Elastic Volume Service

Best Practices

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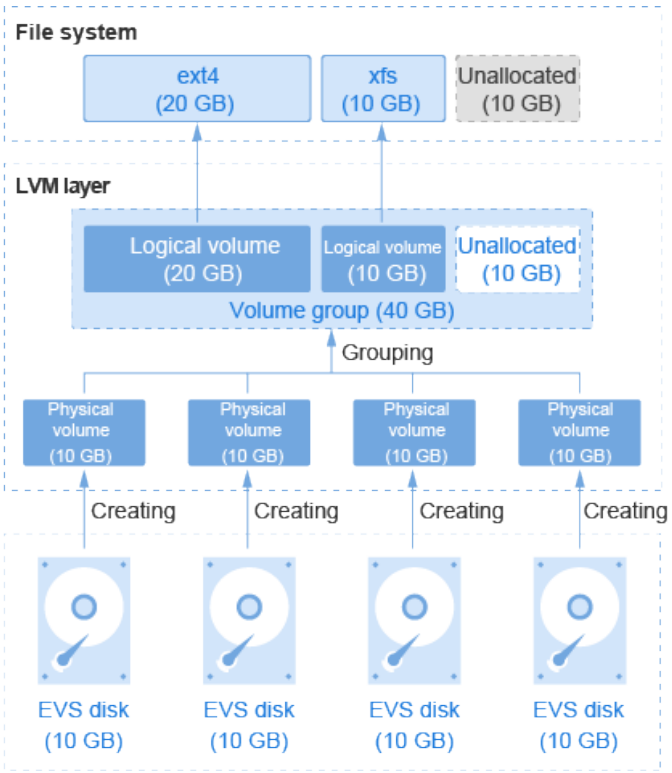
1 Using LVM to Manage EVS Disks

1.1 Overview of EVS Disk Management Using LVM

LVM is short for Logical Volume Manager, which is a mechanism used for managing disk partitions in Linux.

By adding a logical layer between EVS disks and file systems, LVM abstracts EVS disk partitions into logical volumes that can then be flexibly partitioned as needed for upper layer file systems. **Figure 1-1** shows the LVM architecture.

Figure 1-1 LVM architecture



The process of managing EVS disks using LVM is as follows:

1. **Create physical volumes using EVS disks.**
2. **Create a volume group for the physical volumes.**
3. **Create logical volumes in the volume group.**
4. **Create file systems on logical volumes.**

With LVM, a file system can be created on top of multiple EVS disks and can be easily resized as needed. This way, the file system size is no longer limited by the underlying disk capacity.

For example, you can expand the size of an ext4 file system in either of the following ways:

- Extend the logical volume directly if the unallocated space in the volume group is sufficient.
- Extend the volume group and then logical volumes if the unallocated space in a volume group is insufficient.

Glossary

- Physical Volume

  Physical volumes are basic storage devices in LVM and are created based on EVS disks and LVM management parameters.
- Volume Group

  A volume group concatenates physical volumes into a large storage pool that can be consecutively addressed.
- Logical Volume

  Logical volumes are obtained by partitioning the volume group according to the logic.

1.2 Resource Planning and Costs

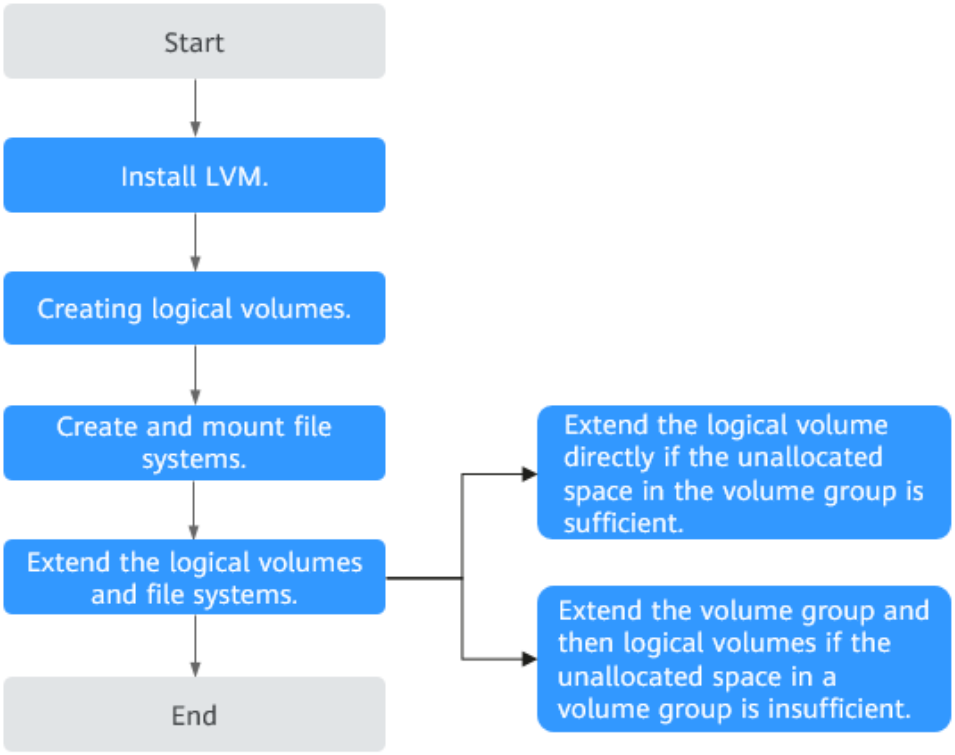
Table 1-1 Resource planning and costs

Resource	Description	Quantity	Monthly Fee
Elastic IP (EIP)	The ECS needs to have an EIP bound.	1	For details about the billing modes and billing standards, see **Billing**.
Elastic Cloud Server (ECS)	Operating system: CentOS	1	For details about the billing modes and billing standards, see **Billing**.
EVS disk	Data disk: 10 GB	4	For details about the billing modes and billing standards, see **Billing for Disks**.

1.3 Operation Process

To manage EVS disks using LVM, you need to first install LVM, create logical volumes, and then create and mount file systems on top of the logical volumes.

Figure 1-2 Using LVM to manage EVS disks



1.4 Implementation Procedure

1.4.1 Installing LVM

Scenarios

By default, LVM is not installed in the ECS operating system (OS), and you need to manually install it. This section shows how to check whether LVM is installed on your ECS and how to install LVM.

In this section, CentOS 7.5 64bit is used as the sample OS. The method for formatting an EVS disk varies depending on the OS running on the server. This section is used for reference only.

Prerequisites

You have an ECS and have bound an EIP to the ECS.

Procedure

Step 1 Log in to the ECS as user **root**.

Step 2 Run the following command to check whether LVM is installed:

rpm -qa |grep lvm2

```
[root@ecs-lvmtest ~]# rpm -qa |grep lvm2
lvm2-libs-2.02.177-4.el7.x86_64
lvm2-2.02.177-4.el7.x86_64
```

- If the preceding information is displayed, LVM has been installed. Go to **Creating a Logical Volume Using LVM**.
- If the preceding information is not displayed, LVM is not installed. Go to **Step 3**.

Step 3 Run the following command and follow the prompts to install LVM:

yum install lvm2

Information similar to the following is displayed:

```
......
Installed:
  lvm2.x86_64 7:2.02.177-4.el7

Dependency Installed:
  device-mapper-event.x86_64 7:1.02.146-4.el7                device-mapper-event-libs.x86_64
7:1.02.146-4.el7
  device-mapper-persistent-data.x86_64 0:0.7.3-3.el7          lvm2-libs.x86_64 7:2.02.177-4.el7

Dependency Updated:
  device-mapper.x86_64 7:1.02.146-4.el7                      device-mapper-libs.x86_64 7:1.02.146-4.el7

Complete!
```

When **Complete!** is displayed, LVM is successfully installed.

----End

1.4.2 Creating a Logical Volume Using LVM

Scenarios

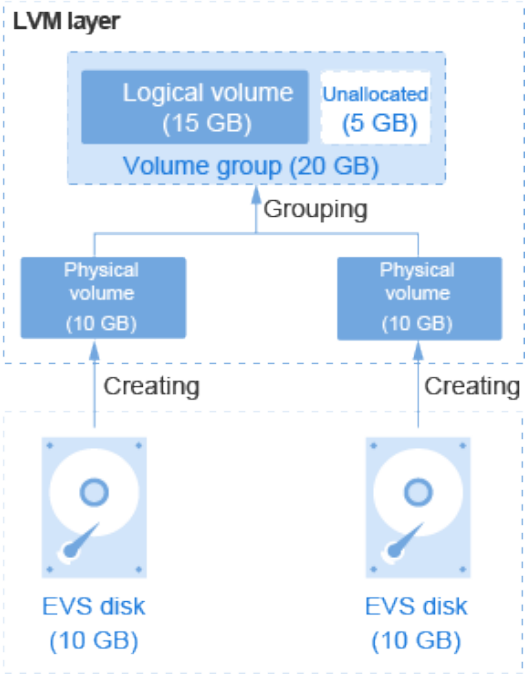
This section shows how to create a 15 GB logical volume based on two 10 GB EVS disks.

NOTE

Logical volumes can be created based on EVS disks with different specifications.

The process includes creating physical volumes, create a volume group, and create a logical volume.

Figure 1-3 Process of creating an LVM logical volume



Prerequisites

Two EVS disks have been attached to the ECS where LVM is installed.

Procedure

Step 1 Log in to the ECS as user **root**.

Step 2 Run the following command to view and take note of the device names:

fdisk -l | grep /dev/vd | grep -v vda

Information similar to the following is displayed:

```
[root@ecs-lvmtest ~]# fdisk -l | grep /dev/vd | grep -v vda
Disk /dev/vdb: 10.7 GB, 10737418240 bytes, 20971520 sectors
Disk /dev/vdc: 10.7 GB, 10737418240 bytes, 20971520 sectors
```

In the command output, two EVS disks are attached to the ECS, and the device names are **/dev/vdb** and **/dev/vdc**.

Step 3 Create physical volumes using EVS disks.

1. Run the following command to create physical volumes using EVS disks:

   pvcreate *Device name 1 Device name 2 Device name 3*...

   Parameter description:

   Device name: indicates the disk device name. If multiple physical volumes need to be created in a batch, specify multiple device names and separate them with spaces.

