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Executive summary

As virtualization environments grow beyond a few hosts and virtual machines (VMs), IT automation becomes vital to provide services faster and more efficiently. Businesses of all sizes can benefit from IT automation. With VMware vRealize® Orchestrator™ and VMware vRealize® Automation™, IT staff can start small and grow their automation of services such as:

- Provisioning infrastructure resources, such as servers and array storage
- Developing composite workflows to decrease infrastructure resource-provisioning time
- Building service Blueprints to create customized environments for development/pre-production testing

By using vRealize Orchestrator and vRealize Automation, IT teams can extend their basic automation of key services with vendor plug-ins, such as Hewlett Packard Enterprise 3PAR Plug-in for VMware vRealize Orchestrator (vRealize Orchestrator plug-in). This document provides an implementation guide and examples of using this plug-in for IT automation.

Target audience

This implementation guide is intended for VMware administrators, storage administrators, or solution architects planning to implement the vRealize Orchestrator plug-in along with HPE 3PAR StoreServ storage (HPE 3PAR) within your private Cloud. Readers should be familiar with VMware vSphere® technologies, VMware vRealize Orchestrator, VMware vRealize Automation, and HPE 3PAR storage arrays. See Resources, contacts, and additional links for supporting resources.

Document purpose

This implementation guide demonstrates how to leverage HPE 3PAR storage arrays within a VMware Private Cloud utilizing the VMware vRealize® Suite. Using the vRealize Orchestrator plug-in, this document demonstrates how to:

- Build and combine workflows in vRealize Orchestrator to manage your IT infrastructure
- Deliver those services and resources to end users via a service-catalog-based solution with vRealize Automation
- Integrate workflows and composites into Blueprints within vRealize Automation
Solution components

Hardware

HPE 3PAR StoreServ storage

HPE 3PAR storage was built to meet the extreme requirements of massively consolidated Cloud service providers. Its remarkable speed—over 3 Million IOPS and consistent sub-ms latency—and proven system architecture has been extended to transform mainstream midrange and enterprise deployments, with solutions from a few TBs up to more than 20 PB.

The HPE 3PAR family of flash-optimized data storage systems modernizes your data center to handle unpredictable workloads with 99.99999% data availability. HPE 3PAR storage provides rapid and automated provisioning, multitenant design, hardware-accelerated deduplication and compression, and sub-1ms latency—all within a single tier-1 storage architecture that starts small and scales big. Figure 1 shows the HPE 3PAR storage portfolio.

HPE 3PAR flash-optimized portfolio

![Operating System Architecture Management Console](image)

![Affordable 75% data reduction](image)

![Enterprise-Class 99.9999% availability](image)

![Lightning Fast SPC-1 and SPC-2 leader](image)

Figure 1. HPE 3PAR StoreServ Storage flash-optimized portfolio
**Software**

**VMware vRealize Orchestrator**

vRealize Orchestrator is part of the VMware vRealize Suite of tools provided by VMware to simplify the creation of IT automation within the data center. vRealize Orchestrator uses workflows to automate simple or very complex tasks to support day-to-day management, decrease time-to-rollout of new services and capabilities, and decrease human error when performing large numbers of operations. With these workflows, you can begin construction of a software-defined data center private Cloud utilizing the vRealize Orchestrator client. Figure 2 shows the VMware vRealize Orchestrator software interface.

