eSDK Huawei Storage Kubernetes CSI Plugins V4.10.0

User Guide

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About This Document

Intended Audience

This document is intended for:

- Technical support engineers
- O&M engineers
- Engineers with basic knowledge of storage and Kubernetes

Symbol Conventions

The symbols that may be found in this document are defined as follows.

Symbol	Description
DANGER	Indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.
WARNING	Indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates a potentially hazardous situation which, if not avoided, could result in equipment damage, data loss, performance deterioration, or unanticipated results. NOTICE is used to address practices not related to personal injury.
NOTE	Supplements the important information in the main text. NOTE is used to address information not related to personal injury, equipment damage, and environment deterioration.

Change History

Issue	Date	Description
01	2025-12-30	This issue is the first official release.

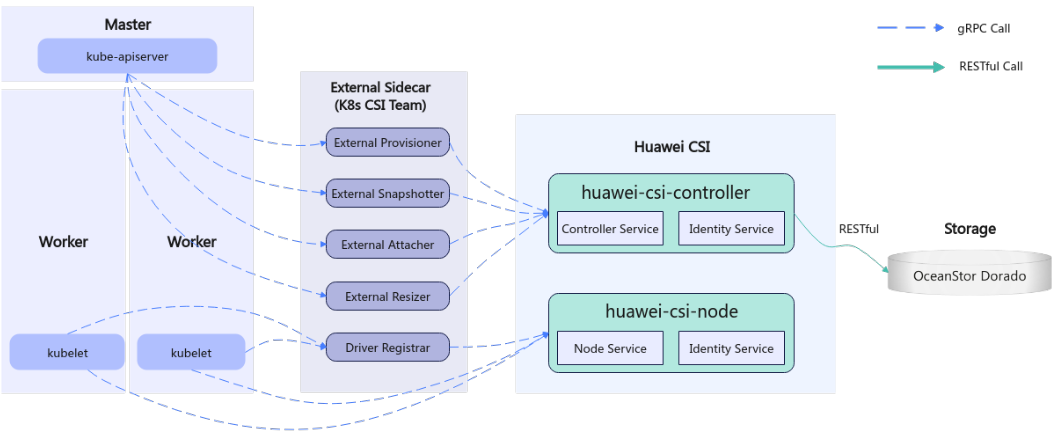
Contents

1 Overview

Container Storage Interface (CSI) is an industry standard protocol used to connect container platforms such as Kubernetes to underlying storage systems. Huawei CSI is a mandatory component that connects Huawei enterprise storage and distributed storage products to Kubernetes clusters, providing persistent storage services for containerized workload.

Kubernetes uses a series of officially maintained sidecar components to register and listen Kubernetes object resources and invoke the CSI driver to trigger physical operations on Huawei storage. For example, when a **Persistent Volume** (PV) is created, the Huawei CSI driver creates a LUN (block storage) or file system on the storage device. **Figure 1-1** shows the overall structure of Kubernetes, Huawei CSI, and Huawei storage.

Figure 1-1 CSI overall architecture



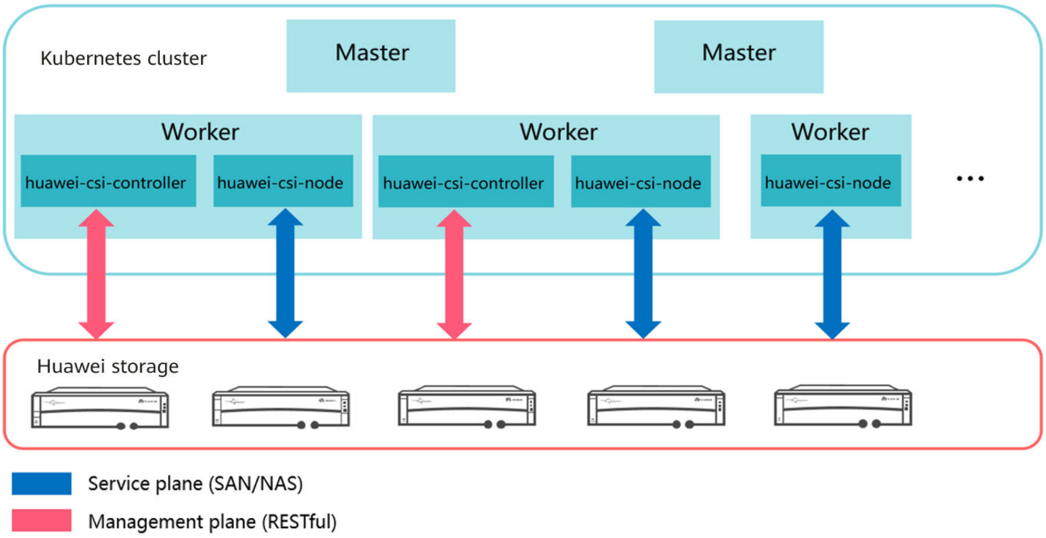
Huawei CSI consists of two components: huawei-csi-controller and huawei-csi-node.

- huawei-csi-controller: one or more Pods (including Controller Service and Identity Service) running in Deployment mode. It is used to interact with Huawei storage using RESTful. Therefore, the node running the huawei-csi-controller component must be connected to the management plane network of the storage.
- huawei-csi-node: a Pod (including Node Service and Identity Service) that runs on Kubernetes worker nodes in DaemonSet mode. It is used to mount

and unmount a LUN/file system provided by Huawei storage on worker nodes. Therefore, the node running the huawei-csi-node component must be connected to the service plane network of the storage.

Figure 1-2 shows the deployment model of Huawei CSI.

Figure 1-2 CSI deployment model



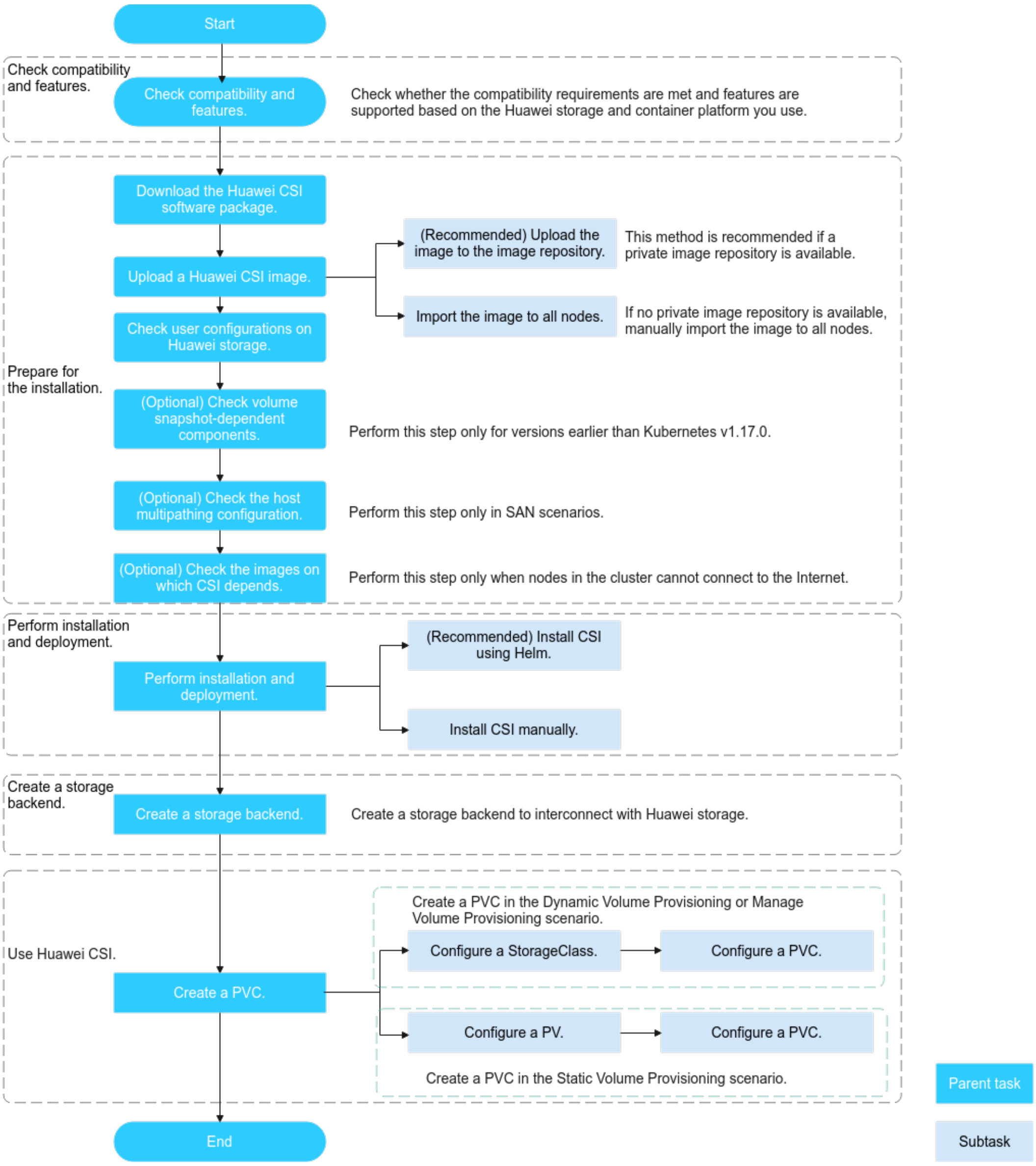
This document describes how to install, deploy, and use the Huawei CSI V4.10.0 plug-in.

2 Quick Start

This chapter describes how to quickly install and use Huawei CSI to manage Persistent Volume Claims (PVCs).

Huawei CSI Use Process

Figure 2-1 CSI installation and use process



Compatibility and Features

Before using this plug-in, learn about its compatibility with Huawei storage, container platforms, and host operating systems (OSs), as well as supported features. For details, see **3 Compatibility and Features**.

Installation Preparations

Before installing Huawei CSI, you need to prepare the configurations of related environments such as container platforms and hosts. For details, see **4.1.1 Installation Preparations**.

Installation and Deployment

Huawei CSI provides two installation modes: installation using Helm and manual installation, which are suitable for different container platforms such as Kubernetes and OpenShift. For details, see **4 Installation and Deployment**.

Creating a Storage Backend

Before using Huawei CSI, you need to create storage backend resources. For details, see **5.1.1 Configuring the Storage Backend**.

Using Huawei CSI

Now, you can use Huawei CSI to manage PVCs. For details, see **5.2.1 Configuring a StorageClass** and **5.3.1 Configuring PVs**.

3 Compatibility and Features

3.1 Flash Storage (OceanStor Dorado/OceanStor V5/OceanStor V6 and Later)

3.1.1 File Service

3.1.1.1 Compatibility

3.1.1.1.1 Storage

Compatibility with Huawei CSI Storage

Table 3-1 Supported Huawei storage products

Storage Product	Version
OceanStor V5	V500R007 and V500R007 Kunpeng
OceanStor	6.1.3, 6.1.5, 6.1.6, 6.1.7, 6.1.8, V700R001C00, and V700R001C10
OceanStor Dorado	6.1.0, 6.1.2, 6.1.3, 6.1.5, 6.1.6, 6.1.7, 6.1.8, V700R001C00, and V700R001C10

Table 3-2 Huawei storage versions supported by Huawei enterprise storage dtrees

Storage Product	Version
OceanStor Dorado	6.1.0, 6.1.2, 6.1.3, 6.1.5, 6.1.6, 6.1.7, 6.1.8, V700R001C00, and V700R001C10

3.1.1.1.2 Container Platform

Huawei CSI Platform Compatibility

Table 3-3 Supported container management platforms

Container Management Platform	Version
Kubernetes	1.16 to 1.34
Red Hat OpenShift Container Platform	4.12 to 4.19
Tanzu Kubernetes Grid Integrated	TKGI 1.17 to 1.19
CCE Agile	22.3.2
CCE	22.9.5

3.1.1.1.3 OS

Huawei CSI OS Compatibility

Table 3-4 Supported host OSs

OS Name	OS Version
CentOS x86_64	7.6, 7.7, and 7.9
CentOS x86_64	8.2 and 8.4
CentOS Arm	7.6
Rocky Linux x86_64	8.6
SUSE 15 x86_64	SP2 and SP3
Red Hat CoreOS x86_64	4.12, 4.13, 4.14, 4.15, 4.16, 4.17, 4.18, and 4.19
Ubuntu x86_64	18.04, 20.04, and 22.04
Ubuntu Arm	22.04
Kylin x86_64	7.6, V10 SP1, V10 SP2, and V10 SP3

OS Name	OS Version
Kylin Arm	V10 SP1, V10 SP2, and V10 SP3
Debian x86_64	9, 11, and 12
EulerOS x86_64	V2R9, V2R10, V2R11, and V2R12
EulerOS Arm	V2R10 and V2R12
UOS x86_64	V20
BC-Linux Arm	21.10
OpenEuler x86_64	22.03 LTS SP1
Red Hat Enterprise Linux x86_64	8.6, 8.7, 8.8, 8.9, 8.10, and 9.4

3.1.1.2 Features

3.1.1.2.1 Huawei CSI

Table 3-5 Features supported by Huawei storage and constraints

<table>
<tr><th>Feature</th><th>OceanStor V5</th><th>OceanStor</th><th>OceanStor Dorado</th></tr>
<tr><td>Static Provisioning</td><td rowspan="3">NFS 3</td><td rowspan="3">NFS 3/4.0/4.1/4.2
NFS over RDMA is supported only in 6.1.7 and later versions.
NFS 4.2 is supported only in 6.1.8 and later versions.</td><td rowspan="3">NFS 3/4.0/4.1/4.2/NFS+
NFS 4.1 is supported only in 6.1.3 and later versions.
NFS over RDMA is supported only in 6.1.7 and later versions.
NFS 4.2 is supported only in 6.1.8 and later versions.
NFS+ is supported only in 6.1.7 and later versions.</td></tr>
<tr><td>Dynamic Provisioning</td></tr>
<tr><td>Manage Provisioning</td></tr>
<tr><td>Expand Persistent Volume</td><td colspan="3">Volumes created in Dynamic Provisioning or Manage Provisioning mode are supported.</td></tr>
<tr><td>Create VolumeSnapshot</td><td colspan="3">Volumes created in Dynamic Provisioning or Manage Provisioning mode are supported.</td></tr>
</table>

Feature	OceanStor V5	OceanStor	OceanStor Dorado
Delete VolumeSnapshot	Supported		
Restore VolumeSnapshot	Supported	Supported only in 6.1.5 and later versions	
Clone Persistent Volume	Non-HyperMetro volumes created in Dynamic Provisioning or Manage Provisioning mode are supported.	Only 6.1.5 and later versions support volumes created in Dynamic Provisioning or Manage Provisioning mode.	
Raw Block Volume	Not supported		
Topology	Supported		
Generic Ephemeral Volumes	Supported		
Access Mode	RWO, ROX, RWX, and RWOP. RWOP is supported only in Kubernetes 1.22 or later.		
QoS	Supported only by system users	Supported	
Application type	Not supported	Supported	
Volume HyperMetro	Not supported	Only the HyperMetro active-active (AA) mode is supported.	
Storage multi-tenant	Supported	Supported in 6.1.3 and later versions	

Table 3-6 Features supported by Huawei enterprise storage dtrees

Feature	Supported
Static Provisioning	√
Dynamic Provisioning	√

Feature	Supported
Manage Provisioning	X
Expand Persistent Volume	√
Access Mode	√ (RWX/RWO/ROX/RWOP: Kubernetes 1.22 or later supports RWOP.)
Multi-tenant	√
Create VolumeSnapshot	X
Delete VolumeSnapshot	X
Restore VolumeSnapshot	X
Clone Persistent Volume	X
QoS	X
Volume HyperMetro	X
Application type	X

3.1.2 Block Service

3.1.2.1 Compatibility

3.1.2.1.1 Storage

Compatibility with Huawei CSI Storage

Table 3-7 Supported Huawei storage products

Storage Product	Version
OceanStor V5	V500R007 and V500R007 Kunpeng
OceanStor	6.1.3, 6.1.5, 6.1.6, 6.1.7, 6.1.8, V700R001C00, and V700R001C10
OceanStor Dorado	6.1.0, 6.1.2, 6.1.3, 6.1.5, 6.1.6, 6.1.7, 6.1.8, V700R001C00, and V700R001C10

3.1.2.1.2 Container Platform

Huawei CSI Platform Compatibility

Table 3-8 Supported container management platforms

Container Management Platform	Version
Kubernetes	1.16 to 1.34
Red Hat OpenShift Container Platform	4.12 to 4.19
Tanzu Kubernetes Grid Integrated	TKGI 1.17 to 1.19
CCE Agile	22.3.2
CCE	22.9.5

3.1.2.1.3 OS

Huawei CSI OS Compatibility

Table 3-9 Supported host OSs

OS Name	OS Version	Native DM-Multipath Version	Huawei UltraPath Version
CentOS x86_64	7.6, 7.7, and 7.9	Delivered with the OS, supporting FC/iSCSI	UltraPath 31.1.0, supporting FC/iSCSI
CentOS x86_64	8.2 and 8.4	Delivered with the OS, supporting FC/iSCSI	UltraPath 31.1.0, supporting FC/iSCSI UltraPath-NVMe 31.1.RC8, supporting NVMe over RoCE/ NVMe over FC
CentOS Arm	7.6	Delivered with the OS, supporting FC/iSCSI	Not supported
Rocky Linux x86_64	8.6	Delivered with the OS, supporting FC/iSCSI	UltraPath-NVMe 31.2.1, supporting NVMe over RoCE

OS Name	OS Version	Native DM-Multipath Version	Huawei UltraPath Version
SUSE 15 x86_64	SP2 and SP3	Delivered with the OS, supporting FC/iSCSI	UltraPath 31.1.0, supporting FC/iSCSI UltraPath-NVMe 31.1.RC8, supporting NVMe over RoCE/ NVMe over FC
Red Hat CoreOS x86_64	4.12, 4.13, 4.14, 4.15, 4.16, 4.17, 4.18, and 4.19	Delivered with the OS, supporting FC/iSCSI	Not supported
Ubuntu x86_64	18.04, 20.04, and 22.04	Delivered with the OS, supporting FC/iSCSI	Not supported
Ubuntu Arm	22.04	Delivered with the OS, supporting FC/iSCSI	Not supported
Kylin x86_64	7.6, V10 SP1, V10 SP2, and V10 SP3	Delivered with the OS, supporting FC/iSCSI	UltraPath 31.2.0, supporting FC/iSCSI
Kylin Arm	V10 SP1, V10 SP2, and V10 SP3	Delivered with the OS, supporting FC/iSCSI	UltraPath 31.3.0, supporting iSCSI
Debian x86_64	9, 11, and 12	Delivered with the OS, supporting FC/iSCSI	Not supported
EulerOS x86_64	V2R9, V2R10, V2R11, and V2R12	Delivered with the OS, supporting FC/iSCSI	Not supported
EulerOS Arm	V2R10 and V2R12	Delivered with the OS, supporting FC/iSCSI	Not supported
UOS x86_64	V20	Delivered with the OS, supporting FC/iSCSI	Not supported

OS Name	OS Version	Native DM-Multipath Version	Huawei UltraPath Version
BC-Linux Arm	21.10	Delivered with the OS, supporting FC/iSCSI	Not supported
OpenEuler x86_64	22.03 LTS SP1	Delivered with the OS, supporting iSCSI	Not supported
Red Hat Enterprise Linux x86_64	8.6, 8.7, 8.8, 8.9, 8.10, and 9.4	Delivered with the OS, supporting FC/iSCSI	Not supported

3.1.2.2 Features

3.1.2.2.1 Huawei CSI

Table 3-10 Features supported by Huawei storage and constraints

<table>
<tr><th>Feature</th><th>OceanStor V5</th><th>OceanStor</th><th>OceanStor Dorado</th></tr>
<tr><td>Static Provisioning</td><td rowspan="3">FC/iSCSI</td><td rowspan="3">FC/iSCSI/NVMe over RoCE/NVMe over FC</td><td rowspan="3">FC/iSCSI/NVMe over RoCE/NVMe over FC</td></tr>
<tr><td>Dynamic Provisioning</td></tr>
<tr><td>Manage Provisioning</td></tr>
<tr><td>Expand Persistent Volume</td><td colspan="3">• Volumes created in Dynamic Provisioning or Manage Provisioning mode are supported.
• The provisioned PVC whose volumeType is lun and accessModes is ReadOnlyMany does not support capacity expansion.</td></tr>
<tr><td>Create VolumeSnapshot</td><td colspan="3">Volumes created in Dynamic Provisioning or Manage Provisioning mode are supported.</td></tr>
<tr><td>Delete VolumeSnapshot</td><td colspan="3">Supported</td></tr>
</table>

Feature	OceanStor V5	OceanStor	OceanStor Dorado
Restore VolumeSnapshot	Supported		
Clone Persistent Volume	Volumes created in Dynamic Provisioning or Manage Provisioning mode are supported.		
Raw Block Volume	Supported		
Topology	Supported		
Generic Ephemeral Volumes	Supported		
Access Mode	• RWO/ROX/RWOP: supported. RWOP is supported only in Kubernetes 1.22 or later. • RWX: supported only by Raw Block volumes		
QoS	Supported. Only system users can configure QoS.		
Application type	Not supported	Supported	
Volume HyperMetro	Not supported		
Storage multi-tenant	Not supported		

NOTE

- If a container platform is deployed on a virtualization platform, you are advised to use the iSCSI protocol when the CSI is connected to SAN storage.
- If the customer requires the FC, NVMe over FC, or NVMe over RoCE protocol, the virtualization platform needs to be configured. In this case, the customer's virtualization team needs to provide technical support.
- When NVMe over RoCE or NVMe over FC is used, the supported nvme-cli tool version is 1.9 or later. To query the version, run the **nvme version** command.

3.2 Flash Storage (OceanStor A600/A800)

3.2.1 File Service

3.2.1.1 Compatibility

3.2.1.1.1 Storage

Compatibility with Huawei CSI Storage

Table 3-11 Supported Huawei storage products

Storage Product	Version
OceanStor A series	V700R001C10

3.2.1.1.2 Container Platform

Huawei CSI Platform Compatibility

Table 3-12 Supported container management platforms

Container Management Platform	Version
Kubernetes	1.16 to 1.34
Red Hat OpenShift Container Platform	4.19 (only the NFS protocol is supported)

3.2.1.1.3 OS

Huawei CSI OS Compatibility

Table 3-13 Supported host OSs

OS Name	OS Version
EulerOS Arm	V2R12 and V2R13
Kylin Arm	V10 SP3
BCLinux Arm	21.10U4

3.2.1.2 Features

3.2.1.2.1 Huawei CSI

Table 3-14 Features supported by Huawei storage and constraints

Feature	OceanStor A Series
Static Provisioning	• DataTurbo/NFS 3/4.0/4.1/4.2 • Only local file systems of storage with a single zone are supported.
Dynamic Provisioning	
Manage Provisioning	
Expand Persistent Volume	Volumes created in Dynamic Provisioning or Manage Provisioning mode are supported.
Create VolumeSnapshot	Not supported
Delete VolumeSnapshot	Not supported
Restore VolumeSnapshot	Not supported
Clone Persistent Volume	Not supported
Raw Block Volume	Not supported
Topology	Supported
Generic Ephemeral Volumes	Supported
Access Mode	RWO, ROX, RWX, and RWOP. RWOP is supported only in Kubernetes 1.22 or later.
QoS	Not supported
Application type	Supported
Volume HyperMetro	Not supported
Storage multi-tenant	Not supported

3.3 DME (Interconnected with an OceanStor A800 Cluster)

3.3.1 File Service

3.3.1.1 Compatibility

3.3.1.1.1 Storage

Compatibility with Huawei CSI Storage

Table 3-15 Supported Huawei storage products

Storage Product	Version
OceanStor A Series	V700R001C10
DME	24.0.0 and 24.1.0

3.3.1.1.2 Container Platform

Huawei CSI Platform Compatibility

Table 3-16 Supported container management platforms

Container Management Platform	Version
Kubernetes	1.16 to 1.34

3.3.1.1.3 OS

Huawei CSI OS Compatibility

Table 3-17 Supported host OSs

OS Name	OS Version
OpenEuler x86_64	22.03 LTS SP4

3.3.1.2 Features

3.3.1.2.1 Huawei CSI

Table 3-18 Features supported by Huawei storage and constraints

<table>
<tr><th>Feature</th><th>OceanStor A800 Cluster on DME</th></tr>
<tr><td>Static Provisioning</td><td rowspan="3">DataTurbo/NFS 3
Global file systems of the OceanStor A800 cluster are supported.</td></tr>
<tr><td>Dynamic Provisioning</td></tr>
<tr><td>Manage Provisioning</td></tr>
</table>

Feature	OceanStor A800 Cluster on DME
Expand Persistent Volume	Volumes created in Dynamic Provisioning or Manage Provisioning mode are supported.
Create VolumeSnapshot	Not supported
Delete VolumeSnapshot	Not supported
Restore VolumeSnapshot	Not supported
Clone Persistent Volume	Not supported
Raw Block Volume	Not supported
Topology	Supported
Generic Ephemeral Volumes	Supported
Access Mode	RWO, ROX, RWX, and RWOP. RWOP is supported only in Kubernetes 1.22 or later.
QoS	Not supported
Application type	Not supported
Volume HyperMetro	Not supported
Storage multi-tenant	Not supported

3.4 Mass Storage (OceanStor Pacific Series)

3.4.1 File Service

3.4.1.1 Compatibility

3.4.1.1.1 Storage

Compatibility with Huawei CSI Storage

Table 3-19 Supported Huawei storage products

Storage Product	Version
OceanStor Pacific series	8.1.0, 8.1.1, 8.1.2, 8.1.3, 8.1.5, 8.2.0, 8.2.1, and V800R001C10

Table 3-20 Huawei storage versions supported by Huawei distributed storage dtrees

Storage Product	Version
OceanStor Pacific series	8.1.0, 8.1.1, 8.1.2, 8.1.3, 8.1.5, 8.2.0, 8.2.1, and V800R001C10

3.4.1.1.2 Container Platform

Huawei CSI Platform Compatibility

Table 3-21 Supported container management platforms

Container Management Platform	Version
Kubernetes	1.16 to 1.34
Red Hat OpenShift Container Platform	4.12 to 4.19
Tanzu Kubernetes Grid Integrated	TKGI 1.17 to 1.19
CCE Agile	22.3.2
CCE	22.9.5

3.4.1.1.3 OS

Table 3-22 Supported host OSs

OS Name	OS Version
CentOS x86_64	7.6, 7.7, and 7.9
CentOS x86_64	8.2 and 8.4
CentOS Arm	7.6
Rocky Linux x86_64	8.6
SUSE 15 x86_64	SP2 and SP3
Red Hat CoreOS x86_64	4.12, 4.13, 4.14, 4.15, 4.16, 4.17, 4.18, and 4.19
Ubuntu x86_64	18.04, 20.04, and 22.04
Ubuntu Arm	22.04
Kylin x86_64	7.6, V10 SP1, V10 SP2, and V10 SP3
Kylin Arm	V10 SP1, V10 SP2, and V10 SP3

OS Name	OS Version
Debian x86_64	9, 11, and 12
EulerOS x86_64	V2R9, V2R10, V2R11, and V2R12
EulerOS Arm	V2R10 and V2R12
UOS x86_64	V20
BC-Linux Arm	21.10
Anolis OS	8.8
OpenEuler x86_64	22.03 LTS SP1
Red Hat Enterprise Linux x86_64	8.6, 8.7, 8.8, 8.9, 8.10, and 9.4

3.4.1.2 Features

3.4.1.2.1 Huawei CSI

Table 3-23 Features supported by Huawei storage and constraints

<table>
<tr><th>Feature</th><th>OceanStor Pacific Series</th></tr>
<tr><td>Static Provisioning</td><td rowspan="3">• DPC/NFS 3/4.1
• DPC is supported only in 8.1.2 and later versions.
• NFS 4.1 is supported by 8.1.2 and later versions.
• Only OceanStor Pacific series 8.2.0 and later versions support NFS over RDMA. When NFS over RDMA is used, only NFS 3 is supported.</td></tr>
<tr><td>Dynamic Provisioning</td></tr>
<tr><td>Manage Provisioning</td></tr>
<tr><td>Expand Persistent Volume</td><td>Volumes created in Dynamic Provisioning or Manage Provisioning mode are supported.</td></tr>
<tr><td>Create VolumeSnapshot</td><td>Not supported</td></tr>
<tr><td>Delete VolumeSnapshot</td><td>Not supported</td></tr>
<tr><td>Restore VolumeSnapshot</td><td>Not supported</td></tr>
<tr><td>Clone Persistent Volume</td><td>Not supported</td></tr>
<tr><td>Raw Block Volume</td><td>Not supported</td></tr>
<tr><td>Topology</td><td>Supported</td></tr>
<tr><td>Generic Ephemeral Inline Volumes</td><td>Supported</td></tr>
<tr><td>Access Mode</td><td>RWO, ROX, RWX, and RWOP. RWOP is supported only in Kubernetes 1.22 or later.</td></tr>
</table>

Feature	OceanStor Pacific Series
QoS	Supported
Soft and hard quotas	Supported
Storage multi-tenant	Supported

Table 3-24 Features supported by Huawei distributed storage dtrees

Feature	Supported
Static Provisioning	√
Dynamic Provisioning	√
Manage Provisioning	X
Expand Persistent Volume	√
Access Mode	√ (RWX/RWO/ROX/RWOP: Kubernetes 1.22 or later supports RWOP.)
Multi-tenant	√
Create VolumeSnapshot	X
Delete VolumeSnapshot	X
Restore VolumeSnapshot	X
Clone Persistent Volume	X
QoS	X
Volume HyperMetro	X
Application type	X

3.4.2 Block Service

3.4.2.1 Compatibility

3.4.2.1.1 Storage

Compatibility with Huawei CSI Storage

Table 3-25 Supported Huawei storage products

Storage Product	Version
FusionStorage block	8.0.1
OceanStor Pacific series	8.1.0, 8.1.1, 8.1.2, 8.1.3, 8.1.5, 8.2.0, 8.2.1, and V800R001C10

3.4.2.1.2 Container Platform

Huawei CSI Platform Compatibility

Table 3-26 Supported container management platforms

Container Management Platform	Version
Kubernetes	1.16 to 1.34
Red Hat OpenShift Container Platform	4.12 to 4.19
Tanzu Kubernetes Grid Integrated	TKGI 1.17 to 1.19
CCE Agile	22.3.2
CCE	22.9.5

3.4.2.1.3 OS

Huawei CSI OS Compatibility

Table 3-27 Supported host OSs

OS Name	OS Version	Native DM-Multipath Version	Huawei UltraPath Version
CentOS x86_64	7.6, 7.7, and 7.9	Delivered with the OS, supporting FC/iSCSI	UltraPath 31.1.0, supporting FC/iSCSI

OS Name	OS Version	Native DM-Multipath Version	Huawei UltraPath Version
CentOS x86_64	8.2 and 8.4	Delivered with the OS, supporting FC/iSCSI	UltraPath 31.1.0, supporting FC/iSCSI UltraPath-NVMe 31.1.RC8, supporting NVMe over RoCE/ NVMe over FC
CentOS Arm	7.6	Delivered with the OS, supporting FC/iSCSI	Not supported
Rocky Linux x86_64	8.6	Delivered with the OS, supporting FC/iSCSI	UltraPath-NVMe 31.2.1, supporting NVMe over RoCE
SUSE 15 x86_64	SP2 and SP3	Delivered with the OS, supporting FC/iSCSI	UltraPath 31.1.0, supporting FC/iSCSI UltraPath-NVMe 31.1.RC8, supporting NVMe over RoCE/ NVMe over FC
Red Hat CoreOS x86_64	4.12, 4.13, 4.14, 4.15, 4.16, 4.17, 4.18, and 4.19	Delivered with the OS, supporting FC/iSCSI	Not supported
Ubuntu x86_64	18.04, 20.04, and 22.04	Delivered with the OS, supporting FC/iSCSI	Not supported
Ubuntu Arm	22.04	Delivered with the OS, supporting FC/iSCSI	Not supported
Kylin x86_64	7.6, V10 SP1, V10 SP2, and V10 SP3	Delivered with the OS, supporting FC/iSCSI	Only V10 SP2 supports UltraPath 31.2.0. FC and iSCSI are supported.
Kylin Arm	V10 SP1, V10 SP2, and V10 SP3	Delivered with the OS, supporting FC/iSCSI	Only V10 SP3 supports UltraPath 31.3.0. iSCSI is supported.

OS Name	OS Version	Native DM-Multipath Version	Huawei UltraPath Version
Debian x86_64	9, 11, and 12	Delivered with the OS, supporting FC/iSCSI	Not supported
EulerOS x86_64	V2R9, V2R10, V2R11, and V2R12	Delivered with the OS, supporting FC/iSCSI	Not supported
EulerOS Arm	V2R10 and V2R12	Delivered with the OS, supporting FC/iSCSI	Not supported
UOS x86_64	V20	Delivered with the OS, supporting FC/iSCSI	Not supported
BC-Linux Arm	21.10	Delivered with the OS, supporting FC/iSCSI	Not supported
Anolis OS (Only OceanStor Pacific storage is supported.)	8.8	Delivered with the OS, supporting iSCSI	Not supported
OpenEuler x86_64	22.03 LTS SP1	Delivered with the OS, supporting iSCSI	Not supported
Red Hat Enterprise Linux x86_64	8.6, 8.7, 8.8, 8.9, 8.10, and 9.4	Delivered with the OS, supporting FC/iSCSI	Not supported

3.4.2.2 Features

3.4.2.2.1 Huawei CSI

Feature	FusionStorage Block	OceanStor Pacific Series
Static Provisioning	iSCSI/SCSI	iSCSI/SCSI

Feature	FusionStorage Block	OceanStor Pacific Series
Dynamic Provisioning		
Manage Provisioning		
Expand Persistent Volume	• Volumes created in Dynamic Provisioning or Manage Provisioning mode are supported. • The provisioned PVC whose **volumeType** is **lun** and **accessModes** is **ReadOnlyMany** does not support capacity expansion.	
Create VolumeSnapshot	Volumes created in Dynamic Provisioning or Manage Provisioning mode are supported.	
Delete VolumeSnapshot	Supported	
Restore VolumeSnapshot	Supported	
Clone Persistent Volume	Volumes created in Dynamic Provisioning or Manage Provisioning mode are supported.	
Raw Block Volume	Supported	
Topology	Supported	
Generic Ephemeral Inline Volumes	Supported	
Access Mode	RWO/ROX/RWOP: supported by all types of volumes. RWOP is supported only by Kubernetes 1.22 and later versions. RWX: supported only by Raw Block volumes.	
QoS	Supported	
Soft and hard quotas	Not supported	
Storage multi-tenant	Not supported	

3.5 Mass Storage (OceanDisk Series)

3.5.1 File Service

3.5.1.1 Compatibility

3.5.1.1.1 Storage

Compatibility with Huawei CSI Storage

Table 3-28 Supported Huawei storage products

Storage Product	Version
OceanDisk 1500T (NAS)	V700R001C01

3.5.1.1.2 Container Platform

Huawei CSI Platform Compatibility

Table 3-29 Supported container management platforms

Container Management Platform	Version
Kubernetes	1.16 to 1.34
Red Hat OpenShift Container Platform	4.12 to 4.19
Tanzu Kubernetes Grid Integrated	TKGI 1.17 to 1.19
CCE Agile	22.3.2
CCE	22.9.5

3.5.1.1.3 OS

Table 3-30 Supported host OSs

OS Name	OS Version
CentOS x86_64	7.6, 7.7, and 7.9
CentOS x86_64	8.2 and 8.4
CentOS Arm	7.6
Rocky Linux x86_64	8.6
SUSE 15 x86_64	SP2 and SP3
Red Hat CoreOS x86_64	4.12, 4.13, 4.14, 4.15, 4.16, 4.17, 4.18, and 4.19
Ubuntu x86_64	18.04, 20.04, and 22.04
Ubuntu Arm	22.04

OS Name	OS Version
Kylin x86_64	7.6, V10 SP1, V10 SP2, and V10 SP3
Kylin Arm	V10 SP1, V10 SP2, and V10 SP3
Debian x86_64	9, 11, and 12
EulerOS x86_64	V2R9, V2R10, V2R11, and V2R12
EulerOS Arm	V2R10 and V2R12
UOS x86_64	V20
BC-Linux Arm	21.10
OpenEuler x86_64	22.03 LTS SP1
Red Hat Enterprise Linux x86_64	8.6, 8.7, 8.8, 8.9, 8.10, and 9.4

3.5.1.2 Features

3.5.1.2.1 Huawei CSI

Table 3-31 Features supported by Huawei storage and constraints

Feature	OceanDisk 1500T
Static Provisioning	NFS 3/4.0
Dynamic Provisioning	
Manage Provisioning	
Expand Persistent Volume	Volumes created in Dynamic Provisioning or Manage Provisioning mode are supported.
Create VolumeSnapshot	Not supported
Delete VolumeSnapshot	Not supported
Restore VolumeSnapshot	Not supported
Clone Persistent Volume	Not supported
Raw Block Volume	Not supported
Topology	Supported
Generic Ephemeral Inline Volumes	Supported
Access Mode	RWO, ROX, RWX, and RWOP. RWOP is supported only in Kubernetes 1.22 or later.
QoS	Supported

Feature	OceanDisk 1500T
Application type	Supported
Storage multi-tenant	Supported

3.5.2 Block Service

3.5.2.1 Compatibility

3.5.2.1.1 Storage

Compatibility with Huawei CSI Storage

Table 3-32 Supported Huawei storage products

Storage Product	Version
OceanDisk 1500/1600 series	1.5.0, V700R001C10, V700R001C11

3.5.2.1.2 Container Platform

Huawei CSI Platform Compatibility

Table 3-33 Supported container management platforms

Container Management Platform	Version
Kubernetes	1.16 to 1.34
Red Hat OpenShift Container Platform	4.12 to 4.19
Tanzu Kubernetes Grid Integrated	TKGI 1.17 to 1.19
CCE Agile	22.3.2
CCE	22.9.5

3.5.2.1.3 OS

Huawei CSI OS Compatibility

Table 3-34 Supported host OSs

OS Name	OS Version	Native DM-Multipath Version	Huawei UltraPath Version
CentOS x86_64	7.6, 7.7, and 7.9	Delivered with the OS, supporting FC/iSCSI	UltraPath 31.1.0, supporting FC/iSCSI
CentOS x86_64	8.2 and 8.4	Delivered with the OS, supporting FC/iSCSI	UltraPath 31.1.0, supporting FC/iSCSI UltraPath-NVMe 31.1.RC8, supporting NVMe over RoCE/ NVMe over FC
CentOS Arm	7.6	Delivered with the OS, supporting FC/iSCSI	Not supported
Rocky Linux x86_64	8.6	Delivered with the OS, supporting FC/iSCSI	UltraPath-NVMe 31.2.1, supporting NVMe over RoCE
SUSE 15 x86_64	SP2 and SP3	Delivered with the OS, supporting FC/iSCSI	UltraPath 31.1.0, supporting FC/iSCSI UltraPath-NVMe 31.1.RC8, supporting NVMe over RoCE/ NVMe over FC
Red Hat CoreOS x86_64	4.12, 4.13, 4.14, 4.15, 4.16, 4.17, 4.18, and 4.19	Delivered with the OS, supporting FC/iSCSI	Not supported
Ubuntu x86_64	18.04, 20.04, and 22.04	Delivered with the OS, supporting FC/iSCSI	Not supported
Ubuntu Arm	22.04	Delivered with the OS, supporting FC/iSCSI	Not supported

OS Name	OS Version	Native DM-Multipath Version	Huawei UltraPath Version
Kylin x86_64	7.6, V10 SP1, V10 SP2, and V10 SP3	Delivered with the OS, supporting FC/iSCSI	UltraPath 31.2.0, supporting FC/iSCSI
Kylin Arm	V10 SP1, V10 SP2, and V10 SP3	Delivered with the OS, supporting FC/iSCSI	UltraPath 31.3.0, supporting iSCSI
Debian x86_64	9, 11, and 12	Delivered with the OS, supporting FC/iSCSI	Not supported
EulerOS x86_64	V2R9, V2R10, V2R11, and V2R12	Delivered with the OS, supporting FC/iSCSI	Not supported
EulerOS Arm	V2R10 and V2R12	Delivered with the OS, supporting FC/iSCSI	Not supported
UOS x86_64	V20	Delivered with the OS, supporting FC/iSCSI	Not supported
BC-Linux Arm	21.10	Delivered with the OS, supporting FC/iSCSI	Not supported
OpenEuler x86_64	22.03 LTS SP1	Delivered with the OS, supporting iSCSI	Not supported
Red Hat Enterprise Linux x86_64	8.6, 8.7, 8.8, 8.9, 8.10, and 9.4	Delivered with the OS, supporting FC/iSCSI	Not supported

3.5.2.2 Features

3.5.2.2.1 Huawei CSI

Feature	OceanDisk 1500/1600
Static Provisioning	SAN: FC/iSCSI/NVMe over RoCE
Dynamic Provisioning	
Manage Provisioning	
Expand Persistent Volume	Volumes created in Dynamic Provisioning or Manage Provisioning mode are supported.
Create VolumeSnapshot	Not supported
Delete VolumeSnapshot	Not supported
Restore VolumeSnapshot	Not supported
Clone Persistent Volume	Not supported
Raw Block Volume	Supported
Topology	Supported
Generic Ephemeral Inline Volumes	Supported
Access Mode	RWO/ROX/RWOP: supported by all types of volumes. RWOP is supported only by Kubernetes 1.22 and later versions. RWX: supported only by Raw Block volumes.
QoS	Supported
Application type	Supported
Storage multi-tenant	Not supported

NOTE

- If a container platform is deployed on a virtualization platform, you are advised to use the iSCSI protocol when the CSI is connected to SAN storage.
- If the customer requires the FC, NVMe over FC, or NVMe over RoCE protocol, the virtualization platform needs to be configured. In this case, the customer's virtualization team needs to provide technical support.
- When NVMe over RoCE or NVMe over FC is used, the supported nvme-cli tool version is 1.9 or later. To query the version, run the **nvme version** command.

4 Installation and Deployment

4.1 CSI

4.1.1 Installation Preparations

This chapter describes the preparations for the installation.

Prerequisites

- The container management platform has been deployed and is running properly. The container platform compatibility requirements in **3 Compatibility and Features** are met.
- (Mandatory for enterprise storage) Initial configuration for interconnecting with Huawei enterprise storage has been completed, including storage pool division and port configuration. The version of the storage product meets the requirements in **3 Compatibility and Features**.
- (Mandatory for distributed storage) Initial configuration for interconnecting with Huawei distributed storage has been completed, including storage pool division and port configuration. The version of the storage product meets the requirements in **3 Compatibility and Features**.
- The connectivity between Huawei storage and the container platform host has been configured. For example, the worker node running huawei-csi-controller communicates properly with the management IP address of the storage device to be connected, and the worker node running huawei-csi-node communicates properly with the service IP address of the storage device to be connected. In iSCSI scenarios, the **ping** command can be used to verify the connectivity.
- Ensure that the language of the operating system is English.
- Ensure that storage resource names, such as storage pool names and tenant names, are in English.

4.1.1.1 Downloading the Huawei CSI Software Package

This section describes how to download the software package and the component structure of the software package.

Step 1 Open a browser and enter **https://github.com/Huawei/eSDK_K8S_Plugin/releases** in the address box.

Step 2 Download the software package of the 4.10.0 version based on the CPU architecture.

NOTE

- Software package naming rule: Plug-in name (**eSDK_Storage_CSI**) + Version number + CPU architecture
- CSI supports the following CPU architectures: x86, Arm, and PPC64LE.

Step 3 Decompress the downloaded software package. The following table shows the component structure of the software package.

Table 4-1 Component description

Component	Description
image/huawei-csi-v4.10.0-*arch*.tar	huawei-csi-driver image. *arch* indicates the CPU architecture.
image/storage-backend-controller-v4.10.0-*arch*.tar	Back-end management controller image. *arch* indicates the CPU architecture.
image/storage-backend-sidecar-v4.10.0-*arch*.tar	Back-end management sidecar image. *arch* indicates the CPU architecture.
image/huawei-csi-extender-v4.10.0-*arch*.tar	huawei-csi-extender image. *arch* indicates the CPU architecture.
bin/	Binary file used by an image provided by Huawei.
bin/oceanctl	Command line tool provided by Huawei, which can be used to manage storage backends.
helm/	Helm project used to deploy Huawei CSI.
manual/	Used to manually install and deploy Huawei CSI.
examples/	.yaml sample file used during CSI use.
examples/backend	.yaml sample file used to create a storage backend.

----End

4.1.1.2 Uploading a Huawei CSI Image

Huawei provides the **huawei-csi** image for users. For details about how to obtain the image file, see **4.1.1.1 Downloading the Huawei CSI Software Package**.

To use the CSI image on the container management platform, you need to import the CSI image to the cluster in advance:

- Method 1: (Recommended) Use Docker to upload the CSI image to the image repository. For details, see **Uploading an Image to the Image Repository**.
- Method 2: Manually import the CSI image to all nodes where Huawei CSI needs to be deployed. For details, see **Uploading an Image to a Local Node**.

Uploading an Image to the Image Repository

The installation of Huawei CSI depends on the following image files provided by Huawei. Import and upload the image files in sequence. For details about how to obtain the image files, see **4.1.1.1 Downloading the Huawei CSI Software Package**.

- huawei-csi-v4.10.0-arch.tar
- storage-backend-controller-v4.10.0-arch.tar
- storage-backend-sidecar-v4.10.0-arch.tar
- huawei-csi-extender-v4.10.0-arch.tar

Prerequisites

A Linux host with Docker installed is available, and the host can access the image repository.

Procedure

Step 1 Run the following command to import the CSI image to the current node. *arch* indicates the CPU architecture.

```
docker load -i huawei-csi-v4.10.0-<arch>.tar
```

Step 2 Run the following command to add the image repository address to the image tag. **repo.huawei.com** indicates the image repository address.

```
docker tag huawei-csi:4.10.0 <repo.huawei.com>/huawei-csi:4.10.0
```

Step 3 Run the following command to upload the CSI image to the image repository. **repo.huawei.com** indicates the image repository address.

```
docker push <repo.huawei.com>/huawei-csi:4.10.0
```

----End

NOTE

- Run the corresponding CLI command to load and push the image based on the container runtime environment (for example, Docker or Containerd).
- For details about how to import and upload images to the CCE or CCE Agile platform, see the user manual of the platform.

Uploading an Image to a Local Node

If the image has been uploaded to the image repository, skip this section.

Prerequisites

- The node has the corresponding Huawei CSI image file. For details about how to obtain the image file, see **4.1.1.1 Downloading the Huawei CSI Software Package**.

- Docker or another container engine has been installed on the node.

Procedure

Step 1 Use a remote access tool, such as PuTTY, to log in to the node where the image is to be imported through the management IP address.

Step 2 Copy the **image** directory in the Kubernetes CSI component package to any directory on the current node.

Step 3 Run the **cd image** command to go to the **image** working directory. For details about the tool path, see **Table 4-1**.

Step 4 Run the following commands in sequence to import all Huawei CSI images in the **image** directory to the local node. In the commands, *name* indicates the name of a .tar image package.

- Run the following command using the Docker container engine:
```
docker load -i <name>.tar
```
- Run the following command using the containerd container engine:
```
ctr -n k8s.io image import <name>.tar
```
- Run the following command using the Podman container engine:
```
podman load -i <name>.tar
```

NOTE

If another container engine is installed on the node, use the image import command for the corresponding container engine.

----End

4.1.1.3 Checking User Configurations on Huawei Storage

After Huawei storage is connected to the container platform, Huawei CSI needs to manage storage resources on Huawei storage based on service requirements, such as creating and mapping volumes. In this case, Huawei CSI needs to use the users created on Huawei storage to communicate with Huawei storage. The following table lists the user information required for different storage devices.

Table 4-2 User requirements for connecting storage to CSI

Storage Type	User Type	Role	Level	Type
OceanStor V5	System user	Administrator	Administrator	Local user/ LDAP user[2]
	vStore user	vStore administrator	Administrator	Local user/ LDAP user[2]
OceanStor	System user	Administrator/ User-defined role[1]	N/A	Local user/ LDAP user[2]

Storage Type	User Type	Role	Level	Type
OceanStor Dorado	System user	Administrator/ User-defined role[1]	N/A	Local user/ LDAP user[2]
	vStore user	vStore administrator	N/A	Local user/ LDAP user[2]
OceanStor A series	System user	Administrator	N/A	Local user/ LDAP user[2]
OceanStor Pacific series	System user	Administrator	N/A	Local user
OceanDisk	System user	Administrator	N/A	Local user

NOTE

- If a user-defined role is used, you need to configure permissions for the role. For details about how to configure the minimum permissions, see **10.2 Configuring Custom Permissions**.
- If the LDAP authentication mode is used, you need to set the **authenticationMode** parameter when creating a backend. For details, see the parameter description in **5.1.1 Configuring the Storage Backend**.
- Based on the principle of minimum and system security requirements, users under the super administrator role are not recommended.

4.1.1.4 Checking Volume Snapshot-Dependent Components

This section describes how to check the volume snapshot-dependent components in the cluster.

NOTICE

If Huawei CSI is deployed in a version earlier than Kubernetes v1.20, perform the following steps:

Step 1 Run the following command to check the Kubernetes version. The following uses Kubernetes v1.16.0 as an example.

```
kubectl get node
```

The following is an example of the command output.

```
NAME          STATUS     ROLES    AGE    VERSION
test-master   Ready      master   311d   v1.16.0
test-node     Ready      <none>   311d   v1.16.0
```

Step 2 Copy the **helm** directory in the Kubernetes CSI component package to any directory on the master node. For details about the Helm tool path, see **Table 4-1**.

Step 3 Go to the **helm/esdk/crds/snapshot-crds** directory and run the following command to delete the snapshot CRD installation file.

```
rm -rf ./huawei-csi-snapshot-crd-v1.yaml
```

----End

4.1.1.5 Checking the Host Multipathing Configuration

If you plan to use the FC/iSCSI/NVMe over RoCE/NVMe over FC protocol to access Huawei storage in a container environment, you are advised to use host multipathing software to enhance the link redundancy and performance of the host and storage. If you do not want to use the software, skip this section.

For details about the OSs and multipathing software that can be interconnected with Huawei CSI software, see the OS compatibility in **3 Compatibility and Features**.

NOTE

- If you want to use the FC/iSCSI protocol to connect to Huawei storage, you are advised to use native DM-Multipath provided by the OS.
- If you want to use the NVMe over RoCE/NVMe over FC protocol to connect to Huawei storage, you are advised to use Huawei-developed UltraPath-NVMe.
- If you want to use the SCSI protocol to connect to Huawei storage, disable DM-Multipath provided by the OS.

Prerequisites

Multipathing software has been correctly installed on a host.

- If you use native DM-Multipath provided by the OS, contact your host or OS provider to obtain the documents and software packages required for the installation.
- If you use Huawei-developed UltraPath or UltraPath-NVMe, contact Huawei engineers to obtain the UltraPath or UltraPath-NVMe documents and software packages. For details about the software package version, see the OS compatibility in **3 Compatibility and Features**.

Procedure

- If you use the iSCSI/FC protocol to connect to Huawei enterprise storage, configure and check host multipathing by referring to **OceanStor Dorado and OceanStor Host Connectivity Guide for Red Hat**.
- If you use the NVMe over RoCE/NVMe over FC protocol to connect to Huawei enterprise storage, configure and check host multipathing by referring to **OceanStor Dorado and OceanStor Host Connectivity Guide for Red Hat**.
- If you use iSCSI to connect to Huawei distributed storage, configure and check host multipathing by referring to Configuring Multipathing for an Application Server in **FusionStorage 8.0.1 Block Storage Basic Service Configuration Guide**

- If you use the native multipathing software provided by the OS, check whether the **/etc/multipath.conf** file contains the following configuration item.
```
defaults {
        user_friendly_names yes
        find_multipaths no
}
```
  If the configuration item does not exist, add it to the beginning of the **/etc/multipath.conf** file.

  NOTE

  For details about the functions of the **user_friendly_names** and **find_multipaths** parameters, see **dm_multipath/config_file_defaults**.

4.1.1.6 Checking the Status of Host-Dependent Software

This section describes how to check whether the status of host-dependent software on worker nodes in a cluster is normal. In this example, the host OS is CentOS 7.9 x86_64.

- Check the status of the iSCSI client.
```
systemctl status iscsi iscsid
```
- Check the status of the NFS client.
```
systemctl status rpcbind
```
- Check the status of DM-Multipath.
```
systemctl status multipathd.socket multipathd
```
- Check the status of UltraPath.
```
systemctl status nxup
```
- Check the status of UltraPath-NVMe.
```
systemctl status upudev upService_plus
```
- Check the status of the DataTurbo client. For details, see **OceanStor DataTurbo 25.1.0 DTFS User Guide**.
- Check the status of the NFS+ client. For details, see **NFS+ Client 1.x User Guide**.

4.1.1.7 Checking the Images on Which CSI Depends

The installation of Huawei CSI depends on the images listed in the following table. If all worker nodes in the cluster have been connected to the Internet and can pull images online, you can skip this section. If nodes in the cluster cannot connect to the Internet, download the corresponding image file based on the Kubernetes version and upload it to the image repository or import it to all worker nodes in the Kubernetes cluster.

The huawei-csi-controller service depends on the following sidecar images: livenessprobe, csi-provisioner, csi-attacher, csi-resizer, csi-snapshotter, snapshot-controller, storage-backend-controller, storage-backend-sidecar, huawei-csi-driver, and huawei-csi-extender. The huawei-csi-node service depends on the following sidecar images: livenessprobe, csi-node-driver-registrar, and huawei-csi-driver.

For details about the functions and details of each image, see the following table.

Table 4-3 Images on which Huawei CSI depends

Container Name	Container Image	K8s Version Requirements	Feature Description
livenessprobe	registry.k8s.io/sig-storage/livenessprobe:v2.12.0	v1.16+	This image is provided by the Kubernetes community, used to monitor the health status of CSI and report it to Kubernetes so that Kubernetes can automatically detect CSI program problems and restart the Pod to rectify the problems.
csi-resizer	registry.k8s.io/sig-storage/csi-resizer:v1.9.0	v1.16+	This image is provided by the Kubernetes community, used to call CSI to provide more storage space for a PVC when expanding the capacity of the PVC.
csi-node-driver-registrar	registry.k8s.io/sig-storage/csi-node-driver-registrar:v2.9.0	v1.16+	This image is provided by the Kubernetes community, used to obtain CSI information and register a node with kubelet using the plug-in registration mechanism of kubelet so that Kubernetes can detect the connection between the node and Huawei storage.
csi-snapshotter	registry.k8s.io/sig-storage/csi-snapshotter:v6.3.0	v1.20+	This image is provided by the Kubernetes community, used to call CSI to create or delete a snapshot on the storage system when creating or deleting a VolumeSnapshot.
snapshot-controller	registry.k8s.io/sig-storage/snapshot-controller:v6.3.0	v1.20+	This image is provided by the Kubernetes community, used to listen to the VolumeSnapshot and VolumeSnapshotContent objects in the Kubernetes API and trigger csi-snapshotter to create a snapshot on the storage system when creating or deleting a VolumeSnapshot.

Container Name	Container Image	K8s Version Requirements	Feature Description
csi-provisioner	registry.k8s.io/sig-storage/csi-provisioner:v3.6.0	v1.20+	This image is provided by the Kubernetes community, used to create or delete PVCs. ● Calls the huawei-csi-controller service to create a LUN or file system on the storage system as a PV when creating a PVC. ● Calls the huawei-csi-controller service to delete the LUN or file system corresponding to the PV when deleting a PVC.
	registry.k8s.io/sig-storage/csi-provisioner:v3.0.0	v1.17-v1.19	
	quay.io/k8scsi/csi-provisioner:v1.4.0	v1.16.x	
csi-attacher	registry.k8s.io/sig-storage/csi-attacher:v4.4.0	v1.17+	Calls the huawei-csi-controller service to perform the "Publish/Unpublish Volume" operation when creating or deleting a Pod.
	quay.io/k8scsi/csi-attacher:v1.2.1	v.1.16.x	
storage-backend-controller	storage-backend-controller:4.10.0	v1.16+	This image is provided by Huawei CSI software package, used to manage storageBackendClaim resources.
storage-backend-sidecar	storage-backend-sidecar:4.10.0	v1.16+	This image is provided by Huawei CSI software package, used to manage storageBackendContent resources.
huawei-csi-driver	huawei-csi:4.10.0	v1.16+	This image is provided by Huawei CSI software package, used to provide all features supported by Huawei CSI.
huawei-csi-extender	huawei-csi-extender:4.10.0	v1.16+	This image is provided by Huawei CSI software package, used to provide extended features of Huawei CSI.

NOTE

If the cluster is not connected to the Internet, manually download the container images and upload them to the cluster. For details, see **7.3 Downloading a Container Image**.

4.1.2 Installation

This section describes how to install Huawei CSI.

NOTE

In the current version, resource requests and limits are added to Huawei CSI. For details, see **10.3 Huawei CSI Resource Management**.

Prerequisites

- Operations described in **4.1.1 Installation Preparations** have been completed.
- All worker nodes of the cluster communicate properly with the service network of the storage device to be connected. In iSCSI scenarios, the **ping** command can be used to verify the connectivity.
- Software clients required by the corresponding protocol, such as iSCSI and NFS clients, have been installed on all worker nodes of the cluster.

4.1.2.1 Installation Using Helm

This section describes how to install Huawei CSI using Helm 3.

Helm Installation Description

NOTICE

- Huawei CSI can be installed as the root user or a non-root user. When installing Huawei CSI as a non-root user, ensure that the current user can access the API Server of the Kubernetes cluster. For details about how to configure access to the Kubernetes cluster as a non-root user, see **7.7 Configuring Access to the Kubernetes Cluster as a Non-root User**.
- Huawei CSI must be run as the root user.

Helm is a software package management tool in the Kubernetes ecosystem. Similar to Ubuntu APT, CentOS YUM, or Python pip, Helm manages Kubernetes application resources.

