbors” on a shared network infrastructure. Consumers of the provisioned resources need to operate in a dedicated environment and benefit from infrastructure standardization. To address these concerns, this solution has been designed for multitenancy. We’ve approached this from a defense-in-depth perspective, which is demonstrated by:

- Implementing virtual local area networks (VLANs) to enable isolation at Layer 2 in the Cloud Management Pod and where the solution intersects with the physical network
- Using virtual extensible LAN (VXLAN) overlay networks to segment tenant and business group traffic flows
- Integrating with firewalls functioning at the hypervisor level to protect virtualized applications and enabling security policy enforcement in a consistent fashion throughout the solution
- Deploying provider and business group edge firewalls to protect the business group and tenant perimeters

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1 In this document, "we" refers to the EMC engineering team that validated the solution.
Security

For enhanced security, the EMC Hybrid Cloud enables customers to establish a hardened security baseline across the hardware and software stacks supporting their hybrid cloud infrastructure. The solution helps to reduce concerns around the complexities of the underlying infrastructure by demonstrating how to tightly integrate an as-a-service solution stack with public key infrastructure (PKI) and a common authentication directory to provide centralized administration and tighter control over security.

The solution addresses the challenges of securing authentication and configuration management to aid compliance with industry and regulatory standards by:

- Securing the infrastructure by integrating with a PKI to provide authenticity, non-repudiation, and encryption
- Converging the various authentication sources into a single directory to enable a centralized point of administration and policy enforcement
- Using configuration management tools to audit the infrastructure and demonstrate compliance

VMware NSX for vSphere

NSX for vSphere can be used in the EMC Hybrid Cloud to enable a richer networking and security feature set than that provided by vCNS solutions. Enhanced networking and security features include:

- **NSX logical routing and firewalls**: Provide line-rate performance distributed across many hosts instead of being limited to a single virtual machine or physical host.
- **Distributed logical routers**: Contain East-West traffic within the hypervisor where workloads reside on the same host.
- **Logical load balancer**: Enables load sharing across a pool of virtual machines with configurable health check monitoring and application-specific rules for service high availability, URL rewriting, and advanced Secure Sockets layer (SSL) handling. A distributed firewall enables consistent data center-wide security policies.
- **Security policies**: Can be applied directly to security groups enabling greater flexibility in enforcing security policies.

Workload-optimized storage

With this solution customers can take advantage of the proven benefits of EMC storage in a hybrid cloud environment. Using EMC ViPR storage services and the capabilities of VNX and VMAX, the EMC Hybrid Cloud provides software-defined storage policy-based management of block- and file-based virtual storage.

With a scalable storage architecture that uses the latest flash and tiering technologies, VNX and VMAX can support any workload requirements with maximum efficiency and performance, and cost-effectiveness. ViPR abstracts the storage configuration and presents it as a single storage control point. This enables cloud administrators to access all heterogeneous storage resources within a data center as if they were a single large array.
Storage administrators are able to maintain control of their storage resources and policies while cloud administrators can automatically provision tiered storage resources into the cloud infrastructure without disruption.

**Elasticity and service assurance**

This solution uses the capabilities of vCAC and the tools provided by EMC, administrators and end users can dynamically add resources as needed, based on their performance requirements.

Infrastructure administrators can add storage, compute, and network resources to their resource pools, while end users can expand the resources of their own virtual machines to achieve the service levels they expect for their application workloads.

Cloud users can select from a range of service levels of compute, storage, and data protection for their applications to achieve the most efficient use of the resources within their hybrid cloud environment.

**Monitoring and resource management**

This EMC Hybrid Cloud solution features automated monitoring capabilities that provide a comprehensive view of the cloud environment to enable smart decision making for resource provisioning and allocation. These capabilities are based on a combination of VMware vCenter Operations Manager (vC Ops) dashboards, alerts, and analytics, using extensive additional storage detail provided by EMC analytics management packs for ViPR, VNX, and VMAX.

vC Ops provides pre-built and configurable dashboards for real-time performance, capacity, and configuration management. Performance data is abstracted to health, risk, and efficiency measurements that enable IT departments to easily identify evolving performance problems. Integrating vC Ops with EMC ViPR Analytics enables full end-to-end visibility of the entire infrastructure, from virtual machine to LUN and every point in between. For application-level monitoring of performance and availability, vCenter Hyperic can be used as an additional component of the vCenter Operations Management Suite.

The ViPR Analytics and EMC Storage Analytics (ESA) management packs are presented through the vC Ops custom interface. This enables administrators to quickly visualize the health of EMC ViPR virtual arrays as well as physical VMAX and VNX arrays (both block and file) using customized EMC dashboards for vC Ops, such as the EMC ViPR dashboard shown in Figure 3.
Figure 3. EMC ViPR Analytics with VMware vCenter Operations Manager

Capacity analytics in vC Ops identify over-provisioned resources so they can be right-sized for the most efficient use of virtualized resources. What-if scenarios eliminate the need for spreadsheets, scripts, and rules of thumb.

For this EMC Hybrid Cloud solution, EMC ViPR SRM, storage resource management software, offers comprehensive monitoring and reporting that helps IT organizations to visualize, analyze, and optimize their software-defined storage infrastructure. Cloud administrators can use ViPR SRM to understand and manage the impact that storage has on their applications and view their storage topologies in their hybrid cloud from application to storage. Capacity and consumption of EMC ViPR software-defined storage and service-level agreement (SLA) issues can be identified through real-time dashboards or reports to meet the needs of the wide range of hybrid cloud users.

Also, for centralized logging, infrastructure components can be configured to forward their logs to VMware vCenter Log Insight, which then aggregates the logs from all the disparate sources for analytics and reporting. When integrated with vCenter Log Insight, EMC content packs for Avamar, VNX, and VMAX provide dashboards and user-defined fields specifically for those EMC products, which enables administrators to conduct problem analysis and analytics on their storage array and backup infrastructure.

The EMC Hybrid Cloud uses VMware IT Business Management (ITBM) Suite to provide cloud administrators with metering and cost information across all business groups in the enterprise.