![VMware vRealize Orchestrator software interface](image)

**Figure 2.** VMware vRealize Orchestrator software interface

**VMware vRealize Automation**

With the growth and demand of Cloud Computing, the need to deliver infrastructure resources to users in a practical and capable way has grown exponentially. Additionally, the ability to provide a self-service portal, as well as providing access control and approval management in a simple way, produces a robust, custom-built Cloud that does not have to be built from scratch. Utilizing vRealize Automation and vRealize Orchestrator workflows combined with the HPE vRealize Orchestrator plug-in, you can deliver critical IT resources to your private Cloud environments. Figure 3 shows the VMware vRealize Automation user interface.
The vRealize Suite brings together DevOps-Ready IT, IT Automation, and Intelligent Operations to create a Hybrid Cloud solution that incorporates the many-faceted needs of a modern IT Organization. Figure 4 details where each of these facets falls in the vRealize Suite. This implementation guide focuses on how vRealize Orchestrator, vRealize Automation, and the vRealize Orchestrator plug-in enables and extends functionality in IT Operations.
Solution overview

Figure 5 shows the connectivity and communication channels present in the environment when using vRealize Orchestrator with an HPE 3PAR storage array. The vRealize Orchestrator appliance is a VM that runs in the vSphere environment. The vRealize Orchestrator appliance requires an IP address that can route to the vCenter and HPE 3PAR storage. Using this IP connectivity, RESTful API commands can be sent between vRealize Orchestrator and the HPE 3PAR storage array. RESTful or WSAPI API commands are handled with the vRealize Orchestrator plug-in.
Using vRealize Orchestrator with HPE 3PAR StoreServ storage

The following setup and configuration instructions assume that the vRealize Orchestrator appliance has been deployed and configured correctly.

To start orchestrating and automating various functions of your private Cloud, it is necessary to build workflows within vRealize Orchestrator or use the included workflows in the vRealize Orchestrator plug-in. The workflows are similar in concept to functions within programming languages and are, by design, built to accomplish a very specific task. Workflows take user input and return output, which can be used as an input for the next workflow.

Prerequisites

This guide is not an exhaustive guide for implementing or installing a Private Cloud. Each data center and IT infrastructure is unique and requires customization to fit each organization’s requirements.

vRealize Orchestrator has the ability to manage your VMware environment as well as third-party vendor products via plug-ins, including networking, storage, virtual, and physical environments. It supports connectivity via:

- RESTful API
- SOAP
- SSH
- PowerShell

The following additional prerequisites are:

- VMware vCenter – installed and configured
- vSphere ESXi – installed and configured
- DNS – configured and validated
- HPE 3PAR storage array – deployed and configured
- vRealize Orchestrator – deployed and configured
- vRealize Automation – deployed and configured

For detailed information on how to deploy these various components, please see Resources, contacts, and additional links.

HPE 3PAR Plug-in for vRealize Orchestrator

The fastest and easiest way to implement workflows in vRealize Orchestrator is to leverage the prebuilt workflows provided by VMware or the workflows included in the HPE 3PAR Plug-in for vRealize Orchestrator.

The vRealize Orchestrator plug-in comes with prebuilt workflows so an administrator can quickly and easily deploy and manage many of the standard operations that might be needed for your storage system. Examples of these are:

- Connect and manage HPE 3PAR storage resources
- Provision volumes
- Create host groups
- Export volumes
- Create VMFS datastores from volumes

The vRealize Orchestrator plug-in provides the following objects that provide additional management capabilities that can be used within workflows or passed to vRealize Automation as a resource:

- Host
- CPG
- Connection
• Snapshot
• Volume
• VLUN

**Installing the HPE 3PAR Plug-in for vRealize Orchestrator**

To install the vRealize Orchestrator plug-in:

1. Navigate to https://<YourVROipAddress>:8283/vco-controlcenter/ and log in as root.

2. Under the **Plug-ins** section, click the **Manage Plug-ins** button.

3. On the next page, under the **Install plug-in** section, click the **Browse** button and navigate to the plug-in (*.dar or *.vmoapp).

4. Accept the EULA and click **Install**.

5. Restart the vRealize Orchestrator appliance. Click the **Home button** → **Startup Options** → **Restart**.
6. Verify that the vRealize Orchestrator plug-in has been installed. Open the vRealize Orchestrator client and navigate to the Library, as shown in Figure 6.