You can use Helm to package, distribute, install, upgrade, and roll back Kubernetes applications in a unified manner.

- For details about how to obtain and install Helm, see **https://helm.sh/docs/intro/install/**.
- For details about the mapping between Helm and Kubernetes versions, see **https://helm.sh/docs/topics/version_skew/**.

When installing huawei-csi-controller, Helm deploys the following components in the workloads of the Deployment type in the specified namespace:

- huawei-csi-driver: Huawei CSI driver.
- storage-backend-controller: Huawei backend management controller, used to manage storageBackendClaim resources.

- storage-backend-sidecar: used to manage storageBackendContent resources.
- Kubernetes External Provisioner: used to provide or delete volumes.
- Kubernetes External Attacher: used to attach or detach volumes.
- Kubernetes External Resizer: used to expand the capacity of volumes.
- Kubernetes External liveness-probe: used to determine the health status of a Pod.
- (Optional) huawei-csi-extender: Huawei CSI extender.
- (Optional) Kubernetes External Snapshotter: used to provide snapshot support (installed as CRD).
- (Optional) Kubernetes External Snapshot Controller: used to control volume snapshots.

When installing huawei-csi-node, Helm deploys the following components in the workloads of the DaemonSet type in the specified namespace:

- huawei-csi-driver: Huawei CSI driver.
- Kubernetes Node Registrar: used to process driver registration.
- liveness-probe: used to determine the health status of a Pod.

4.1.2.1.1 Installing Huawei CSI on Kubernetes, OpenShift, and Tanzu

Installation Procedure

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the cluster through the management IP address.

Step 2 Copy the **helm** directory in the Kubernetes CSI component package to any directory on the master node. For details about the Helm tool path, see **Table 4-1**.

Step 3 Go to the **helm/esdk** working directory.

```
cd helm/esdk
```

Step 4 Prepare the **values.yaml** file. Huawei CSI provides the **values.yaml** template file in the **helm/esdk** directory of the software package. You can also modify parameters according to **4.1.2.1.3 Parameters in the values.yaml File of Helm** to customize Huawei CSI.

Step 5 Perform the following configuration before the installation:

- If the container platform is Kubernetes, skip this step.
- If the container platform is OpenShift, perform the configuration in **Installation and Configuration on the OpenShift Platform**.
- If the container platform is Tanzu, perform the configuration in **Installation and Configuration on the Tanzu Platform**.

Step 6 Run the following command to update the storage backend CRD.

```
kubectl apply -f ./crds/backend/
```

Step 7 (Optional) Check snapshot-dependent components by following the instructions provided in **4.1.1.4 Checking Volume Snapshot-Dependent Components**. After confirming that the components are correct, run the following command to update the snapshot CRD. If **controller.snapshot.enabled** is set to **false** or the Kubernetes version is earlier than v1.20, you can skip this step. For details, see **Table 4-5**.

```
kubectl apply -f ./crds/snapshot-crds/ --validate=false
```

Step 8 Run the following command to install Huawei CSI. In the preceding command, *helm-huawei-csi* indicates the custom Helm chart name, **./** indicates that the Helm project in the current directory is used, and *huawei-csi* indicates the custom Helm chart namespace.

```
helm install helm-huawei-csi ./ -n huawei-csi --create-namespace
```

The following is an example of the command output.

```
NAME: helm-huawei-csi
LAST DEPLOYED: Wed Jun  8 11:50:28 2022
NAMESPACE: huawei-csi
STATUS: deployed
REVISION: 1
TEST SUITE: None
```

Step 9 After the huawei-csi service is deployed, run the following command to check whether the service is started.

```
kubectl get pod -n huawei-csi
```

The following is an example of the command output. If the Pod status is **Running**, the installation is successful.

```
NAME                                   READY   STATUS    RESTARTS   AGE
huawei-csi-controller-6dfcc4b79f-9vjtq   9/9     Running   0          24m
huawei-csi-controller-6dfcc4b79f-csphc   9/9     Running   0          24m
huawei-csi-node-g6f4k                   3/3     Running   0          20m
huawei-csi-node-tqs87                   3/3     Running   0          20m
```

----End

Installation and Configuration on the OpenShift Platform

For the OpenShift platform, perform the following steps to create the **SecurityContextConstraints** resource.

Step 1 Run the following command to edit the **helm_scc.yaml** file.

```
vi helm_scc.yaml
```

Step 2 Modify the **helm_scc.yaml** file. In the following commands, *huawei-csi* indicates the created namespace. Replace it based on the actual situation.

```
apiVersion: security.openshift.io/v1
kind: SecurityContextConstraints
metadata:
  name: helm-scc
allowHostDirVolumePlugin: true
allowHostIPC: true
allowHostNetwork: true
allowHostPID: true
allowHostPorts: true
allowPrivilegeEscalation: true
allowPrivilegedContainer: true

defaultAddCapabilities:
- SYS_ADMIN
runAsUser:
  type: RunAsAny
seLinuxContext:
  type: RunAsAny
fsGroup:
  type: RunAsAny
users:
- system:serviceaccount:huawei-csi:huawei-csi-controller
- system:serviceaccount:huawei-csi:huawei-csi-node
```

Step 3 Run the following command to create a **SecurityContextConstraints** file.

```
oc create -f helm_scc.yaml
```

----End

Installation and Configuration on the Tanzu Platform

On the Tanzu platform, run the following command to configure the **kubelet** installation directory.

Step 1 Go to the **helm/esdk** directory in the installation package, and run the following command to open the configuration file. For details about the installation package directory, see **Table 4-1**.

```
vi values.yaml
```

Step 2 Modify the **kubeletConfigDir** parameter as follows and save the settings.

```
# Specify kubelet config dir path.
# kubernetes and openshift is usually /var/lib/kubelet
# Tanzu is usually /var/vcap/data/kubelet
# CCE is usually /mnt/paas/kubernetes/kubelet
kubeletConfigDir: /var/vcap/data/kubelet
```

----End

For TKGI 1.16 or earlier of the Tanzu platform, run the following commands to configure the RBAC permission.

Step 1 Run the following command to create a file named **rbac.yaml**.

```
vi rbac.yaml
```

Step 2 Copy the following content to the **rbac.yaml** file, save the file, and exit.

```
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRole
metadata:
  name: huawei-csi-psp-role
rules:
- apiGroups: ['policy']
  resources: ['podsecuritypolicies']
  verbs: ['use']
---
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRoleBinding
metadata:
  name: huawei-csi-psp-role-cfg
roleRef:
  kind: ClusterRole
  name: huawei-csi-psp-role
  apiGroup: rbac.authorization.k8s.io
subjects:
- kind: Group
  apiGroup: rbac.authorization.k8s.io
  name: system:serviceaccounts:huawei-csi
- kind: Group
  apiGroup: rbac.authorization.k8s.io
  name: system:serviceaccounts:default
```

Step 3 Run the following command to create the RBAC permission.

```
kubectl create -f rbac.yaml
```

----End

4.1.2.1.2 Installing Huawei CSI on the CCE or CCE Agile Platform

This section describes how to install Huawei CSI on the CCE or CCE Agile platform.

Creating a Helm Installation Package

The CCE or CCE Agile platform cannot directly install Huawei CSI using Helm. You need to manually create a Helm installation package and upload it to the chart list on the platform for installation.

Step 1 Use a remote access tool, such as PuTTY, to log in to any node where Helm is deployed through the management IP address.

Step 2 Copy the **helm** directory in the Huawei CSI component package to any directory on the node. For details about the Helm tool path, see **Table 4-1**.

Step 3 Go to the **helm** working directory.

```
cd helm/
```

Step 4 Modify the **kubeletConfigDir** and **csiDriver.driverName** parameters in the **helm/esdk/values.yaml** file.

```
vi ./esdk/values.yaml
```

Modify the following parameters:

```
# Specify kubelet config dir path.
# kubernetes and openshift is usually /var/lib/kubelet
# Tanzu is usually /var/vcap/data/kubelet
# CCE is usually /mnt/paas/kubernetes/kubelet
kubeletConfigDir: /mnt/paas/kubernetes/kubelet

# The CSI driver parameter configuration
csiDriver:
  # Driver name, it is strongly recommended not to modify this parameter
  # The CCE platform needs to modify this parameter, e.g. csi.oceanstor.com
  driverName: csi.oceanstor.com
```

Step 5 Run the following command to create a Helm installation package. This command will generate the installation package to the current path.

```
helm package ./esdk/ -d ./
```

----End

Installing Huawei CSI

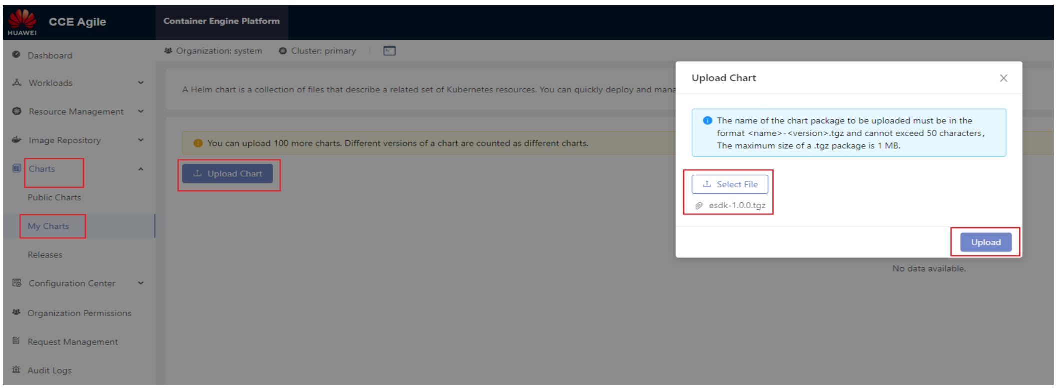
Step 1 Use a remote access tool, such as PuTTY, to log in to any master node where the CCE Agile platform is deployed through the management IP address.

Step 2 Run the following command to create a namespace for deploying Huawei CSI. *huawei-csi* indicates the custom namespace.

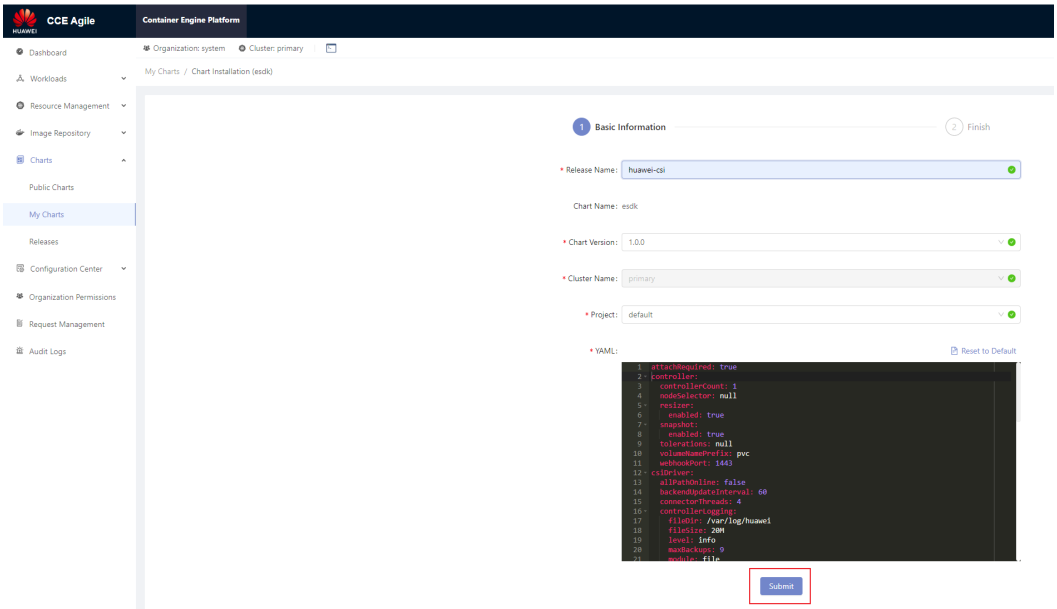
```
kubectl create namespace huawei-csi
```

Step 3 Export the Helm installation package. For details, see **Creating a Helm Installation Package**.

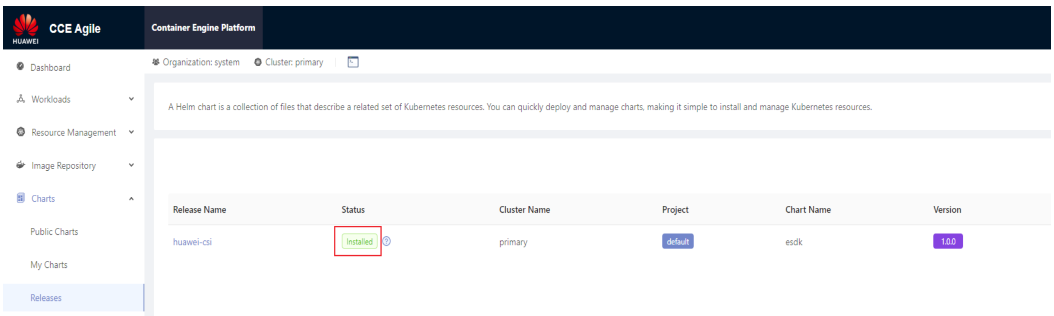
Step 4 On the home page, choose **Charts** > **My Charts** > **Upload Chart**. The **Upload Chart** dialog box is displayed. Import the exported Helm installation package to the CCE Agile platform.



Step 5 After the installation package is uploaded, choose **Charts** > **My Charts**. On the **My Charts** page that is displayed, choose **Install** > **Submit**. The chart release name can be customized.



Step 6 On the home page, choose **Charts** > **Releases** and select the project specified during installation (for example, **default** in the following figure). After the installation is successful, **Installed** is displayed in the **Status** column.



----End

4.1.2.1.3 Parameters in the values.yaml File of Helm

When using Helm to install CSI, you need to prepare the **values.yaml** file of the Helm project based on the features required during deployment. Huawei CSI provides the **values.yaml** template file in the **helm/esdk** directory of the software package.

This section describes the configuration items in the **values.yaml** file and backend configuration examples in typical scenarios.

images Parameters

The images parameters in the **values.yaml** file are used to configure the component image information on which Huawei CSI depends during running. Set the following parameters:

Table 4-4 images parameters

Parameter	Description	Mandatory	Default Value
images.huaweiCSIService	huawei-csi image.	Yes	huawei-csi:4.10.0
images.storageBackendSidecar	Huawei back-end management sidecar image.	Yes	storage-backend-sidecar:4.10.0
images.storageBackendController	Huawei back-end management controller image.	Yes	storage-backend-controller:4.10.0
images.huaweiCSIExtender	huawei-csi-extender image.	No	huawei-csi-extender:4.10.0
images.sidecar.livenessProbe	**livenessprobe** sidecar image.	Yes	registry.k8s.io/sig-storage/livenessprobe:v2.12.0
images.sidecar.provisioner	**csi-provisioner** sidecar image.	Yes	registry.k8s.io/sig-storage/csi-provisioner:v3.6.0
images.sidecar.attacher	**csi-attacher** sidecar image.	Yes	registry.k8s.io/sig-storage/csi-attacher:v4.4.0
images.sidecar.resizer	**csi-resizer** sidecar image.	Yes	registry.k8s.io/sig-storage/csi-resizer:v1.9.0
images.sidecar.snapshotter	**csi-snapshotter** sidecar image.	Yes	registry.k8s.io/sig-storage/csi-snapshotter:v6.3.0
images.sidecar.snapshotController	**snapshot-controller** sidecar image.	Yes	registry.k8s.io/sig-storage/snapshot-controller:v6.3.0

Parameter	Description	Mandatory	Default Value
images.sidecar.registrar	**csi-node-driver-registrar** sidecar image.	Yes	registry.k8s.io/sig-storage/csi-node-driver-registrar:v2.9.0

NOTICE

- For details about the values of **huaweiCSIService**, **storageBackendSidecar**, **storageBackendController**, and **huaweiCSIExtender**, see **4.1.1.2 Uploading a Huawei CSI Image**. Use the name and version of the finally generated image.
- For details about other sidecar image parameters, see **4.1.1.7 Checking the Images on Which CSI Depends**. Use the name and version of the finally uploaded image.

controller Parameters

The controller parameters are used to configure the huawei-csi-controller component.

Table 4-5 controller parameters

Parameter	Description	Mandatory	Default Value	Remarks
controller.controllerCount	Number of huawei-csi-controller component copies.	Yes	1	If the Kubernetes version is earlier than v1.17, the huawei-csi-controller component can be deployed only in single-copy mode because the csi-provisioner sidecar image provided by the Kubernetes community does not support the **--leader-election** parameter. Therefore, if the Kubernetes version is earlier than v1.17, this parameter can only be set to **1**.

Parameter	Description	Mandatory	Default Value	Remarks
controller.volumeNamePrefix	PV name prefix. The default value is **pvc**, that is, the name of a created PV is **pvc-**<*uuid*>. The prefix must comply with the naming rules of **DNS Subdomain Names**, and the total length of the PV name cannot exceed 253 characters.	No	pvc	The corresponding provisioner parameter name is **--volume-name-prefix**. It is recommended that the prefix contain no more than 20 characters. For details, see **Configuring the PV Name Prefix**. • If the connected backend is OceanStor V5 SAN storage, it is recommended that the prefix contain a maximum of 5 characters. • If the connected backend is OceanStor V5 NAS storage, the prefix can contain only lowercase letters, hyphens (-), and digits. • If the connected backend is OceanStor Dorado or OceanStor storage, the prefix can contain only lowercase letters, hyphens (-), and digits. • If the connected backend is OceanStor Pacific series storage, the prefix can

Parameter	Description	Mandatory	Default Value	Remarks
				contain a maximum of 58 characters, including only letters, digits, underscores (_), hyphens (-), and periods (.). • If the connected backend is FusionStorage Block, the prefix can contain a maximum of 58 characters, including only letters, digits, underscores (_), and hyphens (-).
controller.webhookPort	Port used by the webhook service.	Yes	4433	If a port conflict occurs, change the port number to an idle one.
controller.snapshot.enabled	Whether to enable the snapshot feature.	Yes	true	If you want to use snapshot-related functions, enable this feature. The Kubernetes version must be later than v1.20.
controller.resizer.enabled	Whether to enable the capacity expansion feature.	Yes	true	The Kubernetes version must be later than v1.16.
controller.nodeSelector	Node selector of huawei-csi-controller. After this parameter is set, huawei-csi-controller will be scheduled only to a node with the label.	No	-	For details about the node selector, see **Assign Pods to Nodes**.

Parameter	Description	Mandatory	Default Value	Remarks
controller.tolerations	Taint toleration of huawei-csi-controller. After this parameter is set, huawei-csi-controller can tolerate taints on a node.	No	-	For details about taints and tolerations, see **Taints and Tolerations**.
controller.affinity	Node affinity of huawei-csi-controller. After this parameter is set, huawei-csi-controller will be preferentially scheduled to a node with the label.	No	-	For details about node affinity, see **Assigning Pods to Nodes**.
controller.livenessProbePort	Liveness probe port of huawei-csi-controller, used for health check.	Yes	9808	If a port conflict occurs, change the port number to an idle one.
controller.csiExtender.volumeModify.enabled	Whether to enable the PVC change feature.	No	false	If you want to use PVC change-related functions, enable this feature.
controller.csiExtender.volumeModify.retryBaseDelay	Minimum retry interval when a PVC change fails to be created.	No	5s	The default value is recommended.
controller.csiExtender.volumeModify.retryMaxDelay	Maximum retry interval when a PVC change fails to be created.	No	5m	The default value is recommended.
controller.csiExtender.volumeModify.reconcileDelay	Interval for reconciling VolumeModifyClaim objects.	No	1s	The default value is recommended.

Parameter	Description	Mandatory	Default Value	Remarks
controller.exportCsiService.enabled	Whether to run CSI services on the Service of the Kubernetes cluster.	No	false	After this function is enabled, other services in the Kubernetes cluster can access CSI services through gRPC.
controller.exportCsiService.port	Port used when CSI services run on the Service of the Kubernetes cluster.	No	9090	If a port conflict occurs, change the port number to an idle one.

NOTE

If **controller.snapshot.enabled** is set to **true**, you need to install the volume snapshot CRD resource in the **helm/crd/snapshot-crds** directory.

node Parameters

The node parameters are used to configure the huawei-csi-node component.

Table 4-6 node parameters

Parameter	Description	Mandatory	Default Value	Remarks
node.maxVolumesPerNode	Maximum number of volumes provisioned by Huawei CSI that can be used by a node. If this parameter is not specified or is set to **0**, the number is unlimited. If **nodeName** is specified during Pod creation, this configuration will be ignored.	No	100	For details, see **Volume Limits**.

Parameter	Description	Mandatory	Default Value	Remarks
node.nodeSelector	Node selector of huawei-csi-node. After this parameter is set, huawei-csi-node will be scheduled only to a node with the label.	No	-	For details about the node selector, see **Assign Pods to Nodes**.
node.tolerations	Taint toleration of huawei-csi-node. After this parameter is set, huawei-csi-node can tolerate taints on a node.	No	`- key: "node.kubernetes.io/memory-pressure" operator: "Exists" effect: "NoExecute"` `- key: "node.kubernetes.io/disk-pressure" operator: "Exists" effect: "NoExecute"` `- key: "node.kubernetes.io/network-unavailable" operator: "Exists" effect: "NoExecute"`	For details about taints and tolerations, see **Taints and Tolerations**.
node.affinity	Node affinity of huawei-csi-node. After this parameter is set, huawei-csi-node will be preferentially scheduled to a node with the label.	No	-	For details about node affinity, see **Assigning Pods to Nodes**.
node.livenessProbePort	Liveness probe port of huawei-csi-node, used for health check.	Yes	9800	If a port conflict occurs, change the port number to an idle one.

Parameter	Description	Mandatory	Default Value	Remarks
node.kubeletVolumeDevicesDirName	Name of the directory where a block device is mounted to kubelet.	No	volumeDevices	After a block device is successfully mounted, the directory structure of the mount path is as follows: `/var/lib/kubelet/plugins/kubernetes.io/csi/{kubeletVolumeDevicesDirName}/publish/{specName}/{podUID}`

csiDriver Parameters

The csiDriver parameters include the basic configurations for running Huawei CSI, such as Huawei driver name and multipathing type.

Table 4-7 csiDriver parameters

Parameter	Description	Mandatory	Default Value	Remarks
csiDriver.driverName	Registered driver name.	Yes	csi.huawei.com	• Use the default value. • For the CCE Agile platform, modify this field. For example, **csi.oceanstor.com**.
csiDriver.endpoint	Communication endpoint.	Yes	/csi/csi.sock	Use the default value.

Parameter	Description	Mandatory	Default Value	Remarks
csiDriver.connectorThreads	Maximum number of disks that can be concurrently scanned/detached. The value is an integer ranging from 1 to 10.	Yes	4	A larger value indicates that more concurrent disk scanning and detaching operations are performed on a single node at the same time. When DM-Multipath is used, a large number of concurrent requests may cause unknown problems and affect the overall time.
csiDriver.volumeUseMultipath	Whether to use multipathing software. The value is a Boolean value.	Yes	true	It is strongly recommended that multipathing software be enabled to enhance the redundancy and performance of storage links.
csiDriver.scsiMultipathType	Multipathing software used when the storage protocol is **fc** or **iscsi**. The following parameter values can be configured: ● DM-multipath ● HW-UltraPath ● HW-UltraPath-NVMe	Mandatory when **volumeUseMultipath** is set to **true**.	DM-multipath	The **DM-multipath** value is recommended.
csiDriver.nvmeMultipathType	Multipathing software used when the storage protocol is **roce** or **fc-nvme**. Only **HW-UltraPath-NVMe** is supported.	Mandatory when **volumeUseMultipath** is set to **true**.	HW-UltraPath-NVMe	-

Parameter	Description	Mandatory	Default Value	Remarks
csiDriver.scanVolumeTimeout	Timeout interval for waiting for multipathing aggregation when DM-Multipath is used on the host. The value ranges from 1 to 600 seconds.	Yes	3	-
csiDriver.execCommandTimeout	Timeout interval for running commands on the host.	Yes	30	In scenarios such as mounting and capacity expansion, the CSI plug-in needs to run some host commands, for example, running the **mount** command to mount a file system. This parameter is used to control the timeout interval for running a single command.
csiDriver.enableRoCEConnect	Whether to enable automatic disk scanning for CSI when the RoCE protocol is used.	No	true	If an external tool is used to establish RoCE connections, you can set this parameter to **false**. For example, if the SNSD automatic connection function is enabled on storage devices, you can set this parameter to **false**.

Parameter	Description	Mandatory	Default Value	Remarks
csiDriver.allPathOnline	Whether to check whether the number of paths aggregated by DM-Multipath is equal to the actual number of online paths. The following parameter values can be configured: ● **true**: The drive letter mounting condition is met only when the number of paths aggregated by DM-Multipath is equal to the actual number of online paths. ● **false**: By default, the number of paths aggregated by DM-Multipath is not checked. As long as virtual drive letters are generated upon aggregation, the drive letter mounting condition is met.	This parameter is mandatory when **csiDriver.scsiMultipathType** is set to **DM-multipath**.	false	-
csiDriver.backendUpdateInterval	Interval for updating backend capabilities. The value ranges from 60 to 600 seconds.	Yes	60	-

Parameter	Description	Mandatory	Default Value	Remarks
csiDriver.controllerLogging.module	Record type of the controller log. The following parameter values can be configured: ● file ● console	Yes	file	When the value is **file**, logs are retained in the specified directory of the node. When the Pod where CSI is located is destroyed, logs are still retained. When the value is **console**, logs are retained in the temporary space of the Pod where CSI is located. When the Pod where CSI is located is destroyed, the logs are also destroyed.
csiDriver.controllerLogging.level	Output level of the controller log. The following parameter values can be configured: ● debug ● info ● warning ● error ● fatal	Yes	info	-
csiDriver.controllerLogging.fileDir	Directory of the controller log in **file** output mode.	Yes	/var/log/huawei	Ensure that the directory has sufficient space for storing logs. It is recommended that the space be greater than or equal to 200 MB.
csiDriver.controllerLogging.fileSize	Size of a single controller log file in **file** output mode.	Yes	20M	-
csiDriver.controllerLogging.maxBackups	Maximum number of controller log file backups in **file** output mode.	Yes	9	-

Parameter	Description	Mandatory	Default Value	Remarks
csiDriver.nodeLogging.module	Record type of the node log. The following parameter values can be configured: • file • console	Yes	file	When the value is **file**, logs are retained in the specified directory of the node. When the Pod where CSI is located is destroyed, logs are still retained. When the value is **console**, logs are retained in the temporary space of the Pod where CSI is located. When the Pod where CSI is located is destroyed, the logs are also destroyed.
csiDriver.nodeLogging.level	Output level of the node log. The following parameter values can be configured: • debug • info • warning • error • fatal	Yes	info	-
csiDriver.nodeLogging.fileDir	Directory of the node log in **file** output mode.	Yes	/var/log/huawei	Ensure that the directory has sufficient space for storing logs. It is recommended that the space be greater than or equal to 200 MB.
csiDriver.nodeLogging.fileSize	Size of a single node log file in **file** output mode.	Yes	20M	-
csiDriver.nodeLogging.maxBackups	Maximum number of node log file backups in **file** output mode.	Yes	9	-

NOTICE

If Huawei CSI has been deployed in your container environment, ensure that the value of **csiDriver.driverName** is the same as that configured during previous deployment. Otherwise, existing volumes or snapshots provisioned by Huawei CSI in the system cannot be managed by the newly deployed Huawei CSI.

Other Parameters

Other parameters include some features of the CSI plug-in or the policies for obtaining images.

Table 4-8 Other parameters

Parameter	Description	Mandatory	Default Value	Remarks
kubernetes.namespace	Kubernetes namespace where Huawei CSI is running, which can be customized. The name must consist of lowercase letters, digits, and hyphens (-), for example, **my-name** and **123-abc**.	No	huawei-csi	-
kubeletConfigDir	Working directory of kubelet.	Yes	/var/lib/kubelet	• Use the default value. • For the Tanzu platform, change the value of this field to **/var/vcap/data/kubelet**. • For the CCE Agile platform, change the value of this field to **/mnt/paas/kubernetes/kubelet**.
sidecarImagePullPolicy	Pull policy of the sidecar image.	Yes	IfNotPresent	-

Parameter	Description	Mandatory	Default Value	Remarks
huaweiImagePullPolicy	Pull policy of the huawei-csi image.	Yes	IfNotPresent	-
imagePullSecrets	Used by the Kubernetes cluster to pass the identity authentication of an image registry to pull private images.	No	-	For details, see **Pull an Image from a Private Registry**.
CSIDriverObject.isCreate	Whether to create the CSIDriver object.	Yes	false	The **CSIDriver** feature is a GA version in Kubernetes v1.18. Therefore, to use this feature, the Kubernetes version must be later than v1.18. If the Kubernetes version is earlier than v1.18, set this parameter to **false**.
CSIDriverObject.attachRequired	Whether the CSI plug-in skips the attach operation. The following parameter values can be configured: • **true**: The attach operation is required. • **false**: The attach operation is skipped.	Yes	true	The **attachRequired** parameter can be configured in Kubernetes v1.18. If **CSIDriverObject.isCreate** is set to **true** and **attachRequired** is set to **false**, the huawei-csi plug-in will not deploy the csi-attacher sidecar. • If NAS storage is used, this parameter can be set to **false**. • If SAN storage is used, set this parameter to **true**.

Parameter	Description	Mandatory	Default Value	Remarks
CSIDriverObject.fsGroupPolicy	Whether the ownership and permissions of a basic volume can be changed before the volume is mounted. The following parameter values can be configured: • **"ReadWriteOnceWithFSType"**: The volume ownership and permission can be changed only when **fsType** is specified and **accessModes** of the volume contains **ReadWriteOnce**. • **"File"**: Kubernetes can use **fsGroup** to change the permissions and ownership of a volume to match **fsGroup** requested by a user in the Pod security policy, regardless of **fsGroup** or **accessModes**. • **"None"**: A volume is mounted without any change. • **"null"**: The **fsGroupPolicy** parameter is not set.	No	null	The **fsGroupPolicy** parameter can be configured in Kubernetes v1.20, and takes effect only when **CSIDriverObject.isCreate** is set to **true**. This feature is a Beta version in Kubernetes v1.20 but a GA version in Kubernetes v1.23. Therefore, the Kubernetes version must be later than v1.20.

Parameter	Description	Mandatory	Default Value	Remarks
leaderElection.leaseDuration	Leader duration.	No	8s	This parameter takes effect only in the multi-controller scenario.
leaderElection.renewDeadline	Time for the leader to be re-elected.	No	6s	This parameter takes effect only in the multi-controller scenario.
leaderElection.retryPeriod	Leader election retry time.	No	2s	This parameter takes effect only in the multi-controller scenario.
service.ipFamilyPolicy	IP protocol stack selection policy of a service.	No	SingleStack	The value can be: • **SingleStack**: The service uses only one IP address family (IPv4 or IPv6). • **PreferDualStack**: The service preferentially uses dual stack. If the cluster does not support dual stack, single stack is used. • **RequireDualStack**: The service must use dual stack. If the cluster does not support dual stack, the service will fail to be created.
service.ipFamilies	List of IP protocol stacks supported by a service.	No	IPv4	The value can be: • IPv4 • IPv6

Parameter	Description	Mandatory	Default Value	Remarks
resources	You can allocate container resources related to huawei-csi-controller and huawei-csi-node: **resources.***<component>***.***<container-name>* *<component>* supports the following values: • **node**: configured when the sidecar in the huawei-csi-node component is configured. • **controller**: configured when the sidecar in the huawei-csi-controller component is configured. **controller.***<container-name>* supports the following values: • livenessProbe • csiProvisioner • csiAttacher • csiResizer • csiSnapshotter • snapshotController • storageBackendController • storageBackendSidecar • huaweiCsiExtender	No	For the default values of different container resources, see **10.3 Huawei CSI Resource Management**.	The following uses livenessProbe of huawei-csi-controller as an example: `resources:` `  controller:` `    limits:` `      cpu: 100m` `      memory: 128Mi` `    requests:` `      cpu: 10m` `      memory: 128Mi`

Parameter	Description	Mandatory	Default Value	Remarks
	• huaweiCsiDriver **node.**<*container-name*> supports the following values: • huaweiCsiDriver • livenessProbe • csiNodeDriverRegistrar			

NOTICE

Ensure that the namespace entered in **kubernetes.namespace** exists on Kubernetes. If the namespace does not exist, run the following command to create it. In this example, the namespace for running Huawei CSI is **huawei-csi**.

```
kubectl create namespace huawei-csi
```

4.1.2.2 Manual Installation

This section describes how to manually install Huawei CSI.

NOTE

Currently, only the Kubernetes platform supports manual installation of Huawei CSI.

Procedure

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the cluster through the management IP address.

Step 2 Copy the **manual** directory in the Kubernetes CSI component package to any directory on the master node.

Step 3 Run the following command to create a namespace. **huawei-csi** is used as an example namespace.

```
kubectl create ns huawei-csi
```

Step 4 Go to the **manual/esdk** working directory. For details about the path, see **Table 4-1**.

```
cd manual/esdk
```

Step 5 Run the following command to update the storage backend CRD.

```
kubectl apply -f ./crds/backend/
```

Step 6 (Optional) Check snapshot-dependent components by following the instructions provided in **4.1.1.4 Checking Volume Snapshot-Dependent Components**. After confirming that the components are correct, run the following command to update the snapshot CRD. If the Kubernetes version is earlier than v1.20, skip this step.

```
kubectl apply -f ./crds/snapshot-crds/ --validate=false
```

Step 7 (Optional) Run the following command to install CSIDriver. If the CSIDriver feature is not used, you can skip this step. For details, see the **CSIDriver** feature.

```
kubectl apply -f ./deploy/csidriver.yaml
```

Step 8 Run the following command to install the huawei-csi-controller service.

> **NOTE**
>
> If the Kubernetes version is earlier than v1.20, modify the *./deploy/huawei-csi-controller.yaml* file as follows:
>
> - If the Kubernetes version is earlier than v1.20, the snapshot feature is not supported. In this case, delete the snapshot-related container configurations items **csi-snapshotter** and **snapshot-controller**.
>
> If the Kubernetes version is earlier than v1.17, modify the *./deploy/huawei-csi-controller.yaml* file as follows:
>
> - If the Kubernetes version is earlier than v1.17, the snapshot feature is not supported. In this case, delete the snapshot-related container configurations items **csi-snapshotter** and **snapshot-controller**.
> - If the Kubernetes version is earlier than v1.17, the csi-provisioner sidecar image provided by the Kubernetes community does not support the **--leader-election** parameter. Therefore, the **leader-election** parameter of the csi-provisioner container is deleted and only single-copy deployment is supported.
> - Modify the dependent image version based on the version requirements in **4.1.1.7 Checking the Images on Which CSI Depends**.

```
kubectl apply -f ./deploy/huawei-csi-controller.yaml
```

Step 9 Run the following command to install the huawei-csi-node service.

```
kubectl apply -f ./deploy/huawei-csi-node.yaml
```

Step 10 Run the following command to check whether the services are started.

```
kubectl get pod -n huawei-csi
```

The following is an example of the command output. If the Pod status is **Running**, the installation is successful.

```
NAME                                     READY   STATUS    RESTARTS   AGE
huawei-csi-controller-68745d489c-v5xkj   9/9     Running   0          13m
huawei-csi-node-4hbqp                    3/3     Running   0          13m
huawei-csi-node-f7dkf                    3/3     Running   0          13m
huawei-csi-node-xrntc                    3/3     Running   0          13m
```

----End

> **NOTE**
>
> In the multi-copy controller deployment scenario, you can modify the **spec.replica** field of the Deployment resource in the *./deploy/huawei-csi-controller.yaml* file to specify the number of copies. After the modification, run the **kubectl apply -f ./deploy/huawei-csi-controller.yaml** command to make the configuration take effect.

4.1.3 Uninstallation

This section describes how to uninstall Huawei CSI. The uninstallation method varies according to the installation mode.

NOTICE

If you do not uninstall Huawei CSI for the purpose of an upgrade, ensure that all resources (such as PV, PVC, snapshot, and storage backend resources) provisioned by Huawei CSI have been cleared on your container platform before uninstalling Huawei CSI. Otherwise, once you uninstall Huawei CSI, these resources cannot be automatically scheduled, managed, or cleared.

4.1.3.1 Uninstallation Using Helm

4.1.3.1.1 Uninstalling Huawei CSI on Kubernetes, OpenShift, and Tanzu

This section describes how to uninstall Huawei CSI on the Kubernetes, OpenShift, and Tanzu platforms.

Procedure

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Run the following command to uninstall Huawei CSI. In the command, *helm-huawei-csi* indicates the custom Helm chart name and *huawei-csi* indicates the namespace where the Helm chart resides. This command will uninstall the huawei-csi-controller, huawei-csi-node, and RBAC resources of Huawei CSI.

```
helm uninstall helm-huawei-csi -n huawei-csi
```

After the uninstallation command is executed, you need to check whether the uninstallation is successful. In the preceding command, *huawei-csi* indicates the namespace where the chart is located.

```
helm list -n huawei-csi
```

The following is an example of the command output. If the command output is empty, the service is successfully uninstalled.

```
NAME NAMESPACE REVISION UPDATED STATUS CHART APP VERSION
```

Step 3 Uninstall the huawei-csi-host-info object. For details, see **Uninstalling the huawei-csi-host-info Object**.

Step 4 Uninstall the webhook resource. For details, see **Uninstalling a Webhook Resource**.

Step 5 (Optional) Uninstall the snapshot-dependent component service. For details, see **Uninstalling the Snapshot-Dependent Component Service**.

Step 6 (Optional) Uninstall the Lease resource. For details, see **Uninstalling a Lease Resource**.

Step 7 (Optional) Run the following command to delete the namespace where Huawei CSI is located. The default namespace **huawei-csi** is used as an example.

```
kubectl delete ns huawei-csi
```

----End

4.1.3.1.2 Uninstalling Huawei CSI on CCE or CCE Agile

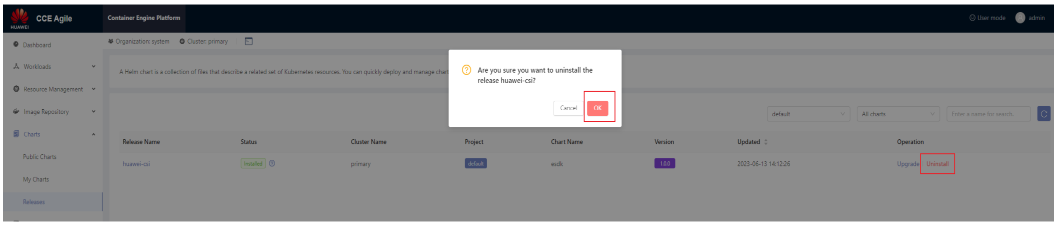
This section describes how to uninstall Huawei CSI on the CCE or CCE Agile platform. The following uses CCE Agile v22.3.2 as an example.

Procedure

Step 1 Log in to the CCE Agile platform.

Step 2 On the home page, choose **Charts** > **Releases**. The **Releases** page is displayed.

Step 3 Select a Huawei CSI release and click **Uninstall**. In the displayed dialog box, click **OK**.



Step 4 Uninstall the huawei-csi-host-info object. For details, see **Uninstalling the huawei-csi-host-info Object**.

Step 5 Uninstall the webhook resource. For details, see **Uninstalling a Webhook Resource**.

Step 6 (Optional) Uninstall the snapshot-dependent component service. For details, see **Uninstalling the Snapshot-Dependent Component Service**.

Step 7 (Optional) Run the following command to delete the namespace where Huawei CSI is located. **huawei-csi** is used as an example namespace.

```
kubectl delete ns huawei-csi
```

----End

4.1.3.1.3 Uninstalling CSI-Dependent Component Services

This section describes how to uninstall the CSI-dependent component services.

Uninstalling the huawei-csi-host-info Object

Secret object **huawei-csi-host-info** stores the initiator information about each node in the cluster, for example, iSCSI initiators. When you run the **helm uninstall** command, the resource will not be uninstalled. To uninstall the resource, perform the following steps:

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Run the following command to delete the Secret object. *huawei-csi-host-info* is the name of the Secret object, and *huawei-csi* is the namespace where the Secret object is located.

```
kubectl delete secret huawei-csi-host-info -n huawei-csi
```

Step 3 Run the following command to check whether the Secret object is successfully uninstalled.

```
kubectl get secret huawei-csi-host-info -n huawei-csi
```

The following is an example of the command output. If **NotFound** is displayed in the command output, the **huawei-csi-host-info** object is successfully uninstalled.

```
Error from server (NotFound): secrets "huawei-csi-host-info" not found
```

----End

Uninstalling a Webhook Resource

The webhook resource named **storage-backend-controller.xuanwu.huawei.io** is used to verify the backend key information and connectivity with the storage. When you run the **helm uninstall** command, the resource will not be uninstalled. To uninstall the resource, perform the following steps:

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Run the following command to query the webhook-dependent component service.

```
kubectl get validatingwebhookconfigurations.admissionregistration.k8s.io storage-backend-controller.xuanwu.huawei.io
```

The following is an example of the command output.

```
NAME                                          WEBHOOKS   AGE
storage-backend-controller.xuanwu.huawei.io   1          12d
```

Step 3 Run the following command to uninstall the webhook-dependent component service.

```
kubectl delete validatingwebhookconfigurations.admissionregistration.k8s.io storage-backend-controller.xuanwu.huawei.io
```

Step 4 Run the following command to check whether the service is successfully uninstalled. If the command output is empty, the uninstallation is successful.

```
kubectl get validatingwebhookconfigurations.admissionregistration.k8s.io storage-backend-controller.xuanwu.huawei.io
```

----End

Uninstalling the Snapshot-Dependent Component Service

NOTICE

- Do not uninstall the snapshot-dependent component service when snapshots exist. Otherwise, Kubernetes will automatically delete all user snapshots and they cannot be restored. For details, see **Delete a CustomResourceDefinition**.
- Do not uninstall the snapshot-dependent component service during the CSI upgrade.

Scenario Description

- Currently, Huawei CSI uses the snapshot feature.
- Currently, only Huawei CSI is available in the Kubernetes cluster, and Huawei CSI is no longer used.

- Before the uninstallation, ensure that no VolumeSnapshot resource managed by Huawei CSI exists in the Kubernetes cluster.

Procedure

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Run the following command to uninstall the snapshot-dependent component service.

```
kubectl delete crd volumesnapshotclasses.snapshot.storage.k8s.io
volumesnapshotcontents.snapshot.storage.k8s.io volumesnapshots.snapshot.storage.k8s.io
```

Step 3 Run the following command to check whether the service is successfully uninstalled. If the command output is empty, the uninstallation is successful.

```
kubectl get crd | grep snapshot.storage.k8s.io
```

----End

Uninstalling a Lease Resource

When huawei-csi-controller is deployed in multi-copy mode, a Lease resource is generated to store the current Holder information. When you run the **helm uninstall** command, the resource will not be uninstalled. To uninstall the resource, perform the following steps:

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Run the following command to query the Lease information.

```
kubectl get lease -n huawei-csi
```

The following is an example of the command output.

```
NAME                                        HOLDER    AGE
csi-huawei-com                              node-1    24d
external-attacher-leader-csi-huawei-com     node-1    24d
external-resizer-csi-huawei-com             node-1    24d
external-snapshotter-leader-csi-huawei-com  node-1    24d
snapshot-controller-leader                  node-1    24d
storage-backend-controller                  node-1    24d
huawei-csi-extender                         node-1    24d
```

Step 3 Run the following command to uninstall the Lease resource.

```
kubectl delete lease -n huawei-csi csi-huawei-com external-attacher-leader-csi-huawei-com external-resizer-
csi-huawei-com external-snapshotter-leader-csi-
```

Step 4 Run the following command to check whether the uninstallation is successful.

```
kubectl get lease -n huawei-csi
```

The following is an example of the command output. If the command output is empty, the uninstallation is successful.

```
No resources found in huawei-csi namespace.
```

----End

4.1.3.2 Manual Uninstallation

This section describes how to manually uninstall Huawei CSI.

NOTICE

If you do not uninstall Huawei CSI for the purpose of an upgrade, ensure that all resources (such as PV, PVC, snapshot, and storage backend resources) provisioned by Huawei CSI have been cleared on your container platform before uninstalling Huawei CSI. Otherwise, once you uninstall Huawei CSI, these resources cannot be automatically scheduled, managed, or cleared.

Uninstalling the huawei-csi-node Service

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Run the following command to uninstall the huawei-csi-node service. Replace *huawei-csi* with the namespace where Huawei CSI is located.

```
kubectl delete daemonset huawei-csi-node -n huawei-csi
```

Step 3 Run the following command to check whether the service is successfully uninstalled. If **NotFound** is displayed, the service is successfully uninstalled.

```
kubectl get daemonset huawei-csi-node -n huawei-csi
```

----End

Uninstalling the huawei-csi-controller Service

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Run the following command to uninstall the huawei-csi-controller service. Replace *huawei-csi* with the namespace where Huawei CSI is located.

```
kubectl delete deployment huawei-csi-controller -n huawei-csi
```

Step 3 Run the following command to check whether the service is successfully uninstalled. If **NotFound** is displayed, the service is successfully uninstalled.

```
kubectl get deployment huawei-csi-controller -n huawei-csi
```

----End

Uninstalling the csidriver Object

If **the CSIDriver feature is not used during installation**, you can skip the following steps.

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Run the following command to uninstall the csidriver object.

```
kubectl delete csidriver csi.huawei.com
```

Step 3 Run the following command to check whether the service is successfully uninstalled. If **NotFound** is displayed, the service is successfully uninstalled.

```
kubectl get csidriver csi.huawei.com
```

----End

Deleting the RBAC Permission

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Delete the RBAC permission.

```
kubectl -n huawei-csi -l provisioner=csi.huawei.com delete
ServiceAccount,Service,role,rolebinding,ClusterRole,ClusterRoleBinding
```

----End

Uninstalling Other Resources

- Uninstall the huawei-csi-host-info object. For details, see **Uninstalling the huawei-csi-host-info Object**.
- Uninstall the webhook resource. For details, see **Uninstalling a Webhook Resource**.
- (Optional) Uninstall the snapshot-dependent component service. For details, see **Uninstalling the Snapshot-Dependent Component Service**.
- (Optional) Uninstall the Lease resource. For details, see **Uninstalling a Lease Resource**.
- (Optional) Run the following command to delete the namespace where Huawei CSI is located. The default namespace **huawei-csi** is used as an example.
```
kubectl delete ns huawei-csi
```

4.1.4 Upgrade

This section describes how to upgrade Huawei CSI.

NOTE

In the current version, resource requests and limits are added to Huawei CSI. For details, see **10.3 Huawei CSI Resource Management**.

4.1.4.1 Upgrade Using Helm

This section describes how to upgrade Huawei CSI.

- To upgrade Huawei CSI from 2.*x* to 4.10.0, uninstall it by referring to the user guide of the earlier version and install Huawei CSI by referring to **4.1.2.1 Installation Using Helm**.
- To upgrade Huawei CSI from 2.*x* or 3.*x* to 4.10.0, see **4.1.4.1.1 Upgrading from 2.x or 3.x to 4.x**.
- To upgrade Huawei CSI from 4.*x* to 4.10.0, see **4.1.4.1.2 Upgrading Huawei CSI on Kubernetes, OpenShift, and Tanzu**.

NOTICE

- Some CSI 2.*x* versions are unavailable now. If the upgrade fails, CSI may fail to be rolled back to a version which is unavailable now.
- After an upgrade from 2.*x*, 3.*x*, or 4.*x* to 4.10.0, a Pod that has been provisioned in the source version may fail to be mounted again. For details, see **4.1.4.1.1 Upgrading from 2.x or 3.x to 4.x**.
- During the upgrade or rollback, you cannot use Huawei CSI to create new resources or mount or unmount an existing PVC.
- During the upgrade or rollback, do not uninstall the snapshot-dependent component service.
- During the upgrade or rollback, the existing resources such as PVCs, snapshots, and Pods will run properly and will not affect your service access.

4.1.4.1.1 Upgrading from 2.x or 3.x to 4.x

NOTE

In CSI 2.*x* or 3.*x*, when block storage is used, the mapping with storage is set up in the huawei-csi-node service. Therefore, the huawei-csi-node service needs to communicate with the storage management network. Because the huawei-csi-node service is deployed as a DaemonSet, the huawei-csi-node service is deployed on each node in the cluster. As a result, in a large-scale cluster, each huawei-csi-node service sends requests to the storage and the number of storage connections may be fully occupied. Accordingly, huawei-csi-node cannot provide services properly.

In CSI 4.*x*, the deployment model is optimized. The setup of the mapping with storage is migrated to the huawei-csi-controller service and the huawei-csi-node service does not need to communicate with the storage management network. This reduces the networking complexity of Huawei CSI. In addition, the huawei-csi-controller service is deployed as a Deployment. The number of copies is set based on the customer's reliability requirements. Generally, the number of copies ranges from 1 to 3. Therefore, the number of connections between Huawei CSI and storage is greatly reduced, so that Huawei CSI can connect to a large-scale cluster.

This change may cause a problem. That is, if a new mount process is generated after CSI is upgraded to 4.*x* but with workloads provisioned using 2.*x* or 3.*x* and the Container Orchestration (CO) system does not invoke the huawei-csi-controller service provided by Huawei CSI, the mounting will fail. For details, see **8.4.6 A Pod Fails to Be Created and Message "publishInfo doesn't exist" Is Displayed in the Events Log**.

To upgrade Huawei CSI from 2.*x* or 3.*x* to 4.*x*, perform following operations.

Backing Up Storage Backend Configurations

If you have evaluated the risks mentioned in the preceding notice and need to upgrade CSI from 2.*x* or 3.*x* to 4.10.0, perform the following steps to back up storage backend configurations:

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Run the following command to back up the backend information to the **configmap.json** file. For the OpenShift platform, replace **kubectl** with **oc**.

```
kubectl get cm huawei-csi-configmap -n huawei-csi -o json > configmap.json
```

----End

Upgrading Huawei CSI

Perform the upgrade according to the procedure described in **Upgrading Huawei CSI**.

Configuring the Storage Backend

Configure the storage backend by following the instructions in **5.1 Storage Backend Management** according to the backend information backed up in **Backing Up Storage Backend Configurations**. After the storage backend is successfully configured, perform operations according to the risk handling methods described in the preceding notice to prevent problems during Pod failover.

4.1.4.1.2 Upgrading Huawei CSI on Kubernetes, OpenShift, and Tanzu

Prerequisites

- Huawei CSI of an earlier version is installed using Helm.
- A Huawei CSI image of a new version has been created and uploaded to the image repository or imported to all nodes by following the instructions provided in **4.1.1.2 Uploading a Huawei CSI Image**.

Upgrading Huawei CSI

If CSI of an earlier version is deployed using Helm, perform the following steps to upgrade Huawei CSI.

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Copy the CSI component package of the target version to any directory on the master node.

Step 3 Go to the **helm/esdk** working directory. For the directory path, see **Table 4-1**.

```
cd helm/esdk
```

Step 4 Run the **kubectl apply -f** *./crds/backend/* command to update the storage backend CRD.

```
kubectl apply -f ./crds/backend/
```

Step 5 (Optional) Check snapshot-dependent components by following the instructions provided in **4.1.1.4 Checking Volume Snapshot-Dependent Components**. After confirming that the components are correct, run the following command to update the snapshot CRD. If **controller.snapshot.enabled** is set to **false** or the Kubernetes version is earlier than v1.20, you can skip this step. For details, see **Table 4-5**.

```
kubectl apply -f ./crds/snapshot-crds/ --validate=false
```

Step 6 Run the following command to obtain the original service configuration file. **helm-huawei-csi** indicates the Helm chart name specified during the installation of the earlier version, and **huawei-csi** indicates the Helm chart namespace specified during the installation of the earlier version.

```
helm get values helm-huawei-csi -n huawei-csi -a > ./update-values.yaml
```

Step 7 Run the **vi update-values.yaml** command to open the file obtained in **Step 6**, modify the **images** configuration items, and update the image to the latest version. For details about the parameters to be modified, see **Table 4-9**.

Table 4-9 images configuration items

Container Name	Description	K8s Version Requirements	New Value
storage-backend-controller	huawei-csi image.	v1.16+	storage-backend-controller:4.10.0
storage-backend-sidecar	Image used by Huawei backends to manage storageBackendContent resources.	v1.16+	storage-backend-sidecar:4.10.0
huawei-csi-driver	Image used by Huawei backends to manage storageBackendClaim resources.	v1.16+	huawei-csi:4.10.0
huawei-csi-extender	huawei-csi-extender image.	v1.16+	huawei-csi-extender:4.10.0
images.sidecar.livenessProbe	**livenessprobe** sidecar image.	v1.16+	registry.k8s.io/sig-storage/livenessprobe:v2.12.0
images.sidecar.resizer	**csi-resizer** sidecar image.	v1.16+	registry.k8s.io/sig-storage/csi-resizer:v1.9.0
images.sidecar.registrar	**csi-node-driver-registrar** sidecar image.	v1.16+	registry.k8s.io/sig-storage/csi-node-driver-registrar:v2.9.0
images.sidecar.snapshotter	**csi-snapshotter** sidecar image.	v1.20+	registry.k8s.io/sig-storage/csi-snapshotter:v6.3.0
images.sidecar.snapshotController	**snapshot-controller** sidecar image.	v1.20+	registry.k8s.io/sig-storage/snapshot-controller:v6.3.0
images.sidecar.provisioner	**csi-provisioner** sidecar image.	v1.20+	registry.k8s.io/sig-storage/csi-provisioner:v3.6.0
		v1.17-v1.19	registry.k8s.io/sig-storage/csi-provisioner:v3.0.0

Container Name	Description	K8s Version Requirements	New Value
		v1.16.x	quay.io/k8scsi/csi-provisioner:v1.4.0
images.sidecar.attacher	**csi-attacher** sidecar image.	v1.17+	registry.k8s.io/sig-storage/csi-attacher:v4.4.0
		v.1.16.x	quay.io/k8scsi/csi-attacher:v1.2.1

Step 8 (Optional) If you need to update configuration items or add configuration information during the upgrade, modify the configuration information in the **update-values.yaml** file by referring to **4.1.2.1.3 Parameters in the values.yaml File of Helm**.

NOTE

During the upgrade, if the **update-values.yaml** and **values.yaml** configuration files contain the same configuration item, the configuration in the **update-values.yaml** file takes effect preferentially.

Step 9 Run the following command to upgrade Huawei CSI. In the following command, **helm-huawei-csi** indicates the specified Helm chart name, **huawei-csi** indicates the specified Helm chart namespace, and **update-values.yaml** indicates the file obtained in **Step 6**.

```
helm upgrade helm-huawei-csi ./ -n huawei-csi -f ./values.yaml -f ./update-values.yaml
```

Step 10 After the huawei-csi service is deployed, run the following command to check whether the service is started.

```
kubectl get pod -n huawei-csi
```

The following is an example of the command output. If the Pod status is **Running**, the service is started successfully.

```
NAME                                      READY   STATUS    RESTARTS   AGE
huawei-csi-controller-6dfcc4b79f-9vjtq   9/9     Running   0          24m
huawei-csi-controller-6dfcc4b79f-csphc   9/9     Running   0          24m
huawei-csi-node-g6f4k                     3/3     Running   0          20m
huawei-csi-node-tqs87                     3/3     Running   0          20m
```

----End

4.1.4.1.3 Upgrading Huawei CSI on CCE or CCE Agile

Prerequisites

You have downloaded the CSI software package of a new version.

Procedure

Step 1 Uninstall CSI. For details, see **4.1.3.1.2 Uninstalling Huawei CSI on CCE or CCE Agile**.

Step 2 Install CSI of the new version. For details, see **4.1.2.1.2 Installing Huawei CSI on the CCE or CCE Agile Platform**.

----End

4.1.4.2 Manual Upgrade

This section describes how to manually upgrade Huawei CSI.

During the upgrade or rollback, the existing resources such as PVCs, snapshots, and Pods will run properly and will not affect your service access.

NOTICE

- Some CSI 2.*x* versions are unavailable now. If the upgrade fails, CSI may fail to be rolled back to a version which is unavailable now.
- During the upgrade or rollback, you cannot use Huawei CSI to create new resources or mount or unmount an existing PVC.
- During the upgrade or rollback, do not uninstall the snapshot-dependent component service.

Upgrading CSI from 2.x or 3.x to 4.10.0

To upgrade CSI from 2.*x* or 3.*x* to 4.10.0, perform the following operations:

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Run the following command to back up the backend information to the **configmap.json** file. For the OpenShift platform, replace **kubectl** with **oc**.

```
kubectl get cm huawei-csi-configmap -n huawei-csi -o json > configmap.json
```

Step 3 Uninstall CSI. For details, see **4.1.3.2 Manual Uninstallation**.

Step 4 Install CSI of the current version. For details, see **4.1.2.2 Manual Installation**.

Step 5 Install the backend information backed up in **Step 2** according to **5.1 Storage Backend Management**.

----End

Upgrading CSI from 4.x to 4.10.0

To upgrade CSI from 4.*x* to 4.10.0, perform the following operations:

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Uninstall CSI. For details, see **4.1.3.2 Manual Uninstallation**.

Step 3 Install CSI of the current version. For details, see **4.1.2.2 Manual Installation**.

----End

4.1.5 Rollback

4.1.5.1 Rollback Using Helm

If CSI fails to be upgraded from 2.*x* or 3.*x* to 4.10.0 and needs to be rolled back, uninstall CSI by referring to **4.1.3.1 Uninstallation Using Helm** and then download and install CSI of the source version.

NOTICE

- During the upgrade or rollback, the existing resources such as PVCs, snapshots, and Pods will run properly and will not affect your service access.
- During the upgrade or rollback, you cannot use Huawei CSI to create new resources or mount or unmount an existing PVC.
- During the upgrade or rollback, do not uninstall the snapshot-dependent component service.

4.1.5.1.1 Rolling Back Huawei CSI on Kubernetes, OpenShift, and Tanzu

Prerequisites

- CSI has been updated using Helm 3.