   In this example, run the following command:

   pvcreate /dev/vdb /dev/vdc

   Information similar to the following is displayed:


```
[root@ecs-lvmtest ~]#  pvcreate /dev/vdb /dev/vdc
  Physical volume "/dev/vdb" successfully created.
  Physical volume "/dev/vdc" successfully created.
```

2. Run the following command to query details of the physical volumes:

   pvdisplay

   Information similar to the following is displayed:

```
[root@ecs-lvmtest ~]# pvdisplay
  "/dev/vdc" is a new physical volume of "10.00 GiB"
  --- NEW Physical volume ---
  PV Name               /dev/vdc
  VG Name
  PV Size               10.00 GiB
  Allocatable           NO
  PE Size               0
  Total PE              0
  Free PE               0
  Allocated PE          0
  PV UUID               dypyLh-xjIj-PvG3-jD0j-yup5-O7SI-462R7C

  "/dev/vdb" is a new physical volume of "10.00 GiB"
  --- NEW Physical volume ---
  PV Name               /dev/vdb
  VG Name
  PV Size               10.00 GiB
  Allocatable           NO
  PE Size               0
  Total PE              0
  Free PE               0
  Allocated PE          0
  PV UUID               srv5H1-tgLu-GRTl-Vns8-GfNK-jtHk-Ag4HHB
```

   In the command output, the system has two new physical volumes named **/dev/vdc** and **/dev/vdb**.

Step 4 Create a volume group for the physical volumes.

1. Run the following command to create a volume group:

   vgcreate *Volume group name Physical volume name 1 Physical volume name 2 Physical volume name 3...*

   Parameter description:

   - *Volume group name*: Specify a volume group name, for example, **vgdata**.
   - *Physical volume name*: Specify the name of a physical volume to be added to the volume group. Multiple names are separated with spaces.

   In this example, run the following command:

   vgcreate vgdata /dev/vdb /dev/vdc

   Information similar to the following is displayed:

```
[root@ecs-lvmtest ~]# vgcreate vgdata /dev/vdb /dev/vdc
  Volume group "vgdata" successfully created
```

2. Run the following command to query details of the volume group:

   vgdisplay

   Information similar to the following is displayed:

```
[root@ecs-lvmtest ~]# vgdisplay
  --- Volume group ---
  VG Name               vgdata
  System ID
  Format                lvm2
  Metadata Areas        2
  Metadata Sequence No  1
  VG Access             read/write
```



```
VG Status             resizable
MAX LV                0
Cur LV                0
Open LV               0
Max PV                0
Cur PV                2
Act PV                2
VG Size               19.99 GiB
PE Size               4.00 MiB
Total PE              5118
Alloc PE / Size       0 / 0
Free  PE / Size       5118 / 19.99 GiB
VG UUID               NLkZV7-hYYE-0w66-tnlt-Y6jL-Ik7S-76w4P6
```

Step 5 Create a logical volume in the volume group.

1. Run the following command to create a logical volume:

   lvcreate -L *Logical volume size* **-n** *Logical volume name Volume group name*

   Parameter description:

   - *Logical volume size*: Specify a value smaller than the volume group's available space, either in MB or GB.
   - *Logical volume name*: Specify a volume name, for example, **lvdata1**.
   - *Volume group name*: Specify the name of the volume group where the logical volume belongs.

   In this example, run the following command:

   lvcreate -L 15GB -n lvdata1 vgdata

   Information similar to the following is displayed:

   ```
   [root@ecs-lvmtest ~]# lvcreate -L 15GB -n lvdata1 vgdata
     Logical volume "lvdata1" created.
   ```

2. Run the following command to query details of the logical volume:

   lvdisplay

   Information similar to the following is displayed:

   ```
   [root@ecs-lvmtest ~]# lvdisplay
     --- Logical volume ---
     LV Path                /dev/vgdata/lvdata1
     LV Name                lvdata1
     VG Name                vgdata
     LV UUID                c7mNcF-CdPW-5PLD-1gVj-QZpB-nHfy-PHXchV
     LV Write Access        read/write
     LV Creation host, time ecs-lvmtest.novalocal, 2018-11-29 11:28:18 +0800
     LV Status              available
     # open                 0
     LV Size                15.00 GiB
     Current LE             3840
     Segments               2
     Allocation             inherit
     Read ahead sectors     auto
     - currently set to     8192
     Block device           252:0
   ```

----End

1.4.3 Creating and Mounting a File System

Scenarios

After the logical volume is created, you need to create a file system on the logical volume and mount the file system on the corresponding directory. This section

shows how to create an ext4 file system on a logical volume and mount the file system on **/Data1**.

Procedure

Step 1 Log in to the ECS as user **root**.

Step 2 Run the following command to create a file system:

mkfs.*File system format Logical volume path*

In this example, run the following command:

mkfs.ext4 /dev/vgdata/lvdata1

Information similar to the following is displayed:

```
[root@ecs-lvmtest ~]# mkfs.ext4 /dev/vgdata/lvdata1
mke2fs 1.42.9 (28-Dec-2013)
Filesystem label=
OS type: Linux
Block size=4096 (log=2)
Fragment size=4096 (log=2)
Stride=0 blocks, Stripe width=0 blocks
983040 inodes, 3932160 blocks
196608 blocks (5.00%) reserved for the super user
First data block=0
Maximum filesystem blocks=2151677952
120 block groups
32768 blocks per group, 32768 fragments per group
8192 inodes per group
Superblock backups stored on blocks:
        32768, 98304, 163840, 229376, 294912, 819200, 884736, 1605632, 2654208

Allocating group tables: done
Writing inode tables: done
Creating journal (32768 blocks): done
Writing superblocks and filesystem accounting information: done
```

Step 3 Run the following command to create a mounting directory:

mkdir *Mounting directory*

In this example, run the following command:

mkdir /Data1

Step 4 Run the following command to mount the file system on the directory:

mount *Logical volume path Mounting directory*

In this example, run the following command:

mount /dev/vgdata/lvdata1 /Data1

Step 5 Run the following command to query the file system mounting information:

mount | grep *Mounting directory*

In this example, run the following command:

mount | grep /Data1

Information similar to the following is displayed:


```
[root@ecs-lvmtest ~]# mount | grep /Data1
/dev/mapper/vgdata-lvdata1 on /Data1 type ext4 (rw,relatime,data=ordered)
```

In the command output, **dev/mapper/vgdata-lvdata1** indicates the file system path. Take note of this path, which will be used in **Step 6**.

Step 6 Perform the following operations to enable automatic mounting of the file system at the system start:

If this is not configured, you need to manually mount the file system every time the ECS is restarted.

1. Run the following command to query the file system UUID:

   blkid *File system path*

   In this example, run the following command to query the UUID of **dev/mapper/vgdata-lvdata1**:

   blkid /dev/mapper/vgdata-lvdata1

   Information similar to the following is displayed:

   ```
   [root@ecs-lvmtest ~]# blkid /dev/mapper/vgdata-lvdata1
   /dev/mapper/vgdata-lvdata1: UUID="c6a243ce-5150-41ac-8816-39db54d1a4b8" TYPE="ext4"
   ```

   In the command output, the UUID is **c6a243ce-5150-41ac-8816-39db54d1a4b8**.

2. Run the following command to open the **/etc/fstab** file:

   vi /etc/fstab

   Information similar to the following is displayed:

   ```
   [root@ecs-lvmtest ~]# vi /etc/fstab

   #
   # /etc/fstab
   # Created by anaconda on Tue Nov  7 14:28:26 2017
   #
   # Accessible filesystems, by reference, are maintained under '/dev/disk'
   # See man pages fstab(5), findfs(8), mount(8) and/or blkid(8) for more info
   #
   UUID=27f9be47-838b-4155-b20b-e4c5e013cdf3 /                       ext4    defaults        1 1
   UUID=2b2000b1-f926-4b6b-ade8-695ee244a901 /boot                   ext4    defaults        1 2
   ```

3. Press **i** to enter editing mode.

4. Move the cursor to the end of the file and press **Enter**. Then add the following information:

   ```
   UUID=c6a243ce-5150-41ac-8816-39db54d1a4b8 /Data1                   ext4    defaults        0 0
   ```

   The file content is described as follows:

   - Column 1: indicates the UUID. Enter the UUID queried in **1**.
   - Column 2: indicates the file system's mounting directory. Enter mounting directory **/Data1** created in **Step 3**.
   - Column 3: indicates the file system format. Enter file system format **ext4** configured in **Step 2**.
   - Column 4: indicates the mounting option. In this example, **defaults** is used.
   - Column 5: indicates the backup option. Enter either **1** (the system automatically backs up the file system) or **0** (does not back up the file system). In this example, **0** is used.
   - Column 6: indicates the scanning option. Enter either **1** (the system automatically scans the file system at system start) or **0** (does not scan the file system). In this example, **0** is used.

5. Press **Esc**, enter **:wq!**, and press **Enter**.
   The system saves the modifications and exits the vi editor.

Step 7 Perform the following operations to verify automatic mounting:

1. Run the following command to unmount a file system:
   umount *Logical volume path*
   In this example, run the following command:
   umount /dev/vgdata/lvdata1
2. Run the following command to reload all the content in the **/etc/fstab** file:
   mount -a
3. Run the following command to query the file system mounting information:
   mount | grep *Mounting directory*
   In this example, run the following command:
   mount | grep /Data1
   If information similar to the following is displayed, the automatic mounting function takes effect:

```
[root@ecs-lvmtest ~]# mount | grep /Data1
/dev/mapper/vgdata-lvdata1 on /Data1 type ext4 (rw,relatime,data=ordered)
```

----End

1.4.4 Extending the Logical Volume Using the Unallocated Space

Scenarios

If the logical volume space becomes insufficient, you can extend the logical volume. This section shows how to add 4 GB space to a 15 GB logical volume, which no longer meets requirements.

NOTE

During the extension, ensure that the volume group has sufficient available space to extend the logical volume. If the volume group's available space is also insufficient, extend the volume group according to **Extending the Logical Volume by Expanding Capacity of an EVS Disk** or **Extending the Volume Group by Adding an EVS Disk**.

Procedure

Step 1 Log in to the ECS as user **root**.

Step 2 Run the following command to extend the logical volume:

lvextend -L +*Additional capacity Logical volume path*

Parameter description:

- *Additional capacity*: Specify a value smaller than the volume group's available space, either in MB or GB.
- *Logical volume path*: Specify the path of the to-be-extended logical volume.

