Technical Note: Using VMware® vCenter™ Chargeback Manager™ with VMware vCloud® Director™

TECHNICAL WHITE PAPER

vmware®

Table of Contents

Introduction

VMware vCloud® Director™ makes broad deployment of clouds possible by enabling self-service access to infrastructure resources. It provides the interface, automation and management feature set that enables enterprises and service providers to supply VMware vSphere® resources as a Web-based service. With the advent of massive cloud environments, keeping track of dynamic cloud resources becomes an increasingly important task.

VMware® vCenter™ Chargeback Manager™ provides the metering capability to measure, analyze, and report on utilization and costs associated with VMware®-based cloud infrastructures. It offers the ability to configure and associate various cost models with vCloud Director entities. The cost transparency enabled by vCenter Chargeback Manager allows cloud providers to validate and adjust financial models based on resource consumption.

This paper has been written to explain the integration of vCloud Director and vCenter Chargeback Manager. Shared deployment design considerations for vCenter Chargeback Manager are also covered. The intended audience is virtualization personnel who have a strong understanding of vSphere and vCloud Director concepts and terminology.

Overview

The process for installing and configuring vCenter Chargeback Manager is as follows:

1. Install vCenter Chargeback Manager along with the vCenter Chargeback Manager, VMware vCloud Director, and VMware® vShield Manager™ data collectors. Refer to the *vCenter Chargeback Manager Installation and Upgrade Guide* for detailed installation instructions.

2. Validate vCenter Chargeback Manager data collector settings. Change vShield Manager login credentials accordingly.

3. Add all vCenter Servers attached to the VMware vCloud Director instance. Refer to the *vCenter Chargeback Manager User's Guide* for detailed instructions.

4. Validate synchronization of inventories between vCloud Director and vCenter Chargeback Manager.

5. Based on approved service definition, create and configure cost models, fixed costs or virtual machine instance.

6. Configure costs for specific vCenter Chargeback Manager entities.

7. Schedule reports manually or leverage automatic scheduler.

8. Create users and associate the appropriate roles and access.

9. (optional) Integrate vCenter Chargeback Manager with external systems.

This technical note provides additional details and best practices for each step in the process.

Architecture

vCenter Chargeback Manager components include:

• vCenter Chargeback Manager server
• vCenter Chargeback Manager database
• vCenter Chargeback Manager data collectors
• vCenter Chargeback Manager web interface
• vCenter Chargeback Manager API

The data collectors gather and send data to the vCenter Chargeback Manager database. The vCenter Chargeback Manager Web interface handles cost modeling, user management, and report generation. Integration with other management products, such as VMware® vCenter™ Orchestrator™ and VMware® vCenter™ Operations Manager™, is available through the appropriate plug-in/adaptor.
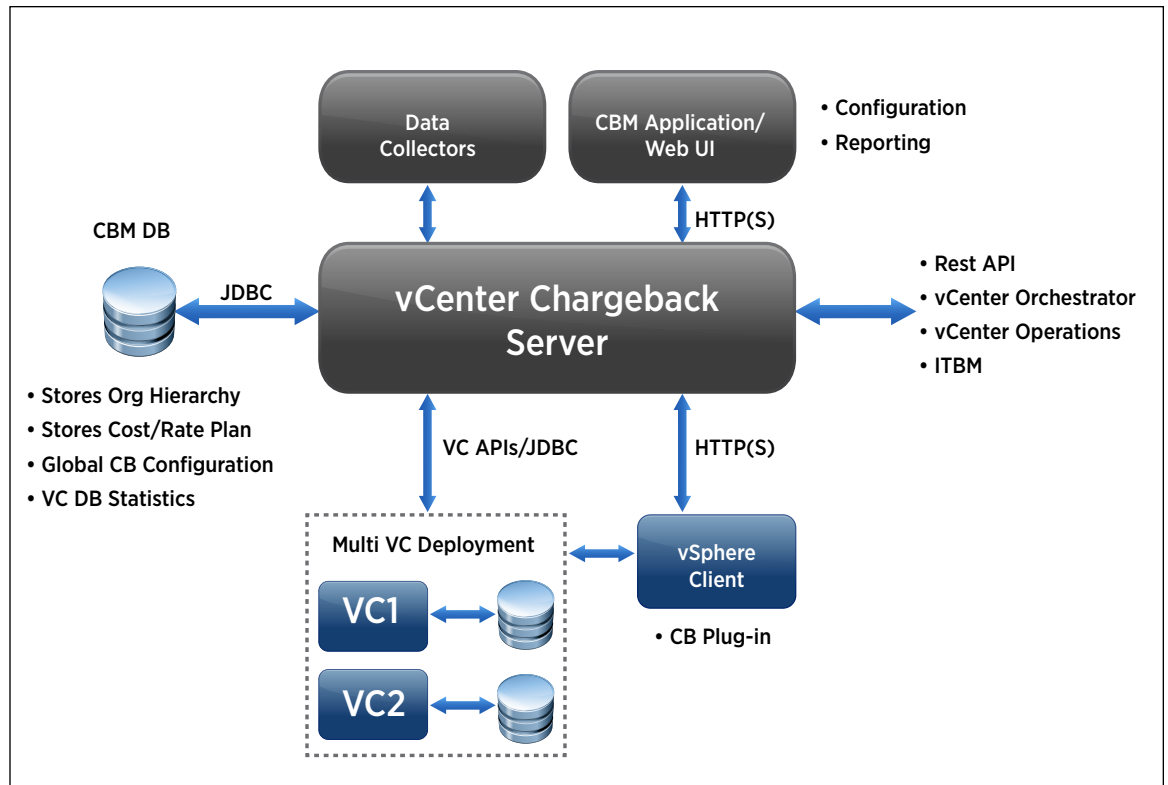
Figure 1. VMware vCenter Chargeback Manager Components

vCenter Chargeback Manager Server

The vCenter Chargeback Manager server runs the web interface, load balancer, and data collector services. This server can be virtual or physical and has the following recommended specifications:

• 2.0GHz or faster Intel or AMD x86 processor

• 4GB or more of RAM

• 3GB disk storage

• 1Gb Ethernet (1GbE) adaptor

Refer to the *vCenter Chargeback Manager Installation and Upgrade Guide* for more details.