VMware ITBM Suite Standard Edition aggregates the cloud resources consumed by business units and application groups across the hybrid cloud environment, and then calculates the cost of those resources for each group. The cloud administrator can easily track those costs, and if necessary, use cost reports as the basis for implementing a cloud chargeback model.
ITBM uses its own reference database, preloaded with industry-standard data and vendor-specific data to generate the base price for resources. vCAC automatically consumes these prices and enables administrators to change them as required. This eliminates the need to manually configure cost profiles in vCAC and assign them to compute resources.

ITBM is integrated into the vCAC portal for the cloud administrator and provides a dashboard overview of the hybrid cloud infrastructure. ITBM is also integrated with vCenter and can import existing resource hierarchies, folder structures, and vCenter tags to associate hybrid cloud resource usage with business units, departments, and projects.

**Application services**

The EMC Hybrid Cloud leverages VMware vCloud Application Director to optimize application deployment and release management through logical application blueprints in vCAC. A drag-and-drop user interface enables you to quickly and easily deploy blueprints for applications and databases such as Microsoft Exchange, Microsoft SQL Server, Microsoft SharePoint, Oracle, SAP, Cloud Foundry, and Syncplicity.

**Data protection services**

Using vCenter Orchestrator workflows customized by EMC, administrators can quickly and easily set up multtier data protection policies and enable users to select an appropriate policy when provisioning their virtual machines. The backup infrastructure takes advantage of Avamar and Data Domain features such as deduplication, compression, and VMware integration.

Avamar provides scalable backup and restore capabilities with integrated data deduplication, which reduces total disk storage by up to 50 times and enables cost-effective, long-term retention on Avamar Data Store servers. Avamar can alternatively use a Data Domain appliance as the backup target.

Using the vCAC application program interface (API) and extensibility toolkits, this solution implements custom functionality to provide Avamar-based, image-level backup services for applications and file systems within a single organization or multiorganization hybrid cloud environment.

With this solution, enterprise administrators can offer IaaS with EMC backup to end users who want a flexible, on-demand, automated backup infrastructure without having to purchase, configure, or maintain it.
Figure 4 shows the overall architecture of the solution’s data protection functions.

**Continuous availability**

A combination of EMC VPLEX® and VMware vSphere vMotion enables hybrid cloud users to effectively distribute applications and their data across multiple hosts over synchronous distances. With virtual storage and virtual servers working together over distance, your infrastructure can provide load balancing, real-time remote data access, and improved application protection. All mobility and migration of live systems is seamlessly executed between sites, completely transparent to all users and applications.

**Disaster recovery**

The EMC Hybrid Cloud enables cloud administrators to select DR protection for their applications and virtual machines when deploying from the vCAC self-service catalog. EMC ViPR automatically places these systems on storage that is protected remotely by EMC RecoverPoint. VMware vCenter SRM, through tight integration with the EMC RecoverPoint Storage Replication Adapter (SRA), can automate the recovery of all virtual storage and virtual machines at a recovery or failover site.

**Public cloud services**

This EMC Hybrid Cloud solution enables IT organizations to broker public cloud services. This solution has been validated with VMware vCloud Air as a public cloud option that can be accessed directly from the solution’s self-service portal by both administrators and users. End users can provision virtual machines while IT administrators can perform virtual machine migration (offline) from the on-premises component of their hybrid cloud to vCloud Air using VMware vCloud Connector.
Key components

Introduction

This section describes the key components of the solution, as shown in Figure 5. These include:

- VMware vCloud Suite
- VMware vCNS or NSX networking
- VMware vCenter Log Insight
- VMware IT Business Management Suite
- EMC ViPR Software-defined Storage
- EMC VNX and VMAX storage platforms and EMC Avamar and Data Domain data protection platforms

Figure 5. EMC Hybrid Cloud solution components

VMware vCloud Automation Center

VMware vCloud Automation Center (vCAC) enables customized, self-service provisioning and lifecycle management of cloud services that comply with established business policies. vCAC provides a secure portal where authorized administrators, developers, and business users can request new IT services and manage existing computer resources from predefined user-specific menus.

VMware vSphere ESXi and VMware vCenter Server

VMware vSphere ESXi is a virtualization platform for building cloud infrastructures. vSphere enables you to run your business-critical applications confidently to meet your most demanding SLAs at the lowest total cost of ownership (TCO). vSphere combines this virtualization platform with the management capabilities of VMware vCenter Server. This solution gives you operational insight into the virtual environment for improved availability, performance, and capacity utilization.
**VMware vCenter Orchestrator**

VMware vCenter Orchestrator is an IT process automation engine that helps automate the cloud and integrates the vCloud Suite with the rest of your management systems. vCenter Orchestrator enables administrators and architects to develop complex automation tasks within the workflow designer. The vCenter Orchestrator library of pre-built activities, workflows, and plug-ins helps accelerate the customization of vCloud Automation Center’s standard capabilities.

**VMware vCloud Networking and Security**

VMware vCloud Networking and Security (vCNS) is a software-defined networking and security solution that enhances operational efficiency, unlocks agility, and enables extensibility to rapidly respond to business needs. It provides a broad range of services in a single solution, including virtual firewall, virtual private network (VPN), load balancing, and VXLAN-extended networks.

**VMware NSX for vSphere**

An alternative deployment option to vCNS is VMware NSX for vSphere, which is the next generation of software-defined network virtualization and offers additional functionality and improved performance over vCNS and traditional network and security devices. This additional functionality includes distributed logical routing, distributed firewalling, logical load balancing, and support for routing protocols such as Border Gateway Protocol (BGP), Intermediate System to Intermediate System (IS-IS), and Open Shortest Path First (OSPF). Where workloads on different subnets share the same host, the distributed logical router optimizes traffic flows by routing locally. This enables substantial performance improvements in throughput, with distributed logical routing and firewalling providing line-rate performance distributed across many hosts, instead of being limited to a single virtual machine or physical host. NSX also introduces Service Composer which integrates with third-party security services.

**VMware vCenter Operations Manager**

VMware vCenter Operations Manager (vC Ops) is the key component of the vCenter Operations Management Suite. It provides a simplified approach to operations management of vSphere, and physical and cloud infrastructures. vC Ops provides operations dashboards to gain insights and visibility into the health, risk, and efficiency of your infrastructure, performance management, and capacity optimization capabilities.