In this example, run the following command:

lvextend -L +4GB /dev/vgdata/lvdata1

Information similar to the following is displayed:

```
[root@ecs-lvmtest ~]# lvextend -L +4GB /dev/vgdata/lvdata1
  Size of logical volume vgdata/lvdata1 changed from 15.00 GiB (3840 extents) to 19.00 GiB (4864 extents).
  Logical volume vgdata/lvdata1 successfully resized.
```

This step only extends the logical volume. You also need to extend the size of the file system on this volume.

Step 3 Run the following command to extend the size of the file system:

resize2fs *Logical volume path*

In this example, run the following command:

resize2fs /dev/vgdata/lvdata1

Information similar to the following is displayed:

```
[root@ecs-lvmtest ~]# resize2fs /dev/vgdata/lvdata1
resize2fs 1.42.9 (28-Dec-2013)
Filesystem at /dev/vgdata/lvdata1 is mounted on /Data1; on-line resizing required
old_desc_blocks = 4, new_desc_blocks = 28
The filesystem on /dev/vgdata/lvdata1 is now 3657728 blocks long.
```

Step 4 Run the following command to check whether the file system size increases:

df -h

Information similar to the following is displayed:

```
[root@ecs-lvmtest ~]# df -h
Filesystem                Size  Used Avail Use% Mounted on
/dev/vda2                  39G  1.5G   35G   5% /
devtmpfs                  487M     0  487M   0% /dev
tmpfs                     496M     0  496M   0% /dev/shm
tmpfs                     496M  6.7M  490M   2% /run
tmpfs                     496M     0  496M   0% /sys/fs/cgroup
/dev/vda1                 976M  131M  779M  15% /boot
tmpfs                     100M     0  100M   0% /run/user/0
/dev/mapper/vgdata-lvdata1   19G   44M   18G   1% /Data1
```

In the command output, the size of file system **/dev/mapper/vgdata-lvdata1** increases by 4 GB.

----End

1.4.5 Extending the Logical Volume by Expanding Capacity of an EVS Disk

Scenarios

If the logical volume space becomes insufficient, you can extend the logical volume. This section describes how to add 10 GB space to a 19 GB logical volume by expanding the capacity of an EVS disk.

Procedure

Step 1 Expand the capacity of an EVS disk on the management console.

1. Log in to the management console.
2. Under **Storage**, click **Elastic Volume Service**. The disk list page is displayed.
3. Locate the to-be-expanded disk and expand the capacity.
   For details, see **Expand Disk Capacity**.

Step 2 Log in to the ECS as user **root**.

Step 3 Run the following command to check whether the system has identified the added space:

fdisk -l

Information similar to the following is displayed:

```
[root@ecs-lvmtest ~]# fdisk -l

Disk /dev/vda: 42.9 GB, 42949672960 bytes, 83886080 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk label type: dos
Disk identifier: 0x000f1217

   Device Boot      Start         End      Blocks   Id  System
/dev/vda1   *        2048    83886079    41942016   83  Linux

Disk /dev/vdb: 21.5 GB, 21474836480 bytes, 41943040 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes


Disk /dev/vdc: 10.7 GB, 10737418240 bytes, 20971520 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes


Disk /dev/mapper/vgdata-lvdata1: 20.4 GB, 20401094656 bytes, 39845888 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
```

The size of **/dev/vdb** has increased from 10 GB to 20 GB.

Step 4 Run the following command to view information of physical volumes:

pvdisplay

Information similar to the following is displayed:

```
[root@ecs-lvmtest ~]# pvdisplay
  --- Physical volume ---
  PV Name               /dev/vdb
  VG Name               vgdata
  PV Size               10.00 GiB / not usable 4.00 MiB
  Allocatable           yes (but full)
  PE Size               4.00 MiB
  Total PE              2559
  Free PE               0
  Allocated PE          2559
  PV UUID               QC8WMe-cHfp-2cAJ-2kUH-qhXM-SDJw-mu8rKI

  --- Physical volume ---
  PV Name               /dev/vdc
  VG Name               vgdata
  PV Size               10.00 GiB / not usable 4.00 MiB
  Allocatable           yes
  PE Size               4.00 MiB
  Total PE              2559
  Free PE               254
  Allocated PE          2305
  PV UUID               vJxNtf-k86g-fHYl-3ZiV-xLCZ-bG9a-nEo0FU
```

The size of /**dev/vdb** remains 10 GB, indicating that the size of the physical volume is not increased.

Step 5 Run the following command to extend the physical volume of the corresponding EVS disk:

pvresize -v *Disk device name*

In this example, run the following command:

pvresize -v /dev/vdb

Information similar to the following is displayed:

```
[root@ecs-lvmtest ~]# pvresize -v /dev/vdb
    Archiving volume group "vgdata" metadata (seqno 3).
    Resizing volume "/dev/vdb" to 41943040 sectors.
    Resizing physical volume /dev/vdb from 2559 to 5119 extents.
    Updating physical volume "/dev/vdb"
    Creating volume group backup "/etc/lvm/backup/vgdata" (seqno 4).
  Physical volume "/dev/vdb" changed
  1 physical volume(s) resized or updated / 0 physical volume(s) not resized
```

In the command output, the physical volume corresponding to **/dev/vdb** has been extended.

Step 6 Run the following command to extend the corresponding logical volume if needed:

lvextend -l +100%FREE *Logical volume path*

In this example, run the following command:

lvextend -l +100%FREE /dev/vgdata/lvdata1

Information similar to the following is displayed:

```
[root@ecs-lvmtest ~]# lvextend -l +100%FREE /dev/vgdata/lvdata1
  Size of logical volume vgdata/lvdata1 changed from 19.00 GiB (4864 extents) to 29.99 GiB (7678 extents).
  Logical volume vgdata/lvdata1 successfully resized.
```

Step 7 Run the following command to extend the file system of the partition:

resize2fs *Logical volume path*

In this example, run the following command:

resize2fs /dev/vgdata/lvdata1

Information similar to the following is displayed:

```
[root@ecs-lvmtest ~]# resize2fs /dev/vgdata/lvdata1
resize2fs 1.42.9 (28-Dec-2013)
Filesystem at /dev/vgdata/lvdata1 is mounted on /Data1; on-line resizing required
old_desc_blocks = 3, new_desc_blocks = 4
[ 2591.781109] EXT4-fs (dm-0): resizing filesystem from 4980736 to 7862272 blocks
[ 2591.782411] EXT4-fs (dm-0): resized filesystem to 7862272
The filesystem on /dev/vgdata/lvdata1 is now 7862272 blocks long.
```

Step 8 Run the following command to view the capacity expansion result:

lvdisplay

Information similar to the following is displayed:

```
[root@ecs-lvmtest ~]# lvdisplay
  --- Logical volume ---
  LV Path                /dev/vgdata/lvdata1
  LV Name                lvdata1
  VG Name                vgdata
  LV UUID                5FCqyK-HBJE-apc1-F198-PUVu-9pEd-Gg5gMM
  LV Write Access        read/write
  LV Creation host, time ecs-lvmtest, 2020-06-04 17:13:26 +0800
  LV Status              available
  # open                 1
  LV Size                29.99 GiB
  Current LE             7678
  Segments               3                                        29.99 GiB (7678 extents).
  Allocation             inherit
  Read ahead sectors     auto
  - currently set to     8192
  Block device           252:0
```

In the command output, the logical volume size (**LV Size**) is increased by 10 GB.

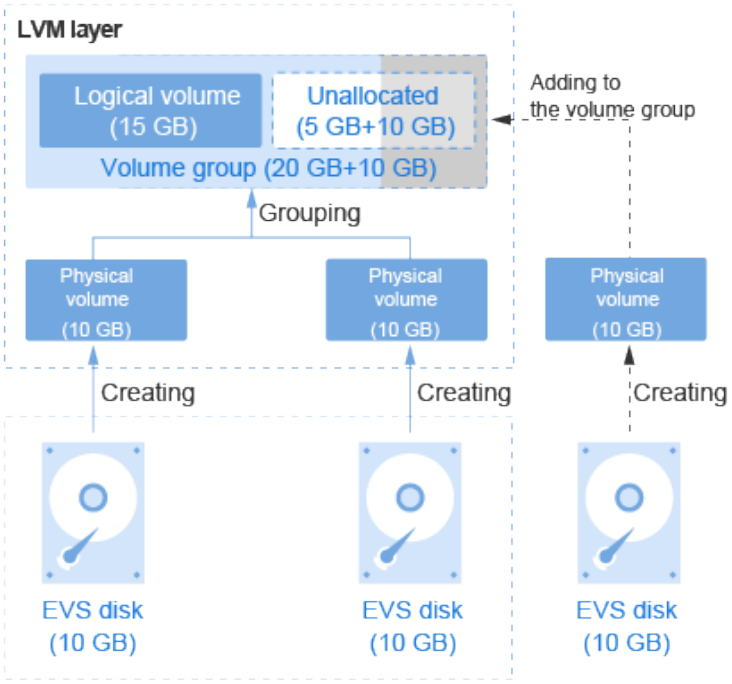
----End

1.4.6 Extending the Volume Group by Adding an EVS Disk

Scenarios

If the space of an LVM volume group no longer meets your needs, you can extend the volume group by adding new EVS disks, creating physical volumes, and adding the physical volumes to the volume group.

Figure 1-4 Example of extending a volume group



Procedure

Step 1 Create an EVS disk and attach it.

1. Log in to the management console.
2. Under **Storage**, click **Elastic Volume Service**. The disk list page is displayed.
3. Click **Buy Disk** and create a disk.

   For details, see **Purchase an EVS Disk**.
4. In the disk list, locate the new disk and click **Attach** in the **Operation** column.
5. On the displayed page, select the target ECS and select a device name from the drop-down list. Ensure that the EVS disk and ECS reside in the same AZ.

   Return to the disk list page. The status of the disk is **Attaching**, indicating that the disk is being attached to the ECS. When the disk status changes to **In-use**, the disk is successfully attached.

Step 2 Log in to the ECS as user **root**.