![Figure 6. Library in vRealize Orchestrator client](image)

To configure vRealize Orchestrator to connect, operate, and manage an HPE 3PAR storage array, there are only two steps required:

1. Enable the WSAPI service on the HPE 3PAR storage array.
2. Add the HPE 3PAR storage array to vRealize Orchestrator.

**Enabling the WSAPI Service on HPE 3PAR storage**

The HPE 3PAR WSAPI is HPE 3PAR's RESTful API. By default, this service is disabled and must be enabled before continuing. Both the CLI and HPE StoreServ Management Console (SSMC) can be used to enable the WSAPI.

**Enable the WSAPI Service with the CLI**

To use the CLI to check the current status of the WSAPI service, execute the following command:

```
% showwsapi
```

If the service is disabled, enable it with the following command:

```
% startwsapi
```

Verify the service started with the `showwsapi` command.

**Enable the WSAPI Service with the HPE SSMC**

To enable the service in the HPE SSMC, under the Systems section in the main menu:

1. Select the HPE 3PAR storage array being configured.
2. Select the main drop-down menu and select Services.
3. Under the Actions drop-down item, select Edit.
4. Scroll to the bottom and enable the WSAPI Service and at least one of the HTTP or HTTPS options, as shown in Figure 7.

![Figure 7. Example showing the WSAPI Service enabled in the HPE SSMC](image)

**Adding an HPE 3PAR storage array**

Open the vRealize Orchestrator client, expand **Library**→**HPE Storage**→**3PAR StoreServ**→**Connection Management**, and select **Add 3PAR Connection**, as shown in Figure 8.

![Figure 8. Adding an HPE 3PAR storage connection](image)
Next, right click the **Add 3PAR Connection** workflow and select **Start Workflow**. Enter appropriate information in the corresponding fields and then click **Submit**, as shown in **Figure 9**.

![Start Workflow: Add 3PAR Connection](image)

**Figure 9. Add 3PAR Connection Wizard**

After successfully running, the schema should look like **Figure 10** and the Logs should look similar to the following:

```
[2017-06-20 10:19:12.975] [I] TESTING THE CONNECTION BEFORE ADDING
[2017-06-20 10:19:13.200] [I] ADDED CONNECTION WITH ID: <ALPHANUMERICID>
```

![Add StoreServ Connect](image)

**Figure 10. Example schema output after successful execution of the workflow**

**Validating connectivity**

The HPE 3PAR storage connectivity needs to be tested before continuing. To do this, you can run a simple workflow, such as the **Get all Virtual Volumes** workflow.

1. Using the **Get all Virtual Volumes** workflow, which is found in the Library/HPE StoreServ/Virtual Volume (VV) Management/Query folder under the **Library** tab in the vRealize Orchestrator client using the **Design** view:
   a. Right click and select **Start the workflow**.
   b. Select the HPE 3PAR storage array and select **Submit**, as shown in **Figure 11**.
2. Another window opens allowing the selection of different HPE 3PAR storage arrays. Select one and then click the Select button, as shown in Figure 12.

![Figure 12. HPE 3PAR array selection window](image)

Figure 11. Example of starting the Query all Volumes workflow

![Figure 11.](image)
3. After selecting your array, click **Submit** on the first window and then look for a successful schema execution, as shown in **Figure 13**.

![Figure 13. Successful Query all Volumes workflow schema](image)

**Management with Workflows and Composites**

Utilizing workflows from VMware or HPE can help you manage your environment efficiently from vRealize Orchestrator. Workflows can be used in their out-of-the-box state or combined into more complex composites for greater management capability. To aid in the simplicity of managing your environment, the vRealize Orchestrator plug-in provides a number of composites.

**Using the included plug-in composite to provision a VMFS volume**

The process of creating a VMFS datastore on an HPE 3PAR storage array consists of a number of sequential steps: creating the Virtual Volume (VV), exporting that VV’s VLUN(s) to the host, rescanning the storage on the ESXi hosts, and then finally formatting the LUN as a VMFS volume. With the **Create 3PAR datastore** composite, all of these steps are accomplished programmatically, finishing the sequence much faster than manually. The following procedure is an example of how to use the composite.

