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About the Multi-Machine Guide

The vCloud Automation Center Multi-Machine Guide describes new features and enhancements to existing functionality for vCloud Automation Center™ (vCAC). It covers functionality that was introduced in releases 5.1, 5.2, 5.2.1, and 5.2.2.
Chapter 1 Multiple Machines as a Single Service

This section introduces and compares the multi-machine services and the vCloud Director integration available with the vCloud Automation Center.

About Multi-Machine Services and vCloud Director Integration

vCAC provides two ways to provision one service composed of multiple machines: multi-machine services and support for vCloud Director vApps. Each method has different benefits and capabilities.

Table 1 provides a comparison of the two features.

<table>
<thead>
<tr>
<th>vCAC Multi-Machine Service</th>
<th>vCloud Director vApp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create a multi-machine blueprint that references individual machine blueprints in vCAC.</td>
<td>Leverage existing vApp templates created in vCloud Director.</td>
</tr>
<tr>
<td>Provision machines of any type (virtual, physical, or cloud) as part of a service.</td>
<td>Provision virtual machines on vSphere resources as part of a vApp.</td>
</tr>
<tr>
<td>Manage component machines of a multi-machine service through vCAC.</td>
<td>Manage vApp virtual machines through vCAC.</td>
</tr>
<tr>
<td>Access component machines through the Remote Desktop Protocol (RDP), Virtual Network Computing (VNC), and other remote access utilities.</td>
<td>Access vApp virtual machines through the VMware Remote Console (VMRC) browser plugin.</td>
</tr>
</tbody>
</table>
Chapter 2 Multi-Machine Services

This section describes the multi-machine service feature.

**Note:** Multi-machine services are sometimes referred to as application services or “AppServices” in some logs and error messages.

About Multi-Machine Services

A multi-machine service is a compound service composed of multiple machines that can be provisioned and managed through vCAC as a single entity.

For example, in a typical web application deployment, you may have one or more database servers, one or more application servers, and any number of web servers. In vCAC, in addition to creating blueprints for each of the server types, you can also create a multi-machine blueprint that includes all the machines that are needed for the entire application deployment. Users can then provision the multi-machine service including all its component machines in a single request, and perform operations such as rebooting all the machines in a multi-machine service with a single action.

The component machines in a multi-machine service may be virtual, physical, or cloud, or any combination of the three.

Multi-machine services in vCAC are similar to machines in several ways:

- They are defined by a blueprint.
- They may have a lease duration associated with them.
- They are listed on the My Machines, Group Machines, and Enterprise Machines pages, and many machine operations can be performed on multi-machine services as a whole.
- Multi-machine service requests can be made subject to approval.

Despite the similarities, a multi-machine service is in essence a container for its component machines and is not itself a machine. Component machines are treated just like any machine managed by vCAC for reporting and licensing purposes, but the multi-machine service container is not counted as a machine in reports or licensing.

Hypervisor and vCloud Director (vApp) blueprints cannot be added as components of a multi-machine blueprint.

Terminology

Table 2 provides definitions of several terms specific to multi-machine services.
Multi-Machine Service Life Cycle

Multi-machine services follow the same general life cycle as machines, from requesting (with optional approval) and provisioning through managing and decommissioning.

A multi-machine blueprint contains references to blueprints for the component machines. For each component blueprint, it specifies the minimum and maximum number of machines for the multi-machine service. An enterprise administrator or provisioning group manager can optionally specify scripts or workflows to execute during the provisioning process or when powering the multi-machine service on or off.

**Note:** The scripts execute on the vCAC DEM Worker machine, not on the guest operating system of the component machine.

When users request a multi-machine service, they have the ability to configure:

- How many machines based on each component blueprint to provision, within the limits specified in the multi-machine blueprint
• The specifications of the component machines (such as CPU, Memory, and Storage) based on the individual component blueprints

• General settings such as lease duration and custom properties to be applied to machines in the multi-machine service

Before provisioning the multi-machine service, vCAC allocates resources for all of the component machines that are being requested. If the multi-machine service would cause a reservation to become overallocated, its provisioning fails. Once the resources are allocated, the component machines are provisioned and powered on.

Once the multi-machine service is provisioned, the machine owner can perform various machine menu tasks on the multi-machine service as a whole, such as powering the multi-machine service off and on, or destroying the multi-machine service and its component machines.

If the multi-machine blueprint allows for a varying number of machines for any component type, the machine owner can add or remove machines from the multi-machine service after it is provisioned.

The machine owner can also view the components that make up a multi-machine service and manage them individually. Most machine operations are available for component machines, except for changing the owner, changing the lease, or expiring component machines.

**Configuring Multi-Machine Services**

You allow users to provision multi-machine services by creating one or more multi-machine blueprints as an enterprise administrator or provisioning group manager.

**Preparing Reservations for Multi-Machine Services**

You should create reservations for all the resources that may be used in multi-machine services in the same provisioning group.

To ensure that component machines are provisioned on the appropriate resources, use reservation policies to associate specific reservations with each blueprint that is a component of a multi-machine service. For information about reservation policies, see the vCloud Automation Center Operating Guide.

**Creating a Multi-Machine Blueprint**

A multi-machine blueprint is a specific type of blueprint that contains references to component blueprints.

Before you create a multi-machine blueprint, you must first create blueprints for each of the component machines you want to include in the multi-machine service.

**Note:** The component blueprints must be available to the same provisioning group or groups as the multi-machine blueprint.

There are some limitations on what you can edit in multi-machine blueprints and their component blueprints after you create them. For details, see About Managing Multi-Machine Blueprints.

The multi-machine blueprint only includes information that applies to a multi-machine service as a whole. Configuration options such as reservation policy apply only to component machines and are specified in the component blueprints. Multi-machine services do not have an archive period; the service and its component machines are destroyed when they expire.
Create a Multi-Machine Blueprint

To create a multi-machine blueprint:

1. Log in to the vCAC Console as an enterprise administrator or provisioning group manager.

2. Select **Enterprise Administrator > Global Blueprints** or **Provisioning Group Manager > Blueprints**.

3. Click **New Blueprint > Multi-Machine**.

4. On the **Blueprint Information** tab, specify the multi-machine service details as you would for a regular machine.

5. Add component blueprints to the multi-machine service:
   a. On the **Build Information** tab, click **Add Blueprints**.
   b. In the **Add Blueprints** dialog box, select the component blueprints to include in the multi-machine service.

   **Note:** If you are editing a local blueprint, only blueprints in the same provisioning group are available in this list. If you are editing a global blueprint, only global blueprints are available. Hypervisor blueprints and vCloud Director blueprints are not available to add as component blueprints.

   c. Click **OK**.

   The **Component machines** grid is populated on the **Build Information** tab.

6. For each component blueprint:
   a. Specify a display **Name** for the component type. Default is the name of the component blueprint.
   b. Specify a **Minimum** number of machines provisioned from that blueprint to be included in the multi-machine service.

      A machine owner cannot request a multi-machine service with fewer than the minimum number of machines for each component type. Additionally, this is the threshold that determines whether a multi-machine service provisioned from this blueprint is healthy. When the number of machines that are provisioned or powered on for a component type is lower than the minimum, the multi-machine service is considered unhealthy and its state is set to **Off**.

   c. Optionally, specify a **Maximum** number of machines to be provisioned from the blueprint in the multi-machine service. If no maximum is specified, then the multi-machine service cannot have more than the minimum number of machines for this component type.

   d. Optionally, adjust the **Startup Order** and **Shutdown Order** for the machines.

   **Note:** The startup and shutdown order do not apply at provisioning time; they are only used when powering the multi-machine service on or off after the initial provisioning.

   e. Optionally, enter a **Description** of the component blueprint.

7. Optionally, specify a lease duration. The multi-machine service lease (whether there is a specific expiration date or no expiration date) overrides the individual component machine leases.
8. Optionally, specify scripts, custom properties, and security options for this multi-machine blueprint.
9. Click **OK** to save the multi-machine blueprint.

### About Specifying Scripts for Multi-Machine Service Provisioning, Startup, and Shutdown

You can designate scripts or workflows to execute at specific points during the multi-machine service lifecycle.

**Note:** The scripts execute on the vCAC DEM Worker machine, and not on the guest operating system of the component machine.

Table 3 describes the stages of the multi-machine lifecycle when scripts can execute. The Scripting tab of the multi-machine blueprint allows you to specify custom logic to execute at each stage.