Procedure

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Go to the **helm/esdk** working directory. For the directory path, see **Table 4-1**.

```
cd helm/esdk
```

Step 3 Run the following command to query the historical versions of the CSI services deployed using Helm.

```
helm history helm-huawei-csi -n huawei-csi
```

The following is an example of the command output.

```
REVISION        UPDATED                     STATUS          CHART           APP VERSION     DESCRIPTION
1           Mon Jan  8 04:15:40 2024    superseded    esdk-4.4.0    4.4.0         Install complete
2           Mon Jan  8 04:16:12 2024    deployed     esdk-4.10.0    4.10.0         Upgrade complete
```

Step 4 Run the following command to roll back the CSI services to the specified version.

In the preceding command, *revision-number* indicates a version number queried in **Step 3**. For example, the version is **1**.

```
helm rollback helm-huawei-csi -n huawei-csi 1
```

The following is an example of the command output. If **Rollback was a success** is displayed in the command output, the CSI services are successfully rolled back to the specified version.

```
Rollback was a success! Happy Helming!
```

----End

4.1.5.1.2 Rolling Back Huawei CSI on CCE or CCE Agile

NOTICE

- During the upgrade or rollback, the existing resources such as PVCs, snapshots, and Pods will run properly and will not affect your service access.
- During the upgrade or rollback, you cannot use Huawei CSI to create new resources or mount or unmount an existing PVC.
- During the upgrade or rollback, do not uninstall the snapshot-dependent component service.

Prerequisites

You have downloaded the CSI software package of the source version.

Procedure

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Uninstall CSI. For details, see **Procedure**.

Step 3 Reinstall CSI of the source version. For details, see **4.1.2.1.2 Installing Huawei CSI on the CCE or CCE Agile Platform**.

----End

4.1.5.2 Manual Rollback

Uninstall CSI by referring to **4.1.3.2 Manual Uninstallation**, and then download and install CSI of the source version.

NOTICE

- During the upgrade or rollback, the existing resources such as PVCs, snapshots, and Pods will run properly and will not affect your service access.
- During the upgrade or rollback, you cannot use Huawei CSI to create new resources or mount or unmount an existing PVC.
- During the upgrade or rollback, do not uninstall the snapshot-dependent component service.

Prerequisites

You have downloaded the CSI software package of the source version.

Procedure

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Uninstall CSI. For details, see **4.1.3.2 Manual Uninstallation**.

Step 3 Reinstall CSI of the source version. For details, see **4.1.2.2 Manual Installation**.

----End

5 Basic Services

5.1 Storage Backend Management

Backend is an abstract concept of Huawei storage resources. Each Huawei storage device can abstract multiple backend resources using features such as tenants, storage pools, and protocols. Each backend exists independently and defines Huawei storage information required for providing persistent volumes for Kubernetes clusters.

This section describes how to use the oceanctl tool to configure and manage storage backends.

Description of the oceanctl Tool

- You have obtained the oceanctl tool, copied the oceanctl tool to the environment directory, for example, **/usr/local/bin**, and obtained the execute permission. The oceanctl tool is stored in **/bin/oceanctl** of the software package.
- Before using the oceanctl tool, ensure that the oceanctl tool version is the same as the CSI version. For details about how to check the oceanctl version, see **Obtaining Help Information**. The current version number should be V4.10.0.
- The oceanctl tool depends on **kubectl** (for the Kubernetes platform) or **oc** (for the OpenShift platform) commands. Therefore, you need to run the tool on a node where **kubectl** or **oc** commands can be executed.
- By default, the user who runs **oceanctl** commands must have the read and write permissions on the **/var/log** directory. If you do not have the permissions on the directory, run the **--log-dir=/path/to/custom** command to specify a directory on which you have the permissions as the log file directory.
- **huawei-csi** is the default namespace used by oceanctl to create a backend.

- For details about **oceanctl** commands, see **9.1 Description of oceanctl Commands**.

5.1.1 Configuring the Storage Backend

NOTE

1. When oceanctl is used to create a storage backend, the entered account and key information is stored in the **Secret** object. It is recommended that the customer container platform encrypt the Secret object based on the suggestions of the supplier or K8s community. For details about how to encrypt the Secret object in the K8s community, see **Encrypting Confidential Data at Rest**.
2. When a backend is created using a .json file, the backend name of an earlier version may contain uppercase letters or underscores (_). In this case, the old name is remapped to a new name. The mapping process automatically occurs and does not affect the original functions. For example, **ABC_123** is mapped to **abc-123-fd68e**. The mapping rules are as follows:
   - Uppercase letters are converted to lowercase letters.
   - An underscore (_) is converted to a hyphen (-).
   - A 5-digit hash code is added to the end.
3. If a storage backend is connected to a vStore, the vStore name cannot be changed after the storage backend is created.

5.1.1.1 Flash Storage (OceanStor Dorado/OceanStor V5/OceanStor V6 and Later)

5.1.1.1.1 File System

5.1.1.1.1.1 NFS

This section describes how to create a storage backend of the NFS protocol type.

Configuration Item Description

Table 5-1 backend parameters

Parameter	Description	Mandatory	Default Value	Remarks
storage	Storage service type.	Yes	-	The value is fixed to **oceanstor-nas**.
name	Storage backend name. The value can contain a maximum of 63 characters, including lowercase letters, digits, and hyphens (-). It must start with a letter or digit.	Yes	-	Ensure that the storage backend name is unique.

Parameter	Description	Mandatory	Default Value	Remarks
namespace	Namespace.	No	huawei-csi	The storage backend must be in the same namespace as Huawei CSI.
vstoreName	vStore name on the storage side. This parameter needs to be specified when the connected backend is OceanStor V5 and resources need to be provisioned under a specified vStore.	No	-	This parameter needs to be specified only when the backend is OceanStor V5 and vStores need to be supported.
urls	Management URLs of the storage device. The value format is a list. The value can be a domain name or an IP address + port number.	Yes	-	● If resources need to be provisioned to a specified vStore, set this parameter to the logical management port URL of the specified vStore. ● If the management URL is of the IPv6 type, the URL format is **https://[***IPv6 address***]:***Port number*.
pools	Storage pools of storage devices. The value format is a list.	Yes	-	Enter the storage pool names.
parameters.protocol	Storage protocol. The value is a character string.	Yes	-	The value is fixed to **nfs**. ● Ensure that an NFS client tool has been installed on the connected compute node.

Parameter	Description	Mandatory	Default Value	Remarks
parameters.portals	Service access port. Nodes will use this port to read and write storage resources. The value format is a list.	Yes	-	• If a vStore is used to connect to a backend, **portals** must be set to the logical port information of the vStore. • You can enter a domain name address. • IPv6 is supported. • Only one port can be configured.
parameters.nfsAutoAuthClient	Enables or disables the automatic management function of NFS share clients. • true: enabled • false: disabled	No	-	When this parameter is enabled, the CSI dynamically sets the permissions of the NFS share clients corresponding to the host IP addresses that meet the rules to read/write or none during PVC mounting or unmounting.
parameters.nfsAutoAuthClientCIDRs	List of IP CIDR blocks for NFS communication between hosts.	No	-	This parameter is valid only when **parameters.nfsAutoAuthClient** is set to **true**. The CSI dynamically manages the host IP addresses within the configured CIDRs. If no CIDRs are specified, the CSI dynamically manages all host IP addresses.

Parameter	Description	Mandatory	Default Value	Remarks
metrovStorePairID	HyperMetro vStore pair ID. This parameter is mandatory when a PV to be created on the storage side needs to support the NAS HyperMetro feature. In this case, you need to enter the ID of the HyperMetro vStore pair to which the PV to be created belongs.	No	-	You can query the HyperMetro vStore pair ID on DeviceManager.
metroBackend	Backend name of the HyperMetro peer. The value is a character string. This parameter is mandatory when a PV to be created on the storage side needs to support the NAS HyperMetro feature. In this case, you need to enter the name of the other backend to form a HyperMetro pair with the current backend.	No	-	The names of the two backends in the pair must be entered. After the two backends form a HyperMetro relationship, they cannot form a HyperMetro relationship with other backends.
supportedTopologies	Storage topology awareness configuration. The parameter format is JSON of the list type.	No	-	This parameter is mandatory if storage topology awareness is enabled. For details, see **7.9 Configuring Storage Topology Awareness**.
maxClientThreads	Maximum number of concurrent connections to a storage backend.	No	30	The value ranges from 1 to 30. If this parameter is not set or the value is not in the specified range, the default value 30 is used.
authenticationMode	Authentication mode for logging in to a storage backend. The following modes are supported: • **local**: local authentication • **ldap**: LDAP authentication	No	local	When Huawei enterprise storage is OceanStor V5, the ID of the LDAP domain authentication server must be 0.

Creating Storage Backends of the Local Type

Step 1 Prepare a backend configuration file, for example, **backend.yaml**.

```
storage: "oceanstor-nas"
name: "backend-demo"
namespace: "huawei-csi"
urls:
  - "https://192.168.129.157:8088"
pools:
  - "StoragePool001"
parameters:
  protocol: "nfs"
  portals:
    - "10.10.30.20"
maxClientThreads: "30"
```

Step 2 Run the following command to create a storage backend.

```
oceanctl create backend -f /path/to/backend.yaml -i yaml
```

The following is an example of the command output.

```
NUMBER  CONFIGURED    NAME            STORAGE               URLS
1       false         backend-demo    oceanstor-nas         https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 3 Enter the serial number of the backend to be created and enter the account and password.

```
Please enter the backend number to configure (Enter 'exit' to exit):1
Please enter this backend user name: admin
Please enter this backend password:

Backend backend-demo is configured
NUMBER  CONFIGURED    NAME            STORAGE               URLS
1       true          backend-demo    oceanstor-nas         https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 4 Check the storage backend creation result.

```
oceanctl get backend
```

The following is an example of the command output. If the backend status is **Bound**, the creation is successful.

```
NAMESPACE     NAME            PROTOCOL    STORAGETYPE      SN                    STATUS  ONLINE
URL
huawei-csi    backend-demo    nfs         oceanstor-nas    xxxxxxxxxxxxxxxxxxxx  Bound   true    https://
192.168.129.157:8088
```

----End

Creating Storage Backends of the HyperMetro Type

NOTE

- Before configuring NAS HyperMetro, you need to configure the HyperMetro relationship between two storage devices, including the remote device and HyperMetro domain. The HyperMetro domain of the file system can only work in HyperMetro active-active (AA) mode. For details about the configuration operation, see the product documentation of the corresponding storage model.
- The accounts for connecting to NAS HyperMetro backends must be the administrator accounts of the storage vStores.
- Except NAS HyperMetro backends, the management URLs of other backends cannot be the URL of a logical management port of a vStore that has established the HyperMetro relationship.
- When a HyperMetro storage backend is used, do not provision common file systems. Otherwise, services may be interrupted in logical port failover scenarios.

Step 1 Prepare a storage backend configuration file, for example, **backend.yaml**.

```
storage: "oceanstor-nas"
name: "backend-active"
namespace: "huawei-csi"
urls:
  - "https://192.168.129.155:8088"
pools:
  - "StoragePool001"
metrovStorePairID: "2100xxxxxxxxxx0000000000600000000"
metroBackend: "backend-standby"
parameters:
  protocol: "nfs"
  portals:
    - "192.168.129.156"
maxClientThreads: "30"
---
storage: "oceanstor-nas"
name: "backend-standby"
namespace: "huawei-csi"
urls:
  - "https://192.168.129.157:8088"
pools:
  - "StoragePool001"
metrovStorePairID: "2100xxxxxxxxxx0000000000600000000"
metroBackend: "backend-active"
parameters:
  protocol: "nfs"
  portals:
    - "192.168.129.158"
maxClientThreads: "30"
```

Step 2 Run the following command to create a storage backend.

```
oceanctl create backend -f /path/to/backend.yaml -i yaml
```

The following is an example of the command output.

```
NUMBER  CONFIGURED    NAME              STORAGE             URLS
1       false         backend-active    oceanstor-nas       https://192.168.129.155:8088
2       false         backend-standby   oceanstor-nas       https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 3 Enter the serial number of the backend to be created and enter the account and password.

```
Please enter the backend number to configure (Enter 'exit' to exit):1
Please enter this backend user name: user1
Please enter this backend password:

Backend backend-standby is configured
```

```
NUMBER  CONFIGURED    NAME              STORAGE              URLS
1       true          backend-active    oceanstor-nas        https://192.168.129.155:8088
2       true          backend-standby   oceanstor-nas        https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 4 Check the storage backend creation result.

```
oceanctl get backend
```

The following is an example of the command output. If the backend status is **Bound**, the creation is successful.

```
NAMESPACE     NAME             PROTOCOL    STORAGETYPE      SN                   STATUS  ONLINE
URL
huawei-csi    backend-active    nfs        oceanstor-nas    xxxxxxxxxxxxxxxxxxxx  Bound   true    https://
192.168.129.155:8088
huawei-csi    backend-standby   nfs        oceanstor-nas    xxxxxxxxxxxxxxxxxxxx  Bound   true    https://
192.168.129.157:8088
```

----End

5.1.1.1.1.2 NFS+

This section describes how to create a storage backend of the NFS+ protocol type.

Configuration Item Description

Table 5-2 backend parameters

Parameter	Description	Mandatory	Default Value	Remarks
storage	Storage service type.	Yes	-	The value is fixed to **oceanstor-nas**.
name	Storage backend name. The value can contain a maximum of 63 characters, including lowercase letters, digits, and hyphens (-). It must start with a letter or digit.	Yes	-	Ensure that the storage backend name is unique.
namespace	Namespace.	No	huawei-csi	The storage backend must be in the same namespace as Huawei CSI.

Parameter	Description	Mandatory	Default Value	Remarks
urls	Management URLs of the storage device. The value format is a list. The value can be a domain name or an IP address + port number.	Yes	-	• If resources need to be provisioned to a specified vStore, set this parameter to the logical management port URL of the specified vStore. • If the management URL is of the IPv6 type, the URL format is **https://[***IPv6 address***]:***Port number*.
pools	Storage pools of storage devices. The value format is a list.	Yes	-	Enter the storage pool names.
parameters.protocol	Storage protocol. The value is a character string.	Yes	-	• The value is fixed to **nfs+**. • Ensure that an NFS+ client tool has been installed on the connected compute node.
parameters.portals	Service access port. Nodes will use this port to read and write storage resources. The value format is a list.	Yes	-	• If a vStore is used to connect to a backend, **portals** must be set to the logical port information of the vStore. • You can enter a domain name address. • IPv6 is supported. • Multiple ports can be configured.

Parameter	Description	Mandatory	Default Value	Remarks
metrovStorePairID	HyperMetro vStore pair ID. This parameter is mandatory when a PV to be created on the storage side needs to support the NAS HyperMetro feature. In this case, you need to enter the ID of the HyperMetro vStore pair to which the PV to be created belongs.	No	-	You can query the HyperMetro vStore pair ID on DeviceManager.
metroBackend	Backend name of the HyperMetro peer. The value is a character string. This parameter is mandatory when a PV to be created on the storage side needs to support the NAS HyperMetro feature. In this case, you need to enter the name of the other backend to form a HyperMetro pair with the current backend.	No	-	The names of the two backends in the pair must be entered. After the two backends form a HyperMetro relationship, they cannot form a HyperMetro relationship with other backends.
supportedTopologies	Storage topology awareness configuration. The parameter format is JSON of the list type.	No	-	This parameter is mandatory if storage topology awareness is enabled. For details, see **7.9 Configuring Storage Topology Awareness**.
maxClientThreads	Maximum number of concurrent connections to a storage backend.	No	30	The value ranges from **1** to **30**. If this parameter is not set or the value is not in the specified range, the default value **30** is used.
authenticationMode	Authentication mode for logging in to a storage backend. The following modes are supported: ● **local**: local authentication ● **ldap**: LDAP authentication	No	local	-

Creating Storage Backends of the Local Type

Step 1 Prepare a backend configuration file, for example, **backend.yaml**.

```
storage: "oceanstor-nas"
name: "backend-demo"
namespace: "huawei-csi"
urls:
  - "https://192.168.129.157:8088"
pools:
  - "StoragePool001"
parameters:
  protocol: "nfs+"
  portals:
    - "10.10.30.20"
    - "10.10.30.30"
maxClientThreads: "30"
```

Step 2 Run the following command to create a storage backend.

```
oceanctl create backend -f /path/to/backend.yaml -i yaml
```

The following is an example of the command output.

```
NUMBER  CONFIGURED    NAME            STORAGE               URLS
1       false         backend-demo    oceanstor-nas         https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 3 Enter the serial number of the backend to be created and enter the account and password.

```
Please enter the backend number to configure (Enter 'exit' to exit):1
Please enter this backend user name: admin
Please enter this backend password:

Backend backend-demo is configured
NUMBER  CONFIGURED    NAME            STORAGE               URLS
1       true          backend-demo    oceanstor-nas         https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 4 Check the storage backend creation result.

```
oceanctl get backend
```

The following is an example of the command output. If the backend status is **Bound**, the creation is successful.

```
NAMESPACE     NAME            PROTOCOL     STORAGETYPE      SN                    STATUS  ONLINE
URL
huawei-csi    backend-demo    nfs+         oceanstor-nas    xxxxxxxxxxxxxxxxxxxx  Bound   true    https://
192.168.129.157:8088
```

----End

Creating Storage Backends of the HyperMetro Type

NOTE

- Before configuring NAS HyperMetro, you need to configure the HyperMetro relationship between two storage devices, including the remote device and HyperMetro domain. The HyperMetro domain of the file system can only work in HyperMetro active-active (AA) mode. For details about the configuration operation, see the product documentation of the corresponding storage model.
- The accounts for connecting to NAS HyperMetro backends must be the administrator accounts of the storage vStores.
- Except NAS HyperMetro backends, the management URLs of other backends cannot be the URL of a logical management port of a vStore that has established the HyperMetro relationship.
- When a HyperMetro storage backend is used, do not provision common file systems. Otherwise, services may be interrupted in logical port failover scenarios.

Procedure

Step 1 Prepare a storage backend configuration file, for example, **backend.yaml**.

```
storage: "oceanstor-nas"
name: "backend-active"
namespace: "huawei-csi"
urls:
  - "https://192.168.129.155:8088"
pools:
  - "StoragePool001"
metrovStorePairID: "2100xxxxxxxxxx0000000000600000000"
metroBackend: "backend-standby"
parameters:
  protocol: "nfs+"
  portals:
    - "192.168.129.156"
    - "192.168.129.157"
maxClientThreads: "30"
---
storage: "oceanstor-nas"
name: "backend-standby"
namespace: "huawei-csi"
urls:
  - "https://192.168.129.158:8088"
pools:
  - "StoragePool001"
metrovStorePairID: "2100xxxxxxxxxx0000000000600000000"
metroBackend: "backend-active"
parameters:
  protocol: "nfs+"
  portals:
    - "192.168.129.159"
    - "192.168.129.160"
maxClientThreads: "30"
```

Step 2 Run the following command to create a storage backend.

```
oceanctl create backend -f /path/to/backend.yaml -i yaml
```

The following is an example of the command output.

```
NUMBER  CONFIGURED    NAME              STORAGE           URLS
1       false         backend-active    oceanstor-nas     https://192.168.129.155:8088
2       false         backend-standby   oceanstor-nas     https://192.168.129.158:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 3 Enter the serial number of the backend to be created and enter the account and password.

```
Please enter the backend number to configure (Enter 'exit' to exit):1
Please enter this backend user name: user1
Please enter this backend password:

Backend backend-standby is configured
NUMBER  CONFIGURED    NAME              STORAGE              URLS
1       true          backend-active    oceanstor-nas        https://192.168.129.155:8088
2       true          backend-standby   oceanstor-nas        https://192.168.129.158:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 4 Check the storage backend creation result.

```
oceanctl get backend
```

The following is an example of the command output. If the backend status is **Bound**, the creation is successful.

```
NAMESPACE     NAME              PROTOCOL     STORAGETYPE      SN                   STATUS  ONLINE
URL
huawei-csi    backend-active    nfs+         oceanstor-nas    xxxxxxxxxxxxxxxxxxxx  Bound   true    https://
192.168.129.155:8088
huawei-csi    backend-standby   nfs+         oceanstor-nas    xxxxxxxxxxxxxxxxxxxx  Bound   true    https://
192.168.129.158:8088
```

----End

5.1.1.1.2 Dtree

5.1.1.1.2.1 NFS

This section describes how to create a storage backend of the NFS protocol type.

Configuration Item Description

Table 5-3 backend parameters

Parameter	Description	Mandatory	Default Value	Remarks
storage	Storage service type.	Yes	-	The value is fixed to **oceanstor-dtree**.
name	Storage backend name. The value can contain a maximum of 63 characters, including lowercase letters, digits, and hyphens (-). It must start with a letter or digit.	Yes	-	Ensure that the storage backend name is unique.
namespace	Namespace.	No	huawei-csi	The storage backend must be in the same namespace as Huawei CSI.

Parameter	Description	Mandatory	Default Value	Remarks
urls	Management URLs of the storage device. The value format is a list. The value can be a domain name or an IP address + port number.	Yes	-	• If resources need to be provisioned to a specified vStore, set this parameter to the logical management port URL of the specified vStore. • If the management URL is of the IPv6 type, the URL format is **https://[***IPv6 address***]:***Port number*.
parameters.protocol	Storage protocol. The value is a character string.	Yes	-	• The value is fixed to **nfs**. • Ensure that an NFS client tool has been installed on the connected compute node.
parameters.portals	Service access port. Nodes will use this port to read and write storage resources. The value format is a list.	Yes	-	• If a vStore is used to connect to a backend, **portals** must be set to the logical port information of the vStore. • You can enter a domain name address. • IPv6 is supported. • Only one port can be configured.
parameters.nfsAutoAuthClient	Enables or disables the automatic management function of NFS share clients. • true: enabled • false: disabled	No	-	When this parameter is enabled, the CSI dynamically sets the permissions of the NFS share clients corresponding to the host IP addresses that meet the rules to read/write or none during PVC mounting or unmounting.

Parameter	Description	Mandatory	Default Value	Remarks
parameters.nfsAutoAuthClientCIDRs	List of IP CIDR blocks for NFS communication between hosts.	No	-	This parameter is valid only when **parameters.nfsAutoAuthClient** is set to **true**. The CSI dynamically manages the host IP addresses within the configured CIDRs. If no CIDRs are specified, the CSI dynamically manages all host IP addresses.
parameters.parentname	Name of a file system on the current storage device. A dtree is created in the file system.	No	-	• Query the name on the **File Systems** page of DeviceManager. • You can configure the parameter in StorageClass.
supportedTopologies	Storage topology awareness configuration. The parameter format is JSON of the list type.	No	-	This parameter is mandatory if storage topology awareness is enabled. For details, see **7.9 Configuring Storage Topology Awareness**.
maxClientThreads	Maximum number of concurrent connections to a storage backend.	No	30	The value ranges from **1** to **30**. If this parameter is not set or the value is not in the specified range, the default value **30** is used.
authenticationMode	Authentication mode for logging in to a storage backend. The following modes are supported: • **local**: local authentication • **ldap**: LDAP authentication	No	local	-

Creating a Storage Backend

Step 1 Prepare a backend configuration file, for example, **backend.yaml**.

```
storage: "oceanstor-dtree"name: "backend-demo"namespace: "huawei-csi"urls:  - "https://192.168.129.157:8088"parameters:  protocol: "nfs"  parentname: "parent-filesystem"  portals:    - "10.10.30.20"maxClientThreads: "30"
```

Step 2 Run the following command to create a storage backend.

```
oceanctl create backend -f /path/to/backend.yaml -i yaml
```

The following is an example of the command output.

```
NUMBER  CONFIGURED    NAME           STORAGE            URLS              1       false        backend-demo   oceanstor-dtree      https://192.168.129.157:8088 Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 3 Enter the serial number of the backend to be created and enter the account and password.

```
Please enter the backend number to configure (Enter 'exit' to exit):1Please enter this backend user name: adminPlease enter this backend password:Backend backend-demo is configuredNUMBER  CONFIGURED  NAME            STORAGE              URLS              1       true         backend-demo    oceanstor-dtree    https://192.168.129.157:8088 Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 4 Check the storage backend creation result.

```
oceanctl get backend
```

The following is an example of the command output. If the backend status is **Bound**, the creation is successful.

```
NAMESPACE     NAME           PROTOCOL    STORAGETYPE      SN                  STATUS  ONLINE  URL              huawei-csi    backend-demo    nfs        oceanstor-dtree  xxxxxxxxxxxxxxxxxxxx  Bound  true    https://192.168.129.157:8088
```

----End

5.1.1.1.2.2 NFS+

This section describes how to create a storage backend of the NFS+ protocol type.

Configuration Item Description

Table 5-4 backend parameters

Parameter	Description	Mandatory	Default Value	Remarks
storage	Storage service type.	Yes	-	The value is fixed to **oceanstor-dtree**.

Parameter	Description	Mandatory	Default Value	Remarks
name	Storage backend name. The value can contain a maximum of 63 characters, including lowercase letters, digits, and hyphens (-). It must start with a letter or digit.	Yes	-	Ensure that the storage backend name is unique.
namespace	Namespace.	No	huawei-csi	The storage backend must be in the same namespace as Huawei CSI.
urls	Management URLs of the storage device. The value format is a list. The value can be a domain name or an IP address + port number.	Yes	-	• If resources need to be provisioned to a specified vStore, set this parameter to the logical management port URL of the specified vStore. • If the management URL is of the IPv6 type, the URL format is **https://[***IPv6 address***]:***Port number*.
parameters.protocol	Storage protocol. The value is a character string.	Yes	-	• The value is fixed to **nfs+**. • Ensure that an NFS+ client tool has been installed on the connected compute node.
parameters.portals	Service access port. Nodes will use this port to read and write storage resources. The value format is a list.	Yes	-	• If a vStore is used to connect to a backend, **portals** must be set to the logical port information of the vStore. • You can enter a domain name address. • IPv6 is supported. • Multiple ports can be configured.

Parameter	Description	Mandatory	Default Value	Remarks
parameters.parentname	Name of a file system on the current storage device. A dtree is created in the file system.	No	-	• Query the name on the **File Systems** page of DeviceManager. • You can configure the parameter in StorageClass.
supportedTopologies	Storage topology awareness configuration. The parameter format is JSON of the list type.	No	-	This parameter is mandatory if storage topology awareness is enabled. For details, see **7.9 Configuring Storage Topology Awareness**.
maxClientThreads	Maximum number of concurrent connections to a storage backend.	No	30	The value ranges from **1** to **30**. If this parameter is not set or the value is not in the specified range, the default value **30** is used.
authenticationMode	Authentication mode for logging in to a storage backend. The following modes are supported: • **local**: local authentication • **ldap**: LDAP authentication	No	local	-

Creating a Storage Backend

Step 1 Prepare a backend configuration file, for example, **backend.yaml**.

```
storage: "oceanstor-dtree"
name: "backend-demo"
namespace: "huawei-csi"
urls:
  - "https://192.168.129.157:8088"
parameters:
  protocol: "nfs+"
  parentname: "parent-filesystem"
  portals:
    - "10.10.30.20"
    - "10.10.30.30"
maxClientThreads: "30"
```

Step 2 Run the following command to create a storage backend.

```
oceanctl create backend -f /path/to/backend.yaml -i yaml
```

The following is an example of the command output.

```
NUMBER  CONFIGURED    NAME          STORAGE            URLS
1       false         backend-demo   oceanstor-dtree      https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 3 Enter the serial number of the backend to be created and enter the account and password.

```
Please enter the backend number to configure (Enter 'exit' to exit):1
Please enter this backend user name: admin
Please enter this backend password:

Backend backend-demo is configured
NUMBER  CONFIGURED    NAME           STORAGE            URLS
1       true          backend-demo    oceanstor-dtree      https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 4 Check the storage backend creation result.

```
oceanctl get backend
```

The following is an example of the command output. If the backend status is **Bound**, the creation is successful.

```
NAMESPACE     NAME           PROTOCOL     STORAGETYPE      SN                  STATUS  ONLINE
URL
huawei-csi    backend-demo    nfs+        oceanstor-dtree  xxxxxxxxxxxxxxxxxxxx  Bound   true    https://
192.168.129.157:8088
```

----End

5.1.1.1.3 Block Service

5.1.1.1.3.1 iSCSI

This section describes how to create a storage backend of the iSCSI protocol type.

Configuration Item Description

Table 5-5 backend parameters

Parameter	Description	Mandatory	Default Value	Remarks
storage	Storage service type.	Yes	-	The value is fixed to **oceanstor-san**.
name	Storage backend name. The value can contain a maximum of 63 characters, including lowercase letters, digits, and hyphens (-). It must start with a letter or digit.	Yes	-	Ensure that the storage backend name is unique.

Parameter	Description	Mandatory	Default Value	Remarks
namespace	Namespace.	No	huawei-csi	The storage backend must be in the same namespace as Huawei CSI.
urls	Management URLs of the storage device. The value format is a list. The value can be a domain name or an IP address + port number.	Yes	-	• If the management URL is of the IPv6 type, the URL format is **https://[***IPv6 address***]:***Port number*.
pools	Storage pools of storage devices. The value format is a list.	Yes	-	Enter the storage pool names.
parameters.protocol	Storage protocol. The value is a character string.	Yes	-	• The value is fixed to **iscsi**. • Ensure that an iSCSI client has been installed on the connected compute node.
parameters.portals	Service access port. Nodes will use this port to read and write storage resources. The value format is a list.	Yes	-	• IPv6 is supported. • Multiple ports can be configured.
supportedTopologies	Storage topology awareness configuration. The parameter format is JSON of the list type.	No	-	This parameter is mandatory if storage topology awareness is enabled. For details, see **7.9 Configuring Storage Topology Awareness**.
maxClientThreads	Maximum number of concurrent connections to a storage backend.	No	30	The value ranges from **1** to **30**. If this parameter is not set or the value is not in the specified range, the default value **30** is used.

Parameter	Description	Mandatory	Default Value	Remarks
authenticationMode	Authentication mode for logging in to a storage backend. The following modes are supported: ● **local**: local authentication ● **ldap**: LDAP authentication	No	local	When Huawei enterprise storage is OceanStor V5, the ID of the LDAP domain authentication server must be 0.

Creating a Storage Backend

Step 1 Prepare a backend configuration file, for example, **backend.yaml**.

```
storage: "oceanstor-san"
name: "backend-demo"
namespace: "huawei-csi"
urls:
  - "https://192.168.129.157:8088"
pools:
  - "StoragePool001"
parameters:
  protocol: "iscsi"
  portals:
    - "10.10.30.20"
    - "10.10.30.21"
maxClientThreads: "30"
```

Step 2 Run the following command to create a storage backend.

```
oceanctl create backend -f /path/to/backend.yaml -i yaml
```

The following is an example of the command output.

```
NUMBER  CONFIGURED    NAME            STORAGE              URLS
1       false         backend-demo    oceanstor-san        https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 3 Enter the serial number of the backend to be created and enter the account and password.

```
Please enter the backend number to configure (Enter 'exit' to exit):1
Please enter this backend user name: admin
Please enter this backend password:

Backend backend-demo is configured
NUMBER  CONFIGURED    NAME            STORAGE              URLS
1       true          backend-demo    oceanstor-san        https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 4 Check the storage backend creation result.

```
oceanctl get backend
```

The following is an example of the command output. If the backend status is **Bound**, the creation is successful.

```
NAMESPACE     NAME          PROTOCOL    STORAGETYPE      SN                STATUS  ONLINE
URL
huawei-csi    backend-demo    iscsi      oceanstor-san    xxxxxxxxxxxxxxxxxxxx  Bound    true    https://
192.168.129.157:8088
```

----End

5.1.1.1.3.2 FC

This section describes how to create a storage backend of the FC protocol type.

Configuration Item Description

Table 5-6 backend parameters

Parameter	Description	Mandatory	Default Value	Remarks
storage	Storage service type.	Yes	-	The value is fixed to **oceanstor-san**.
name	Storage backend name. The value can contain a maximum of 63 characters, including lowercase letters, digits, and hyphens (-). It must start with a letter or digit.	Yes	-	Ensure that the storage backend name is unique.
namespace	Namespace.	No	huawei-csi	The storage backend must be in the same namespace as Huawei CSI.
urls	Management URLs of the storage device. The value format is a list. The value can be a domain name or an IP address + port number.	Yes	-	● If the management URL is of the IPv6 type, the URL format is **https://[***IPv6 address***]:***Port number*.
pools	Storage pools of storage devices. The value format is a list.	Yes	-	Enter the storage pool names.
parameters.protocol	Storage protocol. The value is a character string.	Yes	-	● The value is fixed to **fc**.

Parameter	Description	Mandatory	Default Value	Remarks
supportedTopologies	Storage topology awareness configuration. The parameter format is JSON of the list type.	No	-	This parameter is mandatory if storage topology awareness is enabled. For details, see **7.9 Configuring Storage Topology Awareness**.
maxClientThreads	Maximum number of concurrent connections to a storage backend.	No	30	The value ranges from **1** to **30**. If this parameter is not set or the value is not in the specified range, the default value **30** is used.
authenticationMode	Authentication mode for logging in to a storage backend. The following modes are supported: ● **local**: local authentication ● **ldap**: LDAP authentication	No	local	When Huawei enterprise storage is OceanStor V5, the ID of the LDAP domain authentication server must be 0.

Creating a Storage Backend

Step 1 Prepare a backend configuration file, for example, **backend.yaml**.

```
storage: "oceanstor-san"
name: "backend-demo"
namespace: "huawei-csi"
urls:
  - "https://192.168.129.157:8088"
pools:
  - "StoragePool001"
parameters:
  protocol: "fc"
maxClientThreads: "30"
```

Step 2 Run the following command to create a storage backend.

```
oceanctl create backend -f /path/to/backend.yaml -i yaml
```

The following is an example of the command output.

```
NUMBER  CONFIGURED    NAME           STORAGE              URLS
1       false         backend-demo   oceanstor-san        https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 3 Enter the serial number of the backend to be created and enter the account and password.

```
Please enter the backend number to configure (Enter 'exit' to exit):1
Please enter this backend user name: admin
Please enter this backend password:
```

```
Backend backend-demo is configured
NUMBER  CONFIGURED    NAME            STORAGE              URLS
1       true          backend-demo    oceanstor-san        https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 4 Check the storage backend creation result.

```
oceanctl get backend
```

The following is an example of the command output. If the backend status is **Bound**, the creation is successful.

```
NAMESPACE     NAME            PROTOCOL    STORAGETYPE      SN                    STATUS  ONLINE
URL
huawei-csi    backend-demo    fc          oceanstor-san    xxxxxxxxxxxxxxxxxxxx  Bound   true    https://
192.168.129.157:8088
```

----End

5.1.1.1.3.3 NVMe over RoCE

This section describes how to create a storage backend of the NVMe over RoCE protocol type.

Configuration Item Description

Table 5-7 backend parameters

Parameter	Description	Mandatory	Default Value	Remarks
storage	Storage service type.	Yes	-	The value is fixed to **oceanstor-san**.
name	Storage backend name. The value can contain a maximum of 63 characters, including lowercase letters, digits, and hyphens (-). It must start with a letter or digit.	Yes	-	Ensure that the storage backend name is unique.
namespace	Namespace.	No	huawei-csi	The storage backend must be in the same namespace as Huawei CSI.
urls	Management URLs of the storage device. The value format is a list. The value can be a domain name or an IP address + port number.	Yes	-	• If the management URL is of the IPv6 type, the URL format is **https://[***IPv6 address***]:***Port number*.

Parameter	Description	Mandatory	Default Value	Remarks
pools	Storage pools of storage devices. The value format is a list.	Yes	-	Enter the storage pool names.
parameters.protocol	Storage protocol. The value is a character string.	Yes	-	• The value is fixed to **roce**. • Ensure that the nvme-cli tool has been installed on the compute node to be connected. The supported nvme-cli tool version is 1.9 and later.
parameters.portals	Service access port. Nodes will use this port to read and write storage resources. The value format is a list.	Yes	-	• IPv6 is supported. • Multiple ports can be configured.
supportedTopologies	Storage topology awareness configuration. The parameter format is JSON of the list type.	No	-	This parameter is mandatory if storage topology awareness is enabled. For details, see **7.9 Configuring Storage Topology Awareness**.
maxClientThreads	Maximum number of concurrent connections to a storage backend.	No	30	The value ranges from **1** to **30**. If this parameter is not set or the value is not in the specified range, the default value **30** is used.
authenticationMode	Authentication mode for logging in to a storage backend. The following modes are supported: • **local**: local authentication • **ldap**: LDAP authentication	No	local	When Huawei enterprise storage is OceanStor V5, the ID of the LDAP domain authentication server must be 0.

Creating a Storage Backend

Step 1 Prepare a backend configuration file, for example, **backend.yaml**.

```
storage: "oceanstor-san"
name: "backend-demo"
```

```
namespace: "huawei-csi"
urls:
  - "https://192.168.129.157:8088"
pools:
  - "StoragePool001"
parameters:
  protocol: "roce"
  portals:
    - "10.10.30.20"
    - "10.10.30.21"
maxClientThreads: "30"
```

Step 2 Run the following command to create a storage backend.

```
oceanctl create backend -f /path/to/backend.yaml -i yaml
```

The following is an example of the command output.

```
NUMBER  CONFIGURED    NAME           STORAGE              URLS
1       false         backend-demo   oceanstor-san        https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 3 Enter the serial number of the backend to be created and enter the account and password.

```
Please enter the backend number to configure (Enter 'exit' to exit):1
Please enter this backend user name: admin
Please enter this backend password:

Backend backend-demo is configured
NUMBER  CONFIGURED    NAME           STORAGE              URLS
1       true          backend-demo    oceanstor-san        https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 4 Check the storage backend creation result.

```
oceanctl get backend
```

The following is an example of the command output. If the backend status is **Bound**, the creation is successful.

```
NAMESPACE     NAME           PROTOCOL    STORAGETYPE      SN                  STATUS  ONLINE
URL
huawei-csi    backend-demo    roce       oceanstor-san    xxxxxxxxxxxxxxxxxxxx  Bound   true    https://
192.168.129.157:8088
```

----End

5.1.1.1.3.4 FC-NVMe

This section describes how to create a storage backend of the FC-NVMe protocol type.

Configuration Item Description

Table 5-8 backend parameters

Parameter	Description	Mandatory	Default Value	Remarks
storage	Storage service type.	Yes	-	The value is fixed to **oceanstor-san**.
name	Storage backend name. The value can contain a maximum of 63 characters, including lowercase letters, digits, and hyphens (-). It must start with a letter or digit.	Yes	-	Ensure that the storage backend name is unique.
namespace	Namespace.	No	huawei-csi	The storage backend must be in the same namespace as Huawei CSI.
urls	Management URLs of the storage device. The value format is a list. The value can be a domain name or an IP address + port number.	Yes	-	• If the management URL is of the IPv6 type, the URL format is **https://[***IPv6 address***]:***Port number.*
pools	Storage pools of storage devices. The value format is a list.	Yes	-	Enter the storage pool names.
parameters.protocol	Storage protocol. The value is a character string.	Yes	-	• The value is fixed to **fc-nvme**. • Ensure that the nvme-cli tool has been installed on the compute node to be connected. The supported nvme-cli tool version is 1.9 and later.
supportedTopologies	Storage topology awareness configuration. The parameter format is JSON of the list type.	No	-	This parameter is mandatory if storage topology awareness is enabled. For details, see **7.9 Configuring Storage Topology Awareness**.

Parameter	Description	Mandatory	Default Value	Remarks
maxClientThreads	Maximum number of concurrent connections to a storage backend.	No	30	The value ranges from **1** to **30**. If this parameter is not set or the value is not in the specified range, the default value **30** is used.
authenticationMode	Authentication mode for logging in to a storage backend. The following modes are supported: ● **local**: local authentication ● **ldap**: LDAP authentication	No	local	When Huawei enterprise storage is OceanStor V5, the ID of the LDAP domain authentication server must be 0.

Creating a Storage Backend

Step 1 Prepare a backend configuration file, for example, **backend.yaml**.

```
storage: "oceanstor-san"
name: "backend-demo"
namespace: "huawei-csi"
urls:
  - "https://192.168.129.157:8088"
pools:
  - "StoragePool001"
parameters:
  protocol: "fc-nvme"
maxClientThreads: "30"
```

Step 2 Run the following command to create a storage backend.

```
oceanctl create backend -f /path/to/backend.yaml -i yaml
```

The following is an example of the command output.

```
NUMBER  CONFIGURED    NAME            STORAGE              URLS
1       false         backend-demo   oceanstor-san        https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 3 Enter the serial number of the backend to be created and enter the account and password.

```
Please enter the backend number to configure (Enter 'exit' to exit):1
Please enter this backend user name: admin
Please enter this backend password:

Backend backend-demo is configured
NUMBER  CONFIGURED    NAME            STORAGE              URLS
1       true          backend-demo    oceanstor-san        https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 4 Check the storage backend creation result.

```
oceanctl get backend
```

The following is an example of the command output. If the backend status is **Bound**, the creation is successful.

```
NAMESPACE     NAME          PROTOCOL    STORAGETYPE      SN                    STATUS  ONLINE
URL
huawei-csi    backend-demo    fc-nvme     oceanstor-san    xxxxxxxxxxxxxxxxxxxx  Bound   true    https://
192.168.129.157:8088
```

----End

5.1.1.2 Flash Storage (OceanStor A600/A800)

5.1.1.2.1 Local File System

5.1.1.2.1.1 NFS

This section describes how to create a storage backend of the NFS protocol type.

Configuration Item Description

Table 5-9 backend parameters

Parameter	Description	Mandatory	Default Value	Remarks
storage	Storage service type.	Yes	-	The value is fixed to **oceanstor-a-series-nas**.
name	Storage backend name. The value can contain a maximum of 63 characters, including lowercase letters, digits, and hyphens (-). It must start with a letter or digit.	Yes	-	Ensure that the storage backend name is unique.
namespace	Namespace.	No	huawei-csi	The storage backend must be in the same namespace as Huawei CSI.
urls	Management URLs of the storage device. The value format is a list.	Yes	-	The value can be a domain name or an IP address + port number.
pools	Storage pools of storage devices. The value format is a list.	Yes	-	Enter the storage pool names.

Parameter	Description	Mandatory	Default Value	Remarks
parameters.protocol	Storage protocol. The value is a character string.	Yes	-	• The value is fixed to **nfs**. • Ensure that an NFS client tool has been installed on the connected compute node.
parameters.portals	Service access port. Nodes will use this port to read and write storage resources. The value format is a list.	Yes	-	Only one port can be configured.
supportedTopologies	Storage topology awareness configuration. The parameter format is JSON of the list type.	No	-	This parameter is mandatory if storage topology awareness is enabled. For details, see **7.9 Configuring Storage Topology Awareness**.
maxClientThreads	Maximum number of concurrent connections to a storage backend.	No	30	The value ranges from **1** to **30**. If this parameter is not set or the value is not in the specified range, the default value **30** is used.
authenticationMode	Authentication mode for logging in to a storage backend. The following modes are supported: • **local**: local authentication • **ldap**: LDAP authentication	No	local	-

Creating a Storage Backend

Step 1 Prepare a backend configuration file, for example, **backend.yaml**.

```
storage: "oceanstor-a-series-nas"
name: "backend-demo"
namespace: "huawei-csi"
urls:
  - "https://192.168.129.157:8088"
pools:
  - "StoragePool001"
parameters:
  protocol: "nfs"
```

```
  portals:
    - "10.10.30.20"
maxClientThreads: "30"
```

Step 2 Run the following command to create a storage backend.

```
oceanctl create backend -f /path/to/backend.yaml -i yaml
```

The following is an example of the command output.

```
NUMBER  CONFIGURED    NAME           STORAGE                  URLS
1       false         backend-demo   oceanstor-a-series-nas   https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 3 Enter the serial number of the backend to be created and enter the account and password.

```
Please enter the backend number to configure (Enter 'exit' to exit):1
Please enter this backend user name: admin
Please enter this backend password:

Backend backend-demo is configured
NUMBER  CONFIGURED    NAME           STORAGE                  URLS
1       true          backend-demo   oceanstor-a-series-nas   https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 4 Check the storage backend creation result.

```
oceanctl get backend
```

The following is an example of the command output. If the backend status is **Bound**, the creation is successful.

```
NAMESPACE     NAME           PROTOCOL    STORAGETYPE              SN                    STATUS  ONLINE
URL
huawei-csi    backend-demo   nfs         oceanstor-a-series-nas   xxxxxxxxxxxxxxxxxxxx  Bound   true
https://192.168.129.157:8088
```

----End

5.1.1.2.1.2 DataTurbo

This section describes how to create a storage backend of the DataTurbo protocol type.

Configuration Item Description

Table 5-10 backend parameters

Parameter	Description	Mandatory	Default Value	Remarks
storage	Storage service type.	Yes	-	The value is fixed to **oceanstor-a-series-nas**.

Parameter	Description	Mandatory	Default Value	Remarks
name	Storage backend name. The value can contain a maximum of 63 characters, including lowercase letters, digits, and hyphens (-). It must start with a letter or digit.	Yes	-	Ensure that the storage backend name is unique.
namespace	Namespace.	No	huawei-csi	The storage backend must be in the same namespace as Huawei CSI.
urls	Management URLs of the storage device. The value format is a list.	Yes	-	The value can be a domain name or an IP address + port number.
pools	Storage pools of storage devices. The value format is a list.	Yes	-	Enter the storage pool names.
parameters.protocol	Storage protocol. The value is a character string.	Yes	-	• The value is fixed to **dtfs**. • Ensure that a DataTurbo client has been installed on the connected compute node and the connectivity of the storage logical port has been configured.
supportedTopologies	Storage topology awareness configuration. The parameter format is JSON of the list type.	No	-	This parameter is mandatory if storage topology awareness is enabled. For details, see **7.9 Configuring Storage Topology Awareness**.
maxClientThreads	Maximum number of concurrent connections to a storage backend.	No	30	The value ranges from **1** to **30**. If this parameter is not set or the value is not in the specified range, the default value **30** is used.

Parameter	Description	Mandatory	Default Value	Remarks
authenticationMode	Authentication mode for logging in to a storage backend. The following modes are supported: • **local**: local authentication • **ldap**: LDAP authentication	No	local	-

Creating a Storage Backend

Step 1 Prepare a backend configuration file, for example, **backend.yaml**.

```
storage: "oceanstor-a-series-nas"
name: "backend-demo"
namespace: "huawei-csi"
urls:
  - "https://192.168.129.157:8088"
pools:
  - "StoragePool001"
parameters:
  protocol: "dtfs"
maxClientThreads: "30"
```

Step 2 Run the following command to create a storage backend.

```
oceanctl create backend -f /path/to/backend.yaml -i yaml
```

The following is an example of the command output.

```
NUMBER  CONFIGURED    NAME           STORAGE              URLS
1       false         backend-demo   oceanstor-a-series-nas    https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 3 Enter the serial number of the backend to be created and enter the account and password.

```
Please enter the backend number to configure (Enter 'exit' to exit):1
Please enter this backend user name: admin
Please enter this backend password:

Backend backend-demo is configured
NUMBER  CONFIGURED    NAME           STORAGE              URLS
1       true          backend-demo   oceanstor-a-series-nas    https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 4 Check the storage backend creation result.

```
oceanctl get backend
```

The following is an example of the command output. If the backend status is **Bound**, the creation is successful.

```
NAMESPACE     NAME          PROTOCOL   STORAGETYPE           SN                 STATUS  ONLINE
URL
```

```
huawei-csi    backend-demo    dtfs     oceanstor-a-series-nas  xxxxxxxxxxxxxxxxxxxx  Bound   true    https://
192.168.129.157:8088
```

----End

5.1.1.3 DME (Interconnected with an OceanStor A800 Cluster)

5.1.1.3.1 Global File System

5.1.1.3.1.1 NFS

This section describes how to create a storage backend of the NFS protocol type.

Configuration Item Description

Table 5-11 backend parameters

Parameter	Description	Mandatory	Default Value	Remarks
storage	Storage service type.	Yes	-	The value is fixed to **oceanstor-a-series-nas**.
name	Storage backend name. The value can contain a maximum of 63 characters, including lowercase letters, digits, and hyphens (-). It must start with a letter or digit.	Yes	-	Ensure that the storage backend name is unique.
namespace	Namespace.	No	huawei-csi	The storage backend must be in the same namespace as Huawei CSI.
urls	Management URLs of the storage device. The value format is a list.	Yes	-	The value can be a domain name or an IP address + port number.
storageDeviceSN	Serial number of the storage device.	Yes		On the DME management page, choose **Infrastructure** > **Storage Devices** > **ESN** to obtain the serial number of the storage device.
pools	Storage pools of storage devices. The value format is a list.	Yes	-	Enter the storage pool names.

Parameter	Description	Mandatory	Default Value	Remarks
parameters.protocol	Storage protocol. The value is a character string.	Yes	-	• The value is fixed to **nfs**. • Ensure that an NFS client tool has been installed on the connected compute node.
parameters.portals	Service access port. Nodes will use this port to read and write storage resources. The value format is a list.	Yes	-	• You can enter a domain name address. • Only one port can be configured.
supportedTopologies	Storage topology awareness configuration. The parameter format is JSON of the list type.	No	-	This parameter is mandatory if storage topology awareness is enabled. For details, see **7.9 Configuring Storage Topology Awareness**.
maxClientThreads	Maximum number of concurrent connections to a storage backend.	No	5	The value ranges from **1** to **30**. If this parameter is not set or the value is not in the specified range, the default value **5** is used.

Creating a Storage Backend

Step 1 Prepare a backend configuration file, for example, **backend.yaml**.

```
storage: "oceanstor-a-series-nas"
name: "backend-demo"
namespace: "huawei-csi"
urls:
  - "https://192.168.129.157:26335"
storageDeviceSN: 21000000000000000000
pools:
  - "StoragePool001"
parameters:
  protocol: "nfs"
  portals:
    - "10.10.30.20"
maxClientThreads: "30"
```

Step 2 Run the following command to create a storage backend.

```
oceanctl create backend -f /path/to/backend.yaml -i yaml
```

The following is an example of the command output:

```
NUMBER  CONFIGURED    NAME          STORAGE                 URLS
1       false         backend-demo   oceanstor-a-series-nas    https://192.168.129.157:26335
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 3 Enter the serial number of the backend to be created and enter the account and password.

```
Please enter the backend number to configure (Enter 'exit' to exit):1
Please enter this backend user name: admin
Please enter this backend password:

Backend backend-demo is configured
NUMBER  CONFIGURED    NAME          STORAGE                 URLS
1       true          backend-demo    oceanstor-a-series-nas    https://192.168.129.157:26335
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 4 Check the storage backend creation result.

```
oceanctl get backend
```

The following is an example of the command output. If the backend status is **Bound**, the creation is successful.

```
NAMESPACE     NAME          PROTOCOL    STORAGETYPE            SN                  STATUS  ONLINE
URL
huawei-csi    backend-demo    nfs        oceanstor-a-series-nas  xxxxxxxxxxxxxxxxxxxx  Bound   true
https://192.168.129.157:26335
```

----End

5.1.1.3.1.2 DataTurbo

This section describes how to create a storage backend of the DataTurbo protocol type.

Configuration Item Description

Table 5-12 backend parameters

Parameter	Description	Mandatory	Default Value	Remarks
storage	Storage service type.	Yes	-	The value is fixed to **oceanstor-a-series-nas**.
name	Storage backend name. The value can contain a maximum of 63 characters, including lowercase letters, digits, and hyphens (-). It must start with a letter or digit.	Yes	-	Ensure that the storage backend name is unique.
namespace	Namespace.	No	huawei-csi	The storage backend must be in the same namespace as Huawei CSI.

Parameter	Description	Mandatory	Default Value	Remarks
urls	Management URLs of the storage device. The value format is a list.	Yes	-	The value can be a domain name or an IP address + port number.
storageDeviceSN	Serial number of the storage device.	Yes		On the DME management page, choose **Infrastructure** > **Storage Devices** > **ESN** to obtain the serial number of the storage device.
pools	Storage pools of storage devices. The value format is a list.	Yes	-	Enter the storage pool names.
parameters.protocol	Storage protocol. The value is a character string.	Yes	-	• The value is fixed to **dtfs**. • Ensure that a DataTurbo client has been installed on the connected compute node and the connectivity of the storage logical port has been configured.
supportedTopologies	Storage topology awareness configuration. The parameter format is JSON of the list type.	No	-	This parameter is mandatory if storage topology awareness is enabled. For details, see **7.9 Configuring Storage Topology Awareness**.
maxClientThreads	Maximum number of concurrent connections to a storage backend.	No	30	The value ranges from **1** to **30**. If this parameter is not set or the value is not in the specified range, the default value **30** is used.

Creating a Storage Backend

Step 1 Prepare a backend configuration file, for example, **backend.yaml**.

```
storage: "oceanstor-a-series-nas"
name: "backend-demo"
namespace: "huawei-csi"
urls:
  - "https://192.168.129.157:26335"
storageDeviceSN: 2100000000000000000
```

```
pools:
  - "StoragePool001"
parameters:
  protocol: "dtfs"
maxClientThreads: "30"
```

Step 2 Run the following command to create a storage backend.

```
oceanctl create backend -f /path/to/backend.yaml -i yaml
```

The following is an example of the command output:

```
NUMBER  CONFIGURED    NAME           STORAGE              URLS
1       false         backend-demo   oceanstor-a-series-nas    https://192.168.129.157:26335
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 3 Enter the serial number of the backend to be created and enter the account and password.

```
Please enter the backend number to configure (Enter 'exit' to exit):1
Please enter this backend user name: admin
Please enter this backend password:

Backend backend-demo is configured
NUMBER  CONFIGURED    NAME           STORAGE              URLS
1       true          backend-demo    oceanstor-a-series-nas    https://192.168.129.157:26335
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 4 Check the storage backend creation result.

```
oceanctl get backend
```

The following is an example of the command output. If the backend status is **Bound**, the creation is successful.

```
NAMESPACE     NAME           PROTOCOL    STORAGETYPE            SN                   STATUS  ONLINE
URL
huawei-csi    backend-demo    dtfs      oceanstor-a-series-nas  xxxxxxxxxxxxxxxxxxxx  Bound   true    https://
192.168.129.157:26335
```

----End

5.1.1.4 Mass Storage (OceanStor Pacific Series)

5.1.1.4.1 File System

5.1.1.4.1.1 NFS

This section describes how to create a storage backend of the NFS protocol type.

Configuration Item Description

Table 5-13 backend parameters

Parameter	Description	Mandatory	Default Value	Remarks
storage	Storage service type.	Yes	-	The value is fixed to **fusionstorage-nas**.

Parameter	Description	Mandatory	Default Value	Remarks
name	Storage backend name. The value can contain a maximum of 63 characters, including lowercase letters, digits, and hyphens (-). It must start with a letter or digit.	Yes	-	Ensure that the storage backend name is unique.
namespace	Namespace.	No	huawei-csi	The storage backend must be in the same namespace as Huawei CSI.
accountName	Account name on the storage side.	No	-	This parameter is mandatory when NAS resources need to be provisioned under a specified account.
urls	Management URLs of the storage device. The value format is a list.	Yes	-	The value can be a domain name or an IP address + port number.
pools	Storage pools of storage devices. The value format is a list.	Yes	-	Enter the storage pool names.
parameters.protocol	Storage protocol. The value is a character string.	Yes	-	• The value is fixed to **nfs**. • Ensure that an NFS client tool has been installed on the connected compute node.
parameters.portals	Service access port. Nodes will use this port to read and write storage resources. The value format is a list.	Yes	-	• If an account is used to connect to a backend, **portals** must be set to the logical port information of the account. • You can enter a domain name address.

Parameter	Description	Mandatory	Default Value	Remarks
supportedTopologies	Storage topology awareness configuration. The parameter format is JSON of the list type.	No	-	This parameter is mandatory if storage topology awareness is enabled. For details, see **7.9 Configuring Storage Topology Awareness**.
maxClientThreads	Maximum number of concurrent connections to a storage backend.	No	30	The value ranges from **1** to **30**. If this parameter is not set or the value is not in the specified range, the default value **30** is used.

Creating a Storage Backend

Step 1 Prepare a backend configuration file, for example, **backend.yaml**.

```
storage: "fusionstorage-nas"
name: "backend-demo"
namespace: "huawei-csi"
urls:
  - "https://192.168.129.157:8088"
pools:
  - "StoragePool001"
parameters:
  protocol: "nfs"
  portals:
    - "10.10.30.20"
maxClientThreads: "30"
```

Step 2 Run the following command to create a storage backend.

```
oceanctl create backend -f /path/to/backend.yaml -i yaml
```

The following is an example of the command output.

```
NUMBER  CONFIGURED    NAME            STORAGE               URLS
1       false         backend-demo    fusionstorage-nas     https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 3 Enter the serial number of the backend to be created and enter the account and password.

```
Please enter the backend number to configure (Enter 'exit' to exit):1
Please enter this backend user name: admin
Please enter this backend password:

Backend backend-demo is configured
NUMBER  CONFIGURED    NAME            STORAGE               URLS
1       true          backend-demo    fusionstorage-nas     https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 4 Check the storage backend creation result.

```
oceanctl get backend
```

The following is an example of the command output. If the backend status is **Bound**, the creation is successful.

```
NAMESPACE     NAME           PROTOCOL    STORAGETYPE       SN           STATUS  ONLINE
URL
huawei-csi    backend-demo    nfs        fusionstorage-nas              Bound   true    https://
192.168.129.157:8088
```

----End

5.1.1.4.1.2 DPC

This section describes how to create a storage backend of the DPC protocol type.

Configuration Item Description

Table 5-14 backend parameters

Parameter	Description	Mandatory	Default Value	Remarks
storage	Storage service type.	Yes	-	The value is fixed to **fusionstorage-nas**.
name	Storage backend name. The value can contain a maximum of 63 characters, including lowercase letters, digits, and hyphens (-). It must start with a letter or digit.	Yes	-	Ensure that the storage backend name is unique.
namespace	Namespace.	No	huawei-csi	The storage backend must be in the same namespace as Huawei CSI.
accountName	Account name on the storage side.	No	-	This parameter is mandatory when NAS resources need to be provisioned under a specified account.
urls	Management URLs of the storage device. The value format is a list.	Yes	-	The value can be a domain name or an IP address + port number.
pools	Storage pools of storage devices. The value format is a list.	Yes	-	Enter the storage pool names.