1. Start a new workflow for **Create 3PAR datastore** in HPE Storage → Datastore management.
2. In the window that appears, select the HPE 3PAR array that serves as the storage for the datastore you are creating, as shown in **Figure 14**.

![Figure 14. Create 3PAR Datstore composite data entry window](image)
3. Select the cluster that has the storage presented to it in vSphere, as shown in Figure 15.

**Figure 15.** Selecting the cluster to present the storage for VMFS to it in vSphere
4. Click **Next** on the workflow window, enter the details for the datastore, select the appropriate CPG on the HPE 3PAR array to use, and specify the host set that the storage should be exported to, as shown in Figure 16.

![Start Workflow: Create 3PAR Datastore](image)

**Figure 16. Create 3PAR Datastore** entry window

5. Click the **Submit** button and verify the schema is similar to Figure 17 to ensure a proper run.

![Create 3PAR Datastore Composite Schema](image)

**Figure 17. Create 3PAR Datastore** composite schema after a successful run
6. Verify the new datastore is present and available in vSphere, as shown in Figure 18.

![Fig 18. Example of final result from running the Create 3PAR Datastore composite](image)

This composite workflow is not only meant to create a VMFS datastore, but it also provides an example of the ability to automate complex or tedious tasks with vRealize Orchestrator. This composite can be used as a step in a larger series of workflows to create a composable virtual infrastructure, at the click of a button, to accomplish the following:

- Automate the creation of a new vSphere cluster from newly installed ESXi hosts
- Configure or manage hosts within the HPE 3PAR array
- Provision and manage storage to the newly created cluster
- Deploy virtual machines

**Creating a custom workflow or composite**

To expand the capabilities provided by the vRealize Orchestrator plug-in, an administrator can use additional actions provided by the vRealize Orchestrator plug-in to modify existing workflows or to create customized workflows that suit the needs of the environment.

By clicking on each action, you can see the requirements for each action. A workflow generally contains several sets of properties:

- Inputs – information provided by the user
- Outputs – information returned by the workflow
- Scripting – custom code specific to the task

For example, click the Action tab, expand the `com.hpe.storeserv.snapshot` folder, and then select `createVolumeSnapshot`.

To create a custom workflow using the `createVolumeSnapshot` action:

1. Open the vRealize Orchestrator client and switch to Design mode.
2. Create a new folder and right click it to create a new workflow, as shown in Figure 19.
3. Click on the **Schema** tab, expand **All Actions**, expand the **com.hpe.storeserv.snapshot** folder, and drag **createVolumeSnapshot** into the **Schema** window, as shown in **Figure 20**.

4. A dialog box appears asking to add the action inputs/outputs to the workflow, as shown in **Figure 21**. Click **Setup**.

---

**Figure 20.** Dragging **createVolumeSnapshot** into the schema window

**Figure 21.** Dialog box for adding action inputs/outputs to the workflow
5. From the **Promote Workflow Input/Output Parameters** window, you can customize the inputs and outputs to be static or user defined and how they are to be used within the workflow.

For this example, keep the default (input and output) selections, as shown in **Figure 22**. Click **Promote**.

![Promote Workflow Input/Output Parameters window](image)

**Figure 22. Promote Workflow Input/Output Parameters window**

**Tip.** You can look at the Input and Output tabs of the workflow to see the previously defined parameters created within the workflow.

6. Click **Save** and then **Close** to complete the creation of your custom workflow.

7. Run the workflow, select the StoreServ Connection and Virtual Volume to snapshot. Set any custom parameters (name, permissions, expiration/retention hours), as shown in **Figure 23**. Click **Submit**.

![figure 23](image)
A log entry is created after the snapshot is successfully created, as shown in Figure 24.