**Table 3  Script Execution Stages in the Multi-Machine Lifecycle**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-provisioning</td>
<td>Executes after all necessary approvals are complete but before provisioning any machines.</td>
</tr>
<tr>
<td>Post-provisioning</td>
<td>Executes after all component machines are provisioned and powered on.</td>
</tr>
<tr>
<td>Pre-startup</td>
<td>Executes before powering on the multi-machine service and all its component machines.</td>
</tr>
<tr>
<td>Post-startup</td>
<td>Executes immediately after powering on the multi-machine service and all its component machines. The multi-machine service state is set to On after the post-startup scripts execute.</td>
</tr>
<tr>
<td>Pre-shutdown</td>
<td>Executes immediately before shutting down or powering off the multi-machine service and its component machines.</td>
</tr>
<tr>
<td>Post-shutdown</td>
<td>Executes after shutting down or powering off the multi-machine service and its component machines. The multi-machine service state is set to <strong>Off</strong> after the post-shutdown scripts execute.</td>
</tr>
</tbody>
</table>

The provisioning scripts execute only during the initial provisioning of a multi-machine service. The startup and shutdown scripts execute every time the multi-machine service is powered on or shutdown (see Power Options for Multi-Machine Services), with the exception of the first time the multi-machine service is powered on during provisioning. The pre-provisioning and post-provisioning scripts must include everything that you want to run before and after the initial startup.

You can also run workflows at those same stages of the multi-machine lifecycle. Those workflows must accept an argument named MasterMachine of type VirtualMachine (DynamicOps.ManagementModel.VirtualMachine). The Components property of MasterMachine is a list of AppServiceComponents, each of which represents a component machine of the multi-machine service.
Scripts or workflows must be installed in the Model Manager before you can use them in a multi-machine blueprint. For details about installing files (including scripts) and workflows using the CloudUtil command-line utility, see the *vCloud Automation Center Extensibility Guide*.

**Specify a script to execute**

To specify logic to execute during the multi-machine service life cycle:

1. Create a new multi-machine blueprint or edit an existing blueprint.
2. Navigate to the **Scripting** tab.
3. For each stage of the life cycle where you want to execute custom logic:
   a. Select the name of a script in the Model Manager to execute that script, or select **Workflow** to execute a workflow.
   b. If you selected **Workflow**, enter the name of the workflow in the Model Manager in the **Workflow** box.
4. Click OK.

**About Specifying Custom Properties for Multi-Machine Services**

You can specify custom properties that apply to all component machines within a multi-machine service in the multi-machine blueprint.

Custom properties specified in the multi-machine blueprint override properties specified in the component blueprint. However, runtime properties on the component machine (specified either at request time or by editing the machine after it has been provisioned) override runtime properties at the multi-machine service level. This allows the multi-machine blueprint to apply a consistent behavior across all of its component machines by default, while allowing a user to override the multi-machine service properties for each component type.

The full order of precedence for custom properties on component machines, including those defined at the multi-machine service level, is as follows (any property value specified in a source later in the list overrides values for the same property specified in sources earlier in the list):

1. Build Profile (specified on component blueprint)
2. Component Blueprint
3. Build Profile (specified on multi-machine blueprint)
4. Multi-Machine Blueprint
5. Provisioning Group
6. Compute Resource
7. Reservations
8. Endpoint
9. Runtime (specified on multi-machine service)
10. Runtime (specified on component machine)

**Note:** Custom properties specified in the multi-machine service are applied to all component machines within the service. Additionally, if a property is designated as
Prompt User on a component blueprint, the value specified at request time is applied to all machines of the same component type that are provisioned as part of that request.

Certain properties, such as Hostname, must be unique to each machine. Do not specify the property at the component type level. If vCAC does find the Hostname property at the component type level, it ignores the property.

About Specifying Security Options for Multi-Machine Services

The Security tab for multi-machine blueprints functions in the same way as the same tab for all blueprints. It allows you to control access to the blueprint and specify which menu operations are available to machine owners for multi-machine services provisioned from this blueprint.

The security settings for the multi-machine blueprint override the access controls on the component blueprints. For example, if you have a component blueprint that is restricted to UserA, and you add it as a component of a multi-machine blueprint that is available to Everyone, then all members of the provisioning group can provision the restricted machine as part of a multi-machine service, but only UserA can provision it as a standalone machine.

The multi-machine service menu is similar to the machine menu, although a different set of operations are available by default. Some operations, such as reprovision, are not supported for multi-machine services. Additional operations are available only for multi-machine services, such as the ability to add component machines.

Just as you can add custom properties to the machine menu, you can also add them to the multi-machine service menu. For information about implementing custom menu operations, see the vCloud Automation Center Extensibility Guide.

About Managing Multi-Machine Blueprints

While you can edit existing multi-machine blueprints, there are some special considerations and limitations.

Once a blueprint has been added as a component blueprint of a multi-machine blueprint, you cannot change the provisioning groups associated with the multi-machine blueprint or the component blueprint.

There are additional restrictions to the configuration of the component machines on the Build Information tab if there are existing multi-machine services provisioned using a blueprint:

- You cannot add new component types to the multi-machine service. (The Add Blueprint link is not available.)
- You cannot delete component blueprints from the multi-machine service.
- When editing component types, the Minimum field is read-only.

These restrictions prevent an existing, healthy multi-machine service from reaching an unhealthy state due to changes in the blueprint. If you want to make any of these changes to the component machine configuration in a multi-machine blueprint, either decommission all existing services that use the blueprint, or create a copy of the blueprint and update the configuration in the copy.

If you change the Maximum value for a component type, existing services that have more component machines of that type than the new maximum do not become invalid, although users cannot add any more machines of that component type until the number of machines falls below the maximum.
When you change custom properties on a multi-machine blueprint, the new properties are not only applied to new multi-machine services that are provisioned from this blueprint, but are also inherited by component machines that are added to existing multi-machine services provisioned from this blueprint.

### Requesting a Multi-Machine Service

When you request a new multi-machine service, you can specify configuration options for the component machines as well as the multi-machine service as a whole.

Requests for multi-machine services (and their component machines) may be subject to approval based on the approval policies specified in their respective blueprints.

#### Request a Multi-Machine Service

To request a multi-machine service:

- **Note:** Depending on the blueprint in use, some options or values mentioned in this procedure may not be editable.

1. In the vCAC console, click **Self-Service > Request Machine**.
2. Select a blueprint with **Type** of **Multi-Machine**.
3. Specify the settings that apply to the multi-machine service as a whole:
   a. Select the **Multi-Machine Service** from the grid at the top.
   b. In the **Request Information** tab, specify a value for the **Number of multi-machine services** to provision as part of this request and the **Lease duration in days**.
   c. Optionally, specify a **Description** to use for the multi-machine service.
   d. Optionally, enter a **Reason for request**. This information is passed along to approvers for the multi-machine service and the component machines.
4. Configure the component machines as needed. For each component type that you want to configure:
   a. Select the component from the grid at the top.
      - The **Request Information** tab updates with machine details based on the component blueprint.
   b. Confirm or update the values for **Number of machines**, **Number of CPUs**, **Memory**, and **Storage**.
      - **Note:** For component blueprints that use vSphere, KVM, SCVMM, or Amazon EC2, storage volumes are configured on a separate **Storage** tab.
   c. Optionally, specify a **Description** to use for all machines of the same component type in this multi-machine service.
   d. For cloud component machines only, specify the instance type, whether to use Virtual Private Cloud (VPC), and the location for the Amazon instance. Selecting VPC may require additional configuration. For details, see the *vCloud Automation Center Operating Guide*.
5. Click **OK**.
Note: If you are an enterprise administrator or provisioning group manager, you can also specify custom properties at request time. You can add custom properties to the Multi-Machine Service that apply to all component machines or add properties that apply only to machines of a particular component type.

About Approval and Multi-Machine Services

You can apply an approval policy to a multi-machine blueprint just as you would for any blueprint. Multi-machine service requests use the same approval policies as machine requests. Advanced approval policies are supported for multi-machine service requests. For information about creating approval groups and approval policies, see the vCloud Automation Center Operating Guide.

The individual component machines in a multi-machine service are also subject to approval based on the approval policies and thresholds specified in the component blueprints just like any standalone machine, and may be approved or rejected independent of the multi-machine service.

After the multi-machine service or any component machine has been approved (or if it does not require approval), its state changes to WaitingToBuild. When the multi-machine service and all its component machines are in this state (that is, all required approvals are complete), the multi-machine service is provisioned.

One or more component machine requests may be rejected during the approval process. If any machines are rejected, one of the following occurs:

- If enough machines are approved to meet the minimum machine requirements for each component type, the multi-machine service is provisioned with the component machines that were approved.
- In a standard approval workflow, if the number of machines that are approved for a particular component type is less than the minimum for that type, then the multi-machine service is destroyed.