vCenter Chargeback Manager servers can be clustered together to provide improved performance and availability for the web interface. A cluster configuration leverages the Apache load balancer, which is bundled with the vCenter Chargeback Manager software. The built-in load balancer can be installed on any vCenter Chargeback Manager server instance, but cannot be replaced by a third-party load balancer. All instances in a cluster must run the same version of vCenter Chargeback Manager.
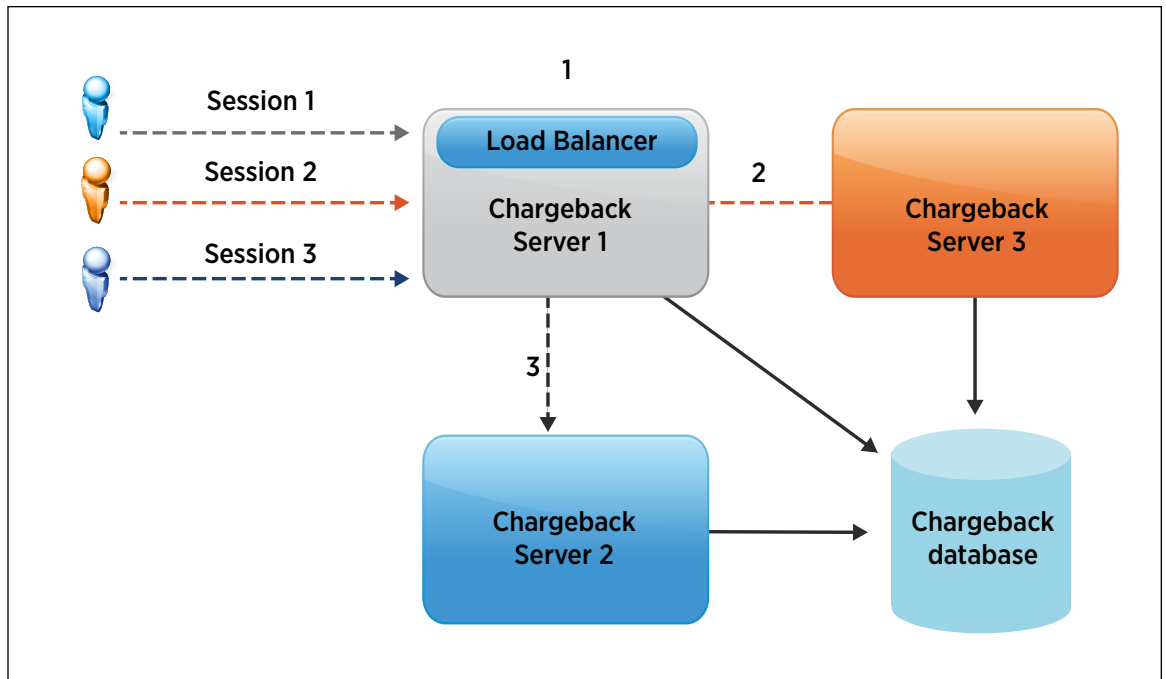
Figure 2. User Request Routing with Clustering

Load balancing is active/active. Each user request, whether it comes from the web interface or API, routes through the load balancer. The load balancer forwards the request to a vCenter Chargeback Manager instance in the cluster, based on the number of requests currently serviced by each instance in the cluster. Sticky sessions are enabled, so sessions always stick to one vCenter Chargeback Manager server. If there are multiple sessions, the load balancer uses the number of requests to find the best worker. With multiple vCenter Chargeback Manager servers, the report processing load is balanced by the internal Quartz Scheduler.

Losing the vCenter Chargeback Manager server that contains the load balancer removes access to the Web interface. Point users to the IP addresses of the remaining vCenter Chargeback Manager servers until the first server is restored.

vCenter Chargeback Manager Database

The vCenter Chargeback Manager database stores organization hierarchies, cost/rate plans and global vCenter Chargeback Manager configuration data. Currently, Microsoft SQL Express, Microsoft SQL Server and Oracle are supported.

SQL scripts are available that enable administrators to manage and retrieve usage data from the vCenter Chargeback Manager database. Refer to the *vCenter Chargeback Manager User's Guide* for more details.

Data Collectors

vCenter Chargeback Manager uses data collectors to pull information from various sources. Each data collector runs on its own schedule, so polling intervals are unique to each and are modifiable.

• **vCenter Chargeback Manager data collector** – Connects to vCenter Servers to pull vCenter information. Add connections to all vCenter Servers attached to the vCloud instance. VMware vSphere® vApp™ virtual machines are not displayed in the vCloud hierarchies until their respective vCenter Servers are registered with vCenter Chargeback Manager.

• **vCloud Director data collector –** Connects to the vCloud Director database and monitors all vCenter Charge-back Manager–related events. The vCloud Director data collector populates the vCenter Chargeback Manager database with vCloud hierarchies, vCloud entities and allocation unit information.

• **vShield Manager data collector –** Connects to vCloud-associated vShield Managers to collect statistics for networks included in vCloud hierarchies.
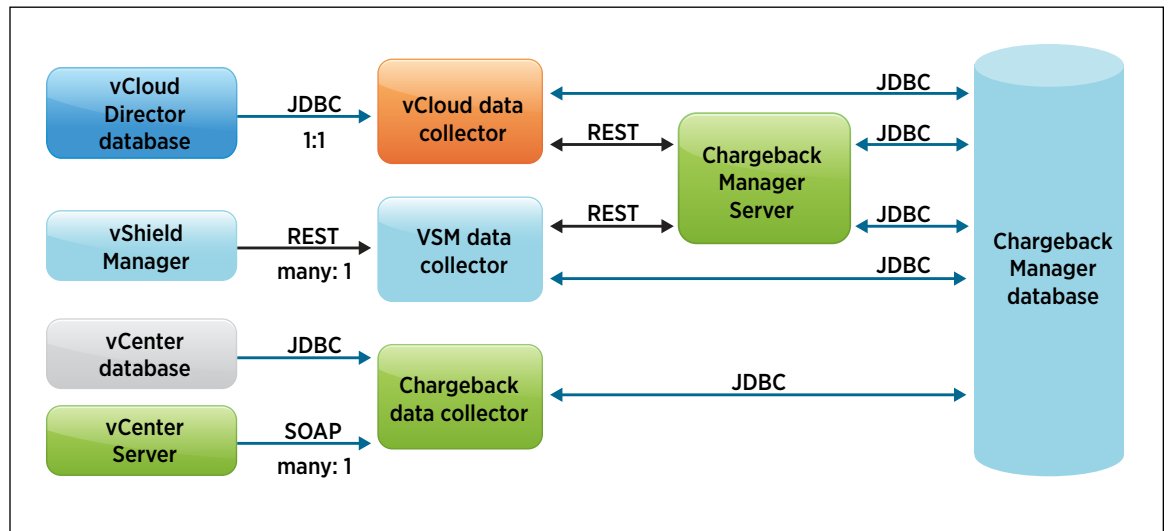

Figure 3. VMware vCenter Chargeback Manager Data Collectors

Install additional vCloud and vShield Manager data collectors on separate servers for increased availability. Data collector instances update their heartbeat every 480 seconds. If instance 1 fails updating its heartbeat, instance 2 takes over event processing after 1,200 seconds (active/passive). The values are not user modifiable.