Step 3 Run the following command to query the volume group size:

vgdisplay

Information similar to the following is displayed:


```
[root@ecs-lvmtest ~]# vgdisplay
  --- Volume group ---
  VG Name               vgdata
  System ID
  Format                lvm2
  Metadata Areas        2
  Metadata Sequence No  3
  VG Access             read/write
  VG Status             resizable
  MAX LV                0
  Cur LV                1
  Open LV               1
  Max PV                0
  Cur PV                2
  Act PV                2
  VG Size               19.99 GiB
  PE Size               4.00 MiB
  Total PE              5118
  Alloc PE / Size       4864 / 19.00 GiB
  Free  PE / Size       254 / 1016.00 MiB
  VG UUID               NLkZV7-hYYE-0w66-tnlt-Y6jL-Ik7S-76w4P6
```

In the command output, the **VG Size** value indicates the volume group size, which is **19.99 GiB**.

Step 4 Run the following command to view and take note of the device names:

fdisk -l | grep /dev/vd | grep -v vda

Information similar to the following is displayed:

```
[root@ecs-lvmtest ~]# fdisk -l | grep /dev/vd | grep -v vda
Disk /dev/vdb: 10.7 GB, 10737418240 bytes, 20971520 sectors
Disk /dev/vdc: 10.7 GB, 10737418240 bytes, 20971520 sectors
Disk /dev/vdd: 10.7 GB, 10737418240 bytes, 20971520 sectors
```

In the command output, the new EVS disk has been attached to the ECS, and the device name is **/dev/vdd**.

Step 5 Run the following command to create a physical volume using the new EVS disk:

pvcreate *Disk device name*

In this example, run the following command:

pvcreate /dev/vdd

Information similar to the following is displayed:

```
[root@ecs-lvmtest ~]# pvcreate /dev/vdd
  Physical volume "/dev/vdd" successfully created.
```

Step 6 Run the following command to extend the volume group by adding the physical volume to the volume group:

vgextend *Volume group name Physical volume name*

In this example, run the following command:

vgextend vgdata /dev/vdd

Information similar to the following is displayed:

```
[root@ecs-lvmtest ~]# vgextend vgdata /dev/vdd
  Volume group "vgdata" successfully extended
```

Step 7 Run the following command to query details of the volume group:

vgdisplay

Information similar to the following is displayed:

```
[root@ecs-lvmtest ~]# vgdisplay
  --- Volume group ---
  VG Name               vgdata
  System ID
  Format                lvm2
  Metadata Areas        3
  Metadata Sequence No  4
  VG Access             read/write
  VG Status             resizable
  MAX LV                0
  Cur LV                1
  Open LV               1
  Max PV                0
  Cur PV                3
  Act PV                3
  VG Size               <29.99 GiB
  PE Size               4.00 MiB
  Total PE              7677
  Alloc PE / Size       4864 / 19.00 GiB
  Free  PE / Size       2813 / <10.99 GiB
  VG UUID               NLkZV7-hYYE-0w66-tnlt-Y6jL-Ik7S-76w4P6
```

In the command output, 10 GB has been added to the **VG Size** volume group.

----End

2 Handling Insufficient Disk Space on a Windows ECS

2.1 Overview

If the disk space on a server is insufficient, the server running speed will be affected, which will further affect user experience. You can handle the disk insufficiency in either of the following ways:

- Clear the disk space.
  - **Clearing Disk Space Using the System Built-in Cleanup Tool**
  - **Uninstalling Unnecessary Programs on Control Panel**
- Expand the disk capacity.
  - See **Expanding Capacity of an In-use EVS Disk** in the *Elastic Volume Service User Guide*.
  - See **Expanding Capacity of an Available EVS Disk** in the *Elastic Volume Service User Guide*.

This document is written based on the best practices of Huawei Cloud Elastic Volume Service (EVS). Windows 2016 is used as the sample OS in the following sections, which describe the common operations for clearing disk space. In addition, it is recommended that you clear redundant files on a regular basis to save disk space.

- Periodically compress and save the files that are not frequently used.
- Periodically use the disk cleanup tool to clean up disk space, delete unnecessary files, and clean up the recycle bin.
- Uninstall unnecessary programs to release disk space.

2.2 Clearing Disk Space Using the System Built-in Cleanup Tool

Scenarios

This topic shows how to use the disk cleanup tool provided by the Windows OS to clean up disks with insufficient space.

In this document, Windows Server 2016 Standard 64bit is used as the sample server OS. The method for cleaning up disk space varies depending on the server OS. This document is used for reference only. For detailed operations and differences, see the corresponding OS documents.

Procedure

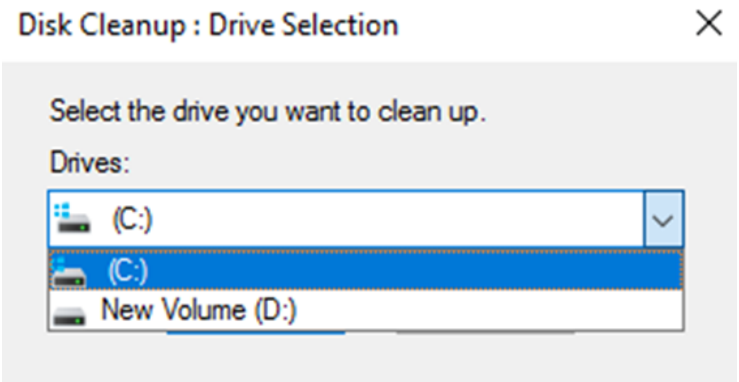
Step 1 On the server desktop, click the start icon in the lower left corner.

The start menu is displayed.

Step 2 In the navigation pane on the left, choose **Windows Administrative Tools** > **Disk Cleanup**.

The **Disk Cleanup: Drive Selection** window is displayed.

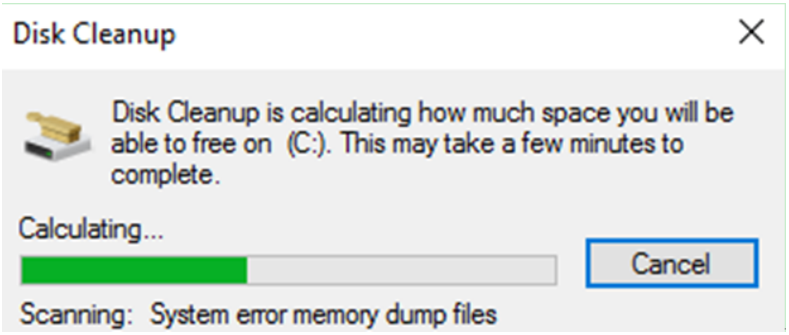
Figure 2-1 Disk Cleanup: Drive Selection



Step 3 Select the target disk from the drop-down list. In this example, disk (C:) is selected.

The **Disk Cleanup** window is displayed, and the system automatically calculates the space that can be freed on disk (C:).

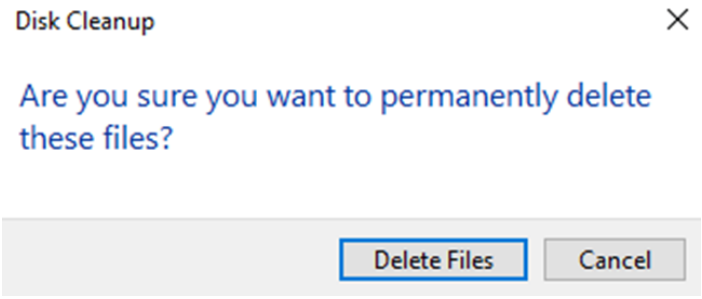
Figure 2-2 Disk Cleanup



Step 4 After the automatic calculation is complete, select the files to be deleted on the displayed window and click **OK**.

A confirmation dialog box is displayed.

Figure 2-3 Deletion confirmation



Step 5 Click **Delete Files** to clean up the disk space.

----End

2.3 Uninstalling Unnecessary Programs on Control Panel

Scenarios

This topic shows how to uninstall unnecessary programs on the server control panel.

In this document, Windows Server 2016 Standard 64bit is used as the sample server OS. The method for cleaning up disk space varies depending on the server OS. This document is used for reference only. For detailed operations and differences, see the corresponding OS documents.

Procedure

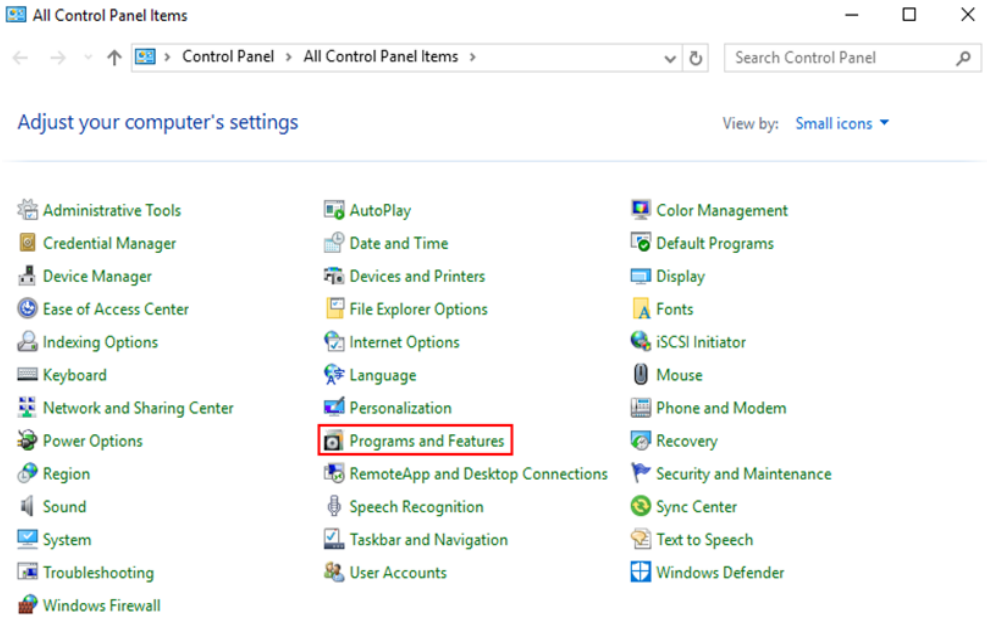
Step 1 On the server desktop, click the start icon in the lower left corner.

The start menu is displayed.

Step 2 In the navigation pane on the left, choose **Windows System** > **Control Panel**.

The **All Control Panel Items** window is displayed.