A message appears under Recent Events similar to the following: “Machine Service-01: Failed to Launch Multi-Machine Service: Not enough components of blueprint "Database Server" are found; Minimum number of machines: 1, number of machines that are found: 0.”

- If advanced approvals are enabled and the approval policy for a multi-machine service includes approval groups after the [MachineProvisioning] step, it is possible for enough components to be rejected after the multi-machine service has been provisioned to cause the multi-machine service to become unhealthy. In this case, the multi-machine service remains provisioned but its state is set to Off.

The following messages appear under Recent Events:

“Machine Service-01: Not all requested components of blueprint "Web Server" are provisioned; Requested number of machines: 4; Provisioned number of machines: 1.”

“Machine Service-01: Not enough components of blueprint "Web Server" are On; Minimum number of machines: 2, number of machines that are On: 1.”

Emails are sent to approvers to notify them of multi-machine service or component machine requests awaiting their approval. For more information about notification emails that are sent for multi-machine services, see About Notification Emails and Multi-Machine Services.
Troubleshooting Multi-Machine Service Requests

Requesting a multi-machine service is a way to provision multiple machines with a single request. Status messages for each individual machine request as well as the overall multi-machine service request are displayed in the Recent Events log.

If an error prevents one or more of the component machines from provisioning, one of the following occurs:

- If enough machines are successfully provisioned to meet the minimum machine requirements for each component type, the multi-machine service is provisioned and turned on. A warning message appears under Recent Events similar to the following: "Machine Service-01: Not all requested components of blueprint "Web Server" are provisioned; Requested number of machines: 4; Provisioned number of machines: 3." After you have resolved the issue that prevented the machine or machines from provisioning, you can add machines to the multi-machine service until it has the number of machines that you originally requested.

- If the minimum number of machines failed to provision successfully for one or more component types, the multi-machine service is provisioned but its state is set to Off. A message appears under Recent Events similar to the following: "Machine Service-01: Failed to Launch Multi-Machine Service: Not enough components of blueprint "Database Server" are found; Minimum number of machines: 1, number of machines that are found: 0." After you have resolved the issue that prevented the machine or machines from provisioning, you can add machines to the multi-machine service until it is healthy.

- If no component machines provision successfully, then the multi-machine service is destroyed. The following message appears under Recent Events: "Multi-Machine Service with no components is invalid." You must resolve any issues that prevented the machines from provisioning and then re-request the entire multi-machine service.

Managing Multi-Machine Services

Once the multi-machine service is provisioned, the machine owner can view its status and perform various machine menu tasks on the multi-machine service as a whole from the My Machines page.

Multi-machine service menu operations include:

- Editing the multi-machine service
- Viewing component machines
- Adding machines to a multi-machine service
- Rebooting or powering the multi-machine service (and its component machines) on and off
- Editing the multi-machine service lease
- Destroying a multi-machine service and its component machines

Reprovisioning is not available at the multi-machine service level, although individual component machines can be reprovisioned.

Note: The Bulk Operations Client is not supported for multi-machine services. If you use the Bulk Operations Client on a server that has multi-machine services, do not select machines of type “Multi-Machine” to perform bulk operations.
Additionally, the Bulk Operations Client does not indicate whether a machine is a component of a multi-machine service. Performing operations on component machines, such as powering off a group of component machines, can lead to the multi-machine service being in an unhealthy state.

About Editing Multi-Machine Services

Machine owners can edit the description of a multi-machine service. Support users can change the owner of a multi-machine service. Enterprise administrators and provisioning group managers can also change the properties of a multi-machine service.

Changing the owner of a multi-machine service updates the owner of all its component machines.

Editing the description or properties of a multi-machine service does not update the description or properties of existing component machines. If you add component machines to the multi-machine service after editing its properties, the newly added machines inherit the current properties on the multi-machine service.

Viewing the Status of Multi-Machine Services

The My Machines page displays multi-machine services in the same grid with standalone machines. By default, the multi-machine services grid displays the name, status, and description of each multi-machine service along with its expiration and destruction dates. Additional columns can be added via the Columns menu.

A multi-machine service is considered to be healthy and has a status of On if at least the minimum number of machines for each component type are powered on. When the number of machines that are powered on for a component type is lower than the minimum, the multi-machine service is considered unhealthy and its state is set to Off. During state data collection, vCAC detects the power state of each component machine, and the status of the multi-machine service is updated as necessary based on the power state of the component machines.

Managing Component Machines

Most machine menu operations are available for component machines in a multi-machine service.

To access the component machines in a multi-machine service, select View Components from the multi-machine service menu. The Component Machines page displays a list of machines similar to the My Machines page, except that it shows only the machines that are components of the multi-machine service.

You can edit component machines just like standalone machines, except that you cannot change the owner of a component machine. To change the owner of a component machine, edit the multi-machine service, which updates the owner for all component machines.

Lease operations (Change Lease, Extend Lease, or Expire) are not available on individual component machines. Leases can be controlled only at the multi-machine service level for all component machines. For more information, see About Managing Leases for Multi-Machine Services

Add Component Machines to a Multi-Machine Service

If the multi-machine service has not reached its maximum number of allowed machines for a component type, you can add component machines to the multi-machine service.
To add component machines to an existing multi-machine service:

1. Log in to vCAC.

2. Navigate to one of the following:
   a. If you are a machine owner, click Self-Service > My Machines.
   b. If you are a provisioning group manager, click Provisioning Group Manager > Group Machines.
   c. As an enterprise administrator, click Enterprise Administrator > Enterprise Machines.

3. Point to the name of a multi-machine service and click Add Components.

4. Select the component type for which you want to add a machine. Component types that are already at their maximum number of machines are disabled.

   **Note:** Adding components to a multi-machine service in the vCAC Console is treated as a new request from the component blueprint. You must specify the configuration for the new component machine as with any request.

5. In the Request Information tab, specify the following:
   a. In the # Machines box, specify the number of machines of this type that you want to add to the multi-machine service. For example if you have 2 machines of this component type and specify 2 additional machines on the Add Components page, the updated multi-machine service has 4 machines of that type.
   b. Configure the resources, such as CPU, Memory, and Storage for the additional machines. Depending on the blueprint, some or all of these options may not be editable.

   **Note:** For component blueprints that use vSphere, KVM, SCVMM, or Amazon EC2, storage volumes are configured on a separate Storage tab.

   c. For cloud component machines only, specify the instance type, whether to use Virtual Private Cloud (VPC), and the location for the Amazon instance. Depending on the blueprint, these options may not be available. Selecting VPC may require additional configuration. For details, see Virtual Private Cloud.

6. Optionally, if you are an enterprise administrator or provisioning group manager, specify custom properties to apply to the new machines of this component type on the Properties tab.

7. Repeat steps 4-6 to add component machines of a different component type.

8. If any of the machines you added require approval, specify a reason for your request.
   a. Select the name of the multi-machine service.
   b. In Reason for request, enter a brief summary of why you need the additional machines.

   This information is passed along to approvers for the component machines.

9. Review the information in the summary grid at the top and click OK to add the machines.

### Power Options for Multi-Machine Services

The multi-machine service menu provides several options for managing the power status of a multi-machine service and all its component machines.
Table 4 describes the behavior of power options on multi-machine services as opposed to individual machines.

Table 4  Power Options on Multi-Machine Services

<table>
<thead>
<tr>
<th>Menu Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power On</td>
<td>Power on all component machines in the startup order specified on the multi-machine blueprint.</td>
</tr>
<tr>
<td>Power Off</td>
<td>Power off all component machines without shutting down the guest OS in the shutdown order specified on the multi-machine blueprint.</td>
</tr>
<tr>
<td>Power Cycle</td>
<td>Power off all component machines in shutdown order (see Power Off), then power on all machines in the startup order.</td>
</tr>
<tr>
<td>Reboot</td>
<td>Shut down all component machines in shutdown order (see Shut Down), then power on all machines in the startup order.</td>
</tr>
<tr>
<td>Shut Down</td>
<td>Shut down the guest OS and power off all component machines in the shutdown order specified in the multi-machine blueprint.</td>
</tr>
</tbody>
</table>

If a multi-machine service has multiple machines of the same component type, all machines of that type are powered on before machines of the next component type in the startup order, and likewise for shutdown order. There is no set order in which individual machines of the same type are powered on or off.

**Destroy Component Machines**

If a component machine is no longer needed, you can destroy the unwanted machine as long as it does not cause the multi-machine service to become unhealthy.