By default, the vCloud Director data collector processes chargeable events in the vCloud Director database every five minutes. This can be reduced to thirty seconds, or increased, depending on the frequency of operations in vCloud Director. Chargeable events that fail to get processed are retained in a temporary store for up to ten days (default setting) and are reprocessed when the system is available again.

A vCenter Chargeback Manager environment can have multiple vCloud Director data collectors, but it can connect to only one vCloud Director database. Without vCloud Director, vCenter Chargeback Manager cannot connect to vShield Manager. There is a dependency between the vCloud Director data collector and the vShield Manager data collector. The vCloud Director data collector populates the network IDs and corresponding MOREF IDs, which are then consumed by the vShield Manager data collector.

The vShield Manager data collector carries the external traffic information for private routed organization networks, routed vApp networks, and fenced vApp networks. If a routed or fenced vApp network is connected to a private routed organization network, the external traffic information of the corresponding virtual machine is recorded at the vApp network level and the organization network level.

vShield Managers are automatically discovered by the vCloud Director data collector. After installation, make sure to set the appropriate username and password for all vShield Managers in the vCenter Chargeback Manager Web interface. If the password is not set properly, no external network statistics will be gathered.

On the vCloud Director system settings page, there is a user-configurable field that defines the number of days to keep vCenter Chargeback Manager event history within the vCloud Director database. By default, this is set to 365 days. After that, there is a daily job that runs in the vCloud Director database once every 24 hours, cleaning up jobs older than 365 days.

NOTE: To avoid errors in event processing and data collection, ensure that all vCloud components—including vSphere environment, vCloud Director, vShield Manager, and vCenter Chargeback Manager—are pointed to the same network time source.

vCenter Chargeback Manager Web Interface

Access to the vCenter Chargeback Manager Web interface requires a supported browser and Adobe Flash Player. vCenter Chargeback Manager provides a utility to generate self-signed SSL certificates.

vCenter Chargeback Manager API

The vCenter Chargeback Manager API is based on representational state transfer (REST) and provides a programming interface for vCenter Chargeback Manager functionality. This includes hierarchy management, cost configuration, and cost reporting. All actions in the Web interface can be performed through the vCenter Chargeback Manager REST API. For more on the API, refer to the *vCenter Chargeback Manager Programming Guide.*

vCenter Chargeback Manager APIs are divided into the following categories:

• Administration

• Cost management

• Hierarchy management

• Report management

• User management

• Event management

• Search

The vCenter Chargeback Manager SDK for Java provides packages containing classes and methods that encapsulate the interfaces, objects and operations supported by the vCenter Chargeback Manager API. Java developers can use the SDK to quickly build applications that integrate with the vCenter Chargeback Manager platform. The SDK uses the JAXB framework to create classes for resources defined in the vCenter Chargeback Manager API XML schemas.

Data Flow

vCenter Chargeback Manager gathers data from various sources through data collectors. The flow of data for a vCloud Director with vCenter Chargeback Manager deployment is depicted in Figure 4:
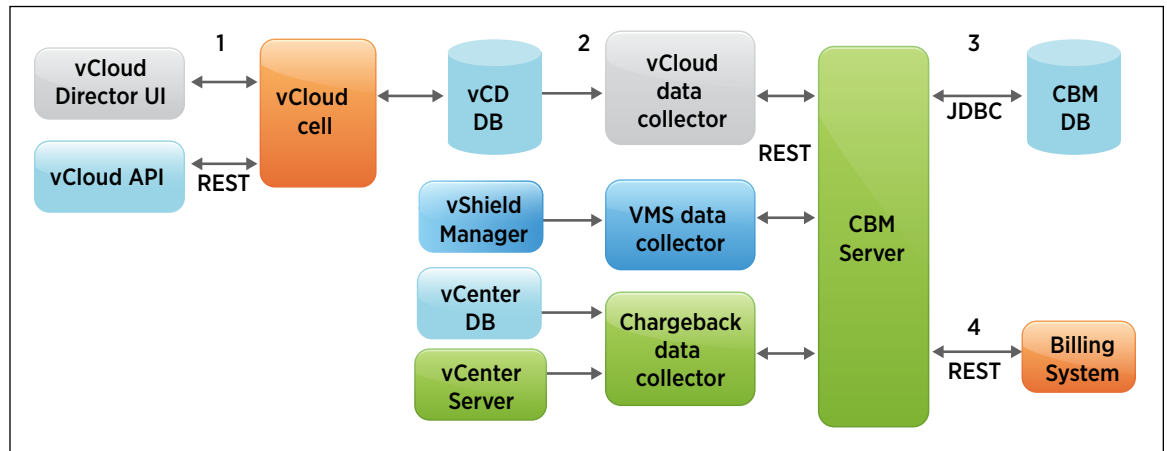

Figure 4. VMware vCenter Chargeback Manager Data Flow

1. vCloud entities are created within vCloud Director through the vCloud Director API or vCloud Director Web console. These entities persist in the vCloud Director database.

2. The vCloud Director data collector connects to the vCloud Director database to process chargeback-specific events. External network traffic counters are pulled from vShield Manager by the VSM data collector.

3. The vCloud Director and vShield Manager data collectors make vCenter Chargeback Manager API calls to perform chargeback-related functions. If changes must be made to data collector settings, the settings are updated directly in the vCenter Chargeback Manager database.

4. Optionally, the vCenter Chargeback Manager REST APIs can be leveraged to pull XML reports from vCenter Chargeback Manager. The XML reports are parsed and passed to the external billing system.

Hierarchy Management

A chargeback hierarchy is automatically created in vCenter Chargeback Manager when an organization is created in vCloud Director. Each imported organization appears as a vCenter Chargeback Manager hierarchy and includes all the organization virtual datacenters (vDCs), the media and template files, vApps, virtual machines and networks.

All organization hierarchies have four folders: *Allocation Pool, Networks, Pay As You Go* and *Reservation Pool*. Organization vDCs are assigned to folders based on the allocation model configured. The *Networks* folder consists of all the networks defined in the organization.

Each organization vDC has two folders: *Media and Template Files* and *vApps*. The *Media and Template Files* folder consists of media files and template files associated with the organization vDC. The *vApp* folder includes all the vApps created in the organization vDC. Each vApp consists of the corresponding virtual machines and a *Network* folder containing the organization networks used by the vApp.

By default, the polling interval between vCloud Director and vCenter Chargeback Manager is five minutes. This is a user-configurable setting that cannot go below thirty seconds. There is no option to refresh or resynchronize with vCloud Director.

Backdate functionality is not currently available for vCloud hierarchies; it can be applied against only vCenter hierarchies.