Parameter	Description	Mandatory	Default Value	Remarks
parameters.protocol	Storage protocol. The value is a character string.	Yes	-	• The value is fixed to **dpc**. • Ensure that DPC has been installed on the connected compute node and the node has been added as a DPC compute node on the storage device to be connected.
supportedTopologies	Storage topology awareness configuration. The parameter format is JSON of the list type.	No	-	This parameter is mandatory if storage topology awareness is enabled. For details, see **7.9 Configuring Storage Topology Awareness**.
maxClientThreads	Maximum number of concurrent connections to a storage backend.	No	30	The value ranges from **1** to **30**. If this parameter is not set or the value is not in the specified range, the default value **30** is used.

Creating a Storage Backend

Step 1 Prepare a backend configuration file, for example, **backend.yaml**.

```
storage: "fusionstorage-nas"
name: "backend-demo"
namespace: "huawei-csi"
urls:
  - "https://192.168.129.157:8088"
pools:
  - "StoragePool001"
parameters:
  protocol: "dpc"
maxClientThreads: "30"
```

Step 2 Run the following command to create a storage backend.

```
oceanctl create backend -f /path/to/backend.yaml -i yaml
```

The following is an example of the command output.

```
NUMBER  CONFIGURED    NAME           STORAGE              URLS
1       false         backend-demo   fusionstorage-nas    https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 3 Enter the serial number of the backend to be created and enter the account and password.

```
Please enter the backend number to configure (Enter 'exit' to exit):1
Please enter this backend user name: admin
```

```
Please enter this backend password:

Backend backend-demo is configured
NUMBER  CONFIGURED    NAME           STORAGE              URLS
1       true          backend-demo    fusionstorage-nas    https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 4 Check the storage backend creation result.

```
oceanctl get backend
```

The following is an example of the command output. If the backend status is **Bound**, the creation is successful.

```
NAMESPACE     NAME           PROTOCOL    STORAGETYPE       SN             STATUS  ONLINE
URL
huawei-csi    backend-demo    dpc        fusionstorage-nas                Bound   true    https://
192.168.129.157:8088
```

----End

5.1.1.4.2 Dtree

5.1.1.4.2.1 NFS

This section describes how to create a storage backend of the NFS protocol type.

Configuration Item Description

Table 5-15 backend parameters

Parameter	Description	Mandatory	Default Value	Remarks
storage	Storage service type.	Yes	-	The value is fixed to **fusionstorage-dtree**.
name	Storage backend name. The value can contain a maximum of 63 characters, including lowercase letters, digits, and hyphens (-). It must start with a letter or digit.	Yes	-	Ensure that the storage backend name is unique.
namespace	Namespace.	No	huawei-csi	The storage backend must be in the same namespace as Huawei CSI.
accountName	Account name on the storage side.	No	-	This parameter is mandatory when NAS resources need to be provisioned under a specified account.

Parameter	Description	Mandatory	Default Value	Remarks
urls	Management URLs of the storage device. The value format is a list.	Yes	-	The value can be a domain name or an IP address + port number.
parameters.protocol	Storage protocol. The value is a character string.	Yes	-	• The value is fixed to **nfs**. • Ensure that an NFS client tool has been installed on the connected compute node.
parameters.portals	Service access port. Nodes will use this port to read and write storage resources. The value format is a list.	Yes	-	• If an account is used to connect to a backend, **portals** must be set to the logical port information of the account. • You can enter a domain name address.
parameters.parentname	Name of a file system on the current storage device. A dtree is created in the file system.	No	-	• Query the name on the **File Systems** page of DeviceManager. • You can configure the parameter in StorageClass.
supportedTopologies	Storage topology awareness configuration. The parameter format is JSON of the list type.	No	-	This parameter is mandatory if storage topology awareness is enabled. For details, see **7.9 Configuring Storage Topology Awareness**.
maxClientThreads	Maximum number of concurrent connections to a storage backend.	No	30	The value ranges from **1** to **30**. If this parameter is not set or the value is not in the specified range, the default value **30** is used.

Creating a Storage Backend

Step 1 Prepare a backend configuration file, for example, **backend.yaml**.

```
storage: "fusionstorage-dtree"
name: "backend-demo"
```

```
namespace: "huawei-csi"
urls:
  - "https://192.168.129.157:8088"
parameters:
  protocol: "nfs"
  parentname: "parent-filesystem"
  portals:
    - "10.10.30.20"
maxClientThreads: "30"
```

Step 2 Run the following command to create a storage backend.

```
oceanctl create backend -f /path/to/backend.yaml -i yaml
```

The following is an example of the command output.

```
NUMBER  CONFIGURED    NAME           STORAGE              URLS
1       false         backend-demo   fusionstorage-dtree  https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 3 Enter the serial number of the backend to be created and enter the account and password.

```
Please enter the backend number to configure (Enter 'exit' to exit):1
Please enter this backend user name: admin
Please enter this backend password:

Backend backend-demo is configured
NUMBER  CONFIGURED    NAME           STORAGE              URLS
1       true          backend-demo    fusionstorage-dtree  https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 4 Check the storage backend creation result.

```
oceanctl get backend
```

The following is an example of the command output. If the backend status is **Bound**, the creation is successful.

```
NAMESPACE     NAME           PROTOCOL    STORAGETYPE          SN           STATUS  ONLINE
URL
huawei-csi    backend-demo    nfs        fusionstorage-dtree               Bound   true    https://
192.168.129.157:8088
```

----End

5.1.1.4.2.2 DPC

This section describes how to create a storage backend of the DPC protocol type.

Configuration Item Description

Table 5-16 backend parameters

Parameter	Description	Mandatory	Default Value	Remarks
storage	Storage service type.	Yes	-	The value is fixed to **fusionstorage-dtree**.

Parameter	Description	Mandatory	Default Value	Remarks
name	Storage backend name. The value can contain a maximum of 63 characters, including lowercase letters, digits, and hyphens (-). It must start with a letter or digit.	Yes	-	Ensure that the storage backend name is unique.
namespace	Namespace.	No	huawei-csi	The storage backend must be in the same namespace as Huawei CSI.
accountName	Account name on the storage side.	No	-	This parameter is mandatory when NAS resources need to be provisioned under a specified account.
urls	Management URLs of the storage device. The value format is a list.	Yes	-	The value can be a domain name or an IP address + port number.
parameters.protocol	Storage protocol. The value is a character string. • dpc	Yes	-	• The value is fixed to **dpc**. • Ensure that DPC has been installed on the connected compute node and the node has been added as a DPC compute node on the storage device to be connected.
parameters.parentname	Name of a file system on the current storage device. A dtree is created in the file system.	No	-	• Query the name on the **File Systems** page of DeviceManager. • You can configure the parameter in StorageClass.
supportedTopologies	Storage topology awareness configuration. The parameter format is JSON of the list type.	No	-	This parameter is mandatory if storage topology awareness is enabled. For details, see **7.9 Configuring Storage Topology Awareness**.

Parameter	Description	Mandatory	Default Value	Remarks
maxClientThreads	Maximum number of concurrent connections to a storage backend.	No	30	The value ranges from **1** to **30**. If this parameter is not set or the value is not in the specified range, the default value **30** is used.

Creating a Storage Backend

Step 1 Prepare a backend configuration file, for example, **backend.yaml**.

```
storage: "fusionstorage-dtree"
name: "backend-demo"
namespace: "huawei-csi"
urls:
  - "https://192.168.129.157:8088"
parameters:
  protocol: "dpc"
  parentname: "parent-filesystem"
maxClientThreads: "30"
```

Step 2 Run the following command to create a storage backend.

```
oceanctl create backend -f /path/to/backend.yaml -i yaml
```

The following is an example of the command output.

```
NUMBER  CONFIGURED    NAME            STORAGE               URLS
1       false         backend-demo    fusionstorage-dtree    https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 3 Enter the serial number of the backend to be created and enter the account and password.

```
Please enter the backend number to configure (Enter 'exit' to exit):1
Please enter this backend user name: admin
Please enter this backend password:

Backend backend-demo is configured
NUMBER  CONFIGURED    NAME            STORAGE               URLS
1       true          backend-demo    fusionstorage-dtree    https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 4 Check the storage backend creation result.

```
oceanctl get backend
```

The following is an example of the command output. If the backend status is **Bound**, the creation is successful.

```
NAMESPACE     NAME            PROTOCOL    STORAGETYPE         SN          STATUS  ONLINE
URL
huawei-csi    backend-demo    dpc         fusionstorage-dtree             Bound   true    https://
192.168.129.157:8088
```

----End

5.1.1.4.3 Block Service

5.1.1.4.3.1 iSCSI

This section describes how to create a storage backend of the iSCSI protocol type.

Configuration Item Description

Table 5-17 backend parameters

Parameter	Description	Mandatory	Default Value	Remarks
storage	Storage service type.	Yes	-	The value is fixed to **fusionstorage-san**.
name	Storage backend name. The value can contain a maximum of 63 characters, including lowercase letters, digits, and hyphens (-). It must start with a letter or digit.	Yes	-	Ensure that the storage backend name is unique.
namespace	Namespace.	No	huawei-csi	The storage backend must be in the same namespace as Huawei CSI.
urls	Management URLs of the storage device. The value format is a list.	Yes	-	The value can be a domain name or an IP address + port number.
pools	Storage pools of storage devices. The value format is a list.	Yes	-	Enter the storage pool names.
parameters.protocol	Storage protocol. The value is a character string.	Yes	-	• The value is fixed to **iscsi**. • Ensure that an iSCSI client has been installed on the connected compute node.

Parameter	Description	Mandatory	Default Value	Remarks
parameters.portals	Service access port. Nodes will use this port to read and write storage resources. The value format is a list.	Conditionally mandatory	-	• Multiple ports can be configured. • Either **iscsiLinks** or **portals** must be set.
parameters.iscsiLinks	Number of dynamic access links. This parameter is supported only in OceanStor Pacific 8.1.5 and later versions.	Conditionally mandatory		Either **iscsiLinks** or **portals** must be set. **NOTE** 1. The **iscsiLinks** parameter takes effect only when the **portals** parameter is left empty. 2. The number of valid links is the maximum value among the following three values: • Value of **iscsiLinks** • Minimum number of links dynamically allocated by the storage • Number of established links on the host
supportedTopologies	Storage topology awareness configuration. The parameter format is JSON of the list type.	No	-	This parameter is mandatory if storage topology awareness is enabled. For details, see **7.9 Configuring Storage Topology Awareness**.
maxClientThreads	Maximum number of concurrent connections to a storage backend.	No	30	The value ranges from **1** to **30**. If this parameter is not set or the value is not in the specified range, the default value **30** is used.

Creating a Storage Backend

Step 1 Prepare a backend configuration file, for example, **backend.yaml**.

```
storage: "fusionstorage-san"
name: "backend-demo"
```

```
namespace: "huawei-csi"
urls:
  - "https://192.168.129.157:8088"
pools:
  - "StoragePool001"
parameters:
  protocol: "iscsi"
  portals:
    - "10.10.30.20"
    - "10.10.30.21"
maxClientThreads: "30"
```

Step 2 Run the following command to create a storage backend.

```
oceanctl create backend -f /path/to/backend.yaml -i yaml
```

The following is an example of the command output.

```
NUMBER  CONFIGURED    NAME          STORAGE             URLS
1       false         backend-demo   fusionstorage-san    https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 3 Enter the serial number of the backend to be created and enter the account and password.

```
Please enter the backend number to configure (Enter 'exit' to exit):1
Please enter this backend user name: admin
Please enter this backend password:

Backend backend-demo is configured
NUMBER  CONFIGURED    NAME          STORAGE             URLS
1       true          backend-demo    fusionstorage-san    https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 4 Check the storage backend creation result.

```
oceanctl get backend
```

The following is an example of the command output. If the backend status is **Bound**, the creation is successful.

```
NAMESPACE     NAME          PROTOCOL    STORAGETYPE       SN       STATUS  ONLINE  URL
huawei-csi    backend-demo    iscsi       fusionstorage-san          Bound   true    https://
192.168.129.157:8088
```

----End

5.1.1.4.3.2 SCSI

This section describes how to create a storage backend of the SCSI protocol type.

Configuration Item Description

Table 5-18 backend parameters

Parameter	Description	Mandatory	Default Value	Remarks
storage	Storage service type.	Yes	-	The value is fixed to **fusionstorage-san**.

Parameter	Description	Mandatory	Default Value	Remarks
name	Storage backend name. The value can contain a maximum of 63 characters, including lowercase letters, digits, and hyphens (-). It must start with a letter or digit.	Yes	-	Ensure that the storage backend name is unique.
namespace	Namespace.	No	huawei-csi	The storage backend must be in the same namespace as Huawei CSI.
urls	Management URLs of the storage device. The value format is a list.	Yes	-	The value can be a domain name or an IP address + port number.
pools	Storage pools of storage devices. The value format is a list.	Yes	-	Enter the storage pool names.
parameters.protocol	Storage protocol. The value is a character string.	Yes	-	• The value is fixed to **scsi**. • Ensure that a distributed storage VBS client has been installed on the connected compute node.
parameters.portals	Service access port. Nodes will use this port to read and write storage resources. The value format is a list.	Yes	-	If the protocol is **scsi**, the port is in dictionary format where the key indicates the name of the host where the VBS client is deployed and the value indicates the IP address of the host where the VBS client is deployed.
supportedTopologies	Storage topology awareness configuration. The parameter format is JSON of the list type.	No	-	This parameter is mandatory if storage topology awareness is enabled. For details, see **7.9 Configuring Storage Topology Awareness**.

Parameter	Description	Mandatory	Default Value	Remarks
maxClientThreads	Maximum number of concurrent connections to a storage backend.	No	30	The value ranges from **1** to **30**. If this parameter is not set or the value is not in the specified range, the default value **30** is used.

Creating a Storage Backend

Step 1 Prepare a backend configuration file, for example, **backend.yaml**.

```
storage: "fusionstorage-san"
name: "backend-demo"
namespace: "huawei-csi"
urls:
  - "https://192.168.129.157:8088"
pools:
  - "StoragePool001"
parameters:
  protocol: "scsi"
  portals:
    - {"hostname01": "192.168.125.21","hostname02": "192.168.125.22"}
maxClientThreads: "30"
```

Step 2 Run the following command to create a storage backend.

```
oceanctl create backend -f /path/to/backend.yaml -i yaml
```

The following is an example of the command output.

```
NUMBER  CONFIGURED    NAME           STORAGE              URLS
1       false         backend-demo   fusionstorage-san    https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 3 Enter the serial number of the backend to be created and enter the account and password.

```
Please enter the backend number to configure (Enter 'exit' to exit):1
Please enter this backend user name: admin
Please enter this backend password:

Backend backend-demo is configured
NUMBER  CONFIGURED    NAME           STORAGE              URLS
1       true          backend-demo   fusionstorage-san    https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 4 Check the storage backend creation result.

```
oceanctl get backend
```

The following is an example of the command output. If the backend status is **Bound**, the creation is successful.

```
NAMESPACE     NAME           PROTOCOL    STORAGETYPE          SN      STATUS  ONLINE  URL
huawei-csi    backend-demo   scsi        fusionstorage-san            Bound   true    https://192.168.129.157:8088
```

----End

5.1.1.5 Mass Storage (OceanDisk Series)

5.1.1.5.1 File System

5.1.1.5.1.1 NFS

This section describes how to create a storage backend of the NFS protocol type.

Configuration Item Description

Table 5-19 backend parameters

Parameter	Description	Mandatory	Default Value	Remarks
storage	Storage service type.	Yes	-	The value is fixed to **oceanstor-nas**.
name	Storage backend name. The value can contain a maximum of 63 characters, including lowercase letters, digits, and hyphens (-). It must start with a letter or digit.	Yes	-	Ensure that the storage backend name is unique.
namespace	Namespace.	No	huawei-csi	The storage backend must be in the same namespace as Huawei CSI.
urls	Management URLs of the storage device. The value format is a list. The value can be a domain name or an IP address + port number.	Yes	-	If resources need to be provisioned to a specified vStore, set this parameter to the logical management port URL of the specified vStore.
pools	Storage pools of storage devices. The value format is a list.	Yes	-	Enter the storage pool names.
parameters.protocol	Storage protocol. The value is a character string.	Yes	-	The value is fixed to **nfs**. Ensure that an NFS client tool has been installed on the connected compute node.

Parameter	Description	Mandatory	Default Value	Remarks
parameters.portals	Service access port. Nodes will use this port to read and write storage resources. The value format is a list.	Yes	-	• If a vStore is used to connect to a backend, **portals** must be set to the logical port information of the vStore. • You can enter a domain name address. • Only one port can be configured.
supportedTopologies	Storage topology awareness configuration. The parameter format is JSON of the list type.	No	-	This parameter is mandatory if storage topology awareness is enabled. For details, see **7.9 Configuring Storage Topology Awareness**.
maxClientThreads	Maximum number of concurrent connections to a storage backend.	No	30	The value ranges from **1** to **30**. If this parameter is not set or the value is not in the specified range, the default value **30** is used.

Creating Storage Backends of the Local Type

Step 1 Prepare a backend configuration file, for example, **backend.yaml**.

```
storage: "oceanstor-nas"
name: "backend-demo"
namespace: "huawei-csi"
urls:
  - "https://192.168.129.157:8088"
pools:
  - "StoragePool001"
parameters:
  protocol: "nfs"
  portals:
    - "10.10.30.20"
maxClientThreads: "30"
```

Step 2 Run the following command to create a storage backend.

```
oceanctl create backend -f /path/to/backend.yaml -i yaml
```

The following is an example of the command output.

```
NUMBER  CONFIGURED    NAME           STORAGE             URLS
1       false         backend-demo   oceanstor-nas       https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```


Step 3 Enter the serial number of the backend to be created and enter the account and password.

```
Please enter the backend number to configure (Enter 'exit' to exit):1
Please enter this backend user name: admin
Please enter this backend password:

Backend backend-demo is configured
NUMBER  CONFIGURED    NAME           STORAGE             URLS
1       true          backend-demo    oceanstor-nas        https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 4 Check the storage backend creation result.

```
oceanctl get backend
```

The following is an example of the command output. If the backend status is **Bound**, the creation is successful.

```
NAMESPACE     NAME           PROTOCOL    STORAGETYPE      SN                  STATUS  ONLINE
URL
huawei-csi    backend-demo    nfs        oceanstor-nas    xxxxxxxxxxxxxxxxxxxx  Bound   true    https://
192.168.129.157:8088
```

----End

5.1.1.5.2 Block Service

5.1.1.5.2.1 iSCSI

This section describes how to create a storage backend of the iSCSI protocol type.

Configuration Item Description

Table 5-20 backend parameters

Parameter	Description	Mandatory	Default Value	Remarks
storage	Storage service type.	Yes	-	The value is fixed to **oceandisk-san**.
name	Storage backend name. The value can contain a maximum of 63 characters, including lowercase letters, digits, and hyphens (-). It must start with a letter or digit.	Yes	-	Ensure that the storage backend name is unique.
namespace	Namespace.	No	huawei-csi	The storage backend must be in the same namespace as Huawei CSI.

Parameter	Description	Mandatory	Default Value	Remarks
urls	Management URLs of the storage device. The value format is a list.	Yes	-	The value can be a domain name or an IP address + port number.
pools	Storage pools of storage devices. The value format is a list.	Yes	-	Enter the storage pool names.
parameters.protocol	Storage protocol. The value is a character string.	Yes	-	• The value is fixed to **iscsi**. • Ensure that an iSCSI client has been installed on the connected compute node.
parameters.portals	Service access port. Nodes will use this port to read and write storage resources. The value format is a list.	Yes	-	Multiple ports can be configured.
supportedTopologies	Storage topology awareness configuration. The parameter format is JSON of the list type.	No	-	This parameter is mandatory if storage topology awareness is enabled. For details, see **7.9 Configuring Storage Topology Awareness**.
maxClientThreads	Maximum number of concurrent connections to a storage backend.	No	30	The value ranges from **1** to **30**. If this parameter is not set or the value is not in the specified range, the default value **30** is used.

Creating a Storage Backend

Step 1 Prepare a backend configuration file, for example, **backend.yaml**.

```
storage: "oceandisk-san"
name: "backend-demo"
namespace: "huawei-csi"
urls:
  - "https://192.168.129.157:8088"
pools:
  - "StoragePool001"
parameters:
  protocol: "iscsi"
  portals:
    - "10.10.30.20"
```

```
  - "10.10.30.21"
maxClientThreads: "30"
```

Step 2 Run the following command to create a storage backend.

```
oceanctl create backend -f /path/to/backend.yaml -i yaml
```

The following is an example of the command output.

```
NUMBER  CONFIGURED    NAME           STORAGE          URLS
1       false         backend-demo   oceandisk-san    https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 3 Enter the serial number of the backend to be created and enter the account and password.

```
Please enter the backend number to configure (Enter 'exit' to exit):1
Please enter this backend user name: admin
Please enter this backend password:

Backend backend-demo is configured
NUMBER  CONFIGURED    NAME           STORAGE          URLS
1       true          backend-demo    oceandisk-san    https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 4 Check the storage backend creation result.

```
oceanctl get backend
```

The following is an example of the command output. If the backend status is **Bound**, the creation is successful.

```
NAMESPACE     NAME           PROTOCOL    STORAGETYPE     SN                   STATUS  ONLINE
URL
huawei-csi    backend-demo    iscsi      oceandisk-san   xxxxxxxxxxxxxxxxxxxx  Bound   true    https://
192.168.129.157:8088
```

----End

5.1.1.5.2.2 FC

This section describes how to create a storage backend of the FC protocol type.

Configuration Item Description

Table 5-21 backend parameters

Parameter	Description	Mandatory	Default Value	Remarks
storage	Storage service type.	Yes	-	The value is fixed to **oceandisk-san**.
name	Storage backend name. The value can contain a maximum of 63 characters, including lowercase letters, digits, and hyphens (-). It must start with a letter or digit.	Yes	-	Ensure that the storage backend name is unique.

Parameter	Description	Mandatory	Default Value	Remarks
namespace	Namespace.	No	huawei-csi	The storage backend must be in the same namespace as Huawei CSI.
urls	Management URLs of the storage device. The value format is a list.	Yes	-	The value can be a domain name or an IP address + port number.
pools	Storage pools of storage devices. The value format is a list.	Yes	-	Enter the storage pool names.
parameters.protocol	Storage protocol. The value is a character string.	Yes	-	• The value is fixed to **fc**.
supportedTopologies	Storage topology awareness configuration. The parameter format is JSON of the list type.	No	-	This parameter is mandatory if storage topology awareness is enabled. For details, see **7.9 Configuring Storage Topology Awareness**.
maxClientThreads	Maximum number of concurrent connections to a storage backend.	No	30	The value ranges from **1** to **30**. If this parameter is not set or the value is not in the specified range, the default value **30** is used.

Creating a Storage Backend

Step 1 Prepare a backend configuration file, for example, **backend.yaml**.

```
storage: "oceandisk-san"
name: "backend-demo"
namespace: "huawei-csi"
urls:
  - "https://192.168.129.157:8088"
pools:
  - "StoragePool001"
parameters:
  protocol: "fc"
maxClientThreads: "30"
```

Step 2 Run the following command to create a storage backend.

```
oceanctl create backend -f /path/to/backend.yaml -i yaml
```

The following is an example of the command output.

```
NUMBER  CONFIGURED    NAME          STORAGE            URLS
1       false         backend-demo   oceandisk-san       https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 3 Enter the serial number of the backend to be created and enter the account and password.

```
Please enter the backend number to configure (Enter 'exit' to exit):1
Please enter this backend user name: admin
Please enter this backend password:

Backend backend-demo is configured
NUMBER  CONFIGURED    NAME          STORAGE            URLS
1       true          backend-demo    oceandisk-san       https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 4 Check the storage backend creation result.

```
oceanctl get backend
```

The following is an example of the command output. If the backend status is **Bound**, the creation is successful.

```
NAMESPACE     NAME           PROTOCOL    STORAGETYPE       SN                   STATUS  ONLINE
URL
huawei-csi    backend-demo    fc         oceandisk-san      xxxxxxxxxxxxxxxxxxxx  Bound   true    https://
192.168.129.157:8088
```

----End

5.1.1.5.2.3 NVMe over RoCE

This section describes how to create a storage backend of the NVMe over RoCE protocol type.

Configuration Item Description

Table 5-22 backend parameters

Parameter	Description	Mandatory	Default Value	Remarks
storage	Storage service type.	Yes	-	The value is fixed to **oceandisk-san**.
name	Storage backend name. The value can contain a maximum of 63 characters, including lowercase letters, digits, and hyphens (-). It must start with a letter or digit.	Yes	-	Ensure that the storage backend name is unique.
namespace	Namespace.	No	huawei-csi	The storage backend must be in the same namespace as Huawei CSI.

Parameter	Description	Mandatory	Default Value	Remarks
urls	Management URLs of the storage device. The value format is a list.	Yes	-	The value can be a domain name or an IP address + port number.
pools	Storage pools of storage devices. The value format is a list.	Yes	-	Enter the storage pool names.
parameters.protocol	Storage protocol. The value is a character string.	Yes	-	• The value is fixed to **roce**. • Ensure that the nvme-cli tool has been installed on the compute node to be connected. The supported nvme-cli tool version is 1.9 and later.
parameters.portals	Service access port. Nodes will use this port to read and write storage resources. The value format is a list.	Yes	-	Multiple ports can be configured.
supportedTopologies	Storage topology awareness configuration. The parameter format is JSON of the list type.	No	-	This parameter is mandatory if storage topology awareness is enabled. For details, see **7.9 Configuring Storage Topology Awareness**.
maxClientThreads	Maximum number of concurrent connections to a storage backend.	No	30	The value ranges from **1** to **30**. If this parameter is not set or the value is not in the specified range, the default value **30** is used.

Creating a Storage Backend

Step 1 Prepare a backend configuration file, for example, **backend.yaml**.

```
storage: "oceandisk-san"
name: "backend-demo"
namespace: "huawei-csi"
urls:
  - "https://192.168.129.157:8088"
pools:
  - "StoragePool001"
parameters:
```

```
  protocol: "roce"
  portals:
    - "10.10.30.20"
    - "10.10.30.21"
maxClientThreads: "30"
```

Step 2 Run the following command to create a storage backend.

```
oceanctl create backend -f /path/to/backend.yaml -i yaml
```

The following is an example of the command output.

```
NUMBER  CONFIGURED    NAME           STORAGE              URLS
1       false         backend-demo   oceandisk-san        https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 3 Enter the serial number of the backend to be created and enter the account and password.

```
Please enter the backend number to configure (Enter 'exit' to exit):1
Please enter this backend user name: admin
Please enter this backend password:

Backend backend-demo is configured
NUMBER  CONFIGURED    NAME            STORAGE              URLS
1       true          backend-demo    oceandisk-san        https://192.168.129.157:8088
Please enter the backend number to configure (Enter 'exit' to exit):
```

Step 4 Check the storage backend creation result.

```
oceanctl get backend
```

The following is an example of the command output. If the backend status is **Bound**, the creation is successful.

```
NAMESPACE     NAME           PROTOCOL    STORAGETYPE       SN                   STATUS  ONLINE
URL
huawei-csi    backend-demo    roce       oceandisk-san      xxxxxxxxxxxxxxxxxxxx  Bound   true    https://
192.168.129.157:8088
```

----End

5.1.2 Managing Storage Backends

5.1.2.1 Querying a Storage Backend

- Run the following command to obtain the help information about querying a backend.
  ```
  oceanctl get backend -h
  ```
- Run the following command to query a single storage backend in the default namespace.
  ```
  oceanctl get backend <backend-name>
  ```
- Run the following command to query all storage backends in the specified namespace.
  ```
  oceanctl get backend -n <namespace>
  ```
- Run the following command to format the output. Currently, **json**, **yaml**, and **wide** are supported.
  ```
  oceanctl get backend <backend-name> -o json
  ```

5.1.2.2 Updating a Storage Backend

NOTICE

- When you use oceanctl to update the storage backend information, only the storage backend password and authentication mode for logging in to the storage backend can be updated.
- If the backend account password is updated on the storage device, the CSI plug-in will retry due to login failures. As a result, the account may be locked. If the account is locked, change the password by referring to **8.2.3 An Account Is Locked After the Password Is Updated on the Storage Device**.

5.1.2.2.1 Updating the Password of a Storage Backend Using oceanctl

Obtaining the Help Information About Updating a Backend

Step 1 Run the following command to obtain the help information about updating a storage backend.

```
oceanctl update backend -h
```

The following is an example of the command output.

```
Update a backend for Ocean Storage in Kubernetes

Usage:
  oceanctl update backend <name> [flags]

Examples:
  # Update backend account information in default(huawei-csi) namespace
  oceanctl update backend <name>  --password

  # Update backend account information in specified namespace
  oceanctl update backend <name> -n namespace --password

  # Update backend account information with ldap authentication mode in default(huawei-csi) namespace
  oceanctl update backend <name> --password --authenticationMode=ldap

  # Update backend account information with local authentication mode in default(huawei-csi) namespace
  oceanctl update backend <name> --password --authenticationMode=local

  # Update backend account information with ldap authentication mode in specified namespace
  oceanctl update backend <name> -n namespace --password --authenticationMode=ldap

Flags:
      --authenticationMode string   Specify authentication mode
  -h, --help                        help for backend
  -n, --namespace string            namespace of resources
      --password                    Update account password

Global Flags:
      --log-dir string   Specify the directory for printing log files. (default "/var/log/huawei")
```

----End

Example of Updating the Password of a Backend

Step 1 Run the following command to update a storage backend. In the command, *backend-name* indicates the name of the storage backend to be updated.

```
oceanctl update backend backend-name --password
```

Enter the user name and new password as prompted:

```
Please enter this backend user name:admin
Please enter this backend password:

backend/backend-name updated
```

----End

5.1.2.2.2 Updating the Login Authentication Mode of a Storage Backend

Example of Updating the Backend Login Authentication Type to LDAP

Step 1 Run the following command to update a storage backend. In the command, *backend-name* indicates the name of the storage backend to be updated.

```
oceanctl update backend backend-name --password --authenticationMode=ldap
```

Enter the user name and new password as prompted:

```
Please enter this backend user name:admin
Please enter this backend password:

backend/backend-name updated
```

----End

5.1.2.2.3 Updating a Storage Backend

NOTE

- PVC provisioning must be based on a configured storage backend. Therefore, if a PVC has been provisioned on a storage backend, do not change the storage backend.
- The name uniquely identifies a storage backend. The name of a storage backend with a PVC provisioned cannot be changed.
- After a storage backend is modified, the new configuration applies only to volumes to be provisioned.
- Do not perform volume management operations during the modification of a storage backend.

Procedure

Step 1 Delete the storage backend to be modified. For details, see **5.1.2.3 Deleting a Storage Backend**.

Step 2 Create a storage backend with the same name. For details, see **5.1.1 Configuring the Storage Backend**. The storage backend name cannot be changed.

----End

5.1.2.3 Deleting a Storage Backend

NOTICE

Do not delete a storage backend when a volume management operation is being performed on it.

Example of Deleting a Backend

Step 1 Run the following command to obtain information about a storage backend.

```
oceanctl get backend
```

The following is an example of the command output.

```
NAMESPACE     NAME         PROTOCOL    STORAGETYPE     SN                   STATUS  ONLINE
URL
huawei-csi    backend-1    roce        oceanstor-san    xxxxxxxxxxxxxxxxxxxx  Bound   true    https://
192.168.129.157:8088
huawei-csi    backend-2    roce        oceanstor-san    xxxxxxxxxxxxxxxxxxxx  Bound   true    https://
192.168.129.158:8088
```

Step 2 Run the following command to delete the specified storage backend.

```
oceanctl delete backend backend-1
```

Step 3 Run the following command to check the deletion result.

```
oceanctl get backend backend-1
```

The following is an example of the command output. If **not found** is displayed, the deletion is successful.

```
Error from server (NotFound): backend "backend-1" not found
```

----End

5.1.2.4 Adding a Storage Backend Certificate

Prerequisites

A certificate has been created. Take OceanStor Dorado as an example. For details about how to create a certificate, **click here**.

Example of Creating a Certificate

Step 1 Prepare a certificate file in advance, for example, **cert.crt**.

Step 2 Run the following command to obtain information about a storage backend.

```
oceanctl get backend
```

The following is an example of the command output.

```
NAMESPACE     NAME         PROTOCOL    STORAGETYPE     SN                   STATUS  ONLINE
URL
huawei-csi    backend-1    roce        oceanstor-san    xxxxxxxxxxxxxxxxxxxx  Bound   true    https://
192.168.129.157:8088
huawei-csi    backend-2    roce        oceanstor-san    xxxxxxxxxxxxxxxxxxxx  Bound   true    https://
192.168.129.158:8088
```

Step 3 Run the following command to create a certificate for the specified storage backend.

```
oceanctl create cert cert-1 -b backend-1 -f /path/to/cert.crt
```

Step 4 Check the certificate creation result.

```
oceanctl get cert -b backend-1
```

The following is an example of the command output.

```
NAMESPACE    NAME    BOUNDBACKEND
huawei-csi   cert-1  backend-1
```

----End

5.1.2.5 Deleting a Storage Backend Certificate

Procedure

Step 1 Run the following command to obtain information about a storage backend.

```
oceanctl get backend
```

The following is an example of the command output.

```
NAMESPACE     NAME        PROTOCOL    STORAGETYPE     SN                   STATUS  ONLINE
URL
huawei-csi    backend-1    roce       oceanstor-san    xxxxxxxxxxxxxxxxxxxx  Bound   true     https://
192.168.129.157:8088
huawei-csi    backend-2    roce       oceanstor-san    xxxxxxxxxxxxxxxxxxxx  Bound   true     https://
192.168.129.158:8088
```

Step 2 Run the following command to obtain information about the certificate of the specified storage backend.

```
oceanctl get cert -b backend-1
```

The following is an example of the command output.

```
NAMESPACE   NAME    BOUNDBACKEND
huawei-csi  cert-1  backend-1
```

Step 3 Run the following command to delete the certificate of the specified storage backend.

```
oceanctl delete cert -b backend-1
```

Step 4 Check the deletion result.

```
oceanctl get cert -b backend-1
```

The following is an example of the command output. If **no cert found** is displayed, the deletion is successful.

```
Error from server (NotFound): no cert found on backend backend-1 in huawei-csi namespace
```

----End

5.2 StorageClass Management

A **StorageClass** provides administrators with methods to describe a storage "class". Different types may map to a different group of capability definitions. Kubernetes cluster users can dynamically provision volumes based on a StorageClass.

5.2.1 Configuring a StorageClass

Cluster administrators can define multiple StorageClass objects as required. When configuring a PVC, the cluster administrators need to specify a StorageClass that meets service requirements. When applying for resources from Huawei storage devices, Huawei CSI creates storage resources that meet service requirements based on the preset StorageClass.

5.2.1.1 Flash Storage (OceanStor Dorado/OceanStor V5/OceanStor V6 and Later)

5.2.1.1.1 File System

Creating a StorageClass

Step 1 Prepare a StorageClass configuration file, for example, **mysc.yaml**. For details about the StorageClass configuration, see the following example.

Step 2 Run the following command to create a StorageClass using the configuration file.

```
kubectl apply -f mysc.yaml
```

Step 3 Run the following command to view the information about the created StorageClass.

```
kubectl get sc mysc
```

The following is an example of the command output.

```
NAME   PROVISIONER     RECLAIMPOLICY   VOLUMEBINDINGMODE   ALLOWVOLUMEEXPANSION   AGE
mysc   csi.huawei.com   Delete          Immediate           true                   8s
```

----End

NFS Protocol Configuration Example

When a container uses the NFS protocol to connect to file system resources, refer to the following StorageClass configuration example. In this example, NFS version 4.1 is specified for mounting.

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: mysc
provisioner: csi.huawei.com
parameters:
  backend: nfs-nas-181
  pool: StoragePool001
  volumeType: fs
  allocType: thin
  authClient: "*"
mountOptions:
  - nfsvers=4.1 # Specify the version 4.1 for NFS mounting.
```

NFS+ Protocol Configuration Example

When a container uses the NFS+ protocol to connect to file system resources, refer to the following StorageClass configuration example.

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: mysc
provisioner: csi.huawei.com
parameters:
  backend: nfs-nas-181
  pool: StoragePool001
  volumeType: fs
  allocType: thin
  authClient: "*"
```

HyperMetro File System Configuration Example

When a container uses an NFS HyperMetro file system as a storage resource, refer to the following configuration example. In this example, the used backend supports HyperMetro, and **hyperMetro** is set to **true**.

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: mysc
provisioner: csi.huawei.com
parameters:
  backend: nfs-hypermetro-dorado-181
  pool: pool001
  volumeType: fs
  hyperMetro: "true" # Provision HyperMetro volumes.
  allocType: thin
  authClient: "*"
```

NOTICE

- Before provisioning a NAS HyperMetro volume, you need to configure the HyperMetro relationship between two storage devices, including the remote device and HyperMetro domain. The HyperMetro domain of the file system can only work in HyperMetro AA mode. For details about the configuration operation, see the product documentation of the corresponding storage model.
- If a storage device is faulty, the logical management port may fail over. In this case, you need to manually clear the corresponding storage resources after deleting the NAS HyperMetro volume.

StorageClass Parameters Supported by File Systems

Table 5-23 StorageClass configuration parameters

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
metadata.name	User-defined name of a StorageClass object.	Yes	-	Yes	Take Kubernetes v1.22.1 as an example. The value can contain digits, lowercase letters, hyphens (-), and periods (.), and must start and end with a letter or digit.
provisioner	Name of the provisioner.	Yes	csi.huawei.com	Yes	Set this parameter to the driver name set during Huawei CSI installation. The value is the same as that of **driverName** in the **values.yaml** file.
reclaimPolicy	Reclamation policy. The following types are supported: • **Delete**: Resources are automatically reclaimed. • **Retain**: Resources are manually reclaimed.	No	Delete	Yes	• **Delete**: When a PV/PVC is deleted, resources on the storage device are also deleted. • **Retain**: When a PV/PVC is deleted, resources on the storage device are not deleted.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
allowVolumeExpansion	Whether to allow volume expansion. If this parameter is set to **true**, the capacity of the PV that uses the StorageClass can be expanded.	No	false	Yes	This function can only be used to expand PV capacity but cannot be used to reduce PV capacity.
mountOptions	List of mount parameters, which can be used to specify the parameters of the **-o** option when the **mount** command is executed on a host.	No	-	Yes	For details about common parameters in **mountOptions**, see **Table 5-24**. You can also specify other mount parameters.
parameters.backend	Name of the backend where the resource to be created is located. This field must be set if **parameters.pool** is set.	Conditionally mandatory	-	No	If this parameter is not set, Huawei CSI will randomly select a backend that meets the capacity requirements to create resources. You are advised to specify a backend to ensure that the created resource is located on the expected backend.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.pool	Name of the storage resource pool where the resource to be created is located.	No	-	No	If this parameter is not set, Huawei CSI will randomly select a storage pool that meets the capacity requirements from the selected backend to create resources. You are advised to specify a storage pool to ensure that the created resource is located in the expected storage pool.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.volumeName	Name of the storage resource created by dynamic volume provisioning. You can configure a placeholder to customize the storage resource name. The following placeholders are supported: ● PVC namespace: {{ .PVCNamespace }} ● PVC name: {{ .PVCName }}	No	-	No	● The value can contain letters, digits, hyphens (-), underscores (_), and periods (.). This parameter cannot be left empty. The length of the generated storage resource name ranges from 1 to 255 characters. ● Both the PVC namespace and PVC name must be configured. ● To avoid duplicate resource names, the PVC UID is added to the end of the name as a unique identifier by default. Configuration example: PVC namespace: **namespace**. PVC name: **pvc-1**. PVC UID: **c2fd3f46-bf17-4a7d-b88e-2e3232bae434**. **volumeName** is set to **prefix-{{ .PVCNamespace }}_{{ .PVCName }}**. The ultimate storage resource name is **prefix-namespace_pvc-1-**

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
					c2fd3f46bf174a7db88e2e3232bae434.
parameters.volumeType	Type of the volume to be created. The following types are supported: • **lun**: A LUN is provisioned on the storage side. • **fs**: A file system is provisioned on the storage side. • **dtree**: A volume of the Dtree type is provisioned on the storage side.	Yes	-	Yes	The value is fixed to **fs**.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.allocType	Allocation type of the volume to be created. The following types are supported: • **thin**: Not all required space is allocated during creation. Instead, the space is dynamically allocated based on the usage. • **thick**: All required space is allocated during creation.	No	thin	No	If this parameter is set to **thin**, the required space is not allocated immediately when a volume is created. Instead, the space is dynamically allocated based on the usage. OceanStor Dorado does not support **thick**.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.authClient	IP address of the NFS client that can access the volume. You can enter the client host name (a full domain name is recommended), client IP address, or client IP address segment.	Yes	-	No	The asterisk (*) can be used to indicate any client. If you are not sure about the IP address of the access client, you are advised to use the asterisk (*) to prevent the client access from being rejected by the storage system. If the client host name is used, you are advised to use the full domain name. The IP addresses can be IPv4 addresses, IPv6 addresses, or a combination of IPv4 and IPv6 addresses. You can enter multiple host names, IP addresses, or IP address segments and separate them with semicolons (;). Example: **192.168.0.10;192.168.0.0/24;myserver1.test**
parameters.cloneSpeed	Cloning speed. The value ranges from 1 to 4.	No	3	No	**4** indicates the highest speed. This parameter takes effect when a persistent volume is cloned or a persistent volume is created from a snapshot.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.applicationType	Application type name when a file system is created.	No	-	Yes	Log in to DeviceManager and choose **Services** > **File Service** > **File Systems** > **Create** to obtain the application type name.
parameters.qos	QoS settings of the file system on the storage side of the PV. The value of the parameter is JSON character strings in dictionary format. A character string is enclosed by single quotation marks and the dictionary key by double quotation marks. Example: **'{"maxMBPS": 999, "maxIOPS": 999}'**	No	-	No	For details about the supported QoS configurations, see **Table 5-25**.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.hyperMetro	Whether a HyperMetro volume is to be created. This parameter needs to be configured when the backend is of the HyperMetro type. ● **"true"**: The created volume is a HyperMetro volume. If the storage backend is a HyperMetro backend, the value must be **true**. ● **"false"**: The created volume is a common volume.	Conditionally mandatory	false	No	When the used backend is a HyperMetro backend and a HyperMetro volume needs to be provisioned, set this parameter to **true**. If this parameter is set to **false**, services may be interrupted if the logical management port connected to the backend fails over.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.metroPairSyncSpeed	Data synchronization speed of a HyperMetro pair. The value ranges from 1 to 4. The value can be: ● **1**: low ● **2**: medium ● **3**: high ● **4**: highest	No	-	No	The configuration takes effect when a HyperMetro volume is created. Note: ● If this parameter is not configured, the storage speed of the HyperMetro pair is determined by the storage device. ● The highest synchronization speed may increase the host latency.
parameters.fsPermission	Permission on the directory mounted to a container.	No	-	No	For details about the configuration format, refer to the Linux permission settings, for example, 777 and 755.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.rootSquash	Controls the **root** permission of the client. The value can be: ● **root_squash**: The client cannot access the storage system as user **root**. If a client accesses the storage system as user **root**, the client will be mapped as an anonymous user. ● **no_root_squash**: A client can access the storage system as user **root** and has the permission of user **root**.	No	-	No	

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.allSquash	Whether to retain the user ID (UID) and group ID (GID) of a shared directory. The value can be: • **all_squash**: The UID and GID of the shared directory are mapped to anonymous users. • **no_all_squash**: The UID and GID of the shared directory are retained.	No	-	No	
parameters.accesskrb5	Configures the krb5 security protocol. • **read_only**: read-only • **read_write**: read and write • **none**: no permission	No	-	No	During mounting, you can specify the **sec** parameter in **mountOptions**.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.accesskrb5i	Configures the krb5i security protocol. • **read_only**: read-only • **read_write**: read and write • **none**: no permission	No	-	No	During mounting, you can specify the **sec** parameter in **mountOptions**.
parameters.accesskrb5p	Configures the krb5p security protocol. • **read_only**: read-only • **read_write**: read and write • **none**: no permission	No	-	No	During mounting, you can specify the **sec** parameter in **mountOptions**.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.snapshotDirectoryVisibility	Whether the snapshot directory is visible. The value can be: ● **visible**: The snapshot directory is visible. ● **invisible**: The snapshot directory is invisible.	No	-	No	Only NAS storage is supported.
parameters.reservedSnapshotSpaceRatio	Configures reserved snapshot space. Value type: character string Value range: 0 to 50	No	-	No	OceanStor Dorado 6.1.5+ and OceanStor 6.1.5+ NAS storage devices are supported.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.disableVerifyCapacity	Whether to disable volume capacity verification. After this function is disabled, the system will not verify whether the volume capacity is an integer multiple of the sector size. The value can be: ● "true": disables volume capacity verification. ● "false": enables volume capacity verification. **NOTICE** When Red Hat OpenShift Virtualization is used to connect to CSI, this parameter must be set to **true**.	No	"true"	Yes	For OceanStor Dorado and OceanStor storage, the sector size is 512 bytes.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.description	Description of the file system to be created. Value type: character string The value contains 0 to 255 characters.	No	Created from Kubernetes CSI	No	
parameters.advancedOptions	Advanced volume creation parameters. The value of the parameter is JSON character strings in dictionary format. A character string is enclosed by single quotation marks and the dictionary key by double quotation marks. Example: **'{"CAPACITYTHRESHOLD": 90}'**	No	-	No	For details about the supported advanced parameters, see **Table 5-26**.

Table 5-24 Common parameters in mountOptions

Parameter	Description	Mandatory	Default Value	Remarks
mountOptions.nfsvers	NFS mount option on the host. The following mount option is supported: **nfsvers**: protocol version for NFS mounting. The value can be **3**, **4**, **4.0**, **4.1**, or **4.2**.	No	-	This parameter specified after the **-o** parameter is optional when the **mount** command is executed on the host. The value is in list format. If the NFS version is specified for mounting, NFS 3, 4.0, 4.1, and 4.2 protocols are supported (the protocol must be supported and enabled on storage devices). If **nfsvers** is set to **4**, the latest protocol version NFS 4 may be used for mounting due to different OS configurations, for example, 4.2. If the 4.0 protocol is required, you are advised to set **nfsvers** to **4.0**.

Parameter	Description	Mandatory	Default Value	Remarks
mountOptions.sec	Kerberos 5 protocol for mounting NFS file systems.	No	-	● If Kerberos 5 is used, set this parameter to **krb5**. ● If Kerberos 5i is used, set this parameter to **krb5i**. ● If Kerberos 5p is used, set this parameter to **krb5p**. ● Kerberos supports only NFSv4.0 and later versions. ● OceanStor Dorado and OceanStor 6.1.3 and later versions support Kerberos.
mountOptions.proto	Transmission protocol used for NFS mounting. The value can be **rdma**.	No	-	● The parameter is supported for NAS storage of OceanStor Dorado and OceanStor 6.1.7 and later.

Parameter	Description	Mandatory	Default Value	Remarks
mountOptions.port	Protocol port used for NFS mounting.	Conditionally mandatory	-	If the transmission protocol is **rdma**, set this parameter to **20049**.

Table 5-25 Supported QoS configurations

Storage Type	Parameter	Description	Remarks
OceanStor V5	IOTYPE	Read/write type.	This parameter is optional. If it is not specified, the default value of the storage backend is used. For details, see related storage documents. The value can be: ● **0**: read I/O ● **1**: write I/O ● **2**: read and write I/Os
	MAXBANDWIDTH	Maximum bandwidth. This is a restriction policy parameter.	The value is an integer greater than 0, expressed in MB/s.
	MINBANDWIDTH	Minimum bandwidth. This is a protection policy parameter.	The value is an integer greater than 0, expressed in MB/s.
	MAXIOPS	Maximum IOPS. This is a restriction policy parameter.	The value is an integer greater than 0.
	MINIOPS	Minimum IOPS. This is a protection policy parameter.	The value is an integer greater than 0.
	LATENCY	Maximum latency. This is a protection policy parameter.	The value is an integer greater than 0, expressed in ms.

Storage Type	Parameter	Description	Remarks
OceanStor Dorado/ OceanStor	IOTYPE	Read/write type.	The value can be: ● **2**: read and write I/Os
	MAXBANDWIDTH	Maximum bandwidth. This is a restriction policy parameter.	The value is an integer ranging from 1 to 999999999, expressed in MB/s.
	MINBANDWIDTH	Minimum bandwidth. This is a protection policy parameter.	The value is an integer ranging from 1 to 999999999, expressed in MB/s.
	MAXIOPS	Maximum IOPS. This is a restriction policy parameter.	The value is an integer ranging from 100 to 999999999.
	MINIOPS	Minimum IOPS. This is a protection policy parameter.	The value is an integer ranging from 100 to 999999999.
	LATENCY	Maximum latency. This is a protection policy parameter.	The value can be **0.5** or **1.5**, expressed in ms.

Table 5-26 Supported advanced volume creation parameters

Parameter	Description	Remarks
CAPACITYTHRESHOLD	Total capacity alarm threshold.	Parameter type: uint64. For details about the default value and value range, see the corresponding storage product manual.

5.2.1.1.2 Dtree

Creating a StorageClass

Step 1 Prepare a StorageClass configuration file, for example, **mysc.yaml**. For details about the StorageClass configuration, see the following example.

Step 2 Run the following command to create a StorageClass using the configuration file.

```
kubectl apply -f mysc.yaml
```

Step 3 Run the following command to view the information about the created StorageClass.

```
kubectl get sc mysc
```

The following is an example of the command output.

```
NAME   PROVISIONER     RECLAIMPOLICY   VOLUMEBINDINGMODE   ALLOWVOLUMEEXPANSION   AGE
mysc   csi.huawei.com   Delete          Immediate           true                   8s
```

----End

Example of StorageClass Configuration Supported by the NFS Protocol

When a container uses the NFS protocol to connect to dtree resources, refer to the following StorageClass configuration example. In this example, NFS version 4.1 is specified for mounting.

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: mysc
provisioner: csi.huawei.com
parameters:
  backend: nfs-dtree-181
  parentname: parent-filesystem-name
  volumeType: dtree
  authClient: "*"
mountOptions:
  - nfsvers=4.1 # Specify the version 4.1 for NFS mounting.
```

Example of StorageClass Configuration Supported by the NFS+ Protocol

When a container uses the NFS+ protocol to connect to dtree resources, refer to the following StorageClass configuration example.

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: mysc
provisioner: csi.huawei.com
parameters:
  backend: nfs-dtree-181
  parentname: parent-filesystem-name
  volumeType: dtree
  authClient: "*"
```

Storage Class Parameters Supported by Dtrees

Table 5-27 StorageClass configuration parameters

Parameter	Description	Mandatory	Default Value	Remarks
metadata.name	User-defined name of a StorageClass object.	Yes	-	Take Kubernetes v1.22.1 as an example. The value can contain digits, lowercase letters, hyphens (-), and periods (.), and must start and end with a letter or digit.
provisioner	Name of the provisioner.	Yes	csi.huawei.com	Set this parameter to the driver name set during Huawei CSI installation. The value is the same as that of **driverName** in the **values.yaml** file.
reclaimPolicy	Reclamation policy. The following types are supported: • **Delete**: Resources are automatically reclaimed. • **Retain**: Resources are manually reclaimed.	No	Delete	• **Delete**: When a PV/PVC is deleted, resources on the storage device are also deleted. • **Retain**: When a PV/PVC is deleted, resources on the storage device are not deleted.
allowVolumeExpansion	Whether to allow volume expansion. If this parameter is set to **true**, the capacity of the PV that uses the StorageClass can be expanded.	No	false	This function can only be used to expand PV capacity but cannot be used to reduce PV capacity.

Parameter	Description	Mandatory	Default Value	Remarks
mountOptions	List of mount parameters, which can be used to specify the parameters of the **-o** option when the **mount** command is executed on a host.	No	-	For details about common parameters in **mountOptions**, see **Table 5-28**. You can also specify other mount parameters.
parameters.backend	Name of the backend where the resource to be created is located.	Conditionally mandatory	-	If this parameter is not set, Huawei CSI will randomly select a backend that meets the capacity requirements to create resources. You are advised to specify a backend to ensure that the created resource is located on the expected backend. This parameter is mandatory if **parameters.parentname** is configured.

Parameter	Description	Mandatory	Default Value	Remarks
parameters.parentname	Name of a file system on the current storage device. Dtree is created in the file system.	Conditionally mandatory	-	This parameter is mandatory when **parentname** is not configured for the backend. If **parentname** is configured only in the StorageClass but not configured in the storage backend, set **CSIDriverObject.attachRequired** to **true** during CSI installation.

Parameter	Description	Mandatory	Default Value	Remarks
parameters.volumeName	Name of the storage resource created by dynamic volume provisioning. You can configure a placeholder to customize the storage resource name. The following placeholders are supported: ● PVC namespace: {{ .PVCNamespace }} ● PVC name: {{ .PVCName }}	No	-	● The value can contain letters, digits, hyphens (-), underscores (_), and periods (.). This parameter cannot be left empty. The length of the generated storage resource name ranges from 1 to 255 characters. ● Both the PVC namespace and PVC name must be configured. ● To avoid duplicate resource names, the PVC UID is added to the end of the name as a unique identifier by default. Configuration example: PVC namespace: **namespace**. PVC name: **pvc-1**. PVC UID: **c2fd3f46-bf17-4a7d-b88e-2e3232bae434**. **volumeName** is set to **prefix-{{ .PVCNamespace }}_{{ .PVCName }}**. The ultimate storage resource name is **prefix-namespace_pvc-1-c2fd3f46bf174a7db88e2e3232bae434**.

Parameter	Description	Mandatory	Default Value	Remarks
parameters.volumeType	Type of the volume to be created. The following types are supported: ● **lun**: A LUN is provisioned on the storage side. ● **fs**: A file system is provisioned on the storage side. ● **dtree**: A volume of the Dtree type is provisioned on the storage side.	Yes	-	When dtree is used, the value must be **dtree**.

Parameter	Description	Mandatory	Default Value	Remarks
parameters.authClient	IP address of the NFS client that can access the volume. You can enter the client host name (a full domain name is recommended), client IP address, or client IP address segment.	Yes	-	The asterisk (*) can be used to indicate any client. If you are not sure about the IP address of the access client, you are advised to use the asterisk (*) to prevent the client access from being rejected by the storage system. If the client host name is used, you are advised to use the full domain name. The IP addresses can be IPv4 addresses, IPv6 addresses, or a combination of IPv4 and IPv6 addresses. You can enter multiple host names, IP addresses, or IP address segments and separate them with semicolons (;). Example: **192.168.0.10;192.168.0.0/24;myserver1.test**
parameters.fsPermission	Permission on the directory mounted to a container.	No	-	For details about the configuration format, refer to the Linux permission settings, for example, 777 and 755.

Parameter	Description	Mandatory	Default Value	Remarks
parameters.rootSquash	Controls the **root** permission of the client. The value can be: ● **root_squash**: The client cannot access the storage system as user **root**. If a client accesses the storage system as user **root**, the client will be mapped as an anonymous user. ● **no_root_squash**: A client can access the storage system as user **root** and has the permission of user **root**.	No	-	

Parameter	Description	Mandatory	Default Value	Remarks
parameters.allSquash	Whether to retain the user ID (UID) and group ID (GID) of a shared directory. The value can be: ● **all_squash**: The UID and GID of the shared directory are mapped to anonymous users. ● **no_all_squash**: The UID and GID of the shared directory are retained.	No	-	
parameters.accesskrb5	Configures the krb5 security protocol. ● **read_only**: read-only ● **read_write**: read and write ● **none**: no permission	No	-	During mounting, you can specify the **sec** parameter in **mountOptions**.
parameters.accesskrb5i	Configures the krb5i security protocol. ● **read_only**: read-only ● **read_write**: read and write ● **none**: no permission	No	-	During mounting, you can specify the **sec** parameter in **mountOptions**.

Parameter	Description	Mandatory	Default Value	Remarks
parameters.accesskrb5p	Configures the krb5p security protocol. ● **read_only**: read-only ● **read_write**: read and write ● **none**: no permission	No	-	During mounting, you can specify the **sec** parameter in **mountOptions**.
parameters.disableVerifyCapacity	Whether to disable volume capacity verification. After this function is disabled, the system will not verify whether the volume capacity is an integer multiple of the sector size. The value can be: ● "true": disables volume capacity verification. ● "false": enables volume capacity verification. **NOTICE** When Red Hat OpenShift Virtualization is used to connect to CSI, this parameter must be set to **true**.	No	"true"	For OceanStor Dorado and OceanStor storage, the sector size is 512 bytes.

Parameter	Description	Mandatory	Default Value	Remarks
parameters.description	Description of the dtree share to be created. Value type: character string The value contains 0 to 255 characters.	No	Created from Kubernetes CSI	

Table 5-28 Common parameters in mountOptions

Parameter	Description	Mandatory	Default Value	Remarks
mountOptions.nfsvers	NFS mount option on the host. The following mount option is supported: **nfsvers**: protocol version for NFS mounting. The value can be **3**, **4**, **4.0**, **4.1**, or **4.2**.	No	-	This parameter specified after the **-o** parameter is optional when the **mount** command is executed on the host. The value is in list format. If the NFS version is specified for mounting, NFS 3, 4.0, 4.1, and 4.2 protocols are supported (the protocol must be supported and enabled on storage devices). If **nfsvers** is set to **4**, the latest protocol version NFS 4 may be used for mounting due to different OS configurations, for example, 4.2. If the 4.0 protocol is required, you are advised to set **nfsvers** to **4.0**.

Parameter	Description	Mandatory	Default Value	Remarks
mountOptions.sec	Kerberos 5 protocol for mounting NFS file systems.	No	-	● If Kerberos 5 is used, set this parameter to **krb5**. ● If Kerberos 5i is used, set this parameter to **krb5i**. ● If Kerberos 5p is used, set this parameter to **krb5p**. ● Kerberos supports only NFSv4.0 and later versions. ● OceanStor Dorado and OceanStor 6.1.3 and later versions support Kerberos.
mountOptions.proto	Transmission protocol used for NFS mounting. The value can be **rdma**.	No	-	● The parameter is supported for NAS storage of OceanStor Dorado and OceanStor 6.1.7 and later.