To remove a component machine from a multi-machine service:

1. Log in to vCAC.
2. Navigate to one of the following:
   - If you are a machine owner, click **Self-Service > My Machines**.
   - If you are a provisioning group manager, click **Provisioning Group Manager > Group Machines**.
   - If you are an enterprise administrator, click **Enterprise Administrator > Enterprise Machines**.
3. Point to the name of a multi-machine service and click **View Components**.
4. Point to the name of a machine and click **Destroy**.
   To remove several machines at once, select the machines using the checkbox next to the machine name, then point to one of the selected machines and click **Destroy**.
5. On the Confirm Machine Action page, review the list of machines that you selected to destroy.
   If destroying one or more of the selected machines would cause the multi-machine service to become unhealthy, you can clear the selection on this page, or click **Cancel** to return to the Component Machines page.
6. Click **OK** to destroy the machines.
About Managing Leases for Multi-Machine Services

The lease period for a multi-machine service always overrides the lease on its component machines.

- A component machine always has the same lease period as the multi-machine service, regardless of any minimum or maximum lease period specified in the component blueprint.
- Operations such as Change Lease and Extend Lease are available on the multi-machine service menu and not on the component machine menus. When the expiration date for a multi-machine service changes, that change is applied to all its component machines.
- Component machines cannot expire earlier than the multi-machine service to which they belong.
- When a multi-machine service expires, all its component machines expire at the same time. The multi-machine service and component machines are destroyed immediately when they expire.

About Notification Emails and Multi-Machine Services

vCAC sends notification emails for events such as provisioning and lease notifications for the multi-machine service. By default, vCAC does not send these emails for individual component machines.

You can override the email behavior for component machines with the custom property MultiMachine.ComponentsEmail.Enabled. If this property exists on a component machine (regardless of the value), vCAC sends event notification emails for that machine.

Approval emails are always sent for both multi-machine services and component machines.

Notification emails for multi-machine service events have a different subject heading and body text than emails for machine events, but they are configured using the same email template files. Multi-machine service emails share the same configuration to enable or disable machine emails for specific events in the Manager Service configuration.

For information about configuring notification emails, see the vCloud Automation Center Operating Guide.

Differences in Multi-Machine Services Between the Self-Service Portal and the vCAC Console

There are some behavioral differences when requesting and managing multi-machine services using the vCAC Self-Service Portal.

- When you use the Self-Service Portal to request a multi-machine service that includes a cloud machine as a component, some configuration options are not available at request time for the cloud component. You can click Customize to select the instance type of a cloud component machine, but you cannot specify network options (including VPC or non-VPC location) or add EBS storage volumes.
- When you add components to a multi-machine service from the Self-Service Portal, vCAC provisions the new machines with the same specifications as existing machines of the same component type. (Cloud component machines have the same instance type but are not guaranteed to have the same network and storage configuration.) If the component machine was provi-
sioned using vSphere, then it may be possible to reconfigure the machine after provisioning to have different specifications.
Chapter 3 vCloud Director Integration

This section describes the integration between vCAC and VMware vCloud® Director™.

About vCloud Director

The vCloud Director integration in vCAC allows a user to provision vApps and their virtual machines in a virtual datacenter (VDC) based on an existing vApp template, bringing the software-defined services of vCloud Director together with the user-centric governance of vCAC. It also allows vCAC to serve as a single self-service portal with multiple provisioning platforms.

Table 5 shows the mapping between entities in vCloud Director and vCAC.

### Table 5  Mapping between Entities in vCloud Director and vCAC

<table>
<thead>
<tr>
<th>vCloud Director</th>
<th>vCAC</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>vCloud Director server</td>
<td>endpoint</td>
<td>A vCAC endpoint can be mapped to a vCloud Director server or the combination of a vCloud Director server and an organization, which provides access only to the relevant organization VDCs.</td>
</tr>
<tr>
<td>organization</td>
<td>provisioning group</td>
<td>User roles and membership in vCloud Director organizations and vCAC provisioning groups are maintained independently in each tool. See vCloud Director Requirements.</td>
</tr>
<tr>
<td>organization virtual datacenter</td>
<td>compute resource</td>
<td>vCAC enforces a one-to-one mapping between a compute resource that represents a VDC and a reservation.</td>
</tr>
<tr>
<td>vApp template</td>
<td>vApp (vCloud Director) blueprint</td>
<td>A vApp (vCloud Director) blueprint must specify a vApp template from which to clone a vApp and one or more virtual machines in vCloud Director. A blueprint in vCAC that is specific to a provisioning group is analogous to a template that is part of an organization’s catalog, while global blueprints are analogous to templates in a public catalog.</td>
</tr>
</tbody>
</table>
vApps are one way to provision several machines with a single request. vCAC also has a multi-machine service feature that provides similar functionality. For a feature comparison between vCloud Director integration and multi-machine services, see About Multi-Machine Services and vCloud Director Integration.

### vCloud Director Requirements

Before you integrate vCloud Director with vCAC, you must install and configure your vCloud Director instance, including setting up organizations, cloud resources, and vApp templates.

The user roles within a vCloud Director organization do not need to correspond with the roles in the vCAC provisioning group. For example, it is not necessary for the vCAC provisioning group manager to have vApp author permissions in order to configure vApp (vCloud Director) blueprints in vCAC, unless the user also needs the ability to create templates in vCloud Director. The only requirement for vCloud Director integration is that the user set as the owner of the vApp request must be a member of the domain associated with the organization VDC on which the vApp is provisioned.

In addition, you must have configured the cloud resources (such as VDCs and networks) that you use to provision vApps and also have created vApp templates for any vApps that you want to provision through vCAC.

For information about configuring vCloud Director and working with vApp templates, see the VMware vCloud Director documentation.

### Known Limitations

The following features are not supported for vApps in the current release of vCAC:

- Creating vApp templates
- Snapshots of vApps
- Static IP
- Customizing Linux VMs that are part of vApps
- Moving vApps between VDCs
- Moving virtual machines between reservations
- Adding or removing components from a vApp

vApp (vCloud Director) blueprints cannot be added as component blueprints to a multi-machine blueprint.
About vApps

A vApp in vCAC is a container object composed of one or more machines that can be provisioned and managed through vCAC as a single entity.

When you provision a vCloud Director vApp through vCAC, vCAC provisions the vApp and one or more virtual machines on the organization VDC; it also provisions a vApp machine and component machine(s) in vCAC to serve as surrogates for the vApp and virtual machine(s) in vCloud Director.

This surrogacy allows you to manage the vCloud Director vApp in many ways by managing the vCAC vApp. For example, you can power off the vApp in vCloud Director by performing the same operation from the vApp’s menu in vCAC. Likewise, when you destroy a vApp machine and its component machines in vCAC, you destroy the corresponding vApp and its virtual machines in vCloud Director.

During provisioning, vCAC uses the vApp (vCloud Director) blueprint, the vApp Component (vCloud Director) blueprint(s), and the vCloud Director vApp template specified in the vApp (vCloud Director) blueprint to provision the vApp in both vCloud Director and vCAC. For example, additional storage volumes specified in the vApp Component (vCloud Director) blueprints determine the number and capacity of disks for the vApp virtual machines in vCloud Director.

vApps in vCAC are similar to machines in several ways:

- They are defined by a blueprint.
- They may have a lease duration associated with them.
- They are listed on the My Machines, Group Machines, and Enterprise Machines pages, and many machine operations can be performed on vApps as a whole.
- vApp requests can be made subject to approval.

Despite the similarities, a vApp is in essence a container for its component machines and is not itself a machine. Component machines are treated just like any machine managed by vCAC for reporting and license purposes, but the vApp container is not counted as a machine in reports or licensing.

Terminology

Table 6 provides definitions of several terms specific to vApp services.

Table 6  vApp Terminology

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>vApp</td>
<td>A compound object composed of one or more machines that can be provisioned and managed through vCAC as a single entity. A vApp is defined by a vApp (vCloud Director) blueprint, which references blueprints for component machines.</td>
</tr>
<tr>
<td>vApp menu</td>
<td>The machine menu that appears when a user points to the name of the vApp on the My Machines, Group Machines, or Enterprise Machines page, allowing the user to perform operations on the vApp (and its component machines) as a whole.</td>
</tr>
<tr>
<td>vApp Component (vCloud Director) blueprint</td>
<td>A blueprint that defines a component machine that is part of a vApp. A vApp Component (vCloud Director) blueprint is referenced by a vApp (vCloud Director) blueprint.</td>
</tr>
</tbody>
</table>
vApp Life Cycle

vApps follow the same general life cycle as machines, from requesting (with optional approval) and provisioning through managing and decommissioning.