Tip
You can log in to the HPE SSMC and verify the snapshot exists.
Integrating HPE 3PAR storage with vRealize Automation

When used in conjunction with the vRealize Orchestrator plug-in, vRealize Automation takes a vRealize Orchestrator workflow and makes a Blueprint out of it. The Blueprint is then assigned to a Service (a group of tasks) that uses policy-based rules that are based on user/group entitlements. The Blueprint is published in a Service Catalog that is available to your users for self-service tasks. It can handle services from multiple Cloud vendors and deliver life-cycle management of resources. To illustrate this, a brief example is shown below.

Creating catalog items from vRealize Orchestrator workflows

The typical use case for vRealize Automation is to create a private Cloud management portal, allowing a user to provision IT resources and then own and manage resources by utilizing actions and services. The following section details how to define these resources and allow users to manipulate resources belonging to them. XaaS (anything as a service) Blueprints allow the creation of a catalog of private Cloud services and actions to be created and customized for the environment. The steps for creating an XaaS Blueprint and adding it to the catalog in the vRealize Automation client are:

- Create a Custom Resource
- Create an XaaS Blueprint
- Create a service
- Configure a Catalog Item
- Edit or create an Entitlement
- Test the new catalog entry

Creating a Custom Resource

For this example, the following sections detail creation of a Blueprint that allows the user to take array snapshots of VMFS datastores. Before creation of a Blueprint, we must define the type of resource that is being provisioned. Under Design → Custom Resources, create a new resource for the StoreServ:Snapshot Orchestrator type, as shown in Figure 25. Provide a name that is meaningful and a brief description, and then click Next to finish.

Figure 25. Defining the resource type
Create XaaS Blueprint

XaaS Blueprints are linked to vRealize Orchestrator workflows, allowing vRealize Automation objects to be linked to vRealize Orchestrator objects. This is accomplished by selecting New under Design→XaaS Blueprints. To link an XaaS Blueprint to a vRealize Orchestrator workflow:

1. Select New under Design→XaaS Blueprints, as shown in Figure 26.

![Figure 26. Selecting a new XaaS Blueprint](image)

2. Under the Workflow tab, navigate to the Create 3PAR snapshot for datastore workflow from the vRealize Orchestrator plug-in, select it, and then click Next, as shown in Figure 27.

![Figure 27. Workflow tab](image)
3. In the **General** tab, provide a name and description for the Blueprint and select the additional options that fit the desired use case for the environment, as shown in [Figure 28](#).
4. Click **Next** on the Blueprint form, and in the **Provisioned Resource** section, select the custom resource that was defined above, as shown in Figure 29.

![Figure 29. Selecting the custom resource for the Blueprint](image)

5. Finish the wizard and publish the XaaS Blueprint, as shown in Figure 30.

![Figure 30. Publishing the XaaS Blueprint](image)
Create a Service

Next, a service must be defined with owners and support teams; otherwise, the service will not show up in the catalog page. Under Administration → Catalog Management → Service, create a new service (unless using an existing service), as shown in Figure 31.

Figure 31. Creating a new service
**Configure Catalog Item**

Define the service for the Catalog Item. This is done in **Administration**→**Catalog Management**→**Catalog Items**→«Catalog Item». Select the correct group under the **Service** drop-down list, as shown in **Figure 32**.

![Configure Catalog Item](image)

**Figure 32.** Defining the service for the Catalog Item.
Edit or create Entitlement

Create a new Entitlement or modify an existing one under Administration→Catalog Management→Entitlements, as shown in Figure 33.

![Figure 33. Creating a new Entitlement](image)

On the Items & Approvals tab, select the service that was defined previously, as shown in Figure 34.

![Figure 34. Selecting the service for the Entitlement](image)
Test the newly added service

After completing these actions, the services appear in the Services Catalog, as shown in Figure 35.

1. Select request on the Create 3PAR snapshot for VMFS datastore service, enter information for the description and reasons fields, and then click Next, as shown in Figure 36.