Custom attributes can be defined against any object within the hierarchy. By default, the system creates an attribute called **vCloudEntityID**, which is an identifier that provides a unique mapping to the corresponding vCloud Director entity. This system-defined attribute indicates the object type and ID as stored in the vCloud Director database (e.g., vCloudOrgEntity-123456789, vCloudvDCEntity-123456789, vCloudVMEntity-123456789).

If a vApp, network, or catalog file is deleted using vCloud Director, it is automatically removed from vCenter Chargeback Manager. If an organization or organization vDC is deleted using vCloud Director, it remains in vCenter Chargeback Manager with "DELETED_" pre-pended and a time stamp post-pended to the name. Cost data associated with that organization/chargeback hierarchy is not automatically deleted. These hierarchies persist until deleted from the vCenter Chargeback Manager UI.

NOTE: If an object or hierarchy is deleted using vCenter Chargeback Manager but still exists in vCloud Director, this is an irreversible operation. There is no method for selectively resynchronizing the hierarchy structure between the two products. vCloud hierarchies deleted from vCenter Chargeback Manager are not recreated by the vCloud Director data collector. Exercise caution when deleting hierarchy objects within vCenter Chargeback Manager.

Allocation Units

vCenter Chargeback Manager tracks resource allocations for all vCloud entities in each hierarchy. The vCloud Director data collector sets allocation unit values in vCenter Chargeback Manager. When the allocations change in vCloud Director, the allocation units are updated accordingly.

NOTE: For vCloud entities such as vDCs and vApps, vCenter Chargeback Manager solely tracks allocation. Usage or reservation data from vCenter Server is not correlated. vCenter Chargeback Manager gets usage and reservation data for the virtual machines pulled from vCenter Server.

Allocation Pool vDCs have allocation units assigned at the organization vDC level. Allocation unit values for CPU and memory are based on the overage flags configured. Modify the **VMware vCloud Director apply overage charge on Allocation Pool vDC** attribute on the vCloud Director data collector to enable or disable overage charging.

• If set to **false** (default), allocation unit = configured limit in vCloud Director.

• If set to **true**, allocation unit = configured limit in vCloud Director* percentage of resources guaranteed. This enables overage charging.

For example:

vCloud Director memory allocation = 10GB, guarantee = 50 percent
global overage flag = true
allocation unit: *10GB* 50 percent = 5GB*

It is possible to override the global setting by assigning the **EntityLevelOverageFlag** attribute on an individual entity. Overage flags are applicable only to newly created *Allocation Pool* vDCs. The allocation units of existing *Allocation Pool* vDCs are not changed.

Reservation Pool vDCs have allocation units assigned at the organization vDC level, with the allocation unit equal to the configured limit in vCloud Director. For this allocation model, the CPU and memory reservations are fully reserved (set to the limit) and the customer should be billed accordingly.

Pay As You Go vDCs have allocation units assigned at the virtual machine level. Parent entities do not have allocation units assigned. vCPU count, total memory and total storage metrics are tracked. If virtual machine details do not appear, ensure that a connection to the vCenter Server hosting the cloud workloads has been established.

Storage allocation units for vCloud entities are set as thick, regardless of provisioning. If the billing policy uses the usage attribute for storage, it is possible to charge for thin-provisioned disks as thick-provisioned disks.

To view allocation units, go to **Manage Hierarchy**, select the hierarchy, right-click the object and select **Set allocation units**. Click **Show** to view historical allocation units.

NOTE: Do not set any allocation units on vCloud objects, because this is done automatically by the vCloud Director data collector. If allocation units are modified in the vCenter Chargeback Manager Web interface, they persist until overridden by a vCloud Director chargeback event.

The allocation units tracked for vCloud objects are listed in Table 1.

OBJECT	PAY AS YOU GO	ALLOCATION POOL	RESERVATION POOL
Organization Virtual Datacenter (vDC)	None	CPU Memory Storage	CPU Memory Storage
vApp	None	None	None
Virtual Machine	vCPU Memory Storage	vCPU Memory Storage	vCPU Memory Storage
Template	Storage	Storage	Storage
Media File	Storage	Storage	Storage
Network	DHCP NAT Firewall Enabled IPSec VPN Tunnel Count Count of Networks	DHCP NAT Firewall Enabled IPSec VPN Tunnel Count Count of Networks	DHCP NAT Firewall Enabled IPSec VPN Tunnel Count Count of Networks

Table 1. VMware vCloud Object Allocation Units

External network Rx/Tx is tracked by vShield Manager data collector by polling vShield Manager, not vCenter Server. The data collector gathers information for **External Network Routed Connection for Org and Routed or Fence Deploy of vApp Network**. External network Rx/Tx is collected only by the vShield Manager data collector. Network Rx/Tx is collected by the vCenter Chargeback Manager data collector. Therefore, use external network Rx/Tx rather than network Rx/Tx for vCloud-specific network entities.

The vShield Manager data collector compiles information on external network Rx/Tx and no other counters. Network service counters such as NAT, DHCP, Firewall, and Enabled IPSec VPN Tunnel Count are gathered by the vCloud Director data collector. The network services are charged based on the service being enabled or disabled for a particular network (disabled = 0 or enabled = 1 for this counter). For example, if you set $1/day for DHCP, the charge depends on whether DHCP is enabled or disabled for that deployed network (1 or 0 respectively).

The (NA) metric unit for NAT, DHCP and Firewall resources indicates that the vShield Manager data collector tracks the count of vShield Edges with those specific services enabled.

Count of networks is set in the allocation units on the *Networks* folder. Each change to number of networks is tracked by vCenter Chargeback Manager.

Figure 5. Count of Networks

Allocation Unit Examples

Allocation Pool example

• Organization vDC created using the *Allocation Pool* model
• CPU = 10GHz, 20 percent reserved
• Memory = 20GB, 20 percent reserved
• Storage = 100GB, thin provisioned
• Global overage flag = false
• **Allocation units:** CPU = 10.0GHz, Memory = 20.0GB, Storage = 100.0GB

