VMware vCenter Server Appliance Management Programming Guide

Update 2

11 APR 2019

vCenter Server 6.7

VMware ESXi 6.7

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About the vCenter Server Appliance Management Programming Guide

The *vCenter Server Appliance Management Programming Guide* provides information about using APIs to work with the vCenter Server Appliance, a turnkey solution for managing data centers featuring VMware® vCenter Server and VMware ESXi.

Intended Audience

This information is intended for anyone who wants to develop software to configure, monitor, and manage the vCenter Server Appliance. The information is written for developers who have some experience with REST APIs, JavaScript, Java, or Python.

Introduction to the vCenter Server Appliance and vCenter Server Appliance APIs

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The vCenter Server Appliance provides a fully packaged solution for data center management in a vSphere environment. You can use the APIs to configure, monitor, and maintain the vCenter Server Appliance.

This chapter includes the following topics:

About vSphere

vSphere is the VMware software stack that implements private-cloud data center management and the on-premises component of hybrid-cloud deployments.

A vSphere installation includes one or more instances of vCenter Server configured to manage one or more virtual data centers. Each virtual data center includes one or more instances of VMware ESXi.

The vCenter Server Appliance contains an instance of vCenter Server. The appliance Management API gives you programmatic access to manage the management elements of your data center.

About ESXi

Each instance of ESXi includes management agents and the VMware hypervisor layer, which runs several virtual machines. Each virtual machine contains a guest operating system, such as Windows or Linux, capable of running IT or user applications.

The vCenter Server Appliance runs as a virtual machine on an ESXi host. The appliance provides an independent endpoint capable of handling API requests both for vCenter Server and for the appliance Management API.

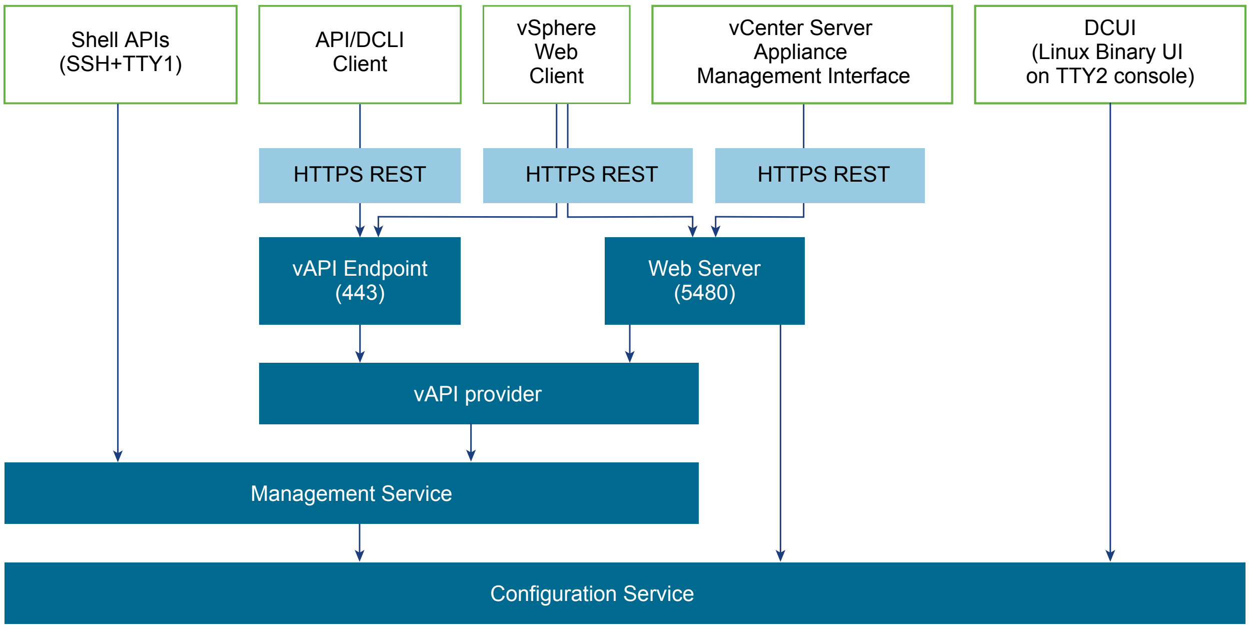
vCenter Server Appliance Management Overview

The vCenter Server Appliance is an instance of vCenter Server running in a Photon OS™ guest operating system.

vCenter Server is a collection of services designed for managing and monitoring vSphere installations. The vCenter Server Appliance responds to CLI commands, requests from the vSphere Web Client, and API requests from custom clients. API clients can be written in a choice of several software languages.

The vCenter Server Appliance is managed by CLI, Web interfaces, or API requests. These requests help you manage appliance configuration, monitor resource usage, or back up and restore the vCenter Server instance. You can also use API requests to check the health of the vCenter Server installed in the appliance. This programming guide explains how to use the APIs that are available to manage the appliance.

Figure 1-1. vCenter Server Appliance Management Connections



For more information about the capabilities of the vCenter Server Appliance, see *vCenter Server Appliance Configuration*.

Limitations of Programming for the vCenter Server Appliance

The vCenter Server Appliance supports several programming interfaces for monitoring appliance health and performance, managing network configuration, security hardening, and other functionalities. The vCenter Server Appliance also supports several user interfaces, which offer overlapping sets of functionality.

You can use vSphere Web Client to perform common operations. By using the API, you have access to more specific settings and operations.

However, the API cannot access all the capabilities. A few special features require direct shell access or special user interfaces. See Supplementing the vCenter Server Appliance API.

API Endpoints for Managing the vCenter Server Appliance

The vCenter Server Appliance integrates with the vSphere Automation API endpoint that provides a common surface for exposing several vSphere services. When you use the vSphere Automation API endpoint, you establish a single session that provides access to virtual machine management, search and filter, Content Library, and other services for working with vSphere objects.

Other endpoints associated with the vCenter Server Appliance include the Lookup Service and the vCenter Single Sign-On Service. For more information about using the Lookup Service, see Chapter 3 Retrieving Service Endpoints. For more information about using the vCenter Single Sign-On Service, see vCenter Single Sign-On Token Authentication for the vCenter Server Appliance.

Supplementing the vCenter Server Appliance API

Some less common features of the vCenter Server Appliance are not accessible by API. These features require direct shell access or specific user interfaces.

Direct Console User Interface to the vCenter Server Appliance

The Direct Console User Interface provides access to basic operations for appliance management and set up.

The DCUI provides access to a subset of management functions. It provides direct access to the appliance if the vSphere Web Client and the vCenter Server Appliance Management Interface become unavailable.

For an illustration showing appliance connections, see the block diagram Figure 1-1.

After the vCenter Server Appliance startup is complete, the DCUI displays basic CPU, memory, and network information on the operator console. The root user can use the DCUI screen to configure network interfaces, DNS, and super administrator password.

vCenter Server Appliance Management Interface

The vCenter Server Appliance Management Interface is an interface for configuring, monitoring, and patching of the vCenter Server Appliance.

The vCenter Server Appliance Management Interface runs in a browser that connects to port 5480 of the appliance. The vCenter Server Appliance Management Interface provides access to all the service APIs of the appliance.

For an illustration showing Appliance connections, see the block diagram Figure 1-1.

Appliance Shell and the vCenter Server Appliance

You can use the appliance shell to access all of the vCenter Server Appliance commands and plug-ins that you use for monitoring, troubleshooting, and configuring the appliance through the API.

For an illustration showing Appliance connections, see the block diagram Figure 1-1.

For more information about the appliance shell, see *vCenter Server Appliance Configuration*.

vSphere Web Client and the vCenter Server Appliance

The vSphere Web Client is a user interface for general management tasks.

For an illustration showing Appliance connections, see the block diagram Figure 1-1.

DCLI and the vCenter Server Appliance

The Data Center CLI (DCLI) is a CLI client of the VMware vSphere® Automation™ SDK. Almost all methods that are available in the vSphere Automation SDKs are available as DCLI commands.

You can run the DCLI from the VMware vSphere® Command-Line Interface (vCLI) package or from the appliance shell.

For an illustration showing appliance connections, see the block diagram Figure 1-1.

For more information about the DCLI, see *Getting Started with vSphere Command-Line Interfaces*.

Quick Start with vCenter Server Appliance APIs

You can start using the vCenter Server Appliance APIs without accessing the Lookup Service Endpoint or the vCenter Single Sign-On Endpoint. In a production environment, you might instead use centralized service registration and token authentication.

To use the vCenter Server Appliance APIs without the Lookup Service or token authentication, see vCenter Single Sign-On User Name and Password Authentication for the vCenter Server Appliance.

vCenter Server Appliance Programming Environment 2

The vCenter Server Appliance is a key component in your vSphere environment, providing several services for data center management, as well as its own management.

This chapter includes the following topics:

Platform Services Controller Services

With Platform Services Controller, all VMware products within the same environment can share the authentication domain and other services. Services include certificate management, authentication, and licensing.

Platform Services Controller includes the following core infrastructure services.

Table 2-1. Platform Services Controller Services

Service	Description
`applmgmt` (VMware Appliance Management Service)	Handles appliance configuration and provides public API endpoints for appliance lifecycle management. Included on the Platform Services Controller appliance.
`vmware-cis-license` (VMware License Service)	Each Platform Services Controller includes VMware License Service, which delivers centralized license management and reporting functionality to VMware products in your environment. The license service inventory replicates across all Platform Services Controller in the domain at 30-second intervals.
`vmware-cm` (VMware Component Manager)	Component manager provides service registration and lookup functionalities.

Table 2-1. Platform Services Controller Services (Continued)

Service	Description

`vmware-sts-idmd`
(VMware Identity Management Service)
`vmware-stsd`
(VMware Security Token Service)
	Services behind the vCenter Single Sign-On feature, which provide secure authentication services to VMware software components and users.
	By using vCenter Single Sign-On, the VMware components communicate using a secure SAML token exchange mechanism. vCenter Single Sign-On constructs an internal security domain (vsphere.local by default) where the VMware software components are registered during installation or upgrade.

`vmware-rhttpproxy` (VMware HTTP Reverse Proxy)	The reverse proxy runs on each Platform Services Controller node and each vCenter Server system. It is a single entry point into the node and enables services that run on the node to communicate securely.
`vmware-sca` (VMware Service Control Agent)	Manages service configurations. You can use the `service-control` CLI to manage individual service configurations.
`vmware-statsmonitor` (VMware Appliance Monitoring Service)	Monitor the vCenter Server Appliance guest operating system resource consumption.
`vmware-vapi-endpoint` (VMware vAPI Endpoint)	The vSphere Automation API endpoint provides a single point of access to vAPI services. You can change the properties of the vAPI Endpoint service from the vSphere Web Client. See the *vSphere Automation SDKs Programming Guide* for details on vAPI endpoints.
`vmafdd` VMware Authentication Framework	Service that provides a client-side framework for vmdir authentication and serves the VMware Endpoint Certificate Store (VECS).
`vmcad` VMware Certificate Service	Provisions each VMware software component that has the vmafd client libraries and each ESXi host with a signed certificate that has VMCA as the root certificate authority. You can change the default certificates by using the Certificate Manager utility. VMware Certificate Service uses the VMware Endpoint Certificate Store (VECS) to serve as a local repository for certificates on every Platform Services Controller instance. Although you can decide not to use VMCA and instead can use custom certificates, you must add the certificates to VECS.
`vmdird` VMware Directory Service	Provides a multitenant, multimastered LDAP directory service that stores authentication, certificate, lookup, and license information. Do not update data in `vmdird` by using an LDAP browser. If your domain contains more than one Platform Services Controller instance, an update of vmdir content in one vmdir instance is propagated to all other instances of vmdir.
`vmdnsd` VMware Domain Name Service	Not used in vSphere 6.x.

Table 2-1. Platform Services Controller Services (Continued)

Service	Description

`vmonapi`
VMware Lifecycle Manager API
`vmware-vmon`
VMware Service Lifecycle Manager
	Start and stop vCenter Server services and monitor service API health. The `vmware-vmon` service is a centralized platform-independent service that manages the lifecycle of Platform Services Controller and vCenter Server. Exposes APIs and CLIs to third-party applications.

`lwsmd` Likewise Service Manager	Likewise facilitates joining the host to an Active Directory domain and subsequent user authentication.
`pschealth` VMware Platform Services Controller Health Monitor	Monitors the health and status of all core Platform Services Controller infrastructure services.
`vmware-analytics` VMware Analytics Service	Consists of components that gather and upload telemetry data from various vSphere components to the VMware Analytics Cloud, and manage the Customer Experience Improvement Program (CEIP).

Platform Services in the vCenter Server Appliance Environment

The vCenter Server Appliance registers its services with the Platform Services Controller, but in some situations you might be unable to use the Lookup Service registration. In those situations, you must access an appliance endpoint directly.

A direct connection to the vCenter Server Appliance can become necessary in configurations where the Platform Services Controller is embedded in the appliance. When the appliance vCenter Server is being restored from a backup, or when the embedded Lookup Service is restarting, you might be unable to look up the appliance's service registration.

For more information about embedded or external Platform Services Controller configurations, see vSphere Deployment Configurations.

For more information about backup and restore operations, see Chapter 8 Maintenance of the vCenter Server Appliance.

vSphere Deployment Configurations

vSphere Automation client applications communicate with services on the Platform Services Controller and vCenter Server components of the virtual environment. vCenter Server can be deployed with an embedded or external Platform Services Controller.

vCenter Server with an Embedded Platform Services Controller

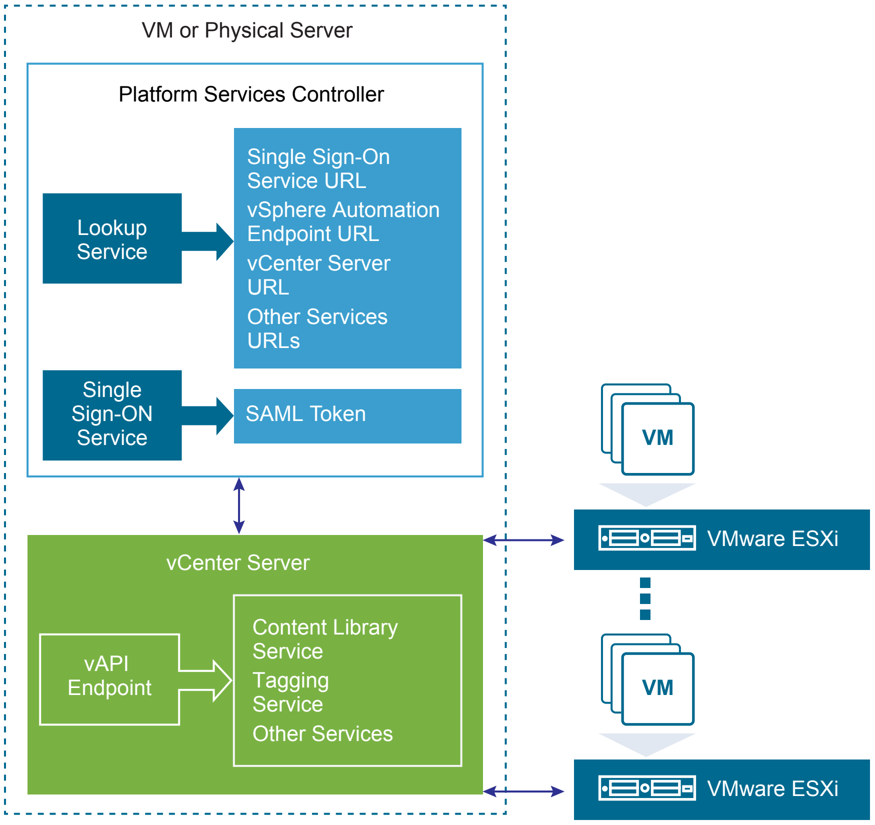
vCenter Server and Platform Services Controller reside on the same virtual machine or physical server. This deployment is most suitable for small environments such as development or test beds.

You can use the Platform Services Controller in two ways to establish secure, authenticated sessions for your client application, by making requests to the Lookup Service and the vCenter Single Sign-On Service.

One way to use the Platform Services Controller is to request an authentication token that can be used to authenticate requests across services. The client connects to the Lookup Service and retrieves the vCenter Single Sign-On Service endpoint and the vSphere Automation API endpoint. The client then uses the vCenter Single Sign-On endpoint to authenticate with user credentials and receive a token that securely verifies the client's credentials. This allows the client to authenticate with a number of service endpoints without sending user credentials over the network repeatedly.

Alternatively, if the client connects directly to the vSphere Automation API endpoint, there is no need for the client to interact with the vCenter Single Sign-On Service. The client sends user credentials to the vSphere Automation API endpoint, which creates a session identifier that persists across requests.

Figure 2-1. vCenter Server with Embedded Platform Services Controller

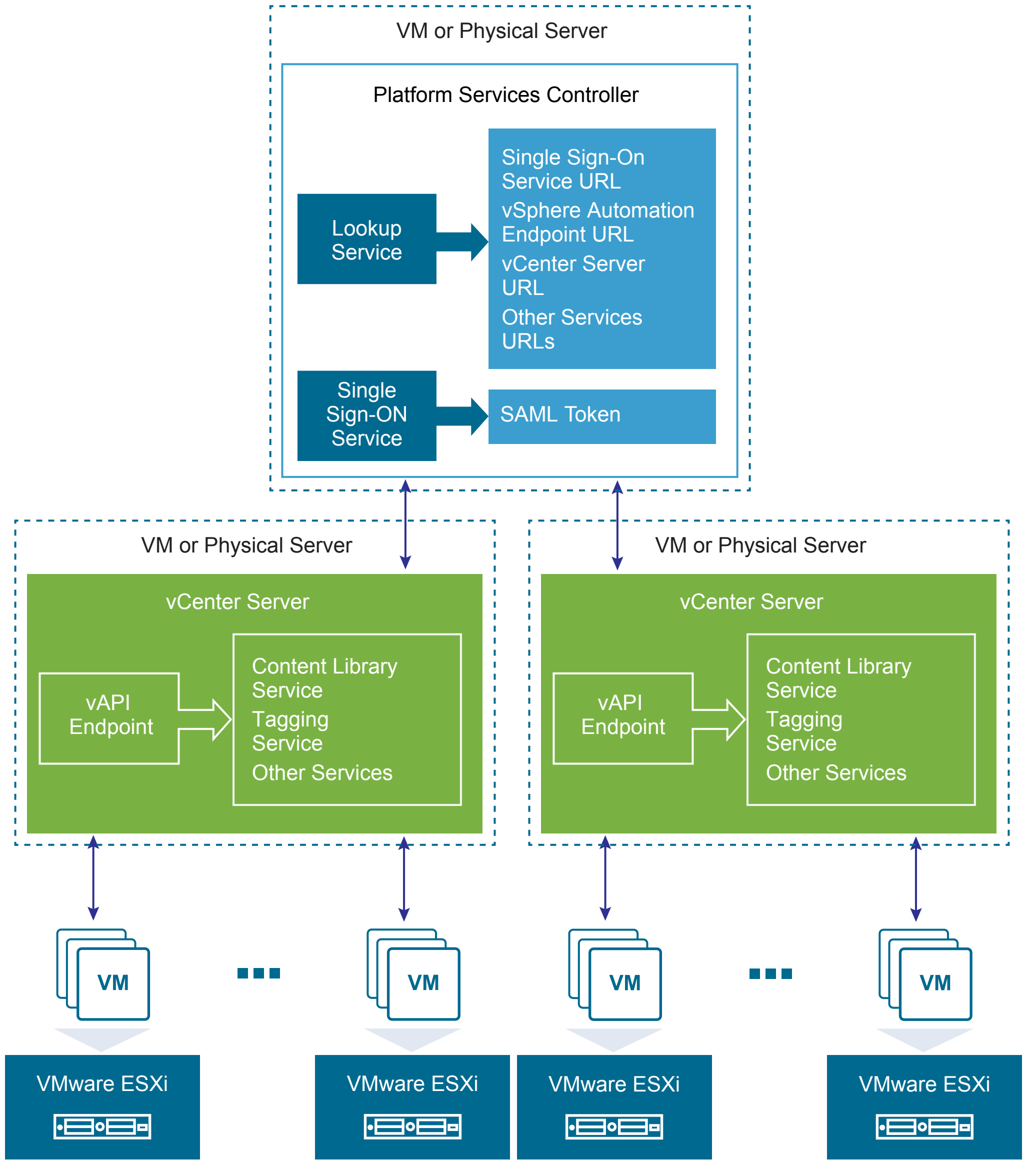


vCenter Server with an External Platform Services Controller

In the case of an external Platform Services Controller, the vCenter Server and the Platform Services Controller are deployed on separate virtual machines or physical servers. The Platform Services Controller can be shared across several vCenter Server instances. For larger deployments or to provide better availability, more than one Platform Services Controller can be deployed. When configured as replication partners within a single vCenter Single Sign-On domain, Platform Services Controller instances replicate all user and system data within the cluster.

A client application functions in a similar way as in a Platform Services Controller with embedded vCenter Server deployment. The only difference is that the client application can access services on multiple vCenter Server instances, or services only on a particular vCenter Server instance.

Figure 2-2. vCenter Server with External Platform Services Controller



Retrieving Service Endpoints 3

To access services and resources in the virtual environment, vSphere Automation API client applications must know the endpoints of vSphere Automation and vSphere services. Client applications retrieve service endpoints from the Lookup Service that runs on the Platform Services Controller.

The Lookup Service provides service registration and discovery by using a Web services API. By using the Lookup Service, you can retrieve endpoints of services on the Platform Services Controller and vCenter Server. The following endpoints are available from the Lookup Service.

- The vCenter Single Sign-On endpoint on the Platform Services Controller. You use the vCenter Single Sign-On service to get a SAML token and establish an authenticated session with a vSphere Automation endpoint or a vCenter Server endpoint.
- The vSphere Automation Endpoint on vCenter Server. Through the vSphere Automation Endpoint, you can make requests to vSphere Automation API services such as virtual machine management, Content Library, and Tagging.
- The vCenter Server endpoint. In an environment with external Platform Services Controller instances, you can use the vCenter Server endpoint to get the node ID of a particular vCenter Server instance. By using the node ID, you can retrieve service endpoints on that vCenter Server instance.
- The vSphere API endpoint and endpoints of other vSphere services that run on vCenter Server.

Workflow for Retrieving Service Endpoints

The workflow that you use to retrieve service endpoints from the Lookup Service might vary depending on the endpoints that you need and their number. Follow this general workflow for retrieving service endpoints.

1. Connect to the Lookup Service on the Platform Services Controller and service registration object so that you can query for registered services.
2. Create a service registration filter for the endpoints that you want to retrieve.
3. Use the filter to retrieve registration information for services from the Lookup Service.
4. Extract one or more endpoint URLs from the array of registration information that you receive from the Lookup Service.

This chapter includes the following topics:

Filtering for Predefined Service Endpoints

The Lookup Service maintains a registration list of vSphere services. You can use the Lookup Service to retrieve registration information for any service by setting a registration filter that you pass to the `List()` function on the Lookup Service. The functions and objects that you can use with the Lookup Service are defined in the `lookup.wsdl` file that is part of the SDK.

Lookup Service Registration Filters

You can query for service endpoints through a service registration object that you obtain from the Lookup Service. You invoke the `List()` function on the Lookup Service to list the endpoints that you need by passing `LookupServiceRegistrationFilter`. `LookupServiceRegistrationFilter` identifies the service and the endpoint type that you can retrieve.

Optionally, you can include the node ID parameter in the filter to identify the vCenter Server instance where the endpoint is hosted. When the node ID is omitted, the `List()` function returns the set of endpoint URLs for all instances of the service that are hosted on different vCenter Server instances in the environment.

For example, a `LookupServiceRegistrationFilter` for querying the vSphere Automation service has these service endpoint elements.

Table 3-1. Service Registration Filter Parameters

Filter Types	Value	Description
`LookupServiceRegistrationServiceType`	`product= "com.vmware.cis"`	vSphere Automation namespace.
	`type="cs.vapi"`	Identifies the vSphere Automation service.

Table 3-1. Service Registration Filter Parameters (Continued)

Filter Types	Value	Description
`LookupServiceRegistrationEndpointType`	`type="com.vmware.vapi.endpoint"`	Specifies the endpoint path for the service.
	`protocol= "vapi.json.https.public"`	Identifies the protocol that will be used for communication with the endpoint .

For information about the filter parameter of the available predefined service endpoints, see Filter Parameters for Predefined Service Endpoints.

Filter Parameters for Predefined Service Endpoints

Depending on the service endpoint that you want to retrieve, you provide different parameters to the `LookupServiceRegistrationFilter` that you pass to the `List()` function on the Lookup Service. To search for services on a particular vCenter Server instance, set the node ID parameter to the filter.

Table 3-2. Input Data for URL Retrieval for the Lookup Service Registration Filter

Service	Input Data	Value
vCenter Single Sign-On	product namespace	`com.vmware.cis`
	service type	`cs.identity`
	protocol	`wsTrust`
	endpoint type	`com.vmware.cis.cs.identity.sso`
vSphere Automation Endpoint	product namespace	`com.vmware.cis`
	service type	`cs.vapi`
	protocol	`vapi.json.https.public`
	endpoint type	`com.vmware.vapi.endpoint`
vCenter Server	product namespace	`com.vmware.cis`
	service type	`vcenterserver`
	protocol	`vmomi`
	endpoint type	`com.vmware.vim`
vCenter Storage Monitoring Service	product namespace	`com.vmware.vim.sms`
	service type	`sms`
	protocol	`https`
	endpoint type	`com.vmware.vim.sms`
vCenter Storage Policy-Based Management	product namespace	`com.vmware.vim.sms`
	service type	`sms`
	protocol	`https`
	endpoint type	`com.vmware.vim.pbm`
vSphere ESX Agent Manager	product namespace	`com.vmware.vim.sms`

Table 3-2. Input Data for URL Retrieval for the Lookup Service Registration Filter (Continued)

Service	Input Data	Value
	service type	`cs.eam`
	protocol	`vmomi`
	endpoint type	`com.vmware.cis.cs.eam.sdk`

Connect to the Lookup Service and Retrieve the Service Registration Object

You must connect to the Lookup Service to gain access to its operations. After you connect to the Lookup Service, you must retrieve the service registration object to make registration queries.

Procedure

1 Connect to the Lookup Service.

  a Configure a connection stub for the Lookup Service endpoint, which uses SOAP bindings, by using the HTTPS protocol.

  b Create a connection object to communicate with the Lookup Service.

2 Retrieve the Service Registration Object.

  a Create a managed object reference to the Service Instance.

  b Invoke the `RetrieveServiceContent()` method to retrieve the `ServiceContent` data object.

  c Save the managed object reference to the service registration object.

  With the service registration object, you can make registration queries.

Python Example of Connecting to the Lookup Service and Retrieving a Service Registration Object

The example is based on the code from the `lookup_service_helper.py` sample file.