**VMware vCenter Log Insight**

VMware vCenter Log Insight delivers automated log management through log aggregation, analytics, and search capabilities. With an integrated cloud operations management approach, it provides the operational intelligence and enterprise-wide visibility needed to proactively enable service levels and operational efficiency in dynamic hybrid cloud environments.

**VMware IT Business Management Suite**

VMware ITBM Suite provides transparency and control over the cost and quality of IT services. By providing a business context to the services that IT offers, ITBM helps IT organizations shift from a technology orientation to a service-broker orientation,
delivering a portfolio of IT services that align with the needs of business stakeholders.

**EMC ViPR**

EMC ViPR is a lightweight, software-only solution that transforms existing storage into a simple, extensible, and open platform. ViPR extends current storage investments to meet new cloud-scale workloads, and enables simple data and application migration out of public clouds and back under the control of IT (or the other way around). ViPR gives IT departments the ability to deliver on-premises, fully automated storage services at price points that are the same as, or lower than, public cloud providers.

**EMC VNX and EMC Symmetrix VMAX**

EMC VNX and EMC Symmetrix VMAX are powerful, trusted, and smart storage arrays that provide the highest level of performance, availability, and intelligence in the hybrid cloud. EMC VNX and VMAX storage systems offer a broad array of functionality and tools, such as the fully automated storage tiering for virtual pools (FAST VP), enabling multiple storage service levels to support ViPR-driven storage-as-a-service offerings in the hybrid cloud environment.

**EMC ViPR SRM**

EMC ViPR SRM provides comprehensive monitoring, reporting, and analysis for heterogeneous block, file, and virtualized storage environments. It enables you to visualize applications to storage dependencies, monitor and analyze configurations and capacity growth, as well as optimize your environment to improve return on investment (ROI).

**EMC storage integration with VMware**

Both VNX and VMAX support VMware vSphere Storage APIs—Array Integration (VAAI), which offloads virtual machine operation to the array to optimize server performance. Both platforms also support VMware vSphere Storage API—Storage Awareness (VASA), which enables VMware administrators to expose the underlying storage performance and protection details to assist them in creating virtual machine storage policies.

**EMC ViPR and EMC Storage Analytics**

Powered by vCenter Operations Management Suite, EMC adapters for ViPR and ESA combine to provide a powerful management tool for VMware and storage administrators to access real-time intelligent analytics for the ViPR software-defined storage layer and the individual VNX and VMAX platforms. Administrators can get detailed statistics through customizable dashboards, heat maps, and alerts and access topology mappings in a VMware environment.

**EMC Virtual Storage Integrator**

The EMC Virtual Storage Integrator (VSI) for VMware vSphere Web Client provides the ability to view, manage, and optimize storage for VMware ESX servers and hosts. VSI is a plug-in for VMware vCenter that enables administrators to map storage to the hosts and supports VNX, VMAX, XtremIO, and ViPR software-defined storage. For this
EMC Hybrid Cloud solution, the VSI simplifies the provisioning of both VNX and VMAX storage for the management infrastructure of the hybrid cloud.

**EMC data protection workflows for vCenter Orchestrator**

With vCenter Orchestrator, cloud administrators can use the data protection workflows created by EMC to automate Avamar and Data Domain protection of virtual machines. These workflows are added to the vCAC virtual machine provisioning blueprints so that cloud users can easily set up protection at provisioning time and request on-demand restores for specific virtual machines, where they can choose to restore from all available backups.

Cloud infrastructure administrators can also use workflows that carry out the entire protection policy setup on Avamar and vCenter, to facilitate quick and easy deployment of the infrastructure needed to support all of the end-user protection needs.

**EMC Avamar**

EMC Avamar is a fast, efficient backup and recovery system that is provided through a complete software and hardware solution. Equipped with integrated variable-length deduplication technology, Avamar backup and recovery software provides integrated source and global data deduplication, which facilitates fast, full daily backups for hybrid cloud environments.

**EMC Data Domain**

With Avamar, you can choose to direct backups to an EMC Data Domain system instead of the Avamar server. Data Domain deduplication storage systems deduplicate data inline so that data is written already deduplicated on the disk, and requires less disk space than the original dataset. With Data Domain, you can retain backup and archive data on site longer to enable quick and reliable data restores from disk.

**EMC Data Protection Advisor**

With EMC Data Protection Advisor (DPA), you can automate and centralize the collection and analysis of all data across backup applications, replication technologies, the virtual environment, and supporting infrastructure. This provides a single, comprehensive view of your data protection environment and activities. In addition, when integrated with vCenter Orchestrator workflows, DPA can be used to provide on-demand reporting of backup statistics and status.
Solution architecture

Overview

This section describes the environment and supporting infrastructure for this EMC Hybrid Cloud solution.

Architecture

Figure 6 shows the overall architecture of the solution.

Figure 6. EMC Hybrid Cloud solution architecture

The architecture in Figure 6 shows the resources that are required to set up an EMC Hybrid Cloud solution:

- EHC Core Pod
- EHC Network Edge Infrastructure (NEI) Pod
- EHC Automation Pod
- Tenant Resource Pods (resources consumed by the end users)

The EHC Core Pod is used to host a core set of resources that must exist before the others. These core resources include the vCenter Servers, Microsoft SQL Server 2012, EMC SMI-S, EMC ViPR, and the vCNS or NSX Manager. The hardware that hosts this pod is not managed by cloud components, but the virtual machines it hosts are a critical foundation of the cloud.
The EHC NEI Pod hosts the vCNS and NSX Edge appliances, as well as the NSX Controllers and becomes the convergence point at which the physical and virtual networks connect.

The EHC Automation Pod hosts the virtual machines that automate and manage the cloud infrastructure; with the exception of the EMC Hybrid Cloud core components, which must exist before the creation of this pod. The automation pod supports the components responsible for functions, such as the user portal and automated provisioning, monitoring, metering, and reporting.

The Tenant Resource Pods are configured and assigned in vCAC as shared resources, to host all machines deployed by the different business groups in the hybrid cloud environment.

EMC Avamar provides data protection for all levels of this EMC Hybrid 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 tenant resource clusters are automatically protected during provisioning through customizations between vCAC and Avamar, the virtual machines in the management cluster are manually protected through the Avamar administrative console.

