

TECHNICAL GUIDE

PKS Enterprise and Pure Storage Deployment Guide

Increase agility and lower costs with platform as a service, Kubernetes, and persistent storage.

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This guide covers how to get started using VMware Pivotal Container Service (PKS) Enterprise with Pure Storage® solutions. The PKS Enterprise platform enables IT organizations to deploy and manage Kubernetes clusters at scale for private- and public-cloud solutions. This paper describes a PKS Enterprise configuration on VMware vSphere using multiple availability zones and highly available Pure FlashArray™ and Pure FlashBlade™ solutions for persistent storage.

Introduction

Deploying platform as a service (PaaS) enables developers to deliver applications to the business faster and more efficiently by using a consistent underlying infrastructure and platform. PKS Enterprise delivers container orchestration with Kubernetes and familiar enterprise PaaS tools. This allows IT to scale applications dynamically, manage them with Kubernetes, and run them with PKS. These applications can utilize enhanced workflows and Kubernetes Statefulsets, DaemonSets, and other features. In most enterprises, PKS leverages VMware vSphere as the underlying infrastructure as a service (IaaS). Therefore, this guide focuses on deploying PKS Enterprise using the Pivotal Ops Manager connected to the VMware vCenter management component of vSphere. There are, however, other infrastructure options to manage private and public clouds in conjunction with Pure Storage solutions.

PKS Enterprise and Pure Storage

Running PKS and Pure Storage enables you to use your existing vSphere environments to support PKS, or else deploy a converged stack that supports both legacy VM workloads and new applications developed for the cloud. The advantages of this approach include:

- **Disaggregated scale:** Scale compute, network, and storage independently with capabilities similar to those of modern cloud and software as service (SaaS) providers.
- **Better overall TCO:** Use stateless compute, storage, and applications in a cloud-consumption model that is never end-of-life and has zero tech refresh cycles. This model delivers the highest levels of flexibility and the lowest operating costs.
- **Single domain:** Now you can avoid building siloed environments that add to operating costs and limit your options going forward.



Pivotal Container Services (PKS)