Parameter	Description	Mandatory	Default Value	Remarks
mountOptions.port	Protocol port used for NFS mounting.	Conditionally mandatory	-	If the transmission protocol is **rdma**, set this parameter to **20049**.

5.2.1.1.3 Block Service

Creating a StorageClass

Step 1 Prepare a StorageClass configuration file, for example, **mysc.yaml**. For details about the StorageClass configuration, see the following example.

Step 2 Run the following command to create a StorageClass using the configuration file.

```
kubectl apply -f mysc.yaml
```

Step 3 Run the following command to view the information about the created StorageClass.

```
kubectl get sc mysc
```

The following is an example of the command output.

```
NAME   PROVISIONER     RECLAIMPOLICY   VOLUMEBINDINGMODE   ALLOWVOLUMEEXPANSION   AGE
mysc   csi.huawei.com   Delete          Immediate           true                   8s
```

----End

Block Storage Class Configuration Example

If LUNs are used as storage resources and the file system needs to be formatted to a local file system, refer to the following example.

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: mysc
provisioner: csi.huawei.com
parameters:
  backend: lun-181
  pool: StoragePool001
  volumeType: lun
  allocType: thin
  fsType: ext4
```

StorageClass Parameters Supported by Block Services

Table 5-29 StorageClass configuration parameters

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
metadata.name	User-defined name of a StorageClass object.	Yes	-	Yes	Take Kubernetes v1.22.1 as an example. The value can contain digits, lowercase letters, hyphens (-), and periods (.), and must start and end with a letter or digit.
provisioner	Name of the provisioner.	Yes	csi.huawei.com	Yes	Set this parameter to the driver name set during Huawei CSI installation. The value is the same as that of **driverName** in the **values.yaml** file.
reclaimPolicy	Reclamation policy. The following types are supported: • **Delete**: Resources are automatically reclaimed. • **Retain**: Resources are manually reclaimed.	No	Delete	Yes	• **Delete**: When a PV/PVC is deleted, resources on the storage device are also deleted. • **Retain**: When a PV/PVC is deleted, resources on the storage device are not deleted.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
allowVolumeExpansion	Whether to allow volume expansion. If this parameter is set to **true**, the capacity of the PV that uses the StorageClass can be expanded.	No	false	Yes	This function can only be used to expand PV capacity but cannot be used to reduce PV capacity.
mountOptions	List of mount parameters, which can be used to specify the parameters of the **-o** option when the **mount** command is executed on a host.	No	-	Yes	For details about common parameters in **mountOptions**, see **Table 5-30**. You can also specify other mount parameters.
parameters.backend	Name of the backend where the resource to be created is located. This field must be set if **parameters.pool** is set.	Conditionally mandatory	-	No	If this parameter is not set, Huawei CSI will randomly select a backend that meets the capacity requirements to create resources. You are advised to specify a backend to ensure that the created resource is located on the expected backend.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.pool	Name of the storage resource pool where the resource to be created is located.	No	-	No	If this parameter is not set, Huawei CSI will randomly select a storage pool that meets the capacity requirements from the selected backend to create resources. You are advised to specify a storage pool to ensure that the created resource is located in the expected storage pool.

<table>
<tr><th>Parameter</th><th>Description</th><th>Mandatory</th><th>Default Value</th><th>Whether the Volume Management Takes Effect</th><th>Remarks</th></tr>
<tr><td>parameters.volumeName</td><td>Name of the storage resource created by dynamic volume provisioning.
You can configure a placeholder to customize the storage resource name. The following placeholders are supported:
PVC namespace: {{ .PVCNamespace }}
PVC name: {{ .PVCName }}</td><td>No</td><td>-</td><td>No</td><td>The value can contain letters, digits, hyphens (-), underscores (_), and periods (.). This parameter cannot be left empty. The length of the generated storage resource name ranges from 1 to 255 characters.
Both the PVC namespace and PVC name must be configured.
To avoid duplicate resource names, the PVC UID is added to the end of the name as a unique identifier by default.
Configuration example:
PVC namespace: namespace. PVC name: pvc-1. PVC UID: c2fd3f46-bf17-4a7d-b88e-2e3232bae434.
volumeName is set to prefix-{{ .PVCNamespace }}_{{ .PVCName }}.
The ultimate storage resource name is prefix-namespace_pvc-1-</td></tr>
</table>

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
					c2fd3f46bf174a7db88e2e3232bae434.
parameters.volumeType	Type of the volume to be created. The following types are supported: ● **lun**: A LUN is provisioned on the storage side. ● **fs**: A file system is provisioned on the storage side. ● **dtree**: A volume of the dtree type is provisioned on the storage side.	Yes	-	Yes	The value is fixed to **lun**.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.allocType	Allocation type of the volume to be created. The following types are supported: • **thin**: Not all required space is allocated during creation. Instead, the space is dynamically allocated based on the usage. • **thick**: All required space is allocated during creation.	No	thin	No	If this parameter is set to **thin**, the required space is not allocated immediately when a volume is created. Instead, the space is dynamically allocated based on the usage. OceanStor Dorado does not support **thick**.
parameters.fsType	Type of a host file system. The supported types are: • ext2 • ext3 • ext4 • xfs	No	ext4	Yes	This parameter is available only when **volumeMode** of the PVC is set to **Filesystem**.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.cloneSpeed	Cloning speed. The value ranges from 1 to 4.	No	3	No	**4** indicates the highest speed. This parameter takes effect when a PVC is cloned or a PVC is created from a snapshot.
parameters.applicationType	Application type name of the LUN to be created.	No	-	Yes	Log in to DeviceManager and choose **Services** > **Block Service** > **LUN Groups** (or **Namespace Groups**) > **LUNs** (or **Namespaces**) > **Create** to obtain the application type name.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.qos	LUN/NAS QoS settings of the PV on the storage side. The value of the parameter is JSON character strings in dictionary format. A character string is enclosed by single quotation marks and the dictionary key by double quotation marks. Example: **'{"maxMBPS": 999, "maxIOPS": 999}'**	No	-	No	For details about the supported QoS configurations, see **Table 5-31**.
parameters.fsPermission	Permission on the directory mounted to a container.	No	-	No	For details about the configuration format, refer to the Linux permission settings, for example, 777 and 755.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.disableVerifyCapacity	Whether to disable volume capacity verification. After this function is disabled, the system will not verify whether the volume capacity is an integer multiple of the sector size. The value can be: • "true": disables volume capacity verification. • "false": enables volume capacity verification. **NOTICE** When Red Hat OpenShift Virtualization is used to connect to CSI, this parameter must be set to **true**.	No	"true"	Yes	For OceanStor Dorado and OceanStor storage, the sector size is 512 bytes.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.description	Description of the LUN to be created. Value type: character string The value contains 0 to 255 characters.	No	Created from Kubernetes CSI	No	

Table 5-30 Common parameters in mountOptions

Parameter	Description	Mandatory	Default Value	Remarks
mountOptions.discard	Automatically triggers the Trim or Discard operation when a file system is mounted. This operation instructs a block device to release unused blocks.	No	-	The xfs and ext4 file systems are supported.

Table 5-31 Supported QoS configurations

Storage Type	Parameter	Description	Remarks
OceanStor V5	IOTYPE	Read/write type.	This parameter is optional. If it is not specified, the default value of the storage backend is used. For details, see related storage documents. The value can be: • **0**: read I/O • **1**: write I/O • **2**: read and write I/Os
	MAXBANDWIDTH	Maximum bandwidth. This is a restriction policy parameter.	The value is an integer greater than 0, expressed in MB/s.
	MINBANDWIDTH	Minimum bandwidth. This is a protection policy parameter.	The value is an integer greater than 0, expressed in MB/s.
	MAXIOPS	Maximum IOPS. This is a restriction policy parameter.	The value is an integer greater than 0.
	MINIOPS	Minimum IOPS. This is a protection policy parameter.	The value is an integer greater than 0.
	LATENCY	Maximum latency. This is a protection policy parameter.	The value is an integer greater than 0, expressed in ms.
OceanStor Dorado/OceanStor	IOTYPE	Read/write type.	The value can be: • **2**: read and write I/Os
	MAXBANDWIDTH	Maximum bandwidth. This is a restriction policy parameter.	The value is an integer ranging from 1 to 999999999, expressed in MB/s.
	MINBANDWIDTH	Minimum bandwidth. This is a protection policy parameter.	The value is an integer ranging from 1 to 999999999, expressed in MB/s.
	MAXIOPS	Maximum IOPS. This is a restriction policy parameter.	The value is an integer ranging from 100 to 999999999.

Storage Type	Parameter	Description	Remarks
	MINIOPS	Minimum IOPS. This is a protection policy parameter.	The value is an integer ranging from 100 to 999999999.
	LATENCY	Maximum latency. This is a protection policy parameter.	The value can be **0.5** or **1.5**, expressed in ms.

5.2.1.2 Flash Storage (OceanStor A600/A800)

5.2.1.2.1 File System

Creating a StorageClass

Step 1 Prepare a StorageClass configuration file, for example, **mysc.yaml**. For details about the StorageClass configuration, see the following example.

Step 2 Run the following command to create a StorageClass using the configuration file.

```
kubectl apply -f mysc.yaml
```

Step 3 Run the following command to view the information about the created StorageClass.

```
kubectl get sc mysc
```

The following is an example of the command output.

```
NAME   PROVISIONER     RECLAIMPOLICY   VOLUMEBINDINGMODE   ALLOWVOLUMEEXPANSION   AGE
mysc   csi.huawei.com   Delete          Immediate           true                   8s
```

----End

NFS Protocol Configuration Example

When a container uses the NFS protocol to connect to file system resources, refer to the following StorageClass configuration example. In this example, NFS version 4.1 is specified for mounting.

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: mysc
provisioner: csi.huawei.com
parameters:
  backend: nfs-nas-181
  pool: StoragePool001
  volumeType: fs
  allocType: thin
  authClient: "*"
mountOptions:
  - nfsvers=4.1 # Specify the version 4.1 for NFS mounting.
```

DataTurbo Protocol Configuration Example

If a container uses OceanStor A series storage and the storage supports DataTurbo-based access, you can refer to the following configuration example. In this example, the DataTurbo share user name is **user01**.

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: mysc
provisioner: csi.huawei.com
parameters:
  backend: dtfs-nas-181
  pool: pool001
  volumeType: fs
  allocType: thin
  authUser: user01
```

StorageClass Parameters Supported by File Services

Table 5-32 StorageClass configuration parameters

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
metadata.name	User-defined name of a StorageClass object.	Yes	-	Yes	Take Kubernetes v1.22.1 as an example. The value can contain digits, lowercase letters, hyphens (-), and periods (.), and must start and end with a letter or digit.
provisioner	Name of the provisioner.	Yes	csi.huawei.com	Yes	Set this parameter to the driver name set during Huawei CSI installation. The value is the same as that of **driverName** in the **values.yaml** file.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
reclaimPolicy	Reclamation policy. The following types are supported: • **Delete**: Resources are automatically reclaimed. • **Retain**: Resources are manually reclaimed.	No	Delete	Yes	• **Delete**: When a PV/PVC is deleted, resources on the storage device are also deleted. • **Retain**: When a PV/PVC is deleted, resources on the storage device are not deleted.
allowVolumeExpansion	Whether to allow volume expansion. If this parameter is set to **true**, the capacity of the PV that uses the StorageClass can be expanded.	No	false	Yes	This function can only be used to expand PV capacity but cannot be used to reduce PV capacity.
mountOptions	List of mount parameters, which can be used to specify the parameters of the **-o** option when the **mount** command is executed on a host.	No	-	Yes	For details about common parameters in **mountOptions**, see **Table 5-33**. You can also specify other mount parameters.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.backend	Name of the backend where the resource to be created is located. This field must be set if **parameters.pool** is set.	Conditionally mandatory	-	No	If this parameter is not set, Huawei CSI will randomly select a backend that meets the capacity requirements to create resources. You are advised to specify a backend to ensure that the created resource is located on the expected backend.
parameters.pool	Name of the storage resource pool where the resource to be created is located.	No	-	No	If this parameter is not set, Huawei CSI will randomly select a storage pool that meets the capacity requirements from the selected backend to create resources. You are advised to specify a storage pool to ensure that the created resource is located in the expected storage pool.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.volumeName	Name of the storage resource created by dynamic volume provisioning. You can configure a placeholder to customize the storage resource name. The following placeholders are supported: ● PVC namespace: {{ .PVCNamespace }} ● PVC name: {{ .PVCName }}	No	-	No	● The value can contain letters, digits, hyphens (-), underscores (_), and periods (.). This parameter cannot be left empty. The length of the generated storage resource name ranges from 1 to 255 characters. ● Both the PVC namespace and PVC name must be configured. ● To avoid duplicate resource names, the PVC UID is added to the end of the name as a unique identifier by default. Configuration example: PVC namespace: **namespace**. PVC name: **pvc-1**. PVC UID: **c2fd3f46-bf17-4a7d-b88e-2e3232bae434**. **volumeName** is set to **prefix-{{ .PVCNamespace }}_{{ .PVCName }}**. The ultimate storage resource name is **prefix-namespace_pvc-1-**

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
					c2fd3f46bf174a7db88e2e3232bae434.
parameters.volumeType	Type of the volume to be created. The following types are supported: ● **lun**: A LUN is provisioned on the storage side. ● **fs**: A file system is provisioned on the storage side. ● **dtree**: A volume of the dtree type is provisioned on the storage side.	Yes	-	Yes	To use the file service, you must set this parameter to **fs**.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.allocType	Allocation type of the volume to be created. The following types are supported: ● **thin**: Not all required space is allocated during creation. Instead, the space is dynamically allocated based on the usage.	No	thin	No	If this parameter is set to **thin**, the required space is not allocated immediately when a volume is created. Instead, the space is dynamically allocated based on the usage.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.authClient	IP address of the NFS client that can access the volume. This parameter is mandatory when the **nfs** or **nfs+** protocol is used. You can enter the client host name (a full domain name is recommended), client IP address, or client IP address segment.	Conditionally mandatory	-	No	The asterisk (*) can be used to indicate any client. If you are not sure about the IP address of the access client, you are advised to use the asterisk (*) to prevent the client access from being rejected by the storage system. If the client host name is used, you are advised to use the full domain name. The IP addresses can be IPv4 addresses, IPv6 addresses, or a combination of IPv4 and IPv6 addresses. You can enter multiple host names, IP addresses, or IP address segments and separate them with semicolons (;). Example: **192.168.0.10;192.168.0.0/24;myserver1.test**
parameters.authUser	DataTurbo user who can access the DataTurbo share. This parameter is mandatory when the **DataTurbo(dtfs)** protocol is used.	Conditionally mandatory	-	No	You can enter multiple DataTurbo users at a time and separate them with semicolons (;). Example: **auth_user1;auth_user2;auth_user3**

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.applicationType	Application type name when a file system is created.	No	-	Yes	Log in to DeviceManager and choose **Services** > **File Service** > **File Systems** > **Create** to obtain the application type name.
parameters.fsPermission	Permission on the directory mounted to a container.	No	-	No	For details about the configuration format, refer to the Linux permission settings, for example, 777 and 755.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.rootSquash	Controls the **root** permission of the client. The value can be: ● **root_squash**: The client cannot access the storage system as user **root**. If a client accesses the storage system as user **root**, the client will be mapped as an anonymous user. ● **no_root_squash**: A client can access the storage system as user **root** and has the permission of user **root**.	No	-	No	

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.allSquash	Whether to retain the user ID (UID) and group ID (GID) of a shared directory. The value can be: ● **all_squash**: The UID and GID of the shared directory are mapped to anonymous users. ● **no_all_squash**: The UID and GID of the shared directory are retained.	No	-	No	

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.disableVerifyCapacity	Whether to disable volume capacity verification. After this function is disabled, the system will not verify whether the volume capacity is an integer multiple of the sector size. The value can be: • "true": disables volume capacity verification. • "false": enables volume capacity verification. **NOTICE** When Red Hat OpenShift Virtualization is used to connect to CSI, this parameter must be set to **true**.	No	"true"	Yes	The sector size of OceanStor A series is 512 bytes.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.description	Description of the file system to be created. Value type: character string The value contains 0 to 255 characters.	No	Created from Kubernetes CSI	No	
parameters.advancedOptions	Advanced volume creation parameters. The value of the parameter is JSON character strings in dictionary format. A character string is enclosed by single quotation marks and the dictionary key by double quotation marks. Example: **'{"CAPACITYTHRESHOLD": 90}'**	No	-	No	For details about the supported advanced parameters, see **Table 5-34**.

Table 5-33 Common parameters in mountOptions

Parameter	Description	Mandatory	Default Value	Remarks
mountOptions.nfsvers	NFS mount option on the host. The following mount option is supported: **nfsvers**: protocol version for NFS mounting. The value can be **3**, **4**, **4.0**, **4.1**, or **4.2**.	No	-	This parameter specified after the **-o** parameter is optional when the **mount** command is executed on the host. The value is in list format. If the NFS version is specified for mounting, NFS 3, 4.0, 4.1, and 4.2 protocols are supported (the protocol must be supported and enabled on storage devices). If **nfsvers** is set to **4**, the latest protocol version NFS 4 may be used for mounting due to different OS configurations, for example, 4.2. If the 4.0 protocol is required, you are advised to set **nfsvers** to **4.0**.

Parameter	Description	Mandatory	Default Value	Remarks
mountOptions.dn	Domain name of the logical port used for mounting when the **DataTurbo(dtfs)** protocol is used.	No	WWN of a storage device.	To mount the HyperScale cluster file system, enter the domain name of the HyperScale cluster. The description of the **dn** parameter is for reference only. For details about other mounting parameters of the DataTurbo protocol, see **OceanStor DataTurbo DTFS User Guide**.

Table 5-34 Supported advanced volume creation parameters

Parameter	Description	Remarks
CAPACITYTHRESHOLD	Total capacity alarm threshold.	Parameter type: uint64. For details about the default value and value range, see the corresponding storage product manual.

5.2.1.3 DME (Interconnected with an OceanStor A800 Cluster)

5.2.1.3.1 File System

Creating a StorageClass

Step 1 Prepare a StorageClass configuration file, for example, **mysc.yaml**. For details about the StorageClass configuration, see the following example.

Step 2 Run the following command to create a StorageClass using the configuration file.

```
kubectl apply -f mysc.yaml
```

Step 3 Run the following command to view the information about the created StorageClass.

```
kubectl get sc mysc
```

The following is an example of the command output.

```
NAME   PROVISIONER      RECLAIMPOLICY   VOLUMEBINDINGMODE   ALLOWVOLUMEEXPANSION   AGE
mysc   csi.huawei.com   Delete          Immediate           true                   8s
```

----End

NFS Protocol Configuration Example

When a container uses the NFS protocol to connect to global file system resources, refer to the following StorageClass configuration example. In this example, NFS version 3 is specified for mounting.

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: mysc
provisioner: csi.huawei.com
parameters:
  backend: nfs-nas-181
  pool: StoragePool001
  volumeType: fs
  allocType: thin
  authClient: "*"
mountOptions:
  - nfsvers=3 # Specify the version 3 for NFS mounting.
```

DataTurbo Protocol Configuration Example

When a container uses the DataTurbo protocol to connect to global file system resources, refer to the following configuration example. In this example, the DataTurbo share user name is **user01**.

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: mysc
provisioner: csi.huawei.com
parameters:
  backend: dtfs-nas-181
  pool: pool001
  volumeType: fs
  allocType: thin
  authUser: user01
mountOptions:
- dn=xxx # Specify the domain name of the logical port as xxx.
```


StorageClass Parameters Supported by File Services

Table 5-35 StorageClass configuration parameters

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
metadata.name	User-defined name of a StorageClass object.	Yes	-	Yes	Take Kubernetes v1.22.1 as an example. The value can contain digits, lowercase letters, hyphens (-), and periods (.), and must start and end with a letter or digit.
provisioner	Name of the provisioner.	Yes	csi.huawei.com	Yes	Set this parameter to the driver name set during Huawei CSI installation. The value is the same as that of **driverName** in the **values.yaml** file.
reclaimPolicy	Reclamation policy. The following types are supported: • **Delete**: Resources are automatically reclaimed. • **Retain**: Resources are manually reclaimed.	No	Delete	Yes	• **Delete**: When a PV/PVC is deleted, resources on the storage device are also deleted. • **Retain**: When a PV/PVC is deleted, resources on the storage device are not deleted.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
allowVolumeExpansion	Whether to allow volume expansion. If this parameter is set to **true**, the capacity of the PV that uses the StorageClass can be expanded.	No	false	Yes	This function can only be used to expand PV capacity but cannot be used to reduce PV capacity.
mountOptions	List of mount parameters, which can be used to specify the parameters of the **-o** option when the **mount** command is executed on a host.	No	-	Yes	For details about common parameters in **mountOptions**, see **Table 5-36**. You can also specify other mount parameters.
parameters.backend	Name of the backend where the resource to be created is located. This field must be set if **parameters.pool** is set.	Conditionally mandatory	-	No	If this parameter is not set, Huawei CSI will randomly select a backend that meets the capacity requirements to create resources. You are advised to specify a backend to ensure that the created resource is located on the expected backend.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.pool	Name of the storage resource pool where the resource to be created is located.	No	-	No	If this parameter is not set, Huawei CSI will randomly select a storage pool that meets the capacity requirements from the selected backend to create resources. You are advised to specify a storage pool to ensure that the created resource is located in the expected storage pool.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.volumeName	Name of the storage resource created by dynamic volume provisioning. You can configure a placeholder to customize the storage resource name. The following placeholders are supported: ● PVC namespace: {{ .PVCNamespace }} ● PVC name: {{ .PVCName }}	No	-	No	● The value can contain letters, digits, hyphens (-), underscores (_), and periods (.). This parameter cannot be left empty. The length of the generated storage resource name ranges from 1 to 255 characters. ● Both the PVC namespace and PVC name must be configured. ● To avoid duplicate resource names, the PVC UID is added to the end of the name as a unique identifier by default. Configuration example: PVC namespace: **namespace**. PVC name: **pvc-1**. PVC UID: **c2fd3f46-bf17-4a7d-b88e-2e3232bae434**. **volumeName** is set to **prefix-{{ .PVCNamespace }}_{{ .PVCName }}**. The ultimate storage resource name is **prefix-namespace_pvc-1-**

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
					c2fd3f46bf174a7db88e2e3232bae434.
parameters.volumeType	Type of the volume to be created. The following types are supported: • **lun**: A LUN is provisioned on the storage side. • **fs**: A file system is provisioned on the storage side. • **dtree**: A volume of the dtree type is provisioned on the storage side.	Yes	-	Yes	To use the file service, you must set this parameter to **fs**.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.allocType	Allocation type of the volume to be created. The following types are supported: • **thin**: Not all required space is allocated during creation. Instead, the space is dynamically allocated based on the usage.	No	thin	No	If this parameter is set to **thin**, the required space is not allocated immediately when a volume is created. Instead, the space is dynamically allocated based on the usage.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.authClient	IP address of the NFS client that can access the volume. This parameter is mandatory when the **nfs** or **nfs+** protocol is used. You can enter the client host name (a full domain name is recommended), client IP address, or client IP address segment.	Conditionally mandatory	-	No	The asterisk (*) can be used to indicate any client. If you are not sure about the IP address of the access client, you are advised to use the asterisk (*) to prevent the client access from being rejected by the storage system. If the client host name is used, you are advised to use the full domain name. The IP addresses can be IPv4 addresses, IPv6 addresses, or a combination of IPv4 and IPv6 addresses. You can enter multiple host names, IP addresses, or IP address segments and separate them with semicolons (;). Example: **192.168.0.10;192.168.0.0/24;myserver1.test**
parameters.authUser	DataTurbo user who can access the DataTurbo share. This parameter is mandatory when the **DataTurbo(dtfs)** protocol is used.	Conditionally mandatory	-	No	You can enter multiple DataTurbo users at a time and separate them with semicolons (;). Example: **auth_user1;auth_user2;auth_user3**

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.rootSquash	Controls the **root** permission of the client. The value can be: • **root_squash**: The client cannot access the storage system as user **root**. If a client accesses the storage system as user **root**, the client will be mapped as an anonymous user. • **no_root_squash**: A client can access the storage system as user **root** and has the permission of user **root**.	No	-	No	

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.allSquash	Whether to retain the user ID (UID) and group ID (GID) of a shared directory. The value can be: • **all_squash**: The UID and GID of the shared directory are mapped to anonymous users. • **no_all_squash**: The UID and GID of the shared directory are retained.	No	-	No	

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.disableVerifyCapacity	Whether to disable volume capacity verification. After this function is disabled, the system will not verify whether the volume capacity is an integer multiple of the sector size. The value can be: ● "true": disables volume capacity verification. ● "false": enables volume capacity verification. **NOTICE** When Red Hat OpenShift Virtualization is used to connect to CSI, this parameter must be set to **true**.	No	"true"	Yes	The sector size of OceanStor A series is 512 bytes.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.description	Description of the file system to be created. Value type: character string The value contains 0 to 255 characters.	No	Created from Kubernetes CSI	No	

Table 5-36 Common parameters in mountOptions

Parameter	Description	Mandatory	Default Value	Remarks
mountOptions.nfsvers	NFS mount option on the host. The following mount option is supported: **nfsvers**: protocol version for NFS mounting. The value can be **3**.	No	-	This parameter specified after the **-o** parameter is optional when the **mount** command is executed on the host. The value is in list format. If the NFS version is specified for mounting, the NFS 3 protocol is supported (the protocol must be supported and enabled on storage devices).

Parameter	Description	Mandatory	Default Value	Remarks
mountOptions.dn	Domain name of the logical port used for mounting when the **DataTurbo(dtfs)** protocol is used.	Yes	-	To mount the HyperScale cluster file system, enter the domain name of the HyperScale cluster. The description of the **dn** parameter is for reference only. For details about other mounting parameters of the DataTurbo protocol, see **OceanStor DataTurbo DTFS User Guide**.

5.2.1.4 Mass Storage (FusionStorage Block/OceanStor Pacific Series)

5.2.1.4.1 File System

Creating a StorageClass

Step 1 Prepare a StorageClass configuration file, for example, **mysc.yaml**. For details about the StorageClass configuration, see the following example.

Step 2 Run the following command to create a StorageClass using the configuration file.

```
kubectl apply -f mysc.yaml
```

Step 3 Run the following command to view the information about the created StorageClass.

```
kubectl get sc mysc
```

The following is an example of the command output.

```
NAME   PROVISIONER     RECLAIMPOLICY   VOLUMEBINDINGMODE   ALLOWVOLUMEEXPANSION   AGE
mysc   csi.huawei.com   Delete          Immediate           true                   8s
```

----End

NFS Protocol Configuration Example

When a container uses the NFS protocol to connect to file system resources, refer to the following StorageClass configuration example. In this example, NFS version 4.1 is specified for mounting.

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: mysc
provisioner: csi.huawei.com
parameters:
  backend: nfs-nas-181
  pool: pool001
  volumeType: fs
  allocType: thin
  authClient: "*"
mountOptions:
  - nfsvers=4.1 # Specify the version 4.1 for NFS mounting.
```

DPC Protocol Configuration Example

When the storage supports access using the DPC protocol, you can configure the mount parameters for DPC access in the StorageClass. In this example, **acl** is used as the authentication parameter for mounting, and **cnflush** is used to set the asynchronous disk flushing mode.

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: mysc
provisioner: csi.huawei.com
parameters:
  backend: nfs-dpc-101
  pool: pool001
  volumeType: fs
  allocType: thin
mountOptions:
  - acl # Set the authentication parameter.
  - cnflush # Set the asynchronous disk flushing mode.
```


StorageClass Parameters Supported by File Systems

Table 5-37 StorageClass configuration parameters

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
metadata.name	User-defined name of a StorageClass object.	Yes	-	Yes	Take Kubernetes v1.22.1 as an example. The value can contain digits, lowercase letters, hyphens (-), and periods (.), and must start and end with a letter or digit.
provisioner	Name of the provisioner.	Yes	csi.huawei.com	Yes	Set this parameter to the driver name set during Huawei CSI installation. The value is the same as that of **driverName** in the **values.yaml** file.
reclaimPolicy	Reclamation policy. The following types are supported: ● **Delete**: Resources are automatically reclaimed. ● **Retain**: Resources are manually reclaimed.	No	Delete	Yes	● **Delete**: When a PV/PVC is deleted, resources on the storage device are also deleted. ● **Retain**: When a PV/PVC is deleted, resources on the storage device are not deleted.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
allowVolumeExpansion	Whether to allow volume expansion. If this parameter is set to **true**, the capacity of the PV that uses the StorageClass can be expanded.	No	false	Yes	This function can only be used to expand PV capacity but cannot be used to reduce PV capacity.
mountOptions	List of mount parameters, which can be used to specify the parameters of the **-o** option when the **mount** command is executed on a host.	No	-	Yes	For details about common parameters in **mountOptions**, see **Table 5-38**. You can also specify other mount parameters.
parameters.backend	Name of the backend where the resource to be created is located. This field must be set if **parameters.pool** is set.	Conditionally mandatory	-	No	If this parameter is not set, Huawei CSI will randomly select a backend that meets the capacity requirements to create resources. You are advised to specify a backend to ensure that the created resource is located on the expected backend.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.pool	Name of the storage resource pool where the resource to be created is located.	No	-	No	If this parameter is not set, Huawei CSI will randomly select a storage pool that meets the capacity requirements from the selected backend to create resources. You are advised to specify a storage pool to ensure that the created resource is located in the expected storage pool.
parameters.volumeType	Type of the volume to be created. The following types are supported: ● **lun**: A LUN is provisioned on the storage side. ● **fs**: A file system is provisioned on the storage side. ● **dtree**: A volume of the Dtree type is provisioned on the storage side.	Yes	-	Yes	The value is fixed to **fs**.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.allocType	Allocation type of the volume to be created. The following types are supported: • **thin**: Not all required space is allocated during creation. Instead, the space is dynamically allocated based on the usage.	No	thin	No	If this parameter is set to **thin**, the required space is not allocated immediately when a volume is created. Instead, the space is dynamically allocated based on the usage.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.authClient	IP address of the NFS client that can access the volume. This parameter is mandatory when the NFS protocol is used. You can enter the client host name (a full domain name is recommended), client IP address, or client IP address segment.	Conditionally mandatory	-	No	The asterisk (*) can be used to indicate any client. If you are not sure about the IP address of the access client, you are advised to use the asterisk (*) to prevent the client access from being rejected by the storage system. If the client host name is used, you are advised to use the full domain name. The IP addresses can be IPv4 addresses, IPv6 addresses, or a combination of IPv4 and IPv6 addresses. You can enter multiple host names, IP addresses, or IP address segments and separate them with semicolons (;). Example: **192.168.0.10;192.168.0.0/24;myserver1.test**

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.storageQuota	File system quota settings. The value of the parameter is JSON character strings in dictionary format. A character string is enclosed by single quotation marks and the dictionary key by double quotation marks. Example: **'{"spaceQuota": "softQuota", "gracePeriod": 100}'**	No	-	No	For details about the supported quota configurations, see **Table 5-40**.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.qos	QoS settings of the file system on the storage side of the PV. The value of the parameter is JSON character strings in dictionary format. A character string is enclosed by single quotation marks and the dictionary key by double quotation marks. Example: **'{"maxMBPS": 999, "maxIOPS": 999}'**	No	-	No	For details about the supported QoS configurations, see **Table 5-39**.
parameters.fsPermission	Permission on the directory mounted to a container.	No	-	No	For details about the configuration format, refer to the Linux permission settings, for example, 777 and 755.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.rootSquash	Controls the **root** permission of the client. The value can be: ● **root_squash**: The client cannot access the storage system as user **root**. If a client accesses the storage system as user **root**, the client will be mapped as an anonymous user. ● **no_root_squash**: A client can access the storage system as user **root** and has the permission of user **root**.	No	-	No	

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.allSquash	Whether to retain the user ID (UID) and group ID (GID) of a shared directory. The value can be: • **all_squash**: The UID and GID of the shared directory are mapped to anonymous users. • **no_all_squash**: The UID and GID of the shared directory are retained.	No	-	No	

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.snapshotDirectoryVisibility	Whether the snapshot directory is visible. The value can be: ● **visible**: The snapshot directory is visible. ● **invisible**: The snapshot directory is invisible.	No	-	No	

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.disableVerifyCapacity	Whether to disable volume capacity verification. After this function is disabled, the system will not verify whether the volume capacity is an integer multiple of the sector size. The value can be: • "true": disables volume capacity verification. • "false": enables volume capacity verification. **NOTICE** When Red Hat OpenShift Virtualization is used to connect to CSI, this parameter must be set to **true**.	No	"true"	No	For OceanStor Pacific NAS, the sector size is 1 KB.

Table 5-38 Common parameters in mountOptions

Parameter	Description	Mandatory	Default Value	Remarks
mountOptions.nfsvers	NFS mount option on the host. The following mount option is supported: **nfsvers**: protocol version for NFS mounting. The value can be **3**, **4**, **4.0**, **4.1**, or **4.2**.	No	-	This parameter is optional after the **-o** parameter when the **mount** command is executed on the host. The value is in list format. If the NFS version is specified for mounting, NFS 3, 4.0, 4.1, and 4.2 protocols are supported (the protocol must be supported and enabled on storage devices). If **nfsvers** is set to **4**, the latest protocol version NFS 4 may be used for mounting due to different OS configurations, for example, 4.2. If the 4.0 protocol is required, you are advised to set **nfsvers** to **4.0**.

Parameter	Description	Mandatory	Default Value	Remarks
mountOptions.proto	Transmission protocol used for NFS mounting. The value can be **rdma**.	No	-	This example applies to 8.2.0 or later.
mountOptions.port	Protocol port used for NFS mounting.	Conditionally mandatory	-	If the transmission protocol is **rdma**, set this parameter to **20049**.
mountOptions.acl	The DPC namespace supports the ACL function. The DPC client supports POSIX ACL, NFSv4 ACL, and NT ACL authentication.	No	-	The descriptions of **acl**, **aclonlyposix**, **cnflush**, and **cflush** are for reference only. For details about the parameters, see **OceanStor Pacific Series Product Documentation** and choose **Configuration** > **Basic Service Configuration Guide for File** > **Configuring Basic Services (DPC Scenario)** > **Accessing a DPC Share on a Client** > **Step 2**.

Parameter	Description	Mandatory	Default Value	Remarks
mountOptions.aclonlyposix	The DPC namespace supports POSIX ACL, and the DPC client supports POSIX ACL authentication. The following protocols support POSIX ACL: DPC, NFSv3, and HDFS. If NFSv4 ACL or NT ACL is used, the DPC client cannot identify the ACL of this type. As a result, the ACL of this type does not take effect.	No	-	If **aclonlyposix** and **acl** are used together, only **acl** takes effect. That is, the namespace supports the ACL function.

Parameter	Description	Mandatory	Default Value	Remarks
mountOptions.cnflush	Asynchronous disk flushing mode. That is, data is not flushed to disks immediately when files in the namespace are closed.	No	-	Asynchronous flushing mode: When a file is closed, data in the cache is not flushed to storage media in synchronous mode. Instead, data is written from the cache to the storage media in asynchronous flushing mode. After the write service is complete, data is flushed from the cache to disks periodically based on the flushing period. In a multi-client scenario, if concurrent operations are performed on the same file, the file size update is affected by the disk flushing period. That is, the file size is updated only after the disk flushing is complete. Generally, the

Parameter	Description	Mandatory	Default Value	Remarks
				update is completed within several seconds. Synchronous I/Os are not affected by the disk flushing period.
mountOptions.cflush	Synchronous disk flushing mode. That is, data is flushed to disks immediately when files in the namespace are closed.	No	-	By default, the synchronous disk flushing mode is used.

Table 5-39 Supported QoS configurations

Parameter	Description	Remarks
maxMBPS	Maximum bandwidth. This is a restriction policy parameter.	This parameter is mandatory. The value is an integer greater than 0, expressed in MB/s. For details about the maximum value, see the actual limit of the storage device. For example, the maximum value of OceanStor Pacific NAS is 1073741824.
maxIOPS	Maximum IOPS. This is a restriction policy parameter.	This parameter is mandatory. The value is an integer greater than 0. For details about the maximum value, see the actual limit of the storage device. For example, the maximum value of OceanStor Pacific NAS is 1073741824000.

Table 5-40 Supported quota configurations

Parameter	Description	Remarks
spaceQuota	File quota type.	This parameter is mandatory. Only **softQuota** or **hardQuota** can be configured.
gracePeriod	Grace period allowed when the soft quota is configured.	This parameter is conditionally optional only when **spaceQuota** is set to **softQuota**. The value is an integer ranging from 0 to 4294967294.

5.2.1.4.2 Dtree

Creating a StorageClass

Step 1 Prepare a StorageClass configuration file, for example, **mysc.yaml**. For details about the StorageClass configuration, see the following example.

Step 2 Run the following command to create a StorageClass using the configuration file.

```
kubectl apply -f mysc.yaml
```

Step 3 Run the following command to view the information about the created StorageClass.

```
kubectl get sc mysc
```

The following is an example of the command output.

```
NAME   PROVISIONER     RECLAIMPOLICY   VOLUMEBINDINGMODE   ALLOWVOLUMEEXPANSION   AGE
mysc   csi.huawei.com   Delete          Immediate           true                   8s
```

----End

Example of StorageClass Configuration Supported by the NFS Protocol

When a container uses the NFS protocol to connect to dtree resources, refer to the following StorageClass configuration example. In this example, NFS version 4.1 is specified for mounting.

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: mysc
provisioner: csi.huawei.com
parameters:
  backend: nfs-dtree-181
  parentname: parent-filesystem-name
  volumeType: dtree
  authClient: "*"
mountOptions:
  - nfsvers=4.1 # Specify the version 4.1 for NFS mounting.
```


Example of StorageClass Configuration Supported by the DPC Protocol

When a container uses the DPC protocol to connect to dtree resources, refer to the following StorageClass configuration example. In this example, **acl** is used as the authentication parameter for mounting, and **cnflush** is used to set the asynchronous disk flushing mode.

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: mysc
provisioner: csi.huawei.com
parameters:
  backend: nfs-dtree-181
  parentname: parent-filesystem-name
  volumeType: dtree
  authClient: "*"
mountOptions:
  - acl # Set the authentication parameter.
  - cnflush # Set the asynchronous disk flushing mode.
```

StorageClass Parameters Supported by Dtrees

Table 5-41 StorageClass configuration parameters

Parameter	Description	Mandatory	Default Value	Remarks
metadata.name	User-defined name of a StorageClass object.	Yes	-	Take Kubernetes v1.22.1 as an example. The value can contain digits, lowercase letters, hyphens (-), and periods (.), and must start and end with a letter or digit.
provisioner	Name of the provisioner.	Yes	csi.huawei.com	Set this parameter to the driver name set during Huawei CSI installation. The value is the same as that of **driverName** in the **values.yaml** file.

Parameter	Description	Mandatory	Default Value	Remarks
reclaimPolicy	Reclamation policy. The following types are supported: ● **Delete**: Resources are automatically reclaimed. ● **Retain**: Resources are manually reclaimed.	No	Delete	● **Delete**: When a PV/PVC is deleted, resources on the storage device are also deleted. ● **Retain**: When a PV/PVC is deleted, resources on the storage device are not deleted.
allowVolumeExpansion	Whether to allow volume expansion. If this parameter is set to **true**, the capacity of the PV that uses the StorageClass can be expanded.	No	false	This function can only be used to expand PV capacity but cannot be used to reduce PV capacity.
mountOptions	List of mount parameters, which can be used to specify the parameters of the **-o** option when the **mount** command is executed on a host.	No	-	For details about common parameters in **mountOptions**, see **Table 5-42**. You can also specify other mount parameters.

Parameter	Description	Mandatory	Default Value	Remarks
parameters.backend	Name of the backend where the resource to be created is located.	Conditionally mandatory	-	If this parameter is not set, Huawei CSI will randomly select a backend that meets the capacity requirements to create resources. You are advised to specify a backend to ensure that the created resource is located on the expected backend. This parameter is mandatory if **parameters.parentname** is set.
parameters.parentname	Name of a file system on the current storage device. Dtree is created in the file system.	Conditionally mandatory	-	This parameter is mandatory when **parentname** is not set for the backend. If **parentname** is configured only in the StorageClass but not configured in the storage backend, set **CSIDriverObject.attachRequired** to **true** during CSI installation.

Parameter	Description	Mandatory	Default Value	Remarks
parameters.volumeType	Type of the volume to be created. The following types are supported: ● **lun**: A LUN is provisioned on the storage side. ● **fs**: A file system is provisioned on the storage side. ● **dtree**: A volume of the Dtree type is provisioned on the storage side.	Yes	-	When dtree is used, the value must be **dtree**.

Parameter	Description	Mandatory	Default Value	Remarks
parameters.authClient	IP address of the NFS client that can access the volume. You can enter the client host name (a full domain name is recommended), client IP address, or client IP address segment.	Yes	-	The asterisk (*) can be used to indicate any client. If you are not sure about the IP address of the access client, you are advised to use the asterisk (*) to prevent the client access from being rejected by the storage system. If the client host name is used, you are advised to use the full domain name. The IP addresses can be IPv4 addresses, IPv6 addresses, or a combination of IPv4 and IPv6 addresses. You can enter multiple host names, IP addresses, or IP address segments and separate them with semicolons (;). Example: **192.168.0.10;192.168.0.0/24;myserver1.test**
parameters.fsPermission	Permission on the directory mounted to a container.	No	-	For details about the configuration format, refer to the Linux permission settings, for example, 777 and 755.

Parameter	Description	Mandatory	Default Value	Remarks
parameters.rootSquash	Controls the **root** permission of the client. The value can be: ● **root_squash**: The client cannot access the storage system as user **root**. If a client accesses the storage system as user **root**, the client will be mapped as an anonymous user. ● **no_root_squash**: A client can access the storage system as user **root** and has the permission of user **root**.	No	-	

Parameter	Description	Mandatory	Default Value	Remarks
parameters.allSquash	Whether to retain the user ID (UID) and group ID (GID) of a shared directory. The value can be: ● **all_squash**: The UID and GID of the shared directory are mapped to anonymous users. ● **no_all_squash**: The UID and GID of the shared directory are retained.	No	-	

Parameter	Description	Mandatory	Default Value	Remarks
parameters.disableVerifyCapacity	Whether to disable volume capacity verification. After this function is disabled, the system will not verify whether the volume capacity is an integer multiple of the sector size. The value can be: ● "true": disables volume capacity verification. ● "false": enables volume capacity verification. **NOTICE** When Red Hat OpenShift Virtualization is used to connect to CSI, this parameter must be set to **true**.	No	"true"	For OceanStor Pacific dtrees, the sector size is 1 byte.

Table 5-42 Common parameters in mountOptions

Parameter	Description	Mandatory	Default Value	Remarks
mountOptions.nfsvers	NFS mount option on the host. The following mount option is supported: **nfsvers**: protocol version for NFS mounting. The value can be **3**, **4**, **4.0**, **4.1**, or **4.2**.	No	-	This parameter is optional after the **-o** parameter when the **mount** command is executed on the host. The value is in list format. If the NFS version is specified for mounting, NFS 3, 4.0, 4.1, and 4.2 protocols are supported (the protocol must be supported and enabled on storage devices). If **nfsvers** is set to **4**, the latest protocol version NFS 4 may be used for mounting due to different OS configurations, for example, 4.2. If the 4.0 protocol is required, you are advised to set **nfsvers** to **4.0**.

Parameter	Description	Mandatory	Default Value	Remarks
mountOptions.proto	Transmission protocol used for NFS mounting. The value can be **rdma**.	No	-	This parameter is supported by 8.2.0 or later.
mountOptions.port	Protocol port used for NFS mounting.	Conditionally mandatory	-	If the transmission protocol is **rdma**, set this parameter to **20049**.
mountOptions.acl	The DPC namespace supports the ACL function. The DPC client supports POSIX ACL, NFSv4 ACL, and NT ACL authentication.	No	-	The descriptions of **acl**, **aclonlyposix**, **cnflush**, and **cflush** are for reference only. For details about the parameters, see **OceanStor Pacific Series Product Documentation** and choose **Configuration** > **Basic Service Configuration Guide for File** > **Configuring Basic Services (DPC Scenario)** > **Accessing a DPC Share on a Client** > **Step 2**.

Parameter	Description	Mandatory	Default Value	Remarks
mountOptions.aclonlyposix	The DPC namespace supports POSIX ACL, and the DPC client supports POSIX ACL authentication. The following protocols support POSIX ACL: DPC, NFSv3, and HDFS. If NFSv4 ACL or NT ACL is used, the DPC client cannot identify the ACL of this type. As a result, the ACL of this type does not take effect.	No	-	If **aclonlyposix** and **acl** are used together, only **acl** takes effect. That is, the namespace supports the ACL function.

Parameter	Description	Mandatory	Default Value	Remarks
mountOptions.cnflush	Asynchronous disk flushing mode. That is, data is not flushed to disks immediately when files in the namespace are closed.	No	-	Asynchronous flushing mode: When a file is closed, data in the cache is not flushed to storage media in synchronous mode. Instead, data is written from the cache to the storage media in asynchronous flushing mode. After the write service is complete, data is flushed from the cache to disks periodically based on the flushing period. In a multi-client scenario, if concurrent operations are performed on the same file, the file size update is affected by the disk flushing period. That is, the file size is updated only after the disk flushing is complete. Generally, the

Parameter	Description	Mandatory	Default Value	Remarks
				update is completed within several seconds. Synchronous I/Os are not affected by the disk flushing period.
mountOptions.cflush	Synchronous disk flushing mode. That is, data is flushed to disks immediately when files in the namespace are closed.	No	-	By default, the synchronous disk flushing mode is used.

5.2.1.4.3 Block Service

Creating a StorageClass

Step 1 Prepare a StorageClass configuration file, for example, **mysc.yaml**. For details about the StorageClass configuration, see the following example.

Step 2 Run the following command to create a StorageClass using the configuration file.

```
kubectl apply -f mysc.yaml
```

Step 3 Run the following command to view the information about the created StorageClass.

```
kubectl get sc mysc
```

The following is an example of the command output.

```
NAME   PROVISIONER      RECLAIMPOLICY   VOLUMEBINDINGMODE   ALLOWVOLUMEEXPANSION   AGE
mysc   csi.huawei.com   Delete          Immediate           true                   8s
```

----End

Block StorageClass Configuration Example

If LUNs are used as storage resources and the file system needs to be formatted to a local file system, refer to the following example.

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
```

```
metadata:
  name: mysc
provisioner: csi.huawei.com
parameters:
  backend: lun-181
  pool: StoragePool001
  volumeType: lun
  allocType: thin
  fsType: ext4
```

StorageClass Parameters Supported by Block Services

Table 5-43 StorageClass configuration parameters

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
metadata.name	User-defined name of a StorageClass object.	Yes	-	Yes	Take Kubernetes v1.22.1 as an example. The value can contain digits, lowercase letters, hyphens (-), and periods (.), and must start and end with a letter or digit.
provisioner	Name of the provisioner.	Yes	csi.huawei.com	Yes	Set this parameter to the driver name set during Huawei CSI installation. The value is the same as that of **driverName** in the **values.yaml** file.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
reclaimPolicy	Reclamation policy. The following types are supported: • **Delete**: Resources are automatically reclaimed. • **Retain**: Resources are manually reclaimed.	No	Delete	Yes	• **Delete**: When a PV/PVC is deleted, resources on the storage device are also deleted. • **Retain**: When a PV/PVC is deleted, resources on the storage device are not deleted.
allowVolumeExpansion	Whether to allow volume expansion. If this parameter is set to **true**, the capacity of the PV that uses the StorageClass can be expanded.	No	false	Yes	This function can only be used to expand PV capacity but cannot be used to reduce PV capacity.
mountOptions	List of mount parameters, which can be used to specify the parameters of the **-o** option when the **mount** command is executed on a host.	No	-	Yes	For details about common parameters in **mountOptions**, see **Table 5-44**. You can also specify other mount parameters.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.backend	Name of the backend where the resource to be created is located. This field must be set if **parameters.pool** is set.	Conditionally mandatory	-	No	If this parameter is not set, Huawei CSI will randomly select a backend that meets the capacity requirements to create resources. You are advised to specify a backend to ensure that the created resource is located on the expected backend.
parameters.pool	Name of the storage resource pool where the resource to be created is located.	No	-	No	If this parameter is not set, Huawei CSI will randomly select a storage pool that meets the capacity requirements from the selected backend to create resources. You are advised to specify a storage pool to ensure that the created resource is located in the expected storage pool.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.volumeType	Type of the volume to be created. The following types are supported: • **lun**: A LUN is provisioned on the storage side. • **fs**: A file system is provisioned on the storage side. • **dtree**: A volume of the Dtree type is provisioned on the storage side.	Yes	-	Yes	The value is fixed to **lun**.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.allocType	Allocation type of the volume to be created. The following types are supported: • **thin**: Not all required space is allocated during creation. Instead, the space is dynamically allocated based on the usage.	No	thin	No	If this parameter is set to **thin**, the required space is not allocated immediately when a volume is created. Instead, the space is dynamically allocated based on the usage.
parameters.fsType	Type of a host file system. The supported types are: • ext2 • ext3 • ext4 • xfs	No	ext4	No	This parameter is available only when **volumeMode** of the PVC is set to **Filesystem**. **NOTICE** When Ubuntu 22.04 LTS with a kernel version earlier than 5.15.194 is used to interconnect with CSI, the XFS file system cannot be mounted due to a kernel bug.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.qos	LUN/NAS QoS settings of the PV on the storage side. The value of the parameter is JSON character strings in dictionary format. A character string is enclosed by single quotation marks and the dictionary key by double quotation marks. Example: **'{"maxMBPS": 999, "maxIOPS": 999}'**	No	-	No	For details about the supported QoS configurations, see **Table 5-45**.
parameters.fsPermission	Permission on the directory mounted to a container.	No	-	No	For details about the configuration format, refer to the Linux permission settings, for example, 777 and 755.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.disableVerifyCapacity	Whether to disable volume capacity verification. After this function is disabled, the system will not verify whether the volume capacity is an integer multiple of the sector size. The value can be: • "true": disables volume capacity verification. • "false": enables volume capacity verification. **NOTICE** When Red Hat OpenShift Virtualization is used to connect to CSI, this parameter must be set to **true**.	No	"true"	Yes	For OceanStor Pacific SAN, the sector size is 1 MiB.

Table 5-44 Common parameters in mountOptions

Parameter	Description	Mandatory	Default Value	Remarks
mountOptions.discard	Automatically triggers the Trim or Discard operation when a file system is mounted. This operation instructs a block device to release unused blocks.	No	-	The xfs and ext4 file systems are supported.

Table 5-45 Supported QoS configurations

Parameter	Description	Remarks
maxMBPS	Maximum bandwidth. This is a restriction policy parameter.	This parameter is mandatory. The value is an integer greater than 0, expressed in MB/s. For details about the maximum value, see the actual limit of the storage device. For example, the maximum value of OceanStor Pacific NAS is 1073741824.
maxIOPS	Maximum IOPS. This is a restriction policy parameter.	This parameter is mandatory. The value is an integer greater than 0. For details about the maximum value, see the actual limit of the storage device. For example, the maximum value of OceanStor Pacific NAS is 1073741824000.

5.2.1.5 Mass Storage (OceanDisk Series)

5.2.1.5.1 File System

Creating a StorageClass

Step 1 Prepare a StorageClass configuration file, for example, **mysc.yaml**. For details about the StorageClass configuration, see the following example.

Step 2 Run the following command to create a StorageClass using the configuration file.

```
kubectl apply -f mysc.yaml
```

Step 3 Run the following command to view the information about the created StorageClass.

```
kubectl get sc mysc
```

The following is an example of the command output.

```
NAME   PROVISIONER     RECLAIMPOLICY   VOLUMEBINDINGMODE   ALLOWVOLUMEEXPANSION
AGEmysc   csi.huawei.com   Delete         Immediate          true                8s
```

----End

NFS Protocol Configuration Example

When a container uses the NFS protocol to connect to file system resources, refer to the following StorageClass configuration example. In this example, NFS version 4.0 is specified for mounting.

```
kind: StorageClassapiVersion: storage.k8s.io/v1metadata:  name: myscprovisioner: csi.huawei.comparameters:  backend: nfs-nas-181  pool: StoragePool001  volumeType: fs  allocType: thin  authClient: "*"mountOptions:  - nfsvers=4.0 # Specify the version 4.0 for NFS mounting.
```

StorageClass Parameters Supported by File Systems

Table 5-46 StorageClass configuration parameters

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
metadata.name	User-defined name of a StorageClass object.	Yes	-	Yes	Take Kubernetes v1.22.1 as an example. The value can contain digits, lowercase letters, hyphens (-), and periods (.), and must start and end with a letter or digit.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
provisioner	Name of the provisioner.	Yes	csi.huawei.com	Yes	Set this parameter to the driver name set during Huawei CSI installation. The value is the same as that of **driverName** in the **values.yaml** file.
reclaimPolicy	Reclamation policy. The following types are supported: • **Delete**: Resources are automatically reclaimed. • **Retain**: Resources are manually reclaimed.	No	Delete	Yes	• **Delete**: When a PV/PVC is deleted, resources on the storage device are also deleted. • **Retain**: When a PV/PVC is deleted, resources on the storage device are not deleted.
allowVolumeExpansion	Whether to allow volume expansion. If this parameter is set to **true**, the capacity of the PV that uses the StorageClass can be expanded.	No	false	Yes	This function can only be used to expand PV capacity but cannot be used to reduce PV capacity.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
mountOptions	List of mount parameters, which can be used to specify the parameters of the **-o** option when the **mount** command is executed on a host.	No	-	Yes	For details about common parameters in **mountOptions**, see **Table 5-47**. You can also specify other mount parameters.
parameters.backend	Name of the backend where the resource to be created is located. This field must be set if **parameters.pool** is set.	Conditionally mandatory	-	No	If this parameter is not set, Huawei CSI will randomly select a backend that meets the capacity requirements to create resources. You are advised to specify a backend to ensure that the created resource is located on the expected backend.
parameters.pool	Name of the storage resource pool where the resource to be created is located.	No	-	No	If this parameter is not set, Huawei CSI will randomly select a storage pool that meets the capacity requirements from the selected backend to create resources. You are advised to specify a storage pool to ensure that the created resource is located in the expected storage pool.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.volumeName	Name of the storage resource created by dynamic volume provisioning. You can configure a placeholder to customize the storage resource name. The following placeholders are supported: ● PVC namespace: {{ .PVCNamespace }} ● PVC name: {{ .PVCName }}	No	-	No	● The value can contain letters, digits, hyphens (-), underscores (_), and periods (.). It cannot be left empty. The length of the expanded placeholder ranges from 1 to 255 characters. ● Both the PVC namespace and PVC name must be configured. ● To avoid duplicate resource names, the PVC UID is added to the end of the name as a unique identifier by default. Configuration example: PVC namespace: **namespace**. PVC name: **pvc-1**. PVC UID: **c2fd3f46-bf17-4a7d-b88e-2e3232bae434**. **volumeName** is set to **prefix-{{ .PVCNamespace }}_{{ .PVCName }}**. The ultimate storage resource name is **prefix-namespace_pvc-1-c2fd3f46bf174a7db88e2e3232bae434**.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.volumeType	Type of the volume to be created. The following types are supported: • **lun**: A LUN is provisioned on the storage side. • **fs**: A file system is provisioned on the storage side. • **dtree**: A volume of the Dtree type is provisioned on the storage side.	Yes	-	Yes	The value is fixed to **fs**.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.allocType	Allocation type of the volume to be created. The following types are supported: ● **thin**: Not all required space is allocated during creation. Instead, the space is dynamically allocated based on the usage.	No	thin	No	If this parameter is set to **thin**, the required space is not allocated immediately when a volume is created. Instead, the space is dynamically allocated based on the usage.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.authClient	IP address of the NFS client that can access the volume. You can enter the client host name (a full domain name is recommended), client IP address, or client IP address segment.	Yes	-	No	The asterisk (*) can be used to indicate any client. If you are not sure about the IP address of the access client, you are advised to use the asterisk (*) to prevent the client access from being rejected by the storage system. If the client host name is used, you are advised to use the full domain name. The IP addresses can be IPv4 addresses, IPv6 addresses, or a combination of IPv4 and IPv6 addresses. You can enter multiple host names, IP addresses, or IP address segments and separate them with semicolons (;). Example: **192.168.0.10;192.168.0.0/24;myserver1.test**
parameters.cloneSpeed	Cloning speed. The value ranges from 1 to 4.	No	3	No	**4** indicates the highest speed. This parameter takes effect when a PV is cloned or a PV is created using a snapshot.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.applicationType	Application type name when a file system is created.	No	-	Yes	Log in to DeviceManager and choose **Services** > **File Service** > **File Systems** > **Create** to obtain the application type name.
parameters.qos	QoS settings of the file system on the storage side of the PV. The value of the parameter is JSON character strings in dictionary format. A character string is enclosed by single quotation marks and the dictionary key by double quotation marks. Example: **'{"maxMBPS": 999, "maxIOPS": 999}'**	No	-	No	For details about the supported QoS configurations, see **Table 5-48**.
parameters.fsPermission	Permission on the directory mounted to a container.	No	-	No	For details about the configuration format, refer to the Linux permission settings, for example, 777 and 755.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.rootSquash	Controls the **root** permission of the client. The value can be: ● **root_squash**: The client cannot access the storage system as user **root**. If a client accesses the storage system as user **root**, the client will be mapped as an anonymous user. ● **no_root_squash**: A client can access the storage system as user **root** and has the permission of user **root**.	No	-	No	

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.allSquash	Whether to retain the user ID (UID) and group ID (GID) of a shared directory. The value can be: • **all_squash**: The UID and GID of the shared directory are mapped to anonymous users. • **no_all_squash**: The UID and GID of the shared directory are retained.	No	-	No	
parameters.accesskrb5	Configures the krb5 security protocol. • **read_only**: read-only • **read_write**: read and write • **none**: no permission	No	-	No	During mounting, you can specify the **sec** parameter in **mountOptions**.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.accesskrb5i	Configures the krb5i security protocol. • **read_only**: read-only • **read_write**: read and write • **none**: no permission	No	-	No	During mounting, you can specify the **sec** parameter in **mountOptions**.
parameters.accesskrb5p	Configures the krb5p security protocol. • **read_only**: read-only • **read_write**: read and write • **none**: no permission	No	-	No	During mounting, you can specify the **sec** parameter in **mountOptions**.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.snapshotDirectoryVisibility	Whether the snapshot directory is visible. The value can be: ● **visible**: The snapshot directory is visible. ● **invisible**: The snapshot directory is invisible.	No	-	No	Only NAS storage is supported.
parameters.reservedSnapshotSpaceRatio	Configures reserved snapshot space. Value type: character string Value range: 0 to 50	No	-	No	-

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.disableVerifyCapacity	Whether to disable volume capacity verification. After this function is disabled, the system will not verify whether the volume capacity is an integer multiple of the sector size. The value can be: ● "true": disables volume capacity verification. ● "false": enables volume capacity verification. **NOTICE** When Red Hat OpenShift Virtualization is used to connect to CSI, this parameter must be set to **true**.	No	"true"	Yes	For OceanDisk, the sector size is 512 bytes.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.description	Description of the file system to be created. Value type: character string The value contains 0 to 255 characters.	No	Created from Kubernetes CSI	No	
parameters.advancedOptions	Advanced volume creation parameters. The value of the parameter is JSON character strings in dictionary format. A character string is enclosed by single quotation marks and the dictionary key by double quotation marks. Example: **'{"CAPACITYTHRESHOLD": 90}'**	No	-	No	For details about the supported advanced parameters, see **Table 5-49**.