Note For a complete and up-to-date version of the sample code, see the vSphere Automation SDK Python samples at GitHub.

```
...

# 1 - Create SOAP client object to communicate with the Lookup Service.
my_ls_stub = Client(url=wsdl_url, location=ls_url)

# 2 - Configure service & port type for client transaction.
my_ls_stub.set_options(service='LsService', port='LsPort')

# 3 - Manufacture a managed object reference.
managed_object_ref = \
    my_ls_stub.factory.create('ns0:ManagedObjectReference')
managed_object_ref._type = 'LookupServiceInstance'
managed_object_ref.value = 'ServiceInstance'

# 4 - Retrieve the ServiceContent object.
ls_service_content = \
my_ls_stub.service.RetrieveServiceContent(managed_object_ref)

# 5 - Retrieve the service registration object.
service_registration = ls_service_content.serviceRegistration
```

Retrieve Service Endpoints on vCenter Server Instances

You can create a function that obtains the endpoint URLs of a service on all vCenter Server instances in the environment. You can modify that function to obtain the endpoint URL of a service on a particular vCenter Server instance.

Prerequisites

- Establish a connection with the Lookup Service.
- Retrieve a service registration object.

Procedure

1 Create a registration filter object, which contains the following parts:

  - A filter criterion for service information
  - A filter criterion for endpoint information

Option	Description
Omit the node ID parameter	Retrieves the endpoint URLs of the service on all vCenter Server instances.
Include the node ID parameter	Retrieves the endpoint URL of the service on a particular vCenter Server instance.

2 Retrieve the specified service information by using the `List()` function.

Depending on whether you included the node ID parameter, the `List()` function returns one of the following results:

- A list of endpoint URLs for a service that is hosted on all vCenter Server instances in the environment.
- An endpoint URL of a service that runs on a particular vCenter Server instance.

What to do next

Call the function that you implemented to retrieve service endpoints. You can pass different filter parameters depending on the service endpoints that you need. For more information, see Filter Parameters for Predefined Service Endpoints.

To retrieve a service endpoint on a particular vCenter Server instance, you must retrieve the node ID of that instance and pass it to the function. For information about how to retrieve the ID of a vCenter Server instance, see Retrieve a vCenter Server ID by Using the Lookup Service.

Python Example of Retrieving Service Endpoints on vCenter Server Instances

This example provides a common pattern for filtering Lookup Service registration data. This example is based on the code in the `lookup_service_helper.py` sample file.

Note For a complete and up-to-date version of the sample code, see the vSphere Automation SDK Python samples at GitHub.

```
def lookup_service_infos(prod, svc_type, proto, ep_type, node_id='*') :

   # 1 - Create a filter criterion for service info.
   filter_service_type = \
     my_ls_stub.factory.create('ns0:LookupServiceRegistrationServiceType')
   filter_service_type.product = prod
   filter_service_type.type = svc_type

   # 2 - Create a filter criterion for endpoint info.
   filter_endpoint_type = \
     my_ls_stub.factory.create('ns0:LookupServiceRegistrationEndpointType')
   filter_endpoint_type.protocol = proto
   filter_endpoint_type.type = ep_type

   # 3 - Create the registration filter object.
   filter_criteria = \
     my_ls_stub.factory.create('ns0:LookupServiceRegistrationFilter')
   filter_criteria.serviceType = filter_service_type
   filter_criteria.endpointType = filter_endpoint_type
   if (node_id != '*') :
     filter_criteria.nodeId = node_id

   # 4 - Retrieve specified service info with the List() method.
   service_infos = my_ls_stub.service.List(service_registration,
                                           filter_criteria)
   return service_infos
```

Retrieve a vCenter Server ID by Using the Lookup Service

You use the node ID of a vCenter Server instance to retrieve the endpoint URL of a service on that vCenter Server instance. You specify the node ID in the service registration filter that you pass to the `List()` function on the Lookup Service.

Managed services are registered with the instance name of the vCenter Server instance where they run. The instance name maps to a unique vCenter Server ID. The instance name of a vCenter Server system is specified during installation and might be an FQDN or an IP address.

Prerequisites

- Establish a connection with the Lookup Service.
- Retrieve a service registration object.

Procedure

1. List the vCenter Server instances.
2. Find the matching node name of the vCenter Server instance and save the ID.

Use the node ID of the vCenter Server instance to filter subsequent endpoint requests. You can use the node ID in a function that retrieves the endpoint URL of a service on a vCenter Server instance. For information about implementing such a function, see Retrieve Service Endpoints on vCenter Server Instances.

Python Example of Retrieving a vCenter Server ID by Using the Lookup Service

This example provides a common pattern for filtering Lookup Service registration data. This example is based on the code in the `lookup_service_helper.py` sample file.

Note For a complete and up-to-date version of the sample code, see the vSphere Automation SDK Python samples at GitHub.

```
def get_mgmt_node_id(node_instance_name) :

   # 1 - List the vCenter Server instances.
   mgmt_node_infos = lookup_service_infos(prod='com.vmware.cis',
                                          svc_type='vcenterserver',
                                          proto='vmomi', ep_type='com.vmware.vim',
                                          node_id='*')

   # 2 - Find the matching node name and save the ID.
   for node in mgmt_node_infos :
     for attribute in node.serviceAttributes :
       if attribute.key == 'com.vmware.vim.vcenter.instanceName' :
         if attribute.value == node_instance_name :
           return node.nodeId
```

Retrieve a vSphere Automation Endpoint on a vCenter Server Instance

Through the vSphere Automation Endpoint, you can access other vSphere Automation services that run on vCenter Server, such as Content Library and Tagging. To use a vSphere Automation service, you must retrieve the vSphere Automation Endpoint.

Prerequisites

- Establish a connection with the Lookup Service.
- Retrieve a service registration object.
- Determine the node ID of the vCenter Server instance where the vSphere Automation service runs.
- Implement a function that retrieves the endpoint URL of a service on a vCenter Server instance.

Procedure

1 Invoke the function for retrieving the endpoint URL of a service on a vCenter Server instance by passing filter strings that are specific to the vSphere Automation endpoint.

2 Save the URL from the resulting single-element list.

Python Example of Retrieving a vSphere Automation Endpoint on a vCenter Server Instance

This example provides a common pattern for filtering Lookup Service registration data. This example is based on the code in the `lookup_service_helper.py` sample file.

Note For a complete and up-to-date version of the sample code, see the vSphere Automation SDK Python samples at GitHub.

```
service_infos = lookup_service_infos(prod='com.vmware.cis',
                                     svc_type='cs.vapi',
                                     proto='vapi.json.https.public',
                                     ep_type='com.vmware.vapi.endpoint',
                                     node_id=my_mgmt_node_id)
my_vapi_url = service_infos[0].serviceEndpoints[0].url
```

Authentication Mechanisms 4

The vCenter Server Appliance accepts several authentication methods. The authentication method that you choose depends on whether you choose token authentication, and on the state of the appliance.

During normal operation, the vCenter Server Appliance enables you to authenticate with vCenter Single Sign-On credentials. You have the option to use either token authentication or user name and password authentication. The user name and password must be recognized within the vCenter Single Sign-On domain.

However, during the process of restoring the Appliance from a backup image, you must use a different authentication protocol. For more information, see Restoring the vCenter Server Appliance.

This chapter includes the following topics:

vCenter Single Sign-On User Name and Password Authentication for the vCenter Server Appliance

You can authenticate with the vCenter Server Appliance by using a user name and password known to the vCenter Single Sign-On Service.

If you prefer to delegate the process of requesting a SAML token for your API client, you can present your vCenter Single Sign-On domain credentials to the vSphere Automation API endpoint and request a session ID. The endpoint process forwards your credentials to the vCenter Single Sign-On Service and requests a SAML token on your behalf. In this case, you never deal with the token.

Authenticate with vCenter Single Sign-On Credentials and Create a Session

To establish a session with the vSphere Automation API Endpoint in the vCenter Server Appliance, you create a connection to the endpoint and authenticate with vCenter Single Sign-On credentials to receive a session ID.

Prerequisites

To perform this task, you must have the following items in place:

- The DNS name or IP address of the vCenter Server Appliance
- A vCenter Single Sign-On domain account that has the requisite permissions for the operation that you intend to invoke

Procedure

1. Create a connection context by specifying the vSphere Automation API Endpoint URL and the message protocol to be used for the connection.

2. Create the request options or stub configuration and set the specific security context to be used.

   The security context contains the vCenter Single Sign-On user name and password that are used for authenticating to the vSphere Automation API Endpoint.

3. Create an interface stub or a REST path that uses the stub configuration.

   The interface stub corresponds to the interface containing the method to be invoked.

4. Invoke the session `create` method.

   The service creates an authenticated session and returns a session identification cookie to the client.

5. Add the cookie to your request headers or to a security context for your client stub configuration.

6. Remove the basic authentication from your request headers or the security context of your client stub configuration.

Subsequent method calls authenticate with the session cookie instead of the user name and password.

What to do next

Use the updated stub configuration with the session ID to create a stub for the interface that you want to use. Method calls on the new stub use the session ID to authenticate.

JavaScript Example of Creating a vSphere Automation API Session with vCenter Single Sign-On Credentials

This example shows the use of JavaScript with the vSphere Automation SDK for REST to send a session creation request to the vCenter Server Appliance using vCenter Single Sign-On credentials. The example retrieves a session cookie for future authentication. The JavaScript code depends on the `Node.js` package, which allows it to run standalone.

This example depends on the following global variables.

- *my_vcsa_host*
- *my_sso_username*
- *my_sso_password*
- *my_http_options*

For clarity, this example specifies a complete set of HTTP options for the NodeJS request, rather than retaining and modifying an existing object.

```
var https = require('https');
var httpPort = 443;
var httpPath = '/rest/com/vmware/cis/session';
var httpMethod = 'POST';

// Prepare the HTTP request.
my_http_options = {
  host: my_vcsa_host,
  port: httpPort,
  path: httpPath,
  method: httpMethod,
  rejectUnauthorized: false,
  requestCert: true,
  agent: false,
  auth: my_sso_username + ":" + my_sso_password
};

// Define the callbacks.
function callback(res) {
  console.log("STATUS: " + res.statusCode);
  res.on('error', function(err) { console.log("ERROR in SSO authentication: ", err) });
  res.on('data', function(chunk) {});
  res.on('end', function() {
    if (res.statusCode == 200) {
      // Save session ID authentication.
      var cookieValue = res.headers['set-cookie'];
      my_http_options.headers = {'Cookie': cookieValue};
      // Remove username-password authentication.
      my_http_options.auth = {};
  }
  console.log("Session ID:\n" + res.headers['set-cookie']);
};

// Issue the session creation request.
https.request(my_http_options, callback).end();
```

Java Example of Creating a vSphere Automation API Session with User Credentials

This example is based on the code in the `VapiAuthenticationHelper.java` sample.

Note For a complete and up-to-date version of the sample code, see the vSphere Automation SDK Java samples at GitHub.

```
...

this.stubFactory = createApiStubFactory(server, httpConfig);

// Create a security context for username/password authentication
```

```
SecurityContext securityContext =
        SecurityContextFactory.createUserPassSecurityContext(
            username, password.toCharArray());

// Create a stub configuration with username/password security context
StubConfiguration stubConfig = new StubConfiguration(securityContext);

// Create a session stub using the stub configuration.
Session session =
        this.stubFactory.createStub(Session.class, stubConfig);

// Login and create a session
char[] sessionId = session.create();

// Initialize a session security context from the generated session id
SessionSecurityContext sessionSecurityContext =
        new SessionSecurityContext(sessionId);

// Update the stub configuration to use the session id
stubConfig.setSecurityContext(sessionSecurityContext);

/*
 * Create a stub for the session service using the authenticated
 * session
 */
this.sessionSvc =
        this.stubFactory.createStub(Session.class, stubConfig);

VM vmService = this.stubFactory.createStub(VM.class, stubConfig);
```

Python Example of Creating a vSphere Automation API Session with SSO Credentials

This example is based on code in the `vapiconnect.py` sample file.

This example uses the following global variables.

- *my_vapi_hostname*
- *my_sso_username*
- *my_sso_password*
- *my_stub_config*

Note For a complete and up-to-date version of the sample code, see the vSphere Automation SDK Python samples at GitHub.

```
import requests
from com.vmware.cis_client import Session
from vmware.vapi.lib.connect import get_requests_connector
from vmware.vapi.security.session import create_session_security_context
from vmware.vapi.security.user_password import create_user_password_security_context
from vmware.vapi.stdlib.client.factories import StubConfigurationFactory
```

```
# Create a session object in the client.
session = requests.Session()

# For development environment only, suppress server certificate checking.
session.verify = False

# Create a connection for the session.
vapi_url = 'https://' + my_vapi_hostname + '/api'
connector = get_requests_connector(session=session, url=vapi_url)

# Add username/password security context to the connector.
basic_context = create_user_password_security_context(my_sso_username,
                                                      my_sso_password)
connector.set_security_context(basic_context)

# Create a stub configuration by using the username-password security context.
my_stub_config = StubConfigurationFactory.new_std_configuration(connector)

# Create a Session stub with username-password security context.
session_stub = Session(my_stub_config)

# Use the create operation to create an authenticated session.
session_id = session_stub.create()

# Create a session ID security context.
session_id_context = create_session_security_context(session_id)

# Update the stub configuration with the session ID security context.
my_stub_config.connector.set_security_context(session_id_context)
```

vCenter Single Sign-On Token Authentication for the vCenter Server Appliance

You can authenticate with the vCenter Server Appliance by using a SAML token from the vCenter Single Sign-On Service. The token can be either a bearer token or a holder-of-key token.

To use SAML token authentication, you issue a request to the vCenter Single Sign-On Service, specifying the token type (bearer or holder-of-key), expected token lifetime, renewability, and other parameters. You also supply a user name and password combination that is valid in the vCenter Single Sign-On domain. These credentials must have an associated role with sufficient privilege for the operations that you intend to invoke with the Management API.

If the vCenter Single Sign-On Service accepts your credentials, it responds with an XML message. The message contains a SAML assertion that your client can extract and present as an `Authorization` header in an HTTP request to the vSphere Automation API endpoint.

Retrieve a SAML Token

The vCenter Single Sign-On service provides authentication mechanisms for securing the operations that your client application performs in the virtual environment. Client applications use SAML security tokens for authentication.

Client applications use the vCenter Single Sign-On service to retrieve SAML tokens. For more information about how to acquire a SAML security token, see the *vCenter Single Sign-On Programming Guide* documentation.

Prerequisites

Verify that you have the vCenter Single Sign-On URL. You can use the Lookup Service on the Platform Services Controller to obtain the endpoint URL. For information about retrieving service endpoints, see Chapter 3 Retrieving Service Endpoints.

Procedure

1 Create a connection object to communicate with the vCenter Single Sign-On service.

   Pass the vCenter Single Sign-On endpoint URL, which you can get from the Lookup Service.

2 Issue a security token request by sending valid user credentials to the vCenter Single Sign-On service on the Platform Services Controller.

The vCenter Single Sign-On service returns a SAML token.

What to do next

You can present the SAML token to the vSphere Automation API Endpoint or other endpoints, such as the vSphere Web Services Endpoint. The endpoint returns a session ID and establishes a persistent session with that endpoint. Each endpoint that you connect to uses your SAML token to create its own session.

JavaScript Example of Retrieving a SAML Token

This example shows the use of JavaScript with the vSphere Automation SDK for REST to send a SAML token request to the vCenter Single Sign-On endpoint.

The example assumes that you have previously saved certain connection information in global variables. The JavaScript depends on the `Node.js` package, which allows it to run standalone.

This example depends on the following global variables.

- *my_sso_username*
- *my_sso_password*

- *my_psc_host*

```
var https = require('https');
var fs = require('fs');

var httpPort = 443;
var tokenFilename = './token.xml';

// Create connection settings object.
my_http_options = {
        host: my_psc_host,
        port: httpPort,
        path: '/sts/STSService/vsphere.local',
        method: 'POST',
        rejectUnauthorized: false,
        requestCert: true,
        agent: false,
        headers: {
           'Content-type': 'text/xml; charset="UTF-8"',
           'Content-length': 0,
           'User-Agent': 'VMware/jsSample',
           'Connection': 'keep-alive',
           'SOAPAction': "http://docs.oasis-open.org/ws-sx/ws-trust/200512/RST/Issue"
        }
 };

// Set parameters for token lifetime.
var now = new Date();
var created = now.toISOString();
now.setHours(now.getHours() + 1);
var expires = now.toISOString();

// Build SOAP token request.
var requestXml = '<SOAP-ENV:Envelope
xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"> \
  <SOAP-ENV:Header xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"> \
    <ns5:Security \
       xmlns="http://docs.oasis-open.org/ws-sx/ws-trust/200512" \
       xmlns:ns2="http://www.w3.org/2005/08/addressing" \
       xmlns:ns3= \
        "http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-wssecurity-utility-1.0.xsd" \
       xmlns:ns4="http://www.rsa.com/names/2009/12/std-ext/WS-Trust1.4/advice" \
       xmlns:ns5= \
        "http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-wssecurity-secext-1.0.xsd"> \
      <ns3:Timestamp> \
        <ns3:Created>' + created + '</ns3:Created> \
        <ns3:Expires>' + expires + '</ns3:Expires> \
      </ns3:Timestamp> \
      <ns5:UsernameToken> \
        <ns5:Username>' + my_sso_username + '</ns5:Username> \
        <ns5:Password>' + my_sso_password + '</ns5:Password> \
      </ns5:UsernameToken> \
    </ns5:Security> \
  </SOAP-ENV:Header> \
  <SOAP-ENV:Body xmlns:SOAP-ENV="http://schemas.xmlsoap.org/soap/envelope/"> \
    <RequestSecurityToken \
      xmlns="http://docs.oasis-open.org/ws-sx/ws-trust/200512" \
      xmlns:ns2="http://www.w3.org/2005/08/addressing" \
      xmlns:ns3= \
        "http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-wssecurity-utility-1.0.xsd" \
      xmlns:ns4="http://www.rsa.com/names/2009/12/std-ext/WS-Trust1.4/advice" \
      xmlns:ns5= \
        "http://docs.oasis-open.org/wss/2004/01/oasis-200401-wss-wssecurity-secext-1.0.xsd"> \
      <TokenType>urn:oasis:names:tc:SAML:2.0:assertion</TokenType> \
      <RequestType>http://docs.oasis-open.org/ws-sx/ws-trust/200512/Issue</RequestType> \
      <Lifetime> \
        <ns3:Created>' + created + '</ns3:Created> \
        <ns3:Expires>' + expires + '</ns3:Expires> \
      </Lifetime> \
      <Renewing Allow="true" OK="false" /> \
      <Delegatable>true</Delegatable> \
      <KeyType>http://docs.oasis-open.org/ws-sx/ws-trust/200512/Bearer</KeyType> \
   <SignatureAlgorithm>http://www.w3.org/2001/04/xmldsig-more#rsa-sha256</SignatureAlgorithm> \
    </RequestSecurityToken> \
  </SOAP-ENV:Body> \
</SOAP-ENV:Envelope>'

// Define callback to extract SAML assertion.
function extractToken(xmlResponse) {
  var token;
token=xmlResponse.toString().match(/\<saml2:Assertion[\s\S]*\<\/saml2:Assertion\>/m).toString();
  return token;
}

// Define request callback functions.
var callback = function(res) {
  str = '';
  res.on('error', function(err) {console.log("ERROR in SSO authentication", err)});
  res.on('data', function(chunk) {str += chunk});
  res.on('end', function() {
    console.log("SSO: Authenticated successfully");
    my_saml_token = extractToken(str);
    fs.writeFile(tokenFilename, my_saml_token, function(err){
      if (err) {
        console.log("Couldn't save SAML token to " tokenFilename)
      } else {
        console.log("Saved SAML token to " + tokenFilename)
      }
    });
  });
}

// Issue security token request.
my_http_options.headers['Content-length'] = requestXml.length;
https.request(my_http_options, callback).end(requestXml);
```

Java Example of Retrieving a SAML Token

The example is based on the code in the `ExternalPscSsoWorkflow.java` sample.

Note For a complete and up-to-date version of the sample code, see the vSphere Automation SDK Java samples at GitHub.

```
...

LookupServiceHelper lookupServiceHelper = new LookupServiceHelper(
            this.lookupServiceUrl);

System.out.println("\nStep 2: Discover the Single Sign-On service URL"
                   + " from lookup service.");
String ssoUrl = lookupServiceHelper.findSsoUrl();

System.out.println("\nStep 3: Connect to the Single Sign-On URL and "
                   + "retrieve the SAML bearer token.");
SamlToken samlBearerToken = SsoHelper.getSamlBearerToken(ssoUrl,
    username,
    password);
```

Python Example of Retrieving a SAML Token

This example is based on the code in the `external_psc_sso_workflow.py` sample file.

This example uses the following global variables.

- *my_vapi_hostname*
- *my_sso_username*
- *my_sso_password*

Note For a complete and up-to-date version of the sample code, see the vSphere Automation SDK Python samples at GitHub.

```
from vsphere.samples.common import sso

# Use the SsoAuthenticator utility class to retrieve
# a bearer SAML token from the vCenter Single Sign-On service.
sso_url = 'https://' + my_vapi_hostname + ':7444/ims/STSService'
authenticator = sso.SsoAuthenticator(sso_url)
saml_token = authenticator.get_bearer_saml_assertion(my_sso_username,
                                                     my_sso_password,
                                                     delegatable=True)
```

Create a vSphere Automation Session with a SAML Token

To establish a vSphere Automation session, you create a connection to the vSphere Automation API Endpoint and then you authenticate with a SAML token to create a session for the connection.

Prerequisites

- Retrieve the vSphere Automation Endpoint URL from the Lookup Service.
- Obtain a SAML token from the vCenter Single Sign-On service.

Procedure

1 Create a connection by specifying the vSphere Automation API Endpoint URL and the message protocol to be used for the connection.

Note To transmit your requests securely, use **`https`** for the vSphere Automation API Endpoint URL.

2 Create the request options or stub configuration and set the security context to be used.

The security context object contains the SAML token retrieved from the vCenter Single Sign-On service. Optionally, the security context might contain the private key of the client application.

3 Create an interface stub or a REST path that uses the stub configuration instance.

The interface stub corresponds to the interface containing the method to be invoked.

4 Invoke the session `create` method.

The service creates an authenticated session and returns a session identification cookie to the client.

5 Create a security context instance and add the session ID to it.

6 Update the stub configuration instance with the session security context.

What to do next

Use the updated stub configuration with the session ID to create a stub for the interface that you want to use. Method calls on the new stub use the session ID to authenticate.

JavaScript Example of Creating a vSphere Automation API Session with a SAML Token

This example shows the use of JavaScript with the vSphere Automation SDK for REST to apply a SAML token to the vSphere Automation API Endpoint and exchange it for a vSphere Automation API session ID.

The example assumes that you have previously saved certain connection information in global variables. The JavaScript depends on the `Node.js` package, which allows it to run standalone.

This example depends on the following global variables.

- *my_vapi_host*
- *my_vapi_port*

- *my_saml_token*
- *my_http_options*

```
// Import required libraries.
var sso = require('./sso');
var https = require('https');
var gzip = require('gzip-js');

// Configure HTTP request.
var sessionPath = '/rest/com/vmware/cis/session';
var httpMethod = 'POST';

// Base64 encode the token value for the security context.
var b64Token = new Buffer(gzip.zip(my_saml_token)).toString('base64');

// Build the Authorization header value.
var start = 0;
var bufSize = 3 * 1024;
var prefix = 'SIGN ';
var authArray = [];
while (start < b64Token.length) {
  var end = start + bufSize;
  authArray.push(prefix + 'token="' + b64Token.slice(start, end) + '"');
  start = end;
  prefix = '';
}

// Prepare the HTTP request.
my_http_options = {
  host: my_vapi_host,
  port: my_vapi_port,
  path: sessionPath,
  method: httpMethod,
  rejectUnauthorized: false,
  requestCert: true,
  agent: false,
  headers: {
    'Authorization': authArray
  }
};

// Define the callbacks.
function callback(res) {
  res.on('error', function(err) { console.log('Login error: ', err) });
  res.on('data', function(chunk) {});
  res.on('end', function() {
    var cookieValue = res.headers['set-cookie'];
    my_http_options[headers] = {'Cookie': cookieValue,
                                'Content-Type': 'application/json'}  // Save the session ID.
  }
}

// Issue the login request.
https.request(my_http_options, callback).end();
```

Java Example of Creating a vSphere Automation API Session with a SAML Token

This example is based on the code in the `ExternalPscSsoWorkflow.java` sample.

Note For a complete and up-to-date version of the sample code, see the vSphere Automation SDK Java samples at GitHub.

```
...

this.stubFactory = createApiStubFactory(server, httpConfig);

// Create a SAML security context using SAML bearer token
SecurityContext samlSecurityContext =
        SecurityContextFactory.createSamlSecurityContext(
            samlBearerToken, null);

// Create a stub configuration with SAML security context
StubConfiguration stubConfig =
        new StubConfiguration(samlSecurityContext);

// Create a session stub using the stub configuration.
Session session =
        this.stubFactory.createStub(Session.class, stubConfig);

// Log in and create a session
char[] sessionId = session.create();

// Initialize a session security context from the generated session id
SessionSecurityContext sessionSecurityContext =
        new SessionSecurityContext(sessionId);

// Update the stub configuration to use the session id
stubConfig.setSecurityContext(sessionSecurityContext);

/*
 * Create a stub for the session service using the authenticated
 * session
 */
this.sessionSvc =
        this.stubFactory.createStub(Session.class, stubConfig);

VM vmService = this.stubFactory.createStub(VM.class, stubConfig);
```

Python Example of Creating a vSphere Automation API Session with a SAML Token

This example is based on code in the `external_psc_sso_workflow.py` sample file.

This example uses the following global variables.

- *my_vapi_hostname*
- *my_stub_config*
- *saml_token*

The example assumes that you previously obtained a vSphere Automation API URL from the Lookup Service, and a SAML token from the vCenter Single Sign-On Service.

Note For a complete and up-to-date version of the sample code, see the vSphere Automation SDK Python samples at GitHub.

```
...

# Create a session object in the client.
session = requests.Session()

# For development environment only, suppress server certificate checking.
session.verify = False
from requests.packages.urllib3 import disable_warnings
from requests.packages.urllib3.exceptions import InsecureRequestWarning
disable_warnings(InsecureRequestWarning)

# Create a connection for the session.
vapi_url = 'https://' + my_vapi_hostname + '/api'
connector = get_requests_connector(session=session, url=vapi_url)

# Add SAML token security context to the connector.
saml_token_context = create_saml_bearer_security_context(saml_token)
connector.set_security_context(saml_token_context)

# Create a stub configuration by using the SAML token security context.
my_stub_config = StubConfigurationFactory.new_std_configuration(connector)

# Create a Session stub with SAML token security context.
session_stub = Session(my_stub_config)

# Use the create operation to create an authenticated session.
session_id = session_stub.create()

# Create a session ID security context.
session_id_context = create_session_security_context(session_id)

# Update the stub configuration with the session ID security context.
my_stub_config.connector.set_security_context(session_id_context)
```

Authorization Model for Administration of the vCenter Server Appliance

5

There are three types of authorization levels in the vCenter Server Appliance.

Table 5-1. Authorization Levels

Authorization Level	Description
operator	A user has read access to appliance configuration settings.
administrator	A user has read and write access to the appliance configuration settings, but cannot manage user accounts.
super administrator	A user has all the capabilities of the other roles, and has the additional capabilities of creating local user accounts and accessing the local Bash shell.

This model applies to the API and all other interfaces to the vCenter Server Appliance except when you use SSH and log in using a local account.