High-level Design

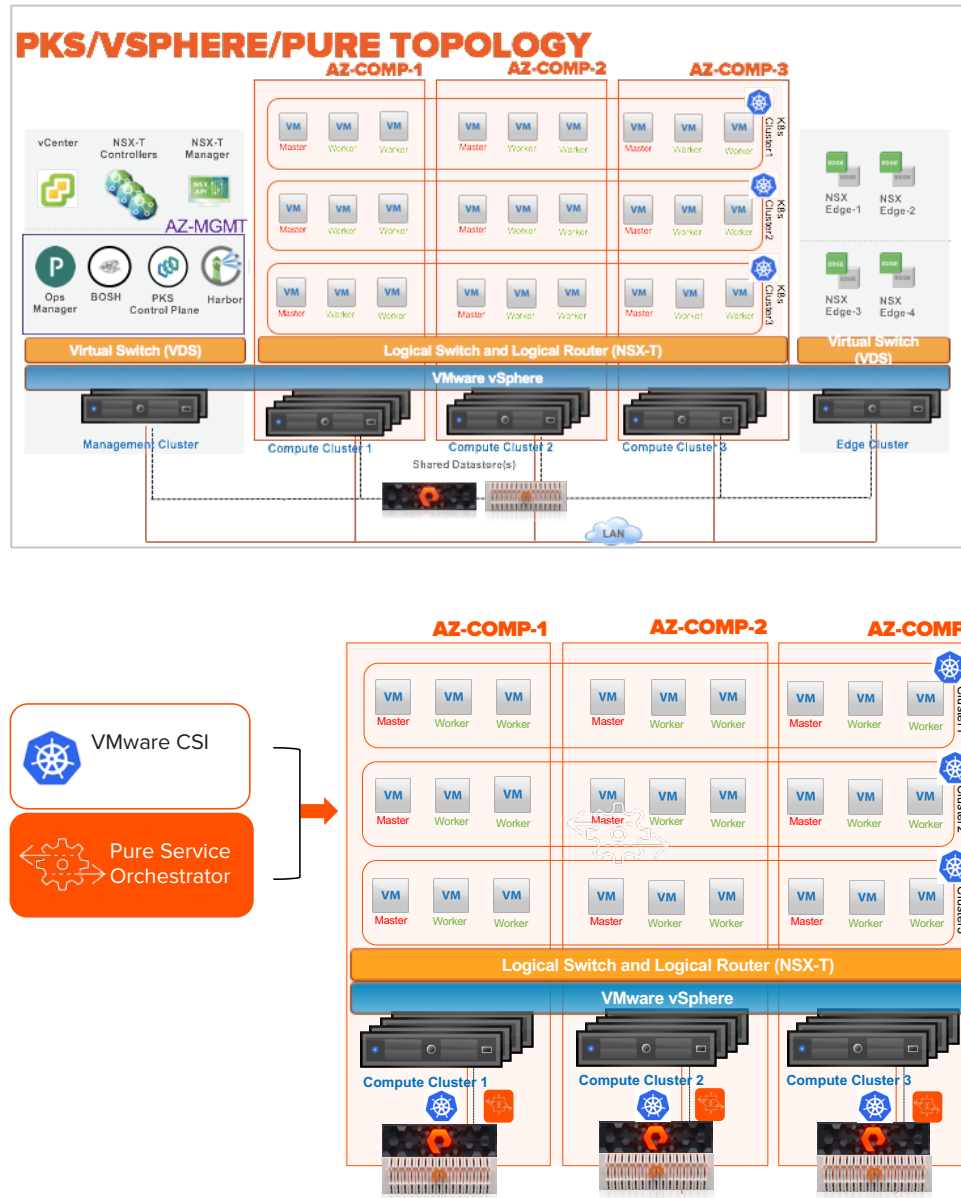


Figure 1. PKS, vSphere, and Pure Storage topology



Software	Version
Ops Manager	2.6.9
VMware vSphere ESXi	6.7 (13006603)
VMware vSphere vCenter	6.7 (13639324)
Pivotal Container Services (PKS)	1.4.1-build.4*+
Purity//FA	5.1.10
Purity//FB	2.4.1
Pivotal Stemcell	Ubuntu-xenial 250.63
Bosh Director for vSphere	2.5.7-build.208*
VMware Harbor Registry	1.8.2-build.6
Pks cli	1.5.0-build.291
Bosh cli	6.0.0-5240e8aa-2019-08-05T22:16:39Z
VMware NSX-T	2.4.2

VMware vSphere Configuration

To configure VMware vSphere and VMware NSX-T, follow the guidelines listed in the [PKS Enterprise documentation](#).

Networking and NSX-T: NSX-T provides the virtual network constructs to allow PKS Enterprise to scale. The key benefit of PKS with NSX-T is the ability to provide a packaged turnkey solution with advanced container networking, micro-segmentation, ingress controller, load balancing, and security policy. Make sure to follow the configuration instructions from Pivotal specific to your version of PKS. In addition, [follow the instructions here](#) to enable networking pathing for iSCSI FlashArray and/or NFS for FlashBlade.

Note: Read this [post from VMware](#) for a review of the network topologies and interactions with NSX-T and PKS.

DRS/HA clusters: This architecture uses a single vSphere High Availability/Distributed Resource Scheduler (HA/DRS) cluster and resource pool for each availability zone. Follow the PKS Enterprise documentation to create a cluster in your vSphere environment:

- [Create the PKS Management Plane](#)
- [Create the PKS Compute Plane](#)



Shared storage: Shared storage using Storage Policy Based Management (SPBM) and Pure Storage Pure Service Orchestrator™ allows for workloads requiring persistent data to be accessible on all compute nodes in all availability zones.

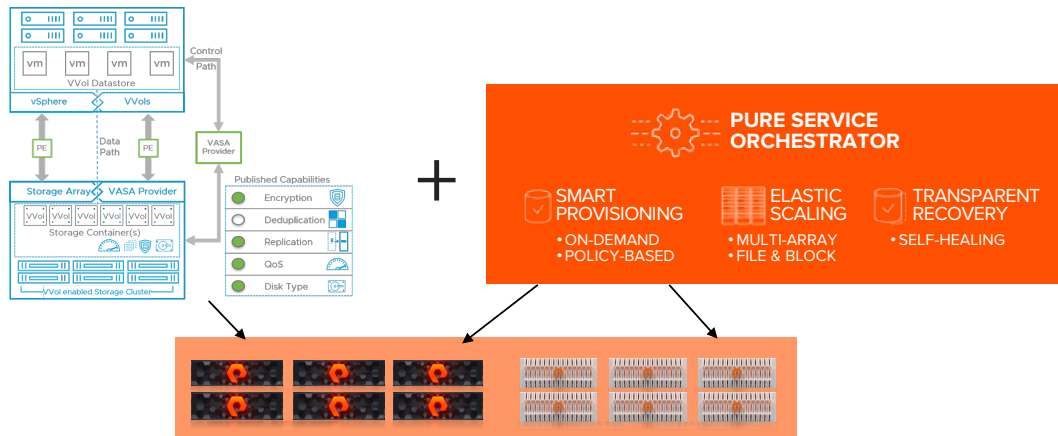


Figure 2. Storage Policy Based Management with Pure Storage Orchestrator

Pure FlashArray and FlashBlade solutions provide the resiliency and performance required for applications to scale for production workloads with no additional management tradeoffs or overhead.

Using the vSphere Cloud Provider for Cloud Native Storage with Pure FlashArray vVols enables data mobility from virtual machines to containers and to the public cloud. It allows for instant movement from other container platforms and even cloning of data between PKS clusters. As a result, PKS clusters are no longer islands of persistent data. Software developers can now quickly and easily move applications from test environments to production while maintaining access to consistent, persistent underlying data.