Table 5-47 Common parameters in mountOptions

Parameter	Description	Mandatory	Default Value	Remarks
mountOptions.nfsvers	NFS mount option on the host. The following mount option is supported: **nfsvers**: protocol version for NFS mounting. The value can be **3** or **4.0**.	No	-	This parameter is optional after the **-o** parameter when the **mount** command is executed on the host. The value is in list format. If the NFS version is specified for mounting, NFS 3 and 4.0 protocols are supported (the protocol must be supported and enabled on storage devices).
mountOptions.sec	Kerberos 5 protocol for mounting NFS file systems.	No	-	• If Kerberos 5 is used, set this parameter to **krb5**. • If Kerberos 5i is used, set this parameter to **krb5i**. • If Kerberos 5p is used, set this parameter to **krb5p**. • Only NFS 4.0 supports Kerberos.

Parameter	Description	Mandatory	Default Value	Remarks
mountOptions.proto	Transmission protocol used for NFS mounting. The value can be **rdma**.	No	-	-
mountOptions.port	Protocol port used for NFS mounting.	Conditionally mandatory	-	If the transmission protocol is **rdma**, set this parameter to **20049**.

Table 5-48 Supported QoS configurations

Storage Type	Parameter	Description	Remarks
OceanStor V5	IOTYPE	Read/write type.	This parameter is optional. If it is not specified, the default value of the storage backend is used. For details, see related storage documents. The value can be: • **0**: read I/O • **1**: write I/O • **2**: read and write I/Os
	MAXBANDWIDTH	Maximum bandwidth. This is a restriction policy parameter.	The value is an integer greater than 0, expressed in MB/s.
	MINBANDWIDTH	Minimum bandwidth. This is a protection policy parameter.	The value is an integer greater than 0, expressed in MB/s.
	MAXIOPS	Maximum IOPS. This is a restriction policy parameter.	The value is an integer greater than 0.
	MINIOPS	Minimum IOPS. This is a protection policy parameter.	The value is an integer greater than 0.

Storage Type	Parameter	Description	Remarks
	LATENCY	Maximum latency. This is a protection policy parameter.	The value is an integer greater than 0, expressed in ms.
OceanStor Dorado/ OceanStor	IOTYPE	Read/write type.	The value can be: ● **2**: read and write I/Os
	MAXBANDWIDTH	Maximum bandwidth. This is a restriction policy parameter.	The value is an integer ranging from 1 to 999999999, expressed in MB/s.
	MINBANDWIDTH	Minimum bandwidth. This is a protection policy parameter.	The value is an integer ranging from 1 to 999999999, expressed in MB/s.
	MAXIOPS	Maximum IOPS. This is a restriction policy parameter.	The value is an integer ranging from 100 to 999999999.
	MINIOPS	Minimum IOPS. This is a protection policy parameter.	The value is an integer ranging from 100 to 999999999.
	LATENCY	Maximum latency. This is a protection policy parameter.	The value can be **0.5** or **1.5**, expressed in ms.

Table 5-49 Supported advanced volume creation parameters

Parameter	Description	Remarks
CAPACITYTHRESHOLD	Total capacity alarm threshold.	Parameter type: uint64. For details about the default value and value range, see the corresponding storage product manual.

5.2.1.5.2 Block Service

Creating a StorageClass

Step 1 Prepare a StorageClass configuration file, for example, **mysc.yaml**. For details about the StorageClass configuration, see the following example.

Step 2 Run the following command to create a StorageClass using the configuration file.

```
kubectl apply -f mysc.yaml
```

Step 3 Run the following command to view the information about the created StorageClass.

```
kubectl get sc mysc
```

The following is an example of the command output.

```
NAME   PROVISIONER      RECLAIMPOLICY   VOLUMEBINDINGMODE   ALLOWVOLUMEEXPANSION   AGE
mysc   csi.huawei.com   Delete          Immediate           true                   8s
```

----End

Block StorageClass Configuration Example

If LUNs are used as storage resources and the file system needs to be formatted to a local file system, refer to the following example.

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: mysc
provisioner: csi.huawei.com
parameters:
  backend: lun-181
  pool: StoragePool001
  volumeType: lun
  allocType: thin
  fsType: ext4
```

StorageClass Parameters Supported by Block Services

Table 5-50 StorageClass configuration parameters

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
metadata.name	User-defined name of a StorageClass object.	Yes	-	Yes	Take Kubernetes v1.22.1 as an example. The value can contain digits, lowercase letters, hyphens (-), and periods (.), and must start and end with a letter or digit.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
provisioner	Name of the provisioner.	Yes	csi.huawei.com	Yes	Set this parameter to the driver name set during Huawei CSI installation. The value is the same as that of **driverName** in the **values.yaml** file.
reclaimPolicy	Reclamation policy. The following types are supported: • **Delete**: Resources are automatically reclaimed. • **Retain**: Resources are manually reclaimed.	No	Delete	Yes	• **Delete**: When a PV/PVC is deleted, resources on the storage device are also deleted. • **Retain**: When a PV/PVC is deleted, resources on the storage device are not deleted.
allowVolumeExpansion	Whether to allow volume expansion. If this parameter is set to **true**, the capacity of the PV that uses the StorageClass can be expanded.	No	false	Yes	This function can only be used to expand PV capacity but cannot be used to reduce PV capacity.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
mountOptions	List of mount parameters, which can be used to specify the parameters of the **-o** option when the **mount** command is executed on a host.	No	-	Yes	For details about common parameters in **mountOptions**, see **Table 5-51**. You can also specify other mount parameters.
parameters.backend	Name of the backend where the resource to be created is located. This field must be set if **parameters.pool** is set.	Conditionally mandatory	-	No	If this parameter is not set, Huawei CSI will randomly select a backend that meets the capacity requirements to create resources. You are advised to specify a backend to ensure that the created resource is located on the expected backend.
parameters.pool	Name of the storage resource pool where the resource to be created is located.	No	-	No	If this parameter is not set, Huawei CSI will randomly select a storage pool that meets the capacity requirements from the selected backend to create resources. You are advised to specify a storage pool to ensure that the created resource is located in the expected storage pool.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.volumeType	Type of the volume to be created. The following types are supported: ● **lun**: A LUN is provisioned on the storage side. ● **fs**: A file system is provisioned on the storage side. ● **dtree**: A volume of the Dtree type is provisioned on the storage side.	Yes	-	Yes	The value is fixed to **lun**.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.allocType	Allocation type of the volume to be created. The following types are supported: ● **thin**: Not all required space is allocated during creation. Instead, the space is dynamically allocated based on the usage.	No	thin	No	If this parameter is set to **thin**, the required space is not allocated immediately when a volume is created. Instead, the space is dynamically allocated based on the usage.
parameters.fsType	Type of a host file system. The supported types are: ● ext2 ● ext3 ● ext4 ● xfs	No	ext4	No	This parameter is available only when **volumeMode** of the PVC is set to **Filesystem**.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.applicationType	Application type name of the LUN to be created.	No	-	Yes	Log in to DeviceManager and choose **Services** > **Block Service** > **LUN Groups** (or **Namespace Groups**) > **LUNs** (or **Namespaces**) > **Create** to obtain the application type name.
parameters.qos	LUN/NAS QoS settings of the PV on the storage side. The value of the parameter is JSON character strings in dictionary format. A character string is enclosed by single quotation marks and the dictionary key by double quotation marks. Example: **'{"maxMBPS": 999, "maxIOPS": 999}'**	No	-	No	For details about the supported QoS configurations, see **Table 5-52**.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.fsPermission	Permission on the directory mounted to a container.	No	-	No	For details about the configuration format, refer to the Linux permission settings, for example, 777 and 755.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.disableVerifyCapacity	Whether to disable volume capacity verification. After this function is disabled, the system will not verify whether the volume capacity is an integer multiple of the sector size. The value can be: ● "true": disables volume capacity verification. ● "false": enables volume capacity verification. **NOTICE** When Red Hat OpenShift Virtualization is used to connect to CSI, this parameter must be set to **true**.	No	"true"	Yes	For OceanDisk, the sector size is 512 bytes.

Parameter	Description	Mandatory	Default Value	Whether the Volume Management Takes Effect	Remarks
parameters.description	Description of the LUN to be created. Value type: character string The value contains 0 to 255 characters.	No	Created from Kubernetes CSI	No	

Table 5-51 Common parameters in mountOptions

Parameter	Description	Mandatory	Default Value	Remarks
mountOptions.discard	Automatically triggers the Trim or Discard operation when a file system is mounted. This operation instructs a block device to release unused blocks.	No	-	The xfs and ext4 file systems are supported.

Table 5-52 Supported QoS configurations

Parameter	Description	Remarks
IOTYPE	Read/write type.	The value can be: ● **2**: read and write I/Os
MAXBANDWIDTH	Maximum bandwidth. This is a restriction policy parameter.	The value is an integer ranging from 1 to 999999999, expressed in MB/s.
MINBANDWIDTH	Minimum bandwidth. This is a protection policy parameter.	The value is an integer ranging from 1 to 999999999, expressed in MB/s.
MAXIOPS	Maximum IOPS. This is a restriction policy parameter.	The value is an integer ranging from 100 to 999999999.
MINIOPS	Minimum IOPS. This is a protection policy parameter.	The value is an integer ranging from 100 to 999999999.
LATENCY	Maximum latency. This is a protection policy parameter.	The value can be **0.5** or **1.5**, expressed in ms.

5.2.2 Managing a StorageClass

5.2.2.1 Querying a StorageClass

Step 1 Run the following command to view the information about the created StorageClass.

```
kubectl get sc mysc
```

The following is an example of the command output.

```
NAME   PROVISIONER      RECLAIMPOLICY   VOLUMEBINDINGMODE   ALLOWVOLUMEEXPANSION   AGE
mysc   csi.huawei.com   Delete          Immediate           true                   8s
```

----End

5.2.2.2 Modifying a StorageClass

Kubernetes allows only the **allowVolumeExpansion** field of a StorageClass to be modified. The modification method is as follows:

Step 1 Run the following command to check whether the StorageClass can be expanded:

```
kubectl get sc mysc
```

If the command output is displayed as the following example, the StorageClass **mysc** cannot be expanded:

```
NAME   PROVISIONER      RECLAIMPOLICY   VOLUMEBINDINGMODE   ALLOWVOLUMEEXPANSION   AGE
mysc   csi.huawei.com   Delete          Immediate           false                  8s
```

Step 2 Run the following command to enable capacity expansion for the StorageClass:

```
kubectl patch sc mysc --patch '{"allowVolumeExpansion":true}'
```

Step 3 Check the StorageClass again and ensure that the modification is successful.

```
NAME   PROVISIONER     RECLAIMPOLICY   VOLUMEBINDINGMODE   ALLOWVOLUMEEXPANSION   AGE
mysc   csi.huawei.com   Delete         Immediate           true                   8s
```

----End

5.2.2.3 Deleting a StorageClass

Step 1 Run the following command to view the StorageClass:

```
kubectl get sc mysc
```

The following is an example of the command output.

```
NAME   PROVISIONER     RECLAIMPOLICY   VOLUMEBINDINGMODE   ALLOWVOLUMEEXPANSION   AGE
mysc   csi.huawei.com   Delete         Immediate           false                  8s
```

Step 2 Run the following command to delete the StorageClass:

```
kubectl delete sc mysc
```

If the following information is displayed, the deletion is successful:

```
storageclass.storage.k8s.io "mysc" deleted
```

----End

5.3 Persistent Volume Management

Based on service requirements, files in containers need to be persistently stored on disks. When the containers are re-built or re-allocated to new nodes, the persistent data can still be used.

To persistently store data on storage devices, you need to use the **PersistentVolume (PV)** and **PersistentVolumeClaim (PVC)** when provisioning containers.

- PV: a piece of storage in the Kubernetes cluster that has been provisioned by an administrator or dynamically provisioned using a **StorageClass**.
- PVC: a request for storage by a user. A PVC consumes PV resources. A PVC can request specific size and access modes. For example, a PV can be mounted in ReadWriteOnce, ReadOnlyMany, or ReadWriteMany mode. For details, see **Access Modes**.

This section describes how to use Huawei CSI to create, clone, and expand the capacity of a PV and PVC.

5.3.1 Configuring PVs

Huawei CSI allows storage resources (LUNs or file systems) to be created on Huawei storage and provided for containers based on user settings. For details about the supported features, see **3 Compatibility and Features** of the storage device.

PV configurations can be classified into configuring dynamic PVs or static PVs, and managing PVs.

- Configuring dynamic PV does not require a PV to be created in advance. Huawei CSI automatically creates resources required by a PV on storage devices based on a StorageClass. In addition, you can create a PV when creating a PVC.
- Configuring a static PV requires the administrator to create required resources on a storage device in advance and use existing resources by creating a PV. In addition, you can specify the associated PV when creating a PVC.
- Managing PVs does not require a PV to be created in advance. You can specify the StorageClass and resource information on the storage device in a PVC. Create the PVC and PV at the same time, and manage all existing storage resources in the cluster.

5.3.1.1 Configuring Dynamic PVs

Dynamic volume provisioning allows storage volumes to be created on demand. Dynamic volume provisioning depends on the StorageClass objects. The cluster administrator can define multiple StorageClass objects as required and specify a StorageClass that meets service requirements when declaring a PV or PVC. When applying for resources from Huawei storage devices, Huawei CSI creates storage resources that meet service requirements based on the preset StorageClass.

Configuration Description

Perform the following steps to configure and use dynamic PVs:

- **Preparation**
- **Configuring a PVC**
- **Using a PVC**

Preparation

Before configuring dynamic PVs, configure StorageClass by referring to **5.2.1 Configuring a StorageClass**.

Configuring a PVC

Step 1 Prepare the PVC configuration file **mypvc.yaml**. The following is an example. For details about other parameters, see **Table 5-53**.

```
kind: PersistentVolumeClaimapiVersion: v1metadata:  name: mypvcspec:  accessModes:    - ReadWriteOnce  volumeMode: Filesystem  storageClassName: mysc  resources:    requests:      storage: 100Gi
```

Step 2 Run the following command to create a PVC using the configuration file.

```
kubectl create -f mypvc.yaml
```

Step 3 After a period of time, run the following command to view the information about the created PVC.

```
kubectl get pvc mypvc
```

The following is an example of the command output. If the PVC status is **Bound**, the PVC has been created and can be used by a Pod.

```
NAME      STATUS   VOLUME                                     CAPACITY   ACCESS MODES   STORAGECLASS   AGEmypvc     Bound    pvc-840054d3-1d5b-4153-b73f-826f980abf9e   100Gi      RWO            mysc           12s
```

NOTICE

- After the PVC is created, if the PVC is in the **Pending** state after a long time (for example, one minute), refer to **8.3.1 When a PVC Is Created, the PVC Is in the Pending State**.
- You are advised to create or delete a maximum of 100 PVCs in a batch.

----End

Table 5-53 PVC parameters for configuring a dynamic PV

Parameter	Description	Mandatory	Default Value	Remarks
metadata.name	User-defined name of a PVC object.	Yes	-	Take Kubernetes v1.22.1 as an example. The value can contain digits, lowercase letters, hyphens (-), and periods (.), and must start and end with a letter or digit.
spec.volumeMode	Volume mode. This parameter is optional. When LUN volumes are used, the following types are supported: • **Filesystem**: local file system. • **Block**: raw device.	No	Filesystem	This parameter takes effect when a PV is mounted. The default value is **Filesystem**. • **Filesystem** indicates that a container accesses a PV using a local file system. The local file system type is specified by the **fsType** field in the specified StorageClass. Storage of the Dtree type also uses this parameter. • **Block** indicates that a PV is accessed in raw volume mode.
spec.storageClassName	Name of the StorageClass object.	Yes	-	Name of the StorageClass object required by services.

Parameter	Description	Mandatory	Default Value	Remarks
spec.resources.requests.storage	Size of the volume to be created. The format is ***Gi and the unit is GiB.	Yes	10Gi	The PVC capacity depends on storage specifications and host specifications. For example, OceanStor Dorado 6.1.2 or OceanStor Pacific series 8.1.0 is connected to CentOS 7. If ext4 file systems are used, see **Table 5-54**. If XFS file systems are used, see **Table 5-55**. If NFS or raw devices are used, the capacity must meet the specifications of the used Huawei storage device model and version. If the PVC capacity does not meet the specifications, a PVC or Pod may fail to be created due to the limitations of storage specifications or host file system specifications.

Parameter	Description	Mandatory	Default Value	Remarks
spec.accessModes	Access mode of the volume. • **RWO** (ReadWriteOnce): A volume can be mounted to a node in read/write mode. This mode also allows multiple Pods running on the same node to access the volume. • **ROX** (ReadOnlyMany): A volume can be mounted to multiple nodes in read-only mode. • **RWX** (ReadWriteMany): A volume can be mounted to multiple nodes in read/write mode. • **RWOP** (ReadWriteOncePod): A volume can only be mounted to a single Pod in read/write mode. Kubernetes 1.22 and later versions support this feature.	Yes	ReadWriteOnce	• RWO/ROX/RWOP: supported by all types of volumes. RWOP is supported only by Kubernetes 1.22 and later versions. For versions earlier than Kubernetes 1.29, you need to enable this feature by following the instructions in **7.6 Enabling the ReadWriteOncePod Feature Gate**. • The support for RWX is as follows: – NAS storage: supported by all volumes – SAN storage: supported only by volumes whose **volumeMode** is set to **Block**

Table 5-54 ext4 capacity specifications

Storage Type	Storage Specifications	ext4 Specifications	CSI Specifications
OceanStor Dorado	512 Ki to 256 Ti	50 Ti	512 Ki to 50 Ti
OceanStor Pacific series	64 Mi to 512 Ti	50 Ti	64 Mi to 50 Ti
OceanDisk	512 Ki to 256 Ti	50 Ti	512 Ki to 50 Ti

Table 5-55 XFS capacity specifications

Storage Type	Storage Specifications	XFS Specifications	CSI Specifications
OceanStor Dorado	512 Ki to 256 Ti	500 Ti	512 Ki to 256 Ti
OceanStor Pacific series	64 Mi to 512 Ti	500 Ti	64 Mi to 500 Ti
OceanDisk	512 Ki to 256 Ti	500 Ti	512 Ki to 256 Ti

Using a PVC

After a PVC is created, you can use the PVC to create a Pod. The following is a simple example of using a PVC. In this example, the created Pod uses the newly created *mypvc*.

```
apiVersion: apps/v1kind: Deploymentmetadata:  name: nginx-deploymentspec:  selector:    matchLabels:      app: nginx  replicas: 2  template:    metadata:      labels:        app: nginx    spec:      containers:      - image: nginx:alpine        name: container-0        volumeMounts:        - mountPath: /tmp          name: pvc-mypvc      restartPolicy: Always      volumes:      - name: pvc-mypvc        persistentVolumeClaim:          claimName:  mypvc  # name of PVC
```

NOTE

If Pods are batch created using PVCs, the Pods are in the **ContainerCreating** status for a long time, and the huawei-csi-node service is in the **OOMKilled** status, the memory of the huawei-csi-node service is insufficient. Increase the memory limit of huawei-csi-node by referring to **Table 10-3**.

5.3.1.2 Configuring a Static PV

Static volume provisioning allows administrators to use a resource created on the storage side as a PV for containers in the cluster.

Configuration Description

Perform the following steps to configure a static PV:

- Preparation
- Configuring a PV
- Configuring a PVC
- Using a PVC

Preparation

A storage resource, such as a LUN or file system, required by the PV to be created exists on the storage device. If the storage resource is a file system, you also need to create the share and client information of the file system.

Configuring a PV

Step 1 Prepare the PV configuration file **mypv.yaml**. The following is an example. For details about other parameters, see **Table 5-56**.

```
kind: PersistentVolume
apiVersion: v1
metadata:
  name: mypv
spec:
  volumeMode: Filesystem
  storageClassName: "" # The value must be to "".
  accessModes:
    - ReadWriteOnce
  csi:
    driver: csi.huawei.com # Enter the CSI driver name.
    volumeHandle: iscsi-dorado-181.lun0001 # Enter the volume name.
    fsType: xfs # Set the file system type.
  capacity:
    storage: 100Gi
```

NOTE

In the configuration file for static volume provisioning, **storageClassName** must be set to **""**. Otherwise, Kubernetes will use the default StorageClass.

Step 2 Run the following command to create a PV based on the prepared .yaml file.

```
kubectl create -f mypv.yaml
```

Step 3 After a period of time, run the following command to view the information about the created PV.

```
kubectl get pv
```

The following is an example of the command output. If the PV status is **Available**, the PV is successfully created.

```
NAME      CAPACITY   ACCESS MODES   RECLAIM POLICY   STATUS      CLAIM             STORAGECLASS
REASON    AGE
mypv      100Gi      RWO            Retain           Available                     4s
```

----End

Table 5-56 Parameters for configuring a static PV

Parameter	Description	Mandatory	Default Value	Remarks
metadata.name	User-defined name of a PV object.	Yes	-	Take Kubernetes v1.22.1 as an example. The value can contain digits, lowercase letters, hyphens (-), and periods (.), and must start and end with a letter or digit.
spec.volumeMode	Volume mode. This parameter is optional. When LUN volumes are used, the following types are supported: ● **Filesystem**: local file system. ● **Block**: raw device.	No	Filesystem	This parameter takes effect when a PV is mounted. The default value is **Filesystem**. ● **Filesystem** indicates that a container accesses a PV using a local file system. The local file system type is specified by the **fsType** field in the specified StorageClass. ● **Block** indicates that a PV is accessed in raw volume mode.
spec.storageClassName	Name of the StorageClass object. This parameter is mandatory.	Yes	-	Set the parameter to an empty string, that is, enter **""**.

Parameter	Description	Mandatory	Default Value	Remarks
spec.accessModes	Access mode of the volume. ● **RWO** (ReadWriteOnce): A volume can be mounted to a node in read/write mode. This mode also allows multiple Pods running on the same node to access the volume. ● **ROX** (ReadOnlyMany): A volume can be mounted to multiple nodes in read-only mode. ● **RWX** (ReadWriteMany): A volume can be mounted to multiple nodes in read/write mode. ● **RWOP** (ReadWriteOncePod): A volume can only be mounted to a single Pod in read/write mode. Kubernetes 1.22 and later versions support this feature.	Yes	ReadWriteOnce	● RWO/ROX/RWOP: supported by all types of volumes. RWOP is supported only by Kubernetes 1.22 and later versions. Check whether this feature is enabled for your Kubernetes cluster by referring to **7.6 Enabling the ReadWriteOncePod Feature Gate**. ● The support for RWX is as follows: – NAS storage: supported by all volumes – SAN storage: supported only by volumes whose **volumeMode** is set to **Block**
spec.csi.driver	CSI driver name.	Yes	csi.huawei.com	Set this parameter to the driver name set during Huawei CSI installation.

Parameter	Description	Mandatory	Default Value	Remarks
spec.csi.volumeHandle	Unique identifier of a storage resource. This parameter is mandatory. Format: *<backendName>***.***<volume-name>*	Yes	-	The value of this parameter consists of the following parts: ● *<backendName>*: indicates the name of the backend where the volume resides. You can run the following command to obtain the configured backend information. **oceanctl get backend** ● *<volume-name>*: indicates the name of a resource (LUN/file system) on the storage. You can obtain the value from DeviceManager.
spec.csi.fsType	Type of a host file system. This parameter is optional. The supported types are: ● ext2 ● ext3 ● ext4 ● xfs	No	-	If this parameter is not set, the default value **ext4** is used. This parameter is available only when **volumeMode** is set to **Filesystem**.

Parameter	Description	Mandatory	Default Value	Remarks
spec.csi.volumeAttributes.dTreeParentName	Name of the parent file system when the volume resource type is dtree.	Conditionally mandatory	-	This parameter is mandatory when the managed object is a dtree resource and the **parentname** parameter is not configured in the storage backend. If **dTreeParentName** is configured only in the PV but **parentname** is not configured in the corresponding storage backend, set **CSIDriverObject.attachRequired** to **true** during CSI installation according to **Table 4-8**.
spec.capacity.storage	Volume size.	Yes	100Gi	Ensure that the size is the same as that of the corresponding resource on the storage. Kubernetes will not invoke CSI to check whether the value of this parameter is correct. Therefore, the PV can be successfully created even if its capacity is inconsistent with that of the corresponding resource on the storage.

Parameter	Description	Mandatory	Default Value	Remarks
spec.mountOptions.nfsvers	NFS mount option on the host. The following mount option is supported: **nfsvers**: protocol version for NFS mounting. The value can be **3**, **4**, **4.0**, **4.1**, or **4.2**.	No	-	This parameter is optional after the **-o** parameter when the **mount** command is executed on the host. The value is in list format. If the NFS version is specified for mounting, NFS 3, 4.0, 4.1, and 4.2 protocols are supported (the protocol must be supported and enabled on storage devices). If **nfsvers** is set to **4**, the latest protocol version NFS 4 may be used for mounting due to different OS configurations, for example, 4.2. If the 4.0 protocol is required, you are advised to set **nfsvers** to **4.0**.
spec.mountOptions.acl	The DPC namespace supports the ACL function. The DPC client supports POSIX ACL, NFSv4 ACL, and NT ACL authentication.	No	-	The descriptions of **acl**, **aclonlyposix**, **cnflush**, and **cflush** are for reference only. For details about the parameters, see **OceanStor Pacific Series Product Documentation** and choose **Configuration** > **Basic Service Configuration Guide for File** > **Configuring Basic Services (DPC Scenario)** > **Accessing a DPC Share on a Client** > **Step 2**.

Parameter	Description	Mandatory	Default Value	Remarks
spec.mountOptions.aclonlyposix	The DPC namespace supports POSIX ACL, and the DPC client supports POSIX ACL authentication. The following protocols support POSIX ACL: DPC, NFSv3, and HDFS. If NFSv4 ACL or NT ACL is used, the DPC client cannot identify the ACL of this type. As a result, the ACL of this type does not take effect.	No	-	If **aclonlyposix** and **acl** are used together, only **acl** takes effect. That is, the namespace supports the ACL function.
spec.mountOptions.cnflush	Asynchronous disk flushing mode. That is, data is not flushed to disks immediately when files in the namespace are closed.	No	-	Asynchronous flushing mode: When a file is closed, data in the cache is not flushed to storage media in synchronous mode. Instead, data is written from the cache to the storage media in asynchronous flushing mode. After the write service is complete, data is flushed from the cache to disks periodically based on the flushing period. In a multi-client scenario, if concurrent operations are performed on the same file, the file size update is affected by the disk flushing period. That is, the file size is updated only after the disk flushing is complete. Generally, the update is completed within several seconds. Synchronous I/Os are not affected by the disk flushing period.

Parameter	Description	Mandatory	Default Value	Remarks
spec.mountOptions.cflush	Synchronous disk flushing mode. That is, data is flushed to disks immediately when files in the namespace are closed.	No	-	By default, the synchronous disk flushing mode is used.

Configuring a PVC

After a PV is created in static volume provisioning mode, you can create a PVC based on the PV for containers.

Step 1 Prepare the PVC configuration file **mypvc.yaml**. The following is an example. For details about other parameters, see **Table 5-57**.

```
kind: PersistentVolumeClaim
apiVersion: v1
metadata:
  name: mypvc
spec:
  storageClassName: ""
  accessModes:
    - ReadWriteOnce
  volumeMode: Filesystem
  resources:
    requests:
      storage: 100Gi
  volumeName: mypv # Enter the name of the corresponding PV.
```

Step 2 Run the following command to create a PVC based on the configured .yaml file.

```
kubectl create -f mypvc.yaml
```

Step 3 After a period of time, run the following command to view the information about the created PVC.

```
kubectl get pvc
```

The following is an example of the command output. If the PVC status is **Bound**, the PVC is successfully created.

```
NAME      STATUS   VOLUME                                     CAPACITY   ACCESS MODES   STORAGECLASS   AGE
mypvc     Bound    pvc-840054d3-1d5b-4153-b73f-826f980abf9e   100Gi      RWO                           12s
```

NOTE

- After the PVC is created, if the PVC is in the **Pending** state after a long time, see **8.3.1 When a PVC Is Created, the PVC Is in the Pending State**.
- You are advised to create or delete a maximum of 100 PVCs in a batch.

----End

Table 5-57 PVC parameters for configuring a static PV

Parameter	Description	Mandatory	Default Value	Remarks
metadata.name	User-defined name of a PVC object.	Yes	-	Take Kubernetes v1.22.1 as an example. The value can contain digits, lowercase letters, hyphens (-), and periods (.), and must start and end with a letter or digit.
spec.accessModes	Access mode of the volume. • **RWO** (ReadWriteOnce): A volume can be mounted to a node in read/write mode. This mode also allows multiple Pods running on the same node to access the volume. • **ROX** (ReadOnlyMany): A volume can be mounted to multiple nodes in read-only mode. • **RWX** (ReadWriteMany): A volume can be mounted to multiple nodes in read/write mode. • **RWOP** (ReadWriteOncePod): A volume can only be mounted to a single Pod in read/write mode. Kubernetes 1.22 and later versions support this feature.	Yes	ReadWriteOnce	• RWO/ROX/RWOP: supported by all types of volumes. RWOP is supported only by Kubernetes 1.22 and later versions. For versions earlier than Kubernetes 1.29, you need to enable this feature by following the instructions in **7.6 Enabling the ReadWriteOncePod Feature Gate**. • The support for RWX is as follows: – NAS storage: supported by all volumes – SAN storage: supported only by volumes whose **volumeMode** is set to **Block**

Parameter	Description	Mandatory	Default Value	Remarks
spec.volumeMode	Volume mode.	No	Filesystem	This parameter is optional. The value can be **Filesystem** or **Block**. The default value is **Filesystem**. This parameter takes effect when a Pod is created. **Filesystem** indicates that a file system is created on a PVC to access the storage. **Block** indicates that a raw volume is used to access the storage.
spec.resources.requests.storage	Size of the volume to be created.	Yes	-	Size of the volume to be created. The format is ***Gi and the unit is GiB. The PVC capacity depends on storage specifications and host specifications. For example, OceanStor Dorado 6.1.2 or OceanStor Pacific series 8.1.0 is connected to CentOS 7. If ext4 file systems are used, see **Table 5-54**. If XFS file systems are used, see **Table 5-55**. If NFS or raw devices are used, the capacity must meet the specifications of the used Huawei storage device model and version. If the PVC capacity does not meet the specifications, a PVC or Pod may fail to be created due to the limitations of storage specifications or host file system specifications. When a PVC is created using a static PV and the PVC capacity is smaller than the capacity of the bound PV, the PVC capacity is set to the capacity of the bound PV. If the PVC capacity is greater than the capacity of the bound PV, the PVC cannot be created.

Parameter	Description	Mandatory	Default Value	Remarks
spec.volumeName	Name of the PV object.	Yes	-	This parameter is mandatory when a PVC is created statically.
spec.storageClassName	Name of the StorageClass object.	Yes	-	When a PVC is created, an empty character string is transferred. If this parameter is not set, the default StorageClass object name will be used.

Using a PVC

The use method is the same as that for dynamic volume provisioning in **Using a PVC**.

5.3.1.3 Managing PVs

Manage Volume Provisioning allows administrators to use resources created on storage as PVs and supports features of dynamic volumes, such as capacity expansion, snapshot, and clone. This is a custom capability of Huawei CSI. This feature applies to the following scenarios:

- In the reconstruction containerized applications, existing storage volumes need to be used.
- The Kubernetes cluster is rebuilt.
- Storage data is migrated in disaster recovery (DR) scenarios.

NOTE

Manage Volume Provisioning allows existing storage resources to be managed by Kubernetes. You are not allowed to manage a storage resource for multiple times and concurrently delete or create a storage resource.

When a storage resource is managed by multiple clusters, operations on the managed volume in a single cluster take effect only in the cluster and will not be synchronized to other clusters. Instead, you need to perform these operations on the managed volume in other clusters.

For example, when you expand the capacity of a PVC in a cluster, the capacity of the corresponding PVC in other clusters will not be automatically expanded. In this case, you need to manually expand the capacity in other clusters by running the expansion commands in **5.3.2.1 Expanding the Capacity of a PV**.

Configuration Description

Perform the following steps to manage and use PVs:

- **Preparation**

- Configuring a PVC
- Using a PVC

Preparation

- You have registered the storage where the volume to be managed resides with CSI.
- You have logged in to the storage device to obtain the name and capacity of the volume to be managed.
- The StorageClass has been configured. For details, see **5.2.1 Configuring a StorageClass** (pay attention to the **Whether the Volume Management Takes Effect** field in the table).

Configuring a PVC

Step 1 Prepare the PVC configuration file **mypvc.yaml**. The following is an example. For details about other parameters, see **Table 5-58**.

```
kind: PersistentVolumeClaim
apiVersion: v1
metadata:
  name: mypvc
  annotations:
    csi.huawei.com/manageVolumeName: "*"  # Enter the storage resource name.
    csi.huawei.com/manageBackendName: "*" # Enter the storage backend name.
  labels:
    provisioner: csi.huawei.com
spec:
  accessModes:
    - ReadWriteOnce
  volumeMode: Filesystem
  storageClassName: mysc
  resources:
    requests:
      storage: 100Gi
```

Step 2 Run the following command to create a PVC using the configuration file.

```
kubectl create -f mypvc.yaml
```

Step 3 After a period of time, run the following command to view the information about the created PVC.

```
kubectl get pvc mypvc
```

The following is an example of the command output. If the PVC status is **Bound**, the PVC has been created and can be used by a Pod.

```
NAME      STATUS   VOLUME                                     CAPACITY   ACCESS MODES   STORAGECLASS   AGE
mypvc     Bound    pvc-840054d3-1d5b-4153-b73f-826f980abf9e   100Gi      RWO            mysc           12s
```

NOTICE

- After the PVC is created, if the PVC is in the **Pending** state after a long time (for example, one minute), refer to **8.3.1 When a PVC Is Created, the PVC Is in the Pending State**.
- You are advised to create or delete a maximum of 100 PVCs in a batch.

----End

Table 5-58 PVC parameters for managing PVs

Parameter	Description	Mandatory	Default Value	Remarks
metadata.annotations	PVC object annotations. Set the following parameters: • *Driver name*/**manageVolumeName**: volume name on the storage. • *Driver name*/**manageBackendName**: name of the backend to which the volume belongs.	Yes	csi.huawei.com/manageVolumeName: * csi.huawei.com/manageBackendName: *	• For details about how to obtain *Driver name*, see **Table 4-7**. • *Driver name*/**manageVolumeName**: name of an existing volume on the storage. Only English characters are supported. • *Driver name*/**manageBackendName**: name of the storage backend in CSI. You can run the **oceanctl get backend -n huawei-csi** command to obtain the backend name.
metadata.labels	PVC object labels.	No	-	Format: **provisioner:** *Driver name specified during installation* Example: **provisioner: csi.huawei.com** This parameter takes effect when a PVC is created. It is used to listen to PVC resources and obtain information about **metadata.annotations**.

Parameter	Description	Mandatory	Default Value	Remarks
metadata.name	User-defined name of a PVC object.	Yes	-	Take Kubernetes v1.22.1 as an example. The value can contain digits, lowercase letters, hyphens (-), and periods (.), and must start and end with a letter or digit.

Parameter	Description	Mandatory	Default Value	Remarks
spec.volumeMode	Volume mode. This parameter is optional. When LUN volumes are used, the following types are supported: ● **Filesystem**: local file system. ● **Block**: raw device.	No	Filesystem	This parameter takes effect when a PV is mounted. ● **Filesystem** indicates that a container accesses a PV using a local file system. The local file system type is specified by the **fsType** field in the specified StorageClass. ● **Block** indicates that a PV is accessed in raw volume mode.

Parameter	Description	Mandatory	Default Value	Remarks
	NOTE This parameter takes effect when a PV is mounted. The use method of this parameter must be the same as that of the managed volume. ● If a volume is used as a raw volume before being managed, **volumeMode** must be set to **Block**. ● If a volume is used in ext2, ext3, or ext4 mode before being managed, **volumeMode** must be set to **Filesystem** and **fsType** in the StorageClass must be set to **ext2**, **ext3**, or **ext4**. ● If a volume is used in XFS mode before being managed, **volumeMode** must be set to **Filesystem** and **fsType** in the StorageClass must be set to **xfs**.			
spec.storageClassName	Name of the StorageClass object.	Yes	-	The configuration of the StorageClass must be the same as that of the managed volume.

Parameter	Description	Mandatory	Default Value	Remarks
spec.resources.requests.storage	Size of the volume to be created. The format is ***Gi and the unit is GiB.	Yes	-	The PVC capacity depends on storage specifications and host specifications. For example, OceanStor Dorado 6.1.2 or OceanStor Pacific series 8.1.0 is connected to CentOS 7. If ext4 file systems are used, see **Table 5-54**. If XFS file systems are used, see **Table 5-55**. If NFS or raw devices are used, the capacity must meet the specifications of the used Huawei storage device model and version. If the PVC capacity does not meet the specifications, a PVC or Pod may fail to be created due to the limitations of storage specifications or host file system specifications.

Parameter	Description	Mandatory	Default Value	Remarks
spec.accessModes	Access mode of the volume. • **RWO** (ReadWriteOnce): A volume can be mounted to a node in read/write mode. This mode also allows multiple Pods running on the same node to access the volume. • **ROX** (ReadOnlyMany): A volume can be mounted to multiple nodes in read-only mode. • **RWX** (ReadWriteMany): A volume can be mounted to multiple nodes in read/write mode. • **RWOP** (ReadWriteOncePod): A volume can only be mounted to a single Pod in read/write mode. Kubernetes 1.22 and later versions support this feature.	Yes	ReadWriteOnce	• RWO/ROX/RWOP: supported by all types of volumes. RWOP is supported only by Kubernetes 1.22 and later versions. For versions earlier than Kubernetes 1.29, you need to enable this feature by following the instructions in **7.6 Enabling the ReadWriteOncePod Feature Gate**. • The support for RWX is as follows: – NAS storage: supported by all volumes – SAN storage: supported only by volumes whose **volumeMode** is set to **Block**

Using a PVC

The procedure is the same as that for **Using a PVC** for dynamic volume provisioning.

5.3.2 Managing PVs

5.3.2.1 Expanding the Capacity of a PV

NOTE

For OceanStor V700R001C10 as well as OceanStor Dorado V700R001C10 and later versions, the minimum capacity of a file system after capacity expansion is limited. For details, see the product documentation of the corresponding storage device.

When the capacity of a PVC used by a container is insufficient, you need to expand the capacity of the PVC.

Prerequisites

- A PVC has been created, the backend to which it resides exists and supports capacity expansion.
- **3 Compatibility and Features** lists the storage that supports capacity expansion, and **10.4 Kubernetes Feature Matrix** lists the Kubernetes versions that support capacity expansion.
- The csi-resizer service is enabled for huawei-csi-controller.
  ```
  kubectl describe deploy huawei-csi-controller -n huawei-csi | grep csi-resizer
  ```
  If the following information is displayed, the csi-resizer service is enabled.
  ```
    csi-resizer:
     Image:      k8s.gcr.io/sig-storage/csi-resizer:v1.9.0
  ```

Procedure

Step 1 Run the following command to check whether the StorageClass supports capacity expansion. In the preceding command, *mysc* indicates the name of the StorageClass to be queried.

```
kubectl get sc mysc
```

The following is an example of the command output.

```
NAME           PROVISIONER      RECLAIMPOLICY   VOLUMEBINDINGMODE
ALLOWVOLUMEEXPANSION   AGE
mysc          csi.huawei.com   Delete          Immediate           true               172m
```

If the value of **ALLOWVOLUMEEXPANSION** is **true**, the current StorageClass supports capacity expansion. In this case, go to **Step 3**.

Step 2 Run the following command to change the value of **allowVolumeExpansion** to **true**. In the preceding command, *mysc* indicates the name of the StorageClass to be modified.

```
kubectl patch sc mysc --patch '{"allowVolumeExpansion":true}'
```

Step 3 Run the following command to query the StorageClass name of the PVC. In the preceding command, *mypvc* indicates the name of the PVC to be expanded.

```
kubectl get pvc mypvc
```

The following is an example of the command output.

```
NAME            STATUS   VOLUME                                     CAPACITY   ACCESS MODES
STORAGECLASS     AGE
mypvc           Bound    pvc-3383be36-537c-4cb1-8f32-a415fa6ba384   2Gi        RW0
mysc            145m
```

Step 4 Run the following command to expand the capacity.

```
kubectl patch pvc mypvc -p '{"spec":{"resources":{"requests":{"storage":"120Gi"}}}}'
```

In the preceding command, *mypvc* indicates the name of the PVC to be expanded, and *120Gi* indicates the capacity after expansion. Change the values based on the site requirements.

NOTE

- The PVC capacity depends on storage specifications and host specifications. For example, OceanStor Dorado 6.1.2 or OceanStor Pacific series 8.1.0 is connected to CentOS 7. If ext4 file systems are used, see **Table 5-54**. If XFS file systems are used, see **Table 5-55**. If NFS or raw devices are used, the capacity must meet the specifications of the used Huawei storage device model and version.
- If the PVC capacity does not meet the specifications, a PVC or Pod may fail to be created due to the limitations of storage specifications or host file system specifications.
- If the capacity expansion fails because the target capacity exceeds the storage pool capacity, see **8.3.4 Failed to Expand the PVC Capacity Because the Target Capacity Exceeds the Storage Pool Capacity**.

Step 5 Run the following command to check whether the capacity modification takes effect.

```
kubectl get pvc
```

The following is an example of the command output. If the value of **CAPACITY** is changed to the specified capacity, the capacity expansion is successful.

```
NAME     STATUS   VOLUME                                     CAPACITY   ACCESS MODES   STORAGECLASS   AGE
mypvc    Bound    pvc-3383be36-537c-4cb1-8f32-a415fa6ba384   120Gi      RWO            mysc           24s
```

----End

5.3.2.2 Cloning a PV

This section describes how to clone a PVC.

When cloning a PVC, you need to specify the data source. The following is an example of cloning a PVC. In this example, **mypvc** is used as the data source and a PVC named **myclone** is created.

```
kind: PersistentVolumeClaim
apiVersion: v1
metadata:
  name: myclone
spec:
  storageClassName: mysc
  dataSource:
    name: mypvc
    kind: PersistentVolumeClaim
  volumeMode: Filesystem
  accessModes:
    - ReadWriteOnce
  resources:
    requests:
      storage: 2Gi
```

NOTICE

- The specified **storageClassName** must be the same as the StorageClass of the source volume in **dataSource**.
- The capacity of the clone volume must be greater than or equal to that of the source volume. Equal capacity is recommended.

Prerequisites

The source PVC already exists in the system, and the backend where the source PVC resides supports cloning. **3 Compatibility and Features** lists the storage that supports cloning, and **10.4 Kubernetes Feature Matrix** lists the Kubernetes versions that support cloning.

Procedure

Step 1 Run the following command to create a PVC based on the configuration file of the clone volume.

```
kubectl create -f myclone.yaml
```

----End

5.3.2.3 Changing a PV

5.3.2.3.1 Enabling the PVC Change Feature

The PVC change feature is disabled by default during Huawei CSI installation. To use this feature, perform the following steps.

5.3.2.3.1.1 Enabling the PVC Change Feature Using Helm

Prerequisites

You have installed Huawei CSI using Helm.

Procedure

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Run the following command to check whether the PVC change feature is enabled.

helm-huawei-csi indicates the Helm chart name specified during installation, and **huawei-csi** indicates the Helm chart namespace specified during installation. For details about the component package path, see **Table 4-1**.

```
helm get values helm-huawei-csi -n huawei-csi -a | grep volumeModify -A 1
```

The following is an example of the command output.

- If **enabled: true** is displayed in the command output, the feature is enabled. In this case, skip the following steps.

- If **enabled: false** is displayed in the command output, perform the following steps to enable the PVC change feature.

```
volumeModify:
  enabled: false
```

Step 3 Go to the **/helm/esdk** directory and run the following command to configure the volume change CRD.

```
# kubectl apply -f ./crds/volume-modify/
customresourcedefinition.apiextensions.k8s.io/volumemodifyclaims.xuanwu.huawei.io configured
customresourcedefinition.apiextensions.k8s.io/volumemodifycontents.xuanwu.huawei.io configured
```

NOTE

If the command output contains **Warning: resource customresourcedefinitions/ volumemodifycontents.xuanwu.huawei.io is missing the kubectl.kubernetes.io/last-applied-configuration...**, you can ignore it. This message is displayed because the **kubectl create** command instead of the **kubectl apply** command is used for installation by Helm.

Step 4 Run the following command to obtain the original service configuration file.

```
helm get values helm-huawei-csi -n huawei-csi -a > ./update-values.yaml
```

Step 5 Run the **vi update-values.yaml** command to open the file obtained in **Step 4** and modify the following configuration. After the modification is complete, press **Esc** and enter **:wq!** to save the modification.

```
csiExtender:
  volumeModify:
    enabled: true
```

Step 6 Run the following command to update Huawei CSI services.

```
helm upgrade helm-huawei-csi ./ -n huawei-csi  -f ./update-values.yaml
```

Step 7 Run the following command to check whether the services are started.

```
kubectl get pod -n huawei-csi
```

The following is an example of the command output. In the preceding command, **huawei-csi** indicates the namespace for deploying Huawei CSI.

```
NAME                                     READY     STATUS    RESTARTS   AGE
huawei-csi-controller-6dfcc4b79f-9vjtq   10/10     Running   0          24m
huawei-csi-node-tqs87                    3/3       Running   0          20m
```

----End

5.3.2.3.1.2 Enabling the PVC Change Feature Manually

Prerequisites

Huawei CSI has been manually installed.

Procedure

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Go to the **manual/esdk** working directory and run the following command to configure the volume change CRD.

```
kubectl apply -f ./crds/volume-modify/
```

Step 3 Run the following command. For details about the component package path, see **Table 4-1**.

```
kubectl apply -f ./deploy/huawei-csi-controller-extender.yaml
```

Step 4 Run the following command to check whether the services are started.

```
kubectl get pod -n huawei-csi
```

The following is an example of the command output. In the preceding command, **huawei-csi** indicates the namespace for deploying Huawei CSI.

```
NAME                                     READY     STATUS    RESTARTS   AGE
huawei-csi-controller-6dfcc4b79f-9vjtq   10/10     Running   0          24m
huawei-csi-node-tqs87                    3/3       Running   0          24m
```

----End

5.3.2.3.2 Configuring PVC Changes

The PVC change feature is implemented using CRD. Related resources are described as follows.

Table 5-59 Resource description

NAME	APIVERSION	NAMESPACED	KIND
volumemodifyclaims	xuanwu.huawei.io/v1	false	VolumeModifyClaim
volumemodifycontents	xuanwu.huawei.io/v1	false	VolumeModifyContent

NOTE

- VolumeModifyClaim resources can be created, deleted, and queried, but cannot be updated.
- VolumeModifyContent resources can only be queried and are used to display the change details of a single PVC. Do not manually create, delete, or modify the resources.
- VolumeModifyContent resources are managed by VolumeModifyClaim. Do not manually manage VolumeModifyContent resources.

5.3.2.3.2.1 Creating a PVC Change

Prerequisites

The storage backends associated with the PVC to be changed are HyperMetro storage backends. If they are not HyperMetro storage backends, configure them by following the instructions in **5.1.2.2.3 Updating a Storage Backend**.

PVC Change File Description

The sample template of the PVC change file is **/examples/volumemodifyclaim.yaml**. The following table lists the configuration items.

Table 5-60 Parameter description

Parameter	Description	Mandatory	Default Value	Remarks
apiVersion	API group, which is of the string type.	Yes	xuanwu.huawei.io/v1	The value is fixed at **xuanwu.huawei.io/v1**.
kind	Resource type, which is of the string type.	Yes	VolumeModifyClaim	The value is fixed at **VolumeModifyClaim**.
metadata.name	Name of a cluster resource object, which is of the string type.	Yes	-	The name must comply with the naming rules of a **DNS subdomain name**. The value can contain a maximum of 63 characters, including digits, lowercase letters, hyphens (-), and periods (.). It must start and end with a lowercase letter or digit. Note: During a PVC change, the original StorageClass is backed up. The name of the backup StorageClass is *<Original StorageClass name><VolumeModifyClaim name>*, and must comply with the StorageClass naming rules.
spec.source.kind	Data source type, which is of the string type.	Yes	StorageClass	This parameter can only be set to **StorageClass**.
spec.source.name	Data source name, which is of the string type.	Yes	-	Only a StorageClass name can be configured.

Parameter	Description	Mandatory	Default Value	Remarks
spec.parameters.hyperMetro	Whether to change a common volume to a HyperMetro volume. Currently, the value can only be **"true"**.	Yes	-	Only common storage volumes at the primary site can be changed to HyperMetro storage volumes.
spec.parameters.metroPairSyncSpeed	Data synchronization speed of a HyperMetro pair. The value ranges from 1 to 4. The value can be: ● **1**: low ● **2**: medium ● **3**: high ● **4**: highest	No	-	This parameter is available only when **spec.parameters.hyperMetro** is set to **"true"**. Note: ● If this parameter is not configured, the storage speed of the HyperMetro pair is determined by the storage device. ● The highest synchronization speed may increase the host latency.

NOTE

- The **spec.source.kind** and **spec.source.name** parameters are used to specify the volume change scope. For example, if they are set to a StorageClass and the corresponding name respectively, all PVCs in the **Bound** state provisioned using the target StorageClass will be changed.
- After all associated PVCs are changed, Huawei CSI will replace the original StorageClass and add the **spec.parameters** parameter of the VolumeModifyClaim so that the PVCs meet the StorageClass definition.

For details about the configuration in typical scenarios, see the following example:

Changing a Common Volume to a HyperMetro Volume

The following is an example of changing a common volume to a HyperMetro volume:

```
apiVersion: xuanwu.huawei.io/v1
kind: VolumeModifyClaim
metadata:
  name: myvmc
spec:
```

```
source:
  kind: StorageClass
  name: mysc
parameters:
  hyperMetro: "true"
```

Creating a PVC Change Resource

NOTE

- The changed HyperMetro volumes must be in HyperMetro AA mode.
- When a common volume is changed to a HyperMetro volume, only the storage volume at the primary site can be changed.
- Do not use Huawei CSI to manage a PVC during PVC change resource creation.
- Multiple VolumeModifyClaim resources cannot be created for the same PVC. If the target PVC needs to be changed for multiple times, perform the changes one by one.

To create a PVC change resource using a PVC change file, perform the following steps:

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Run the following command to create a PVC change.

```
kubectl create -f volumemodifyclaim.yaml
```

Step 3 Query the creation result by following the instructions in **Querying a PVC Change**.

----End

5.3.2.3.2.2 Querying a PVC Change

This section describes how to use Kubectl to query the PVC change status. Currently, Huawei CSI provides the following APIs through CRD.

Querying a VolumeModifyClaim

To query a VolumeModifyClaim using kubectl, perform the following steps.

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Run the following command to query a PVC change. In the command, *vmc-name* indicates the name of the VolumeModifyClaim resource.

```
kubectl get volumemodifyclaims <vmc-name> -owide
```

The following is an example of the command output.

```
NAME   STATUS    READY  SOURCEKIND   SOURCENAME  STARTEDAT            COMPLETEDAT
AGE
myvmc  Completed  1/1   StorageClass  mysc       2024-06-06T03:19:13Z  2024-06-06T03:19:16Z
2m2s
```


Table 5-61 Command output description

Parameter	Description
NAME	VolumeModifyClaim resource name.
STATUS	VolumeModifyClaim resource status. The value can be: ● **Pending**: initial status. ● **Creating**: The VolumeModifyClaim has completed basic verification and the server has received the change task, but the task has not been completed. ● **Completed**: All associated PVCs are changed. ● **Rollback**: When associated PVCs are partially changed, a user deletes PVCs. ● **Deleting**: When all associated PVCs are changed, a user deletes PVCs.
READY	Ratio of the number of changed PVCs to the total number of PVCs that need to be changed.
SOURCEKIND	Data source type, for example, StorageClass.
SOURCENAME	Data source name, for example, StorageClass name.
STARTEDAT	Change start time, that is, the timestamp when the server receives the task and starts to process the task.
COMPLETEDAT	Change completion time, that is, the timestamp when the changes of all associated PVCs are complete. This parameter exists only when **STATUS** is **Completed**.
AGE	Lifetime of a VolumeModifyClaim from the time when it is created to the current time.

----End

NOTE

You can use kubectl to view the **Events** information of a VolumeModifyClaim. If a VolumeModifyClaim cannot meet the creation requirements or an error occurs during the creation, the server will record the **Events** information. The following command is used as an example:

```
kubectl describe volumemodifyclaims local-to-hypermetro
```

Querying a VolumeModifyContent

A VolumeModifyContent is created using a VolumeModifyClaim and records the change details of a single PVC. To query a VolumeModifyContent using kubectl, perform the following steps:

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Run the following command to query a PVC change. In the command, *myvmc-uid* indicates the VolumeModifyContent resource name.

```
kubectl get volumemodifycontents myvmc-uid  -owide
```

The following is an example of the command output.

```
NAME        STATUS      MODIFYCLAIMNAME     SOURCEVOLUME   STARTEDAT            
COMPLETEDAT           AGE
myvmc-uid    Completed   myvmc            default/mypvc  2024-06-06T03:19:07Z   2024-06-06T03:19:09Z
36m
```

Table 5-62 Command output description

Parameter	Description
NAME	VolumeModifyContent resource name. The format is *VolumeModifyClaim name*-*UID of the associated PVC*.
STATUS	VolumeModifyContent resource status. The value can be: ● **Pending**: initial status. ● **Creating**: The VolumeModifyContent has completed basic verification and the server has received the change task, but the task has not been completed. ● **Completed**: The associated PVC is changed. ● **Rollback**: The PVC change is being rolled back.
MODIFYCLAIMNAME	Name of the associated VolumeModifyClaim.
SOURCEVOLUME	Information about the associated PVC. The format is *Namespace name*/*PVC name*.
STARTEDAT	PVC change start time, that is, the timestamp when the server receives the task and starts to process the task.
COMPLETEDAT	PVC change completion time, that is, the timestamp when the changes of all associated PVCs are complete. This parameter exists only when **STATUS** is **Completed**.
AGE	Lifetime of a VolumeModifyContent from the time when it is created to the current time.

----End

NOTE

You can use kubectl to view the **Events** information of a VolumeModifyContent. If a VolumeModifyContent cannot meet the creation requirements or an error occurs during the PVC change, the server will record the **Events** information. The following command is used as an example:

```
kubectl describe volumemodifycontents myvmc-uid
```

5.3.2.3.2.3 Deleting a PVC Change

NOTICE

- If **STATUS** of a VolumeModifyClaim is **Creating**, deleting the VolumeModifyClaim resource will delete the created resource on the storage side and then remove the cluster resource. After the deletion, if you continue to use the original StorageClass for PVC management, you need to restore the associated storage backend to a non-HyperMetro storage backend.
- If **STATUS** of a VolumeModifyClaim is **Pending** or **Completed**, deleting the VolumeModifyClaim resource will only remove the cluster resource and will not delete the created resource on the storage side (that is, there is not interaction with the storage side).
- VolumeModifyContent resources are managed by VolumeModifyClaim. Do not manually manage VolumeModifyContent resources.
- If some PVCs among the PVCs to be changed meet the change requirements and the batch change fails, all PVC changes will be removed. As a result, the PVCs that meet the change requirements will not meet the change requirements.
- If a PVC to be changed has been manually managed on the storage side, the change may fail. Do not manually manage storage volumes when using the change feature.

This section describes how to use kubectl to delete a PVC change. The procedure is as follows.

Procedure

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Run the following command to delete a PVC change. In the command, *vmc-name* indicates the name of the VolumeModifyClaim resource.