This chapter includes the following topics:

Authorization Model Mapping to the vCenter Single Sign-On Domain

The three-level authorization model of the vCenter Server Appliance maps to local roles and to vCenter Single Sign-On groups, depending on how the user authenticated. This model allows consistent security control regardless of operational context.

The authorization levels map to group and role.

Table 5-2. Authorization Mapping

Authorization Level	vCenter Single Sign-On Group	Appliance Local Role
operator	SystemConfiguration.Administrators	operator
administrator	SystemConfiguration.Administrators	admin
superAdministrator	SystemConfiguration.BashShellAdministrators	superAdmin

When a super administrator adds user accounts, the options available include a choice of the role to assign to the new user.

Using the Appliance Operator Role

The **operator** role is the most restricted of the authorization levels available to users who work with the vCenter Server Appliance.

Appliance operators are allowed to view information about the appliance. They are not allowed to alter its configuration. The **operator** role is suited for monitoring and reporting functions. For example, the **operator** role allows access to these methods:

- resources.system.health.get
- resources.storage.stats.list
- services.status.get

Using the Appliance Admin Role

The **administrator** role provides an intermediate authorization level for users who manage the vCenter Server Appliance.

An **administrator** role is required for users who alter the appliance configuration, exercise control functions, or other operations that can affect appliance users.

For example, use the **administrator** role for these methods:

- networking.ip4v.renew
- networking.firewall.addr.inbound.add
- services.control
- shutdown.reboot

Using the Appliance SuperAdmin Role

The **superAdmin** role is the most expansive authorization level for users who manage the vCenter Server Appliance.

The **superAdmin** role allows unrestricted access to the appliance. This role is required for adding or altering user accounts and for using the Bash shell.

Installing, Upgrading, and Converging the vCenter Server Appliance and Platform Services Controller Appliance

6

You can use the vCenter Server Appliance API to perform operations related to stage 2 of the appliance installation and upgrade processes. You can also perform historical data transfer and convergence operations.

This chapter includes the following topics:

Install Stage 2

The vCenter Server Appliance API provides methods for performing stage 2 deployment operations on a newly installed appliance.

The vCenter Server Appliance is deployed in two stages. With stage 1 of the deployment process, you deploy the OVA file, which is included in the appliance installer. With stage 2 of the deployment process, you set up and start the services of the newly deployed appliance.

To complete stage 1 of the deployment process, you can use the GUI installer or perform a CLI deployment. For details, see *vSphere Installation and Setup*. Alternatively, you can perform a deployment by using the VMware OVF Tool. See the *OVF Tool User's Guide*.

Setting Up a Newly Installed Appliance

You can use the API to set up a newly deployed vCenter Server Appliance or Platform Services Controller appliance.

After stage 1 of the deployment process completes successfully, the appliance enters in an `INITIALIZED` state. If the appliance is not initialized, you cannot run stage 2 of the deployment process. You can get the state of the appliance by using the `vcenter deployment` service. The appliance can enter six states during the deployment process.

Figure 6-1. Install Stage 2 State Diagram

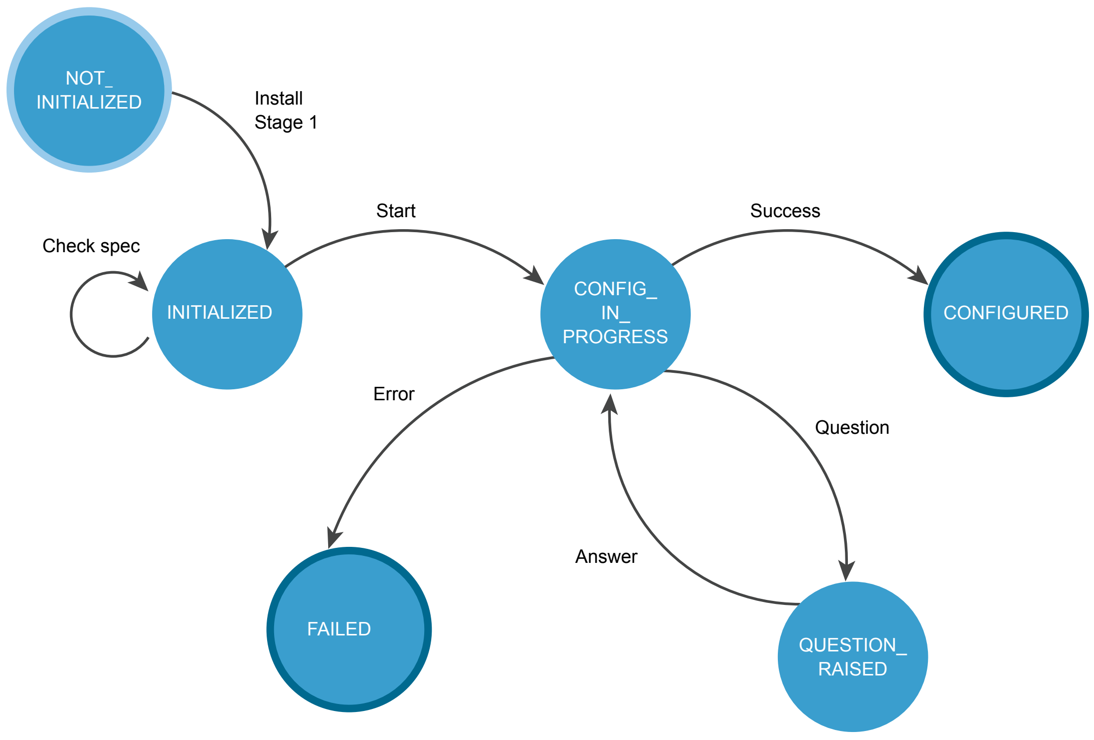


Table 6-1. Appliance States During Install Stage 2

State	Description
`NOT_INITIALIZED`	The install stage 1 phase is in progress, not started, or failed.
`INITIALIZED`	The appliance is deployed and ready for setup.
`CONFIG_IN_PROGRESS`	The setup process is in progress.
`QUESTION_RAISED`	You must answer the question to continue the setup process. The appliance stays in the `QUESTION_RAISED` state until it receives the correct answer.
`FAILED`	Errors occurred during the setup process. You can check the errors, warnings, and info data structures.
`CONFIGURED`	The appliance is installed and configured successfully.

`FAILED` and `CONFIGURED` are final states.

Table 6-2 lists operations that you can perform to set up your newly deployed appliance.

Table 6-2. User Operations

Operation	Description
Get deployment information	You can retrieve information about the current deployment status. This operation is useful both before initiating stage 2 of the deployment and for monitoring the progress of the setup process.
Validate the configuration document	You can optionally verify whether your install spec is valid before starting the setup process.

Table 6-2. User Operations (Continued)

Operation	Description
Configure the appliance	You can initiate the setup process by providing an install spec that defines the values for the settings that you want to configure.
Get question	You can retrieve a question raised during the setup process.
Answer question	You can provide an answer to the question raised during the setup process. The available answer values are `YES`, `NO`, `OK`, `CANCEL`, `ABORT`, `RETRY`, and `IGNORE`. The possible answer values depend on the type of the question. **Note** Each question has a default answer value. If you set questions to receive automatic answers in the install spec and a question is raised during the setup process, the default answer value is automatically provided as the answer to the question.

For information about the HTTP requests that you can use to perform the user operations, see HTTP Requests for Install Stage 2.

HTTP Requests for Install Stage 2

You can use HTTP requests to set up a newly deployed vCenter Server Appliance or Platform Services Controller appliance.

HTTP Requests

After stage 1 of the deployment process completes successfully, you can perform setup by sending HTTP requests.

Note When you send the requests, you must authenticate with vCenter Server Appliance **root** credentials.

The following HTTP requests show the syntax that you can use to perform the available user operations.

- Get deployment information

```
GET https://<appliance>:5480/rest/vcenter/deployment
```

- Validate the install spec

```
POST https://<appliance>:5480/rest/vcenter/deployment/install?action=check
```

- Configure the appliance

```
POST https://<appliance>:5480/rest/vcenter/deployment/install?action=start
```

- Get question

```
GET https://<appliance>:5480/rest/vcenter/deployment/question
```

- Answer question

```
POST https://<appliance>:5480/rest/vcenter/deployment/question?action=answer
```

For information about the content and syntax of the HTTP request body, see the *API reference* documentation. For use case examples, see Use HTTP Requests to Set Up a Newly Deployed vCenter Server Appliance with an Embedded Platform Services Controller, Use HTTP Requests to Set Up a Newly Deployed Platform Services Controller Appliance, and Use HTTP Requests to Set Up a Newly Deployed vCenter Server Appliance with an External Platform Services Controller.

HTTP Status Codes and Errors

Table 6-3 lists the status codes that you can receive when you send HTTP requests.

Table 6-3. HTTP Status Codes and Errors

HTTP Status Code	Description	Operations that Return the Status Code
200	The operation is successful.	All operations. You can check the returned data in the results data structure.
400	You cannot perform the operation because the appliance is in the current state. For information about the states of the appliance, see Setting Up a Newly Installed Appliance.	■ Validate the install spec ■ Start the setup ■ Get the install spec ■ Get the raised question ■ Answer the question ■ Get the state of the appliance
401	You use an invalid user name or password, or authentication has failed.	■ Validate the install spec ■ Start the setup ■ Get the install spec ■ Get the raised question ■ Answer the question ■ Get the state of the appliance
404	The state of the appliance cannot be determined .	Get the appliance state.
500	There is a `vapi std` error. For information about the types of `vapi std` errors, see `vapi.std.errors` in the *API Reference* documentation.	Get the raised question.

If errors occur during the setup process, you can check the `results` data structure, the API log file, and download the appliance support bundle from `https://<appliance_address>:443/appliance/support-bundle`.

Use HTTP Requests to Set Up a Newly Deployed vCenter Server Appliance with an Embedded Platform Services Controller

You can send HTTP requests to complete stage 2 of the deployment process of a newly deployed vCenter Server Appliance with an embedded Platform Services Controller.

You set up a newly deployed appliance by providing configuration settings in the body of the HTTP request. The input fields in the body of the HTTP request depend on the type of your deployment. You can configure vCenter Server Appliance deployments with either an embedded or external Platform Services Controller, or a Platform Services Controller appliance deployment. For the other deployment types, see Use HTTP Requests to Set Up a Newly Deployed vCenter Server Appliance with an External Platform Services Controller and Use HTTP Requests to Set Up a Newly Deployed Platform Services Controller Appliance.

Prerequisites

- Verify that the newly deployed appliance is reachable.
- Verify that you have the correct credentials for sending HTTP requests.

Procedure

1 Check whether the appliance state is set to `INITIALIZED`.

```
GET https://<appliance>:5480/rest/vcenter/deployment
```

If the appliance is in the correct state, you receive a message body that contains the following line and you can continue with the setup process.

```
...
    "state": "INITIALIZED",
...
```

2 (Optional) Validate the configuration settings that you provide in the body of the HTTP request.

```
POST https://<appliance>:5480/rest/vcenter/deployment/install?action=check
```

The following example shows syntax that you can use in the body of the HTTP request.

```
{
  "spec": {
    "vcsa_embedded": {
        "ceip_enabled": true,
        "standalone": {
        "sso_domain_name": "vsphere.local",
        "sso_admin_password": "<your_password>"
      }
    },
    "auto_answer": true
  }
}
```

If the input is valid, you receive the following response.

```
{
    "status": "SUCCESS"
}
```

3 Initiate the setup process by providing valid input in the body of the HTTP request.

```
POST https://<appliance>:5480/rest/vcenter/deployment/install?action=start
```

4 Monitor the progress of the setup process.

```
GET https://<appliance>:5480/rest/vcenter/deployment
```

The following example shows part of the response body when the setup process is ongoing.

```
{
    "progress": {
        "completed": 2,
        "message": {
            "id": "install.ciscommon.component.starting",
            "args": [
                "VMware Authentication Framework"
            ],
            "default_message": "Starting VMware Authentication Framework..."
        },
        "total": 3
    },
    "status": "RUNNING",
    "state": "CONFIG_IN_PROGRESS",
    "operation": "INSTALL",
...
```

The following example shows part of the response body when the setup process has completed successfully.

```
{
    "subtask_order": [
        "rpminstall",
        "validate",
        "firstboot"
    ],
    "cancelable": false,
    "progress": {
        "completed": 3,
        "total": 3,
        "message": {
            "default_message": "Task has completed successfully.",
            "id": "com.vmware.vcenter.deploy.task.complete.success",
            "args": []
        }
    },
    "status": "SUCCEEDED",
    "description": {
        "default_message": "Install vCenter Server appliance.",
        "id": "com.vmware.vcenter.deploy.task.description.op.install",
        "args": []
    },
    "state": "CONFIGURED",
...
```

You successfully configured the newly deployed vCenter Server Appliance with an embedded Platform Services Controller.

Use HTTP Requests to Set Up a Newly Deployed Platform Services Controller Appliance

You can send HTTP requests to complete stage 2 of the deployment process of a newly deployed Platform Services Controller appliance.

You set up a newly deployed appliance by providing configuration settings in the body of the HTTP request. The input fields in the body of the HTTP request depend on the type of your deployment. You can configure vCenter Server Appliance deployments with either an embedded or external Platform Services Controller, or a Platform Services Controller appliance deployment. For the other deployment types, see Use HTTP Requests to Set Up a Newly Deployed vCenter Server Appliance with an Embedded Platform Services Controller and Use HTTP Requests to Set Up a Newly Deployed vCenter Server Appliance with an External Platform Services Controller.

Prerequisites

- Verify that the newly deployed appliance is reachable.
- Verify that you have the correct credentials for sending HTTP requests.

Procedure

1 Check whether the appliance state is set to `INITIALIZED`.

```
GET https://<appliance>:5480/rest/vcenter/deployment
```

If the appliance is in the correct state, you receive a message body that contains the following line and you can continue with the setup process.

```
...
    "state": "INITIALIZED",
...
```

2 (Optional) Validate the configuration settings that you provide in the body of the HTTP request.

```
POST https://<appliance>:5480/rest/vcenter/deployment/install?action=check
```

The following example shows syntax that you can use in the body of the HTTP request.

```
{
  "spec": {
    "psc": {
        "ceip_enabled": true,
        "standalone": {
        "sso_domain_name": "vsphere.local",
        "sso_site_name": "default-site",
        "sso_admin_password": "<your_password>"
      }
    },
    "auto_answer": true
  }
}
```

If the input is valid, you receive the following response.

```
{
    "status": "SUCCESS"
}
```

3 Initiate the setup process by providing valid input in the body of the HTTP request.

```
POST https://<appliance>:5480/rest/vcenter/deployment/install?action=start
```

4 Monitor the progress of the setup process.

```
GET https://<appliance>:5480/rest/vcenter/deployment
```

The following example shows part of the response body when the setup process is ongoing.

```
{
    "state": "CONFIG_IN_PROGRESS",
    "operation": "INSTALL",
    "cancelable": false,
    "progress": {
        "message": {
            "default_message": "Starting VMware HTTP Reverse Proxy...",
            "id": "install.ciscommon.component.starting",
            "args": [
                "VMware HTTP Reverse Proxy"
            ]
        },
        "total": 3,
        "completed": 2
    },
...
```

The following example shows part of the response body when the setup process has completed successfully.

```
{
    "subtask_order": [
        "rpminstall",
        "validate",
        "firstboot"
    ],
    "progress": {
        "completed": 3,
        "message": {
            "args": [],
            "id": "com.vmware.vcenter.deploy.task.complete.success",
            "default_message": "Task has completed successfully."
        },
        "total": 3
    },
    "end_time": "2018-03-01T15:30:48.019Z",
    "start_time": "2018-03-01T15:09:43.948Z",
    "service": "",
    "status": "SUCCEEDED",
    "state": "CONFIGURED",
...
```

You successfully configured the newly deployed Platform Services Controller appliance.

Use HTTP Requests to Set Up a Newly Deployed vCenter Server Appliance with an External Platform Services Controller

You can send HTTP requests to complete stage 2 of the deployment process of a newly deployed vCenter Server Appliance with an external Platform Services Controller.

You set up a newly deployed appliance by providing configuration settings in the body of the HTTP request. The input fields in the body of the HTTP request depend on the type of your deployment. You can configure vCenter Server Appliance deployments with either an embedded or external Platform Services Controller, or a Platform Services Controller appliance deployment. For the other deployment types, see Use HTTP Requests to Set Up a Newly Deployed vCenter Server Appliance with an Embedded Platform Services Controller and Use HTTP Requests to Set Up a Newly Deployed Platform Services Controller Appliance.

Prerequisites

- Verify that the newly deployed appliance is reachable.

- Verify that you have the correct credentials for sending HTTP requests.
- Verify that you have the FQDN of the external Platform Services Controller.

Procedure

1. Check whether the appliance state is set to `INITIALIZED`.

   ```
   GET https://<appliance>:5480/rest/vcenter/deployment
   ```

   If the appliance is in the correct state, you receive a message body that contains the following line and you can continue with the setup process.

   ```
   ...
       "state": "INITIALIZED",
   ...
   ```

2. (Optional) Validate the configuration settings that you provide in the body of the HTTP request.

   ```
   POST https://<appliance>:5480/rest/vcenter/deployment/install?action=check
   ```

   The following example shows syntax that you can use in the body of the HTTP request.

   ```
   {
     "spec": {
       "vcsa_external": {
           "https_port": 443,
           "psc_hostname": "<external_psc_fqdn>",
           "ssl_verify": false,
           "sso_admin_password": "<your_password>"
       },
       "auto_answer": true
     }
   }
   ```

   If the input is valid, you receive the following response.

   ```
   {
       "status": "SUCCESS"
   }
   ```

3. Initiate the setup process by providing valid input in the body of the HTTP request.

   ```
   POST https://<appliance>:5480/rest/vcenter/deployment/install?action=start
   ```

4 Monitor the progress of the setup process.

```
GET https://<appliance>:5480/rest/vcenter/deployment
```

The following example shows part of the response body when the setup process is ongoing.

```
...
    "operation": "INSTALL",
    "status": "RUNNING",
    "state": "CONFIG_IN_PROGRESS",
    "progress": {
        "completed": 2,
        "message": {
            "id": "install.ciscommon.component.starting",
            "args": [
                "VMware Analytics Service"
            ],
            "default_message": "Starting VMware Analytics Service..."
        },
        "total": 3
    }
}
```

The following example shows part of the response body when the setup process has completed successfully.

```
{
    "progress": {
        "message": {
            "default_message": "Task has completed successfully.",
            "id": "com.vmware.vcenter.deploy.task.complete.success",
            "args": []
        },
        "completed": 3,
        "total": 3
    },
    "start_time": "2018-03-01T16:04:13.663Z",
    "service": "",
    "operation": "INSTALL",
    "description": {
        "default_message": "Install vCenter Server appliance.",
        "id": "com.vmware.vcenter.deploy.task.description.op.install",
        "args": []
    },
...
    "end_time": "2018-03-01T17:37:16.181Z",
    "status": "SUCCEEDED",
    "cancelable": false,
    "state": "CONFIGURED"
}
```

You successfully configured the newly deployed vCenter Server Appliance with an external Platform Services Controller.

Workflows and Class Diagrams for Install Stage 2

You can use the `vcenter deployment` API to run the install stage 2 process of your vCenter Server Appliance and Platform Services Controller appliance.

Figure 6-2 and Figure 6-3 show example install workflows.

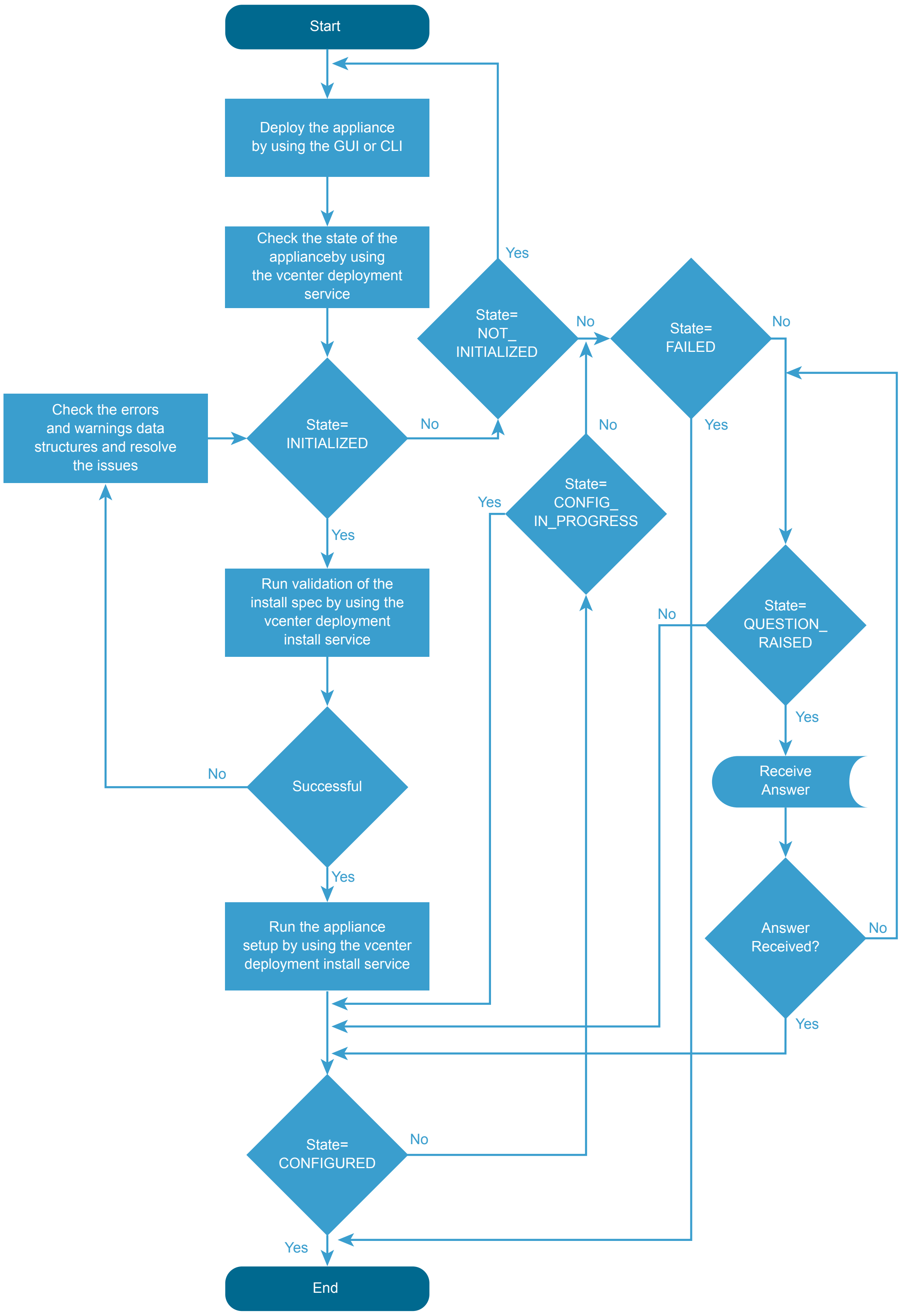
During stage 1, the appliance is in a `NOT_INITIALIZED` state. After a successful deployment, the appliance enters in an `INITIALIZED` state. If there are errors during stage 1, the appliance stays in a `NOT_INITIALIZED` state and you must redeploy it.

You can check the state of the appliance before, during, and after the setup process. You can run the install stage 2 process if the appliance is initialized. You can check the setup configuration before you initiate stage 2 by running the appliance pre-checks. If errors or warnings appear during the validation of the install specification, you must remove the causes and correct the specification.

During the setup process, the regular appliance state is `CONFIG_IN_PROGRESS`. The appliance can also enter in a `FAILED` or `QUESTION_RASED` state. If a question appears during the setup, the appliance enters in a `QUESTION_RAISED` state and stays in it until you provide an answer. You can set questions to receive automatic answers in the install spec and if a question is raised during the setup process, the default answer value is automatically provided as the answer to the question.

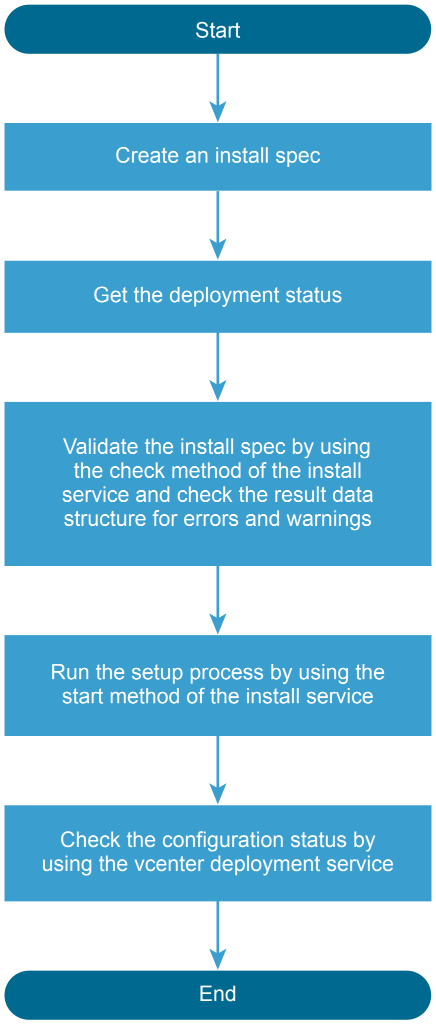
If errors occur during the setup process, the appliance enters in a `FAILED` state and you must restart the setup after the causes are removed. If the setup is successful, the appliance enters in a `CONFIGURED` state.

Figure 6-2. Install Workflow


Start
Deploy the appliance by using the GUI or CLI
Check the state of the applianceby using the vcenter deployment service
State= INITIALIZED
Check the errors and warnings data structures and resolve the issues
No
Yes
State= NOT_ INITIALIZED
Yes
No
State= FAILED
No
Yes
No
State= CONFIG_ IN_PROGRESS
Yes
Run validation of the install spec by using the vcenter deployment install service
Successful
No
Yes
Run the appliance setup by using the vcenter deployment install service
No
State= QUESTION_ RAISED
Yes
Receive Answer
Answer Received?
No
Yes
State= CONFIGURED
No
Yes
End

For information about the states of the appliance and available operations, see Setting Up a Newly Installed Appliance.

Figure 6-3. Install Stage 2 Workflow


Start
Create an install spec
Get the deployment status
Validate the install spec by using the check method of the install service and check the result data structure for errors and warnings
Run the setup process by using the start method of the install service
Check the configuration status by using the vcenter deployment service
End

You can run the setup pre-checks and the install stage 2 process by creating and passing an `InstallSpec`. In `InstallSpec`, you define the setup configuration. See Figure 6-3 and Figure 6-4. You can run the setup in silent mode by setting the `InstallSpec.auto_answer` to `true`. The default value of `InstallSpec.auto_answer` is `false` and the setup is in interactive mode, in which you must provide answers to the raised questions.