Client Configuration

The management and configuration of PKS requires the right command-line interface tools. These tools are available for Linux, Mac OS, and Windows. You will need the Bosh, Kubectl, UAAC Client, OM CLI, and PKS CLI tools to follow the instructions for this guide. These tools are available for Linux, Mac OS and Windows. [Visit this post](#) for an excellent review of tool options.

Configure Ops Manager and BOSH Director: Deploy OVA for Ops Manager in MGT Cluster or Resource Pool. This requires importing the Operations Manager OVA from the [Pivotal website](#). Choose your Auth method: Use Internal for Setup Guide as LDAP or OAUTH outside this scope. Once logged into your Ops Manager instance, you should see the screen shown in Figure 3.



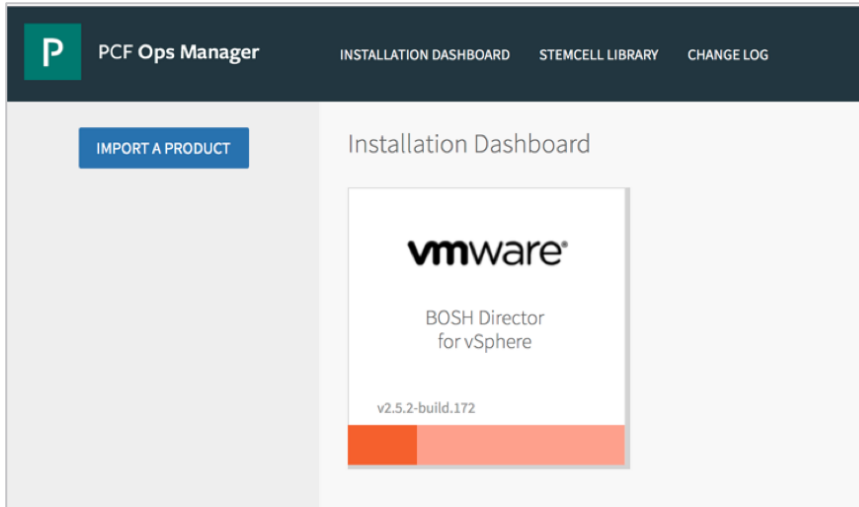


Figure 3. Bosh Director for vSphere

Configure the BOSH Director tile: First set up the vCenter software that manages your PKS Enterprise cluster. The data center name is required and case sensitive (Figure 4).

The screenshot shows the 'BOSH Director for vSphere' configuration page. It has three tabs: 'Settings', 'Status', and 'Credentials', with 'Settings' selected. On the left is a sidebar with a list of configuration steps: 'vCenter Config', 'Director Config', 'Create Availability Zones', 'Create Networks', 'Assign AZs and Networks', 'Security', 'BOSH DNS Config', 'Syslog', and 'Resource Config'. The 'vCenter Config' step is highlighted. The main area shows the configuration fields for 'vCenter Config': 'Name*' (value: 'pksvc'), 'vCenter Host*' (value: 'pksvc.newstack.local'), 'vCenter Username*' (value: 'administrator@pksvc.local'), 'vCenter Password*' (masked with dots), 'Datacenter Name*' (empty), and 'Virtual Disk Type*' (value: 'thin'). A small note 'The passw' is visible next to the password field.

Figure 4. vCenter Software Configuration

Additionally, add a datastore for your persistent and ephemeral data.



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Figure 5. Datastore Configuration

Last, supply the details for your VMware NSX environment. Be sure the networking and certificates are set up to match the PKS Enterprise for NSX-T documentation (Figure 6).

[illegible]

Figure 6. VMware NSX Configuration

Set the NTP and other settings as needed. There's not much you need to change for PKS.



Figure 7. NTP Settings

PKS requires you to click on Enable Post Deploy Scripts. The PKS documentation also recommends enabling the VM Resurrector plugin and clicking the Recreate All VMs checkbox.

***Note about the Director VM:** If you are using NSX-T in NAT mode, you will most likely need to access the director VM via Bosh for troubleshooting if anything goes wrong. Make sure to set the Director Hostname to the DNS record for the NAT routable IP in your network. If you don't do this, the SSL certificate will be issued to the internal IP and connecting to the host name on the outside network will fail.*

Figure 8. Setting the Director Host Name

Optional—Blob Store: You have the option to use an S3 bucket on FlashBlade to house the Bosh Blobstore. The endpoint, bucket name, and keys are required to configure the Blobstore.



The screenshot shows a configuration form for a blobstore. At the top, there is a checkbox labeled "Enable TLS" which is checked. Below it is a radio button selection for "S3 Compatible Blobstore", which is selected. The form contains four text input fields: "S3 Endpoint*" with the value "http://10.21.200.4/", "Bucket Name*" with the value "pivotal", "Access Key*" with the value "PSFBIAZFKDAACHNM", and "Secret Key*" which is filled with dots. At the bottom, there are two radio buttons for "V2 Signature" (selected) and "V4 Signature".