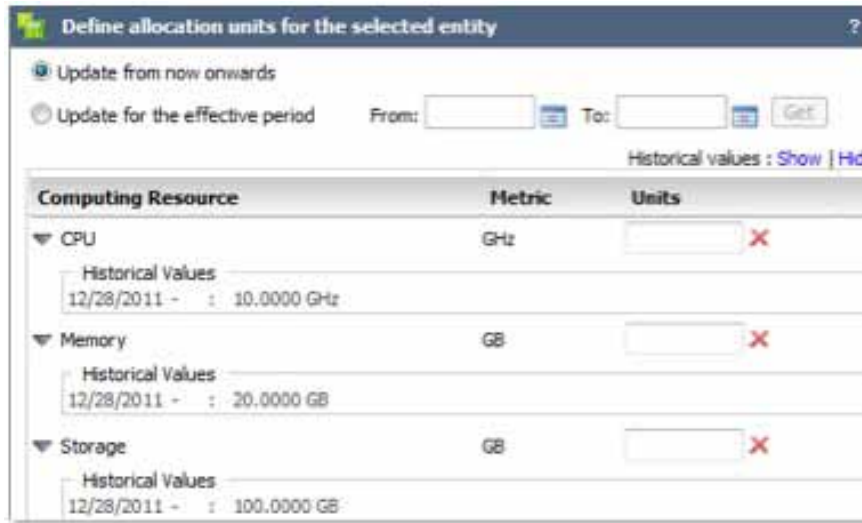**Figure 6.** VMware vCloud Director Allocation Pool vDC Configuration

Figure 7. VMware vCenter Chargeback Manager Allocation Units

Reservation Pool example

• Organization vDC created using the *Reservation Pool* model
• CPU = 10GHz, Memory = 20GB, Storage = 100GB
• **Allocation units:** CPU = 10.0GHz, Memory = 20.0GB, Storage = 100.0GB

Pay As You Go example

• Organization vDC created using *Pay As You Go* model
• vApp deployed in PAYG vDC
• vCPU count = 2, Memory = 4GB, Storage = 40GB
• **Allocation units:** vCPU = 2.0, Memory = 4.0GB, Storage = 40.0GB

Although the *Allocation Pool* and *Reservation Pool* examples differ as to the percentage of guaranteed resources, the two vDCs are sized identically to the end user and vCenter Chargeback Manager. Without overage enabled, the allocation units for the two vDCs are the same.

Although actual CPU GHz allocation is not provided for PAYG entities, it is possible to calculate this value by multiplying the vCPU count by the vCPU speed set on the PAYG organization vDC. For instance, if the vCPU speed is set to 1vCPU = 1GHz, the vCPU count always equates to the CPU allocation (vCPU Count value = CPU GHz) for each virtual machine.

After vCenter Chargeback Manager has allocation units populated for vCloud entities, cost calculations can be performed through the use of cost models, billing policies and fixed costs.

Cost Models

Cost models are used to associate base rates, billing policies and fixed costs with chargeable entities. vCenter Chargeback Manager comes with the following default cost models for vCloud Director entities. These vCD-specific cost models are mapped to the appropriate billing policy and have no base rates defined.

• vCloud Director actual usage cost model

• vCloud Director *Allocation Pool* cost model

• vCloud Director *Networks* cost model

• vCloud Director overage *Allocation Pool* cost model

• vCloud Director *Pay As You Go – fixed-based–charging* cost model

• vCloud Director *Pay As You Go – resource–based–charging* cost model

• vCloud Director *Reservation Pool* cost model

Use the default vCloud Director cost models or define new, custom cost models. Do not use the default vCenter Chargeback Manager cost model, which has preexisting base rates defined.

Use the *Pay As You Go – fixed-based–charging cost* model if you intend to charge a flat, fixed fee per virtual machine; use the *Pay As You Go – resource-based–charging* cost model if you intend to charge based on the amount of vCPU, memory and storage allocated to the vApp.

Consider the following options for applying costs to vCloud entities:

• Define standard units of consumption (small, medium, large, x-large). Create cost models for each allocation type. Define fixed costs for each unit of consumption and apply them to the appropriate vCloud vDC entities.

• Create a cost model for each allocation type and set base rates. Apply the cost model to the vCloud entity regardless of allocation size. This assumes that the wanted charge scales linearly with changes in allocation units. For example, a 2GHz, 4GB virtual machine is double the cost of a 1GHz, 2GB virtual machine.

• Determine pricing for range of offerings and create virtual machine matrices.

Each cost model contains a tab for **Other Costs**, which include definable fixed costs for guest operating systems and vServices such as VMware vSphere® High Availability (VMware HA), VMware vSphere® Fault Tolerance (VMware FT) and virtual machine creation and deletion costs.

Billing Policies

Billing policy expressions define how vCenter Chargeback Manager associates a cost to a particular metered resource. The attributes available for the resource depend on the resource type. For example, memory has the following assignable attributes:

• Allocation – Custom allocation unit value set in vCenter Chargeback Manager

• Size – Configured size of the resource

• Usage – Usage of the resource

• Reservation – Reservation set for the resource

Figure 6 depicts a graph of the attributes for memory over time. Typically, only usage shows variance unless the user modifies the size, allocation or reservation of the resource.
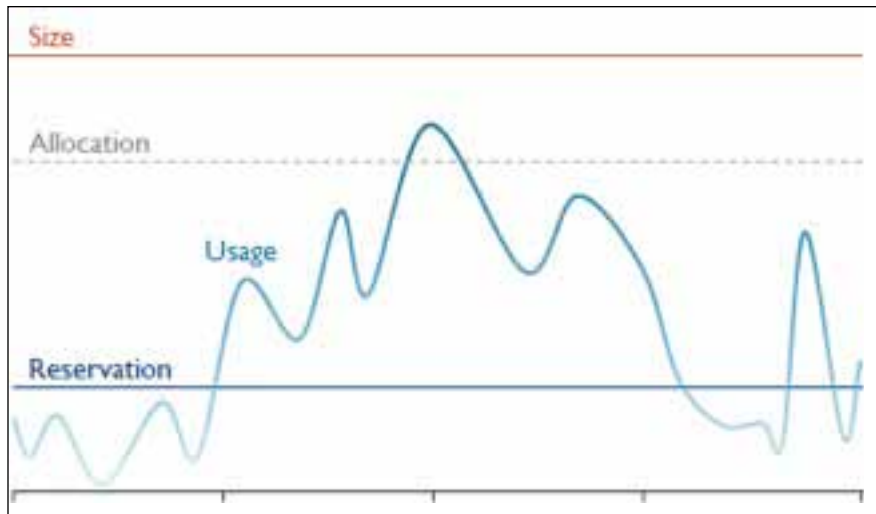
Figure 8. Memory Attributes Example

Therefore, the billing policy indicates to vCenter Chargeback Manager which attribute to use for each metered resource when calculating costs for report generation. With vCloud entities, the allocation unit value is set by the vCloud Director data collector and maps to the limit specified in vCloud Director.