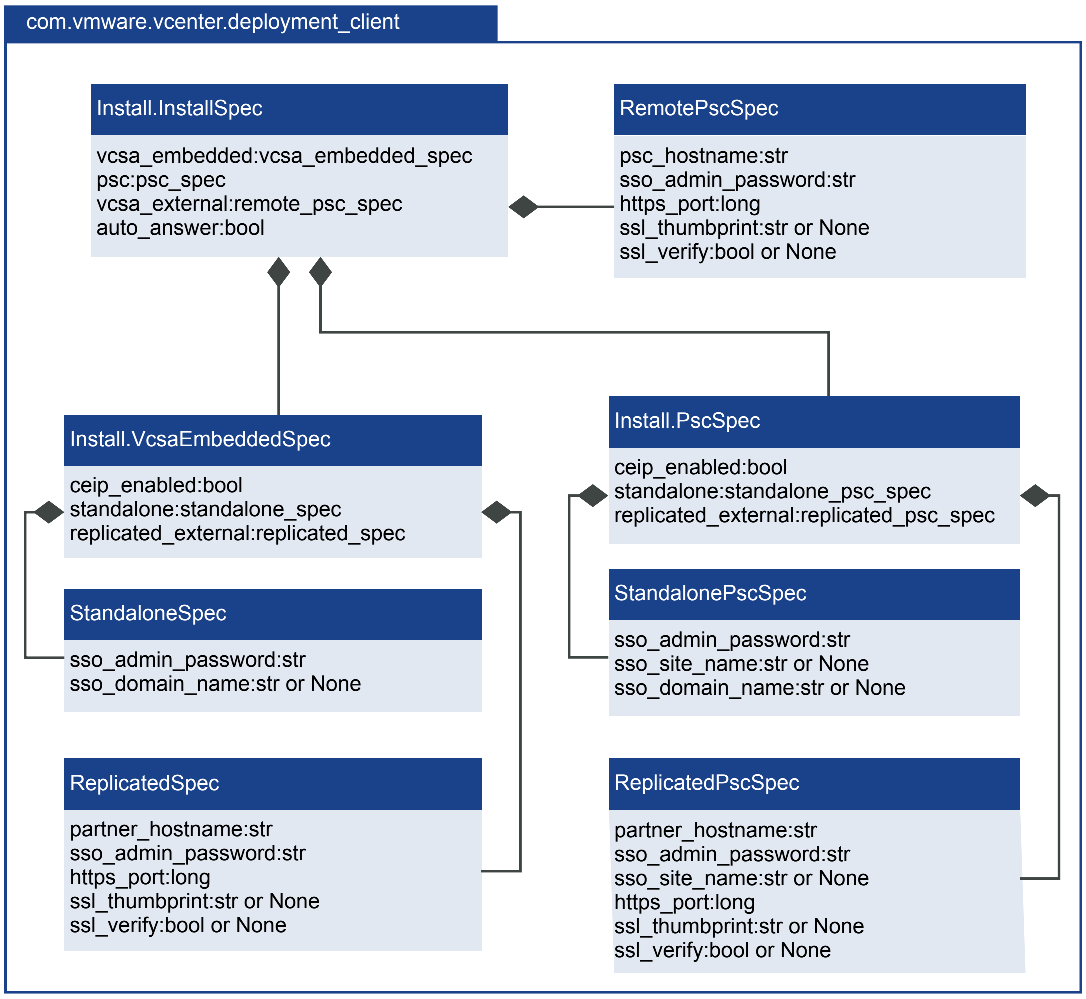
If you set up a vCenter Server Appliance with an embedded Platform Services Controller, you must create a `VcsaEmbeddedSpec` and include it in the `InstallSpec`. You can optionally include `StandaloneSpec` and `ReplicatedSpec` in the `VcsaEmbeddedSpec`.

If you set up a vCenter Server Appliance with an external Platform Services Controller, you must create a `RemotePscSpec` and include it in the `InstallSpec`.

If you set up a Platform Services Controller appliance, you must create a `PscSpec`. You can optionally include `StandalonePscSpec` and `ReplicatedPscSpec` in the `PscSpec`.

Figure 6-4 shows the classes that you can use to complete stage 2.

Figure 6-4. InstallSpec Python Class Diagram



For information about the classes, variables, and default values, see the *API Reference* documentation.

Upgrade Stage 2

You can upgrade your vCenter Server Appliance and Platform Services Controller appliance by using the API, CLI, or the User Interface.

For information about how to upgrade the vCenter Server Appliance and Platform Services Controller appliance by using CLI and User Interface, see the *vSphere Upgrade* documentation.

Upgrading the vCenter Server Appliance and Platform Services Controller Appliance

You can use the API during stage 2 of the vCenter Server Appliance and Platform Services Controller appliance upgrade. You can use the `vcenter deployment` API for configuring and upgrading your appliance on stage 2 of the upgrade process.

By using the API, you can upgrade your vCenter Server Appliance with embedded or external Platform Services Controller. For information about the upgrade process, its stages, supported configurations, upgrade paths, prerequisites for upgrading, and the sequence for upgrading a vSphere environment, see the *vSphere Upgrade* documentation.

After you deploy the appliance on stage 1 by using the GUI or CLI, the appliance enters in an `INITIALIZED` state. If the appliance is not initialized, you cannot run stage 2 of the upgrade process. You can get the state of the appliance by using the `vcenter deployment` service. The appliance has six states during the upgrade process.

Figure 6-5. Upgrade Stage 2 State Diagram

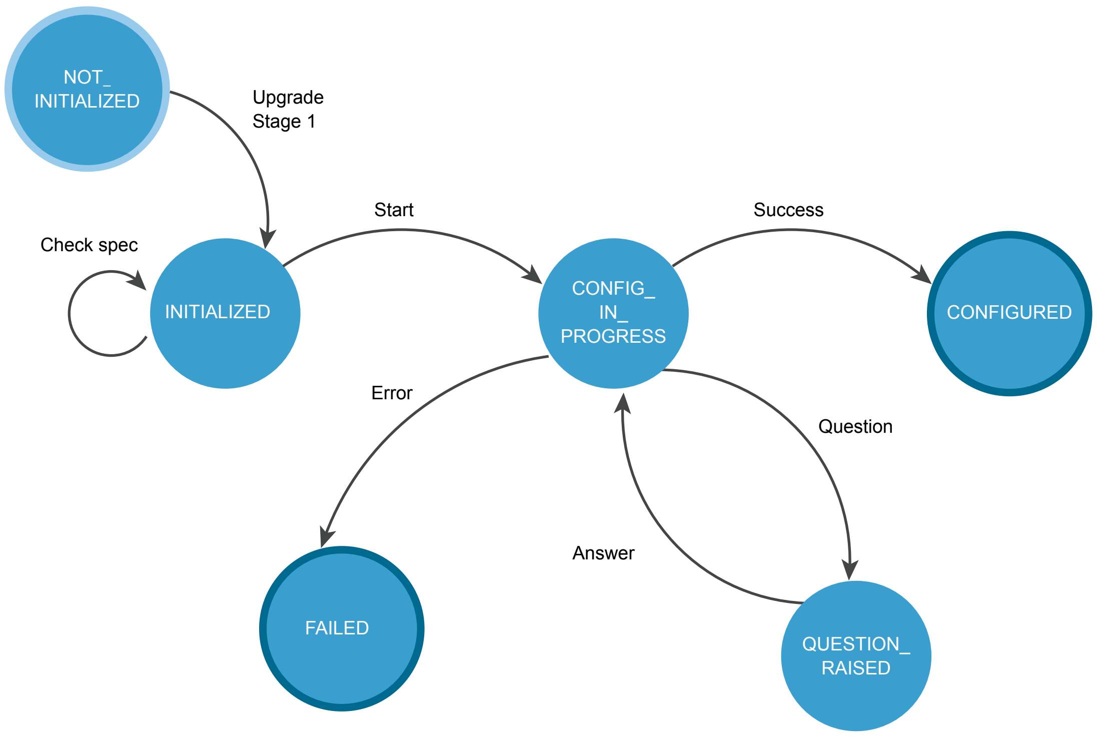


Table 6-4. Appliance States During Upgrade Stage 2

State	Description
`NOT_INITIALIZED`	The upgrade stage 1 phase is in progress, not started, or failed.
`INITIALIZED`	The appliance is deployed and ready for upgrading.
`CONFIG_IN_PROGRESS`	The upgrade process is in progress.
`QUESTION_RAISED`	You must answer the question to continue the upgrade process. The appliance stays in the `QUESTION_RAISED` state until it receives the correct answer.
`FAILED`	Errors appeared during the upgrade process. You can check the errors, warnings, and info data structures.
`CONFIGURED`	The appliance is upgraded or configured successfully.

`FAILED` and `CONFIGURED` are final states.

You can roll back a vCenter Server Appliance upgrade by using the User Interface. For information about how to roll back a vCenter Server Appliance, see the *vSphere Upgrade* documentation.

After the upgrade of your appliance you can check the appliance type, domain registration, appliance services, their state and health status by using the API. For information about how to verify whether the upgrade of your vCenter Server Appliance is successful, see the *vSphere Upgrade* documentation.

Table 6-5 shows operations that you can perform to upgrade your appliance.

Table 6-5. User Operations

Operation	Description
Operations for Upgrading	
Check	You can validate the upgrade spec before you run the upgrade process. If the appliance is in the `INITIALIZED` state, you can run the validation. The operation runs upgrade pre-checks. You can check the errors, warnings, and status data structures before you run the upgrade process. For information about the HTTP requests for upgrading, see HTTP Requests for Upgrade Stage 2. **Note** If you want to transfer the historical data of your vCenter Server Appliance, the upgrade spec must include a history spec. For information about how to transfer the historical data of your vCenter Server Appliance, see the Historical Data Transfer chapter.
Start	If the appliance is in an `INITIALIZED` state, you can run the upgrade process. If errors appear during the upgrade, you can download the vCenter Server Appliance support bundle. For information about the HTTP requests for upgrading, see HTTP Requests for Upgrade Stage 2.
Get	If the appliance is in a `CONFIGURED` state, you can get the `spec` that is used for upgrading. For information about the HTTP requests for upgrading, see HTTP Requests for Upgrade Stage 2.
Operations for getting and answering a question	
Get	You can get the raised question. If you set the `Upgrade.auto_answer` to `true`, the upgrade process will be in a `silent` mode and the appliance does not generate questions. It uses default answers and you should not provide an answer. For information about the HTTP requests for getting and answering a question, see HTTP Requests for Upgrade Stage 2.

Table 6-5. User Operations (Continued)

Operation	Description
Answer	You can provide an answer to the raised question. The available answers for the upgrading are `OK`, `CANCEL`, `YES`,`NO`, `ABORT`, `RETRY`, and `IGNORE`. The answer depends on the type of the question. If you set the `Upgrade.auto_answer` to `true`, the upgrade process will be in a `silent` mode and the appliance does not generate questions. It uses default answers and you should not provide an answer. For information about the HTTP requests for getting and answering a question, see HTTP Requests for Upgrade Stage 2.
Operations for diagnostic and deferring the transfer of historical data	
Get the state of the appliance	You can get the state of the appliance before, during and after the upgrade process. For information about the HTTP requests for diagnostic and deferring the transfer of historical data, see HTTP Requests for Upgrade Stage 2.
Check the type of the appliance	If the appliance is in a `CONFIGURED` state, you can check its type. vCenter Server Appliance with embedded Platform Services Controller, vCenter Server Appliance with external Platform Services Controller, and Platform Services Controller appliance. The available values are : ■ `VCSA_EMBEDDED` ■ `VCSA_EXTERNAL` ■ `PSC_EXTERNAL` For information about the HTTP requests for diagnostic and deferring the transfer of historical data, see HTTP Requests for Upgrade Stage 2.
Check the Platform Services Controller registration	You can check the Platform Services Controller and the domain that the appliance is registered with. The appliance must be in a `CONFIGURED` state. For information about the HTTP requests for diagnostic and deferring the transfer of historical data, see HTTP Requests for Upgrade Stage 2.

Table 6-5. User Operations (Continued)

Operation	Description
Get the list of services	You can get the list of the vCenter Server Appliance and Platform Services Controller services, their state, and status. For information about the HTTP requests for diagnostic and deferring the transfer of historical data, see HTTP Requests for Upgrade Stage 2.
Pause the data import	If you use an external database, you can transfer the historical data of your vCenter Server by using the deferred import feature. After a successful upgrade, the transfer of historical data starts automatically. You can decrease the vCenter Server Appliance downtime and defer the transfer. For information about the deferred import, see the Historical Data Transfer chapter. For information about the HTTP requests for diagnostic and deferring the transfer of historical data, see HTTP Requests for Upgrade Stage 2.

For information about the available operations in the API, see the following services in the API reference documentation: `vcenter deployment`, `vcenter deployment upgrade`, `vcenter deployment import history`, `vcenter services`, `vcenter system-config deployment type`, and `vcenter system-config deployment psc-registration`.

You can upgrade your appliance, make a diagnostic, and postpone the historical data transfer by using HTTP requests. For information about the HTTP requests, see HTTP Requests for Upgrade Stage 2

HTTP Requests for Upgrade Stage 2

You can use HTTP requests or the API to upgrade your vCenter Server Appliance and Platform Services Controller appliance.

HTTP Requests

HTTP requests for Upgrading

- Validate the upgrade spec

  ```
  POST https://<IP_address_target_appliance>:5480/rest/vcenter/deployment/upgrade?action=check
  ```

- Run the upgrading

  ```
  POST https://<IP_address_target_appliance>:5480/rest/vcenter/deployment/upgrade?action=start
  ```

- Get the upgrade spec used for upgrading

  ```
  GET https:// https://<IP_address_upgraded_appliance>:5480/rest/vcenter/deployment/upgrade
  ```

HTTP requests for getting and answering a question

- Get the raised question

  ```
  GET https://<IP_address_upgraded_or_target_appliance>:5480/rest/vcenter/deployment/question
  ```

- Answer to the question

  ```
  POST https://<IP_address_upgraded_or_target_appliance>:5480/rest/vcenter/deployment/question?
  action=answer
  ```

HTTP requests for diagnostic and deferring the transfer of historical data

- Get the state of the appliance

  ```
  GET https://<IP_address_upgraded_or_target_appliance>:5480/rest/vcenter/deployment
  ```

- Check the deployment type

  ```
  GET https://<IP_address_upgraded_or_target_appliance>:5480/rest/vcenter/system-config/deployment-
  type
  ```

- Check the Platform Services Controller registration

  ```
  GET: https://<IP_address_upgraded_appliance>:5480/rest/vcenter/system-config/psc-registration
  ```

- Get the list of services

  ```
  GET: https://<IP_address_upgraded_appliance>:5480/rest/vcenter/services
  ```

- Pausing the transfer of historical data of the vCenter Server

  ```
  POST https://<IP_address_upgraded_appliance>:5480/rest/vcenter/deployment/history?action=pause
  ```

For information about the content of the HTTP request body and the syntax of `spec`, `psc`, `source_appliance`, `source_location`, `vcsa_embedded`, and `history`, see the *API reference* documentation.

Note When you send the requests, you must authenticate with vCenter Server Appliance **root** credentials.

HTTP Status Codes and Errors

Table 6-6. HTTP Status Codes and Errors

HTTP Status Code	Description	Operations That Return the Status Code
200	The operation is successful.	All operations. You can check the returned data in the results data structure.
400	You cannot perform the operation because the appliance is in the current state. For information about the states of the appliance, see the Upgrading the vCenter Server Appliance and Platform Services Controller Appliance topic.	■ Validate the upgrade spec ■ Run the upgrade ■ Get the upgrade spec ■ Get the raised question ■ Answer to the question ■ Get the state of the appliance
401	You use invalid user name or password, or authentication is failed.	■ Validate the upgrade spec ■ Run the upgrade ■ Get the upgrade spec ■ Get the raised question ■ Answer to the question ■ Get the state of the appliance
404	The state of the appliance cannot be determined	Get the state of the appliance.
500	There is a `vapi std` error. For information about the types of `vapi std` errors, see the `vapi.std.errors` API in the *API Reference* documentation.	Get the raised question.

If errors appear during the upgrade process, you can check the `results` data structure, the API log file, and download the appliance support bundle from `https://FQDN_IP_address_of_your_appliance:443/appliance/support-bundle`.

Workflows and Class Diagrams for Upgrade Stage 2

You can use the `vcenter deployment` API to run the upgrade stage 2 process of your vCenter Server Appliance and Platform Services Controller appliance.

Figure 6-6 and Figure 6-7 show example upgrade workflows.

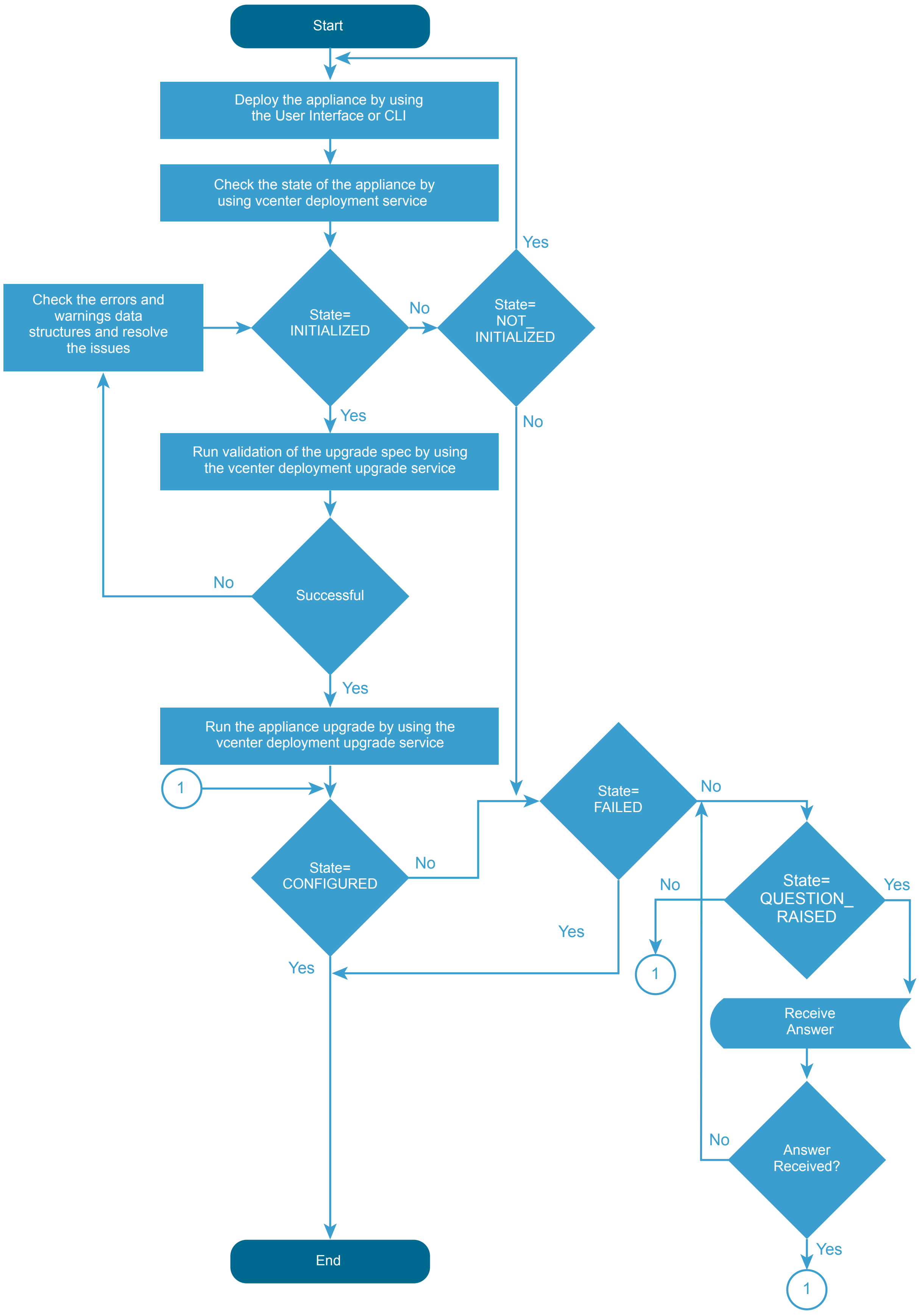
During stage 1, the appliance is in a `NOT_INITIALIZED` state. After a successful deployment, the appliance enters in an `INITIALIZED` state. If there are errors during stage 1, the appliance stays in a `NOT_INITIALIZED` state and you must redeploy it.

You can check the state of the appliance before, during, and after the upgrade process. You can run the upgrade stage 2 process if the appliance is initialized. You can check the upgrade configuration before you run the upgrade by running the appliance pre-checks. If errors or warnings appear during the validation of the upgrade specification, you must remove the causes and correct the specification.

During the upgrade process, the appliance can enter in a `FAILED` or `QUESTION_RASED` state. If a question appears during the upgrade, the appliance enters in a `QUESTION_RAISED` state and stays in it until you provide an answer. You can run the upgrade in silent mode, in which the appliance does not generate questions, and uses default answers.

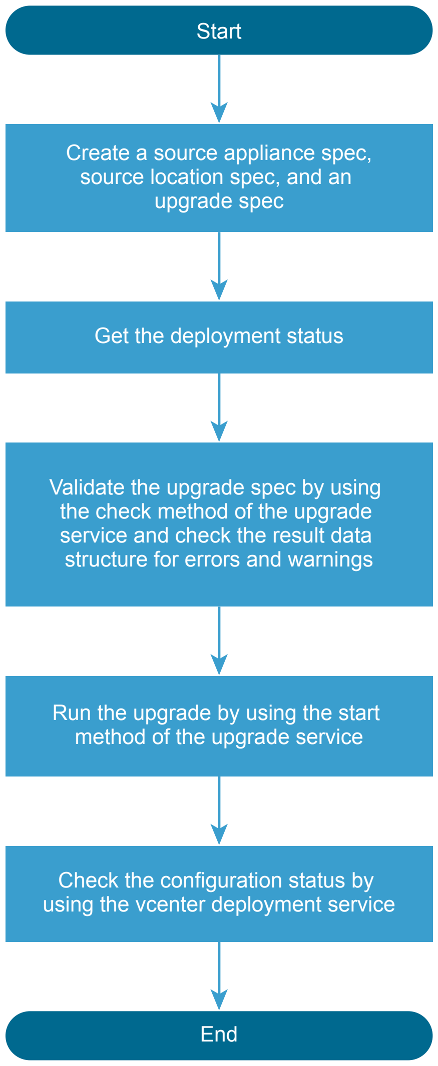
If errors appear during the upgrade, the appliance enters in a `FAILED` state and you must remove the causes, redeploy the appliance and restart the upgrade. If stage 2 of the upgrade process is successful, the appliance enters in a `CONFIGURED` state. If the appliance is configured, you can check its services and pause the historical data transfer.

Figure 6-6. Upgrade Workflow


Start
Deploy the appliance by using the User Interface or CLI
Check the state of the appliance by using vcenter deployment service
Check the errors and warnings data structures and resolve the issues
State= INITIALIZED
No
State= NOT_ INITIALIZED
Yes
No
Yes
Run validation of the upgrade spec by using the vcenter deployment upgrade service
Successful
No
Yes
Run the appliance upgrade by using the vcenter deployment upgrade service
1
State= CONFIGURED
No
Yes
State= FAILED
No
Yes
State= QUESTION_ RAISED
No
Yes
1
Receive Answer
Answer Received?
No
Yes
1
End

For information about the states of the appliance and available operations, see Upgrading the vCenter Server Appliance and Platform Services Controller Appliance.

Figure 6-7. Upgrade Stage 2 Workflow


Start
Create a source appliance spec, source location spec, and an upgrade spec
Get the deployment status
Validate the upgrade spec by using the check method of the upgrade service and check the result data structure for errors and warnings
Run the upgrade by using the start method of the upgrade service
Check the configuration status by using the vcenter deployment service
End

You can run the upgrade pre-checks and the upgrade stage 2 process by creating and passing an `UpgradeSpec`. In `UpgradeSpec`, you define the upgrade configuration and specify the source appliance and the source ESXi host in `SourceApplianceSpec` and `LocationSpec`. See Figure 6-7, Figure 6-8, and Figure 6-9. You can run the upgrading in silent mode by setting the `UpgradeSpec.auto_answer` to `true`. The default value of `UpgradeSpec.auto_answer` is `false` and the upgrading is in interactive mode, in which you must provide answers to the raised questions.

If your vCenter Server Appliance uses an external database and you want to transfer the historical data of your appliance, you must create a `HistoryMigrationSpec` and include it in the `UpgradeSpec` with the `SourceAppliance` and `LocationSpec`. In the `HistoryMigrationSpec`, you can specify the data scope and whether you want to use the deferred import feature. For information about the transfer of historical data, see Historical Data Transfer chapter.

If you upgrade an external Platform Services Controller appliance, you must create a `PscSpec` and include it in the `UpgradeSpec`. If you upgrade a vCenter Server Appliance with embedded Platform Services Controller, you must create a `VcsaEmbeddedSpec` and include it in the `UpgradeSpec`. If you upgrade a vCenter Server Appliance that works with an external Platform Services Controller, you must not create a `VcsaEmbeddedSpec`. You must provide only `SourceApplianceSpec` and `LocationSpec`.

Figure 6-8 and Figure 6-9 show the classes that you can use to upgrade your appliance on stage 2.