Figure 9. Blobstore Configuration

Create Availability Zones

Set the availability zones by creating one for each vSphere cluster or resource pool depending on your vSphere setup. Our example (Figure 10) uses three compute zones and one management zone.

The screenshot shows the "Availability Zones" configuration page. The title is "Availability Zones" with a subtitle "Clusters and resource pools to which you will deploy Pivotal products". There is a section for "AZ-WEST" which is expanded. Inside this section, there is a "Name*" field with the value "AZ-WEST" and a note "A unique name". Below this is an "IaaS Configuration*" dropdown menu with the value "pksvc". Under the "Clusters" heading, there are three input fields: "Cluster*" with the value "AZ-WEST", "Resource Pool" (empty), and "Host Group" (empty).

Figure 10. Setting the Availability Zones

Set up your networks as necessary. Please visit the Pivotal documentation for NSX-T setup information.



One or many IP ranges upon which your products will be deployed

▼ pks-net1

Name*

pks-net1

Subnets*

vSphere Network Name*

VM

The name of the network is either "name" or "<folder>name".

CIDR*

10.21.230.0/24

Reserved IP Ranges*

10.21.230.1-10.21.230.130,10.21.230.210-10.21.230.254

DNS*

10.21.230.6,10.21.230.7

Gateway*

10.21.230.1

Figure 11. Setting up Your Network

Assign where the Bosh Director will be deployed (Figure 12).

Assign AZs and Networks

The BOSH Director is a single instance.

Choose the availability zone in which to place that instance. It is highly available.

Singleton Availability Zone

MGT

Network

pks-net1

Save

Figure 12. Assign the Bosh Director

Optional: Increase the VM size for the Bosh VMs as needed. (My settings are shown in Figure 13.)



The 'Resource Config' interface displays configuration for two jobs: 'BOSH Director' and 'Master Compilation Job'. Each job has a dropdown for 'INSTANCES' (set to 'Automatic: 1' and 'Automatic: 4' respectively), a dropdown for 'PERSISTENT DISK TYPE' (set to 'Automatic: 50 GB' and 'None' respectively), and a dropdown for 'VM TYPE'. The 'VM TYPE' dropdown for the Master Compilation Job is highlighted, showing 'xlarge.cpu (cpu: 8, ram: 8 GB, disk: 32 GB)' as the selected option. A 'Save' button is located at the bottom left.

Figure 13. Increase the VM size for the Bosh VMs

Initiate the setup of BOSH Director, then click the Installation Dashboard link to return to the Installation Dashboard. Review and apply pending changes (Figure 14).

The 'Installation Dashboard' shows the 'BOSH Director' setup. It includes a 'Select All Products' checkbox, a 'BOSH Director' entry with 'Version 2.5.7-build.208', a 'Staged' status, and an 'APPLY CHANGES' button. Below the entry, it states 'Depends on: No Dependencies'. A 'SEE CHANGES' link is also present.

Figure 14. Setting up the Bosh Director

Enterprise PKS Setup (PKS)

PKS Enterprise Configuration

Upload the PKS Package Downloaded from Pivotal and Install PKS.

1. Import **Pivotal-container-service-1.4.1-build.4.pivotal**
2. Import the stemcell - **Ubuntu-Xenial 250.63**.
Update: The required stem is now included in the PKS package from step 1. If you don't see the stemcell, you can manually import one from Pivotal's website.
3. Go to the API Endpoint section
 - a. Click "Generate Certificate," then enter in your wildcard domain (*.newstack.local and *.app.newstack.local) and hit Generate. Use your Certificate Authority to sign the certificate. This should be default practice for production. (For more on PKS and certificates please see the PKS Documentation.)
 - b. Enter the FQDN of your PKS API endpoint: (pks.app.newstack.local)
4. **Plan 1-n.** No matter how many plans you require, we will spread the load across the availability zones created with our vSphere clusters. Plan 1 might include a lightweight dev cluster, one Master, and three Workers. Set the Worker and Master Type VMs to fit your requirements.



Master Persistent Disk Type*

Automatic: 10 GB

Master/ETCD Availability Zones *

☒ AZ-WEST *

☒ AZ-EAST *

☒ AZ-SOUTH *

☐ MGT *

Maximum number of workers on a cluster (min: 1) *

50

Worker Node Instances (min: 1) *

3

Worker VM Type*

Automatic: medium.disk (cpu: 2, ram: 4 GB, disk: 32 GB)

Worker Persistent Disk Type*

Automatic: 50 GB

Worker Availability Zones *

☒ AZ-WEST *

☒ AZ-EAST *

☒ AZ-SOUTH *

☐ MGT *

Specify the availability zones you want your worker nodes spread across equally.

Figure 15. Spreading the Load Across Availability Zones

If you plan to use Helm and Pure Service Orchestrator with your cluster, first enable the “Allow Privileged” setting near the bottom and click save.