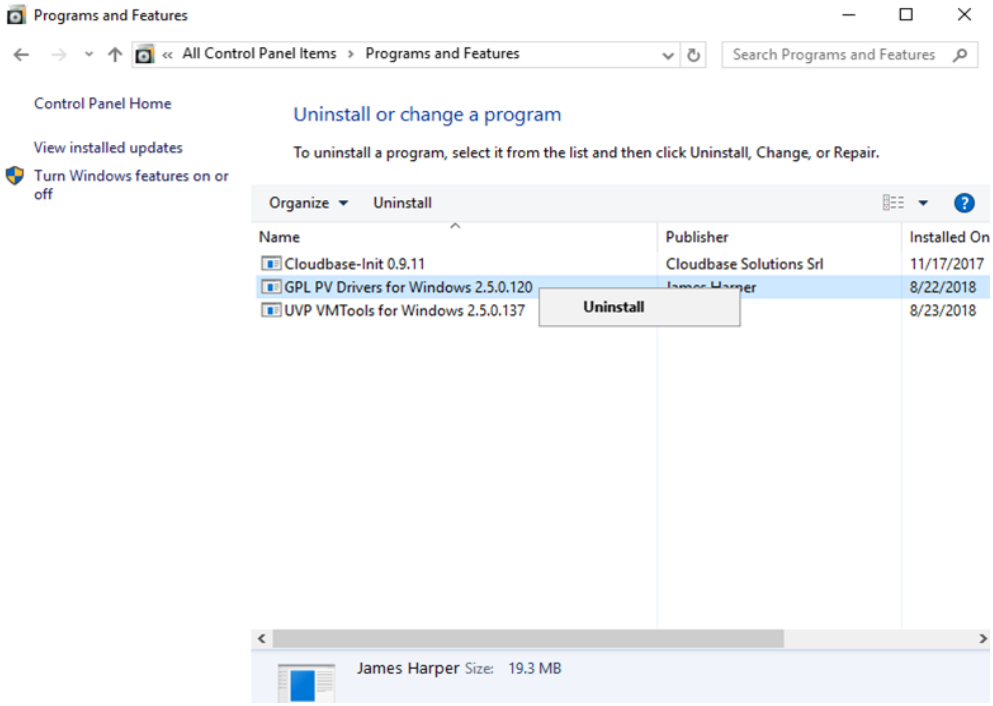
Figure 2-4 All Control Panel Items



Step 3 In the list, select **Programs and Features**.

The **Programs and Features** window is displayed.

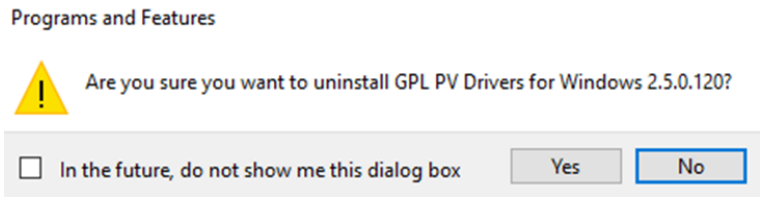
Figure 2-5 Programs and Features



Step 4 In the program list, right-click the program to be uninstalled and choose **Uninstall** from the shortcut menu.

A confirmation dialog box is displayed.

Figure 2-6 Uninstallation confirmation



Step 5 Click **Yes** to uninstall the program.

----End

3 RAID Array Creation with EVS Disks

3.1 Overview

Redundant Array of Independent Disks (RAID) is a technology that combines multiple physical disks into one or more logical units for the purposes of data redundancy and performance improvement.

NOTE

In this document, Elastic Volume Service (EVS) disks instead of physical disks are used to create RAID arrays. The working principles are the same.

This document uses CentOS 7.5 as the sample OS to describe how to create a RAID 10 array with four EVS disks. A RAID 10 array consists of RAID 0 and RAID 1 arrays. In this example, EVS disks are used to create a mirroring array (RAID 1) and then create a RAID 0 array to store data in stripes. At least four EVS disks are required. The resource information is as follows:

- Resource planning: **Resource Planning**
- Resource creation: **Creating an ECS** and **Creating and Attaching EVS Disks**

Introduction to Common RAID Arrays

Table 3-1 Introduction to common RAID arrays

RAID Level	Description	Read/Write Performance	Security	Disk Usage	Min. Number of Disks Required
RAID 0	RAID 0 stores data on multiple disks, implementing parallel read/write and providing the fastest read/write speed.	Parallel read/write from multiple disks achieves high performance.	Worst No redundancy capability. If one disk is damaged, the data of the entire RAID array is unavailable.	100%	2
RAID 1	RAID 1 implements data redundancy based on data mirroring. Half of the disk capacity in the RAID array is used, and the other half is used for mirroring to provide data backup.	Read performance: Same as a single disk Write performance: Data needs to be written into two disks. The write performance is lower than that of a single disk.	Highest Provides full backup of disk data. If a disk in the RAID array fails, the system automatically uses the data on the mirror disk.	50%	2
RAID 01	RAID 01 combines RAID 0 and RAID 1, in which half disks are first grouped into RAID 0 stripes and then used together with the other half to set up a RAID 1 array.	Read performance: Same as RAID 0 Write performance: Same as RAID 1	The security of RAID 01 is lower than that of RAID 10.	50%	4

RAID Level	Description	Read/Write Performance	Security	Disk Usage	Min. Number of Disks Required
RAID 10	RAID 10 combines RAID 1 and RAID 0, in which half disks are first set up as a RAID 1 array and then used together with the other half to create RAID 0 stripes.	Read performance: Same as RAID 0 Write performance: Same as RAID 1	The security performance of RAID 10 is the same as that of RAID 1.	50%	4
RAID 5	RAID 5 does not specify a dedicated parity disk and consists of block-level striping with parity information distributed among the disks.	Read performance: Same as RAID 0 Write performance: Because parity data needs to be written into disks, the write performance is lower than that of a single disk.	The security of RAID 5 is lower than that of RAID 10.	66.7%	3

3.2 Resource Planning

This topic describes the servers and disks planned for creating a RAID 10 array.

Servers

In this example, one Elastic Cloud Server (ECS) is created, and **Table 3-2** shows the parameter specifications.

Table 3-2 ECS parameter configurations

Parameter	Configuration Information
Name	ecs-raid10
Image	CentOS 7.5 64bit

Parameter	Configuration Information
Specifications	General computing and s2.medium.2 (1 vCPU and 2 GiB memory)
Elastic IP Address (EIP)	139.*XX.XX.XX*
Private IP Address	192.168.1.189

EVS Disks

Setting up RAID 10 requires at least 4 disks. Therefore, 4 EVS disks are created and attached to the ECS in this example.

3.3 Implementation Procedure

3.3.1 Creating an ECS

Scenarios

This section shows how to create an ECS. In this example, one ECS needs to be created. For details about the ECS parameter configurations, see **Resource Planning**.

Procedure

Step 1 Log in to the management console.

Step 2 Choose **Compute** > **Elastic Cloud Server**.

The **Elastic Cloud Server** page is displayed.

Step 3 Click **Buy ECS**.

For details, see the *Elastic Cloud Server User Guide*.

Configure the following parameters as planned:

- **Image**: Select **CentOS 7.5 64bit**.
- **EIP**: An EIP is mandatory if the ECS needs to access the public network. In this example, the multiple devices admin (mdadm) tool needs to be installed. Therefore, an EIP must be configured. Buy an EIP or configure an existing one based on the environment condition.

  Figure 3-1 shows how to buy a new EIP.

  Figure 3-1 Configuring EIP

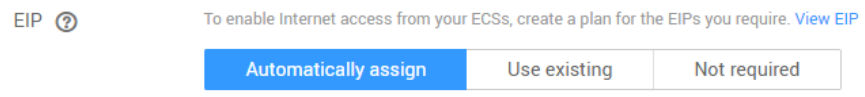


Table 3-3 shows the ECS parameter configurations.

Table 3-3 ECS parameter configurations

ECS Parameter Configurations		Billing Mode	Quantity
Specifications	General computing | s2.medium.2 | 1 vCPU | 2 GiB	Pay-per-use	1
Image	CentOS 7.5 64bit		
System disk	High I/O, 40 GB		
VPC	vpc-1a55		
Security group	Sys-default		
NIC	subnet-1a55(192.168.1.0/24)		
EIP	Specifications: Static BGP Billing mode: By bandwidth (Bandwidth: 5 Mbit/s)		
ECS Name	ecs-raid10		

----End

3.3.2 Creating and Attaching EVS Disks

Scenarios

This section shows how to create four EVS disks in a batch and attach the disks to the ECS.

Procedure

Step 1 Log in to the management console.

Step 2 Under **Storage**, click **Elastic Volume Service**.

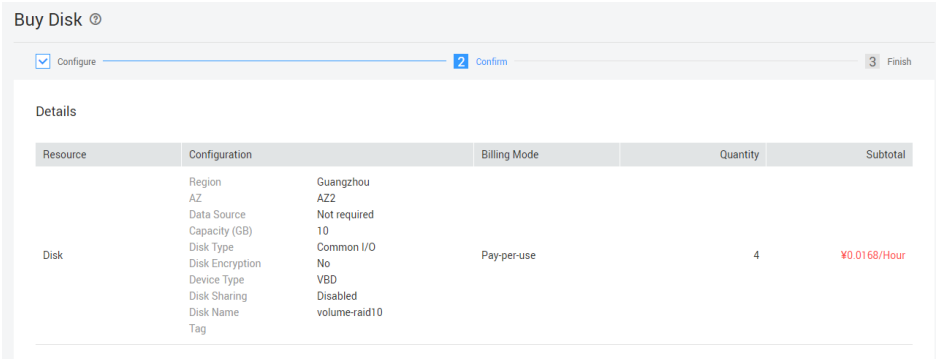
The disk list page is displayed.

Step 3 Click **Buy Disk** and create a disk.

For details, see the *Elastic Volume Service User Guide*.

In this example, four EVS disks are created in a batch. Figure 3-2 shows the detailed parameter configurations.

Figure 3-2 EVS disk specifications



Step 4 Attach the disks to the ECS.

----End

3.3.3 Creating a RAID Array Using mdadm

Scenarios

This section shows how to create a RAID 10 array using mdadm.

In this example, the ECS runs CentOS 7.5 64bit. Configurations vary depending on the OS running on the ECS. This section is used for reference only. For the detailed operations and differences, see the corresponding OS documents.

Procedure

Step 1 Log in to the ECS as user **root**.