Figure 6-8. Upgrade Python Class Diagram

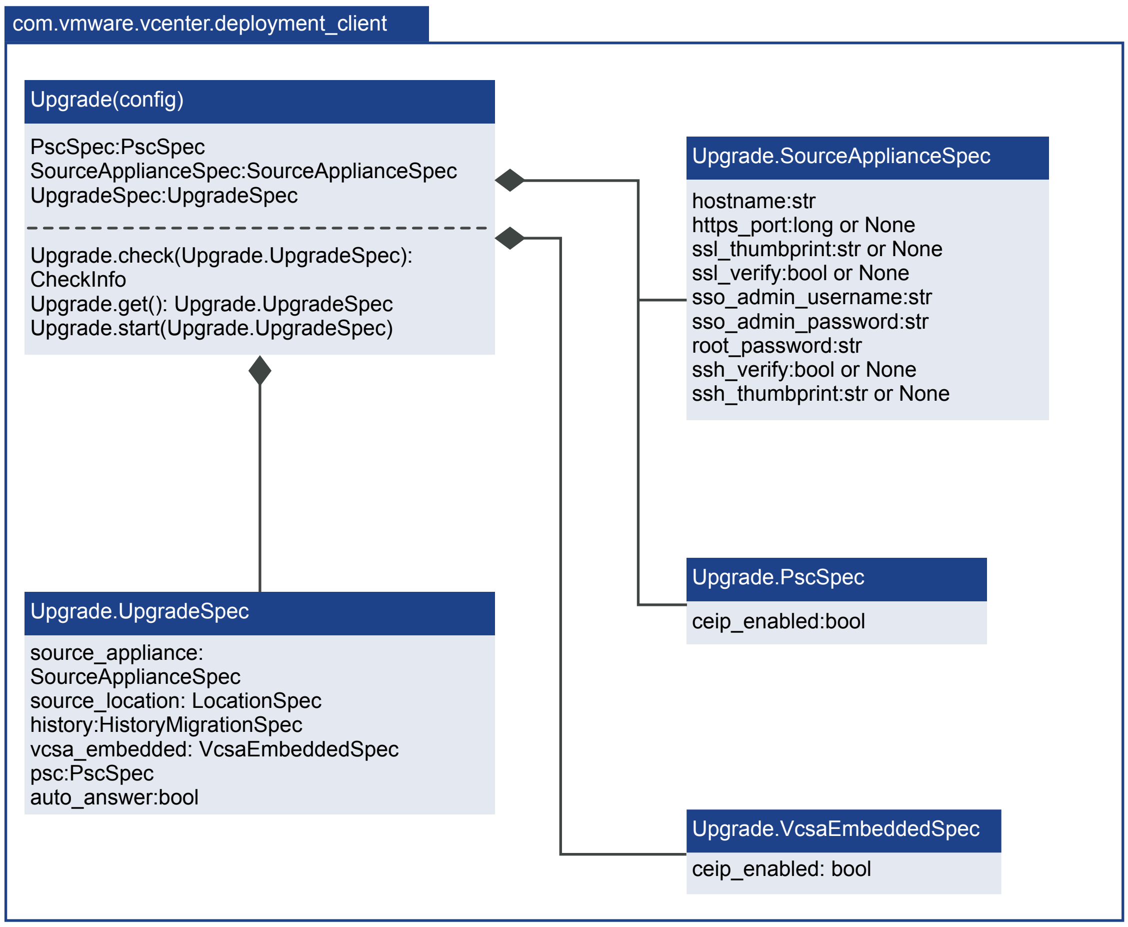
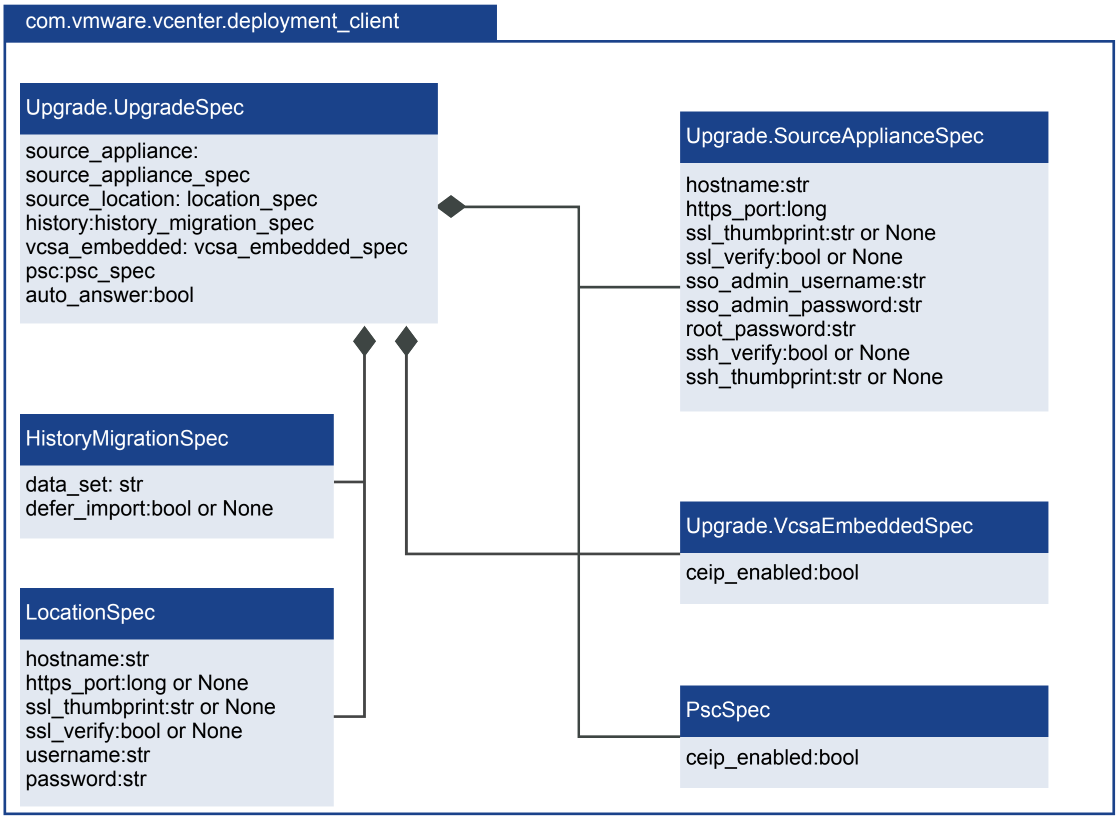

com.vmware.vcenter.deployment_client
Upgrade(config)
PscSpec:PscSpec
SourceApplianceSpec:SourceApplianceSpec
UpgradeSpec:UpgradeSpec
Upgrade.check(Upgrade.UpgradeSpec): CheckInfo
Upgrade.get(): Upgrade.UpgradeSpec
Upgrade.start(Upgrade.UpgradeSpec)
Upgrade.SourceApplianceSpec
hostname:str
https_port:long or None
ssl_thumbprint:str or None
ssl_verify:bool or None
sso_admin_username:str
sso_admin_password:str
root_password:str
ssh_verify:bool or None
ssh_thumbprint:str or None
Upgrade.PscSpec
ceip_enabled:bool
Upgrade.UpgradeSpec
source_appliance: SourceApplianceSpec
source_location: LocationSpec
history:HistoryMigrationSpec
vcsa_embedded: VcsaEmbeddedSpec
psc:PscSpec
auto_answer:bool
Upgrade.VcsaEmbeddedSpec
ceip_enabled: bool

Figure 6-9. UpgradeSpec Python Class Diagram



For information about the classes, variables, and default values, see the *API Reference* documentation.

Historical Data Transfer

After you migrate vCenter Server for Windows or upgrade the vCenter Server Appliance, you can transfer the historical data of your source vCenter Server instance together with the core configuration data.

Deferred Import

The deferred import is a process of historical data transfer after the successful upgrade or migration of a vCenter Server instance with an external database. The historical data includes statistics, events, and tasks.

By using the deferred import feature, you can postpone the historical data transfer after the migration or upgrade process completes, so that you manage the downtime of your environment. You can select whether all historical data, or only events and tasks, will be migrated with the core data during the upgrade or migration. The historical data transfer and deferred import of historical data are disabled by default. You can enable and configure the historical data transfer by using the API, vCenter Server Appliance Management Interface, vCenter Server installer, or CLI installer. A vCenter Server Appliance super administrator can run and control the migration, upgrade, and deferred import processes.

If you use the deferred import feature, the historical data is migrated with the core data and the historical data import process starts automatically after a successful upgrade or migration and when the vCenter Server instance is running. You can pause the historical data import and resume it later.

For information about how to configure and run the migration, upgrade, and deferred import processes by using the vCenter Server Appliance Management Interface, see the *vCenter Server Upgrade* documentation.

By using the API, you can configure, control, and monitor the data transfer process. If you use the API to enable the deferred import feature, you must create a history migration spec and set `defer_import` to `true`. For information about how to configure the deferred import by using the API, see Class Diagrams and Workflows for Deferred Import and the API reference.

The data import process has five states that you can check. If the historical data migration and the deferred import are configured, the historical data import starts automatically after a successful upgrade or migration.

Figure 6-10. Deferred Import State Diagram

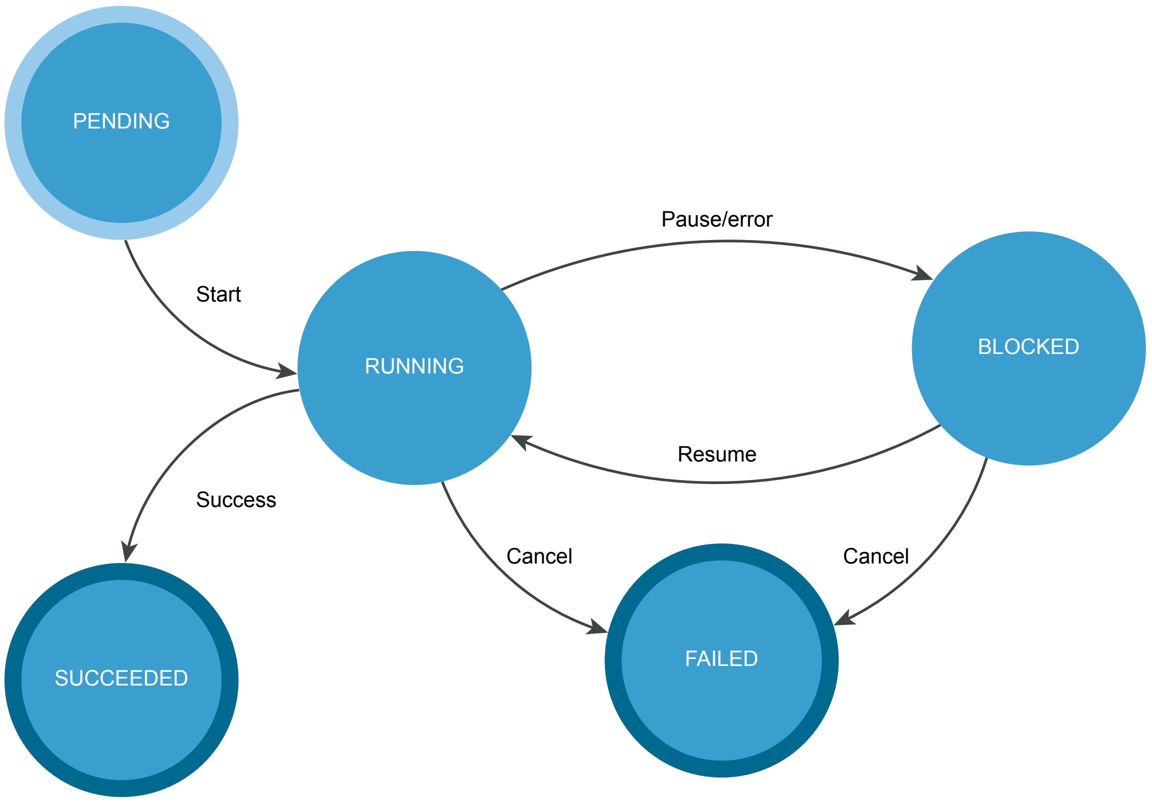


Table 6-7. User Operations

Operation	Description
Pause	You can pause the running data transfer process. If the data transfer is paused, you can resume or cancel it.
Cancel	You can cancel the data transfer process if it is in a `RUNNING` or `BLOCKED` state. **Note** If you cancel the data transfer, the process enters in a final `FAILED` state and you cannot resume the transfer.
Resume	You can resume the stopped data transfer.
Get status	You can retrieve the status of the data transfer process. There are five states. **`PENDING`** The transfer is not started. **`RUNNING`** The transfer is started or resumed. **`BLOCKED`** The transfer is paused or there was a recoverable error, such as not enough disk space, during the import. **`SUCCEEDED`** The transfer is successful. **`FAILED`** The transfer is canceled.

You can run the deferred import operations by using the API or sending an HTTP request.

Note When you send the requests, you must use an authentication.

If you send requests to port `5480`, you must authenticate with vCenter Server Appliance **root** credentials. If you send requests to the vCenter Server reverse proxy port, you must authenticate with vCenter Single Sign-On credentials.

The following HTTP requests show the syntax that you can use to perform the available user operations.

```
https://<IP_of_upgraded_or_migrated_instance>:5480/rest/vcenter/deployment/history?action=pause
```

```
https://<IP_of_upgraded_or_migrated_instance>:5480/rest/vcenter/deployment/history?action=cancel
```

```
https://<IP_of_upgraded_or_migrated_instance>:5480/rest/vcenter/deployment/history?action=resume
```

```
https://<IP_of_upgraded_or_migrated_instance>:5480/rest/vcenter/deployment/history
```

```
https://<IP_of_upgraded_or_migrated_instance>/rest/vcenter/deployment/history?action=pause
```

```
https://<IP_of_upgraded_or_migrated_instance>/rest/vcenter/deployment/history?action=cancel
```

```
https://<IP_of_upgraded_or_migrated_instance>/rest/vcenter/deployment/history?action=resume
```

```
https://<IP_of_upgraded_or_migrated_instance>/rest/vcenter/deployment/history
```

For information about the status codes and historical data transfer errors, see HTTP Status Codes and Historical Data Import Errors.

If you pause the data transfer by using the API or an HTTP request, you can resume or cancel the process by using the API or the vCenter Server Appliance Management Interface.

Important If you cancel the transfer process, and want to transfer the historical data later, you must restart the upgrade or migration process.

HTTP Status Codes

Each operation returns an HTTP status code.

The following table lists the HTTP status codes that you can receive and the operations which can trigger each status code.

Table 6-8. HTTP Status Codes

HTTP Status Code	Description	Operations that return the status code
200	The operation is successful.	■ `pause` ■ `cancel` ■ `resume`
400	You cannot perform the operation because the data import is in the current state. For information about the data import states and transitions between the states, see the Figure 6-10 figure.	■ `pause` ■ `cancel` ■ `resume`

Table 6-8. HTTP Status Codes (Continued)

HTTP Status Code	Description	Operations that return the status code
401	You use invalid user name or password, or the authentication has failed.	■ **pause** ■ **cancel** ■ **resume** ■ **getstatus**
403	You do not have permissions to perform the operation. The vCenter Server Appliance super administrator has permissions to run the operation.	■ **pause** ■ **cancel** ■ **resume** ■ **getstatus**
500	There is a `vapi std` error. For information about the types of `vapi std` errors, see *vapi.std.errors* in the API Reference.	■ **pause** ■ **cancel** ■ **resume** ■ **getstatus**

Historical Data Import Errors

If an error appears during the data import, the import stops and the process enters in a `BLOCKED` state. You can resume the data import after you eliminate the cause.

You can check the errors, warnings, and info messages by reading the `info`, `status`, and `notifications` data structures.

If the information in the data structures is not enough, you can download the vCenter Server Appliance support-bundle from *<IP_Address_of_your_appliance>*`:443/appliance/support-bundle` and check the log files.

Table 6-9. Log Files

Log File	Path
API log file	`/var/log/vmware/applmgmt/applmgmt.log`
Backend log file	`/var/log/vmware/upgrade/upgrade-post-import.log`
Upgrade Runner log file	`/var/log/vmware/upgrade/deferredimport-upgrade-runner.log`
Deferred import log file	`/var/log/vmware/upgrade/DeferredImport_com.vmware.vcdb_`*<date_time>*`.log`

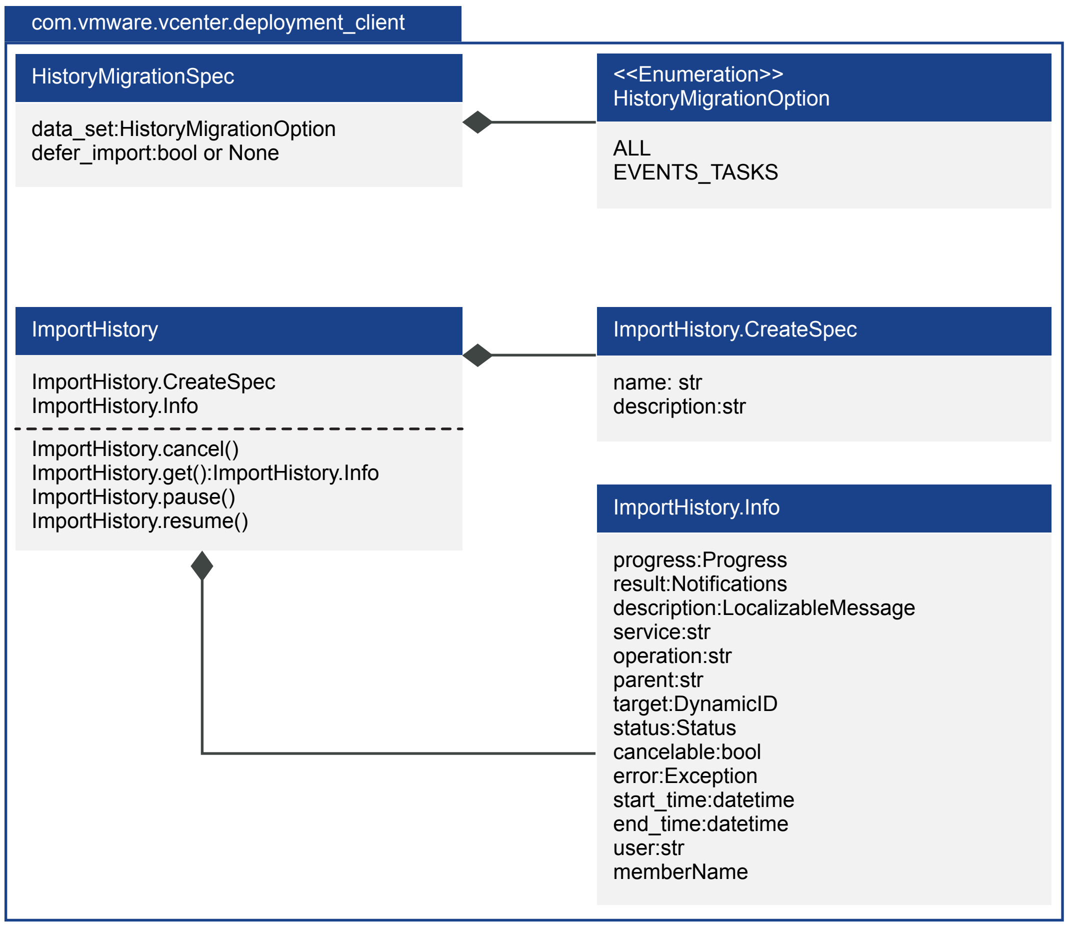
Class Diagrams and Workflows for Deferred Import

The `vcenter deployment` API provides classes and interfaces that you can use for configuring and controlling the historical data import.

The historical data transfer during the vCenter Server migration or upgrade is disabled by default and only the core data is migrated. You can enable the historical data transfer and the deferred import by creating a history migration spec and setting `defer_import` to `true`. For example, see Figure 6-11. You can change the historical data scope by using the `HistoryMigrationOption` enum. By default, the `data_set` is set to `EVENTS_TASKS`.

You can control the deferred import by creating an import history spec and calling the methods of the `ImportHistory` class. Figure 6-11 shows the classes that you can use to configure and control the deferred import.

Figure 6-11. Python Class Diagrams for Deferred Import



To use the deferred import after upgrading the vCenter Server Appliance, you must create a history migration spec and include it in the upgrade spec. See Figure 6-12, Figure 6-13, and Figure 6-11.

Figure 6-12. Upgrade Workflow

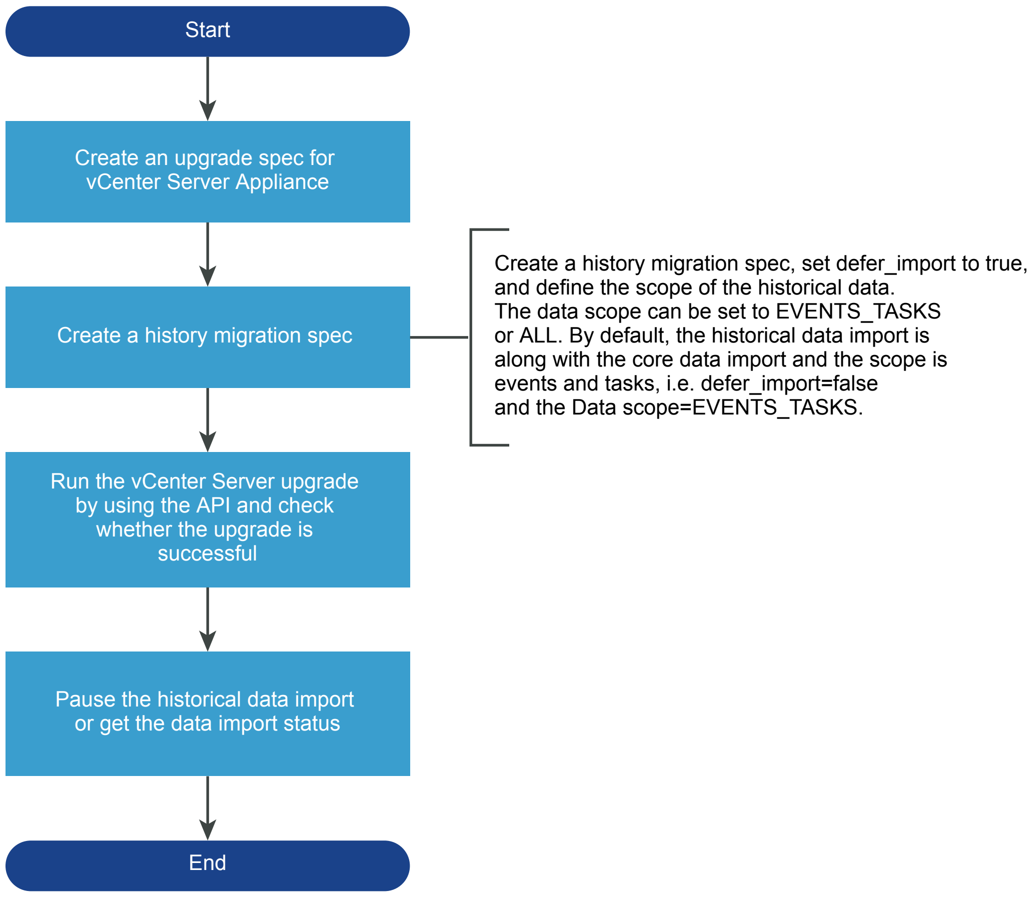
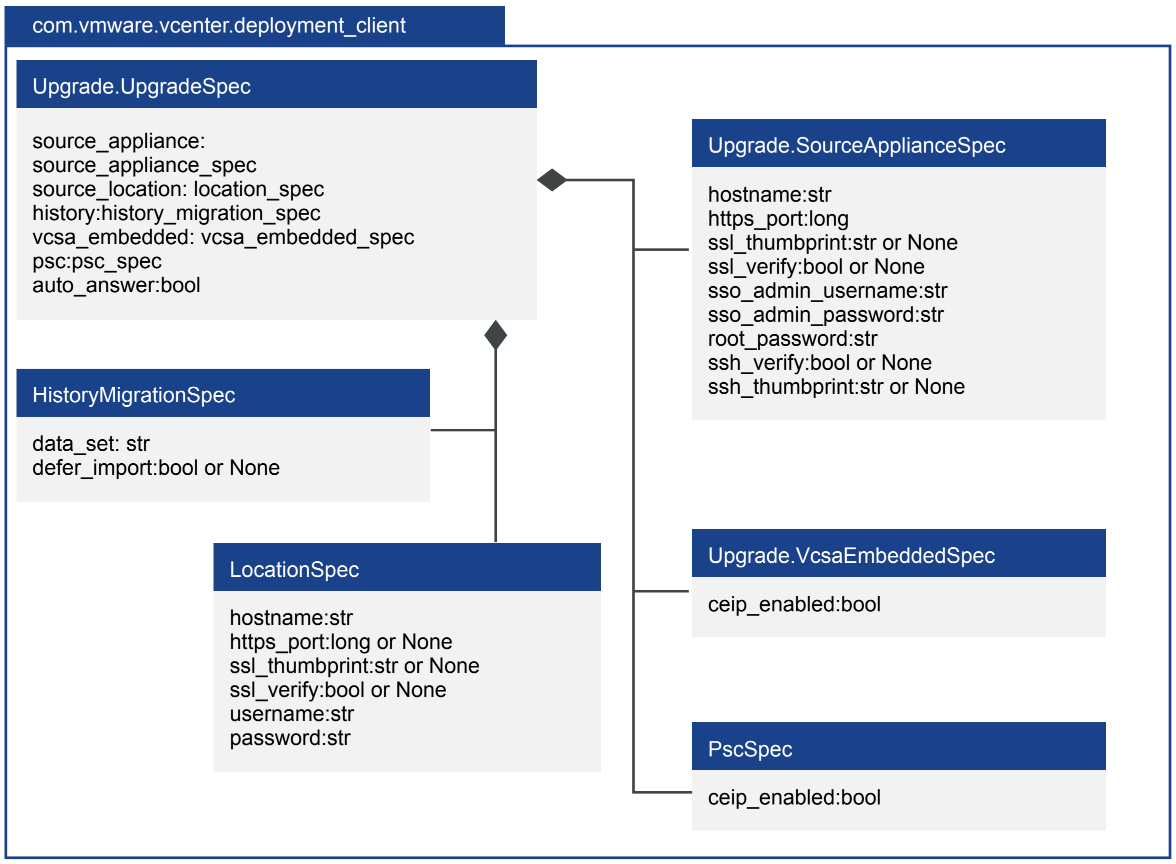

Start
Create an upgrade spec for vCenter Server Appliance
Create a history migration spec
Run the vCenter Server upgrade by using the API and check whether the upgrade is successful
Pause the historical data import or get the data import status
End
Create a history migration spec, set defer_import to true, and define the scope of the historical data. The data scope can be set to EVENTS_TASKS or ALL. By default, the historical data import is along with the core data import and the scope is events and tasks, i.e. defer_import=false and the Data scope=EVENTS_TASKS.

Figure 6-13. Python Class Diagram for Upgrade



Use the Deferred Import Sample

You can use the vCenter Server Appliance Management Interface to migrate or upgrade your vCenter Server instance and to run the `vc_import_history_sample.py` sample to pause and resume the historical data import.

Prerequisites

- Verify that you cloned or downloaded the vSphere Automation SDK for Python from https://github.com/vmware/vsphere-automation-sdk-python.
- Verify that you set up a test environment. For information about the prerequisites and how to set up a test environment, see the `README.md` file in the `deferhistoryimport` directory and the Quick Start guide for vSphere Automation SDK for Python at https://github.com/vmware/vsphere-automation-sdk-python.
- Verify that you have vCenter Server Appliance root credentials.
- Verify that you opened the vCenter Server Appliance Management Interface of your target vCenter Server Appliance.

Procedure

1. From the getting started page, run the **Upgrade** or **Migrate** wizard.
2. Select one of the options for **Configuration and historical data**.

   You can import only events and tasks or import all historical data.
3. Select **Import historical data in the background** and complete all steps from the wizard.
4. Run the `vc_import_history_sample.py` sample after successful upgrade or migration.

   Use the IP address of your source vCenter Server instance and the vCenter Server administrator credentials when you run the sample. You can use or skip the verification of the vCenter Server certificate. For example, you can use the following command.

   ```
   vc_import_history_sample.py --server <IP_of_upgraded_or_migrated_instance> --username
   <admin_username> --password <admin_password> --skipverification
   ```

Python Example of Pausing and Resuming the Deferred Import Process

The example shows how you can pause and resume the deferred import process by using the API. The example is based on the `vc_import_history_sample.py` sample.

Note For a complete and up-to-date version of the sample code, see the vSphere Automation SDK Python samples at GitHub.

```
        ...
        self.service_manager = ServiceManager(args.server,
                                              args.username,
                                              args.password,
                                              args.skipverification)
        self.service_manager.connect()
        ...
        # Using REST API service
        import_history = ImportHistory(self.service_manager.stub_config)
        ...
        # Change the status - either pause or resume it
        start_status = get_defer_history_import_status(import_history)
        if start_status == Status.RUNNING:
            print('Pausing Defer History Data Import.')
            import_history.pause()
            ...
        elif start_status == Status.PAUSED:
            print('Resuming Defer History Data Import.')
            import_history.resume()
        ...
```

Converging a vCenter Server Appliance with an External Platform Services Controller to a vCenter Server Appliance with an Embedded Platform Services Controller

Convergence is the process of reconfiguring or converting a vCenter Server Appliance with an external Platform Services Controller to a vCenter Server Appliance with an embedded Platform Services Controller.

Figure 6-14 illustrates the process of converging a single standalone vCenter Server Appliance with an external Platform Services Controller to a vCenter Server Appliance with an embedded Platform Services Controller.