When users request a vApp, they have the ability to configure:

- How many vApps to provision, within the limits specified in the vApp (vCloud Director) blueprint
- The specifications of the component machines (such as CPU, Memory, and Storage) based on the individual vApp Component (vCloud Director) blueprints
- General settings such as lease duration and custom properties to be applied to component machines in the vApp

Before provisioning the vApp, vCAC allocates resources for all of the component machines that are being requested. If the vApp would cause a reservation to become overallocated, its allocation fails. Once the resources have been allocated, the component machines are provisioned and powered on.

Once the vApp is provisioned, the machine owner can perform various vApp menu tasks on the vApp as a whole, such as powering the vApp off and on, or destroying the vApp and its component machines.

The machine owner can also view the components that make up a vApp and manage them individually. Most machine operations are available for component machines, except for destroying the component, changing the owner, changing the lease, or expiring component machines.

Configuring vApps

You allow users to provision vApps by creating one or more vApp (vCloud Director) blueprints as an enterprise administrator or provisioning group manager.

The high-level process for configuring vCloud Director provisioning in vCAC is as follows:

1. Create a credential to authenticate with the vCloud Director server.
2. Create a vCloud Director endpoint.
3. Add one or more organization VDCs to an enterprise group.
4. Create a provisioning group that corresponds to a vCloud Director organization.
5. Create a reservation for each organization VDC.
6. Create vApp Component (vCloud Director) and vApp (vCloud Director) blueprints.

This section describes only the procedures that are specific to provisioning with vCloud Director. For general information about configuring vCAC for provisioning, see the vCloud Automation Center Operating Guide.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>component machine</td>
<td>An individual machine instance that is managed as part of a vApp. A vApp may include multiple component machines provisioned using the same vApp Component (vCloud Director) blueprint, or using different vApp Component (vCloud Director) blueprints.</td>
</tr>
</tbody>
</table>
Creating a vCloud Director Credential

You must create a vCAC credential for authenticating with the vCloud Director server. The procedure for creating a credential for vCloud Director is the same as for any credentials in vCAC.

The credentials you provide are typically those of a vCloud Director organization administrator. Alternatively, you can use the credentials for the vCloud Director system administrator. The latter could be more advantageous if you plan to work regularly with multiple organizations.

**Note:** The credentials that you specify must include the username only and not the domain.

Creating a vCloud Director Endpoint

A vCloud Director endpoint is required to connect to a vCloud Director server.

You can specify the name of a vCloud Director organization when you create an endpoint. You must choose one of the following options:

- Use the credentials for a vCloud Director organization administrator to connect to the vCloud Director server and specify the organization for which the user has the administrator role. With these credentials, the endpoint can only access the associated organization VDCs. You can add endpoints for each additional organization in your vCloud Director instance that you want to integrate with vCAC.

- Use the credentials for a vCloud Director system administrator and leave the Organization field empty to enable access to all organization VDCs within the vCloud Director instance.

If you set up multiple organizations (either as separate endpoints or a single endpoint), VMware recommends that you create reservation policies for each organization to ensure that vApps are provisioned to the appropriate VDCs.

You cannot set up both organization-specific endpoints and single endpoints that access all organizations for the same vCloud Director instance.

**Note:** A vCloud Director instance is backed by vSphere resources that provide the CPU, memory, and storage for its virtual machines. When vCAC performs data collection on a vCloud Director endpoint, it collects information about the underlying vSphere resources. To avoid conflicts in resource accounting, if you create a vCloud Director endpoint, do not create an endpoint for its underlying vSphere resources.

Although vCAC uses a proxy agent to manage vSphere resources, no agent is needed for vCloud Director.

If you later rename a vCloud Director endpoint, run data collection on it afterwards to re-assert the connection between vCAC and the vCloud Director server represented by the endpoint.

Create a vCloud Director Endpoint

To create a vCloud Director endpoint:

1. Log in to the vCAC Console as a vCAC Administrator.
2. Select **vCAC Administrator > Endpoints**.
3. Click **New Endpoint > Cloud > vApp (vCloud Director)**.
4. Specify a **Name** for the endpoint.
5. Optionally, specify a description of the endpoint. This information displays on the Endpoints page.
6. Specify a URL with the fully qualified hostname or IP address of the vCloud Director server, for example: `https://vcd.example.com`.

   **Note:** You must specify https as the transport protocol.

7. Specify the credentials to use to connect to this endpoint.
8. Optionally, specify custom properties to apply to all machines provisioned using this endpoint.
9. Click **OK**.

**Adding a VDC to an Enterprise Group**

You must add each organization VDC to an enterprise group to make it available for provisioning. The procedure is the same for configuring any compute resource with an enterprise group.

Data collection runs automatically when you create a new endpoint. The organization VDCs identified by the endpoint should therefore be available for selection when you create the enterprise group. If not, save and then edit the enterprise group to refresh the list of organization VDCs.

**Mapping a Provisioning Group to a vCloud Director Organization**

A vCAC provisioning group corresponds to an organization in vCloud Director. The procedure for setting up a provisioning group for vCloud Director is the same as for any provisioning group.

The user roles for vCAC and vCloud Director are maintained independently in each tool.

**Preparing Reservations for vApps**

You should create reservations for all the resources that may be used in vApps in the same enterprise group.

To ensure that component machines are provisioned on the appropriate resources, use a reservation policy to associate reservations with the vApp (vCloud Director) blueprint. For information about reservation policies, see the *vCloud Automation Center Operating Guide*.

You can specify an allocation model in the **Provision into** field on the Confirm Machine Request page when you request a vApp machine; an Enterprise Administrator or Provisioning Group Manager must have selected the **Allow user to specify reservation type** check box on the vApp (vCloud Director) blueprint for the field to be available. Specifying a value here limits qualifying reservations to those using this allocation model.

**Create a vApp Reservation**

You can have multiple vCAC reservations for each vCloud Director organization VDC.

To create a vCloud Director reservation:

1. Log in to the vCAC Console as an enterprise administrator.
2. Select **Enterprise Administrator > Reservations**.
3. Click **New Reservation > Cloud > vApp (vCloud Director)**.

4. On the **Reservation Information** tab:
   a. From the **Compute resource** list, select the name of the organization vDC. The **Allocation Model** field then appears with the applicable allocation model displayed (Reservation Pool, Allocation Pool, or Pay As You Go).
   b. Specify a **Name** of the reservation, or accept the auto-generated name.
   c. Select the **Provisioning group** that corresponds to an organization that has access to this VDC in vCloud Director.
   d. Optionally, specify a **Reservation policy** to apply to this reservation.
   e. Optionally, specify the **Machine quota** for this reservation. This quota limits the number of vApps that can be provisioned on this reservation, each of which may contain one or more virtual machines. VMware recommends leaving this field empty for a vCloud Director reservation.
   f. Specify a priority for this reservation.

5. On the **Resources** tab, complete the following sections:
   • **Memory**—Use the Memory section of the New Reservation – vApp (vCloud Director) page to specify how much of the cloud compute resource’s memory is reserved by this reservation.
      
      The section also shows you the current total physical, allocated, and reserved memory of the compute resource. The amounts shown here reflect the allocation model used by the compute resource: Allocation Pool, Pay-As-You-Go, or Reservation Pool. For example, when the compute resource uses the Pay-As-You-Go allocation model, the physical memory and other values are set to Unlimited (read-only). You can set the top limit of the reservation by specifying a value in the This Reservation field.
   • **Storage**—Use the Storage section of the New Reservation - vApp (vCloud Director) page to enable storage paths and to specify how much storage on each is reserved by this reservation. For each storage path available on the selected compute resource, this section shows you
      • The current physical, free, and reserved storage on the entire storage path. For a compute resource using the Reservation Pool allocation model, the Reserved figure is for all vCAC reservations, not just the one you are currently editing.
      • The amount of storage reserved by the reservation you are creating and the storage currently allocated from it to cloud machines. (Remember that the amount actually used by those machines will be less if space-efficient storage is in use.)

      These statistics let you select among the available storage paths and specify an amount of storage for the current reservation within the context of each storage path’s overall usage to avoiding over-reservation of storage paths. You must select at least one storage path.

      A storage cost is also displayed for each storage path. This cost is specified either in the cost profile assigned to the compute resource or in the storage cost profile assigned to the individual storage path. If no cost profile of either type is assigned, the storage cost is 0.
   • **Network**—The Network section of the New Reservation - vApp (Cloud Director) page lets you select the network paths to which machines using the reservation will be added from
among those available on the compute resource. You must select at least one. If you select more than one, machines are distributed among them in round-robin fashion.