(Optional) Add-ons - Use with caution

☒ Allow Privileged

⚠ Allows containers to run in privileged mode. Sets --allow-privileg

Admission Plugins

☐ PodSecurityPolicy

☐ DenyEscalatingExec

☐ SecurityContextDeny

Save

Figure 16. Setting up Helm and Pure Service Orchestrator

For a more production-ready or permanent cluster, master nodes will need to be HA with increased memory and CPU. Make sure to spread the master nodes across your availability zones and place Workers in different availability zones as necessary.



Master/ETCD Node Instances (min: 1, max: 5) *

3

Master/ETCD VM Type *

large (cpu: 2, ram: 8 GB, disk: 16 GB)

Master Persistent Disk Type *

Automatic: 10 GB

Master/ETCD Availability Zones *

☐ AZ-WEST *

☐ AZ-EAST *

☒ AZ-SOUTH *

☐ MGT *

Maximum number of workers on a cluster (min: 1) *

50

Worker Node Instances (min: 1) *

5

Worker VM Type *

xlarge (cpu: 4, ram: 16 GB, disk: 32 GB)

Worker Persistent Disk Type *

Automatic: 50 GB

The K8s worker persistent disk type

Figure 17. Spreading Master Nodes Across Availability Zones

Don't forget to click "Allow Privileged" if you need it later. Create as many plans as you need. (I would suggest creating at least three for now.)

5. **Kubernetes cloud provider configuration:** Fill in your vSphere information. Note that the Stored VM Folder must match what you put into the Ops Manager Director earlier in the configuration. Additionally, Pure recommends using vVols for the persistent datastore. This allows the use of storage-policy-based management and disaggregated scaling of compute and capacity to provide flexibility as you grow your Kubernetes footprint. Click Save.

Choose your IaaS *

☐ GCP

☒ vSphere

vCenter Master Credentials *

administrator@pksvc.local

vCenter Host *

pksvc.newstack.local

Datacenter Name *

pkdemo

Datastore Name *

m50-vvols, m70r2-vvols

Stored VM Folder *

pcf-vms

☐ AWS

☐ Azure

Figure 18. Kubernetes Cloud Provider Configuration



- Under Monitoring, enable syslog and VMware vRealize Log Insight Integration if you need it. Agree or disagree with the Usage Data Portion.
- Click "Installation Dashboard." Once you have green checks next to every config category, click Review Pending Changes, then Apply Changes. This will take several minutes to complete.

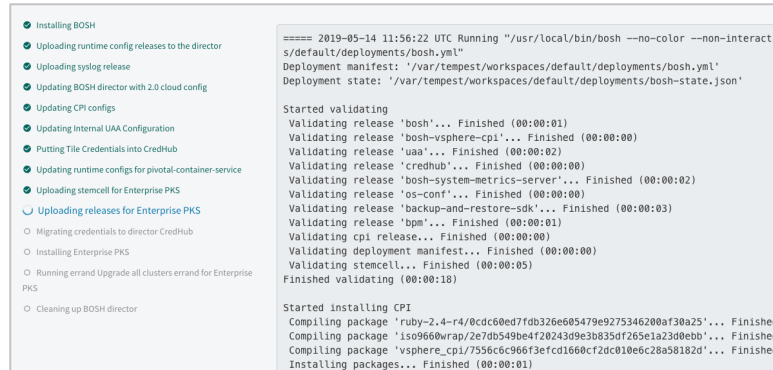


Figure 19. Enabling VMware vRealize Insight Integration

DNS Configuration

Once the BOSH setup is completed and successful, make sure to enter your DNS records for the pks api endpoint. In this configuration example (Figure 20), pks.app.newstack.local must map to the IP given to the VM during the rollout of PKS Enterprise. Trying to access the PKS endpoint or cluster managers by IP will result in the request failing. The certificates generated are tied to the host or endpoint names. Therefore, working DNS servers are required to complete this step.

Select the Enterprise PKS tile in Ops Manager and click the Status tab.

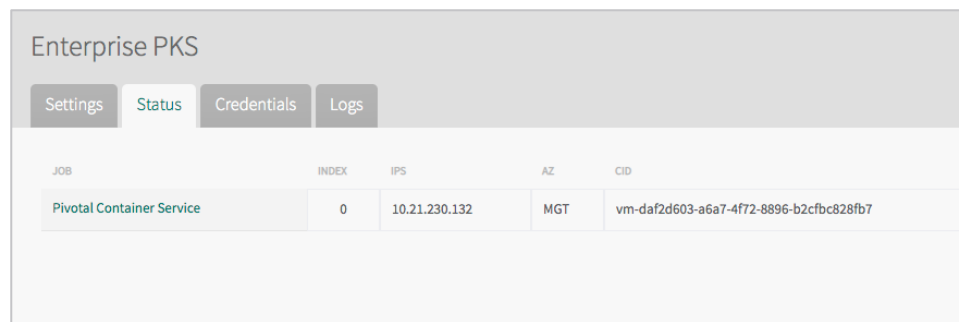


Figure 20. DNS Configuration

Set up Access to Ops Manager and PKS CLI

Create a PKS User

Set your UAAC target to the PKS API endpoint. (gem install cf-uaac). If you get an error installing on ubuntu, make sure to install Ruby.

```
uaac target https://pks.newstack.local:8443 --skip-ssl-validation
```