Figure 6‑14. Convergence Internal Workflow

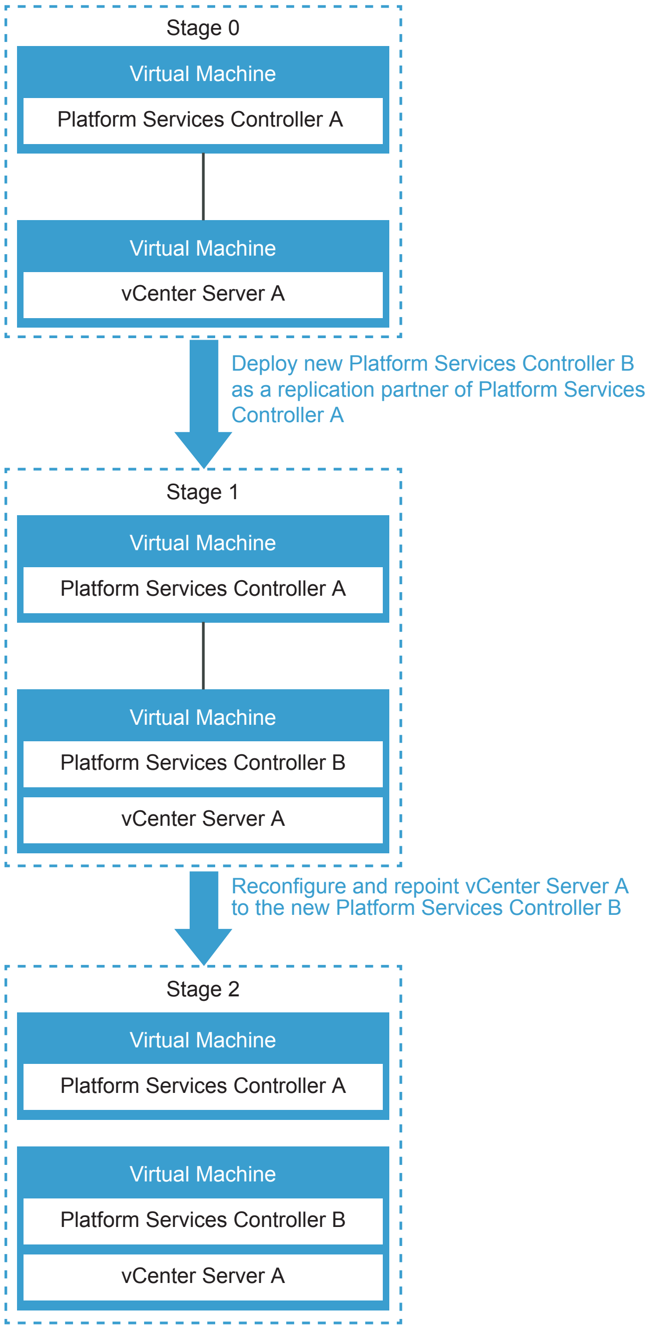

Stage 0
Virtual Machine
Platform Services Controller A
Virtual Machine
vCenter Server A
Deploy new Platform Services Controller B as a replication partner of Platform Services Controller A
Stage 1
Virtual Machine
Platform Services Controller A
Virtual Machine
Platform Services Controller B
vCenter Server A
Reconfigure and repoint vCenter Server A to the new Platform Services Controller B
Stage 2
Virtual Machine
Platform Services Controller A
Virtual Machine
Platform Services Controller B
vCenter Server A

Table 6-10. Legend for Single Convergence

Stage	Description
Stage 0	Stage 0 represents the original vCenter Server A with external Platform Services Controller A node.
Stage 1	In Stage 1, the converge process performs the following tasks: 1 Deploys the new embedded Platform Services Controller B on the vCenter Server A and sets it up so that all the data in the original Platform Services Controller A is replicated in the new embedded Platform Services Controller B. 2 Configures the new embedded Platform Services Controller B so that it works on the vCenter Server A node. 3 Repoints vCenter Server A to the new embedded Platform Services Controller B.
Stage 2	Stage 2 shows the new node which contains vCenter Server A with embedded Platform Services Controller B. The original Platform Services Controller A can be decommissioned.

HTTP Requests for Convergence Operations

You can use HTTP requests to perform convergence operations such as converging and decommissioning nodes. You can also use HTTP requests to retrieve information about the vCenter Server Appliance type.

HTTP Requests

The following HTTP requests show the syntax that you can use to perform the available user operations.

Note When you send the requests, you must use an authentication.

When you send requests to port `5480`, you must authenticate with vCenter Single Sign-On credentials.

- Get the type of the vCenter Server Appliance

```
GET https://<server>:5480/rest/vcenter/system-config/deployment-type
```

- Convert a management node to an embedded node

```
POST https://<server>:5480/rest/vcenter/system-config/deployment-type?action=convert-to-vcsa-
embedded&vmw-task=true
```

- Decommission an external Platform Services Controller node

```
POST https://<server>:5480/rest/vcenter/topology/pscs/{hostname}?action=decommission&vmw-task=true
```

For information about the content and syntax of the HTTP request body, see the *API Reference* documentation.

Converging Nodes

You can converge a vCenter Server Appliance with an external Platform Services Controller to a vCenter Server Appliance with an embedded Platform Services Controller. Converging nodes can help you set up your vCenter Embedded Linked Mode environment by running the same operation on each management node.

The following HTTP request shows the syntax for performing a convergence operation.

```
POST https://<server>:5480/rest/vcenter/system-config/deployment-type?action=convert-to-vcsa-
embedded&vmw-task=true
```

In the body of the HTTP request, you must provide values that are appropriate for your environment. The following request body contains the correct syntax and details about the values.

Note If the Platform Services Controller is not joined to any domain, you do not need to include the `ad_domain` section. If you are performing initial convergence, you do not need to include the `replication_partner_hostname` line.

```
{
  "spec": {
    "psc": {
        "sso_admin_username": "String: administrator@<SSO_domain_name>",
        "sso_admin_password": "Secret string: <vCenter_Single_Sign-On_administrator_password>",
        "skip_ad_domain_join": false,
        "ad_domain": {
            "ad_domain_name": "String: <Platform_Services_Controller_appliance's_AD_domain_name>",
            "ad_domain_admin_username": "String:
<AD_domain_user_name_with_privileges_to_join_any_machine_to_the_provided_domain>",
            "ad_domain_admin_password": "Secret string:
<AD_domain_password_with_privileges_to_join_any_machine_to_the_provided_domain>",
            "dns_server": "String: <DNS_IP_which_resolves_AD_domain_name>"
        }
    },
    "replication_partner_hostname": "String: <FQDN_or_IP_address_of_the_target_VCSA_PSC_node>",
    "only_precheck": false
  }
}
```

When the convergence operation initiates successfully, you receive a task ID in the response body of the HTTP request. You can use the task ID to query the status of the operation.

Example: Check the Convergence Status

This example shows how you can use the task ID of a convergence operation to monitor the status of the operation.

The following response body contains an example task ID value that you receive after successfully initiating a convergence operation.

```
{
    "value": "5c89e7cb-1e6a-4021-95be-12f9dbd05367:com.vmware.vcenter.system_config.deployment_type"
}
```

You must use the task ID as part of the HTTP request that you send to retrieve the operation status.

```
GET: https://<server>:5480/rest/cis/tasks?filter_spec.tasks.
0=5c89e7cb-1e6a-4021-95be-12f9dbd05367:com.vmware.vcenter.system_config.deployment_type
```

The following example shows the response body when the convergence operation is ongoing.

```
{
    "value": [
        {
            "key":
"5c89e7cb-1e6a-4021-95be-12f9dbd05367:com.vmware.vcenter.system_config.deployment_type",
            "value": {
                "status": "RUNNING",
                "service": "com.vmware.vcenter.system_config.deployment_type",
                "operation": "convert_to_vcsa_embedded$task",
                "progress": {
                    "total": 100,
                    "completed": 42,
                    "message": {
                        "id": "prog",
                        "args": [],
                        "default_message": "Running firstboot stage 1 of 4."
                    }
                },
                "cancelable": false,
                "start_time": "2019-03-29T11:45:14.210Z",
                "description": {
                    "id": "desc",
                    "args": [],
                    "default_message": "Running firstboot stage 1 of 4."
                }
            }
        }
    ]
}
```

Decommissioning Nodes

You can decommission an external Platform Services Controller node after you have converted your existing environment to a vCenter Embedded Linked Mode environment. Decommissioning a Platform Services Controller shuts it down and removes it from the single sign-on domain.

Note Before decommissioning, you must verify that no vCenter Server Appliance instances are pointing to the Platform Services Controller. You must also reconfigure any products deployed into the environment that use the external Platform Services Controller to use the newly deployed embedded Platform Services Controller.

The following HTTP request shows the syntax for performing a decommission operation.

Note If the Platform Services Controller is configured in an HA environment, you must use the host name of the load balancer instead of the Platform Services Controller host name and disable the virtual IP of the load balancer before decommissioning. If you encounter any complications with your environment, you can manually unregister nodes by using the `cmsso-util unregister` command as described in KB article 2106736.

```
POST https://<server>:5480/rest/vcenter/topology/pscs/{hostname}?action=decommission&vmw-task=true
```

In the body of the HTTP request, you must provide values that are appropriate for your environment. The following request body contains the correct syntax and details about the values.

```
{
  "spec": {
        "sso_admin_username": "String: administrator@<SSO_domain_name>",
        "sso_admin_password": "Secret string: <vCenter_Single_Sign-On_administrator_password>"
  },
  "only_precheck": false
}
```

When the decommission operation initiates successfully, you receive a task ID in the response body of the HTTP request. You can use the task ID to query the status of the operation.

Example: Check the Decommission Status

This example shows how you can use the task ID of a decommission operation to monitor the status of the operation.

The following response body contains an example task ID value that you receive after successfully initiating a decommission operation.

```
{
    "value": "d1ed9bc4-6d4a-423f-b0fb-39829cf78a59:com.vmware.vcenter.topology.pscs"
}
```

You must use the task ID as part of the HTTP request that you send to retrieve the operation status.

```
GET: https://<server>:5480/rest/cis/tasks?filter_spec.tasks.0=d1ed9bc4-6d4a-423f-
b0fb-39829cf78a59:com.vmware.vcenter.topology.pscs
```

The following example shows the response body when the decommission operation is ongoing.

```
{
    "value": [
        {
            "key": "d1ed9bc4-6d4a-423f-b0fb-39829cf78a59:com.vmware.vcenter.topology.pscs",
            "value": {
                "service": "com.vmware.vcenter.topology.pscs",
                "start_time": "2019-03-29T12:00:43.626Z",
                "description": {
                    "args": [],
                    "default_message": "External Platform Services Controller node shutdown
successful.",
                    "id": "desc"
                },
                "operation": "decommission$task",
                "status": "RUNNING",
                "progress": {
                    "message": {
                        "args": [],
                        "default_message": "External Platform Services Controller node shutdown
successful.",
                        "id": "prog"
                    },
                    "completed": 50,
                    "total": 100
                },
                "cancelable": false
            }
        }
    ]
}
```

Converge to an Embedded Platform Services Controller Node

You can use the API to converge a vCenter Server Appliance with an external Platform Services Controller to a vCenter Server Appliance with an embedded Platform Services Controller.

Prerequisites

- Create backups of the vCenter Server Appliance and external Platform Services Controller instances so that you can restore them if the reconfiguration fails. See Backing up the vCenter Server Appliance for information on backing up the vCenter Server Appliance.

- Disable and remove vCenter HA before starting the process. Converging with vCenter HA configurations is not supported. Remove any vCenter HA configurations before starting the converge process. After converging, enable vCenter HA configurations in the embedded node.

Procedure

1 Provide authentication details for the Platform Services Controller.

2 Establish a session.

3 Run the converge operation.

What to do next

Decommission the Platform Services Controller. See Decommission the External Platform Services Controller Node.

Python Example of Converging a vCenter Server Appliance with an External Platform Services Controller

The example is based on the `converge_sample.py` sample.

Note For a complete and up-to-date version of the sample code, see the vSphere Automation SDK Python samples at GitHub.

```
...
    # Provide authentication details
    def __init__(self):
        parser = sample_cli.build_arg_parser()
        parser.add_argument(
            '-a', '--sso_admin_username', action='store', required=True,
            default='Sample_PSC_username',
            help='Platform Services Controller admin username')
        parser.add_argument(
            '-w', '--sso_admin_password', action='store', required=True,
            default='Sample_PSC_Admin_Password',
            help='Platform Services Controller admin password')
        args = sample_util.process_cli_args(parser.parse_args())
        self.username = args.username
        self.password = args.password
        self.sso_admin_username = args.sso_admin_username
        self.sso_admin_password = args.sso_admin_password
        self.server = args.server
        self.skipverification = args.skipverification

    # Establish a session
    def run(self):
        session = get_unverified_session() if self.skipverification else None

        sec_ctx = create_user_password_security_context(
                    self.username, self.password)

        connector = get_requests_connector(
                session=session,
                msg_protocol='json',
                url='https://{0}:5480/api'.format(self.server),
                provider_filter_chain=[
                    LegacySecurityContextFilter(
                        security_context=sec_ctx)])
        connector.set_application_context(app_ctx)
        stub_config = StubConfigurationFactory.new_std_configuration(connector)
        deployment_type = DeploymentType(stub_config)

    # Run the converge operation
    convergence_task = deployment_type.convert_to_vcsa_embedded_task(
            DeploymentType.ConvergenceSpec(DeploymentType.PscInfo(
                sso_admin_username=self.sso_admin_username,
                sso_admin_password=self.sso_admin_password)))
...
```

Decommission the External Platform Services Controller Node

You can use the API to decommission a Platform Services Controller.

After converging an external Platform Services Controller node to an embedded Platform Services Controller node, decommission the original external Platform Services Controller. Decommissioning a Platform Services Controller shuts it down and removes it from the single sign-on domain.

Note If the Platform Services Controller is configured in an HA environment, you must use the host name of the load balancer instead of the Platform Services Controller host name and disable the virtual IP of the load balancer before decommissioning. If you encounter any complications with your environment, you can manually unregister nodes by using the `cmsso-util unregister` command as described in KB article 2106736.

Prerequisites

- Verify that no vCenter Server Appliance instances are pointing to the Platform Services Controller before decommissioning.
- Reconfigure any products deployed into the environment that use the Platform Services Controller to use the newly deployed embedded Platform Services Controller.
- (Optional) Make a backup of the Platform Services Controller before decommissioning to ensure no loss of data.

Procedure

1. Provide authentication details for the Platform Services Controller.
2. Establish a session.
3. Run the decommission operation.

What to do next

You can delete virtual machine for the decommissioned Platform Services Controller.

Ensure that any external solutions or products are registered with the new embedded Platform Services Controller.

Python Example of Decommissioning an External Platform Services Controller

The example is based on the `decommission_sample.py` sample.

Note For a complete and up-to-date version of the sample code, see the vSphere Automation SDK Python samples at GitHub.

```
...
    # Provide authentication details
    def __init__(self):
        parser = sample_cli.build_arg_parser()
        parser.add_argument(
            '-psc_h', '--psc_host_name', action='store',
            default='Sample_PSC_hostname',
            help='Platform Services Controller FQDN / IP as per configuration')
        parser.add_argument(
            '-a', '--sso_admin_username', action='store',
            default='Sample_PSC_username',
            help='Platform Services Controller admin username')
        parser.add_argument(
            '-w', '--sso_admin_password', action='store',
            default='Sample_PSC_Admin_Password',
            help='Platform Services Controller admin password')
        args = sample_util.process_cli_args(parser.parse_args())
        self.psc_hostname = args.psc_host_name
        self.username = args.username
        self.password = args.password
        self.sso_admin_username = args.sso_admin_username
        self.sso_admin_password = args.sso_admin_password
        self.server = args.server
        self.skipverification = args.skipverification

    # Establish a session
    def run(self):
        session = get_unverified_session() if self.skipverification else None

        sec_ctx = create_user_password_security_context(
                    self.username, self.password)

        connector = get_requests_connector(
            session=session,
            msg_protocol='json',
            url='https://{0}:5480/api'.format(self.server))
        connector.set_security_context(sec_ctx)
        connector.set_application_context(app_ctx)
        stub_config = StubConfigurationFactory.new_std_configuration(connector)
        pscs_obj = Pscs(stub_config)

    # Run the decommission operation
    decommission_task = pscs_obj.decommission_task(
            self.psc_hostname,
            Pscs.DecommissionSpec(
            sso_admin_username=self.sso_admin_username,
            sso_admin_password=self.sso_admin_password))
...
```

Monitoring the vCenter Server Appliance 7

The vCenter Server Appliance provides interfaces to check the current health of its subsystems, and to report the appliance's history of resource consumption. You can use these interfaces to spot potential trouble areas or predict future shortages.

This chapter includes the following topics:

Health Monitoring of the vCenter Server Appliance

The vCenter Server Appliance API offers health status indicators for several key components of the appliance. These indicators can be polled periodically to monitor the components for problems.

The health status indicators report graded values from green to red. The general meanings of the grades are as follows.

green	The component is healthy.
yellow	The component is healthy, but may have some problems.
orange	The component is degraded, and may have serious problems.
red	The component is unavailable, or will stop functioning soon.
gray	No health data is available.

Check Overall System Health of the vCenter Server Appliance

The vCenter Server Appliance provides a composite health indicator that enables you to test a single value that represents the health of all the appliance components. This procedure shows how to test the composite health indicator.

The value of the overall system health indicator reflects the strongest trouble indication among the appliance components. If any component has a `red` indicator, the overall system health indicator is `red`, else if any component has an `orange` indicator, the overall system health indicator is `orange`, and so on.

A `gray` value for any component indicates that data for the subsystem is unknown. If one or more components have a `gray` value, but all other subsystems are `green`, then the overall system health indicator is `gray` rather than `green`. However, if any component has a definite trouble indication, the overall system health indicator reflects the strongest trouble indication among the components.

Prerequisites

Verify that you have an active authenticated session with the vCenter Server Appliance. This procedure assumes that the session ID is present in the security context of a stub configuration.

Procedure

1. Create an interface stub or REST path that uses the stub configuration.
2. Invoke the `health.system` method.
3. Format and display the resulting value.

JavaScript Example of Checking Overall System Health of the vCenter Server Appliance

This example shows the use of JavaScript with the vSphere Automation SDK for REST to request the overall system health indicator for the vCenter Server Appliance.

The example assumes a previously existing session with the vSphere Automation API endpoint. The JavaScript code depends on the `Node.js` package.

This example depends on the following global variables.

- *my_http_options*

```
var https = require('https');
var httpPort = 443;
var httpPath = '/rest/appliance/health/system';
var httpMethod = 'GET';

// Prepare the HTTP request.
my_http_options = session.my_http_options;
my_http_options.method = httpMethod;
my_http_options.path = httpPath;

// Define the callbacks.
function callback(res) {
  res.on('error',
         function(err) {console.log('ERROR checking system health: ', err)});
  res.on('data', function(chunk) {data = chunk.toString();});
  res.on('end', function() {
    if (res.statusCode == 200) {
      console.log('Overall system health status: ', JSON.parse(data).value);
    }
  })
};

// Issue the request.
https.request(my_http_options, callback).end();
```

Python Example of Checking the Overall System Health of the vCenter Server Appliance

This example shows the use of Python with the vSphere Automation SDK for Python to request the overall system health indicator for the vCenter Server Appliance and the overall health indicator for management services. The example assumes a previously existing session with the vSphere Automation API endpoint.

This example depends on the following global variables.

- *my_stub_config*

```
from com.vmware.appliance import health_client

# This example assumes you have previously created a session
# and stored the session ID in my_stub_config.

# Issue request for overall system health.
System_stub = health_client.System( my_stub_config )
health = System_stub.get()
print( 'Overall system health: %s' % health )

# Issue request for applmgmt services health.
Applmgmt_stub = health_client.Applmgmt( my_stub_config )
health = Applmgmt_stub.get()
print( 'Applmgmt services health: %s' % health )
```

Capacity Monitoring of the vCenter Server Appliance

The vCenter Server Appliance keeps a history of statistics that you can use to monitor resources used by the vCenter Server instance.

You can use the statistics to spot peak usage demands or to monitor trends for advance warning of potential resource exhaustion.

Frequency and Retention of Statistics Collection in the vCenter Server Appliance

The vCenter Server Appliance collects statistics from the guest operating system at regular intervals and stores them in a database. Users can query the statistics in the database by selecting a time period and a roll-up function that the appliance applies to the statistics before returning them to the client.

After the appliance monitoring service starts up, it begins requesting statistics from the guest operating system periodically, at a frequency that depends on the type of statistic. The service requests storage statistics once every 10 minutes, while it requests memory, CPU, and networking statistics once per minute. The collection times are fixed relative to the startup time of the monitoring service, rather than to clock time.

The monitoring service retains statistics approximately 13 months, by default. Older statistics are deleted by the service, creating a 13-month moving window within which you can query statistics. You can choose to delete statistics as needed to conserve storage resources.

Nature of Statistics in the vCenter Server Appliance

The vCenter Server Appliance supplies statistics of several types.

The guest operating system computes statistics either as rates, such as CPU cycles per second, or as snapshots of size, such as KB used for storage. Statistics stored as size snapshots are collected at the end of their sample periods. Statistics stored as rates are computed as averages of values sampled frequently during each sample period.

When you query the statistics database, the units are not returned with the data, but you can determine the units for any metric by requesting metadata for the metric with the `get()` method.

Requesting Statistics from the vCenter Server Appliance

To request statistics, you must construct an appropriate request structure to filter statistics from the database.

To request data or metadata for a metric, you must supply the ID of the metric. You can get a list of metric IDs by using the `list()` method, which returns information on all available metrics.

When you query statistics, you provide a list of IDs to specify the metrics in which you are interested. You also supply a start time, an end time, a roll-up interval, and a roll-up function. These values interact as follows to determine the data returned to you.

- The response contains a list of data points for each metric ID you specified in the request.
- The start time and end time control the limits for the data you want in the response. The response contains data points only for statistics that have timestamps between those limits, inclusive of the endpoints. However, the start time is adjusted to a round number, in some cases. For more information, see Statistics Interval Adjustment in the vCenter Server Appliance.
- The roll-up interval enables you to control the granularity of the data points in the response. Rather than a response with a data point for every statistic between the start time and end time, you get a response with a number of data points equal to the number of intervals between the start and end times. Generally, you should specify a time period that is an even multiple of the interval, so that each data point in the response represents the same number of statistics.
- The roll-up function specifies how the response summarizes the statistics that fall within each interval. The resulting data point can be the maximum statistic value within collection interval, or the mean of the statistics values within the interval, and so on.

Statistics Collection Times

The actual time that a statistic was collected is not readily predictable.

The API does not enable you to determine the exact time that a statistic was collected. Furthermore, some statistics, such as those for storage metrics, might take seconds or minutes to collect, so that they are not available immediately at the time a request is made to the guest operating system.

However, because statistics are collected at regular intervals, and roll-up intervals for a request generally all have the same size, each data point in the response represents the same number of statistics as the others. See Statistics Interval Adjustment in the vCenter Server Appliance for more information.

Statistics Interval Adjustment in the vCenter Server Appliance

When you make a request for statistics, the monitoring service might adjust the specified roll-up interval times to improve the appearance of statistics graphs in a graphical interface.

The monitoring service adjusts the start time of a data collection request when it is not an exact multiple of the interval length. In these instances, the start time is rounded downward to the previous UTC time that is a multiple of the interval. All subsequent intervals of the data collection are also adjusted to align with the new start time.

For example, if the start time is 10:31 and the interval length is 1 hour, the monitoring service adjusts the start time to 10:00 and the roll-up intervals have the following continuous pattern.

- 10:00 to 10:59:59.999
- 11:00 to 11:59:59.999
- 12:00 to 12:59:59.999

The monitoring service does not adjust the end time of a data collection. Consequently, the response to a statistics query might contain one more data value than expected, or an incomplete final interval might be lengthened.

Empty Data Values

In some instances, you might encounter a response that reports an empty data value, or even a series of empty data values. This might manifest as a list of data values containing some numeric values alternating with empty values.

- Empty data values can happen when the report time period is too short to be certain of containing any statistics. For instance, a time period of 30 seconds is half the length of the sample period for network metrics, so you have only a 50% chance of finding a network statistic during any 30-second reporting period.
- Empty data values can also happen when the interval is shorter than the sample period for a metric you have requested. In this case, some data points are present in the list, while others are empty because no statistic was collected during those intervals. For instance, an interval of 5 minutes is only half the length of the sample period for storage metrics, so every second data value is empty.

- Empty data values can also happen when the monitoring service has not finished collecting and writing the last sample to the database, even if the nominal sample timestamp falls within the report time period. For example, calculation of storage used can delay writing a storage statistic to the database. A request for the statistic during that delay time produces an empty data point in the response.

When a response contains an empty data value, this indicates that no statistics were collected during a collection interval. An appropriate action for the client in such a case depends on how the client is using the data. For example, if you are graphing a resource usage trend, you might choose to interpolate for the missing value to produce a smooth line.

Check Database Usage in the vCenter Server Appliance

The vCenter Server Appliance contains a database of all objects managed by the vCenter Server instance. In addition to inventory objects, the database includes vCenter Server statistics, events, alarms, and tasks. You can calculate the database storage consumption by adding the sizes of all data categories.

You need to monitor storage consumption in the vCenter Server Appliance.

Prerequisites

This task assumes you have previously authenticated and created a client session.

Procedure

1 Prepare a request for database usage statistics.

   Include metric IDs both for `vcdb_core_inventory` and `vcdb_seat`. The name `vcdb_seat` refers to Statistics, Events, and Tasks in the vCenter Server database.

2 Issue the request to the API endpoint.

3 Process the resulting data points as needed.

4 Format and print the results.

The result of this procedure shows the storage used in the vCenter Server database, which includes storage overhead used for indexes and other optimizations beyond the actual size of the data.

JavaScript Example of Checking Database Usage in the vCenter Server Appliance

This example shows the use of JavaScript with the vSphere Automation SDK for REST to view recent statistics for the vCenter database usage in the vCenter Server Appliance.

The example assumes a previously existing session with the vSphere Automation API endpoint. The JavaScript code depends on the `Node.js` package.

This example requests statistics at 30-minute intervals for a recent 2-hour report period. The example requests the storage used by the inventory component and the storage used by the combination of statistics, events, alarms, and tasks. The example adds the two values to calculate the vCenter Server database usage in each 30-minute roll-up interval, and then reports the maximum size found over the 2-hour report period.

This example depends on the following global variables.