NOTE: Fixed costs are not included by default in any of the above billing policies, with the exception of Pay As You Go – *fixed charging. Inclusion of fixed costs can be enabled for any of the above policies by selecting* **Add/Include Fixed Cost** *in the* **Edit Billing Policy** *wizard.*

Figure 9. Including Fixed Costs in Billing Policy

You can apply 95th-percentile billing to **external network transfer** rate and **external network receive** rate by adding the resource and selecting **Burstable Utilization** as the attribute. vCenter Chargeback Manager performs the calculation on daily data recorded from vShield Manager.

vCenter Chargeback Manager comes with the following default vCloud Director billing policies:

• vCloud Director billing policy – actual usage
• vCloud Director billing policy – *Allocation Pool*
• vCloud Director billing policy – *Networks*
• vCloud Director billing policy – Overage *Allocation Pool*
• vCloud Director billing policy – *Pay As You Go* fixed-based charging
• vCloud Director billing policy – *Pay As You Go* resource-based charging
• vCloud Director billing policy – *Reservation Pool*

Other default billing policies are specific to vCenter Server only (e.g., fixed cost and CPU reservation). Use the default vCloud Director billing policies or define new billing policies.

Table 2 presents the expressions used to construct the default vCloud billing policies.

BILLING POLICY	RESOURCE	EXPRESSION
Actual Usage Pool	Count of networks Enabled IPsec VPN tunnel count NAT service DHCP service Firewall service All other resources	Allocation Allocation Allocation Allocation Allocation Usage
Allocation Pool	External network transfer External network receive All other resources	Usage Usage Allocation
Networks	External network transfer External network receive All other resources	Usage Usage Allocation
Overage Allocation Pool	CPU Memory External network transfer External network receive All other resources	Usage Usage Usage Usage Allocation
Pay As You Go Fixed-Based	Fixed cost External network transfer External network receive All other resources	Include Usage Usage Allocation

Pay As You Go
Resource-Based
	vCPU
	
	Memory
	
	External network transfer
	External network receive
	All other resources
		If (vmpoweron){
		allocation
		}
		if(vmpoweron){
		allocation
		}
		usage
		usage
		allocation

Reservation Pool	External network transfer External network receive All other resources	Usage Usage Allocation

Table 2. VMware vCloud Billing Policy Expressions

Base Rates

Base rates are those charged to metered computing resources over a specific time interval. Work with the appropriate stakeholders to define base rates and fixed costs. In the absence of concrete costs, use approximate values to provide an estimation.

vCenter Chargeback Manager includes a built-in base rate calculator to help compute base rates for CPU, memory and storage. Refer to the *vCenter Chargeback Manager User's Guide* for detailed instructions.

Fixed Costs

Fixed costs are costs defined for any resources not directly metered by vCenter Chargeback Manager. For example, a provider might want to inject costs for datacenter space, power, cooling, one-time setup fee, and physical load balancers into the customer's cost report.

vCenter Chargeback Manager can consider virtual machine state when applying fixed costs to entities containing virtual machines. By default, fixed costs are prorated. It is possible to disable proration if wanted.

After defining fixed costs, apply the fixed costs through the **Configure Cost** tab.

VM Instance

VM Instance enables the creation of a matrix of fixed costs that apply to a hard bundle of vCPU (count) and memory (MB). VM Instance matrices are linked with a cost model and consist of the hierarchy selection criteria, a fixed-cost table and a default fixed cost. Selection criteria can be based on name-pattern matching or custom-attribute matching. VM Instance uses a stepping function, where the virtual machine charge steps up to the next instance size. Costs are applied only for the duration when a virtual machine is powered on and is not prorated. VM Instance costing is specific to *Pay As You Go* vDCs.

Figure 10. VM Instance Matrix

Multiple cost matrices can be created for a cost model and ordered by selection criteria priority. In this case, the criteria must be unique for each matrix.

See the "Configuring a Pricing Matrix for Virtual Machines" section in the *vCenter Chargeback Manager User's Guide* for additional details.

vApp Lifecycle

Pay As You Go service offerings monitor the consumption of vSphere resources during the lifecycle of a vApp. When vApps are instantiated or composed, vCloud Director instructs vCenter Server to begin a clone or create operation. Storage resources are consumed during this process and are used until the vApp is deleted. Table 3 illustrates how vApp or virtual machine operations correlate to the usage of CPU, memory, network and storage resources.

✓

vAPP UI	VM UI	VCLOUD DIRECTOR API	CPU	MEMORY	NETWORK	STORAGE
Add/New		Instantiate/Compose				✓
Start		Deploy			✓	✓
	Power On	Power On	✓	✓	✓	✓
Reset	Reset	Reset	✓	✓	✓	✓
Suspend		Suspend (vApp)			✓	✓
	Suspend	Suspend (virtual machine)			✓	✓
		Shut Down	✓	✓	✓	✓
		Reboot	✓	✓	✓	✓
Stop	Power Off	Power Off			✓	✓
		Undeploy				✓
Delete	Delete	Delete				✓

Table 3. VMware vSphere vApp Resource Usage Lifecycle

Configure Costs

Costs can be individually configured on vDCs, vApps, virtual machines, media, template files and networks within an organization. Fixed costs and rate factors can be set for each computing resource for a selected cost model. This enables differentiation of costing between hierarchies while using the same cost model. For example, you can define a fixed cost for the operating system at the virtual machine level and a fixed cost for network maintenance at the network level.

Billing can be enabled or disabled at any level within the hierarchy. vCenter Chargeback Manager does not account for an entity on which billing is disabled when a report is generated on any of its parent levels. The cost configuration on an entity can vary for different time periods. vCenter Chargeback Manager can apply a specific cost configuration that is applicable for a certain time interval.

Report Generation

Automatic report schedulers can be used to generate reports on demand for hierarchies and entities that match the specified criteria. This is especially useful for the onboarding of new organizations into vCloud environments. See the "Managing Automatic Report Scheduler" section in the *vCenter Chargeback Manager User's Guide* for additional details.

During report generation, deselect resources from computation resources, report summary, and details that are not used for cost calculation. This improves report generation time and produces a cleaner report. Usage processing is ignored if the cost model contains no defined base rates.

Figure 11. Pay As You Go–Resource Based

Figure 12. Allocation Pool and Reservation Pool

To generate a single report against an organization that uses multiple cost models, use **Ctrl-Shift** to multiselect the entities to be included in the report. In the **Create Report** wizard, select **Use different cost models for entities** and choose the appropriate cost models in the drop-down menus. In Figure 13, five different vCloud entities are selected and mapped to the appropriate cost model for report generation.
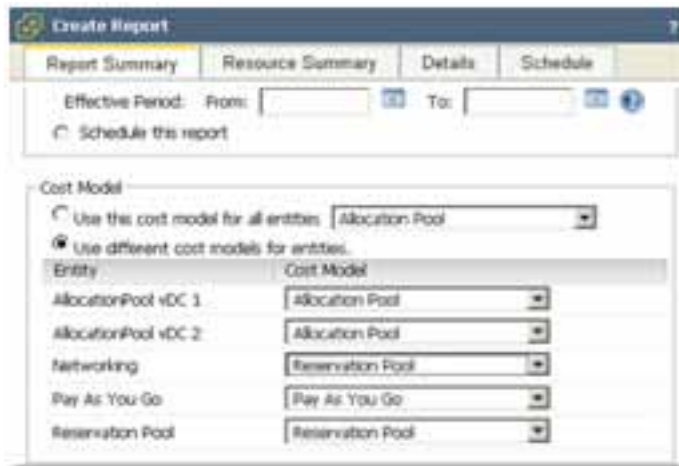
Figure 13. Multiple Cost Models in a Report

Dashboard functionality is currently limited to one cost model and might not yield accurate results for organizations with multiple vDC types and cost models.