Go to the PKS Enterprise tile:

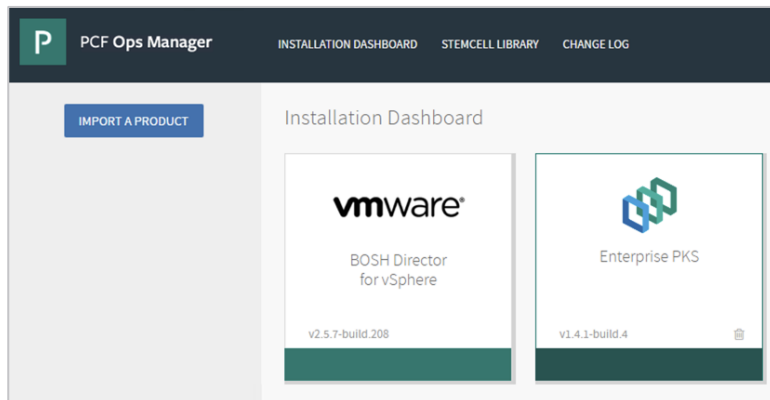


Figure 21. PKS Enterprise Tile

Go to Credentials Tab and get the **PKS Uaa Management Admin Client key** by clicking “Link to Credential.” **Copy the key without the “ marks.**

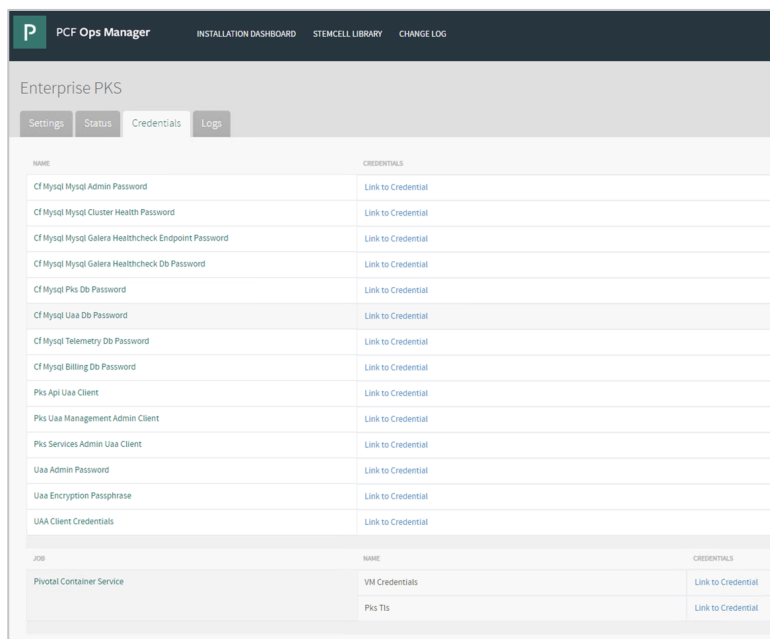


Figure 22. PKS CLI Access

```
uaac token client get admin -s <paste key here>
```

Create your PKS user:

```
uaac user add jowings --emails jowings@newstack.local -p <create a password>
```

Make your user cluster admin:

```
uaac member add pks.clusters.admin jowings
```




Login to the PKS API server

```
pks login -a pks.newstack.local -u jowings -k
```

Use the -k if your SSL is self-signed. Use your password created in the above step.

Test Cluster Creation

```
pks create-cluster testcluster --external-hostname test --plan small
```

Use PKS Cli to check your cluster status.

```
pks cluster testcluster
```

When provisioning is finished, your output will look like this:



```
Name: testcluster
Plan Name: small
UUID: f408a2fb-b90a-4efa-a4f0-2db928fddc7b
Last Action: CREATE
Last Action State: succeeded
Last Action Description: Instance provisioning completed
Kubernetes Master Host: test
Kubernetes Master Port: 8443
Worker Nodes: 3
Kubernetes Master IP(s): 10.21.230.133
```

Figure 23. PKS CLI Output

Now run: `pks get-credentials testcluster`

Add a DNS record for the Master Host name to the IP. With this example, we will create a host “test” pointing to the IP 10.21.230.133. If you get a timeout or error, the DNS record may not be ready. Make sure your client can resolve the IP.

Sequence to Create and Use a PKS Cluster

```
pks create-cluster <cluster name> --external-hostname <host name> --plan <plan name>
pks cluster <cluster name>
pks get-credentials <cluster name>
```

Create DNS Record Match <host name> to the Output IP from the Successful Cluster Creation



Creating the SPBM Storage Class for the vSphere Cloud Provider

[This GitHub page](#) describes the SPBM options available to the VCP. At publication of this guide, the issue described in [issue 75040 listed on GitHub](#) is blocking this from working. Recent testing (6/25/19) shows that the PKS Enterprise version 1.4.1-build.4 is not working.