The server hardware and networking requirements for this EMC Hybrid Cloud solution conforms to the VMware Compatibility Guide.

This solution uses standard VMware- and EMC-supported I/O devices to support Ethernet and Fibre Channel connectivity, including:

- 10 Gb Ethernet
- 8 Gb/s Fibre Channel

The VMware Compatibility Guide provides detailed lists that show vendor devices that have been either physically tested or are similar to the devices tested by VMware or VMware partners.

Resource sizing information is provided in Resource sizing.
**Software resources**  
Table 1 lists the software used in this solution.

<table>
<thead>
<tr>
<th>Software</th>
<th>Version</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>VMware virtualization and cloud infrastructure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VMware vCloud Automation Center</td>
<td>6.0.1.1</td>
<td>VMware cloud management and infrastructure</td>
</tr>
<tr>
<td>VMware vCenter Server</td>
<td>5.5.0c</td>
<td>vSphere management server</td>
</tr>
<tr>
<td>VMware vSphere ESXi</td>
<td>5.5.0c</td>
<td>Server hypervisor</td>
</tr>
<tr>
<td>VMware vCenter Orchestrator</td>
<td>5.5.1</td>
<td>vCenter orchestration engine</td>
</tr>
<tr>
<td>VMware vCAC plug in for vCenter Orchestrator</td>
<td>6.0.1</td>
<td>vCAC plug in vCO</td>
</tr>
<tr>
<td>VMware vCenter Operations Manager</td>
<td>5.8.1</td>
<td>Automated operations management</td>
</tr>
<tr>
<td>VMware vCenter Log Insight</td>
<td>2.0</td>
<td>Optional vCenter log analytics and management</td>
</tr>
<tr>
<td>VMware IT Business Management Suite</td>
<td>1.0.1</td>
<td>Standard Edition</td>
</tr>
<tr>
<td>VMware vCloud Networking and Security (vCNS)</td>
<td>5.5.0a</td>
<td>Software-defined networking and security</td>
</tr>
<tr>
<td>VMware NSX for vSphere</td>
<td>6.0.4</td>
<td>Next-generation software-defined networking and security</td>
</tr>
<tr>
<td>Microsoft SQL Server</td>
<td>2012 SP1</td>
<td>Database server for vCenter Server and vCAC</td>
</tr>
<tr>
<td>Microsoft Windows Server</td>
<td>2012</td>
<td>Operating system for the server environment</td>
</tr>
<tr>
<td><strong>EMC storage</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMC ViPR</td>
<td>2.0 P1</td>
<td>Software-defined storage</td>
</tr>
<tr>
<td>EMC ViPR SRM</td>
<td>3.5</td>
<td>Storage resource management software</td>
</tr>
<tr>
<td>EMC Unisphere</td>
<td>1.6.2.4</td>
<td>Management software for EMC VMAX and VNX</td>
</tr>
<tr>
<td>EMC Enginunity™</td>
<td>5876.229.145</td>
<td>Operating environment for Symmetrix VMAX</td>
</tr>
<tr>
<td>EMC VNX Operating Environment</td>
<td>Release 33</td>
<td>Operating environment for VNX block</td>
</tr>
<tr>
<td>EMC Solutions Enabler</td>
<td>7.6.2.8</td>
<td>CLI software for Symmetrix VMAX storage management</td>
</tr>
<tr>
<td>EMC SMI-S Provider</td>
<td>4.6.2.3</td>
<td>EMC SMI-S Provider for Solutions Enabler 7.6.2.8</td>
</tr>
<tr>
<td>EMC PowerPath®/Virtual Edition</td>
<td>5.9 SP1</td>
<td>Multipathing and load balancing for block access</td>
</tr>
<tr>
<td><strong>EMC and VMware integration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EHC Foundation Module</td>
<td>2.5</td>
<td>Customization package for STaaS and foundation workflows</td>
</tr>
<tr>
<td>EMC Virtual Storage Integrator</td>
<td>6.2</td>
<td>EMC plug-in for VMware vSphere Web Client</td>
</tr>
<tr>
<td>EMC ViPR plug-in for VMware vCO</td>
<td>2.0.0.15</td>
<td>EMC ViPR plug in for vCO workflows</td>
</tr>
</tbody>
</table>
The cloud sizing examples in the following sections rely on the assumed values in the Sizing assumptions section. Sizing tools are available for the EMC Hybrid Cloud solution and for the EMC infrastructure at a detailed, customer-specific level. Your EMC account team has access to these tools and can help you size your solution.

**Resource sizing**

When sizing a hybrid cloud, it is important to size the management infrastructure so that it has adequate capacity to address the size of the resource clusters being planned for deployment. This section outlines the suggested management infrastructure requirements to support the cloud models shown in Table 2.

**Table 2. Cloud sizes**

<table>
<thead>
<tr>
<th>Cloud size</th>
<th>Supported virtual machines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>1,000</td>
</tr>
<tr>
<td>Medium</td>
<td>5,000</td>
</tr>
<tr>
<td>Large</td>
<td>10,000</td>
</tr>
</tbody>
</table>

**Sizing assumptions**

The sizing of the management infrastructure in each case is subject to a number of assumptions. The resources assigned to the management infrastructure may require adjustment if any of the following assumptions are altered:

- All virtual machines must be capable of being powered on simultaneously.
- The number of resource virtual machines for each ESX server is 15.
- A single vCenter Server instance is used for VMware NSX integrations.
- In the small cloud, with the exception of networking edge devices, high availability for all management components relies on VMware vSphere High Availability (HA) only. Networking Edge devices are deployed in HA configuration as business resource groups rely on them. No further measures are taken at the component level to enhance HA.
• For medium and large instances, high availability is enhanced where possible by using clustering and load balancing features at the component level.
• Four business groups are deployed (for example, dedicated groups for Engineering, Finance, and HR departments, with one generic group for everything else).
• A buffer of 20 percent is allowed for RAM utilization for the EHC Core, Automation, and NEI Pods.
• A buffer of 20 percent is allowed for CPU core utilization for the EHC Core, Automation, and NEI Pods.
• One additional management platform node (ESX server) is allowed for in each pod to account for a single host failure.
• Servers for the management platform are assumed to have 12 CPU cores and 96 GB RAM.
• CPU cores are assumed to be 2.4 GHz or equivalent.
• CPU core over-subscription is assumed to be 4:1 for business group pods and 2:1 for all other pods.
• Any appliances used have no additional OS disks requirements beyond their documented deployment sizes.
• For resource cluster storage array type, it is assumed that cloud owners will always choose fewer larger arrays instead of a greater number of smaller arrays.
• For the storage array type for the business group pods, assume that cloud owners will deploy a standard array type in a cloud (that is, all arrays are the same model for any given cloud).