Cost Calculation

This example consists of an organization vDC (CPU = 10GHz, Memory = 20GB, Storage = 100GB) containing a vApp with two virtual machines (vCPU = 1, Memory = 4GB, Storage = 50GB). VM2 is powered off at 10:40 a.m. and a second vCPU is added. VM2 is subsequently powered on at 11:30 a.m.

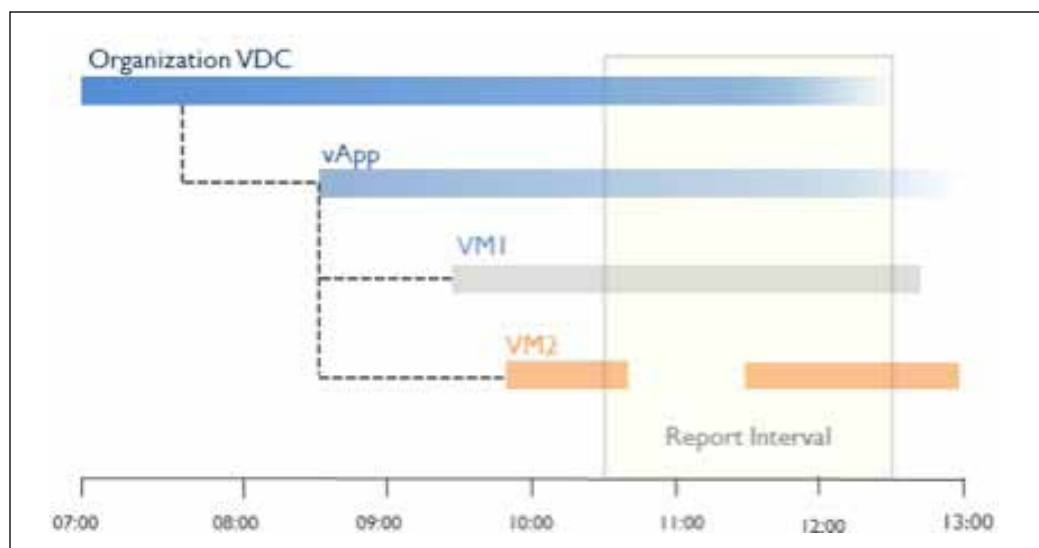The report interval is two hours, from 10:30 a.m. to 12:30 p.m.

Figure 14. VMware vCloud Entity State Timeline

Cost calculation components include report interval length, base rates, fixed costs and billing policy chosen.

Calculating Resource Costs

Base-rate calculation includes: *time interval* rate cost* used units* rate factor.*

Performing this calculation on the organization vDC for CPU (allocation), with a base rate of $0.1 USD GHz/hour and no rate factor: *2 hours* $0.02 USD GHz/hour* 10GHz* 1.0 = $0.4 USD.*

Doing the same for memory (allocation) with a base rate of $0.5 USD GB/hour and no rate factor yields the following result: *2 hours* $0.05 USD GB/hour* 20GB* 1.0 = $2 USD.*

If the billing policy is set to charge based on usage instead of allocation, the used units is the usage value for the resource that is obtained from vCenter Server.

At the virtual machine level, the billing policy dictates whether costs are applied for the entire report duration or for only the duration when a virtual machine is powered on.

Calculating Fixed Costs

Fixed-cost calculation considers: *time interval* fixed cost/duration of the resource.*

Applying a weekly prorated fixed cost of $125 USD to the organization vDC and generating the report will result in the following: *2 hours* $125 USD/168 hours in a week = $1.49 USD.*

Calculating VM Instance Costs

The second virtual machine is powered off during the middle of the reporting interval. The time interval for this virtual machine is approximately 70 minutes. If using VM Instance to apply costs, the fixed costs are not prorated and are applied only for the duration when a virtual machine is powered on. The change in virtual machine size will trigger a separate line item in the report, reflecting the configuration change and the new fixed cost applied. The two totals are added together for the final cost.

User Management

vCenter Chargeback Manager does not extract, consume or sync with vCloud Director user logins, roles or permissions. After initial installation of vCenter Chargeback Manager, an administrator user is created in it, and all the vCloud Director objects belong to this user. Only the administrator/supervisor user can grant permissions. There are no per-organization users, and no vCloud Director user information is passed on to vCenter Chargeback Manager.

Example use case: Grant vCloud Director organization administrators the ability to view and run cost reports for their organizations.

Creating users

• Create local users in vCenter Chargeback Manager that map to those created in vCloud Director.

• Import LDAP users into vCenter Chargeback Manager that map to those created in vCloud Director.
  vCenter Chargeback Manager supports Microsoft Active Directory but does not support OpenLDAP.

• Import LDAP groups into vCenter Chargeback Manager that map to those created in vCloud Director.

Assigning roles to users

• Assigning a role on vCenter Chargeback Manager, other than the supervisor user role, defines only the actions that the user can perform in the application. This does not implicitly give access to the resources created in the application. To access a resource, the user either must have created it or explicitly be assigned a role for it.

Assigning roles to users (e.g., organization administrator) for a resource (e.g., organization)

• The hierarchy manager role is assigned to vCenter Server, so the user can view the vCenter Server. To make an existing hierarchy visible to the user, assign the hierarchy manager role to the hierarchy.

• Assigning the hierarchy manager role in vCenter Chargeback Manager enables a user to create hierarchies. Assigning a role (other than the supervisor user role) defines the actions that the user can perform on the application but does not provide access to the existing resources. To access the existing resources, apply roles to each resource explicitly.

Availability

What happens if access is lost to components in the vCloud environment?

vCenter Server scenarios

• If a vCloud-associated vCenter Server is removed from vCloud Director (through the UI and not some failure) but is present in vCenter Chargeback Manager, the vCenter Server is not used by vCloud Director data collector anymore in vCenter Chargeback Manager. If there are any unprocessed events from the removed vCenter Server, they are not processed.