```
kubectl delete volumemodifyclaims <vmc-name>
```

Step 3 Query the deletion result by following the instructions in **Querying a PVC Change**.

----End

6 Advanced Services

6.1 Snapshot Management

In Kubernetes, a **VolumeSnapshot** is a snapshot of a volume on a storage system. The VolumeSnapshot capability provides Kubernetes users with a standard way to replicate the content of a volume at a specified point in time without creating a volume. For example, this function enables database administrators to back up the database before making changes such as editing or deleting.

This section describes how to create a VolumeSnapshot using Huawei CSI. To create a VolumeSnapshot, perform the following steps:

- Checking information about volume snapshot-dependent components
- Configuring a VolumeSnapshotClass
- Configuring a VolumeSnapshot

Prerequisites

- **3 Compatibility and Features** lists storage that support VolumeSnapshot creation. You need to search by the storage type and service type.
- For details about the Kubernetes versions that support VolumeSnapshot creation, see **Table 10-4**.
- If you need to use volume snapshots and features associated with volume snapshots in the container environment, perform the operations in **4.1.1.4 Checking Volume Snapshot-Dependent Components** to check whether volume snapshot-dependent components have been deployed in your environment and check the api-versions information about volume snapshots.
- The source PVC exists, and the backend where the PVC resides supports VolumeSnapshot creation.

6.1.1 Configuring a Volume Snapshot

Creating a Volume Snapshot Class

VolumeSnapshotClass provides a way to describe the "classes" of storage when provisioning a VolumeSnapshot. Each VolumeSnapshotClass contains the **driver**, **deletionPolicy**, and **parameters** fields, which are used when a VolumeSnapshot belonging to the class needs to be dynamically provisioned.

The name of a VolumeSnapshotClass object is significant, and is how users can request a particular class. Administrators set the name and other parameters of a class when first creating VolumeSnapshotClass objects, and the objects cannot be updated once they are created.

The following is an example of a VolumeSnapshotClass used by Huawei CSI:

```
apiVersion: snapshot.storage.k8s.io/v1
kind: VolumeSnapshotClass
metadata:
  name: mysnapclass
driver: csi.huawei.com
deletionPolicy: Delete
```

You can modify the parameters according to **Table 6-1**. Currently, Huawei CSI does not support user-defined parameters (**parameters**) in a VolumeSnapshotClass. Therefore, you are advised to create a VolumeSnapshotClass for all snapshots.

Table 6-1 VolumeSnapshotClass parameters

Parameter	Description	Remarks
metadata.name	User-defined name of a VolumeSnapshotClass object.	Take Kubernetes v1.22.1 as an example. The value can contain digits, lowercase letters, hyphens (-), and periods (.), and must start and end with a letter or digit.
driver	driver identifier. This parameter is mandatory.	Set this parameter to the driver name set during Huawei CSI installation. The default driver name is **csi.huawei.com**.
deletionPolicy	Snapshot deletion policy. This parameter is mandatory. The value can be: ● Delete ● Retain	● If the deletion policy is **Delete**, the snapshot on the storage device will be deleted together with the VolumeSnapshotContent object. ● If the deletion policy is **Retain**, the snapshot and VolumeSnapshotContent object on the storage device will be retained.

Procedure

Step 1 Run the following command to create a VolumeSnapshotClass using the created VolumeSnapshotClass configuration file.

```
kubectl create -f mysnapclass.yaml
```

Step 2 Run the following command to view the information about the created VolumeSnapshotClass.

```
kubectl get volumesnapshotclass
```

The following is an example of the command output.

```
NAME         DRIVER          DELETIONPOLICY   AGE
mysnapclass   csi.huawei.com   Delete           25s
```

----End

Creating a Snapshot for a Volume

VolumeSnapshot can be provisioned in two ways: **pre-provisioning and dynamic provisioning**. Currently, Huawei CSI supports only dynamic provisioning. This section describes how to dynamically provision a VolumeSnapshot using Huawei CSI. The following is an example of the VolumeSnapshot configuration file:

```
apiVersion: snapshot.storage.k8s.io/v1
kind: VolumeSnapshot
metadata:
  name: mysnapshot
spec:
  volumeSnapshotClassName: mysnapclass
  source:
    persistentVolumeClaimName: mypvc
```

You can modify the parameters according to **Table 6-2**.

Table 6-2 VolumeSnapshot parameters

Parameter	Description	Remarks
metadata.name	User-defined name of a VolumeSnapshot object.	Take Kubernetes v1.22.1 as an example. The value can contain digits, lowercase letters, hyphens (-), and periods (.), and must start and end with a letter or digit.
spec.volumeSnapshotClassName	Name of the VolumeSnapshotClass object.	--
spec.source.persistentVolumeClaimName	Name of the source PVC object.	Name of the source PVC of the snapshot

Procedure

Step 1 Run the following command to create a VolumeSnapshot using the created VolumeSnapshot configuration file.

```
kubectl create -f mysnapshot.yaml
```

Step 2 Run the following command to view the information about the created VolumeSnapshot.

```
kubectl get volumesnapshot
```

The following is an example of the command output.

```
NAME        READYTOUSE   SOURCEPVC   SOURCESNAPSHOTCONTENT   RESTORESIZE
SNAPSHOTCLASS   SNAPSHOTCONTENT                                  CREATIONTIME   AGE
mysnapshot   true         mypvc                              100Gi         mysnapclass
snapcontent-1009af0a-24c2-4435-861c-516224503f2d   <invalid>      78s
```

----End

6.1.2 Managing Volume Snapshots

6.1.2.1 Querying a VolumeSnapshot

Viewing a VolumeSnapshotClass

Step 1 Run the following command to view the information about the created VolumeSnapshotClass.

```
kubectl get volumesnapshotclass
```

The following is an example of the command output.

```
NAME          DRIVER           DELETIONPOLICY   AGE
mysnapclass   csi.huawei.com   Delete           25s
```

----End

Querying a Volume Snapshot

Step 1 Run the following command to view the information about the created VolumeSnapshot.

```
kubectl get volumesnapshot
```

The following is an example of the command output.

```
NAME        READYTOUSE   SOURCEPVC   SOURCESNAPSHOTCONTENT   RESTORESIZE
SNAPSHOTCLASS   SNAPSHOTCONTENT                                  CREATIONTIME   AGE
mysnapshot   true         mypvc                              100Gi         mysnapclass
snapcontent-1009af0a-24c2-4435-861c-516224503f2d   <invalid>      78s
```

----End

6.1.2.2 Creating a PV Using a VolumeSnapshot

Prerequisites

- **3 Compatibility and Features** lists storage that support PVC creation using a VolumeSnapshot. You need to search by the storage type and service type.
- **10.4 Kubernetes Feature Matrix** lists the Kubernetes versions that support PVC creation using a VolumeSnapshot.
- A VolumeSnapshot exists, and the backend where the VolumeSnapshot resides supports cloning.

When creating a PVC, you need to specify a VolumeSnapshot as the data source. The following is an example of creating a PVC using a VolumeSnapshot. In this example, **mysnapshot** is used as the data source and a PVC named **myrestore** is created.

```
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
  name: myrestore
spec:
  storageClassName: mysc
  dataSource:
    name: mysnapshot
    kind: VolumeSnapshot
    apiGroup: snapshot.storage.k8s.io
  volumeMode: Filesystem
  accessModes:
    - ReadWriteOnce
  resources:
    requests:
      storage: 100Gi
```

NOTICE

- The specified **storageClassName** must be the same as the StorageClass of the snapshot source volume in **dataSource**.
- The capacity of the clone volume must be greater than or equal to that of the snapshot. Equal capacity is recommended.

Procedure

Step 1 Run the following command to create a PVC based on the configuration file for creating a volume using a snapshot.

```
kubectl create -f myrestore.yaml
```

----End

6.1.2.3 Deleting a VolumeSnapshot

Deleting a VolumeSnapshot

Perform this operation when the volume snapshot is no longer required.

Procedure

Step 1 Run the following command to view the information about the created VolumeSnapshot.

```
kubectl get volumesnapshot
```

The following is an example of the command output.

```
NAME        READYTOUSE   SOURCEPVC   SOURCESNAPSHOTCONTENT   RESTORESIZE
SNAPSHOTCLASS   SNAPSHOTCONTENT                                 CREATIONTIME   AGE
mysnapshot   true         mypvc                                 100Gi        mysnapclass
snapcontent-1009af0a-24c2-4435-861c-516224503f2d   <invalid>      78s
```

Step 2 Run the following command to delete the VolumeSnapshot:

```
kubectl delete volumesnapshot mysnapshot
```

If the following information is displayed, the deletion is successful:

```
volumesnapshot.snapshot.storage.k8s.io "mysnapshot" deleted
```

----End

Deleting a VolumeSnapshotClass

Perform this operation when the VolumeSnapshotClass is not bound to any VolumeSnapshot and the VolumeSnapshotClass is no longer required.

Procedure

Step 1 Run the following command to view the VolumeSnapshotClass:

```
kubectl get vsclass
```

The following is an example of the command output.

```
NAME          DRIVER            DELETIONPOLICY   AGE
mysnapclass   csi.huawei.com    Delete           25s
```

Step 2 Run the following command to delete the StorageClass:

```
kubectl delete vsclass mysnapclass
```

If the following information is displayed, the deletion is successful:

```
volumesnapshotclass.snapshot.storage.k8s.io "mysnapclass" deleted
```

----End

7 Common O&M Operations

7.1 Installing Helm 3

This section describes how to install Helm 3.

For details, see **https://helm.sh/docs/intro/install/**.

Prerequisites

Ensure that the master node in the Kubernetes cluster can access the Internet.

Procedure

Step 1 Run the following command to download the Helm 3 installation script.

```
curl -fsSL -o get_helm.sh https://raw.githubusercontent.com/helm/helm/master/scripts/get-helm-3
```

Step 2 Run the following command to modify the permission on the Helm 3 installation script.

```
chmod 700 get_helm.sh
```

Step 3 Determine the Helm version to be installed based on the version mapping between Helm and Kubernetes. For details about the version mapping, see **Helm**

Version Support Policy. Then run the following command to change the **DESIRED_VERSION** environment variable to the Helm version to be installed and run the installation command.

```
DESIRED_VERSION=v3.9.0 ./get_helm.sh
```

Step 4 Run the following command to check whether Helm 3 of the specified version is successfully installed.

```
helm version
```

If the following information is displayed, the installation is successful.

```
version.BuildInfo{Version:"v3.9.0", GitCommit:"7ceeda6c585217a19a1131663d8cd1f7d641b2a7",
GitTreeState:"clean", GoVersion:"go1.17.5"}
```

----End

7.2 Collecting Information

7.2.1 Obtaining the CSI Version

This section describes how to view the CSI version.

Procedure

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Run the following command to query information about the node where huawei-csi-node resides.

```
kubectl get pod -A  -owide | grep huawei-csi-node
```

The following is an example of the command output.

```
NAMESPACE     NAME                              READY   STATUS    RESTARTS       AGE     IP
NODE          NOMINATED NODE   READINESS GATES
huawei-csi    huawei-csi-node-87mss                3/3     Running   0             6m41s
192.168.129.155       node-1          <none>          <none>
huawei-csi    huawei-csi-node-xp8cc               3/3     Running   0            6m41s   192.168.129.156
node-2         <none>           <none
```

Step 3 Use a remote access tool, such as PuTTY, to log in to any node where huawei-csi-node resides through the node IP address.

Step 4 Run the following command to view the CSI version.

```
cat /var/lib/kubelet/plugins/csi.huawei.com/version
```

The version information is displayed as follows:

```
4.10.0
```

----End

7.2.2 Viewing Huawei CSI Logs

Viewing Logs of the huawei-csi-controller Service

Step 1 Run the following command to obtain the node where huawei-csi-controller is located.

```
kubectl get pod -A -o wide | grep huawei
```

The following is an example of the command output, where **IP** indicates the node IP address and **NODE** indicates the node name.

```
NAME                                    READY   STATUS    RESTARTS   AGE    IP           NODE         NOMINATED NODE   READINESS GATES
huawei-csi-controller-695b84b4d8-tg64l  9/9     Running   0          14s    <host1-ip>   <host1-name>   <none>           <none>
```

Step 2 Use a remote access tool, such as PuTTY, to log in to the node where the huawei-csi-controller service resides in the Kubernetes cluster through the management IP address.

Step 3 Go to the log directory.

```
cd /var/log/huawei
```

Step 4 Run the following command to view the customized output logs of the container.

```
vi huawei-csi-controller
```

Step 5 Go to the container directory.

```
cd /var/log/containers
```

Step 6 Run the following command to view the standard output logs of the container.

```
vi huawei-csi-controller-<name>_huawei-csi_huawei-csi-driver-<container-id>.log
```

----End

Viewing Logs of the huawei-csi-node Service

Step 1 Run the following command to obtain the node where huawei-csi-node is located.

```
kubectl get pod -A -o wide | grep huawei
```

The following is an example of the command output, where **IP** indicates the node IP address and **NODE** indicates the node name.

```
NAME                    READY   STATUS    RESTARTS   AGE    IP           NODE         NOMINATED NODE   READINESS GATES
huawei-csi-node-g6f7z   3/3     Running   0          14s    <host2-ip>   <host2-name> <none>           <none>
```

Step 2 Use a remote access tool, such as PuTTY, to log in to the node where the huawei-csi-node service resides in the Kubernetes cluster through the management IP address.

Step 3 Go to the log directory.

```
cd /var/log/huawei
```

Step 4 Run the following command to view the customized output logs of the container.

```
vi huawei-csi-node
```

Step 5 Go to the container directory.

```
cd /var/log/containers
```

Step 6 Run the following command to view the standard output logs of the container.

```
vi huawei-csi-node-<name>_huawei-csi_huawei-csi-driver-<container-id>.log
```

----End

7.2.3 Collecting Logs

Performing Check Before Collection

Step 1 Use a remote access tool, such as PuTTY, to log in to the node where the oceanctl tool is installed in the Kubernetes cluster through the management IP address.

Step 2 Run the following command. The displayed version is **v4.10.0**.

```
oceanctl version
```

The following is an example of the command output.

```
Oceanctl Version: v4.10.0
```

Step 3 Run the **oceanctl collect logs --help** command. The following information is displayed.

```
$ oceanctl collect logs --help
Collect logs of one or more nodes in specified namespace in Kubernetes

Usage:
  oceanctl collect logs [flags]

Examples:
  # Collect logs of all nodes in specified namespace
  oceanctl collect logs -n <namespace>

  # Collect logs of specified node in specified namespace
  oceanctl collect logs -n <namespace> -N <node>

  # Collect logs of all nodes in specified namespace
  oceanctl collect logs -n <namespace> -a

  # Collect logs of all nodes in specified namespace with a maximum of 50 nodes collected at the same time
  oceanctl collect logs -n <namespace> -a --threads-max=50

  # Collect logs of specified node in specified namespace
  oceanctl collect logs -n <namespace> -N <node> -a

Flags:
  -a, --all                Collect all nodes messages
  -h, --help               help for logs
  -n, --namespace string   namespace of resources
  -N, --nodename string    Specify the node for which information is to be collected.
      --threads-max int    set maximum number[1~1000] of threads for nodes to be collected. (default 50)

Global Flags:
      --log-dir string   Specify the directory for printing log files. (default "/var/log/huawei")
```

Step 4 Run the following command to check whether a Pod is started properly. In the command, *huawei-csi* indicates the namespace for installing CSI.

```
kubectl get deployment -n huawei-csi
```

The following is an example of the command output.

```
NAME                    READY   UP-TO-DATE   AVAILABLE   AGE
huawei-csi-controller   1/1     1            1           21h
```

----End

Collecting All Logs in the CSI Namespace Using oceanctl

Step 1 Use a remote access tool, such as PuTTY, to log in to the node checked in **Performing Check Before Collection** through the management IP address.

Step 2 Run the **oceanctl collect logs -n <namespace> -a --threads-max=***<max_node_processing_num>* command to collect CSI logs of all nodes where CSI containers reside in the cluster. In the command, **threads-max** indicates the maximum number of nodes for which logs can be collected at the same time. The default value is **50**. You can set the value based on the host performance and load.

```
oceanctl collect logs -n huawei-csi -a --threads-max=10
```

Step 3 Check the log package generated in the **/tmp** directory. You can run the **unzip** *<zip_name>* **-d collect_logs** command to decompress the log package. In the preceding command, *<zip_name>* indicates the package name.

```
# date
Wed Sep 20 02:49:24 EDT 2023

# ls
huawei-csi-2023-09-20-02:48:22-all.zip
```

----End

Collecting the Log of a Single CSI Node Using oceanctl

Step 1 Use a remote access tool, such as PuTTY, to log in to the node checked in **Performing Check Before Collection** through the management IP address.

Step 2 Run the **oceanctl collect logs -n** *<namespace>* **-N** *<nodeName>* command to collect CSI logs of all nodes where CSI containers reside in the cluster.

```
oceanctl collect logs -n huawei-csi -N node-1
```

Step 3 Check the log package generated in the **/tmp** directory. You can run the **unzip** *<zip_name>* **-d collect_logs** command to decompress the log package. In the preceding command, *<zip_name>* indicates the package name.

```
# date
Thu Sep 21 04:08:47 EDT 2023

# ls
huawei-csi-2023-09-21-04:05:15-node-1.zip
```

----End

7.3 Downloading a Container Image

Downloading a Container Image Using containerd

Step 1 Run the following command to download an image to a local path. In the command, *image:tag* indicates the image to be pulled and its tag.

```
ctr image pull <image>:<tag>
```

Step 2 Run the following command to export the image to a file. In the command, *image:tag* indicates the image to be exported, and *file* indicates the name of the exported image file.

```
ctr image export <file>.tar <image>:<tag>
```

----End

Downloading a Container Image Using Docker

Step 1 Run the following command to download an image to a local path. In the command, *image:tag* indicates the image to be pulled.

```
docker pull <image>:<tag>
```

Step 2 Run the following command to export the image to a file. In the command, *image:tag* indicates the image to be exported, and *file* indicates the name of the exported image file.

```
docker save <image>:<tag> -o <file>.tar
```

----End

Downloading a Container Image Using Podman

Step 1 Run the following command to download an image to a local path. In the command, *image:tag* indicates the image to be pulled.

```
podman pull <image>:<tag>
```

Step 2 Run the following command to export the image to a file. In the command, *image:tag* indicates the image to be exported, and *file* indicates the name of the exported image file.

```
podman save <image>:<tag> -o <file>.tar
```

----End

7.4 Updating the huawei-csi-controller or huawei-csi-node Service

Perform this operation when you need to update the huawei-csi-controller or huawei-csi-node service, for example, changing the number of copies for the huawei-csi-controller service.

Procedure

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Go to the **/helm/esdk** directory and run the following command to obtain the original service configuration file. **helm-huawei-csi** indicates the Helm chart name specified during the installation of the earlier version, and **huawei-csi** indicates the Helm chart namespace specified during the installation of the earlier version. For details about the component package path, see **Table 4-1**.

```
helm get values helm-huawei-csi -n huawei-csi -a > ./update-values.yaml
```

Step 3 Run the **vi update-values.yaml** command to open the file obtained in **Step 2** and modify the configuration items by referring to **4.1.2.1.3 Parameters in the values.yaml File of Helm**. After the modification, press **Esc** and enter **:wq!** to save the modification.

Step 4 Run the following command to update Huawei CSI services.

```
helm upgrade helm-huawei-csi ./ -n huawei-csi  -f ./update-values.yaml
```

----End

7.5 Modifying the Log Output Mode

huawei-csi supports two log output modes: **file** and **console**. **file** indicates that logs are output to the fixed directory (**/var/log/huawei**), and **console** indicates that logs are output to the standard directory of the container. You can set the log output mode as required. The default mode is **file**.

Procedure

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Go to the **/helm/esdk** directory and run the following command to obtain the original service configuration file. **helm-huawei-csi** indicates the Helm chart name specified during the installation of the earlier version, and **huawei-csi** indicates the Helm chart namespace specified during the installation of the earlier version. For details about the component package path, see **Table 4-1**.

```
helm get values helm-huawei-csi -n huawei-csi -a > ./update-values.yaml
```

Step 3 Run the **vi update-values.yaml** command to open the file obtained in **Step 2** and modify the configuration items. After the modification, press **Esc** and enter **:wq!** to save the modification.

```
# The CSI driver parameter configuration
csiDriver:
  # Driver name, it is strongly recommended not to modify this parameter
  # The CCE platform needs to modify this parameter, e.g. csi.oceanstor.com
  driverName: csi.huawei.com
  # Endpoint, it is strongly recommended not to modify this parameter
  endpoint: /csi/csi.sock
  # DR Endpoint, it is strongly recommended not to modify this parameter
  drEndpoint: /csi/dr-csi.sock
  # Maximum number of concurrent disk scans or detaches, support 1~10
  connectorThreads: 4
  # Flag to enable or disable volume multipath access, support [true, false]
  volumeUseMultipath: true
  # Multipath software used by fc/iscsi. support [DM-multipath, HW-UltraPath, HW-UltraPath-NVMe]
  scsiMultipathType: DM-multipath
  # Multipath software used by roce/fc-nvme. only support [HW-UltraPath-NVMe]
  nvmeMultipathType: HW-UltraPath-NVMe
  # Timeout interval for waiting for multipath aggregation when DM-multipath is used on the host. support
1~600
  scanVolumeTimeout: 3
  # Timeout interval for running command on the host. support 1~600
  execCommandTimeout: 30
  # check the number of paths for multipath aggregation
  # Allowed values:
  #   true: the number of paths aggregated by DM-multipath is equal to the number of online paths
  #   false: the number of paths aggregated by DM-multipath is not checked.
  # Default value: false
  allPathOnline: false
  # Interval for updating backend capabilities. support 60~600
  backendUpdateInterval: 60
  # Huawei-csi-controller log configuration
  controllerLogging:
    # Log record type, support [file, console]
    module: file
    # Log Level, support [debug, info, warning, error, fatal]
    level: info
    # Directory for storing logs
    fileDir: /var/log/huawei
    # Size of a single log file
```

```
    fileSize: 20M
    # Maximum number of log files that can be backed up.
    maxBackups: 9
  # Huawei-csi-node log configuration
  nodeLogging:
    # Log record type, support [file, console]
    module: file
    # Log Level, support [debug, info, warning, error, fatal]
    level: info
    # Directory for storing logs
    fileDir: /var/log/huawei
    # Size of a single log file
    fileSize: 20M
    # Maximum number of log files that can be backed up.
    maxBackups: 9
```

Step 4 Run the following command to update the log configuration.

```
helm upgrade helm-huawei-csi ./ -n huawei-csi  -f ./update-values.yaml
```

----End

7.6 Enabling the ReadWriteOncePod Feature Gate

The ReadWriteOnce access mode is the fourth access mode introduced by Kubernetes v1.22 for PVs and PVCs. If you create a Pod using a PVC in ReadWriteOncePod access mode, Kubernetes ensures that the Pod is the only Pod in the cluster that can read or write the PVC.

If the Kubernetes version is earlier than v1.29, you need to enable the ReadWriteOncePod feature in feature-gates of kube-apiserver, kube-scheduler, and kubelet.

NOTE

Currently, the ReadWriteOncePod feature gate cannot be enabled on the CCE or CCE Agile platform.

Procedure

Step 1 Enable the ReadWriteOncePod feature gate for kube-apiserver.

1. Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.
2. Run the **vi /etc/kubernetes/manifests/kube-apiserver.yaml** command, press **I** or **Insert** to enter the insert mode, and add **--feature-gates=ReadWriteOncePod=true** to the kube-apiserver container. After the modification is complete, press **Esc** and enter **:wq!** to save the modification.

```
...
spec:
  containers:
  - command:
    - kube-apiserver
    - --feature-gates=ReadWriteOncePod=true
    ...
```

NOTE

After the editing is complete, Kubernetes will automatically apply the updates.

Step 2 Enable the ReadWriteOncePod feature gate for kube-scheduler.

1. Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.
2. Run the **vi /etc/kubernetes/manifests/kube-scheduler.yaml** command, press **I** or **Insert** to enter the insert mode, and add **--feature-gates=ReadWriteOncePod=true** to the kube-scheduler container. After the modification is complete, press **Esc** and enter **:wq!** to save the modification.

```
...
spec:
  containers:
  - command:
    - kube-scheduler
    - --feature-gates=ReadWriteOncePod=true
    ...
```

NOTE

After the editing is complete, Kubernetes will automatically apply the updates.

Step 3 Enable the ReadWriteOncePod feature gate for kubelet.

NOTICE

The dynamic Kubelet configuration function is not used since v1.22 and deleted in v1.24. Therefore, you need to perform the following operations on kubelet on each worker node in the cluster.

1. Use a remote access tool, such as PuTTY, to log in to any worker node in the Kubernetes cluster through the management IP address.
2. Run the **vi /var/lib/kubelet/config.yaml** command, press **I** or **Insert** to enter the editing state, and add **ReadWriteOncePod: true** to the **featureGates** field of the KubeletConfiguration object. If the **featureGates** field does not exist, add it at the same time. After the modification is complete, press **Esc** and enter **:wq!** to save the modification.

```
apiVersion: kubelet.config.k8s.io/v1beta1
featureGates:
  ReadWriteOncePod: true
  ...
```

NOTE

The default path of the kubelet configuration file is **/var/lib/kubelet/config.yaml**. Enter the path based on site requirements.

3. After the configuration is complete, run the **systemctl restart kubelet** command to restart kubelet.

----End

7.7 Configuring Access to the Kubernetes Cluster as a Non-root User

Procedure

Step 1 Copy the authentication file of the Kubernetes cluster and modify **/etc/kubernetes/admin.conf** to be the actual authentication file.

```
mkdir -p $HOME/.kube
sudo cp -i /etc/kubernetes/admin.conf $HOME/.kube/config
```

Step 2 Change the user and user group of the authentication file.

```
sudo chown $(id -u):$(id -g) $HOME/.kube/config
```

Step 3 Configure the **KUBECONFIG** environment variable of the current user. The following uses Ubuntu 20.04 as an example.

```
echo "export KUBECONFIG=$HOME/.kube/config" >> ~/.bashrc
source ~/.bashrc
```

----End

7.8 Configuring IPv6

This section describes how to use Huawei CSI to configure IPv6.

7.8.1 Configuring IPv6 During the Initial Installation of Huawei CSI

This section describes how to specify IPv6 during the initial installation of Huawei CSI.

Prerequisites

- IPv6 can be configured only when the storage backend type is **oceanstor-nas**, **oceanstor-san**, or **oceanstor-dtree**.
- The host environment and Kubernetes cluster environment support IPv6. For details, see **IPv4/IPv6 dual-stack of Kubernetes**.

Procedure

Step 1 Install the CSI-dependent components by following the instructions in **Step 1** to **Step 7** in **Installation Procedure**.

Step 2 Run the **vi values.yaml** command to open the configuration file and modify the **service.ipFamilyPolicy** and **service.ipFamilies** configuration items. For details about the parameters, see **Table 4-8**.

The following is an example:

```
service:
  ipFamilyPolicy: SingleStack
  ipFamilies:
    - IPv6
```

Step 3 Install and deploy Huawei CSI by following the instructions in **Step 8** to **Step 9** in **Installation Procedure**.

Step 4 Run the following command to check the status of the service in the **huawei-csi** namespace.

```
kubectl get service -n huawei-csi
```

The following is an example of the command output.

```
NAME                   TYPE        CLUSTER-IP        EXTERNAL-IP   PORT(S)    AGE
huawei-csi-controller   ClusterIP   fd00:10:96::8136   <none>        4433/TCP   19m
```

Step 5 Run the following command to check the value of **ipFamilies** for the huawei-csi-controller service.

```
kubectl get svc -n huawei-csi huawei-csi-controller -o=jsonpath='{.spec.ipFamilies}'
```

The following is an example of the command output.

```
["IPv6"]
```

Step 6 Run the following command to check the value of **ipFamilyPolicy** for the huawei-csi-controller service.

```
kubectl get svc -n huawei-csi huawei-csi-controller -o=jsonpath='{.spec.ipFamilyPolicy}'
```

The following is an example of the command output.

```
SingleStack
```

----End

7.8.2 Switching from IPv4 to IPv6 for Huawei CSI

This section describes how to switch from IPv4 to IPv6 when updating Huawei CSI.

Prerequisites

- The host environment and Kubernetes cluster environment support IPv6. For details, see **IPv4/IPv6 dual-stack of Kubernetes**.
- Huawei CSI has been installed and services are running properly.

Procedure

Step 1 Run the following command to obtain the original service configuration file. **helm-huawei-csi** indicates the Helm chart name specified during the installation of the earlier version, and **huawei-csi** indicates the Helm chart namespace specified during the installation of the earlier version.

```
helm get values helm-huawei-csi -n huawei-csi -a > ./update-values.yaml
```

Step 2 Run the **vi update-values.yaml** command to open the file obtained in **Step 1** and modify the **service.ipFamilyPolicy** and **service.ipFamilies** configuration items. For details about the parameters, see **Table 4-8**.

The following is an example:

```
service:
  ipFamilyPolicy: SingleStack
  ipFamilies:
    - IPv6
```

Step 3 Before switching to IPv6, run the following command to delete the service in the **huawei-csi** namespace.

```
kubectl delete service -n huawei-csi --all
```

Step 4 Run the following command to upgrade Huawei CSI. In the following command, **helm-huawei-csi** indicates the specified Helm chart name, **huawei-csi** indicates the specified Helm chart namespace, and **update-values.yaml** indicates the file obtained in **Step 1**.

```
helm upgrade helm-huawei-csi ./ -n huawei-csi -f ./values.yaml -f ./update-values.yaml
```

Step 5 Run the following command to query the **ipFamilies** parameter of the huawei-csi-controller service after the update.

```
kubectl get svc -n huawei-csi huawei-csi-controller -o=jsonpath='{.spec.ipFamilies}'
```

The expected output is as follows:

```
["IPv6"]
```

----End

7.9 Configuring Storage Topology Awareness

In the Kubernetes cluster, resources can be scheduled and provisioned based on the topology labels of nodes and the topology capabilities supported by storage backends.

Prerequisites

You need to configure topology labels on worker nodes in the cluster. The method is as follows:

1. Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.
2. Run the following command to view information about worker nodes in the current cluster.
```
kubectl get node
```
The following is an example of the command output.
```
NAME     STATUS   ROLES                       AGE   VERSION
node01   Ready    controlplane,etcd,worker   42d   v1.22.3
node02   Ready    worker                     42d   v1.22.3
node03   Ready    worker                     42d   v1.22.3
```
3. Run the following command to configure a topology label for a worker node. In the preceding command, *nodename* indicates the name of a worker node. For details about the **key** and **value** parameters, see **Table 7-1**.
```
kubectl label node <nodename> <key>=<value>
```

Table 7-1 Description of topology label parameters

Parameter	Description	Remarks
<key>	Unique identifier of a topology label.	The value can be **zone**, **region**, or **protocol.**<*protocol*>. <*protocol*> can be set to **iscsi**, **nfs**, **fc**, or **roce**.
<value>	Value of a topology label.	If **key** is set to **zone** or **region**, **value** is a user-defined parameter. If **key** is set to **protocol.**<*protocol*>, **value** is fixed at **csi.huawei.com**.

NOTE

- A topology label must start with **topology.kubernetes.io**. Topology label examples:
  - Example 1: **topology.kubernetes.io/region=China-west**
  - Example 2: **topology.kubernetes.io/zone=ChengDu**
  - Example 3: **topology.kubernetes.io/protocol.iscsi=csi.huawei.com**
  - Example 4: **topology.kubernetes.io/protocol.fc=csi.huawei.com**
- A key in a topology label on a node can have only one value.
- If multiple protocols are configured in a topology label on a node, when you configure a StorageClass, the StorageClass needs to meet only one of the protocols.
- If both the region and the zone are configured in a topology label on a node, when you configure a StorageClass, the StorageClass must meet all filter criteria.

4. Run the following command to view the label information about all worker nodes in the current cluster.

```
kubectl get nodes -o=jsonpath='{range .items[*]}[{.metadata.name}, {.metadata.labels}]{"\n"}{end}' | 
grep --color "topology.kubernetes.io"
```

The following is an example of the command output.

```
[node01,"beta.kubernetes.io/arch":"amd64","beta.kubernetes.io/os":"linux","kubernetes.io/
arch":"amd64","kubernetes.io/hostname":"node01","kubernetes.io/os":"linux","node-role.kubernetes.io/
controlplane":"true","node-role.kubernetes.io/etcd":"true","node-role.kubernetes.io/
worker":"true","topology.kubernetes.io/zone":"ChengDu"}]
```

Procedure

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Go to the directory where the Helm project is located. If the previous Helm project cannot be found, copy the **helm** directory in the component package to any directory on the master node. For details about the component package path, see **Table 4-1**.

Step 3 Go to the backend service configuration directory **/examples/backend/** and back up the **backend.yaml** file.

```
cp backend.yaml backend.yaml.bak
```

Step 4 Run the **vi backend.yaml** command to open the file and configure topology awareness as required. The following is an example. After the modification is complete, press **Esc** and enter **:wq!** to save the modification.

```
storage: "oceanstor-san"
name: "dorado-iscsi-155"
namespace: "huawei-csi"
urls:
  - "https://192.168.129.155:8088"
pools:
  - "StoragePool001"
parameters:
  protocol: "iscsi"
  portals:
    - "10.10.30.20"
    - "10.10.30.21"
supportedTopologies:
  - { "topology.kubernetes.io/region": "China-west", "topology.kubernetes.io/zone": "ChengDu" }
  - { "topology.kubernetes.io/region": "China-south","topology.kubernetes.io/zone": "ShenZhen" }
maxClientThreads: "30"
```

Step 5 Run the following command to delete the storage backend to be modified. In the command, **dorado-iscsi-155** indicates the storage backend name.

```
oceanctl delete backend dorado-iscsi-155 -n huawei-csi
```

Step 6 Run the following command to create a storage backend.

```
oceanctl create backend -f ../examples/backend/backend.yaml -i yaml
```

Enter the storage user name and password as prompted.

```
Please enter this backend user name:admin
Please enter this backend password:
```

Step 7 Run the **vi StorageClass.yaml** command to modify the .yaml file. Press **I** or **Insert** to enter the insert mode and add related parameters in the .yaml file. For details about the parameters, see **Table 7-2**. After the modification is complete, press **Esc** and enter **:wq!** to save the modification.

Add the following configuration items to the *StorageClass.yaml* file.

- Example 1: Configure zone and region information in the StorageClass.

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: example-storageclass
provisioner: csi.huawei.com
parameters:
  volumeType: lun
  allocType: thin
volumeBindingMode: WaitForFirstConsumer
allowedTopologies:
- matchLabelExpressions:
  - key: topology.kubernetes.io/zone
    values:
    - ChengDu
  - key: topology.kubernetes.io/region
    values:
    - China-west
```

- Example 2: Configure protocol information in the StorageClass.

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: protocol-example-storageclass
provisioner: csi.huawei.com
parameters:
  volumeType: lun
  allocType: thin
volumeBindingMode: WaitForFirstConsumer
allowedTopologies:
- matchLabelExpressions:
  - key: topology.kubernetes.io/protocol.iscsi
    values:
    - csi.huawei.com
```

Table 7-2 StorageClass parameter description

Parameter	Description	Remarks
volumeBindingMode	PersistentVolume binding mode, used to control the time when PersistentVolume resources are dynamically allocated and bound.	You can set this parameter to **WaitForFirstConsumer** or **Immediate**. **WaitForFirstConsumer**: indicates that the binding and allocation of the PersistentVolume are delayed until a Pod that uses the PVC is created. **Immediate**: The PersistentVolume is bound and allocated immediately after a PVC is created.
allowedTopologies.matchLabelExpressions	Topology information label, which is used to filter CSI backends and Kubernetes nodes. If the matching fails, PVCs or Pods cannot be created. Both **key** and **values** must be configured in a fixed format.	**key**: This parameter can be set to **topology.kubernetes.io/zone** or **topology.kubernetes.io/region**. **topology.kubernetes.io/protocol.**<*protocol*>: <*protocol*> indicates the protocol type and can be **iscsi**, **fc**, or **nfs**.
		values: If **key** is **topology.kubernetes.io/zone** or **topology.kubernetes.io/region**, **values** must be the same as that in **Prerequisites**. If **key** is **topology.kubernetes.io/protocol.**<*protocol*>, **value** is fixed at **csi.huawei.com**.

Step 8 Run the following command to create a StorageClass based on the .yaml file.

```
kubectl create -f StorgeClass.yaml
```

Step 9 Use the StorageClass to create a PVC with the topology capability. For details, see **Table 5-53**.

----End

7.10 Configuring ALUA

Asymmetric Logical Unit Access (ALUA) is a model that supports access to multiple target ports. In the multipathing state, ALUA presents active/passive volumes to the host and provides a port access status switchover interface to switch over the working controllers for volumes. For example, when a volume of a controller fails, you can set the status of ports on the controller to **Unavailable**. After the host multipathing software that supports ALUA detects the status, it switches subsequent I/Os from the failed controller to the peer controller.

7.10.1 Configuring ALUA Parameters for a Huawei Enterprise Storage Backend

For details about how to configure ALUA for Huawei enterprise storage, see the host connectivity guide of the corresponding product.

The ALUA configuration may vary according to the OS. Visit **Huawei Technical Support**, enter **Host Connectivity Guide** in the search box, and click the search button. In the search result, select the host connectivity guide for the desired OS. Configure ALUA according to the actual situation and the description in the guide. Huawei CSI will apply the configuration items you set to the initiator of the host on Huawei storage.

NOTE

A node with a Pod provisioned does not proactively change ALUA information. The host ALUA configuration changes only after a Pod is provisioned again to the node.

ALUA Parameters for OceanStor V5 Series

Table 7-3 lists the ALUA parameters supported by Huawei CSI for OceanStor V5 series.

Table 7-3 ALUA parameters supported by Huawei CSI for OceanStor V5 series

Parameter	Description	Remarks
HostName	Host name rule. This parameter is mandatory. You can use a regular expression.	The host name can be obtained by running the **cat /etc/hostname** command. It can be matched by using regular expressions. When **HostName** is set to *****, the configuration takes effect on hosts with any name. For details, see **Regular expression**. If the host name of a compute node matches multiple ALUA configuration options, they will be sorted based on the matching accuracy and the first ALUA configuration option will be used. For details about the sorting rules, see **Rules for Matching ALUA Configuration Items with Host Names**.

Parameter	Description	Remarks
MULTIPATHTYPE	Multipathing type. This parameter is mandatory. The value can be: ● **0**: Third-party multipathing is not used. ● **1**: Third-party multipathing is used.	--
FAILOVERMODE	Initiator switchover mode. This parameter is conditionally mandatory. The value can be: ● **0**: early-version ALUA ● **1**: common ALUA ● **2**: ALUA not used ● **3**: special ALUA	This parameter needs to be specified only when third-party multipathing is used. Configure the initiator switchover mode by referring to the connectivity guide.
SPECIALMODETYPE	Special mode type of the initiator. This parameter is conditionally mandatory. The value can be: ● **0**: special mode 0 ● **1**: special mode 1 ● **2**: special mode 2 ● **3**: special mode 3	This parameter needs to be specified only when the initiator switchover mode is special ALUA. Configure the special mode type of the initiator by referring to the connectivity guide.
PATHTYPE	Initiator path type. This parameter is conditionally mandatory. The value can be: ● **0**: preferred path ● **1**: non-preferred path	This parameter needs to be specified only when third-party multipathing is used. Configure the initiator path type by referring to the connectivity guide.

The following uses OceanStor 18500 V5 as an example to describe how to connect to Red Hat. For details about the host connectivity guide, see *Huawei SAN Storage Host Connectivity Guide for Red Hat*.

The following ALUA configuration example is recommended in the OceanStor 18500 V5 host connectivity guide for Red Hat in non-HyperMetro storage scenarios. In this example, the OS on compute node **myhost01** in the Kubernetes cluster is RHEL 5.*x*, and that on other compute nodes is RHEL 7.*x*. According to the recommendation, the switchover mode of RHEL 5.*x* should be "ALUA not used", and that of RHEL 7.*x* should be "common ALUA".

```
storage: oceanstor-san
name: oceanstor-iscsi-155
urls:
  - https://192.168.129.155:8088
  - https://192.168.129.156:8088
pools:
  - StoragePool001
parameters:
  protocol: iscsi
  portals:
    - 192.168.128.120
    - 192.168.128.121
  ALUA:
    ^myhost01$:
      MULTIPATHTYPE: 1
      FAILOVERMODE: 2
      PATHTYPE: 0
    "*":
      MULTIPATHTYPE: 1
      FAILOVERMODE: 1
      PATHTYPE: 0
```

ALUA Parameters for OceanStor and OceanStor Dorado Series

Table 7-4 lists the ALUA parameters supported by Huawei CSI for OceanStor and OceanStor Dorado series.

NOTE

By default, the initiator host access mode of OceanStor and OceanStor Dorado series storage is "balanced mode". Therefore, you are advised not to configure ALUA parameters for OceanStor and OceanStor Dorado series storage.

Table 7-4 ALUA parameters for OceanStor and OceanStor Dorado series

Parameter	Description	Remarks
HostName	Host name rule. This parameter is mandatory. You can use a regular expression.	The host name can be obtained by running the **cat /etc/hostname** command. It can be matched by using regular expressions. When **HostName** is set to *, the configuration takes effect on hosts with any name. For details, see **Regular expression**. If the host name of a compute node matches multiple ALUA configuration options, they will be sorted based on the matching accuracy and the first ALUA configuration option will be used. For details about the sorting rules, see **Rules for Matching ALUA Configuration Items with Host Names**.

Parameter	Description	Remarks
accessMode	Host access mode. This parameter is mandatory. The value can be: ● **0**: balanced mode ● **1**: asymmetric mode	The balanced mode is recommended in non-HyperMetro scenarios. Currently, Huawei CSI does not support SAN HyperMetro scenarios. Exercise caution when using the asymmetric mode.
hyperMetroPathOptimized	Whether the path of the host on the current storage array is preferred in HyperMetro scenarios. The value can be: ● **1**: yes ● **0**: no	This parameter needs to be specified only when the host access mode is set to asymmetric. Currently, Huawei CSI does not support SAN HyperMetro scenarios. Exercise caution when using the asymmetric mode.

The following uses OceanStor Dorado 18000 as an example to describe how to connect to Red Hat. For details about the host connectivity guide, see *OceanStor Dorado and OceanStor Host Connectivity Guide for Red Hat*.

The following ALUA configuration example is recommended in the OceanStor Dorado 18000 host connectivity guide for Red Hat in non-HyperMetro storage scenarios.

```
storage: "oceanstor-san"
name: "dorado-iscsi-155"
urls:
  - "https://192.168.129.155:8088"
  - "https://192.168.129.156:8088"
pools:
  - "StoragePool001"
parameters:
  protocol: "iscsi"
  portals:
    - "192.168.128.120"
    - "192.168.128.121"
  ALUA:
    "*":
      accessMode: 0
```

Rules for Matching ALUA Configuration Items with Host Names

- If the configured host name rule exactly matches the host name of the service node, the ALUA configuration item corresponding to the host name rule is used.

  For example, the host name rule in configuration item 1 is ***** and that in configuration item 2 is **^myhost01$**. If the host name of a compute node is **myhost01**, it exactly matches configuration item 2. In this case, Huawei CSI will apply the configuration information in configuration item 2 to the storage side.

- If the configured host name rule does not exactly match the host name of the service node, the first ALUA configuration item matched by regular expressions is used.

  For example, the host name rule in configuration item 1 is **myhost0[0-9]** and that in configuration item 2 is **myhost0[5-9]**. In this case, configuration item 1 has a higher priority than configuration item 2. If the host name of a compute node is **myhost06**, both configuration items can be matched. In this case, Huawei CSI will apply the configuration information in configuration item 1 to the storage side.

7.10.2 Configuring ALUA Parameters for a Distributed Storage Backend

For details about how to configure ALUA for Huawei distributed storage, see the host connectivity guide of the corresponding product.

The ALUA configuration may vary according to the OS. Visit **Huawei Technical Support**, enter **Host Connectivity Guide** in the search box, and click the search button. In the search result, select the host connectivity guide for the desired OS. Configure ALUA according to the actual situation and the description in the guide. Huawei CSI will apply the configuration items you set to the initiator of the host on Huawei storage.

NOTE

A node with a Pod provisioned does not proactively change ALUA information. The host ALUA configuration changes only after a Pod is provisioned again to the node.

In non-HyperMetro scenarios of distributed storage, you are advised to set the switchover mode to "disable ALUA" (default value). This is because the storage system is in active/active mode and "enables ALUA" is meaningless. Therefore, you are advised not to configure ALUA parameters for distributed storage.

Table 7-5 lists the ALUA parameters supported by Huawei CSI for distributed storage.

Table 7-5 ALUA parameters for distributed storage

Parameter	Description	Remarks
HostName	The value of **HostName** is the host name of a worker node, for example, **HostName1** and **HostName2**.	The host name can be obtained by running the **cat /etc/hostname** command. It can be matched by using regular expressions. When **HostName** is set to *, the configuration takes effect on hosts with any name. For details, see **Regular expression**. If the host name of a compute node matches multiple ALUA configuration options, they will be sorted based on the matching accuracy and the first ALUA configuration option will be used. For details about the sorting rules, see **Rules for Matching ALUA Configuration Items with Host Names**.
switchoverMode	Switchover mode. This parameter is mandatory. The value can be: ● **Disable_alua**: disables ALUA. ● **Enable_alua**: enables ALUA.	In non-HyperMetro scenario, you are advised to set the switchover mode to "disable ALUA". This is because the storage system is in active/active mode and "enables ALUA" is meaningless. Currently, Huawei CSI does not support SAN HyperMetro scenarios. Exercise caution when enabling ALUA.
pathType	Path type. This parameter is conditionally mandatory. The value can be: ● **optimal_path**: preferred path ● **non_optimal_path**: non-preferred path	This parameter is mandatory when the switchover mode is set to "enables ALUA".

Rules for Matching ALUA Configuration Items with Host Names

- If the configured host name rule exactly matches the host name of the service node, the ALUA configuration item corresponding to the host name rule is used.

  For example, the host name rule in configuration item 1 is ***** and that in configuration item 2 is **^myhost01$**. If the host name of a compute node is **myhost01**, it exactly matches configuration item 2. In this case, Huawei CSI will apply the configuration information in configuration item 2 to the storage side.

- If the configured host name rule does not exactly match the host name of the service node, the first ALUA configuration item matched by regular expressions is used.

  For example, the host name rule in configuration item 1 is **myhost0[0-9]** and that in configuration item 2 is **myhost0[5-9]**. In this case, configuration item 1 has a higher priority than configuration item 2. If the host name of a compute node is **myhost06**, both configuration items can be matched. In this case, Huawei CSI will apply the configuration information in configuration item 1 to the storage side.

7.10.3 Example ALUA Configuration Policy of OceanStor V5 Series

Example 1: The configuration file content is as follows:

```
parameters:
  ALUA:
    "*":
      MULTIPATHTYPE: 1
      FAILOVERMODE: 3
      SPECIALMODETYPE: 0
      PATHTYPE: 0
    node1:
      MULTIPATHTYPE: 1
      FAILOVERMODE: 3
      SPECIALMODETYPE: 0
      PATHTYPE: 1
```

If the host name is **node1**, both of the preceding ALUA configuration sections can be used to configure initiators. According to the configuration policy rules in **7.10.1 Configuring ALUA Parameters for a Huawei Enterprise Storage Backend**, the priority of the second configuration section (where **HostName** is **node1**) is higher than that of the first configuration section (where **HostName** is *****).

Example 2: The configuration file content is as follows:

```
parameters:
  ALUA:
    node[0-9]:
      MULTIPATHTYPE: 1
      FAILOVERMODE: 3
      SPECIALMODETYPE: 0
      PATHTYPE: 0
    node[5-7]:
      MULTIPATHTYPE: 1
      FAILOVERMODE: 3
      SPECIALMODETYPE: 0
      PATHTYPE: 1
```

If the host name is **node6**, both of the preceding ALUA configuration sections can be used to configure initiators. According to the configuration policy rules in **7.10.1 Configuring ALUA Parameters for a Huawei Enterprise Storage Backend**, select the first ALUA configuration section to configure initiators.

Example 3: The configuration file content is as follows:

```
parameters:
  ALUA:
   node$:
      MULTIPATHTYPE: 1
      FAILOVERMODE: 3
      SPECIALMODETYPE: 0
      PATHTYPE: 0
   node10$:
      MULTIPATHTYPE: 1
      FAILOVERMODE: 3
      SPECIALMODETYPE: 0
      PATHTYPE: 1
```

According to the configuration policy rules in **7.10.1 Configuring ALUA Parameters for a Huawei Enterprise Storage Backend**: For host **node1**, select the first ALUA configuration section to configure initiators. For host **node10**, select the second ALUA configuration section to configure initiators. **^** matches the beginning of a character string, and **$** matches the end of a character string.

7.10.4 Example ALUA Configuration Policy of OceanStor Dorado

Example 1: The configuration file content is as follows:

```
parameters:
  ALUA:
    "*":
     accessMode: 1
     hyperMetroPathOptimized: 1
   node1:
      accessMode: 1
      hyperMetroPathOptimized: 0
```

If the host name is **node1**, both of the preceding ALUA configuration sections can be used to configure initiators. According to the configuration policy rules in **7.10.1 Configuring ALUA Parameters for a Huawei Enterprise Storage Backend**, the priority of the second configuration section (where **HostName** is **node1**) is higher than that of the first configuration section (where **HostName** is *****).

Example 2: The configuration file content is as follows:

```
parameters:
  ALUA:
   node[0-9]:
     accessMode: 1
     hyperMetroPathOptimized: 1
   node[5-7]:
     accessMode: 1
     hyperMetroPathOptimized: 0
```

If the host name is **node6**, both of the preceding ALUA configuration sections can be used to configure initiators. According to the configuration policy rules in **7.10.1 Configuring ALUA Parameters for a Huawei Enterprise Storage Backend**, select the first ALUA configuration section to configure initiators.

Example 3: The configuration file content is as follows:

```
parameters:
  node1$:
    node[0-9]:
    accessMode: 1
    hyperMetroPathOptimized: 1
  node10$:
    accessMode: 1
    hyperMetroPathOptimized: 0
```

According to the configuration policy rules in **7.10.1 Configuring ALUA Parameters for a Huawei Enterprise Storage Backend**: For host **node1**, select the first ALUA configuration section to configure initiators. For host **node10**, select the second ALUA configuration section to configure initiators. **^** matches the beginning of a character string, and **$** matches the end of a character string.

7.10.5 Example ALUA Configuration Policy of Distributed Storage

Example 1: The configuration file content is as follows:

```
parameters:
  ALUA:
    "*":
      switchoverMode: Enable_alua
      pathType: optimal_path
    node1:
      switchoverMode: Enable_alua
      pathType: non_optimal_path
```

If the host name is **node1**, both of the preceding ALUA configuration sections can be used to configure initiators. According to the configuration policy rules in **7.10.2 Configuring ALUA Parameters for a Distributed Storage Backend**, the priority of the second configuration section (where **HostName** is **node1**) is higher than that of the first configuration section (where **HostName** is *****).

Example 2: The configuration file content is as follows:

```
parameters:
  ALUA:
    node[0-9]:
      switchoverMode: Enable_alua
      pathType: optimal_path
    node[5-7]:
      switchoverMode: Enable_alua
      pathType: non_optimal_path
```

If the host name is **node6**, both of the preceding ALUA configuration sections can be used to configure initiators. According to the configuration policy rules in **7.10.2 Configuring ALUA Parameters for a Distributed Storage Backend**, select the first ALUA configuration section to configure initiators.

Example 3: The configuration file content is as follows:

```
parameters:
  ALUA:
    node1$:
      switchoverMode: Enable_alua
      pathType: optimal_path
    node10$:
      switchoverMode: Enable_alua
      pathType: non_optimal_path
```


According to the configuration policy rules in **7.10.2 Configuring ALUA Parameters for a Distributed Storage Backend**: For host **node1**, select the first ALUA configuration section to configure initiators. For host **node10**, select the second ALUA configuration section to configure initiators. **^** matches the beginning of a character string, and **$** matches the end of a character string.

8 Troubleshooting

8.1 Huawei CSI Service Issues

8.1.1 Failed to Start the huawei-csi-node Service with Error Message "/var/lib/iscsi is not a directory" Reported

Symptom

The huawei-csi-node service cannot be started. When you run the **kubectl describe daemonset huawei-csi-node -n huawei-csi** command, error message "/var/lib/iscsi is not a directory" is reported.

Root Cause Analysis

The **/var/lib/iscsi** directory does not exist in the huawei-csi-node container.

Solution or Workaround

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Go to the directory where the Helm project is located. If the previous Helm project cannot be found, copy the **helm** directory in the component package to any directory on the master node. For details about the component package path, see **Table 4-1**.

Step 3 Go to the **templates** directory and find the **huawei-csi-node.yaml** file.

```
cd /templates
```

Step 4 Run the following command to set **path** in **huawei-csi-node.yaml** > **volumes** > **iscsi-dir** > **hostPath** to **/var/lib/iscsi**, save the file, and exit.

```
vi huawei-csi-node.yaml
```

Step 5 Run the following command to upgrade the Helm chart. The upgrade command will update the Deployment, DaemonSet, and RBAC resources. In the preceding command, *helm-huawei-csi* indicates the custom chart name and *huawei-csi* indicates the custom namespace.

```
helm upgrade helm-huawei-csi ./  -n huawei-csi -f values.yaml
```

The following is an example of the command output.

```
Release "helm-huawei-csi" has been upgraded. Happy Helming!
NAME: helm-huawei-csi
LAST DEPLOYED: Thu Jun  9 07:58:15 2022
NAMESPACE: huawei-csi
STATUS: deployed
REVISION: 2
TEST SUITE: None
```

----End

8.1.2 Huawei CSI Services Fail to Be Started and Error Message "/etc/localtime is not a file" Is Displayed

Symptom

During the installation and deployment of CSI, a Pod fails to run and is in the **ContainerCreating** state. Alarm **/etc/localtime is not a file** is generated for the Pod.

Root Cause Analysis

When the container mounts the **/etc/localtime** file on the host, the type is incorrectly identified. As a result, the container fails to mount the **/etc/localtime** file on the host and the Pod cannot run.

Procedure

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Run the following command to check the running status of the Pod of the CSI services.

```
kubectl get pod -n huawei-csi
```

The following is an example of the command output. *huawei-csi* indicates the namespace where the CSI services are deployed.

```
NAME                                      READY   STATUS              RESTARTS   AGE
huawei-csi-controller-6dfcc4b79f-9vjtq   9/9     ContainerCreating    0          24m
huawei-csi-controller-6dfcc4b79f-csphc   9/9     ContainerCreating    0          24m
huawei-csi-node-g6f4k                     3/3     ContainerCreating    0          20m
huawei-csi-node-tqs87                     3/3     ContainerCreating    0          20m
```

Step 3 Run the following command to check the **Events** parameter of the container.

```
kubectl describe pod huawei-csi-controller-6dfcc4b79f-9vjtq -n huawei-csi
```

The following is an example of the command output. In the command, *huawei-csi-controller-6dfcc4b79f-9vjtq* indicates the name of the Pod in the **ContainerCreating** state found in **Step 2**, and *huawei-csi* indicates the namespace to which the Pod belongs.

```
...
Events:
  Type     Reason       Age                From               Message
  ----     ------       ----               ----               -------
  Normal   Scheduled    96s                default-scheduler  Successfully assigned huawei-csi/huawei-csi-controller-6dfcc4b79f-9vjtq to node1
  Warning  FailedMount  33s (x8 over 96s)  kubelet            MountVolume.SetUp failed for volume "host-time" : hostPath type check failed: /etc/localtime is not a file
```

Step 4 Run the **cd /helm/esdk/templates** command to go to the CSI installation package path. For the path, see **Table 4-1**.

Step 5 Take the **huawei-csi-controller.yaml** file as an example. Run the following command to view the file content.

```
vi huawei-csi-controller.yaml
```

Find the **host-time** configuration item under **volumes**, and delete the **type: File** line. Perform the same operations on the **huawei-csi-node.yaml** deployment file that involves the configuration item in the **templates** directory.

```
...
...
volumes:
  - hostPath:
      path: /var/log/
      type: Directory
    name: log
  - hostPath:
      path: /etc/localtime
      type: File
    name: host-time
...
...
```

Step 6 Uninstall and reinstall the service by referring to **4.1.3.1 Uninstallation Using Helm**.

Step 7 Run the following command to check whether the Pod running status of Huawei CSI services is **Running**.

```
kubectl get pod -n huawei-csi
```

The following is an example of the command output.

```
NAME                                     READY   STATUS    RESTARTS   AGE
huawei-csi-controller-6dfcc4b79f-9vjts   9/9     Running   0          24m
huawei-csi-controller-6dfcc4b79f-csphb   9/9     Running   0          24m
huawei-csi-node-g6f41                    3/3     Running   0          20m
huawei-csi-node-tqs85                    3/3     Running   0          20m
```

----End

8.1.3 Failed to Start huawei-csi Services with the Status Displayed as InvalidImageName

Symptom

The huawei-csi services (huawei-csi-controller or huawei-csi-node) cannot be started. After the **kubectl get pod -A | grep huawei** command is executed, the command output shows that the service status is **InvalidImageName**.

```
kubectl get pod -A | grep huawei
```

The following is an example of the command output.

```
huawei-csi     huawei-csi-controller-fd5f97768-qlldc     6/9     InvalidImageName     0          16s
huawei-csi     huawei-csi-node-25txd                     2/3     InvalidImageName     0          15s
```

Root Cause Analysis

In the .yaml configuration files of the controller and node, the Huawei CSI image version number is incorrect. For example:

```
...
- name: huawei-csi-driver
  image: huawei-csi:4.10.0
...
```

Solution or Workaround

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Run the following command to modify the configuration file of the huawei-csi-node service. Press **I** or **Insert** to enter the insert mode and modify related parameters. After the modification is complete, press **Esc** and enter **:wq!** to save the modification.

```
kubectl edit daemonset huawei-csi-node -o yaml -n=huawei-csi
```

NOTE

- In **huawei-csi-driver** in the sample .yaml file, modify **image** to Huawei CSI image **huawei-csi:4.10.0**.

```
containers:
  ...
  - name: huawei-csi-driver
    image: huawei-csi:4.10.0
```

Step 3 Run the following command to modify the configuration file of the huawei-csi-controller service: Press **I** or **Insert** to enter the insert mode and modify related parameters. After the modification is complete, press **Esc** and enter **:wq!** to save the modification.

```
kubectl edit deployment huawei-csi-controller -o yaml -n=huawei-csi
```

NOTE

- In **huawei-csi-driver** in the sample .yaml file, modify **image** to Huawei CSI image **huawei-csi:4.10.0**.

```
containers:
  ...
  - name: huawei-csi-driver
    image: huawei-csi:4.10.0
```

Step 4 Wait until the huawei-csi-node and huawei-csi-controller services are started.

Step 5 Run the following command to check whether the huawei-csi services are started.