6. Optionally, on the **Alerts** tab, configure capacity alerts for any limited resources specified in this reservation.

7. Click **OK**.

### Using Storage Reservation Policies

You can use a storage reservation policy to ensure that a volume defined in a vApp Component (vCloud Director) blueprint uses a particular storage path or group of storage paths during provisioning. The Enterprise Administrator or Provisioning Group Administrator must select the **Allow user to see and change storage reservation policies** check box on a vApp Component (vCloud Director) blueprint for storage reservation policies to be available for volumes specified on that blueprint. Only an Enterprise Administrator can assign a storage reservation policy to a storage path. For more information about storage reservation policies, see the [vCloud Automation Center Operating Guide](#).

### About vCloud Director Blueprints

For users to provision vApps from within vCAC, you must have a vApp template with one or more virtual machines in vCloud Director. In vCAC, you must also have a vApp (vCloud Director) blueprint that refers to the vApp template and vApp Component (vCloud Director) blueprints that refer to the virtual machines specified in the vApp template. The vApp (vCloud Director) blueprint must specify provisioning by cloning from the vApp template. It must also have one vApp Component (vCloud Director) blueprint for every virtual machine to be provisioned.

Put another way, the vApp (vCloud Director) blueprints that are available to members of a provisioning group are analogous to catalog items that are available to members of a vCloud Director organization. The vApp Component (vCloud Director) blueprints that accompany those vApp (vCloud Director) blueprints are analogous to virtual machines within those catalog items. Public catalog items in vCloud Director are similar to global blueprints in vCAC.

A vApp (vCloud Director) blueprint and its vApp Component (vCloud Director) blueprints provision by cloning. The vApp template that you select for the vApp (vCloud Director) blueprint is the primary source of information for provisioning vApp virtual machines from within the vCAC console. The vApp template determines how many virtual machines to provision per vApp, and what properties to apply to the virtual machines being provisioned.

You use the vApp (vCloud Director) blueprint to assign vApp Component (vCloud Director) blueprints to the provisioning of associated virtual machines. Though the vApp template in vCloud Designer specifies properties for each virtual machine to be provisioned, you can use the vApp Component (vCloud Director) blueprints assigned to those virtual machines to specify additional storage volumes, the maximum number of volumes, the maximum number of network adapters, and additional machine resources. For example, the vApp template defines volume 0 for virtual machine vm1, but if the assigned vApp Component (vCloud Director) blueprint defines two additional storage volumes, and the reservation and other settings allow, vm1 will be provisioned with three storage volumes.

After you assign a vApp Component (vCloud Director) blueprint to a vApp (vCloud Director) blueprint, the virtual machine properties specified by the vApp template and displayed as machine resources in the vApp Component (vCloud Director) blueprint become the minimum values allowed for provisioning. However, you can increase a vApp Component (vCloud Director) blueprint’s machine resources to the maximums allowed by the reservation and other settings.
vCAC uses the vApp template identified in the vApp (vCloud Director) blueprint to provision the vApp and its virtual machines. The cloning templates you specified in the Clone from field when creating the vApp Component (vCloud Director) blueprints are not used during provisioning. Instead, vCAC uses the vm properties specified in the vApp template.

Note: When selecting a cloning template for a vApp Component (vCloud Director) blueprint, search on the name of the vApp template you intend to use (in the Clone from field of the vApp blueprint) and select from the results.

Creating a vApp Component (vCloud Director) Blueprint

Before you can create a vApp (vCloud Director) blueprint, you must have its vApp component blueprint(s) ready to select. If you try to create a vApp (vCloud Director) blueprint without having access to its vApp Component (vCloud Director) blueprint(s), an alert message appears and the operation fails.

The purpose of a vApp Component (vCloud Director) blueprint is to provide policy for provisioning a vApp virtual machine in vCloud Director. In addition to specifying the standard blueprint information and security settings required by vCAC, a vApp Component (vCloud Director) blueprint can specify additional volumes, assign storage reservation policies, set the maximum number of volumes and network adaptors allowed, and define custom properties. The vApp Component (vCloud Director) blueprint may be assigned to a cloning template that determines the number of CPUs, the amount of memory and storage, and one or more volumes.

Create a vApp Component (vCloud Director) Blueprint

To create a vApp Component (vCloud Director) blueprint:

1. Log in to the vCAC Console as an enterprise administrator or provisioning group manager.
2. Select Enterprise Administrator > Global Blueprints or Provisioning Group Manager > Blueprints.
3. Click New Blueprint > Cloud > vApp Component (vCloud Director)
4. On the Blueprint Information tab, specify blueprint details as you would for any blueprint.

Note: The machine prefix that you specify for the blueprint is used for all vApp Component (vCloud Director) provisioned from this blueprint.

5. On the Build Information tab:
   a. Select the Blueprint type. Your selection determines which type of vCAC license the blueprint uses when machines are provisioned from it.
   b. The Provisioning workflow must be vAppCloneWorkflow.
   c. In the Clone from field, click the ellipsis to open the Select vApp Component Template pane.
   d. In the vApp Templates list, select a name associated with the vApp template you will use to create a vApp (vCloud Director) blueprint in the next section. To filter the list for applicable names, enter the name of the vApp template in the vApp Template text box.
   e. Optionally, select the Allow user to see and change storage reservation policies check box to make storage reservation policies available for the blueprint’s volume(s) on the Confirm Machine Request page.
f. Click **OK**.

**Note:** If you have multiple endpoints for different organizations in the same vCloud Director instance and there are vApp templates that are shared between organizations as part of a published catalog, the shared templates appear once in the list for each endpoint or organization. You can filter the list of blueprints by endpoint to ensure that you are choosing from templates that are available to a particular organization. Optionally, you can save the filter for later use.

6. Optionally, specify custom properties, security options, and Reconfigure options.

7. Click **OK**.

### Creating a vApp (vCloud Director) Blueprint

A vApp (vCloud Director) blueprint is a specific type of blueprint that contains references to vApp Component (vCloud Director) blueprints.

Before you can create a vApp (vCloud Director) blueprint, you must first create vApp Component (vCloud Director) blueprints for the component machines you want to include in the vApp.

**Note:** The vApp Component (vCloud Director) blueprints must be available to the same provisioning group as the vApp (vCloud Director) blueprint.

A member of the provisioning group associated with a vApp (vCloud Director) blueprint can use the blueprint to provision a vApp and its virtual machine(s) in a vCloud Director organization. The provisioning process also produces an analogous vApp machine and its component machine(s) in vCAC.

The vApp (vCloud Director) blueprint specifies a vApp template (located in a vCloud Director catalog) which vCAC uses to create the vApp and to provision its virtual machine(s). For names, the vApp and its virtual machine(s) assume the machine prefix specified in vCAC and the next available sequence of numbers (for example, CA04, CA05, and CA06). The analogous vApp machine and component machine(s) in vCAC use the same names as the vApp and its virtual machine(s).

In the vApp (vCloud Director) blueprint, you associate a vApp Component (vCloud Director) blueprint with each virtual machine in the vApp template. The vApp Component (vCloud Director) blueprint lets you specify additional machine resources, storage volumes, custom properties, and other options for the vApp component machine to be cloned.

A vApp (vCloud Director) blueprint can also specify the minimum and maximum duration of the machine’s lease.

### Create a vApp (vCloud Director) Blueprint

To create a vApp (vCloud Director) blueprint:

1. Log in to the vCAC Console as an enterprise administrator or provisioning group manager.
2. Select **Enterprise Administrator > Global Blueprints** or **Provisioning Group Manager > Blueprints**.
3. Click **New Blueprint > Cloud > vApp (vCloud Director)**
4. On the **Blueprint Information** tab, specify blueprint details as you would for any blueprint.
5. On the **Build Information** tab:
   a. The Provisioning workflow must be `vAppCloneWorkflow`.
   b. In the **Clone from** field, click the ellipsis to open the **Select vApp Template** pane.
      The **Name** column in the **Component machines** grid then lists the name(s) of the vApp template’s virtual machine(s).
   c. Select a vApp template from the **vApp Templates** list.

   **Note:** If you have multiple endpoints for different organizations in the same vCloud Director instance and there are vApp templates that are shared between organizations as part of a published catalog, the shared templates appear once in the list for each endpoint or organization. You can filter the list of blueprints by endpoint to ensure that you are choosing from templates that are available to a particular organization. Optionally, you can save the filter for later use.

d. Assign a vApp Component (vCloud Director) blueprint to each virtual machine listed:
   1. Click the Edit button next to a name to edit the entry.
   2. Click the drop-down box in the **Blueprint** column and select a vApp Component (vCloud Director) blueprint.
   3. Click the Save button to save the new entry.
   4. Repeat for all virtual machines listed.

e. Optionally, select the **Allow user to specify reservation type** check box to allow the user to select the reservation type (Pay As You Go, Reserved Resources, or blank for none). Selecting this option displays the **Provision into** field on the **Request Information** tab of the **Confirm Machine Request** page. Use this option when there are multiple allocation types available in the provisioning group. A reservation policy may not be necessary if you use this option.

f. Optionally, enter the lease duration range in the **Machine resources** section. If left blank, there is no expiration date.