- *my_http_options*

```
var https = require('https');
var httpPort = 443;
var httpPath = '/rest/appliance/monitoring/query';
var httpMethod = 'GET';

  // Prepare the HTTP request.
  my_http_options = session.my_http_options;
  my_http_options.method = httpMethod;
  var query = '?item.names.1=storage.used.filesystem.vcdb_core_inventory';
  query += '&item.names.2=storage.used.filesystem.vcdb_seat';
  query += '&item.function=MAX&item.interval=MINUTES30';
  var d_now = new Date();
  var ms = d_now.getTime();
  var min_15 = 15*60*1000;
  var endTime = new Date( d_now - min_15 ).toISOString();
  var startTime = new Date( d_now - 9*min_15 ).toISOString();
  query += '&item.start_time=' + startTime;
  query += '&item.end_time=' + endTime;
  my_http_options.path = httpPath + query;

  // Define the callbacks.
  function callback(res) {
    res.on('error', function(err) {console.log('ERROR querying database size: ', err)});
    res.on('data', function(chunk) {data = chunk.toString();});
    res.on('end', function() {
      if (res.statusCode === 200) {
        var results = JSON.parse(data).value;
        var coreSizes = results[0].data;
        var seatSizes = results[1].data;

        // Eliminate empty data points and process remaining data.
        var highest = coreSizes.filter(function(s){return s !== ''}).
                        map(function(n,i){return parseInt(n) + parseInt(seatSizes[i])}).
                        reduce(function(t,n){return Math.max( t,parseInt(n) )});
        console.log('vCenter database inventory + stats, events, alarms, tasks: (max) size = ',
                    highest);
      }
    })
  };
  // Issue the request.
  https.request(my_http_options, callback).end();
```

Python Example of Checking Database Usage in the vCenter Server Appliance

This example shows the use of Python with the vSphere Automation SDK for Python to view recent statistics for the vCenter database usage in the vCenter Server Appliance. The example assumes a previously existing session with the vSphere Automation API endpoint.

This example requests statistics at 30-minute intervals for a recent 2-hour report period. The example requests the storage used by the inventory component and the storage used by the combination of statistics, events, alarms, and tasks. The example adds the two values to calculate the vCenter Server database usage in each 30-minute roll-up interval, and then reports the maximum size found over the 2-hour report period.

```
from com.vmware import appliance_client
import datetime

# This example assumes you have previously created a session
# and stored the session ID in my_stub_config.

# Issue request for core inventory and 'SEAT' (stats, events, & alarms) usage.
req = appliance_client.Monitoring.MonitoredItemDataRequest()
req.names = ['storage.used.filesystem.vcdb_core_inventory',
             'storage.used.filesystem.vcdb_seat']
req.interval = appliance_client.Monitoring.IntervalType.MINUTES30
req.function = appliance_client.Monitoring.FunctionType.MAX
d_now = datetime.datetime.utcnow()
 req.start_time = d_now - datetime.timedelta( minutes=135 )
 req.end_time = d_now - datetime.timedelta( minutes=15 )
 Monitoring_stub = appliance_client.Monitoring( my_stub_config )
 resp = Monitoring_stub.query( req )

 # Extract resulting arrays.
 core_sizes = resp[0].data
 seat_sizes = resp[1].data
 # Remove empty data points:
 core_sizes = filter( (lambda x: x != ''), core_sizes )
 seat_sizes = filter( (lambda x: x != ''), seat_sizes )

 # Add the usage stats for each interval, and display maximum usage.
 highest = max( map( (lambda a,b: int(a) + int(b)),
                     core_sizes, seat_sizes ) )
 print( 'vCenter database inventory + stats, events, alarms, tasks:' +
        ' (max) size = {0} KB'.format( highest ) )
```

List Storage Consumption By Data Type in the vCenter Server Appliance

The vCenter Server Appliance provides statistics on several types of storage used in the appliance.

For example, you can query statistics about inventory storage, transaction log, and vCenter Server tasks. Many of these statistics are available both for storage consumed and storage available.

This task provides data for system administrators who need to monitor storage consumption in the guest operating system of the vCenter Server Appliance.

Prerequisites

Verify that you have authenticated and created a client session.

Procedure

1 Prepare a request for database usage statistics.

  Include metric IDs for each data type you wish to monitor.

2 Issue the request to the API endpoint.

3 Process the resulting data points as needed.

4 Format and print the results.

JavaScript Example of Listing Storage Consumption By Data Type in the vCenter Server Appliance

This example shows the use of JavaScript with the vSphere Automation SDK for REST to break down storage consumption by type in the vCenter Server Appliance.

The example assumes a previously existing session with the vSphere Automation API endpoint. The JavaScript code depends on the `Node.js` package.

This example requests the most recent statistics for several categories of storage. The example requests both current usage and total storage available for each category, then calculates the percentage used in each category.

This example depends on the following global variables.

- *my_http_options*

```
var https = require('https');
var httpPort = 443;
var httpPath = '/rest/appliance/monitoring/query';
var httpMethod = 'GET';
  // Prepare the HTTP request.
  my_http_options = session.my_http_options;
  my_http_options.method = httpMethod;
  var query = '?item.function=MAX&item.interval=MINUTES30';
  var d_now = new Date();
  var ms = d_now.getTime();
  var min_30 = 30*60*1000;
  var startTime = new Date( d_now - min_30 ).toISOString();
  var endTime = d_now.toISOString();
  query += '&item.start_time=' + startTime;
  query += '&item.end_time=' + endTime;
  // Array of monitoring points with output labels:
```

```
  var mon = [ ['VCDB core: ',
               'storage.used.filesystem.vcdb_core_inventory',
               'storage.totalsize.filesystem.vcdb_core_inventory'],
              ['VCDB SEAT: ',
               'storage.used.filesystem.vcdb_seat',
               'storage.totalsize.filesystem.vcdb_seat'],
              ['Log: ',
               'storage.used.filesystem.log',
               'storage.totalsize.filesystem.log'] ];
  for (var i=0, j=0; i<mon.length; i++) {
    query += '&item.names.' + (++j).toString() + '=' + mon[i][1];
    query += '&item.names.' + (++j).toString() + '=' + mon[i][2];
  }
  my_http_options.path = httpPath + query;
  // Define the callbacks.
  function callback(res) {
    res.on('error', function(err) {
                       console.log('ERROR retrieving storage sizes: ', err)});
    res.on('data', function(chunk) {data = chunk.toString();});
    res.on('end', function() {
      if (res.statusCode == 200) {
        var results = JSON.parse(data).value;
        console.log(results);
        for (var i=0, j=0; i<mon.length; i++) {
          // Discard empty data points:
          var u='', t;
          while (u == '') {
            u = results[j].data.pop();
            t = results[j+1].data.pop();
          }
          j += 2;
          mon[i].push(u, t, (u == 0 ? 0 : Math.floor(10000 * u / t)) / 100);
        }
        for (i=0; i<mon.length; i++) {
          console.log(mon[i][0], mon[i][3], '/', mon[i][4], ' (', mon[i][5], '%)');
        }
      }
    })
  };
  // Issue the request.
  https.request(my_http_options, callback).end();
```

Python Example of Listing Storage Consumption By Data Type in the vCenter Server Appliance

This example shows how to use the Monitoring interface to break down database usage by data type. The example requests the individual data types that you can also query as a composite metric for all storage used by Alarms, Statistics, Events, and Tasks in the vCenter Server instance.

```
from com.vmware import appliance_client
import datetime

# This example assumes you have previously created a session
# and stored the session ID in my_stub_config.

# Prepare request for chosen data types.
req = appliance_client.Monitoring.MonitoredItemDataRequest()
req.interval = appliance_client.Monitoring.IntervalType.MINUTES30
req.function = appliance_client.Monitoring.FunctionType.MAX
d_now = datetime.datetime.utcnow()
req.start_time = d_now - datetime.timedelta( minutes=30 )
req.end_time = d_now
mon = {'storage.totalsize.directory.vcdb_hourly_stats' :
         'Hourly stats',
       'storage.totalsize.directory.vcdb_daily_stats' :
         'Daily stats',
       'storage.totalsize.directory.vcdb_monthly_stats' :
         'Monthly stats',
       'storage.totalsize.directory.vcdb_yearly_stats' :
         'Yearly stats',
       'storage.totalsize.directory.vcdb_events' :
         'Events',
       'storage.totalsize.directory.vcdb_alarms' :
         'Alarms',
       'storage.totalsize.directory.vcdb_tasks' :
         'Tasks'}

req.names = []
for item in mon.keys() :
   req.names.append( item )

# Issue request.
Monitoring_stub = appliance_client.Monitoring( my_stub_config )
resp = Monitoring_stub.query( req )

# Assemble data from response.
out = {}
for metric in resp :
  # Discard empty data points:
  stat = ''
  while (stat == '') :
    stat = metric.data.pop()
  stat = int(stat)
  out[mon[metric.name]] = stat

# Format and print statistics.
for label in sorted( out.keys() ) :
  print( '{0:15s}: {1:8d} KB'.format( label, out[label] ) )
```

Maintenance of the vCenter Server Appliance

8

The vCenter Server Appliance Management API facilitates backup and restore operations.

You can create a backup file that includes the database and configuration of the vCenter Server instance. You can also use the API to restore the backup file into a freshly deployed appliance.

This chapter includes the following topics:

Backing up the vCenter Server Appliance

The vCenter Server Appliance Management API supports backing up key parts of the appliance. This allows you to protect vCenter Server data and to minimize the time required to restore data center operations.

The backup process collects key files into a tar bundle and compresses the bundle to reduce network load. To minimize storage impact, the transmission is streamed without caching in the appliance. To reduce total time required to complete the backup operation, the backup process handles the different components in parallel.

You have the option to encrypt the compressed file before transmission to the backup storage location. When you choose encryption, you must supply a password which can be used to decrypt the file during restoration.

The backup operation always includes the vCenter Server database and system configuration files, so that a restore operation has all the data needed to re-create an operational appliance. Current Alarms are included as well. You also have the option to specify additional data sets, called parts. In this release, you can specify a data set that includes Statistics, Events, and Tasks.

Backup and Restore Protocols for the vCenter Server Appliance

The vCenter Server Appliance backup and restore feature supports a number of plug-in communication protocols.

Choose one of these protocols as the backup location type when you invoke the operation.

- FTP
- FTPS
- SCP
- HTTP
- HTTPS
- NFS
- SMB

The value `PATH` for the location type field indicates a locally mounted volume.

Note If you specify the `SCP` protocol, you must specify an absolute path as the value of the location type field when you create the backup job.

Calculate the Size Needed To Store the Backup File

When you prepare to do a backup of the vCenter Server Appliance, you can use the API to calculate the storage space needed for the backup file.

You can do this task when you are choosing a backup storage location or whenever your existing storage location may be approaching full capacity.

Prerequisites

- Verify that you have a vCenter Server Appliance running.
- Verify that you are familiar with authentication methods. See Chapter 4 Authentication Mechanisms.

Procedure

1. Authenticate to the vSphere Automation API endpoint and establish a session.
2. Request a list of backup parts available.
3. For each available backup part, request the size of the backup file.

   The backup process calculates the compressed size of each backup part.
4. Choose which parts to include in the backup, and sum their sizes.

   The backup storage server must have sufficient space to contain the chosen parts.

What to do next

After you choose which backup parts you will store, and verify that the backup storage server has sufficient free space, you can launch a backup job. For information, see Back up a vCenter Server Appliance by Using the API.

Bash Example of Calculating the Size Needed To Store the Backup File

This example shows how to invoke `curl` from a bash script to collect the information you use to calculate the size needed to store a backup file of the vCenter Server Appliance.

This example depends on certain variables that specify the address of the vCenter Server Appliance and credentials to access the `appliance.recovery` API. For simplicity, the variables are hard-coded at the start of the bash script.

```
#!/bin/bash
 ##### EDITABLE BY USER to specify vCenter Server instance and credentials. #####
 VC_ADDRESS=vcsa_ip
 VC_USER=sso_user
 VC_PASSWORD=sso_pass
 ############################

 # Authenticate with basic credentials.
 curl -u "$VC_USER:$VC_PASSWORD" \
    -X POST \
    -k --cookie-jar cookies.txt \
    "https://$VC_ADDRESS/rest/com/vmware/cis/session"
 echo ''

 # Issue a request to list the backup file parts.
 curl -k -s --cookie cookies.txt \
     -H 'Accept:application/json' \
     "https://$VC_ADDRESS/rest/appliance/recovery/backup/parts" \
     >response.txt

 # Extract IDs of backup file parts.
 IDs=$(awk '{for (s=$0; match(s,/"id":"\w+"/); s=substr(s,RSTART+RLENGTH)) \
            print substr(s,RSTART+6,RLENGTH-7);}' \
           response.txt)

 # Request sizes of parts.
 echo Backup space required, by part ID:
 let "total=0"
 for ID in $IDs ; do
     curl -k -s --cookie cookies.txt \
         -H 'Accept:application/json' \
         "https://$VC_ADDRESS/rest/appliance/recovery/backup/parts/$ID" \
         >response.txt
     size=$(awk '{if (match($0,/"value":\w+/)) \
                 print substr($0,RSTART+8,RLENGTH-8);}' \
                response.txt)
     printf "  %-8s - %5dMB\n" "$ID" "$size"
     let "total += $size"
 done
 echo ''
 echo "Complete backup file size:  ${total}MB"
 # Clean up temporary files.
 echo ''
 rm -f response.txt
 rm -f cookies.txt
```

Python Example of Calculating the Size Needed To Store the Backup Image

This example shows how to use Python to collect the information you need to calculate the size needed to store a backup image of the vCenter Server instance.

```
from com.vmware.appliance.recovery.backup_client import Parts

 # This example assumes you have previously created a session
 # and stored the session ID in my_stub_config.

 # Issue a request to list the backup image parts.
 Parts_stub = Parts( my_stub_config )
 parts = Parts_stub.list()

 # Extract IDs of backup image parts.
 sizes = {}
 total = 0
 for part in parts :
    size = Parts_stub.get( part.id )
    sizes[part.id] = size
    total += size

 # Show the result.
 print( 'Backup image parts:' )
 for part_id in sizes.keys() :
    print( '  part {0} = {1}KB'.format( part_id, sizes[part_id] ) )
    print( 'Total size: {0}KB'.format( total ) )
```

Back up a vCenter Server Appliance by Using the API

You can use the Management API of the vCenter Server Appliance to create a backup of the vCenter Server database and key components of the appliance.

This procedure explains the sequence of operations you use to create a backup file of the vCenter Server instance in the appliance. You can do this as part of a regular maintenance schedule.

Prerequisites

- Verify that the vCenter Server instance is in a ready state. All processes with start-up type automatic must be running.
- Verify that no other backup or restore jobs are running.
- Verify that the destination storage location is accessible to the appliance backup process.
- Verify that the path to the destination directory already exists, as far as the parent directory.

- If the destination directory does not exist, the backup process will create it. If the directory does exist, verify that it is empty.
- Verify that the destination storage device has sufficient space for the backup file. For information about how to calculate the space needed for the backup file, see Calculate the Size Needed To Store the Backup File.

Procedure

1 Authenticate to the vSphere Automation API endpoint and establish a session.

2 Create a backup request object to describe the backup operation.

The request specifies several attributes, especially the backup location, the protocol used to communicate with the storage server, the necessary authorization, and which optional parts of the database you want to back up. The core inventory data and Alarms are always backed up, but you can choose whether or not to back up Statistics, Events, and Tasks. Collectively, this optional part of the backup is referred to as `seat`.

3 Issue a request to start the backup operation.

4 From the response, save the unique job identifier of the backup operation.

5 Monitor progress of the job until it is complete.

6 Report job completion.

Bash Example of Backing up the vCenter Server Instance

This example shows how to invoke `curl` from a bash script to back up the vCenter Server instance. A bash script can be invoked regularly as a `cron` job in the vCenter Server Appliance.

This example depends on certain variables that specify the source and destination for the backup operation. For simplicity, the variables are hard-coded at the start of the bash script.

This script does not encrypt the backup file.

```
#!/bin/bash
##### EDITABLE BY USER to specify vCenter Server instance and backup destination. #####
VC_ADDRESS=vc_server_ip
VC_USER=sso_user
VC_PASSWORD=sso_pass
FTP_ADDRESS=storage_server
FTP_USER=ftpuser
FTP_PASSWORD=ftpuser
BACKUP_FOLDER=backup
############################

# Authenticate with basic credentials.
curl -u "$VC_USER:$VC_PASSWORD" \
   -X POST \
   -k --cookie-jar cookies.txt \
   "https://$VC_ADDRESS/rest/com/vmware/cis/session"
```

```
# Create a message body for the backup request.
TIME=$(date +%Y-%m-%d-%H-%M-%S)
cat << EOF >task.json
{ "piece":
     {
         "location_type":"FTP",
         "comment":"Automatic backup",
         "parts":["seat"],
         "location":"ftp://$FTP_ADDRESS/$BACKUP_FOLDER/$TIME",
         "location_user":"$FTP_USER",
         "location_password":"$FTP_PASSWORD"
     }
}
EOF

# Issue a request to start the backup operation.
echo Starting backup $TIME >>backup.log
curl -k --cookie cookies.txt \
   -H 'Accept:application/json' \
   -H 'Content-Type:application/json' \
   -X POST \
   --data @task.json 2>>backup.log >response.txt \
   "https://$VC_ADDRESS/rest/appliance/recovery/backup/job"
cat response.txt >>backup.log
echo '' >>backup.log

# Parse the response to locate the unique identifier of the backup operation.
ID=$(awk '{if (match($0,/"id":"\w+-\w+-\w+"/)) \
          print substr($0, RSTART+6, RLENGTH-7);}' \
         response.txt)
echo 'Backup job id: '$ID

# Monitor progress of the operation until it is complete.
PROGRESS=INPROGRESS
until [ "$PROGRESS" != "INPROGRESS" ]
do
     sleep 10s
     curl -k --cookie cookies.txt \
       -H 'Accept:application/json' \
       --globoff \
       "https://$VC_ADDRESS/rest/appliance/recovery/backup/job/$ID" \
       >response.txt
     cat response.txt >>backup.log
     echo ''  >>backup.log
     PROGRESS=$(awk '{if (match($0,/"state":"\w+"/)) \
                     print substr($0, RSTART+9, RLENGTH-10);}' \
                    response.txt)
     echo 'Backup job state: '$PROGRESS
done

# Report job completion and clean up temporary files.
echo ''
echo "Backup job completion status: $PROGRESS"
```

```
rm -f task.json
rm -f response.txt
rm -f cookies.txt
echo ''  >>backup.log
```

Python Example of Backing Up a vCenter Server Appliance

This example specifies that the backup image should include Statistics, Events, and Tasks as well as the core inventory and alarm data. The value for `req.parts` indicates the optional data part for Statistics, Events, and Tasks.

This example uses the following global variables.

- *my_storage_server*
- *my_backup_folder*
- *my_scp_user*
- *my_scp_password*
- *my_stub_config*

When you back up the vCenter Server instance, you need two sets of authentication credentials. The API client needs to authenticate to the vCenter Server Appliance, and the Appliance backup service needs to authenticate to the backup storage server.

The example assumes that your API client has already authenticated the connection to the vCenter Server Appliance, and the security context is stored in *my_stub_config*.

In the backup request, you need to specify the folder that will contain the backup image. The folder name must be specified as a path name relative to the home directory of the user that authenticates with the storage server.

```
from com.vmware.appliance.recovery.backup_client import Job
import time

# This example assumes you have previously created a session
# and stored the session ID in my_stub_config.

# Create a backup request object.
req = Job.BackupRequest()
# Include optional backup part for Statistics, Events, and Tasks.
req.parts = ['seat']
req.location_type = Job.LocationType.SCP
req.comment = 'On-demand backup'
req.location = my_storage_server + ':/home/scpuser/' + my_backup_folder \
  + '/' + time.strftime('%Y-%m-%d-%H-%M-%S')
req.location_user = my_scp_user
req.location_password = my_scp_password

# Issue a request to start the backup operation.
backup_job = Job( my_stub_config )
job_status = backup_job.create( req )
job_id = job_status.id
```

```
# Monitor progress of the job until it is complete.
while (job_status.state == Job.BackupRestoreProcessState.INPROGRESS) :
    print( 'Backup job state: {} ({}%)'.format( job_status.state, \
                                             job_status.progress ) )
    time.sleep( 10 )
    job_status = backup_job.get( job_id )

# Report job completion.
print( 'Backup job completion status: {}'.format( job_status.state) )
```

Schedule a Backup Job

You can automate the backup process by creating a schedule that runs backup jobs at specific times.

You can keep existing backups on the backup server. The retention policy defines the maximum number of backups that the server keeps. You can also specify whether the backup job should run once, or on a recurring basis. The recurrence policy defines the days of the week and specific times at which the backup job is scheduled to run.

Prerequisites

- Verify that you can access the backup server and you have read and write permissions.
- Verify that you have established a connection to the vAPI services.

Procedure

1 Create a `Schedules` object.

2 Specify the retention and recurrence information.

3 Create a schedule by passing the backup location, user credentials to access the location, retention, and recurrence information.

4 Create an `UpdateSpec` and pass the updated information.

5 Get a backup schedule by passing a schedule ID.

What to do next

Run the backup job by using the schedule.

Python Example of Scheduling a Backup Job

This example shows how you can schedule a backup job, update the schedule, and get a schedule. The example is based on the `backup_schedule.py` sample.

Note For a complete and up-to-date version of the sample code, see the vSphere Automation SDK Python samples at GitHub.

```
...
   # Connect to vAPI services
   self.stub_config = vapiconnect.connect(
                            host=args.server,
                            user=args.username,
                            pwd=args.password,
                            skip_verification=args.skipverification)

   self.schedule_client = Schedules(self.stub_config)
...

   def create_schedule(self):
         retention_info = Schedules.RetentionInfo(self.max_count)
         recurrence_info = Schedules.RecurrenceInfo(
                                  days=self.days,
                                  hour=self.hour,
                                  minute=self.minute)
         create_spec = Schedules.CreateSpec(
                                  location=self.location,
                                  location_user=self.location_user,
                                  location_password=self.location_password,
                                  recurrence_info=recurrence_info,
                                  retention_info=retention_info)

         self.schedule_client.create(self._schedule_id, create_spec)

   def update_schedule(self):
         retention_info = Schedules.RetentionInfo(self.max_count)
         recurrence_info = Schedules.RecurrenceInfo(
                                  days=self.days,
                                  hour=self.hour,
                                  minute=self.minute)
         update_spec = Schedules.UpdateSpec(
                                  location=self.location,
                                  location_user=self.location_user,
                                  location_password=self.location_password,
                                  recurrence_info=recurrence_info,
                                  retention_info=retention_info)

         self.schedule_client.update(self._schedule_id, update_spec)

   def get_schedule(self):
         self.schedule_client = Schedules(self.stub_config)
         schedule_spec = self.schedule_client.get(self._schedule_id)
```

```
        recurrence_info = schedule_spec.recurrence_info
        retention_info = schedule_spec.retention_info

        table = []
        data = [self._schedule_id,
                "{}:{}".format(recurrence_info.hour, recurrence_info.minute),
                " ".join(recurrence_info.days),
                retention_info.max_count]
        table.append(data)
        headers = ["Schedule ID", "Time", "Days", "Retention"]
        print(tabulate(table, headers))

...
```

Restoring the vCenter Server Appliance

The vCenter Server Appliance Management API supports restoring the appliance from a backup copy. The API simplifies the process by unifying the handling of various components of vCenter Server in a single operation.

The process of restoring a vCenter Server Appliance from a backup has two phases.

1 Deploy a new appliance. OVF deployment is described in the *vSphere Automation SDKs Programming Guide*.

2 Invoke the `restore` operation from the Management API to apply configuration settings and load the vCenter Server database from the backup file.

Note You cannot specify optional parts for the restore operation. The restore operation includes all optional parts, such as Events and Tasks, that were specified at the time when the backup file was created.

Authentication When Restoring the vCenter Server Appliance

During the process of restoring the vCenter Server Appliance from a backup image, you cannot use vCenter Single Sign-On authentication. You must use local authentication until the appliance is fully configured.

When you restore your vCenter Server Appliance from a backup file, it begins in an unconfigured state. During this time, you must use local authentication to access the Management API. When you use local authentication, do not use the vSphere Automation API endpoint. Instead, you must connect your client to port 5480 of the appliance.

When you use local authentication you must pass user name and password credentials with each method invocation. Use credentials that are known to the guest operating system of the appliance.

Availability of Services While Restoring the vCenter Server Appliance

During the process of restoring the vCenter Server backup file in the vCenter Server Appliance, services in the appliance must restart. While they are restarting, your API client receives an error message.

You can write your client to trap the error, but you have no way to know when the Appliance services are running again. To determine when the restore process is complete, you must retry the API connection until it succeeds, then request the status of the job.

Restore the vCenter Server Appliance by Using the API

You can use the Management API of the vCenter Server Appliance to restore the appliance from a backup file containing the vCenter Server database and key components of the appliance.

Prerequisites

- Verify that the backed up vCenter Server Appliance is powered off.
- A new vCenter Server Appliance must be deployed in an unconfigured state, except that it must have a fully qualified domain name or IP address that matches the old one.
- Verify that the new vCenter Server Appliance has the same build number as the one in the backup file.
- Verify that the new vCenter Server Appliance has a size equal to or greater than the old one. If the old vCenter Server Appliance was customized to exceed the largest template size, the new one must be customized to the same size.
- If the old vCenter Server Appliance was deployed with an external Platform Services Controller, the new one must be also. If the old one was deployed in an embedded configuration, the new one must be also.
- Verify that no other backup or restore jobs are running.
- Verify that the destination storage location is accessible to the appliance restore process.

Procedure

1. Create a restore request object to describe the restore operation.
2. Issue a request to start the restore operation.
3. Monitor progress of the job until it is complete.
4. Report job completion.

What to do next

After the vCenter Server Appliance is fully configured by the restore operation, you can resume using the vSphere Automation API endpoint for subsequent operations.

Bash Example of Restoring the vCenter Server Instance

This example shows how to invoke `curl` from a bash script to restore a vCenter Server instance in a newly deployed vCenter Server Appliance. This operation is the second phase of restoring the appliance from a backup file.

The example uses local user name and password authentication because the vSphere Automation API endpoint is not yet running when you restore the appliance. The client must connect to port 5480 for this operation.

This example depends on certain variables that specify the source and destination for the restore operation. For simplicity, the variables are hard-coded at the start of the bash script.

This example assumes the backup image is not encrypted.

```
#!/bin/bash
##### EDITABLE BY USER to specify vCenter Server instance and backup location. #####
VC_ADDRESS=vc_server_ip
VC_USER=sso_user
VC_PASSWORD=sso_pass
FTP_ADDRESS=storage_server
FTP_USER=ftpuser
FTP_PASSWORD=ftpuser
BACKUP_FOLDER=backup
BACKUP_SUBFOLDER=2016-07-08-09-10-11
############################

# Create a message body for the restore request.
cat << EOF > task.json
{ "piece":
    {
        "location_type":"FTP",
        "location":"ftp://$FTP_ADDRESS/$BACKUP_FOLDER/$BACKUP_SUBFOLDER",
        "location_user":"$FTP_USER",
        "location_password":"$FTP_PASSWORD"
    }
}
EOF

# Issue a request to start the restore operation.
TIME=$(date +%Y-%m-%d-%H-%M-%S)
echo Starting restore $TIME $VC_B64_PASS >> restore.log
curl -k -u "$VC_USER:$VC_PASSWORD" \
  -H 'Accept:application/json' \
  -H 'Content-Type:application/json' \
  -X POST \
  "https://$VC_ADDRESS:5480/rest/com/vmware/appliance/recovery/restore/job" \
  --data @task.json 2>restore.log >response.txt
cat response.txt >> restore.log
echo '' >> restore.log

# Monitor progress of the operation until it is complete.
STATE=INPROGRESS
```

```
PROGRESS=0
until [ "$STATE" != "INPROGRESS" ]
do
    echo "Restore job state: $STATE ($PROGRESS%)"
    sleep 10s
    curl -s -k -u "$VC_USER:$VC_PASSWORD" \
      -H 'Accept:application/json' \
      -H 'Content-Type:application/json' \
      -X POST -d '' \
      "https://$VC_ADDRESS:5480/rest/com/vmware/appliance/recovery/restore/job?~action=get" \
      >response.txt
    cat response.txt >> restore.log
    echo '' >> restore.log
    PROGRESS=$(awk \
               '{if (match($0,/"progress":\w+/)) print substr($0, RSTART+11,RLENGTH-11);}' \
               response.txt)
    STATE=$(awk \
            '{if (match($0,/"state":"\w+"/)) print substr($0, RSTART+9, RLENGTH-10);}' \
            response.txt)
done
# Report job completion and clean up temporary files.
echo ''
echo Restore job completed.
rm -f task.json
rm -f response.txt
echo '' >> restore.log
```

Python Example of Restoring the vCenter Server Instance

This example shows how to use Python to restore a vCenter Server instance in a newly deployed vCenter Server Appliance. This operation is the second phase of restoring the appliance from a backup image.