Small cloud management requirements

The small cloud architecture uses built-in databases where possible; for example, the vCAC integrated database is used instead of an external PostgreSQL database.

The vCAC architecture itself uses the core option (all roles in one) to minimize the footprint. Further redundancy may be added to the small cloud by doubling the virtual machine count for vCAC Appliance, vCAC IaaS All-in-One, or vCenter Orchestrator, with the implication that adding them will also require the addition of load balancers.

0 lists the infrastructure recommendations for a small environment, which can manage up to 1,000 physical or virtual machines.
Table 3. Small deployment: Up to 1,000 virtual machines

<table>
<thead>
<tr>
<th>Component</th>
<th>Pod</th>
<th>No. of VMs</th>
<th>CPU cores</th>
<th>RAM (GB)</th>
<th>OS (GB)</th>
<th>Data (GB)</th>
<th>NIC speed (Gb/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SQL Server 2012</td>
<td>EHC Core</td>
<td>1</td>
<td>8</td>
<td>16</td>
<td>60</td>
<td>212</td>
<td>1</td>
</tr>
<tr>
<td>Cloud vCenter Server</td>
<td>EHC Core</td>
<td>1</td>
<td>4</td>
<td>8</td>
<td>60</td>
<td>303</td>
<td>1</td>
</tr>
<tr>
<td>vCloud Network and Security (vCNS)</td>
<td>EHC Core</td>
<td>1</td>
<td>24</td>
<td>8</td>
<td>0</td>
<td>60</td>
<td>1</td>
</tr>
<tr>
<td>EMC SMI-S/Unisphere</td>
<td>EHC Core</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>60</td>
<td>100</td>
<td>1</td>
</tr>
<tr>
<td>EMC ViPR Controller</td>
<td>EHC Core</td>
<td>3</td>
<td>4</td>
<td>16</td>
<td>1000</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>EMC VSI appliance</td>
<td>EHC Core</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>80</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>External vCenter Server</td>
<td>EHC Core</td>
<td>1</td>
<td>2</td>
<td>12</td>
<td>60</td>
<td>50</td>
<td>1</td>
</tr>
<tr>
<td>vCNS Enterprise Edge</td>
<td>EHC NEI</td>
<td>2</td>
<td>14</td>
<td>0.25</td>
<td>0</td>
<td>0.3</td>
<td>1</td>
</tr>
<tr>
<td>vCNS Business Group Edge</td>
<td>EHC NEI</td>
<td>8</td>
<td>1</td>
<td>0.25</td>
<td>0</td>
<td>0.3</td>
<td>1</td>
</tr>
<tr>
<td>vShield App</td>
<td>EHC NEI</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>vCAC Appliance</td>
<td>EHC Automation</td>
<td>1</td>
<td>4</td>
<td>16</td>
<td>30</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>vCAC IaaS Core (All-in-One)</td>
<td>EHC Automation</td>
<td>1</td>
<td>4</td>
<td>8</td>
<td>60</td>
<td>40</td>
<td>1</td>
</tr>
<tr>
<td>vCenter Operations UI</td>
<td>EHC Automation</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>100</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>vCenter Operations Analytics</td>
<td>EHC Automation</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>400</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>vCenter Log Insight Manager</td>
<td>EHC Automation</td>
<td>1</td>
<td>8</td>
<td>16</td>
<td>168</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>VMware ITBM</td>
<td>EHC Automation</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>50</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>vCenter Orchestrator Appliance</td>
<td>EHC Automation</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>7</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>EMC Data Protection Advisor Application Server</td>
<td>EHC Automation</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>60</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>EMC Data Protection Advisor Database Server</td>
<td>EHC Automation</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>60</td>
<td>142</td>
<td>1</td>
</tr>
<tr>
<td>EMC PowerPath License Server</td>
<td>EHC Automation</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>10</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>vShield App</td>
<td>EHC Automation</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>EMC ViPR SRM Frontend</td>
<td>EHC Automation</td>
<td>1</td>
<td>4</td>
<td>16</td>
<td>120</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>EMC ViPR SRM Primary Backend</td>
<td>EHC Automation</td>
<td>1</td>
<td>4</td>
<td>24</td>
<td>600</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>EMC ViPR SRM Secondary Backend</td>
<td>EHC Automation</td>
<td>1</td>
<td>4</td>
<td>24</td>
<td>1200</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>EMC ViPR SRM Collector</td>
<td>EHC Automation</td>
<td>1</td>
<td>4</td>
<td>16</td>
<td>120</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 4 represents a summary of the virtual machine resources by pod and shows how they relate to the requirements for acquiring and deploying the respective pods.

**Table 4. Small cloud management platform: Virtual machine requirements**

<table>
<thead>
<tr>
<th>Pod name</th>
<th>Resource type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>EHC Core</td>
<td>Number of virtual machines</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Virtual CPU cores</td>
<td>32 cores</td>
</tr>
<tr>
<td></td>
<td>Virtual RAM</td>
<td>108 GB</td>
</tr>
<tr>
<td></td>
<td>Storage (OS and data)</td>
<td>4,045 GB</td>
</tr>
<tr>
<td>EHC NEI</td>
<td>Number of virtual machines</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Virtual CPU cores</td>
<td>14 cores</td>
</tr>
<tr>
<td></td>
<td>Virtual RAM</td>
<td>10 GB</td>
</tr>
<tr>
<td></td>
<td>Storage (OS and data)</td>
<td>25 GB</td>
</tr>
<tr>
<td>EHC Automation</td>
<td>Number of virtual machines</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Virtual CPU cores</td>
<td>52 cores</td>
</tr>
<tr>
<td></td>
<td>Virtual RAM</td>
<td>162 GB</td>
</tr>
<tr>
<td></td>
<td>Storage (OS and data)</td>
<td>3,200 GB</td>
</tr>
</tbody>
</table>
Table 5 lists the physical hardware requirements for the respective pods based on the aggregate virtual machine requirements and the Sizing assumptions for the physical hardware specifications.