Step 2 Run the following command to view and take note of the device names:

fdisk -l | grep /dev/vd | grep -v vda

Information similar to the following is displayed:

```
[root@ecs-raid10 ~]# fdisk -l | grep /dev/vd | grep -v vda
Disk /dev/vdb: 10.7 GB, 10737418240 bytes, 20971520 sectors
Disk /dev/vdc: 10.7 GB, 10737418240 bytes, 20971520 sectors
Disk /dev/vdd: 10.7 GB, 10737418240 bytes, 20971520 sectors
Disk /dev/vde: 10.7 GB, 10737418240 bytes, 20971520 sectors
```

In the command output, four disks are attached to the ECS, and the device names are **/dev/vdb**, **/dev/vdc**, **/dev/vdd**, and **/dev/vde**, respectively.

Step 3 Run the following command to install mdadm:

yum install mdadm -y

NOTE

mdadm is a utility to create and manage software RAID arrays on Linux. Ensure that an EIP has been bound to the ECS where mdadm is to be installed.

Information similar to the following is displayed:

```
[root@ecs-raid10 ~]# yum install mdadm -y
......
Installed:
  mdadm.x86_64 0:4.0-13.el7
```



```
Dependency Installed:
  libreport-filesystem.x86_64 0:2.1.11-40.el7.centos

Complete!
```

Step 4 Run the following command to create a RAID array using the four disks queried in **Step 2**:

mdadm -Cv *RAID array device name* **-a yes -n** *Disk quantity* **-l** *RAID level Device name of disk1 Device name of disk2 Device name of disk3 Device name of disk4*

Parameter description:

- *RAID array device name*: The value can be user-definable. In this example, **/dev/md0** is used.
- *Disk quantity*: Set this parameter based on the actual condition. In this example, RAID 10 is created, and at least four disks are required.

  The minimum number of disks required varies depending on the RAID level. For details, see **Overview**.
- *RAID level*: Set this parameter based on the actual condition. In this example, set it to RAID 10.
- *Device name of the disk*: Enter the device names of all the disks that will be used to create the RAID array. Multiple names are separated with spaces.

In this example, run the following command:

mdadm -Cv /dev/md0 -a yes -n 4 -l 10 /dev/vdb /dev/vdc /dev/vdd /dev/vde

Information similar to the following is displayed:

```
[root@ecs-raid10 ~]# mdadm -Cv /dev/md0 -a yes -n 4 -l 10 /dev/vdb /dev/vdc /dev/vdd /dev/vde
mdadm: layout defaults to n2
mdadm: layout defaults to n2
mdadm: chunk size defaults to 512K
mdadm: size set to 10476544K
mdadm: Defaulting to version 1.2 metadata
mdadm: array /dev/md0 started.
```

Step 5 Run the following command to format the created RAID array:

mkfs.*File system format Device name of the RAID array*

In this example, run the following command:

mkfs.ext4 /dev/md0

Information similar to the following is displayed:

```
[root@ecs-raid10 ~]# mkfs.ext4 /dev/md0
mke2fs 1.42.9 (28-Dec-2013)
Filesystem label=
OS type: Linux
Block size=4096 (log=2)
Fragment size=4096 (log=2)
Stride=128 blocks, Stripe width=256 blocks
1310720 inodes, 5238272 blocks
261913 blocks (5.00%) reserved for the super user
First data block=0
Maximum filesystem blocks=2153775104
160 block groups
32768 blocks per group, 32768 fragments per group
8192 inodes per group
Superblock backups stored on blocks:
        32768, 98304, 163840, 229376, 294912, 819200, 884736, 1605632, 2654208,
        4096000
```



```
Allocating group tables: done
Writing inode tables: done
Creating journal (32768 blocks): done
Writing superblocks and filesystem accounting information: done
```

Step 6 Run the following command to create a mounting directory:

mkdir *Mount point*

In this example, run the following command:

mkdir /RAID10

Step 7 Run the following command to mount the RAID array:

mount *RAID array device name Mounting directory*

In this example, run the following command:

mount /dev/md0 /RAID10

Step 8 Run the following command to view the mount result:

df -h

Information similar to the following is displayed:

```
[root@ecs-raid10 ~]# df -h
Filesystem      Size  Used Avail Use% Mounted on
/dev/vda2        39G  1.5G   35G   5% /
devtmpfs        911M     0  911M   0% /dev
tmpfs           920M     0  920M   0% /dev/shm
tmpfs           920M  8.6M  911M   1% /run
tmpfs           920M     0  920M   0% /sys/fs/cgroup
/dev/vda1       976M  146M  764M  17% /boot
tmpfs           184M     0  184M   0% /run/user/0
/dev/md0         20G   45M   19G   1% /RAID10
```

Step 9 Perform the following operations to enable automatic mounting of the RAID array at the system start:

1. Run the following command to open the **/etc/fstab** file:

   vi /etc/fstab

2. Press **i** to enter editing mode.

   Information similar to the following is displayed:

   ```
   [root@ecs-raid10 ~]# vi /etc/fstab

   #
   # /etc/fstab
   # Created by anaconda on Tue Nov  7 14:28:26 2017
   #
   # Accessible filesystems, by reference, are maintained under '/dev/disk'
   # See man pages fstab(5), findfs(8), mount(8) and/or blkid(8) for more info
   #
   UUID=27f9be47-838b-4155-b20b-e4c5e013cdf3 /                       ext4    defaults        1 1
   UUID=2b2000b1-f926-4b6b-ade8-695ee244a901 /boot                   ext4    defaults        1 2
   ```

3. Add the following information to the end of the file:

   ```
   /dev/md0                                /RAID10                 ext4    defaults        0 0
   ```

4. Press **Esc**, enter **:wq!**, and press **Enter**.

   The system saves the modifications and exits the vi editor.

Step 10 Run the following command to view the RAID array information:

mdadm -D *RAID array device name*

In this example, run the following command:

mdadm -D /dev/md0

Information similar to the following is displayed:

```
[root@ecs-raid10 ~]# mdadm -D /dev/md0
/dev/md0:
           Version : 1.2
     Creation Time : Thu Nov  8 15:49:02 2018
        Raid Level : raid10
        Array Size : 20953088 (19.98 GiB 21.46 GB)
     Used Dev Size : 10476544 (9.99 GiB 10.73 GB)
      Raid Devices : 4
     Total Devices : 4
       Persistence : Superblock is persistent

       Update Time : Thu Nov  8 16:15:11 2018
             State : clean
    Active Devices : 4
   Working Devices : 4
    Failed Devices : 0
     Spare Devices : 0

            Layout : near=2
        Chunk Size : 512K

Consistency Policy : resync

              Name : ecs-raid10.novalocal:0  (local to host ecs-raid10.novalocal)
              UUID : f400dbf9:60d211d9:e006e07b:98f8758c
            Events : 19

    Number   Major   Minor   RaidDevice State
       0     253       16        0      active sync set-A   /dev/vdb
       1     253       32        1      active sync set-B   /dev/vdc
       2     253       48        2      active sync set-A   /dev/vdd
       3     253       64        3      active sync set-B   /dev/vde
```

----End

3.3.4 Configuring Automatic Start of the RAID Array at Server Startup

Scenarios

This section shows how to add RAID array information, such as the device name and UUID to the mdadm configuration file. In this case, the RAID array can be started by querying information in the configuration file when the system starts.

In this example, the ECS runs CentOS 7.5 64bit. Configurations vary depending on the OS running on the ECS. This section is used for reference only. For the detailed operations and differences, see the corresponding OS documents.

Procedure

Step 1 Log in to the ECS as user **root**.

Step 2 Run the following command to view the RAID array information:

mdadm --detail --scan

Information similar to the following is displayed:


```
[root@ecs-raid10 ~]# mdadm --detail --scan
ARRAY /dev/md0 metadata=1.2 name=ecs-raid10.novalocal:0 UUID=f400dbf9:60d211d9:e006e07b:98f8758c
```

Step 3 Perform the following operations to add information of the new RAID array to the mdadm file:

1. Run the following command to open the **mdadm.conf** file:

   vi /etc/mdadm.conf

2. Press **i** to enter editing mode.
3. Add the following information to the end of the file:

   ```
   DEVICE /dev/vdb /dev/vdc /dev/vdd /dev/vde
   ARRAY /dev/md0 metadata=1.2 name=ecs-raid10.novalocal:0
   UUID=f400dbf9:60d211d9:e006e07b:98f8758c
   ```

   Description:

   - DEVICE line: Indicates the device names of the disks that set up the RAID array. Multiple device names are separated with spaces.
   - ARRAY line: Indicates RAID array information. Input the RAID array information obtained in **Step 2**.

   NOTE

   The preceding information is used for reference only. Add RAID array information based on the site information.

4. Press **Esc**, enter **:wq!**, and press **Enter**.

   The system saves the modifications and exits the vi editor.

Step 4 Run the following command to check whether the **mdadm.conf** file is modified:

more /etc/mdadm.conf

Information similar to the following is displayed:

```
[root@ecs-raid10 ~]# more /etc/mdadm.conf
DEVICE /dev/vdb /dev/vdc /dev/vdd /dev/vde
ARRAY /dev/md0 metadata=1.2 name=ecs-raid10.novalocal:0 UUID=f400dbf9:60d211d9:e006e07b:98f8758c
```

If the information added in **Step 3** is displayed, the file is successfully modified.

----End

4 Extending Disk Partitions and File Systems (Linux Kernel Earlier Than 3.6.0)

4.1 Preparing for Extending Disk Partitions and File Systems (Linux Kernel Earlier Than 3.6.0)

After a disk is expanded on the management console, the disk size is enlarged, but the additional space cannot be used directly.

NOTICE

- Exercise caution when expanding the disk capacity. Incorrect operations may lead to data loss or exceptions. So you are advised to back up the disk data using backups or snapshots before expansion. For details about backups, see **Managing EVS Backups**. For details about snapshots, see **Creating a Snapshot (OBT)**.
- If the OS kernel version is earlier than 3.6.0, the extension of an existing MBR partition and file system takes effect only after a system reboot, and services will be interrupted. After you run **reboot**, the additional space is automatically added to the partition at the end of the system disk.
- If you do not want to reboot your ECS, you can migrate data from the system disk to a data disk on the same ECS, detach the data disk, and attach it to an ECS whose OS kernel version is later than 3.6.0. In this case, the disk partition and file system can be extended without a reboot. You can then detach and attach back the extended disk to the original ECS, and migrate data back to the system disk. There are risks in migrating data. Back up the data before migration. To extend partitions and file systems on an ECS whose kernel version is greater than 3.6.0, see **Expanding Disk Partitions and File Systems (Linux)**.