1. Create a StorageClass file. For example: pure-vvols.yaml.

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: pure-vvols
provisioner: kubernetes.io/vsphere-volume
parameters:
  diskformat: zeroedthick
  storagePolicyName: FlashArray
```

An alternative is to create a Storage Class tied directly to the datastore. Example:

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: pure-ds
provisioner: kubernetes.io/vsphere-volume
parameters:
  datastore: m70-vvols-datastore
```

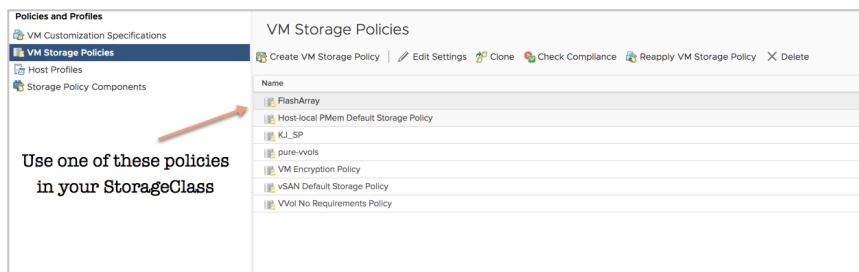


Figure 24. Creating a Storage Class

2. Apply the storage class:
Kubectl apply
3. Run a test application.

More Information on Configuring the vSphere Cloud Provider

- [vSphere Storage for Kubernetes Overview](#)
- [vSphere Storage for Kubernetes: Policy-Based Management](#)



Setting Up Bosh

You will need Bosh CLI to create releases. This tool is also helpful when troubleshooting and performing other tasks in the PKS clusters. Note: you must first install the om tool first by following [these instructions](#).

1. Output the CA into a file to be used when connecting to your Bosh Director.
`om --target https://opsman.newstack.local -u admin -p <Ops Manager PW you created at the very beginning> -k curl -p /api/v0/certificate_authorities -s | jq -r '.certificate_authorities | select(map(.active == true))[0] | .cert_pem' > ~/opsmanager.pem`
2. Output your credentials.
`om --target https://opsman.newstack.local -u jowings -p <Ops Manager PW you created at the very beginning> -k curl -p /api/v0/deployed/director/credentials/bosh2_commandline_credentials -s | jq -r '.credential'`

Output from last command

```
BOSH_CLIENT=ops_manager BOSH_CLIENT_SECRET=anXl0m55LdLNNLAib1i_5HP-Je5jToYn
BOSH_CA_CERT=/var/tempest/workspaces/default/root_ca_certificate
BOSH_ENVIRONMENT=10.21.230.32 bosh
```

3. Format as follows for .bashrc notice just the IP for the BOSH_ENVIRONMENT and the CA_CERT it pointing to the file we dumped the cert into earlier

```
export BOSH_CLIENT=ops_manager
export BOSH_CLIENT_SECRET=anXl0m55LdLNNLAib1i_5HP-Je5jToYn
export BOSH_CA_CERT=~/.opsmanager.pem
export BOSH_ENVIRONMENT=10.21.230.32
```

4. Test BOSH from the CLI

Bosh releases.

Output should look like this:

```
[jowings@pwkdev ~ (~|prod01:default)]$ bosh releases
Using environment '10.21.230.131' as client 'ops_manager'
```

Name	Version	Commit Hash
backup-and-restore-sdk	1.8.0*	8b305df
bosh-dns	1.10.0*	7c6515f
bpm	1.0.4*	420dc51
cf-mysql	36.14.0.1*	2400c66a
cfcr-etcd	1.10.0*	3f69d31
docker	35.1.0*	fb29f63
kubo	0.31.0*	43bee79
kubo-service-adapter	1.4.0-build.194*	7b57641e
nsx-cf-cni	2.4.0.12511604*	37923f7+
on-demand-service-broker	0.26.0*	d074e07
pkcs-api	1.4.0-build.194*	5f3e572f
pkcs-nsx-t	1.25.1*	286dfefc
pkcs-telemetry	2.0.0-build.175*	7f937fe
pkcs-vrli	0.9.0*	566ba95
pkcs-vrops	0.13.0*	bd256c3
pxc	0.14.0*	c19b825
sink-resources-release	0.1.27*	2df5885+
syslog	11.4.0*	feedfa7
uaa	71.0*	6bbc04b

Figure 25. Bosh Output



Optional: Pure Service Orchestrator for ISCSI

Pure Service Orchestrator provides container storage as a service with direct access to FlashArray or FlashBlade resources. PSO requires additional packages when using the FlashArray that are not currently included in the Ubuntu Xenial Stemcell used by PKS. The NFS Client Packages required by PSO when using the FlashBlade are used by other Pivotal use cases and are therefore included. *Note: If you are using FlashBlade only, follow the directions for installing Helm and Pure Service Orchestrator. For FlashBlade, follow the section "Runtime Config for PSO."*