6. Optionally, specify custom properties and security options.

7. Click **OK**.

### About Specifying Custom Properties for vApps

You can specify custom properties that apply to all component machines within a vApp in the vApp (vCloud Director) blueprint.

Custom properties specified in the vApp (vCloud Director) blueprint override properties specified in the vApp Component (vCloud Director) blueprint. However, runtime properties on the component machine (specified either at request time or by editing the machine after it has been provisioned) override runtime properties at the vApp level. This allows the vApp (vCloud Director) blueprint to apply a consistent behavior across all of its component machines by default, while allowing a user to override the vApp properties for each component.
The full order of precedence for custom properties on component machines, including those defined at the vApp level, is as follows (any property value specified in a source later in the list overrides values for the same property specified in sources earlier in the list):

1. Build Profile, specified on vApp Component (vCloud Director) blueprint
2. vApp Component (vCloud Director) blueprint
3. Build Profile, specified on vApp (vCloud Director) blueprint
4. vApp (vCloud Director) blueprint
5. Provisioning Group
6. Compute Resource
7. Reservations
8. Endpoint
9. Runtime, specified on vApp
10. Runtime, specified on component machine

**About Specifying Security Options for vApps**

The **Security** tab for vApp (vCloud Director) blueprints functions in the same way as the same tab for all blueprints. It allows you to control access to the blueprint and specify which menu operations are available to machine owners for vApps provisioned from this blueprint. The View Components menu operation is always available to machine owners.

You can add custom operations to the vApp menu as you can for the machine menu. For information about implementing custom menu operations, see the *vCloud Automation Center Extensibility Guide*.

**Enable a vApp’s Virtual Machine to join an Active Directory Domain**

If you want a virtual machine in a vApp to join an Active Directory domain, you must specify certain custom properties in the blueprint, or in a build profile which you then select for the blueprint. In situations where a vApp has both Linux and Windows machines for example, you could use a build profile to assign the custom properties to the vApp Component (vCloud Director) blueprint associated with the Windows machine. Joining an Active Directory domain is only supported for Windows machines.

To enable the virtual machines in a vApp to join an Active Directory domain:

1. Log in to the vCAC Console as an enterprise administrator or provisioning group manager.
2. Select **Enterprise Administrator > Global Blueprints** or **Provisioning Group Manager > Blueprints**.
3. Create a vApp (vCloud Director) blueprint or edit an existing one.
4. On the **Properties** tab, add the following custom properties (case sensitive):
Clone an Identical Copy from the vApp Template

You can clone an identical copy of a vApp template in vCloud Director with the custom property `VCloud.Template.MakeIdenticalCopy`. When set to True, the custom property instructs vCloud Automation Center to ignore the customizations specified in the vApp blueprint selected for provisioning and its vApp Component blueprints. In other words, vCloud Automation Center uses only the vApp template and not the vApp and vApp Component blueprints to provision the vApp and its virtual machines. The only changes from the vApp template are the names of the cloned vApp and its component virtual machines, which are generated from the machine prefix. A vApp and its component machines are provisioned in vCloud Automation Center as an identical copy of the vApp blueprint. The default setting for the custom property is False.

Enter the custom property on the Properties tab of the vApp blueprint you selected when requesting a machine; you can enter the property on the tab directly or as part of a build profile selected on the tab. You can also put the property in a provisioning group that includes the selected vApp blueprint. Using this approach affects all vApp blueprints in the provisioning group.

Table below shows the interaction of the custom property `VCloud.Template.MakeIdenticalCopy` in vCloud Automation Center and the option Make Identical Copy located in the vCloud Director vApp template properties.

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sysprep.Identification.DomainAdmin</td>
<td>The username of an administrator of the target domain in Active Directory. Do not include the user domain in the credentials that you send to vCloud Director.</td>
</tr>
<tr>
<td>Sysprep.Identification.JoinDomain</td>
<td>The name of the domain in Active Directory to join.</td>
</tr>
</tbody>
</table>

5. Click OK.
Machine Resource Changes Ignored

If the custom property is set to True on the vApp blueprint and an assigned vApp Component blueprint specifies a minimum/maximum range for machine resources (CPUs, memory, or storage), any change you make to those machine resources when using those blueprints to request a machine is ignored. However, you can change the machine resources after provisioning the machine and while it is powered on.

Storage Path Changes Ignored

If the custom property is set to TRUE on the vApp blueprint and an assigned vApp Component blueprint specifies a different storage path than the one specified in the vApp template, the storage path specified in the vApp template prevails. This is also true if you change the storage path for a component when requesting a vApp machine.

About Leases and vApps

Both vCAC and vCloud Director provide the ability to specify a lease on vApps. For vApps provisioned through vCAC, the lease specified in vCAC overrides any lease specified in vCloud Director.

When a vApp in vCAC expires, all its component machines expire at the same time. The vApp and its component machines are destroyed immediately when they expire. The corresponding vApp in vCloud Director and its virtual machines are also destroyed.

To avoid conflicts in resource accounting, specify a lease period of Never Expires for vApps within an organization whose vApps can be managed by vCAC.

Request a vApp Machine

When you request a new vApp machine, you can specify configuration options for the component machines as well as the vApp machine as a whole.

Requests for vApp machines (and their component machines) may be subject to approval based on the approval policies specified in their respective blueprints.
To request a vApp machine:

1. Log in to vCAC and click **Self-Service > Request Machine**.
2. Click the name of a blueprint whose **Type** is **vApp (vCloud Director)**.
3. Specify the settings that apply to the vApp as a whole:
   a. Select the **vApp** from the grid at the top.
   b. In the **Request Information** tab, specify a value for the number of vApp machines to provision (**# Machines**) as part of this request.
   c. Optionally, specify a **Description** to use for the vApp machine.
   d. (Provisioning Group Manager or Support user only) If desired, specify a different machine **Owner** in domain\username format.
   e. Optionally, specify an allocation model for the new vApp machine in the **Provision into** field. Specifying a value here limits qualifying reservations to those using this allocation model.
   f. Optionally, enter a **Reason for request**. This information is passed along to approvers for the vApp machine and its component machines.
4. Configure the component machine(s) as needed. For each component that you want to configure:
   a. Select the component from the grid at the top.
      The **Request Information** tab updates with machine details based on the vApp Component (vCloud Director) blueprint.
   b. Confirm or update the values for **# Machines**, **# CPUs**, **Memory (MB)**, and **Storage (GB)**.
   c. Optionally, specify a **Description** to use for the component machine.
   d. Optionally, click the **Storage** tab to add or edit a storage volume and assign a storage reservation policy if permitted by the vApp Component (vCloud Director) blueprint.
5. Click **OK**.

**Note:** If you are a provisioning group manager, you can also specify custom properties at request time. You can add custom properties to the vApp that apply to all component machines or add properties to a component that apply only to its component machines.

### About Approval and vApps

You can apply an approval policy to a vApp blueprint just as you would for any blueprint.

vApp requests use the same approval policies as machine requests. Advanced approval policies are supported for vApp requests. For information about creating approval groups and approval policies, see the **vCloud Automation Center Operating Guide**.
The individual component machines in a vApp are also subject to approval based on the approval policies and thresholds specified in the vApp Component (vCloud Director) blueprints just like any stand-alone machine, and may be approved or rejected independent of the vApp.

After the vApp or any component machine has been approved (or if it does not require approval), its state changes to **WaitingToBuild**. When the vApp and all its component machines are in this state (that is, all required approvals are complete), the vApp is provisioned.

One or more component machine requests may be rejected during the approval process.

**Note:** If any machines are rejected, the vApp is destroyed.

Emails are sent to approvers to notify them of vApp or component machine requests awaiting their approval. For more information about notification emails that are sent for vApps, see About Notification Emails and vApps.

### Managing vApps

Once the vApp is provisioned, the machine owner can view its status and perform various vApp menu tasks on the vApp as a whole from the My Machines page.

vApp menu operations include:

- Editing the vApp
- Viewing component machines
- Rebooting or powering the vApp (and its component machines) on and off
- Editing the vApp lease
- Destroying a vApp and its component machines

**Note:** The Bulk Operations Client is not supported for vApps. If you use the Bulk Operations Client on a server that has vApps, do not select machines of type “vApp (vCloud Director)” to perform bulk operations.