Table 5. Small cloud management platform: Physical hardware requirements

<table>
<thead>
<tr>
<th>Pod name</th>
<th>Resource type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>EHC Core</td>
<td>Number of physical hosts</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Physical CPU cores</td>
<td>36 cores</td>
</tr>
<tr>
<td></td>
<td>Physical RAM</td>
<td>288 GB</td>
</tr>
<tr>
<td></td>
<td>Number of volumes</td>
<td>9 x 500 GB</td>
</tr>
<tr>
<td>EHC NEI</td>
<td>Number of physical hosts</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Physical CPU cores</td>
<td>36 cores</td>
</tr>
<tr>
<td></td>
<td>Physical RAM</td>
<td>288 GB</td>
</tr>
<tr>
<td></td>
<td>Number of volumes</td>
<td>1 x 500 GB</td>
</tr>
<tr>
<td>EHC Automation</td>
<td>Number of physical hosts</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Physical CPU cores</td>
<td>48 cores</td>
</tr>
<tr>
<td></td>
<td>Physical RAM</td>
<td>384 GB</td>
</tr>
<tr>
<td></td>
<td>Number of volumes</td>
<td>7 x 500 GB</td>
</tr>
</tbody>
</table>

Medium cloud management requirements

The medium architecture splits the vCAC roles for better scalability, but still combines the Web and Management roles; these do not need to be separate until the total resource virtual machine counts exceed 20,000.

With the inclusion of multiple vCAC appliances, this architecture also introduces an external, clustered PostgreSQL database and load balancers to distribute the vCAC traffic evenly between vCAC appliances and IaaS roles. The same load balancers can be used for any load balancing purposes within the environment.
Table 6 lists the management infrastructure recommendations for a medium environment, which can manage up to 5,000 physical or virtual machines.

<table>
<thead>
<tr>
<th>Component</th>
<th>Pod</th>
<th>No. of VMs</th>
<th>CPU cores</th>
<th>RAM (GB)</th>
<th>OS (GB)</th>
<th>Data (GB)</th>
<th>NIC speed (Gb/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SQL Server 2012</td>
<td>EHC Core</td>
<td>2</td>
<td>10</td>
<td>20</td>
<td>60</td>
<td>321</td>
<td>1</td>
</tr>
<tr>
<td>Cloud vCenter Server</td>
<td>EHC Core</td>
<td>1</td>
<td>8</td>
<td>16</td>
<td>60</td>
<td>150</td>
<td>1</td>
</tr>
<tr>
<td>NSX Manager</td>
<td>EHC Core</td>
<td>1</td>
<td>4</td>
<td>12</td>
<td>0</td>
<td>60</td>
<td>1</td>
</tr>
<tr>
<td>EMC SMI-S/Unisphere</td>
<td>EHC Core</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>60</td>
<td>100</td>
<td>1</td>
</tr>
<tr>
<td>EMC ViPR Controller</td>
<td>EHC Core</td>
<td>3</td>
<td>4</td>
<td>16</td>
<td>1000</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>EMC VSI appliance</td>
<td>EHC Core</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>80</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>External vCenter Server</td>
<td>EHC Core</td>
<td>1</td>
<td>2</td>
<td>12</td>
<td>60</td>
<td>50</td>
<td>1</td>
</tr>
<tr>
<td>vCenter Update Manager</td>
<td>EHC Core</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>60</td>
<td>203</td>
<td>1</td>
</tr>
<tr>
<td>NSX Enterprise Edge</td>
<td>EHC NEI</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>0.5</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>NSX Business Group Edge</td>
<td>EHC NEI</td>
<td>8</td>
<td>2</td>
<td>1</td>
<td>0.5</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>NSX Controller</td>
<td>EHC NEI</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>24</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>vCAC Appliance</td>
<td>EHC Automation</td>
<td>2</td>
<td>4</td>
<td>16</td>
<td>30</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>vCAC vPostgreSQL</td>
<td>EHC Automation</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>20</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>vCAC IaaS Web/Manager</td>
<td>EHC Automation</td>
<td>2</td>
<td>2</td>
<td>8</td>
<td>60</td>
<td>40</td>
<td>1</td>
</tr>
<tr>
<td>vCAC DEM Server</td>
<td>EHC Automation</td>
<td>4</td>
<td>2</td>
<td>6</td>
<td>60</td>
<td>40</td>
<td>1</td>
</tr>
<tr>
<td>vCAC Agent Server</td>
<td>EHC Automation</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>60</td>
<td>40</td>
<td>1</td>
</tr>
<tr>
<td>Load Balancers</td>
<td>EHC Automation</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>40</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>vCenter Operations UI</td>
<td>EHC Automation</td>
<td>1</td>
<td>6</td>
<td>18</td>
<td>300</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>vCenter Operations Analytics</td>
<td>EHC Automation</td>
<td>1</td>
<td>6</td>
<td>14</td>
<td>2000</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>vCenter Log Insight Manager</td>
<td>EHC Automation</td>
<td>1</td>
<td>16</td>
<td>32</td>
<td>441</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>VMware ITBM</td>
<td>EHC Automation</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>50</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>vCenter Orchestrator Appliance</td>
<td>EHC Automation</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>7</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>EMC Data Protection Advisor Application Server</td>
<td>EHC Automation</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>60</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>EMC Data Protection Advisor Database Server</td>
<td>EHC Automation</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>60</td>
<td>655</td>
<td>1</td>
</tr>
<tr>
<td>EMC PowerPath License Server</td>
<td>EHC Automation</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>10</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Component</td>
<td>Pod</td>
<td>No. of VMs</td>
<td>CPU cores</td>
<td>RAM (GB)</td>
<td>OS (GB)</td>
<td>Data (GB)</td>
<td>NIC speed (Gb/s)</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>---------------------</td>
<td>------------</td>
<td>-----------</td>
<td>----------</td>
<td>---------</td>
<td>-----------</td>
<td>------------------</td>
</tr>
<tr>
<td>EMC ViPR SRM Frontend</td>
<td>EHC Automation</td>
<td>1</td>
<td>4</td>
<td>16</td>
<td>120</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>EMC ViPR SRM Primary Backend</td>
<td>EHC Automation</td>
<td>1</td>
<td>4</td>
<td>24</td>
<td>600</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>EMC ViPR SRM Secondary Backend</td>
<td>EHC Automation</td>
<td>1</td>
<td>4</td>
<td>24</td>
<td>1200</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>EMC ViPR SRM Collector</td>
<td>EHC Automation</td>
<td>1</td>
<td>4</td>
<td>16</td>
<td>120</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 7 represents a summary of the virtual machine resources by pod and shows how they relate to the requirements for acquiring and deploying the respective pods.