• If a vCloud-associated vCenter Server experiences a failure and becomes inaccessible, corresponding virtual machines are not added in vCenter Chargeback Manager until the vCenter Server has been recovered. Keep track of the configurable property **Unprocessed VMware vCloud Director chargeback event lifetime (in seconds).** If vCenter Server is recovered after the above-specified value, some events are flushed out before they are processed. Virtual machines from the inaccessible vCenter Server might not be added to vCenter Chargeback Manager.

• If the vCloud-associated vCenter Servers are not added, or if those vCenter Servers go down, this can cause issues with *Pay As You Go* allocation model reporting. The absence of virtual machine data results in inaccurate reports.

vCloud Director scenarios

• If the vCloud Director database goes down, the vCloud data collector installed with vCenter Chargeback Manager tries to reconnect. The retry interval/count (stops retrying after a certain number of attempts) is configurable.

• If an error occurs while the vCloud Director data collector is reading the events from the vCloud Director database, the current job cycle fails immediately and the vCloud Director data collector tries to read the events in the next scheduled cycle.

vCenter Chargeback Manager scenarios

• If the vCenter Chargeback Manager server goes down while the vCloud Director data collector is processing the events, all the events in the current cycle are reprocessed in the next cycle.

• If the vCenter Chargeback Manager database goes down while the vCloud Director data collector is processing the events, the whole cycle is repeated again.

Integration with External Systems

Integration between vCenter Chargeback Manager and external systems requires the use of the vCenter Chargeback Manager API. Data is exported in XML format through an API call and then formatted to meet the input requirements of the billing system. Table 4 lists the primary task flows when integrating vCenter Chargeback Manager with a billing system. Task flows that require integration effort are highlighted in grey.

TASK NAME	DESCRIPTION	RESULT	APIs USED
Initial Setup	• Configure the vCenter Chargeback Manager server and the vCloud Director connection information inside the internal billing system.	All the components are able to talk to each other.	• None
Create a New User Account	• The customer submits a request for a new account from the self-service portal. • The self-service portal creates a vCloud organization and user inside the organization. • The self-service portal provisions the infrastructure as a service (IaaS) inside vCloud Director. • The self-service portal passes a request to the billing system, which creates a billing account. • The billing system updates a mapping of the billing account to the organization.	The customer can log in to the vCloud account and use the provisioned service.	• vCloud administrator APIs • Billing system APIs
Create a New Hierarchy in vCenter Chargeback Manager	• The vCloud Director data collector performs this task automatically.	The vCloud organization and the services provisioned are reflected inside vCenter Chargeback Manager.	• N/A
Schedule a Cost Report	• A cost report for the newly created hierarchy is scheduled with a frequency that matches the customer's billing cycle.	A report schedule is created inside vCenter Chargeback Manager.	• Automated vCenter Chargeback Manager report management APIs
Export Report in XML	• The billing system searches the vCenter Chargeback Manager report archive and exports the appropriate reports in XML format.	Cost reports are now available in the billing system.	• vCenter Chargeback Manager search API • vCenter Chargeback Manager report management API
Generate Invoice	• The billing system generates the invoice for each customer on the billing anniversary.	Customers receive invoices.	• N/A
Payment Processing	• The billing system handles payments against invoices.	Payments are processed.	• N/A

Table 4. Integration Task Flows

Summary

Metering is a core component of a cloud service offering. Providers can govern and shape end-user behavior through pricing schemes for infrastructure resources consumed. Collected data can be used to plug into advanced analytics engines such as ITBM for cost optimization and planning. vCenter Chargeback Manager provides the metering and cost calculation capabilities for vCloud environments.

Key Points

• vCenter Chargeback Manager servers can be clustered together for higher availability.

• Multiple data collectors can be installed for active/passive redundancy.

• One vCenter Chargeback Manager instance can manage one vCloud Director database.

• Define standard units of consumption and allocation models.

• Simplify service offerings where possible.

• Determine pricing through financial analysis.

• Map pricing scheme through vCenter Chargeback Manager/vCloud cost models.

• Metering enables differentiation of service offerings through cost models.

Authors

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References

ITEM	URL
VMware vCenter Chargeback Manager	http://www.vmware.com/products/vcenter-chargeback/
VMware vCenter Chargeback Manager documentation	http://www.vmware.com/support/pubs/vcbm_pubs.html
VMware vCenter Chargeback Manager API	http://communities.vmware.com/community/developer/forums/chargeback
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VMware vCenter Chargeback Manager connector for ITBM suite	https://www.vmware.com/support/vcbm/doc/cbm_itbm_connector.pdf
VMware vCenter Chargeback Manager communities	http://communities.vmware.com/community/vmtn/mgmt/chargeback
VMware vCloud Director API	http://vmware.com/go/vcloudapi
VMware vCloud Director	http://www.vmware.com/products/vcloud-director/

Table 5. VMware vCenter Chargeback Manager References

Appendix A: Configuration Maximums

CONSTRAINT	LIMIT
VMware vCenter Servers in a vCenter Chargeback Manager system	10
VMware vCenter Servers per data collector	5
Virtual machines per data collector	15,000
Virtual machines/entities in a vCenter Chargeback Manager system	35,000
Virtual machines/entities per hierarchy	1,000
Hierarchies in a vCenter Chargeback Manager system	5,000
Concurrent reports (approximately 3,000 pages) per vCenter Chargeback Manager system	5
Concurrent reports (approximately 10 pages) per vCenter Chargeback Manager system	150

Table 6. VMware vCenter Chargeback Manager Configuration Maximums

Appendix B: Port Requirements

DESCRIPTION	PORT(S)	PROTOCOL
VMware vCenter Chargeback Manager Web interface to VMware vCenter Chargeback Manager server	8,080	TCP
VMware vCenter Chargeback Manager Web interface to VMware vCenter Chargeback Manager server	443	TCP
VMware vCenter Chargeback Manager server (load balancer) to VMware vCenter Chargeback Manager server	8,009	TCP
VMware vCenter Chargeback Manager server to VMware vCenter Chargeback Manager database (JDBC)	Varies*	TCP
Data collector (all) to VMware vCenter Chargeback Manager database (JDBC)	Varies*	UDP
VMware vCenter Chargeback Manager data collector to VMware vCenter Server database (JDBC)	Varies*	TCP
VMware vCloud Director data collector to VMware vCloud Director database (JDBC)	1,521	TCP
VMware vCenter Chargeback Manager data collector to VMware vCenter Server	443	TCP
VMware vShield data collector to VMware vShield Manager	443	TCP
VMware vCenter Chargeback Manager server to LDAP server	389	TCP, UDP
VMware vCenter Chargeback Manager server to SMTP server	25	TCP

*Depends on database—Oracle: 1,521 ports; SQL server: 1,433 ports.

Table 7. VMware vCenter Chargeback Manager Port Requirements