```
kubectl get pod -A  | grep huawei
```

The following is an example of the command output. If the Pod status is **Running**, the services are started successfully.

```
huawei-csi   huawei-csi-controller-58799449cf-zvhmv   9/9     Running       0          2m29s
huawei-csi   huawei-csi-node-7fxh6                    3/3     Running       0          12m
```

----End

8.2 Storage Backend Issues

8.2.1 A Backend Fails to Be Created Using the oceanctl Tool and Error Message "context deadline exceeded" Is Displayed

Symptom

A user fails to create a storage backend using the oceanctl tool, and "failed to call webhook: xxx :context deadline exceeded; error: exist status 1" is displayed on the console.

Root Cause Analysis

When a storage backend is created, the webhook service provided by CSI is invoked to verify the connectivity with the storage management network and the storage account and password. The possible causes are as follows:

- Huawei CSI fails to verify the connectivity of the storage management network.
- The communication between kube-apiserver and CSI webhook is abnormal.

Huawei CSI Fails to Verify the Connectivity of the Storage Management Network

Perform the following steps to check whether Huawei CSI fails to verify the connectivity of the storage management network.

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Run the following command to obtain CSI service information. *huawei-csi* indicates the namespace where the CSI services are deployed.

```
kubectl get pod -n huawei-csi -owide
```

The following is an example of the command output.

```
NAME                      READY   STATUS    RESTARTS   AGE   IP         NODE       NOMINATED NODE
READINESS GATES
huawei-csi-controller-xxx   9/9     Running   0          19h   host-ip1   host-1     <none>           <none>
huawei-csi-node-mnqbz       3/3     Running   0          19h   host-ip1   host-1     <none>           <none>
```

Step 3 Log in to the node where huawei-csi-controller resides, for example, **host-1** in **Step 2**.

Step 4 Go to the **/var/log/huawei** directory.

```
# cd /var/log/huawei
```

Step 5 View the **storage-backend-controller** log. The following uses the storage connection timeout as an example.

```
tail -n 1000 storage-backend-controller
```

The following is a log example.

```
2024-01-01 06:30:44.280661 1 [INFO]: Try to login https://192.168.129.155:8088/deviceManager/rest
2024-01-01 06:31:44.281626 1 [ERROR]: Send request method: POST, Url: https://192.168.129.155:8088/
deviceManager/rest/xx/sessions, error: Post "https://192.168.129.155:8088/deviceManager/rest/xx/sessions":
context deadline exceeded (Client.Timeout exceeded while awaiting headers)
2024-01-01 06:31:44.281793 1 [WARNING]: Login https://192.168.129.155:8088/deviceManager/rest error
due to connection failure, gonna try another Url
2024-01-01 06:31:44.291668 1 [INFO]: Finished validateCreate huawei-csi/backend-test.
2024-01-01 06:31:44.291799 1 [ERROR]: Failed to validate StorageBackendClaim, error: unconnected
```

Step 6 If the log contains information about login timeout, login failure, or long request duration, check the connectivity between the host machine and the storage or the network status.

Step 7 If no request is recorded in the log, the communication between kube-apiserver and CSI webhook is abnormal.

----End

Abnormal Communication Between kube-apiserver and CSI Webhook

Contact the Kubernetes platform administrator to check the network between kube-apiserver and CSI webhook. For example, if kube-apiserver has an HTTPS proxy, the CSI webhook service may fail to be accessed.

NOTE

In the temporary workaround, the webhook resource will be deleted. This resource is used to check whether the entered account information is correct and whether the connection to the storage can be set up when a storage backend is created. Therefore, deleting this resource affects only the verification during backend creation and does not affect other functions. Pay attention to the following:

- Ensure that the host machine where the huawei-csi-controller service is located can properly communicate with the storage.
- Ensure that the entered account and password are correct.

Step 1 Run the following command to view CSI webhook information.

```
kubectl get validatingwebhookconfiguration storage-backend-controller.xuanwu.huawei.io
```

The following is an example of the command output.

```
NAME                                         WEBHOOKS   AGE
storage-backend-controller.xuanwu.huawei.io   1         4d22h
```

Step 2 Contact the Kubernetes platform administrator to check whether the communication between kube-apiserver and CSI webhook is abnormal.

Step 3 Perform the following temporary workaround: Run the following command to delete the webhook.

```
kubectl delete validatingwebhookconfiguration storage-backend-controller.xuanwu.huawei.io
```


Step 4 Create a storage backend. For details, see **5.1 Storage Backend Management**.

Step 5 If the communication between kube-apiserver and CSI webhook is restored, you need to reconstruct the webhook. In this case, run the following command to restart CSI Controller and restore the number of CSI Controller copies by specifying **--replicas=***. In the following example, the number is restored to **1**. Change it based on actual requirements.

Change the number of copies to 0 first.

```
kubectl scale deployment huawei-csi-controller -n huawei-csi --replicas=0
```

Then restore the number of copies to the original number.

```
kubectl scale deployment huawei-csi-controller -n huawei-csi --replicas=1
```

----End

8.2.2 The Value of the ONLINE Field Is "false" When the oceanctl Tool Is Used to Obtain Storage Backend Information

Symptom

The following command is executed to check storage backend status:

```
oceanctl get backend
```

The value of the **ONLINE** field of the storage backend is **false**:

```
NAMESPACE    NAME                  PROTOCOL   STORAGETYPE    SN                   STATUS   ONLINE   Url
huawei-csi   backend-201-nas-nfs   nfs        oceanstor-nas  XXXXXXXXXXXXXX000006   Bound    false
https://192.168.129.157:8088
```

Root Cause Analysis

When CSI uses the account and password entered during storage backend creation to log in to the storage backend, if the login fails due to either of the following reasons, the **ONLINE** field will be set to **false**.

1. Incorrect account password: The possible cause is that the password is changed on the storage backend but not updated in the Kubernetes cluster. For details about how to solve this problem, see **Solution or Workaround**.
2. Locked account. For details about how to solve this problem, see **8.2.3 An Account Is Locked After the Password Is Updated on the Storage Device**.

Solution or Workaround

Step 1 Obtain the latest account password.

Step 2 Update the storage backend password by following the instructions in **5.1.2.2.1 Updating the Password of a Storage Backend Using oceanctl**.

----End

8.2.3 An Account Is Locked After the Password Is Updated on the Storage Device

Symptom

After a user changes the password on the storage device, the account is locked.

Root Cause Analysis

CSI uses the account and password configured on the storage device to log in to the storage device. After the account password is changed on the storage device, CSI attempts to log in to the storage device again after the login fails. Take OceanStor Dorado as an example. The default login policy is that an account will be locked after three consecutive password verification failures. Therefore, when CSI retries for more than three times, the account will be locked.

Solution or Workaround

Step 1 If the backend account is **admin**, run the following command to set the number of huawei-csi-controller service copies to 0. If an account other than **admin** is used, skip this step.

```
kubectl scale deployment huawei-csi-controller -n huawei-csi --replicas=0
```

Step 2 Log in to the storage device as user **admin** and modify the login policy. Take OceanStor Dorado as an example. On DeviceManager, choose **Settings** > **User and Security** > **Security Policies** > **Login Policy**, click **Modify**, and disable **Account Lockout**.

Step 3 If the backend account is **admin**, run the following command to restore the number of CSI Controller copies using **--replicas=***. In the following example, the number of copies is restored to **1**. Change it based on site requirements. If an account other than **admin** is used, skip this step.

```
kubectl scale deployment huawei-csi-controller -n huawei-csi --replicas=1
```

Step 4 Use the oceanctl tool to change the storage backend password. For details about how to change the backend password, see **5.1.2.2 Updating a Storage Backend**.

Step 5 Log in to the storage device as user admin and modify the login policy. Take OceanStor Dorado as an example. On DeviceManager, choose **Settings** > **User and Security** > **Security Policies** > **Login Policy**, click **Modify**, and enable **Account Lockout**.

----End

8.3 PVC Issues

8.3.1 When a PVC Is Created, the PVC Is in the Pending State

Symptom

A PVC is created. After a period of time, the PVC is still in the **Pending** state.

Root Cause Analysis

Cause 1: A StorageClass with the specified name is not created in advance. As a result, Kubernetes cannot find the specified StorageClass name when a PVC is created.

Cause 2: The storage pool capability does not match the StorageClass capability. As a result, huawei-csi fails to select a storage pool.

Cause 3: An error code (for example, 50331651) is returned by a RESTful interface of the storage. As a result, huawei-csi fails to create a PVC.

Cause 4: The storage does not return a response within the timeout period set by huawei-csi. As a result, huawei-csi returns a timeout error to Kubernetes.

Cause 5: Other causes.

Solution or Workaround

When a PVC is created, if the PVC is in the **Pending** state, you need to take different measures according to the following causes.

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Run the following command to view details about the PVC.

```
kubectl describe pvc mypvc
```

Step 3 Perform the corresponding operation according to the **Events** information in the detailed PVC information.

- If the PVC is in the **Pending** state due to cause 1, perform the following steps.

  ```
  Events:
   Type     Reason              Age                From                         Message
   ----     ------              ----               ----                         -------
   Warning  ProvisioningFailed  0s (x15 over 3m24s)  persistentvolume-controller
  storageclass.storage.k8s.io "mysc" not found
  ```

  a. Delete the PVC.
  b. Create a StorageClass. For details, see **5.2.1 Configuring a StorageClass**.
  c. Create a PVC. For details, see **5.3.1 Configuring PVs**.

- If the PVC is in the **Pending** state due to cause 2, perform the following steps.

  ```
  Events:
   Type     Reason              Age
  From                                                                         Message
   ----     ------              ----               ----
  -------
   Normal   Provisioning         63s (x3 over 64s)  csi.huawei.com_huawei-csi-controller-b59577886-qqzm8_58533e4a-884c-4c7f-92c3-6e8a7b327515  External provisioner is provisioning volume for claim "default/mypvc"
   Warning  ProvisioningFailed   63s (x3 over 64s)  csi.huawei.com_huawei-csi-controller-b59577886-qqzm8_58533e4a-884c-4c7f-92c3-6e8a7b327515  failed to provision volume with StorageClass "mysc": rpc error: code = Internal desc = failed to select pool, the capability filter failed, error: failed to select pool, the final filter field: replication, parameters map[allocType:thin replication:True size:1099511627776 volumeType:lun]. please check your storage class
  ```

  a. Delete the PVC.
  b. Delete the StorageClass.
  c. Modify the **StorageClass.yaml** file based on the **Events** information.

d. Create a StorageClass. For details, see **5.2.1 Configuring a StorageClass**.

e. Create a PVC. For details, see **5.3.1 Configuring PVs**.

- If the PVC is in the **Pending** state due to cause 3, contact Huawei engineers.

```
Events:
  Type     Reason                Age
From                                                                                          Message
  ----     ------                ----                 ----
-------
  Normal   Provisioning          63s (x4 over 68s)  csi.huawei.com_huawei-csi-controller-b59577886-qqzm8_58533e4a-884c-4c7f-92c3-6e8a7b327515  External provisioner is provisioning volume for claim "default/mypvc"
  Warning  ProvisioningFailed    62s (x4 over 68s)  csi.huawei.com_huawei-csi-controller-b59577886-qqzm8_58533e4a-884c-4c7f-92c3-6e8a7b327515  failed to provision volume with StorageClass "mysc": rpc error: code = Internal desc = Create volume map[ALLOCTYPE:1 CAPACITY:20 DESCRIPTION:Created from Kubernetes CSI NAME:pvc-63ebfda5-4cf0-458e-83bd-ecc PARENTID:0] error: 50331651
```

- If the PVC is in the **Pending** state due to cause 4, perform the following steps.

```
Events:
  Type     Reason                Age
From                                                                                          Message
  ----     ------                ----                 ----
-------
  Normal   Provisioning          63s (x3 over 52s)  csi.huawei.com_huawei-csi-controller-b59577886-qqzm8_58533e4a-884c-4c7f-92c3-6e8a7b327515  External provisioner is provisioning volume for claim "default/mypvc"
  Warning  ProvisioningFailed    63s (x3 over 52s)  csi.huawei.com_huawei-csi-controller-b59577886-qqzm8_58533e4a-884c-4c7f-92c3-6e8a7b327515  failed to provision volume with StorageClass "mysc": rpc error: code = Internal desc = context deadline exceeded (Client.Timeout exceeded while awaiting headers)
```

a. Wait for 10 minutes and check the PVC details again by referring to this section.

b. If it is still in the **Pending** state, contact Huawei engineers.

- If the PVC is in the **Pending** state due to cause 5, contact Huawei engineers.

----End

8.3.2 Before a PVC Is Deleted, the PVC Is in the Pending State

Symptom

Before a PVC is deleted, the PVC is in the **Pending** state.

Root Cause Analysis

Cause 1: A StorageClass with the specified name is not created in advance. As a result, Kubernetes cannot find the specified StorageClass name when a PVC is created.

Cause 2: The storage pool capability does not match the StorageClass capability. As a result, huawei-csi fails to select a storage pool.

Cause 3: An error code (for example, 50331651) is returned by a RESTful interface of the storage. As a result, huawei-csi fails to create a PVC.

Cause 4: The storage does not return a response within the timeout period set by huawei-csi. As a result, huawei-csi returns a timeout error to Kubernetes.

Cause 5: Other causes.

Solution or Workaround

To delete a PVC in the **Pending** state, you need to take different measures according to the following causes.

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Run the following command to view details about the PVC.

```
kubectl describe pvc mypvc
```

Step 3 Perform the corresponding operation according to the **Events** information in the detailed PVC information.

- If the PVC is in the **Pending** state due to cause 1, run the **kubectl delete pvc** *mypvc* command to delete the PVC.

```
Events:
  Type     Reason              Age                  From                         Message
  ----     ------              ----                 ----                         -------
  Warning  ProvisioningFailed  0s (x15 over 3m24s)  persistentvolume-controller
storageclass.storage.k8s.io "mysc" not found
```

- If the PVC is in the **Pending** state due to cause 2, run the **kubectl delete pvc** *mypvc* command to delete the PVC.

```
Events:
  Type     Reason                Age
From                                                                                  Message
  ----     ------                ----               ----
-------
  Normal   Provisioning          63s (x3 over 64s)  csi.huawei.com_huawei-csi-controller-b59577886-
qqzm8_58533e4a-884c-4c7f-92c3-6e8a7b327515  External provisioner is provisioning volume for
claim "default/mypvc"
  Warning  ProvisioningFailed    63s (x3 over 64s)  csi.huawei.com_huawei-csi-controller-b59577886-
qqzm8_58533e4a-884c-4c7f-92c3-6e8a7b327515  failed to provision volume with StorageClass
"mysc": rpc error: code = Internal desc = failed to select pool, the capability filter failed, error: failed
to select pool, the final filter field: replication, parameters map[allocType:thin replication:True
size:1099511627776 volumeType:lun]. please check your storage class
```

- If the PVC is in the **Pending** state due to cause 3, run the **kubectl delete pvc** *mypvc* command to delete the PVC.

```
Events:
  Type     Reason                Age
From                                                                                  Message
  ----     ------                ----               ----
-------
  Normal   Provisioning          63s (x4 over 68s)  csi.huawei.com_huawei-csi-controller-b59577886-
qqzm8_58533e4a-884c-4c7f-92c3-6e8a7b327515  External provisioner is provisioning volume for
claim "default/mypvc"
  Warning  ProvisioningFailed    62s (x4 over 68s)  csi.huawei.com_huawei-csi-controller-b59577886-
qqzm8_58533e4a-884c-4c7f-92c3-6e8a7b327515  failed to provision volume with StorageClass
"mysc": rpc error: code = Internal desc = Create volume map[ALLOCTYPE:1 CAPACITY:20
DESCRIPTION:Created from Kubernetes CSI NAME:pvc-63ebfda5-4cf0-458e-83bd-ecc PARENTID:0]
error: 50331651
```

- If the PVC is in the **Pending** state due to cause 4, contact Huawei engineers.

```
Events:
  Type     Reason                Age
From                                                                                  Message
  ----     ------                ----               ----
-------
  Normal   Provisioning          63s (x3 over 52s)  csi.huawei.com_huawei-csi-controller-b59577886-
qqzm8_58533e4a-884c-4c7f-92c3-6e8a7b327515  External provisioner is provisioning volume for
claim "default/mypvc"
  Warning  ProvisioningFailed    63s (x3 over 52s)  csi.huawei.com_huawei-csi-controller-b59577886-
qqzm8_58533e4a-884c-4c7f-92c3-6e8a7b327515  failed to provision volume with StorageClass
"mysc": rpc error: code = Internal desc = context deadline exceeded (Client.Timeout exceeded
while awaiting headers)
```

- If the PVC is in the **Pending** state due to cause 5, contact Huawei engineers.

----End

8.3.3 Failed to Expand the Capacity of a Generic Ephemeral Volume

Symptom

In an environment where the Kubernetes version is earlier than 1.25, the capacity of a **generic ephemeral volume** of the LUN type fails to be expanded. The system displays a message indicating that the PV capacity has been expanded, but the PVC capacity fails to be updated.

Root Cause Analysis

This problem is caused by a Kubernetes **bug**, which has been resolved in Kubernetes 1.25.

8.3.4 Failed to Expand the PVC Capacity Because the Target Capacity Exceeds the Storage Pool Capacity

Symptom

In a Kubernetes environment earlier than 1.23, PVC capacity expansion fails when the target capacity exceeds the storage pool capacity.

Root Cause Analysis

This is a known issue in the Kubernetes community. For details, see **Recovering from Failure when Expanding Volumes**.

Solution or Workaround

For details, see **Recovering from Failure when Expanding Volumes**.

8.4 Pod Issues

8.4.1 After a Worker Node in the Cluster Breaks Down and Recovers, Pod Failover Is Complete but the Source Host Where the Pod Resides Has Residual Drive Letters

Symptom

A Pod is running on worker node A, and an external block device is mounted to the Pod through CSI. After worker node A is powered off abnormally, the Kubernetes platform detects that the node is faulty and switches the Pod to worker node B. After worker node A recovers, the drive letters on worker node A change from normal to faulty.

Environment Configuration

Kubernetes version: 1.18 or later

Storage type: block storage

Root Cause Analysis

After worker node A recovers, Kubernetes initiates an unmapping operation on the storage, but does not initiate a drive letter removal operation on the host. After Kubernetes completes the unmapping, residual drive letters exist on worker node A.

Solution or Workaround

Currently, you can only manually clear the residual drive letters on the host. Alternatively, restart the host again and use the disk scanning mechanism during the host restart to clear the residual drive letters. The specific method is as follows:

Step 1 Check the residual drive letters on the host.

1. Run the following command to check whether a DM multipathing device with abnormal multipathing status exists.

   ```
   multipath -ll
   ```

   The following is an example of the command output. The path status is **failed faulty running**, the corresponding DM multipathing device is **dm-12**, and the associated SCSI disks are **sdi** and **sdj**. If multiple paths are configured, multiple SCSI disks exist. Record these SCSI disks.

   ```
   mpathb (3618cf24100f8f457014a764c000001f6) dm-12 HUAWEI  ,XSG1
   size=100G features='0' hwhandler='0' wp=rw
   `-+- policy='service-time 0' prio=-1 status=active
     |- 39:0:0:1        sdi 8:48  failed faulty running
     `- 38:0:0:1        sdj 8:64  failed faulty running
   ```

   – If yes, go to **step 1.2**.
   – If no, no further action is required.

2. Run the following command to check whether the residual DM multipathing device is readable.

   ```
   dd if=/dev/dm-12 of=/dev/null count=1 bs=1M iflag=direct
   ```

   The following is an example of the command output. If the returned result is **Input/output error** and the read data is **0 bytes (0 B) copied**, the device is unreadable. *dm-xx* indicates the device ID obtained in **step 1.1**.

   ```
   dd: error reading '/dev/dm-12': Input/output error
   0+0 records in
   0+0 records out
   0 bytes (0 B) copied, 0.0236862 s, 0.0 kB/s
   ```

   – If yes, record the residual *dm-xx* device and associated disk IDs (for details, see **step 1.1**) and perform the clearing operation.
   – If the command execution is suspended, go to **step 1.3**.
   – If other cases, contact technical support engineers.

3. Log in to the node again in another window.

   a. Run the following command to view the suspended process.

      ```
      ps -ef | grep dm-12 | grep -w dd
      ```

The following is an example of the command output.

```
root     21725  9748  0 10:33 pts/10    00:00:00 dd if=/dev/dm-12 of=/dev/null count=1 bs=10M
iflag=direct
```

b. Kill the pid.

```
kill -9 pid
```

c. Record the residual *dm-xx* device and associated disk IDs (for details, see **step 1.1**) and perform the clearing operation.

Step 2 Clear the residual drive letters on the host.

1. Run the following command to delete residual multipathing aggregation device information according to the DM multipathing device obtained in **step 1**.

```
multipath -f /dev/dm-12
```

If an error is reported, contact technical support engineers.

2. Run the following command to clear the residual SCSI disks according to the drive letters of the residual disks obtained in **step 1**.

```
echo 1 > /sys/block/xxxx/device/delete
```

When multiple paths are configured, clear the residual disks based on the drive letters. The residual paths are **sdi** and **sdj**.

```
echo 1 > /sys/block/sdi/device/delete
echo 1 > /sys/block/sdj/device/delete
```

If an error is reported, contact technical support engineers.

3. Check whether the DM multipathing device and SCSI disk information has been cleared.

Run the following commands in sequence to query the multipathing and disk information. If the residual **dm-12** device and SCSI disks **sdi** and **sdj** are cleared, the clearing is complete.

a. View multipathing information.

```
multipath -ll
```

The following is an example of the command output. The residual **dm-12** device is cleared.

```
mpathb (3618cf24100f8f457014a764c000001f6) dm-3 HUAWEI  ,XSG1
size=100G features='0' hwhandler='0' wp=rw
`-+- policy='service-time 0' prio=-1 status=active
  |- 39:0:0:1        sdd 8:48  active ready running
  `- 38:0:0:1        sde 8:64  active ready running
mpathn (3618cf24100f8f457315a764c000001f6) dm-5 HUAWEI  ,XSG1
size=100G features='0' hwhandler='0' wp=rw
`-+- policy='service-time 0' prio=-1 status=active
  |- 39:0:0:2        sdc 8:32  active ready running
  `- 38:0:0:2        sdb 8:16  active ready running
```

b. View device information.

```
ls -l /sys/block/
```

The following is an example of the command output. SCSI disks **sdi** and **sdj** are cleared.

```
total 0
lrwxrwxrwx 1 root root 0 Aug 11 19:56 dm-0 -> ../devices/virtual/block/dm-0
lrwxrwxrwx 1 root root 0 Aug 11 19:56 dm-1 -> ../devices/virtual/block/dm-1
lrwxrwxrwx 1 root root 0 Aug 11 19:56 dm-2 -> ../devices/virtual/block/dm-2
lrwxrwxrwx 1 root root 0 Aug 11 19:56 dm-3 -> ../devices/virtual/block/dm-3
lrwxrwxrwx 1 root root 0 Aug 11 19:56 sdb -> ../devices/platform/host35/session2/
target35:0:0/35:0:0:1/block/sdb
lrwxrwxrwx 1 root root 0 Aug 11 19:56 sdc -> ../devices/platform/host34/
target34:65535:5692/34:65535:5692:0/block/sdc
lrwxrwxrwx 1 root root 0 Aug 11 19:56 sdd -> ../devices/platform/host39/session6/
```

```
target39:0:0/39:0:0:1/block/sdd
lrwxrwxrwx 1 root root 0 Aug 11 19:56 sde -> ../devices/platform/host38/session5/
target38:0:0/38:0:0:1/block/sde
lrwxrwxrwx 1 root root 0 Aug 11 19:56 sdh -> ../devices/platform/host39/session6/
target39:0:0/39:0:0:3/block/sdh
lrwxrwxrwx 1 root root 0 Aug 11 19:56 sdi -> ../devices/platform/host38/session5/
target38:0:0/38:0:0:3/block/sdi
```

c. View disk information.

```
ls -l /dev/disk/by-id/
```

The following is an example of the command output. SCSI disks **sdi** and **sdj** are cleared.

```
total 0
lrwxrwxrwx 1 root root 10 Aug 11 19:57 dm-name-mpathb -> ../../dm-3
lrwxrwxrwx 1 root root 10 Aug 11 19:58 dm-name-mpathn -> ../../dm-5
lrwxrwxrwx 1 root root 10 Aug 11 19:57 dm-uuid-mpath-3618cf24100f8f457014a764c000001f6
-> ../../dm-3
lrwxrwxrwx 1 root root 10 Aug 11 19:58 dm-uuid-mpath-3618cf24100f8f457315a764c000001f6
-> ../../dm-5
lrwxrwxrwx 1 root root  9 Aug 11 19:57 scsi-3618cf24100f8f457014a764c000001f6 -> ../../sdd
lrwxrwxrwx 1 root root  9 Aug 11 19:57 scsi-3618cf24100f8f45712345678000103e8 -> ../../sdi
lrwxrwxrwx 1 root root  9 Aug  3 15:17 scsi-3648435a10058805278654321ffffffff -> ../../sdb
lrwxrwxrwx 1 root root  9 Aug  2 14:49 scsi-368886030000020aff44cc0d060c987f1 -> ../../sdc
lrwxrwxrwx 1 root root  9 Aug 11 19:57 wwn-0x618cf24100f8f457014a764c000001f6 -> ../../sdd
lrwxrwxrwx 1 root root  9 Aug 11 19:57 wwn-0x618cf24100f8f45712345678000103e8 -> ../../sdi
lrwxrwxrwx 1 root root  9 Aug  3 15:17 wwn-0x648435a10058805278654321ffffffff -> ../../sdb
lrwxrwxrwx 1 root root  9 Aug  2 14:49 wwn-0x68886030000020aff44cc0d060c987f1 -> ../../sdc
```

----End

8.4.2 When a Pod Is Created, the Pod Is in the ContainerCreating State

Symptom

A Pod is created. After a period of time, the Pod is still in the **ContainerCreating** state. Check the log information (for details, see **7.2.2 Viewing Huawei CSI Logs**). The error message "Fibre Channel volume device not found" is displayed.

Root Cause Analysis

This problem occurs because residual disks exist on the host node. As a result, disks fail to be found when a Pod is created next time.

Solution or Workaround

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Run the following command to query information about the node where the Pod resides.

```
kubectl get pod -o wide
```

The following is an example of the command output.

```
NAME       READY   STATUS              RESTARTS   AGE     IP             NODE    NOMINATED NODE
READINESS GATES
mypod      0/1     ContainerCreating   0          51s     10.244.1.224   node1   <none>          <none>
```

Step 3 Delete the Pod.

Step 4 Use a remote access tool, such as PuTTY, to log in to the *node1* node in the Kubernetes cluster through the management IP address. *node1* indicates the node queried in **Step 2**.

Step 5 Clear the residual drive letters. For details, see **Solution or Workaround**.

----End

8.4.3 A Pod Is in the ContainerCreating State for a Long Time When It Is Being Created

Symptom

When a Pod is being created, the Pod is in the **ContainerCreating** state for a long time. Check the huawei-csi-node log (for details, see **7.2.2 Viewing Huawei CSI Logs**). No Pod creation information is recorded in the huawei-csi-node log. After the **kubectl get volumeattachment** command is executed, the name of the PV used by the Pod is not displayed in the **PV** column. After a long period of time (more than ten minutes), the Pod is normally created and the Pod status changes to **Running**.

Root Cause Analysis

The kube-controller-manager component of Kubernetes is abnormal.

Solution or Workaround

Contact container platform engineers to rectify the fault.

8.4.4 A Pod Fails to Be Created and the Log Shows That the Execution of the mount Command Times Out

Symptom

When a Pod is being created, the Pod keeps in the **ContainerCreating** status. In this case, check the log information of huawei-csi-node (for details, see **7.2.2 Viewing Huawei CSI Logs**). The log shows that the execution of the mount command times out.

Root Cause Analysis

Cause 1: The configured service IP address is disconnected. As a result, the **mount** command execution times out and fails.

Cause 2: For some operating systems, such as Kylin V10 SP1 and SP2, it takes a long time to run the **mount** command in a container using NFSv3. As a result, the **mount** command may time out and error message "error: exit status 255" is displayed. The possible cause is that the value of **LimitNOFILE** of container runtime containerd is too large (over 1 billion).

Cause 3: The mounting may fail due to network problems. The default mounting timeout period of CSI is 30 seconds. If the mounting still fails after 30 seconds, logs show that the execution of the **mount** command times out.

Solution or Workaround

Step 1 Run the **ping** command to check whether the service IP network is connected. If the ping fails, the fault is caused by cause 1. In this case, configure an available service IP address. If the ping succeeds, go to **Step 2**.

Step 2 Go to any container where the **mount** command can be executed and use NFSv3 to run the **mount** command. If the command times out, the fault may be caused by cause 2. Run the **systemctl status containerd.service** command to check the configuration file path, and then run the **cat** */xxx/containerd.service* command to check the configuration file. If the file contains **LimitNOFILE=infinity** or the value of **LimitNOFILE** is 1 billion, go to **Step 3**. Otherwise, contact Huawei technical support engineers.

Step 3 For cause 2, perform the following operations:

- Try using NFSv4.0.
- Change the value of **LimitNOFILE** to a proper one by referring to **change solution provided by the community**. This solution will restart the container runtime. Evaluate the impact on services.

Step 4 Manually mount the file system on the host machine where the mounting fails. If the required time exceeds 30 seconds, check whether the network between the host machine and the storage node is normal. An example of the **mount** command is as follows.

- Run the following command to create a test directory.
```
mkdir /tmp/test_mount
```
- Run the **mount** command to mount the file system and observe the time consumed. The value of *ip:nfs_share_path* can be obtained from the huawei-csi-node log. For details, see **7.2.2 Viewing Huawei CSI Logs**.
```
time mount ip:nfs_share_path /tmp/test_mount
```
- After the test is complete, run the following command to unmount the file system.
```
umount /tmp/test_mount
```

----End

8.4.5 A Pod Fails to Be Created and the Log Shows That the mount Command Fails to Be Executed

Symptom

In NAS scenarios, when a Pod is being created, the Pod keeps in the **ContainerCreating** status. In this case, check the log information of huawei-csi-node (for details, see **7.2.2 Viewing Huawei CSI Logs**). The log shows that the mount command fails to be executed.

Root Cause Analysis

The possible cause is that the NFS 4.0/4.1/4.2 protocol is not enabled on the storage side. After the NFS v4 protocol fails to be used for mounting, the host does not negotiate to use the NFS v3 protocol for mounting.

Solution or Workaround

- Enable the NFS 3/4.0/4.1/4.2 protocol on the storage side and retry the default mounting.
- Specify an available NFS protocol for mounting. For details, see **5.2.1 Configuring a StorageClass**.

8.4.6 A Pod Fails to Be Created and Message "publishInfo doesn't exist" Is Displayed in the Events Log

Symptom

When a Pod is being created, the Pod keeps in the **ContainerCreating** state. It is found that the following alarm event is printed for the Pod: **rpc error: code = Internal desc = publishInfo doesn't exist**

Root Cause Analysis

As required by CSI, when a workload needs to use a PV, the Container Orchestration system (CO system, communicating with the CSI plug-in using RPC requests) invokes the ControllerPublishVolume interface (provided by huawei-csi-controller) in the **CSI protocol** provided by the CSI plug-in to map the PV, and then invokes the NodeStageVolume interface (provided by huawei-csi-node) provided by the CSI plug-in to mount the PV. During a complete mounting operation, only the huawei-csi-node service receives the NodeStageVolume request. Before that, the huawei-csi-controller service does not receive the ControllerPublishVolume request. As a result, the huawei-csi-controller service does not map the PV volume and does not send the mapping information to the huawei-csi-node service. Therefore, error message **publishInfo doesn't exist** is reported.

Solution

To solve this problem, Kubernetes needs to invoke the ControllerPublishVolume interface.

If this operation is triggered by all workloads created by earlier versions in the cluster, this problem will not occur.

Procedure

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Run the following command to obtain the information about the node where a workload is located.

```
kubectl get pod error-pod -n error-pod-in-namespace -owide
```

The following is an example of the command output.

```
NAME     READY   STATUS              RESTARTS   AGE   IP       NODE     NOMINATED NODE   READINESS
GATES
pod-nfs  0/1     ContainerCreating   0          3s    <none>   node-1   <none>           <none>
```

Step 3 Fail over the workload to another node.

Step 4 If the failover cannot be completed in the cluster, you can delete the workload and create a new one on the original node.

Step 5 Check whether the workload is successfully started. If it fails to be started, contact Huawei technical support engineers.

----End

Checking Cluster Workloads

When Kubernetes invokes the CSI plug-in to complete volume mapping, the VolumeAttachment resource is used to save the mapping information, indicating that a specified volume is attached to or detached from a specified node. This problem occurs because publishInfo does not exist. You can view the VolumeAttachment resource information to check whether this problem is also involved in other workloads in the cluster. The procedure is as follows:

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Run the following command to obtain the VolumeAttachment information and retain resources whose **ATTACHER** field is **csi.huawei.com**. **csi.huawei.com** indicates the Huawei CSI driver name and can be configured in the **values.yaml** file. The corresponding configuration item is **csiDriver.driverName**. For details about the configuration item, see **Table 4-7**.

```
kubectl get volumeattachments.storage.k8s.io
```

The following is an example of the command output.

```
NAME         ATTACHER         PV        NODE      ATTACHED   AGE
csi-47abxx   csi.huawei.com   pvc-1xx   node-1    true       12h
```

Step 3 Run the following command to view the VolumeAttachment resource details. In the following information, **csi-47abxx** is the resource name obtained in **Step 2**.

```
kubectl get volumeattachments.storage.k8s.io csi-47abxx -o yaml
```

The following is an example of the command output.

```
kind: VolumeAttachment
metadata:
  annotations:
    csi.alpha.kubernetes.io/node-id: '{"HostName":"node-1"}'
   finalizers:
  - external-attacher/csi-huawei-com
  name: csi-47abxxx
  uid: 0c87fa8a-c3d6-4623-acb8-71d6206d030d
spec:
  attacher: csi.huawei.com
  nodeName: debian-node
  source:
    persistentVolumeName: pvc-1xx
status:
  attached: true
  attachmentMetadata:
     publishInfo: '{<PUBLISH-INFO>}'
```

Step 4 If **status.attachmentMetadata.publishInfo** exists in the resource obtained in **Step 3**, the problem described in this FAQ is not involved in the workloads created using **pvc-1xx** on the **node-1** node. **node-1** and **pvc-1xx** are the query results in

Step 2. If **status.attachmentMetadata.publishInfo** does not exist, rectify the fault by referring to **Solution**.

Step 5 If multiple VolumeAttachment resources exist, repeat **Step 3** to **Step 4**.

----End

8.4.7 After a Pod Fails to Be Created or kubelet Is Restarted, Logs Show That the Mount Point Already Exists

Symptom

When a Pod is being created, the Pod is always in the **ContainerCreating** state. Alternatively, after kubelet is restarted, logs show that the mount point already exists. Check the log information of huawei-csi-node (for details, see **7.2.2 Viewing Huawei CSI Logs**). The error information is: **The mount /var/lib/kubelet/pods/xxx/mount is already exist, but the source path is not /var/lib/kubelet/plugins/kubernetes.io/xxx/globalmount**

Root Cause Analysis

The root cause of this problem is that Kubernetes performs repeated mounting operations.

Solution or Workaround

Run the following command to unmount the existing path. In the command, **/var/lib/kubelet/pods/xxx/mount** indicates the existing mount path displayed in the logs.

```
umount /var/lib/kubelet/pods/xxx/mount
```

8.4.8 "I/O error" Is Displayed When a Volume Directory Is Mounted to a Pod

Symptom

When a Pod reads or writes a mounted volume, message "I/O error" is displayed.

Root Cause Analysis

When a protocol such as SCSI is used, if the Pod continuously writes data to the mount directory, the storage device will restart. As a result, the link between the device on the host and the storage device is interrupted, triggering an I/O error. When the storage device is restored, the mount directory is still read-only.

Solution

Remount the volume. That is, reconstruct the Pod to trigger re-mounting.

8.4.9 Failed to Create a Pod Because the iscsi_tcp Service Is Not Started Properly When the Kubernetes Platform Is Set Up for the First Time

Symptom

When you create a Pod, error **Cannot connect ISCSI portal *.*.*.*: libkmod: kmod_module_insert_module: could not find module by name='iscsi_tcp'** is reported in the **/var/log/huawei-csi-node** log.

Root Cause Analysis

The iscsi_tcp service may be stopped after the Kubernetes platform is set up and the iSCSI service is installed. You can run the following command to check whether the service is stopped.

```
lsmod | grep iscsi | grep iscsi_tcp
```

The following is an example of the command output.

```
iscsi_tcp            18333  6
libiscsi_tcp         25146  1 iscsi_tcp
libiscsi             57233  2 libiscsi_tcp,iscsi_tcp
scsi_transport_iscsi    99909  3 iscsi_tcp,libiscsi
```

Solution or Workaround

Run the following command to manually load the iscsi_tcp service.

```
modprobe iscsi_tcp
lsmod | grep iscsi | grep iscsi_tcp
```

8.4.10 A Pod Fails to Be Created and Logs Show That an Initiator Has Been Associated with Another Host

Symptom

When a Pod is created using SAN storage, the Pod is always in the **ContainerCreating** status. The Pod logs report alarm event "rpc error: code = Internal desc = initiator xxx is already associated to another host".

Root Cause Analysis

Cause 1: CSI automatically creates hosts, host groups, and initiators based on certain rules. If the same resources exist on the storage side before CSI is used, conflicts will occur. The possible cause is that the same initiator has been added before CSI is used.

Cause 2: In the container cluster, the initiator names of different worker nodes are the same. In this case, perform the following steps to rectify the fault:

Step 1 Log in to different worker nodes in the container cluster and run the following command to check whether different worker nodes use the same initiator name:

- To view the iSCSI initiator name, run the following command:

```
cat /etc/iscsi/initiatorname.iscsi
```

- To view the FC initiator name, run the following command:
```
cat /sys/class/fc_host/host*/port_name
```
- To view the RoCE initiator name, run the following command:
```
cat /etc/nvme/hostnqn
```

Step 2 If different worker nodes use the same initiator name, rectify the fault according to **Solution or Workaround**.

----End

Solution or Workaround

Step 1 Check whether the host associated with the initiator has volumes in use. If the host has volumes in use, migrate the Pod in use to another node.

Step 2 After confirming that the host has no volume in use, change the initiator name to ensure that the initiator is unique.

Step 3 Run the following command to restart the iscsid service.

```
systemctl restart iscsid
```

NOTICE

Restarting the iscsid service may cause I/O interruption. Before restarting the service, ensure that the host associated with the initiator has no volume in use.

Step 4 Restart the huawei-csi-node service.

----End

8.4.11 A Pod Fails to Be Created and Logs Show "Get DMDevice by alias: dm-x failed"

Symptom

When a Pod is created, the Pod is in the **ContainerCreating** status for a long time. In addition, the following error message is reported in the logs of huawei-csi-node (for details, see **7.2.2 Viewing Huawei CSI Logs**):

```
check device: dm-1 is a partition device failed. error: Get DMDevice by alias:dm-1 failed. error: Can not get DMDevice by alias: dm-1
```

Root Cause Analysis

In the DM-Multipath configuration file, the **user_friendly_names** parameter is not set to **yes**.

Solution or Workaround

Step 1 Check whether the worker node where the Pod is running has volumes in use. If the node has volumes in use, migrate the Pod in use to another node.

Step 2 Configure the **/etc/multipath.con** file by following the instructions in **4.1.1.5 Checking the Host Multipathing Configuration**.

Step 3 Run the following command to restart the multipathing software.

```
systemctl reload multipathd.service
systemctl restart multipathd
```

NOTICE

Restarting the multipathing software may cause I/O interruption. Ensure that the worker node where the Pod is running has no volume in use before restarting the multipathing software.

----End

8.5 Common Problems and Solutions for Interconnecting with the Tanzu Kubernetes Cluster

This section describes the common problems and solutions for interconnecting with the Tanzu Kubernetes cluster. Currently, the following problems occur during interconnection with the Tanzu Kubernetes cluster:

- A Pod cannot be created because the PSP permission is not created.
- The mount point of the host is different from that of the native Kubernetes. As a result, a volume fails to be mounted.
- The livenessprobe container port conflicts with the Tanzu vSphere port. As a result, the container restarts repeatedly.

8.5.1 A Pod Cannot Be Created Because the PSP Permission Is Not Created

Symptom

When huawei-csi-controller and huawei-csi-node are created, only the Deployment and DaemonSet resources are successfully created, and no Pod is created for the controller and node.

Root Cause Analysis

The service account used for creating resources does not have the "use" permission of the PSP policy.

Solution or Workaround

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Run the **vi** *psp-use.yaml* command to create a file named **psp-use.yaml**

```
vi psp-use.yaml
```

Step 3 Configure the **psp-use.yaml** file.

```
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRole
metadata:
  name: huawei-csi-psp-role
rules:
- apiGroups: ['policy']
  resources: ['podsecuritypolicies']
  verbs: ['use']
---
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRoleBinding
metadata:
  name: huawei-csi-psp-role-cfg
roleRef:
  kind: ClusterRole
  name: huawei-csi-psp-role
  apiGroup: rbac.authorization.k8s.io
subjects:
- kind: Group
  apiGroup: rbac.authorization.k8s.io
  name: system:serviceaccounts:huawei-csi
- kind: Group
  apiGroup: rbac.authorization.k8s.io
  name: system:serviceaccounts:default
```

Step 4 Run the following command to create the PSP permission.

```
kubectl create -f psp-use.yaml
```

----End

8.5.2 Changing the Mount Point of a Host

Symptom

A Pod fails to be created, and error message "mount point does not exist" is recorded in Huawei CSI logs.

Root Cause Analysis

The native Kubernetes cluster in the **pods-dir** directory of huawei-csi-node is inconsistent with the Tanzu Kubernetes cluster.

Solution or Workaround

Step 1 Go to the **helm/esdk/** directory and run the **vi values.yaml** command to open the configuration file.

```
vi values.yaml
```

Step 2 Change the value of **kubeletConfigDir** to the actual installation directory of kubelet.

```
# Specify kubelet config dir path.
# kubernetes and openshift is usually /var/lib/kubelet
# Tanzu is usually /var/vcap/data/kubelet
kubeletConfigDir: /var/vcap/data/kubelet
```

----End

8.5.3 Changing the Default Port of the livenessprobe Container

Symptom

The livenessprobe container of the huawei-csi-controller component keeps restarting.

Root Cause Analysis

The default port (9808) of the livenessprobe container of huawei-csi-controller conflicts with the existing vSphere CSI port of Tanzu.

Solution or Workaround

Change the default port of the livenessprobe container to an idle port.

Step 1 Go to the **helm/esdk** directory and run the **vi values.yaml** command to open the configuration file.

```
vi values.yaml
```

Step 2 Change the default value **9808** of **controller.livenessProbePort** to an idle port, for example, **9809**.

```
controller:
  livenessProbePort: 9809
```

Step 3 Update Huawei CSI using Helm. For details, see **4.1.4.1 Upgrade Using Helm**.

----End

8.5.4 Failed to Create an Ephemeral Volume

Symptom

A **generic ephemeral volume** fails to be created, and the error message **PodSecurityPolicy: unable to admit pod: [spec.volumes[0]: Invalid value: "ephemeral": ephemeral volumes are not allowed to be used spec.volumes[0]** is displayed.

Root Cause Analysis

The current PSP policy does not contain the permission to use ephemeral volumes.

Solution or Workaround

Add the permission to use ephemeral volumes to the default PSP **pks-privileged** and **pks-restricted**. The following is an example of modifying **pks-privileged**:

Step 1 Use a remote access tool, such as PuTTY, to log in to any master node in the Kubernetes cluster through the management IP address.

Step 2 Run the following command to modify the **pks-privileged** configuration.

```
kubectl edit psp pks-privileged
```


Step 3 Add **ephemeral** to **spec.volumes**. The following is an example.

```
# Please edit the object below. Lines beginning with a '#' will be ignored,
# and an empty file will abort the edit. If an error occurs while saving this file will be
# reopened with the relevant failures.
#
apiVersion: policy/v1beta1
kind: PodSecurityPolicy
metadata:
  annotations:
    apparmor.security.beta.kubernetes.io/allowedProfileName: '*'
    seccomp.security.alpha.kubernetes.io/allowedProfileNames: '*'
  creationTimestamp: "2022-10-11T08:07:00Z"
  name: pks-privileged
  resourceVersion: "1227763"
  uid: 2f39c44a-2ce7-49fd-87ca-2c5dc3bfc0c6
spec:
  allowPrivilegeEscalation: true
  allowedCapabilities:
  - '*'
  supplementalGroups:
    rule: RunAsAny
  volumes:
  - glusterfs
  - hostPath
  - iscsi
  - nfs
  - persistentVolumeClaim
  - ephemeral
```

Step 4 Run the following command to check whether the addition is successful.

```
kubectl get psp pks-privileged -o yaml
```

----End

9 Command Parameter Description

9.1 Description of oceanctl Commands

Obtaining Help Information

- Obtain the oceanctl help information.
```
oceanctl --help
```
- Check the oceanctl version.
```
oceanctl version
```
- Specify the custom log file directory. The following example describes how to check the oceanctl version.
```
oceanctl version --log-dir=/path/to/custom
```

Creating a Storage Backend

- Run the following command to obtain the help information about creating a backend.
```
oceanctl create backend -h
```
- Run the following command to create a storage backend based on the specified yaml file.
```
oceanctl create backend -f /path/to/backend.yaml -i yaml
```
- Run the following command to create a storage backend based on the specified json file. The **huawei-csi-configmap** file can be exported only in json format.
```
oceanctl create backend -f /path/to/configmap.json -i json
```
- Run the following command to create a storage backend in the specified namespace.
```
oceanctl create backend -f /path/to/backend.yaml -i yaml -n <namespace>
```
- Run the following command to create a storage backend and ignore the storage backend name verification, for example, uppercase letters and underscores (_). Do not run this command unless necessary.
```
oceanctl create backend -f /path/to/backend.yaml -i yaml --not-validate-name
```
- Run the following command to create a storage backend and specify **provisioner**. **csi.oceanstor.com** is the driver name specified during installation. For details, see **Step 4**.

NOTE

This command is used only when a backend is created on the CCE or CCE Agile platform.

```
oceanctl create backend -f /path/to/backend.yaml  -i yaml --provisioner=csi.oceanstor.com
```

Querying a Storage Backend

- Run the following command to obtain the help information about querying a backend.
```
oceanctl get backend -h
```
- Run the following command to query a single storage backend in the default namespace.
```
oceanctl get backend <backend-name>
```
- Run the following command to query all storage backends in the specified namespace.
```
oceanctl get backend -n <namespace>
```
- Run the following command to format the output. Currently, **json**, **yaml**, and **wide** are supported.
```
oceanctl get backend <backend-name> -o json
```

Updating a Storage Backend

- Run the following command to obtain the help information about updating a backend.
```
oceanctl update backend -h
```
- Run the following command to update the specified storage backend in the default namespace.
```
oceanctl update backend <backend-name> --password
```
- Run the following command to update a storage backend in the specified namespace.
```
oceanctl update backend <backend-name> -n <namespace> --password
```

Deleting a Storage Backend

- Run the following command to obtain the help information about deleting a backend.
```
oceanctl delete backend -h
```
- Run the following command to delete the specified storage backend in the default namespace.
```
oceanctl delete backend <backend-name>
```
- Run the following command to delete all storage backends in the default namespace.
```
oceanctl delete backend  --all
```
- Run the following command to delete a storage backend in the specified namespace.
```
oceanctl delete backend <backend-name...> -n <namespace>
```

Creating a Storage Backend Certificate

- Run the following command to obtain the help information about querying a certificate.
```
oceanctl create cert -h
```
- Run the following command to create a certificate for a single storage backend in the default namespace based on the specified .crt certificate file.


```
oceanctl create cert <name> -f /path/to/cert.crt -b <backend-name>
```

- Run the following command to create a certificate for a single storage backend in the specified namespace based on the specified .crt certificate file.
```
oceanctl create cert <name> -f /path/to/cert.crt -b <backend-name> -n <namespace>
```
- Run the following command to create a certificate for a single storage backend in the specified namespace based on the specified .pem certificate file.
```
oceanctl create cert <name> -f /path/to/cert.pem -b <backend-name> -n <namespace>
```

Querying a Storage Backend Certificate

- Run the following command to obtain the help information about querying a certificate.
```
oceanctl get cert -h
```
- Run the following command to query the certificate of a specified storage backend in the default namespace.
```
oceanctl get cert -b <backend-name>
```
- Run the following command to query the certificate of a specified storage backend in the specified namespace.
```
oceanctl get cert -b <backend-name> -n <namespace>
```

Updating a Storage Backend Certificate

- Run the following command to obtain the help information about updating a certificate.
```
oceanctl update cert -h
```
- Run the following command to update a certificate for a specified storage backend in the default namespace based on the specified .crt certificate file.
```
oceanctl update cert -b <backend-name> -f /path/to/cert.crt
```
- Run the following command to update a certificate for a specified storage backend in the specified namespace based on the specified .crt certificate file.
```
oceanctl update cert -b <backend-name> -n <namespace> -f /path/to/cert.crt
```
- Run the following command to update a certificate for a specified storage backend in the specified namespace based on the specified .pem certificate file.
```
oceanctl update cert -b <backend-name> -n <namespace> -f /path/to/cert.pem
```

Deleting a Storage Backend Certificate

- Run the following command to obtain the help information about deleting a certificate.
```
oceanctl delete cert -h
```
- Run the following command to delete the certificate of a specified storage backend in the default namespace.
```
oceanctl delete cert -b <backend-name>
```
- Run the following command to delete the certificate of a specified storage backend in the specified namespace.
```
oceanctl delete cert -b <backend-name> -n <namespace>
```


10 Appendix

10.1 Communication Matrix

Source Device	Host where CSI controller is located	Host where CSI controller is located	Host where CSI node is located	Kubernetes master node
Source IP Address	IP address of the source device	IP address of the source device	IP address of the source device	IP address of the source device
Source Port	1024 to 65536	1024 to 65536	1024 to 65536	1024 to 65536
Destination Device	Storage device	Host where CSI controller is located	Host where CSI node is located	Host where CSI controller is located
Destination IP Address	Management IP address of the storage device	IP address of the destination device	IP address of the destination device	IP address of the destination device
Destination Port (for Listening)	8088	9808	9800	4433
Protocol	TCP	TCP	TCP	TCP

Port Description	Used to create, manage, and delete volumes	Used by Kubernetes to check the health status of CSI controller	Used by Kubernetes to check the health status of CSI node	Used to invoke webhook verification
Listening Port Configurable	No	No	No	Yes
Authentication Mode	User name and password	Certificate	Certificate	Certificate
Encryption Mode	TLS 1.3/TLS 1.2	TLS 1.3/TLS 1.2	TLS 1.3/TLS 1.2	TLS 1.3/TLS 1.2
Plane	OM	O&M plane	O&M plane	O&M plane
Special Scenario	None	None	None	None
Remarks	Enable some source ports.	-	-	For details about how to change the webhook port, see the CSI user guide.

10.2 Configuring Custom Permissions

User-defined Role Configurations

For different storage resources, refer to the following configurations:

- For NAS resources, configure the minimum permissions by referring to **Table 10-1**.
- For SAN resources, configure the minimum permissions by referring to **Table 10-2**.

NOTE

For details about how to configure permissions for user-defined roles, see **OceanStor Dorado 6000, Dorado 18000 Series Product Documentation**.

Table 10-1 Minimum permissions for NAS resources

Permission Object	Parent Object	Read/Write Permission	Function
workload_type	file_storage_service	Read-only	Queries the workload type.

Permission Object	Parent Object	Read/Write Permission	Function
file_system	file_storage_service	Read and write	Manages file systems.
fs_snapshot	file_storage_service	Read and write	Manages file system snapshots.
quota	file_storage_service	Read and write	Manages file system quotas.
nfs_service	file_storage_service	Read-only	Queries NFS services.
share	file_storage_service	Read and write	Manages NFS shares.
dtree	file_storage_service	Read and write	Manages dtrees.
hyper_metro_pair	hyper_metro	Read and write	Creates file system HyperMetro pairs.
hyper_metro_domain	hyper_metro	Read-only	Queries information about file system HyperMetro domains.
remote_device	local_data_protection	Read-only	Queries remote device information.
storage_pool	pool	Read-only	Queries storage pool information.
smart_qos	resource_performance_tuning	Read and write	Manages SmartQoS policies.
system	system	Read-only	Queries storage device information (this object needs to be configured only when the owning group is the system group).
vstore	vstore	Read-only	Queries vStore information.
port	network	Read-only	Queries logical port information.

Table 10-2 Minimum permissions for SAN resources

Permission Object	Parent Object	Read/Write Permission	Function
remote_device	local_data_protection	Read-only	Queries remote device information.
hyper_clone	local_data_protection	Read and write	Manages clone pairs.
lun_snapshot	local_data_protection	Read and write	Manages LUN snapshots.
workload_type	lun	Read-only	Queries the workload type.
lun	lun	Read and write	Manages LUNs.
host	mapping_view	Read and write	Manages hosts.
host_group	mapping_view	Read and write	Manages host groups.
initiator	mapping_view	Read and write	Manages initiators.
lun_group	mapping_view	Read and write	Manages LUN groups.
mapping_view	mapping_view	Read and write	Manages mapping views.
target	mapping_view	Read-only	Queries iSCSI initiators.
port	network	Read-only	Queries logical ports.
storage_pool	pool	Read-only	Queries storage pool information.
smart_qos	resource_performance_tuning	Read and write	Manages SmartQoS policies.
system	system	Read-only	Queries storage device information (this object needs to be configured only when the owning group is the system group).
vstore	vstore	Read-only	Queries vStore information.

10.3 Huawei CSI Resource Management

This section lists the resource requests and limits used by each container of the Huawei CSI plug-in. For details about the unit, see **Resource units in Kubernetes**.

Table 10-3 Container resource requests and limits

Pod Name	Container Name	CPU Request	CPU Limit	Memory Request	Memory Limit
huawei-csi-controller	huawei-csi-driver	50m	500m	128Mi	1Gi
	storage-backend-sidecar	50m	300m	128Mi	512Mi
	storage-backend-controller	50m	300m	128Mi	512Mi
	huawei-csi-extender	50m	300m	128Mi	512Mi
	csi-attacher	50m	300m	128Mi	512Mi
	csi-provisioner	50m	300m	128Mi	512Mi
	csi-resize	50m	300m	128Mi	512Mi
	csi-snapshotter	50m	300m	128Mi	512Mi
	snapshot-controller	50m	300m	128Mi	512Mi
	liveness-probe	10m	100m	128Mi	128Mi
huawei-csi-node	huawei-csi-driver	50m	500m	128Mi	1Gi
	csi-node-driver-registrar	50m	300m	128Mi	128Mi
	liveness-probe	10m	100m	128Mi	128Mi

Modifying Resource Requests and Limits

If you need to modify the resource requests and limits of a container, perform the following steps (in the following example, Helm is used to install Huawei CSI):

Step 1 If Helm is used for installation, go to the **/helm/esdk/templates** directory. For manual deployment, the file to be modified is in the **/manual/esdk/deploy** directory. For details about the component package path, see **Table 4-1**.

Step 2 Modify the deployment template file.

- If the Pod name is **huawei-csi-controller**, modify the **huawei-csi-controller.yaml** file.

- If the Pod name is **huawei-csi-node**, modify the **huawei-csi-node.yaml** file.

NOTE

For details about Pod names, see **Table 10-3**.

For example, to modify the resource request of the **huawei-csi-driver** container in the Pod named **huawei-csi-node**, run the following command to edit the configuration file and find the container whose **spec.template.spec.containes.name** is **huawei-csi-driver**. Modify resource requests and limits as required.

```
vi huawei-csi-node.yaml
```

Edit the following content.

```
containers
 - name: huawei-csi-driver
   ...
   resources:
     limits:
       cpu: 500m
       memory: 1Gi
     requests:
       cpu: 50m
       memory: 128Mi
```

Step 3 If Huawei CSI is not installed, the modification of resource requests and limits takes effect after Huawei CSI is installed by referring to **4.1.2.1.1 Installing Huawei CSI on Kubernetes, OpenShift, and Tanzu**.

Step 4 If Huawei CSI has been installed, the modification of resource requests and limits takes effect after Huawei CSI is updated by referring to **Upgrading Huawei CSI**.

----End

10.4 Kubernetes Feature Matrix

This section describes the features of different Kubernetes versions supported by Huawei CSI.

Table 10-4 Kubernetes versions and supported features

Feature	V1.16	V1.17	V1.18	V1.19	V1.20	V1.21+
Static Provisioning	√	√	√	√	√	√
Dynamic Provisioning	√	√	√	√	√	√
Manage Provisioning[1]	√	√	√	√	√	√
Expand Persistent Volume	√	√	√	√	√	√
Create VolumeSnapshot	x	x	x	x	√	√
Restore VolumeSnapshot	x	x	x	x	√	√

Feature	V1.16	V1.17	V1.18	V1.19	V1.20	V1.21+
Delete VolumeSnapshot	x	x	x	x	√	√
Clone Persistent Volume	x	√	√	√	√	√
Modify Volume[2]	√	√	√	√	√	√
Raw Block Volume	√	√	√	√	√	√
Topology	√	√	√	√	√	√
Generic Ephemeral Inline Volumes	x	x	x	x	x	√
Volume Limits	x	√	√	√	√	√
FSGroup Support	x	x	x	x	√	√

- Note 1: Manage Provisioning is a volume management feature customized by Huawei CSI. This feature allows existing storage resources to be managed by Kubernetes. You are not allowed to manage a storage resource for multiple times and concurrently delete or create a storage resource. When a storage resource is managed by multiple clusters, operations on the managed volume in a single cluster take effect only in the cluster and will not be synchronized to other clusters. Instead, you need to perform these operations on the managed volume in other clusters.
- Note 2: Modify Volume is a PVC change feature customized by Huawei CSI. This feature allows a common volume to be changed to a HyperMetro volume. To use this feature, ensure that the connected storage supports the volume HyperMetro feature.