1. Install Helm using these [Pivotal Docs](#).
2. Setup the PSO Helm Repo
`helm repo add pure https://purestorage.github.io/helm-charts`
`helm repo update`
3. Create your values.yaml file
 Use the latest full file from the [Pure Storage Helm repo](#).
 Example changes

```
namespace:
c pure: pks
arrays:
  FlashBlades:
    - MgmtEndPoint: "<FlashBlade MGT IP>"
      NfsEndPoint: "<FlashBlade NFS IP>"
      APIToken: "T-9f276a18-50ab-446e-8a0c-666a3529a1b6"
```
4. Install PSO.
`helm install -n pso pure/pure-k8s-plugin -f pkdemo-values.yaml`
5. List the Storage Classes.
`kubectl get sc`
6. This example only used a single FlashBlade as we have not made runtime config changes needed for FlashArray.
7. [Deploy an app](#) using the pure-file StorageClass.
`git clone https://github.com/2vcps/pksapp.git`
`cd pksapp`
`kubectl apply -f . #notice the . in the cli`



- Verify the demo app is running

```
Kubectl get pod
```

```
Kubectl get pvc
```

Output should look like this:

```
[jowings@pwpkdev pksapp (testcluster:default)]$ kubectl get pod
NAME                                READY    STATUS    RESTARTS   AGE
frontend-74b4665db5-f7hc2          1/1      Running   0           12m
frontend-74b4665db5-m997n          1/1      Running   0           12m
frontend-74b4665db5-tj28f          1/1      Running   0           12m
frontend-74b4665db5-wf2mz          1/1      Running   0           12m
pure-flex-l98jm                     1/1      Running   0           15m
pure-flex-nxc5t                     1/1      Running   0           15m
pure-flex-wdfq6                     1/1      Running   0           15m
pure-provisioner-7444b7d54b-xkkgk   1/1      Running   0           15m
redis-master-54df6fb787-cqm5w       1/1      Running   0           12m
redis-slave-678676d9b7-hpt7b       1/1      Running   0           12m
[jowings@pwpkdev pksapp (testcluster:default)]$ kubectl get pvc
NAME                                STATUS    VOLUME                                     CAPACITY   ACCESS MODES   STORAGECLASS   AGE
redis-master-claim                  Bound     pvc-d119f92f-764c-11e9-af05-005056a93580  2Gi         RWO             pure-file      12m
redis-slave-claim                   Bound     pvc-d11f2ee7-764c-11e9-af05-005056a93580  2Gi         RWO             pure-file      12m
[jowings@pwpkdev pksapp (testcluster:default)]$
```

Figure 26. Pure Service Orchestrator Output

Runtime Config for PSO

Create a custom Bosh Release to add the open-iscsi and multipath-tools packages to your PKS environment. Perform the steps below to create a runtime config that will install these two packages in the stemcell. This is an included and supported feature of Pivotal and is used by other third-party vendors for storage plugins and monitoring.

Go to [git repo](#) and clone to your client with the BOSH CLI tools. Follow the README in the repo as it will have the most recent instructions for deployment.

Optional: Setup Harbor

For Enterprise environments it is recommended to use an internal container repo. VMware provides a [tile to deploy Harbor](#) built into the Pivotal Platform. The deployment and use of Harbor requires the import CA Certificate from Harbor for use by your Docker registry.

- Deploy tile following the documentation
- Download ca cert
- Copy ca.crt to /etc/docker/harbor.newstack.local/
- You will have to login to push and pull from Harbor

```
docker login harbor.newstack.local
jowings
password##
```



If you have images you need to push into the Harbor repo , you must tag them correctly prior to the Docker push. Mind the line wrapping in the document:

```
docker tag gcr.io/google-samples/gb-frontend:v4
harbor.newstack.local/library/gb-frontend:v4

docker tag gcr.io/google-samples/gb-redisslave:v1
harbor.newstack.local/library/gb-redisslave:v1
docker tag gcr.io/google-containers/redis:e2e
harbor.newstack.local/library/redis:e2e

docker push harbor.newstack.local/library/gb-frontend:v4
docker push harbor.newstack.local/library/redis:e2e
docker push harbor.newstack.local/library/gb-redisslave:v1
```

References

Useful Information to Guide Installation and Configuration

- [Installing Enterprise PKS](#)
- [Getting Started with PKS](#)
- [Getting Started with PKS Part 2: PKS Client](#)
- [Getting Started with PKS Part 3: NSX-T](#)
- [Getting Started with PKS Part 4: Ops Manager](#)
- [Getting Started with PKS Part 5: Control Plane](#)
- [Getting Started with PKS Part 6: Kubernetes Go!](#)
- [Getting Started with PKS Part 7: Harbor](#)

More Helpful Information

- [Harbor Documentation](#)

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