This example uses the following global variables.

- *my_vcsa_hostname*
- *my_vcsa_username*
- *my_vcsa_password*
- *my_backup_name*
- *my_storage_server*
- *my_scp_user*
- *my_scp_password*
- *my_backup_folder*

When you restore the vCenter Server instance from a backup image, you need two sets of authentication credentials. The API client needs to authenticate to the vCenter Server Appliance, and the appliance backup service needs to authenticate to the backup storage server.

The example uses local username and password authentication for the connection to the vCenter Server Appliance because the vSphere Automation API endpoint is not yet running when you restore the appliance. The client must connect to port 5480 for this operation.

In the restore request, you need to specify the folder that contains the backup image. The folder name is the same name that was specified in the backup request. It must be specified as a path name relative to the home directory of the user that authenticates with the storage server.

This example assumes the backup image is not encrypted.

```
import requests
 from vmware.vapi.lib.connect import get_requests_connector
 from vmware.vapi.security.user_password import create_user_password_security_context
 from vmware.vapi.stdlib.client.factories import StubConfigurationFactory
 from com.vmware.appliance.recovery.restore_client import (Job)
 import time

 # Create a session object in the client.
 session = requests.Session()

 # For development environment only, suppress server certificate checking.
 session.verify = False
 from requests.packages.urllib3 import disable_warnings
 from requests.packages.urllib3.exceptions import InsecureRequestWarning
 disable_warnings(InsecureRequestWarning)

 # Create a connection to Appliance port 5480.
 local_url = 'https://%s:5480/api' % my_vcsa_hostname
 connector = get_requests_connector(session=session, url=local_url)

 # Add username/password security context to the connector.
 basic_context = create_user_password_security_context(my_vcsa_username, my_vcsa_password)
 connector.set_security_context(basic_context)

 # Create a stub configuration by using the username-password security context.
 local_stub_config = StubConfigurationFactory.new_std_configuration(connector)

 # Create a restore request object.
 req = Job.RestoreRequest()
 req.location_type = Job.LocationType.SCP
 req.location = my_storage_server + ':/home/scpuser/' + my_backup_folder + '/' + my_backup_name
 req.location_user = my_scp_user
 req.location_password = my_scp_password

 # Issue a request to start the restore operation.
 restore_job = Job( local_stub_config )
 job_status = restore_job.create( req )

 # Monitor progress of the job until it is complete.
 while (job_status.state == Job.BackupRestoreProcessState.INPROGRESS) :
     print( 'Restore job state: {} ({}%)'.format( job_status.state,
 job_status.progress ) )
     time.sleep( 10 )
```

```
    job_status = restore_job.get()

# Report job completion.
print( 'Restore job completion status: {}'.format( job_status.state) )
```

Reconcile a vCenter Server Appliance Instance with Nodes in Embedded Linked Mode

You can run the reconciliation process after you successfully restored your vCenter Server Appliance instance. By using the API or HTTP requests, you can reconcile vCenter Server Appliance nodes that work in an embedded linked mode and are connected in a ring or daisy-chain.

Reconciliation is a post-restore process that checks whether the vCenter Server Appliance partners in embedded linked mode are available, synchronizes the vCenter Server Appliance data and services with the partners, and runs the appliance services. The processes of restore and reconciliation depend on the topology and if there are changes in the topology between the backup and restore, you cannot restore the embedded linked mode. If the replication partners are not available and you try to restore the first node, you must ignore the warnings. In this case, the data of the Platform Services Controller corresponds to the vCenter Server Appliance backup and any changes that are made in the topology or infrastructure after the backup will be lost. If you restore a node different from the first one, you must add it to the domain of the first node. If you use a daisy-chain topology, you must first restore the first node, and after that to restore the second, link it to the first one, and apply the same to the following nodes.

You can use the reconciliation API after a file-based and an image-based restore. After an image-based restore, you can run the reconciliation process by using the API or UI. After a file-based restore, you can monitor the reconciliation process by using the `GET https://`*`<appliance_IP_address>`*`:5480/rest/appliance/recovery/reconciliation/job` HTTP request. For information about how to restore a vCenter Server Appliance instance from an image or a file by using the UI, see the *vCenter Server Installation and Setup* documentation.

Prerequisites

- Verify that you successfully restored your node from an image.
- Verify that the replication partners are available.
- Verify that you restored your nodes in the correct order, if you use a daisy-chain topology.
- Verify that you have administrator's credentials to your Single Sign-On domain.
- Verify that there is no running or failed reconciliation job.

Procedure

1 Create a `Job.CreateSpec` object, specify user name and password of Single Sign-On administrator, and set the `ignore_warnings` field to `true`.

  The default value of `ignore_warnings` is `false`. If you do not set `ignore_warnings` to `true`, the reconciliation fails due to the validation warnings.

2 Run a reconciliation job by using the `create(Job.CreateSpec)` method.

   You can check the result of the operation by reading the `Job.Info` object. `Job.Info` contains information about the job such as description, status, progress, error, start and end time.

3 Get the status of the job by calling the `get()` method.

   The possible states are `NONE`, `RUNNING`, `FAILED`, and `SUCCEEDED`.

Managing System Logs

You can automate the forwarding of vCenter Server Appliance system log messages to remote logging servers by using the vCenter Server Appliance Management API.

You can configure the syslog forwarding by using the API or user interface. For information about how to manage the syslog by using the user interface, see the *vSphere Monitoring and Performance* documentation.

Configuring Syslog Forwarding

You can use the `appliance` API or HTTP requests to configure the forwarding of vCenter Server Appliance syslog messages and test the connection between the appliance and remote servers.

Table 8-1 lists operations that you can perform to manage the forwarding of syslog messages to remote logging servers.

Table 8-1. User Operations

Operation	Description
Get forwarding configuration	You can retrieve information about the log forwarding configuration. See Figure 8-1 and HTTP Requests for Configuring Syslog Forwarding.
Test forwarding configuration	You can validate the current log forwarding configuration. Optionally, you can send a test diagnostic log message from the appliance to all configured logging servers to allow manual end-to-end validation. See Figure 8-1 and HTTP Requests for Configuring Syslog Forwarding.
Set forwarding configuration	You can change the log forwarding configuration. See Figure 8-1 and HTTP Requests for Configuring Syslog Forwarding.

The forwarding configuration includes the IP or FQDN of the remote server, the remote port for receiving syslog information, and the communication protocol. The remote server must be a server with running `rsyslog`, for example, another vCenter Server Appliance instance. The API supports the TCP, UDP, TLS, and RELP protocols. For information about the supported TLS versions, see KB article 2147469. By creating a `Forwarding.Config` object, you specify the connection with a remote server. For information about the `Forwarding` class and its methods, see the *API Reference* documentation, Figure 8-1, and Figure 8-2.

You can use several remote servers by creating a list with `Forwarding.Config` objects and passing it to the `set` method. The maximum number of remote servers is three. You can validate the forwarding configuration by using the `test` method. The returned `Forwarding.ConnectionStatus` object shows the status of the connection between the vCenter Server Appliance and a remote server. The `State` enumeration shows whether the appliance can reach the remote server. `State` can be `UP`, `DOWN`, or `UNKNOWN`. If the state is `DOWN` or `UNKNOWN`, the appliance cannot access the remote server and you must check the remote server and its settings such as network ports, firewall, supported protocols, and syslog configuration.

Note If you use UDP, the connection status is always `UNKNOWN`.

Figure 8-1. Forwarding Class Diagram for Python

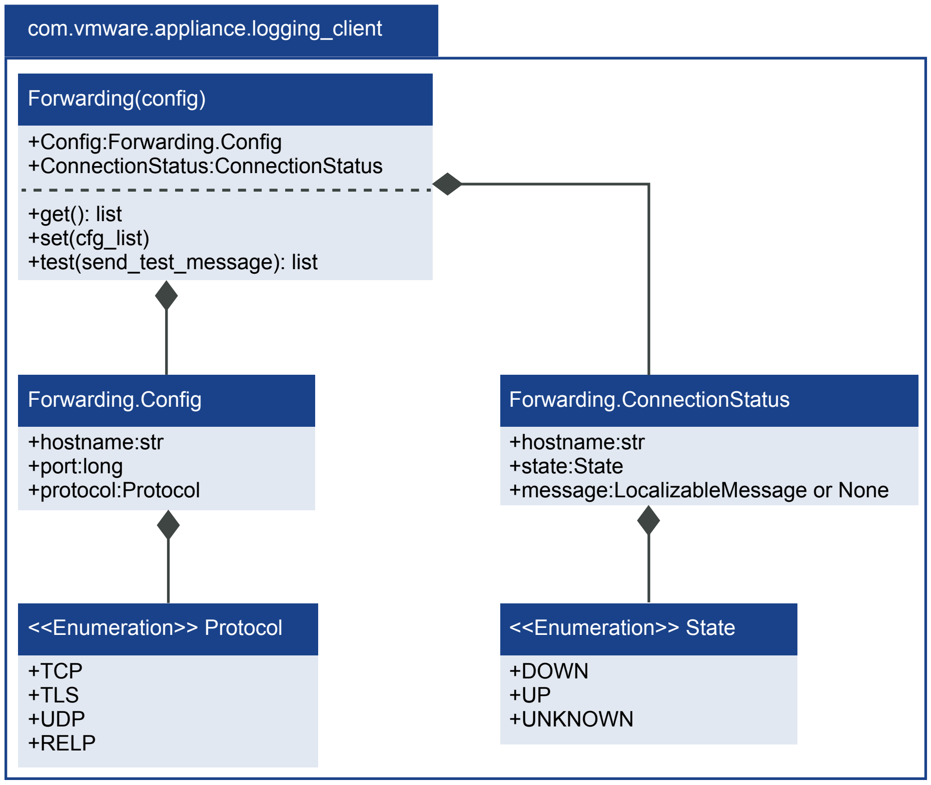
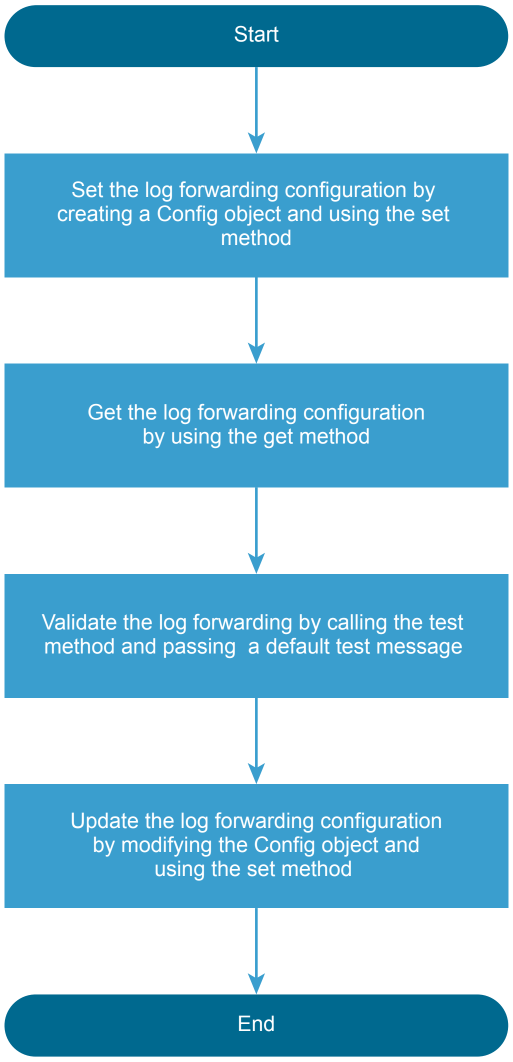


Figure 8-2. Example Configuration Workflow


Start
Set the log forwarding configuration by creating a Config object and using the set method
Get the log forwarding configuration by using the get method
Validate the log forwarding by calling the test method and passing a default test message
Update the log forwarding configuration by modifying the Config object and using the set method
End

For a code example of configuring the syslog forwarding, see Python Example of Configuring Syslog Forwarding.

HTTP Requests for Configuring Syslog Forwarding

By using the API or HTTP requests, you can set and get the forwarding configuration, check the connection with the remote server or servers, and exchange test messages with them.

The following HTTP requests show the syntax that you can use to perform the available user operations.

Note When you send the requests, you must authenticate with vCenter Server Appliance **root** credentials.

```
GET https://<appliance_IP_address>:5480/rest/appliance/logging/forwarding
```

```
POST https://<appliance_IP_address>:5480/rest/appliance/logging/forwarding?action=test
```

```
PUT https://<appliance_IP_address>:5480/rest/appliance/logging/forwarding
```

For information about the body of each HTTP request, see the *REST API Reference* documentation.

Table 8-2. HTTP Status Codes

HTTP Status Code	Description	Operations That Return the Status Code
200	The operation is successful.	All available operations. You can check the returned data in the results data structure.
400	You use an invalid argument. For example, a protocol that it is not supported, invalid port number, or the number of configurations is greater than 3.	Set forwarding configuration.
401	You use invalid user name or password, or authentication is failed.	All available operations.
500	There is a `vapi std` error. For information about the types of `vapi std` errors, see the `vapi.std.errors` API in the *API Reference* documentation.	Set forwarding configuration.

Python Example of Configuring Syslog Forwarding

This example shows how you can configure and test the forwarding of a vCenter Server Appliance syslog by using the API. The example is based on the `log_forwarding.py` sample.

Note For a complete and up-to-date version of the sample code, see the vSphere Automation SDK Python samples at GitHub.

```
...

        self.log_forwarding_client = Forwarding(self.stub_config)

...

    def set_log_forwarding(self):
        log_forwarding_config = [Forwarding.Config(hostname=self.loghost,
                                                   port=self.port,
                                                   protocol=self.protocol)]
        self.log_forwarding_client.set(log_forwarding_config)

    def get_log_forwarding(self):
        configs = self.log_forwarding_client.get()

        print("\nLog forwarding configurations:")
        table = [[cfg.hostname, cfg.port, cfg.protocol] for cfg in configs]
        headers = ["Loghost", "Port", "Protocol"]
        print(tabulate(table, headers))

    def test_log_forwarding(self):
        test_response = self.log_forwarding_client.test(True)

        print("\nLog forwarding test response:")
        table = [[resp.hostname,
                  resp.state,
                  resp.message.default_message if resp.message else None]
                 for resp in test_response]
        headers = ["Loghost", "State", "Message"]
        print(tabulate(table, headers))

    def update_log_forwarding(self):
        # Read log forwarding configuration
        log_forwarding_config = self.log_forwarding_client.get()

        # Delete the newly added configuration
        log_forwarding_config = list(filter(
                                    lambda cfg: cfg.hostname != self.loghost,
                                    log_forwarding_config))

        # Apply the modified log forwarding configuration
        self.log_forwarding_client.set(log_forwarding_config)

...
```

Updating the vCenter Server Appliance

9

The vCenter Server Appliance provides interfaces to perform software updates.

Before applying updates, you must make sure that your environment is prepared for the vCenter Server Appliance software update process. If you have a deployment with an external Platform Services Controller, verify that the Platform Services Controller is updated first.

Applying vCenter Server Appliance Software Updates

You can automate the installation of vCenter Server Appliance software updates to ensure that your system is stable and protected. Software updates can include security fixes, performance optimizations, and new features.

Security patches usually address vulnerabilities in third-party components and do not affect the vCenter Server Appliance functionality. vCenter Server bug fixes can introduce changes to the functionality without affecting the data format or database schema of the system.

Each update contains metadata with information about the updated content, for example, whether high-priority OS updates are included. The update metadata includes a list of components to be updated, the release date of the update, a list of fixed issues, time and disk space requirements, and information whether a reboot is required. The metadata can also contain a new vCenter Server Appliance version number, including a build number. In addition to the metadata, an update can contain optional components such as update scripts, new versions of vCenter Server Appliance software components, and new versions of OS components.

The vCenter Server Appliance can obtain software updates from either a URL or an ISO image. The URL can either point to the VMware Web repository or to a custom repository in which you upload the updates in ZIP format. To perform an update by using an ISO image, attach the image to the CD/DVD drive of the vCenter Server Appliance.

There are multiple phases of the update process. For details, see vCenter Server Appliance Software Update Workflow.

If you want to prevent issues related to the possibility of update installation failures, you should create a backup or take a snapshot of your vCenter Server Appliance instance before you start the update process. A backup can also be useful when an update is successfully installed. For example, you might decide to revert to the previous version if you encounter any undesired system behavior related to functional changes in the new software version.

Table 9-1. User Operations

Operation	Description
Get state information	You can retrieve information about the update state.
Check for update	You can check whether a new update is available.
Get update information	You can retrieve information about the available updates.
Get update requirements	You can retrieve information about the update requirements.
Stage	You can initiate the download of the update. **Note** The check phase must have completed successfully before you can stage the update.
Get staging status	You can retrieve information about the status of the stage operation. **Note** You must provide the task ID value that you received as a response when you initiated the stage operation.
Install	You can initiate the installation of the update. **Note** The update must be staged before you can install it.
Get installation status	You can retrieve information about the status of the install operation. **Note** You must provide the task ID value that you received as a response when you initiated the install operation.
Stage and install	You can initiate the download of the update and the installation starts when the download completes.

You can run software update operations by using the API or sending an HTTP request.

Note When you send the requests, you must use an authentication.

If you send requests to port `5480`, you must authenticate with vCenter Server Appliance **root** credentials. If you send requests to the vCenter Server reverse proxy port, you must authenticate with vCenter Single Sign-On credentials.

The following HTTP requests show the syntax that you can use to perform the available user operations.

```
https://<server>:5480/rest/appliance/update
```

```
https://<server>:5480/rest/appliance/update/pending?source_type=DEFAULT
```

```
https://<server>:5480/rest/appliance/update/pending/<target_version>
```

```
https://<server>:5480/rest/appliance/update/pending/<target_version>/requirements
```

```
https://<server>:5480/rest/appliance/update/pending/<target_version>?action=stage
```

```
https://<server>:5480/rest/appliance/task/<update_stage_task_id>
```

```
https://<server>:5480/rest/appliance/update/pending/<target_version>?action=install
```

```
https://<server>:5480/rest/appliance/task/<update_install_task_id>
```

```
https://<server>:5480/rest/appliance/update/pending/<target_version>?action=stage-and-install
```

```
https://<server>/rest/appliance/update
```

```
https://<server>/rest/appliance/update/pending?source_type=DEFAULT
```

```
https://<server>/rest/appliance/update/pending/<target_version>
```

```
https://<server>/rest/appliance/update/pending/<target_version>/requirements
```

```
https://<server>/rest/appliance/update/pending/<target_version>?action=stage
```

```
https://<server>/rest/appliance/task/<update_stage_task_id>
```

```
https://<server>/rest/appliance/update/pending/<target_version>?action=install
```

```
https://<server>/rest/appliance/task/<update_install_task_id>
```

```
https://<server>/rest/appliance/update/pending/<target_version>?action=stage-and-install
```

In addition to sending HTTP requests, you can also run cURL commands to perform update operations. See cURL Examples of Performing vCenter Server Appliance Software Update Operations.

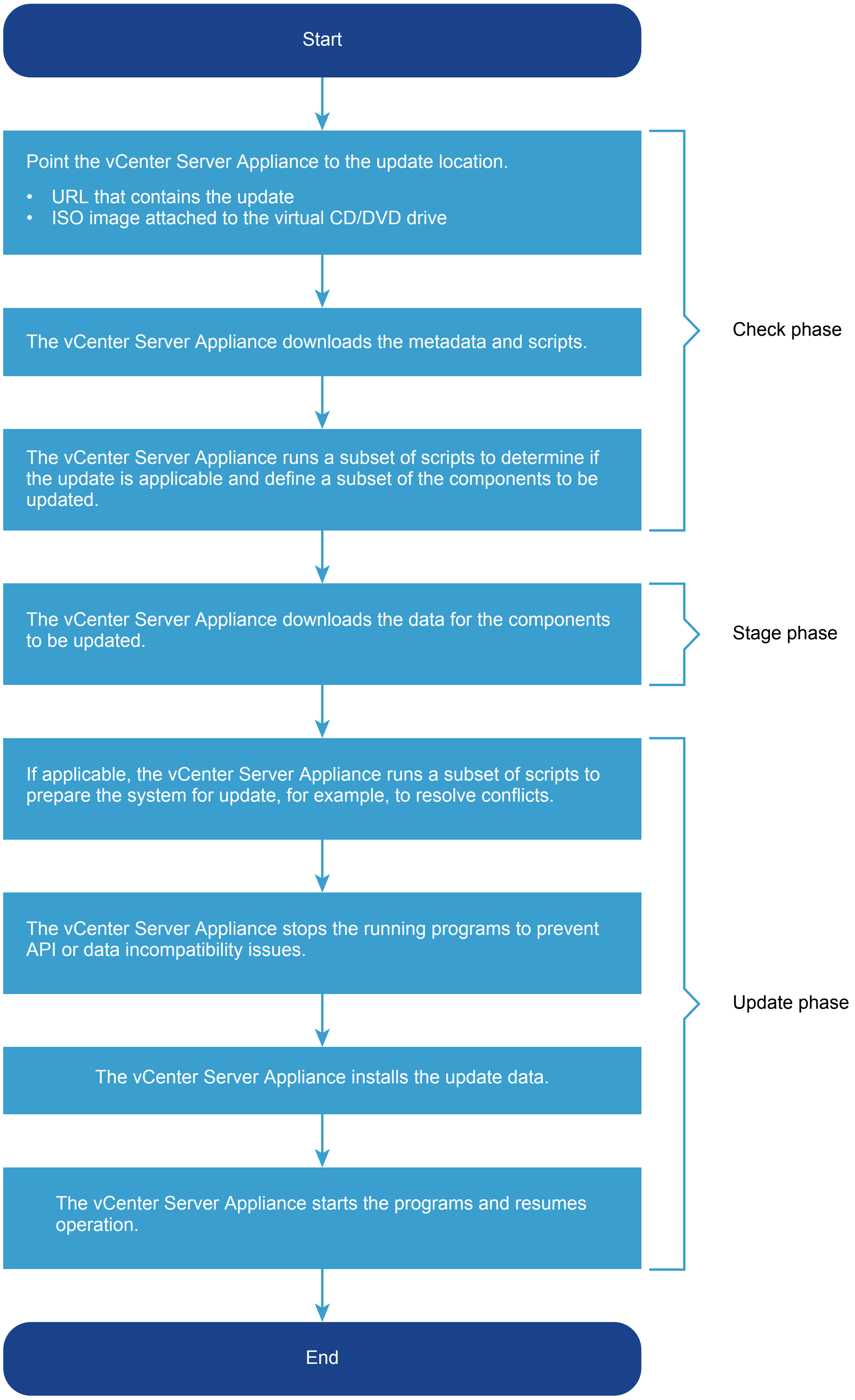
vCenter Server Appliance Software Update Workflow

The vCenter Server Appliance software update process consists of three major phases. In the first phase, the vCenter Server Appliance performs various checks, in the second phase it stages the update , and applies the update in the final phase.

To initiate the update process, you must choose whether the vCenter Server Appliance should obtain software updates from a URL or an ISO image. If you use an ISO image to update the vCenter Server Appliance, the image must remain attached to the CD/DVD drive of the appliance during the stage and install operations.

The workflow in Figure 9-1 describes the standard steps of the update process.

Figure 9-1. Update Process Workflow


Start
Point the vCenter Server Appliance to the update location.
• URL that contains the update
• ISO image attached to the virtual CD/DVD drive
The vCenter Server Appliance downloads the metadata and scripts.
The vCenter Server Appliance runs a subset of scripts to determine if the update is applicable and define a subset of the components to be updated.
Check phase
The vCenter Server Appliance downloads the data for the components to be updated.
Stage phase
If applicable, the vCenter Server Appliance runs a subset of scripts to prepare the system for update, for example, to resolve conflicts.
The vCenter Server Appliance stops the running programs to prevent API or data incompatibility issues.
The vCenter Server Appliance installs the update data.
The vCenter Server Appliance starts the programs and resumes operation.
Update phase
End

You can automate checks for new updates and staging of updates by using an update policy. For example, you can set an update policy to make the vCenter Server Appliance perform automatic checks for new updates at midnight every day. If there are new updates available, the vCenter Server Appliance can stage them automatically. Using an update policy reduces the waiting time by automating the first two phases and giving you the option to initiate only the update phase manually.

cURL Examples of Performing vCenter Server Appliance Software Update Operations

The following cURL command examples show the syntax for performing update operations such as checking for, staging, and installing updates, as well as retrieving information about update status, and setting update policies.

Example: Check for an Update

This example queries a custom URL for a new update.

```
curl -X GET -k -u root:<root_password> "https://<server>:5480/rest/appliance/update/pending?
source_type=LOCAL_AND_ONLINE&url=https://<custom_url>"
```

Example: Stage an Update

This example initiates the staging of the update.

```
curl -X POST -k -u root:<root_password> -H  "Content-Type: application/json"  -d
'{"version":"<target_version>"}' https://<server>:5480/rest/appliance/update/pending/<target_version>?
action=stage
```

Example: Install an Update

This example initiates the installation of the update.

```
curl -X POST -k -u root:<root_password> -H "Content-Type: application/json" -d
'{"version":"<target_version>","user_data":[{"key":"vmdir.password","value":"<sso_password>"}]}'
https://<server>/rest/appliance/update/pending/<target_version>?action=install
```

Example: Stage and Install an Update

This example downloads the update and installs it when the download completes.

```
curl -X POST -k -u root:<root_password> -H "Content-Type: application/json" -d
'{"version":"<target_version>","user_data":[{"key":"vmdir.password","value":"<sso_password>"}]}'
https://<server>/rest/appliance/update/pending/<target_version>?action=stage-and-install
```

Example: Retrieve Update Status

This example retrieves information about the update state.

```
curl -X GET -k -u root:<root_password> https://<server>:5480/rest/appliance/update
```

Example: Set an Update Policy

This example sets an update policy to check a custom URL for new updates at specific times every Friday and Saturday, and if a new update is available, it is staged automatically.

```
curl -X PUT -k -u root:<root_password> -H "Content-Type: application/json" -d '{"policy":
{"auto_stage": true,"check_schedule": [{"day": "FRIDAY","hour": 23,"minute": 30},{"day":
"SATURDAY","hour": 12,"minute": 30}],"custom_URL":"https://123.com"}}'
```