Table 7. Medium cloud management platform: Virtual machine requirements

<table>
<thead>
<tr>
<th>Pod name</th>
<th>Resource type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>EHC Core</td>
<td>Number of virtual machines</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Virtual CPU cores</td>
<td>52 cores</td>
</tr>
<tr>
<td></td>
<td>Virtual RAM</td>
<td>146 GB</td>
</tr>
<tr>
<td></td>
<td>Storage (OS and data)</td>
<td>4,645 GB</td>
</tr>
<tr>
<td>EHC NEI</td>
<td>Number of virtual machines</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Virtual CPU cores</td>
<td>32 cores</td>
</tr>
<tr>
<td></td>
<td>Virtual RAM</td>
<td>22 GB</td>
</tr>
<tr>
<td></td>
<td>Storage (OS and data)</td>
<td>77 GB</td>
</tr>
<tr>
<td>EHC Automation</td>
<td>Number of virtual machines</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Virtual CPU cores</td>
<td>88 cores</td>
</tr>
<tr>
<td></td>
<td>Virtual RAM</td>
<td>270 GB</td>
</tr>
<tr>
<td></td>
<td>Storage (OS and data)</td>
<td>6,617 GB</td>
</tr>
</tbody>
</table>
Table 8 lists the physical hardware requirements for the respective pods based on the aggregate virtual machine requirements and the Sizing assumptions for the physical hardware specifications.

**Table 8. Medium cloud management platform: Physical hardware requirements**

<table>
<thead>
<tr>
<th>Pod name</th>
<th>Resource type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>EHC Core</td>
<td>Number of physical hosts</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Physical CPU cores</td>
<td>48 cores</td>
</tr>
<tr>
<td></td>
<td>Physical RAM</td>
<td>384 GB</td>
</tr>
<tr>
<td></td>
<td>Number of volumes</td>
<td>10 x 500 GB</td>
</tr>
<tr>
<td>EHC NEI</td>
<td>Number of physical hosts</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Physical CPU cores</td>
<td>36 cores</td>
</tr>
<tr>
<td></td>
<td>Physical RAM</td>
<td>288 GB</td>
</tr>
<tr>
<td></td>
<td>Number of volumes</td>
<td>1 x 500 GB</td>
</tr>
<tr>
<td>EHC Automation</td>
<td>Number of physical hosts</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Physical CPU cores</td>
<td>72 cores</td>
</tr>
<tr>
<td></td>
<td>Physical RAM</td>
<td>576 GB</td>
</tr>
<tr>
<td></td>
<td>Number of volumes</td>
<td>14 x 500 GB</td>
</tr>
</tbody>
</table>

**Large cloud management requirements**

The large architecture is similar in many respects to the medium architecture, but takes into account the larger data requirements needed to manage twice the number of virtual machines.

vCAC resources are still sized to provide high availability at a minimum, but if the run rate for vCAC deployments requires it, additional vCAC roles can be deployed in order to run additional concurrent deployments.
Table 9 lists the management infrastructure recommendations for a large environment, which can manage more than 10,000 physical or virtual machines.