Additionally, the Bulk Operations Client does not indicate whether a machine is a component of a vApp. Performing operations on component machines, such as powering off a group of component machines, can lead to the vApp being in an unhealthy state.

The status displayed for the vApp in vCAC corresponds to its status in vCloud Director.

When a user selects an operation from the vApp menu for a vApp, such as Destroy, Expire, or any power operation, it is performed on the entire vApp and all its virtual machines. Table 7 lists the menu options available to vApps and their virtual machines.

**Table 7**  Menu Options Available to vApps and Their Virtual Machines

<table>
<thead>
<tr>
<th>Menu option</th>
<th>vApp</th>
<th>Component Machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>View Components</td>
<td>Display the components of the vApp on a page similar to My Machines.</td>
<td>Not available</td>
</tr>
<tr>
<td>Menu option</td>
<td>vApp</td>
<td>Component Machine</td>
</tr>
<tr>
<td>---------------------</td>
<td>----------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Connect using VMRC</td>
<td>Not available</td>
<td>Remote connection to VM in vCloud Director with VMware Remote Console (VMRC) browser plug-in</td>
</tr>
<tr>
<td>Destroy</td>
<td>Destroy vApp and component machines</td>
<td>Not available</td>
</tr>
<tr>
<td>Change Lease</td>
<td>Change lease (in vCAC only) The vApp in vCloud Director always has an unlimited lease and is unaffected.</td>
<td>Not available</td>
</tr>
<tr>
<td>Expire</td>
<td>Expire vApp In vCAC, the vApp machine and its component machine(s) are destroyed. In vCloud Director, the vApp and its virtual machine(s) are destroyed.</td>
<td>Not available</td>
</tr>
<tr>
<td>Menu option</td>
<td>vApp</td>
<td>Component Machine</td>
</tr>
<tr>
<td>-------------</td>
<td>------</td>
<td>-------------------</td>
</tr>
<tr>
<td><strong>Edit</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Enterprise Administrator: | • Change Description  
• Add/Edit/Delete Properties | • Change Description  
• Reconfigure VM (CPU, Memory, and Disk)  
• Add/Edit/Delete Properties  
• Change Execution (request type, reconfigure shutdown, and reason for request) |
| Provisional Group Manager: | • Change Description  
• Change Owner  
• Add/Edit/Delete Properties | Provisional Group Manager (same as Enterprise Administrator):  
• Change Description  
• Reconfigure VM (CPU, Memory, and Disk)  
• Add/Edit/Delete Properties  
• Change Execution (request type, reconfigure shutdown, and reason for request) |
| Owner: | • Change Description | Owner:  
• Change Description  
• Reconfigure VM (CPU, Memory, and Disk)  
Change Execution (request type, reconfigure shutdown, and reason for request) |
| **Power On** | Power on the vApp and all virtual machines in the startup order specified on the vApp template. | Power on the virtual machine. |
| **Power Off** | Power off the vApp and all virtual machines without shutting down the guest OS in the shutdown order specified on the vApp template. | Power off the virtual machine without shutting down the guest OS. |
| **Power Cycle** | Power off the vApp and all virtual machines in shutdown order (see Power Off), then power on the vApp and all machines in the startup order. | Power off the virtual machine, then power it back on. |
About Editing vApps

Machine owners can edit the description of a vApp. Support users can change the owner of a vApp. Enterprise administrators and provisioning group managers can also change the properties of a vApp.

Changing the owner of a vApp updates the owner of all its component machines.

Editing the description or properties of a vApp does not update the description or properties of existing component machines.

Viewing the Status of vApps

The My Machines page displays vApps in the same grid with standalone machines.

By default, the vApps grid displays the name, status, platform type, and description of each vApp along with its expiration and destruction dates. Additional columns can be added via the Columns menu.

A vApp is considered to be healthy and has a status of On only if its components are powered on. When one or more of the component machines are powered Off, the vApp is considered unhealthy and its state is set to Off. During state data collection, vCAC detects the power state of each component machine, and the status of the vApp is updated as necessary based on the power state of the component machines.

Managing Component Machines

Most vApp menu operations are available for component machines in a vApp.

To access the component machines in a vApp, select View Components from the vApp menu. The Component Machines page displays a list of machines similar to the My Machines page, except that it shows only the machines that are components of the vApp.

You can edit component machines just like standalone machines, except that you cannot change the owner of a component machine. To change the owner of a component machine, edit the vApp as a provisioning group manager, which updates the owner for all component machines.

Lease operations (Change Lease, Extend Lease, or Expire) are not available on individual component machines. Leases can only be controlled at the vApp level for all component machines. For more information, see About Leases and vApps.
About Notification Emails and vApps

vCAC sends notification emails for events such as provisioning and lease notifications for the vApp. By default, vCAC does not send these emails for individual component machines.

You can override the email behavior for component machines with the custom property `MultiMachine.ComponentsEmail.Enabled`. If this property exists on a component machine (regardless of the value), vCAC sends event notification emails for that machine.

Approval emails are always sent for both vApp and component machines.

Notification emails for vApp events have a different subject heading and body text than emails for machine events, but they are configured using the same email template files. vApp emails share the same configuration to enable or disable machine emails for specific events in the Manager Service configuration.

For information about configuring notification emails, see the `vCloud Automation Center Operating Guide`.

Reconfiguring a Component Machine in a vApp

The machine owner, enterprise administrator, or provisioning group manager can reconfigure a provisioned vApp component machine in vCAC and the changes will also appear in the corresponding vApp virtual machine in vCloud Director. Reconfiguration can include the following changes:

- Increase or decrease memory
- Increase or decrease the number of CPUs
- Modify storage by adding volumes

The `Execute request` option on the `Execution` tab of the `Edit Machine – vApp` page determines the speed of the changes. The choices are `Immediate`, `Scheduled`, or `Queue for Owner`. See the `vCloud Automation Center Operating Guide` for a full description of the Reconfigure Machine feature.

Connect Remotely to a vApp’s Virtual Machine

A machine owner, enterprise administrator, or provisioning group manager can connect remotely to a vApp’s virtual machine in vCloud Director; this feature is available only with the Microsoft Internet Explorer and Mozilla Firefox browsers. To make the connection from vCAC, click `Connect using VMRC` in the vApp menu of a provisioned vApp component machine. If necessary, you are prompted to download and install the VMware Remote Console browser plug-in (VMRC). Once the VMRC plugin is installed, clicking the `Connect using VMRC` in the vApp menu of a provisioned vApp component machine displays the logon window for the corresponding virtual machine in the vApp.

To connect remotely to a vApp’s virtual machine in vCloud Director:

1. Log in to vCAC (Internet Explorer or Firefox browser only).
2. Navigate to one of the following:
   a. If you are a machine owner, click `Self-Service > My Machines`.
   b. If you are a provisioning group manager, click `Provisioning Group Manager > Group Machines`. 
c. If you are an enterprise administrator, click Enterprise Administrator > Enterprise Machines.

The provisioned vApp machine and its vApp component machine(s) must be powered On.

3. Point to the name of the vApp machine and click View Components in the machine menu.

4. Point to the name of the vApp component machine and click Connect Using VMRC in the vApp menu.

5. If the VMRC plugin is not installed, an error message appears with a link to download the installer.
   a. Click the link to download the installer.
   b. When prompted, run the installer.
   c. Restart the system.
   d. Restart vCAC and repeat steps 1 through 4.

6. Log in to the virtual machine (Linux or Windows) as directed.

7. When finished, log off and close the VM Browser window.

vCloud Director Integration Extensibility

You can create and deploy a vApp custom workflow from the vCloud Automation Center Designer console or with the Workflow Generator plugin and have vCloud Automation Center execute the workflow during vApp provisioning. To be executed, a vApp custom workflow must be deployed to the Model Manager repository and have the name vCloudCustomizeVMn where n is an integer equal to or greater than 1. After vCloud Automation Center completes its own customizations to the vApp and before the vApp is initially powered on, vCloud Automation Center executes all workflows in the repository that have the name vCloudCustomizeVMn in alphabetical order. Note how this differs from numerical ordering in the following examples that use the same workflow names:

(alphabetical) vCloudCustomizeVM2 > vCloudCustomizeVM236 > vCloudCustomizeVM26

(numerical) vCloudCustomizeVM2 > vCloudCustomizeVM26 > vCloudCustomizeVM236

To see if your workflows ran, search the DEM Worker and Orchestrator logs available in vcac_install_dir\Distributed Execution Manager where vcac_install_dir is the vCloud Automation Center installation directory (typically C:\Program Files (x86)\VMware\vCAC).