Figure 35. Services in the Service Catalog

Figure 36. Selecting request on Create 3PAR snapshot for VMFS datastore service
2. On the next screen, fill out the appropriate fields, select the VMFS datastore to create a snapshot on, and click **Submit** to finish, as shown in Figure 37.

![Figure 37. Creating snapshot information for the datastore](image)

3. After the request is finished, it can be viewed in the **Requests** tab, as shown in Figure 38.

![Figure 38. Viewing the request in the Requests tab](image)

Additional vRealize Automation services can be created using workflows provided by the vRealize Orchestrator plug-in.

**Key findings**

- When creating custom workflows, (not provided by the HPE 3PAR plug-in for vRealize Orchestrator), a Session Key is required for all operations.
- REST calls might need to be encoded (UTF-8).
- Some included workflows are not intended to be run by themselves, but instead to be called as part of a composite.

**Summary**

HPE 3PAR storage arrays are capable and robust, easily managed, and reliable. When adding the workflows included in the vRealize Orchestrator plug-in and automating using vRealize Automation, the array can be leveraged at scale in a virtualized environment. The administrator no longer has to spend days provisioning new resources. Instead, vRealize Orchestrator and vRealize Automation enable users to do this on their own—while still providing the administrator complete control over the environment. The acceleration gained from the vRealize Orchestrator plug-in and vRealize Automation enables a business to custom design their Cloud automation without starting from scratch.
Appendix - Troubleshooting the vRealize Orchestrator plug-in when upgrading

When upgrading the vRealize Orchestrator plug-in to the next version, the plug-in must be manually removed, along with the HPE 3PAR StoreServ packages. The following steps guide you through this process.

1. Remove the o11nplugin-storeserv.dar file from the plugins install folder or delete it, which is located at:
   a. For vRealize Orchestrator installed on Microsoft® Windows® with vCenter:
      Install_Directory\VMware\Infrastructure\Orchestrator\app-server\plugins
   b. For vRealize Orchestrator standalone on Windows:
      Install_Directory\VMware\Orchestrator\app-server\plugins
   c. For the vRealize Orchestrator Appliance:
      /usr/lib/vco/app-server/plugins

2. Modify the _VSOPluginInstallationVersion.xml XML file and remove the line that mentions the vRealize Orchestrator plug-in name. The file is located at:
   a. For vRealize Orchestrator installed on Windows:
      Install_Directory\VMware\Orchestrator\app-server\conf\plugins\
   b. For vRealize Orchestrator Appliance 6.x and below:
      /var/lib/vco/app-server/conf/plugins/
   c. For vRealize Orchestrator Appliance 7.x:
      /etc/vco/app-server/plugins/

3. Remove the com.hpe.storeserv package installed during the plug-in installation from the vRealize Orchestrator client in “Administer” mode under the Packages tab.

   **Important** HPE recommends removing the old package, because not doing this can cause conflicts with the new vRealize Orchestrator plug-in version.

4. Restart the service by visiting https://<your_vro_ip>:8283 » Startup options » Restart

   **Note** appliances might need to be rebooted.

5. Follow the installation procedure above to install the new version of the vRealize Orchestrator plug-in.
Resources, contacts, and additional links

HPE 3PAR StoreServ storage documentation
HPE 3PAR Plug-in for VMware vRealize Orchestrator download site
HPE 3PAR for VMware vRealize Orchestrator User Guide
HPE 3PAR Web Services API 1.6.1 Developer Guide
HPE 3PAR StoreServ Storage Concepts Guide
HPE 3PAR StoreServ Storage Best Practices Guide

vRealize Orchestrator documentation
Installing and Configuring VMware vRealize Orchestrator
Using the VMware vRealize Orchestrator Client
Using VMware vRealize Orchestrator Plug-ins

vRealize Automation documentation
Installing vRealize Automation
Configuring vRealize Automation
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