<table>
<thead>
<tr>
<th>Component</th>
<th>Pod</th>
<th>No. of VMs</th>
<th>CPU cores</th>
<th>RAM (GB)</th>
<th>OS (GB)</th>
<th>Data (GB)</th>
<th>NIC speed (Gb/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SQL Server 2012</td>
<td>EHC Core</td>
<td>2</td>
<td>14</td>
<td>28</td>
<td>60</td>
<td>456</td>
<td>1</td>
</tr>
<tr>
<td>Cloud vCenter Server</td>
<td>EHC Core</td>
<td>1</td>
<td>8</td>
<td>16</td>
<td>60</td>
<td>150</td>
<td>1</td>
</tr>
<tr>
<td>NSX Manager</td>
<td>EHC Core</td>
<td>1</td>
<td>4</td>
<td>12</td>
<td>60</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>EMC SMI-S/Unisphere</td>
<td>EHC Core</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>60</td>
<td>100</td>
<td>1</td>
</tr>
<tr>
<td>EMC ViPR Controller</td>
<td>EHC Core</td>
<td>3</td>
<td>4</td>
<td>16</td>
<td>1000</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>EMC VSI appliance</td>
<td>EHC Core</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>80</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>External vCenter Server</td>
<td>EHC Core</td>
<td>1</td>
<td>2</td>
<td>12</td>
<td>60</td>
<td>50</td>
<td>1</td>
</tr>
<tr>
<td>vCenter Update Manager</td>
<td>EHC Core</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>60</td>
<td>203</td>
<td>1</td>
</tr>
<tr>
<td>NSX Enterprise Edge</td>
<td>EHC NEI</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>0.5</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>NSX Business Group Edge</td>
<td>EHC NEI</td>
<td>8</td>
<td>4</td>
<td>1</td>
<td>0.5</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>NSX Controller</td>
<td>EHC NEI</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>24</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>vCAC Appliance</td>
<td>EHC Automation</td>
<td>2</td>
<td>4</td>
<td>16</td>
<td>30</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>vCAC vPostgreSQL</td>
<td>EHC Automation</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>20</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>vCAC IaaS Web/Manager</td>
<td>EHC Automation</td>
<td>2</td>
<td>2</td>
<td>8</td>
<td>60</td>
<td>40</td>
<td>1</td>
</tr>
<tr>
<td>vCAC DEM Server</td>
<td>EHC Automation</td>
<td>4</td>
<td>2</td>
<td>6</td>
<td>60</td>
<td>40</td>
<td>1</td>
</tr>
<tr>
<td>vCAC Agent Server</td>
<td>EHC Automation</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>60</td>
<td>40</td>
<td>1</td>
</tr>
<tr>
<td>Load Balancers</td>
<td>EHC Automation</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>40</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>vCenter Operations UI</td>
<td>EHC Automation</td>
<td>1</td>
<td>10</td>
<td>36</td>
<td>500</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>vCenter Operations Analytics</td>
<td>EHC Automation</td>
<td>1</td>
<td>10</td>
<td>28</td>
<td>3900</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>vCenter Log Insight Manager</td>
<td>EHC Automation</td>
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<td>16</td>
<td>32</td>
<td>784</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>VMware ITBM</td>
<td>EHC Automation</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>50</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>vCenter Orchestrator Appliance</td>
<td>EHC Automation</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>7</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>EMC Data Protection Advisor</td>
<td>EHC Automation</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>60</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>EMC Data Protection Advisor</td>
<td>EHC Automation</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>60</td>
<td>1,294</td>
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<tr>
<td>Database Server</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EMC PowerPath License Server</td>
<td>EHC Automation</td>
<td>1</td>
<td>2</td>
<td>8</td>
<td>10</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Component</td>
<td>Pod</td>
<td>No. of VMs</td>
<td>CPU cores</td>
<td>RAM (GB)</td>
<td>OS (GB)</td>
<td>Data (GB)</td>
<td>NIC speed (Gb/s)</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>----------------</td>
<td>------------</td>
<td>-----------</td>
<td>----------</td>
<td>---------</td>
<td>-----------</td>
<td>-----------------</td>
</tr>
<tr>
<td>EMC ViPR SRM Frontend</td>
<td>EHC Automation</td>
<td>1</td>
<td>4</td>
<td>16</td>
<td>120</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>EMC ViPR SRM Primary Backend</td>
<td>EHC Automation</td>
<td>1</td>
<td>4</td>
<td>24</td>
<td>600</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>EMC ViPR SRM Secondary Backend</td>
<td>EHC Automation</td>
<td>1</td>
<td>4</td>
<td>24</td>
<td>1200</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>EMC ViPR SRM Collector</td>
<td>EHC Automation</td>
<td>1</td>
<td>4</td>
<td>16</td>
<td>120</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 10 represents a summary of the virtual machine resources by pod and shows how they relate to the requirements for acquiring and deploying the respective pods.

**Table 10. Large cloud management platform: Virtual machine requirements**

<table>
<thead>
<tr>
<th>Pod name</th>
<th>Resource type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>EHC Core</td>
<td>Number of virtual machines</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Virtual CPU cores</td>
<td>60 cores</td>
</tr>
<tr>
<td></td>
<td>Virtual RAM</td>
<td>162 GB</td>
</tr>
<tr>
<td></td>
<td>Storage (OS and data)</td>
<td>4,915 GB</td>
</tr>
<tr>
<td>EHC NEI</td>
<td>Number of virtual machines</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Virtual CPU cores</td>
<td>60 cores</td>
</tr>
<tr>
<td></td>
<td>Virtual RAM</td>
<td>30 GB</td>
</tr>
<tr>
<td></td>
<td>Storage (OS and data)</td>
<td>125 GB</td>
</tr>
<tr>
<td>EHC Automation</td>
<td>Number of virtual machines</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>Virtual CPU cores</td>
<td>112 cores</td>
</tr>
<tr>
<td></td>
<td>Virtual RAM</td>
<td>334 GB</td>
</tr>
<tr>
<td></td>
<td>Storage (OS and data)</td>
<td>10,483 GB</td>
</tr>
</tbody>
</table>
Table 11 lists the physical hardware requirements for the respective pods based on the aggregate virtual machine requirements and the Sizing assumptions for the physical hardware specifications.

**Table 11. Large cloud management platform physical hardware requirements**

<table>
<thead>
<tr>
<th>Pod name</th>
<th>Resource type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>EHC Core</td>
<td>Number of physical hosts</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Physical CPU cores</td>
<td>48 cores</td>
</tr>
<tr>
<td></td>
<td>Physical RAM</td>
<td>384 GB</td>
</tr>
<tr>
<td></td>
<td>Number of volumes</td>
<td>10 x 500 GB</td>
</tr>
<tr>
<td>EHC NEI</td>
<td>Number of physical hosts</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Physical CPU cores</td>
<td>48 cores</td>
</tr>
<tr>
<td></td>
<td>Physical RAM</td>
<td>384 GB</td>
</tr>
<tr>
<td></td>
<td>Number of volumes</td>
<td>1 x 500 GB</td>
</tr>
<tr>
<td>EHC Automation</td>
<td>Number of physical hosts</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Physical CPU cores</td>
<td>96 cores</td>
</tr>
<tr>
<td></td>
<td>Physical RAM</td>
<td>768 GB</td>
</tr>
<tr>
<td></td>
<td>Number of volumes</td>
<td>21 x 500 GB</td>
</tr>
</tbody>
</table>

For guidelines on sizing vC Ops, compute, storage, and data protection, which are all dependent on the size of the ultimate tenant resource environment, refer to the *EMC Hybrid Cloud with VMware: Foundation Infrastructure Solution Guide 2.5*. 
Conclusion

Summary

This EMC Hybrid Cloud solution enables customers to build an enterprise-class, scalable, multitenant platform for complete infrastructure service lifecycle management. This solution provides on-demand access and control of infrastructure resources and security while enabling customers to maximize asset utilization. Specifically, the solution integrates all of the key functionality that customers demand of a hybrid cloud and provides a framework and foundation for adding other services.

This solution incorporates the following principles:

- Self-service and automated provisioning
- Multitenancy and secure separation
- Security and compliance
- Elasticity and service assurance
- Monitoring
- Metering and chargeback
- Availability and data protection

The solution uses the best of EMC and VMware products and services to empower customers to accelerate the implementation and adoption of a hybrid cloud while enabling customer choice for the compute and networking infrastructure within the data center.