Before extending the disk partition and file system, you must check the disk partition style and file system format, and then select an appropriate operation accordingly.

1. To view the disk partition style, see the following methods:

- **Method 1: Check Partition Style and File System Format Using fdisk**
- **Method 2: Check Partition Style and File System Format Using parted**

2. To select an appropriate operation, see **Table 4-1**.

Table 4-1 Disk partition and file system extension scenarios

Disk	Scenario	Method
System disk	Create a new MBR partition with the additional space.	**Creating a New MBR Partition**
	Allocate the additional space to an existing MBR partition.	**Extending an Existing MBR Partition (Kernel Version Earlier Than 3.6.0)**
Data disk	Create a new MBR partition with the additional space.	**Creating a New MBR Partition**
	Allocate the additional space to an existing MBR partition.	**Extending an Existing MBR Partition**
	Create a new GPT partition with the additional space.	**Creating a New GPT Partition**
	Allocate the additional space to an existing GPT partition.	**Extending an Existing GPT Partition**
SCSI data disk	Create a new MBR partition with the additional space.	**Creating a New MBR Partition**
	Allocate the additional space to an existing MBR partition.	**Extending an Existing MBR Partition**

NOTE

The maximum disk capacity that MBR supports is 2 TB, and the disk space exceeding 2 TB cannot be used.

If your disk uses MBR and you need to expand the disk capacity to over 2 TB, change the partition style from MBR to GPT. Ensure that the disk data has been backed up before changing the partition style because services will be interrupted and data on the disk will be cleared during this change.

Method 1: Check Partition Style and File System Format Using fdisk

Step 1 Run the following command to view all the disks attached to the server:

lsblk

Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# lsblk
NAME   MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
vda    253:0    0   40G  0 disk
└─vda1 253:1    0   40G  0 part /
vdb    253:16   0  150G  0 disk
└─vdb1 253:17   0  100G  0 part /mnt/sdc
```

In this example, data disk **/dev/vdb** already has partition **/dev/vdb1** before capacity expansion, and the additional 50 GB added has not been allocated yet. Therefore, **/dev/vdb** has 150 GB, and **/dev/vdb1** has 100 GB.

Step 2 Run the following command to view the current disk partition style:

fdisk -l

Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# fdisk -l

Disk /dev/vda: 42.9 GB, 42949672960 bytes, 83886080 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk label type: dos
Disk identifier: 0x000bcb4e

   Device Boot      Start         End      Blocks   Id  System
/dev/vda1   *        2048    83886079    41942016   83  Linux

Disk /dev/vdb: 161.1 GB, 161061273600 bytes, 314572800 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk label type: dos
Disk identifier: 0x38717fc1

   Device Boot      Start         End      Blocks   Id  System
/dev/vdb1            2048   209715199   104856576   83  Linux
```

The value in the **System** column indicates the disk partition style. Value **Linux** indicates the MBR partition style. Value **GPT** indicates the GPT partition style.

- If the disk partitions displayed are inconsistent with those obtained in **Step 1**, the partition that is not displayed uses the GPT partition style and has unallocated space. In this case, you cannot query all the partition information using the **fdisk -l** command. Go to **Method 2: Check Partition Style and File System Format Using parted**.
- If the disk partitions displayed are consistent with those obtained in **Step 1**, continue with the following operations.

Step 3 Run the following command to view the partition's file system format:

blkid *Disk partition*

In this example, run the following command:

blkid /dev/vdb1

```
[root@ecs-test-0001 ~]# blkid /dev/vdb1
/dev/vdb1: UUID="0b3040e2-1367-4abb-841d-ddb0b92693df" TYPE="ext4"
```

In the command output, the **TYPE** value is **ext4**, indicating that **/dev/vdb1**'s file system format is **ext4**.

Step 4 Run the following command to view the file system status:

ext*: **e2fsck -n** *Disk partition*

xfs: **xfs_repair -n** *Disk partition*

In this example, the ext4 file system is used. Therefore, run the following command:

e2fsck -n /dev/vdb1

Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# e2fsck -n /dev/vdb1
e2fsck 1.42.9 (28-Dec-2013)
Warning!  /dev/vdb1 is mounted.
Warning: skipping journal recovery because doing a read-only filesystem check.
/dev/vdb1: clean, 11/6553600 files, 459544/26214144 blocks
```

If the file system status is **clean**, the file system status is normal. Otherwise, rectify the faulty and then perform the capacity expansion.

----End

Method 2: Check Partition Style and File System Format Using parted

Step 1 Run the following command to view all the disks attached to the server:

lsblk

Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# lsblk
NAME   MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
vda    253:0    0   40G  0 disk
└─vda1 253:1    0   40G  0 part /
vdb    253:16   0  150G  0 disk
└─vdb1 253:17   0  100G  0 part /mnt/sdc
```

In this example, data disk **/dev/vdb** already has partition **/dev/vdb1** before capacity expansion, and the additional 50 GB added has not been allocated yet. Therefore, **/dev/vdb** has 150 GB, and **/dev/vdb1** has 100 GB.

Step 2 Run the following command and enter **p** to view the disk partition style:

parted *Disk*

For example, run the following command to view **/dev/vdb**'s partition style:

parted /dev/vdb

Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# parted /dev/vdb
GNU Parted 3.1
Using /dev/vdb
Welcome to GNU Parted! Type 'help' to view a list of commands.
(parted) p
Error: The backup GPT table is not at the end of the disk, as it should be.  This might mean that another operating system believes the
disk is smaller.  Fix, by moving the backup to the end (and removing the old backup)?
Fix/Ignore/Cancel? Fix
Warning: Not all of the space available to /dev/vdb appears to be used, you can fix the GPT to use all of the space (an extra 104857600
blocks) or continue with the current setting?
Fix/Ignore? Fix
Model: Virtio Block Device (virtblk)
Disk /dev/vdb: 161GB
Sector size (logical/physical): 512B/512B
Partition Table: gpt
Disk Flags:

Number  Start   End    Size   File system  Name  Flags
 1      1049kB  107GB  107GB  ext4         test

(parted)
```


In the command output, parameter **Partition Table** indicates the disk partition style. Value **msdos** indicates the MBR partition style, and value **gpt** indicates the GPT partition style.

- If the following error information is displayed, enter **Fix**.
  ```
  Error: The backup GPT table is not at the end of the disk, as it should be.  This might mean that another operating system believes the
  disk is smaller.  Fix, by moving the backup to the end (and removing the old backup)?
  ```
  The GPT partition table information is stored at the start of the disk. To reduce the risk of damages, a backup of the information is saved at the end of the disk. When you expand the disk capacity, the end of the disk changes accordingly. In this case, enter **Fix** to move the backup file of the information to new disk end.
- If the following warning information is displayed, enter **Fix**.
  ```
  Warning: Not all of the space available to /dev/vdb appears to be used, you can fix the GPT to use all of the space (an extra 104857600
  blocks) or continue with the current setting?
  Fix/Ignore? Fix
  ```
  Enter **Fix** as prompted. The system automatically sets the GPT partition style for the additional space.

Step 3 Enter **q** and press **Enter** to exit parted.

----End

4.2 Extending System Disk Partitions and File Systems (Linux Kernel Earlier Than 3.6.0)

Scenarios

After a disk is expanded on the management console, the disk size is enlarged, but the additional space cannot be used directly.

In Linux, you must allocate the additional space to an existing partition or a new partition.

If the disk capacity is expanded when its server is stopped, the additional space of a Linux system disk will be automatically added to the partition at the disk end upon the server startup. In this case, the additional space can be used directly.

This section uses CentOS 6.5 64bit (kernel version earlier than 3.6.0) as the example OS to describe how to extend the disk partition using growpart and fdisk. The way you allocate additional space depends on the OS. This example is used for reference only. For detailed operations and differences, see the corresponding OS documentations.

- **Extending an Existing MBR Partition (Kernel Version Earlier Than 3.6.0)**
- **Creating a New MBR Partition**

For how to query the Linux kernel version, see **Querying the Linux Kernel Version**.

NOTICE

- Exercise caution when expanding the disk capacity. Incorrect operations may lead to data loss or exceptions. So you are advised to back up the disk data using backups or snapshots before expansion. For details about backups, see **Managing EVS Backups**. For details about snapshots, see **Creating a Snapshot (OBT)**.
- If the OS kernel version is earlier than 3.6.0, the extension of an existing MBR partition and file system takes effect only after a system reboot, and services will be interrupted. After you run **reboot**, the additional space is automatically added to the partition at the end of the system disk.
- If you do not want to reboot your ECS, you can migrate data from the system disk to a data disk on the same ECS, detach the data disk, and attach it to an ECS whose OS kernel version is later than 3.6.0. In this case, the disk partition and file system can be extended without a reboot. You can then detach and attach back the extended disk to the original ECS, and migrate data back to the system disk. There are risks in migrating data. Back up the data before migration. To extend partitions and file systems on an ECS whose kernel version is greater than 3.6.0, see **Expanding Disk Partitions and File Systems (Linux)**.

Prerequisites

- You have expanded the system disk capacity and attached the disk to a server on the console. For details, see **Expand Disk Capacity**.
- You have logged in to the server.
  - For how to log in to an ECS, see **Logging in to an ECS**.
  - For how to log in to a BMS, see **Logging in to a BMS**.

Querying the Linux Kernel Version

Run the following command to query the Linux kernel version:

uname -a

Then, perform corresponding operations depending on whether the Linux kernel version is later than 3.6.0.

- For CentOS 7.4 64bit, information similar to the following is displayed:
  ```
  Linux ecs-test-0001 3.10.0-957.5.1.el7.x86_64 #1 SMP Fri Feb 1 14:54:57 UTC 2019 x86_64 x86_64
  ```
  The kernel version is 3.10.0, later than 3.6.0. For detailed operations, see **Extending Partitions and File Systems for Data Disks (Linux Kernel Later Than 3.6.0)**.
- For CentOS 6.5 64bit, information similar to the following is displayed:
  ```
  Linux ecs-test-0002 2.6.32-754.10.1.el6.x86_64 #1 SMP Tue Jan 15 17:07:28 UTC 2019 x86_64
  ```
  The kernel version is 2.6.32, earlier than 3.6.0. In this case, the partition and file system are extended only after a server reboot. For detailed operations, see the content in this section.

Extending an Existing MBR Partition (Kernel Version Earlier Than 3.6.0)

CentOS 6.5 64bit is used as the sample OS. Originally, system disk **/dev/vda** has 40 GB and one partition (**/dev/vda1**), and then 60 GB is added to the disk. The

following procedure shows you how to allocate the additional 60 GB to the existing MBR partition **/dev/vda1**.

Step 1 (Optional) Run the following command to install the growpart tool:

yum install cloud-utils-growpart

NOTE

You can run the **growpart** command to check whether the growpart tool has been installed. If the command output displays the tool usage instructions, the tool has been installed and you do not need to install it separately.

Step 2 Run the following command to install the dracut-modules-growroot tool:

yum install dracut-modules-growroot

Information similar to the following is displayed:

```
[root@ecs-test-0002 ~]# yum install dracut-modules-growroot
Loaded plugins: fastestmirror, security
Setting up Install Process
Loading mirror speeds from cached hostfile
epel/metalink                                                 | 4.3 kB
00:00
 * epel: pubmirror1.math.uh.edu
base                                                          | 3.7 kB
00:00
extras                                                        | 3.4 kB
00:00
updates                                                       | 3.4 kB
00:00
Package dracut-modules-growroot-0.20-2.el6.noarch already installed and latest version
Nothing to do
```

Step 3 Run the following command to regenerate the initramfs file:

dracut -f

Step 4 Run the following command to view the total capacity of the **/dev/vda** system disk:

fdisk -l

Information similar to the following is displayed:

```
[root@ecs-test-0002 ~]# fdisk -l

Disk /dev/vda: 107.4 GB, 107374182400 bytes
255 heads, 63 sectors/track, 13054 cylinders
Units = cylinders of 16065 * 512 = 8225280 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk identifier: 0x0004e0be

   Device Boot      Start         End      Blocks   Id  System
/dev/vda1   *           1        5222    41942016   83  Linux
```

Step 5 Run the following command to view the capacity of the **/dev/vda1** partition:

df -TH

Information similar to the following is displayed:

```
[root@ecs-test-0002 ~]# df -TH
Filesystem     Type   Size  Used Avail Use% Mounted on
/dev/vda1      ext4    43G  1.7G   39G   5% /
tmpfs          tmpfs  2.1G     0  2.1G   0% /dev/shm
```


Step 6 Run the following command to restart the server:

reboot

After the server is restarted, reconnect to the server and perform the following steps.

NOTE

The partition and file system are extended right after the server is restarted, so you no longer need to run the **resize2fs** *Disk partition* command.

Step 7 Run the following command to view the new capacity of the **/dev/vda1** partition:

df -TH

Information similar to the following is displayed:

```
[root@ecs-test-0002 ~]# df -TH
Filesystem     Type   Size  Used Avail Use% Mounted on
/dev/vda1      ext4   106G  1.7G   99G   2% /
tmpfs          tmpfs  2.1G     0  2.1G   0% /dev/shm
```

----End

Creating a New MBR Partition

Originally, system disk **/dev/vda** has 40 GB and one partition (**/dev/vda1**), and then 40 GB is added to the disk. The following procedure shows you how to create a new MBR partition **/dev/vda2** with this 40 GB.

Step 1 Run the following command to view the disk partition information:

fdisk -l

Information similar to the following is displayed:

```
[root@ecs-2220 ~]# fdisk -l

Disk /dev/vda: 85.9 GB, 85899345920 bytes, 167772160 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk label type: dos
Disk identifier: 0x0008d18f

   Device Boot      Start         End      Blocks   Id  System
/dev/vda1   *        2048    83886079    41942016   83  Linux
```

In the command output, the capacity of the **dev/vda** system disk is 80 GB, in which the in-use **dev/vda1** partition takes 40 GB and the additional 40 GB has not been allocated.

Step 2 Run the following command to enter fdisk:

fdisk /dev/vda

Information similar to the following is displayed:

```
[root@ecs-2220 ~]# fdisk /dev/vda
Welcome to fdisk (util-linux 2.23.2).

Changes will remain in memory only, until you decide to write them.
Be careful before using the write command.


Command (m for help):
```


Step 3 Enter **n** and press **Enter** to create a new partition.

Information similar to the following is displayed:

```
Command (m for help): n
Partition type:
  p   primary (1 primary, 0 extended, 3 free)
  e   extended
```

There are two types of disk partitions:

- Choosing **p** creates a primary partition.
- Choosing **e** creates an extended partition.

NOTE

If the MBR partition style is used, a maximum of 4 primary partitions, or 3 primary partitions and 1 extended partition can be created. The extended partition cannot be used directly and must be divided into logical partitions before use.

Disk partitions created using GPT are not categorized.

Step 4 In this example, a primary partition is created. Therefore, enter **p** and press **Enter** to create a primary partition.

Information similar to the following is displayed:

```
Select (default p): p
Partition number (2-4, default 2):
```

Step 5 Enter the serial number of the primary partition and press **Enter**. Partition number **2** is used in this example. Therefore, enter **2** and press **Enter.**

Information similar to the following is displayed:

```
Partition number (2-4, default 2): 2
First sector (83886080-167772159, default 83886080):
```

Step 6 Enter the new partition's start sector and press **Enter**. In this example, the default start sector is used.

The system displays the start and end sectors of the partition's available space. You can customize the value within this range or use the default value. The start sector must be smaller than the partition's end sector.

Information similar to the following is displayed:

```
First sector (83886080-167772159, default 83886080):
Using default value 83886080
Last sector, +sectors or +size{K,M,G} (83886080-167772159,default 167772159):
```

Step 7 Enter the new partition's end sector and press **Enter**. In this example, the default end sector is used.

The system displays the start and end sectors of the partition's available space. You can customize the value within this range or use the default value. The start sector must be smaller than the partition's end sector.

Information similar to the following is displayed:

```
Last sector, +sectors or +size{K,M,G} (83886080-167772159,
default 167772159):
Using default value 167772159
Partition 2 of type Linux and of size 40 GiB is set

Command (m for help):
```

Step 8 Enter **p** and press **Enter** to view the new partition.

Information similar to the following is displayed:


```
Command (m for help): p

Disk /dev/vda: 85.9 GB, 85899345920 bytes, 167772160 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk label type: dos
Disk identifier: 0x0008d18f

   Device Boot      Start         End      Blocks   Id  System
/dev/vda1   *        2048    83886079    41942016   83  Linux
/dev/vda2        83886080   167772159    41943040   83  Linux
Command (m for help):
```

Step 9 Enter **w** and press **Enter** to write the changes to the partition table.

Information similar to the following is displayed:

```
Command (m for help): w
The partition table has been altered!

Calling ioctl() to re-read partition table.

WARNING: Re-reading the partition table failed with error 16: Device or resource busy.
The kernel still uses the old table. The new table will be used at
the next reboot or after you run partprobe(8) or kpartx(8)
Syncing disks.
```

The partition is created.

NOTE

In case that you want to discard the changes made before, you can exit fdisk by entering **q**.

Step 10 Run the following command to synchronize the new partition table to the OS:

partprobe

Step 11 Run the following command to set the file system format for the new partition:

mkfs -t *File system Disk partition*

- Sample command of the ext* file system:

  (The ext4 file system is used in this example.)

  mkfs -t ext4 /dev/vda2

  Information similar to the following is displayed:

```
[root@ecs-2220 ~]# mkfs -t ext4 /dev/vda2
mke2fs 1.42.9 (28-Dec-2013)
Filesystem label=
OS type: Linux
Block size=4096 (log=2)
Fragment size=4096 (log=2)
Stride=0 blocks, Stripe width=0 blocks
2621440 inodes, 10485760 blocks
524288 blocks (5.00%) reserved for the super user
First data block=0
Maximum filesystem blocks=2157969408
320 block groups
32768 blocks per group, 32768 fragments per group
8192 inodes per group
Superblock backups stored on blocks:
        32768, 98304, 163840, 229376, 294912, 819200, 884736, 1605632, 2654208,
        4096000, 7962624

Allocating group tables: done
Writing inode tables: done
```



```
Creating journal (32768 blocks): done
Writing superblocks and filesystem accounting information: done
```

- Sample command of the xfs file system:

  mkfs -t xfs /dev/vda2

  Information similar to the following is displayed:

```
[root@ecs-2220 ~]# mkfs -t xfs /dev/vda2
meta-data=/dev/vda2              isize=512    agcount=4, agsize=2621440 blks
         =                       sectsz=512   attr=2, projid32bit=1
         =                       crc=1        finobt=0, sparse=0
data     =                       bsize=4096   blocks=10485760, imaxpct=25
         =                       sunit=0      swidth=0 blks
naming   =version2               bsize=4096   ascii-ci=0 ftype=1
log      =internal log           bsize=4096   blocks=5120, version=2
         =                       sectsz=512   sunit=0 blks, lazy-count=1
realtime =none                   extsz=4096   blocks=0, rtextents=0
```

The formatting takes a while, and you need to observe the system running status. Once **done** is displayed in the command output, the formatting is complete.

Step 12 (Optional) Run the following command to create a mount point:

Perform this step if you want to mount the partition on a new mount point.

mkdir *Mount point*

In this example, run the following command to create the **/opt** mount point:

mkdir /opt

Step 13 Run the following command to mount the new partition:

mount *Disk partition Mount point*

In this example, run the following command to mount the new partition **/dev/vda2** on **/opt**:

mount /dev/vda2 /opt

NOTE

If the new partition is mounted on a directory that is not empty, the subdirectories and files in the directory will be hidden. Therefore, you are advised to mount the new partition on an empty directory or a new directory. If the new partition must be mounted on a directory that is not empty, move the subdirectories and files in this directory to another directory temporarily. After the partition is successfully mounted, move the subdirectories and files back.

Step 14 Run the following command to view the mount result:

df -TH

Information similar to the following is displayed:

```
[root@ecs-2220 ~]# df -TH
Filesystem     Type      Size  Used Avail Use% Mounted on
/dev/vda1      ext4       43G  2.0G   39G   5% /
devtmpfs       devtmpfs  509M     0  509M   0% /dev
tmpfs          tmpfs     520M     0  520M   0% /dev/shm
tmpfs          tmpfs     520M  7.2M  513M   2% /run
tmpfs          tmpfs     520M     0  520M   0% /sys/fs/cgroup
tmpfs          tmpfs     104M     0  104M   0% /run/user/0
/dev/vda2      ext4       43G   51M   40G   1% /opt
```

NOTE

If the server is restarted, the mounting will become invalid. You can modify the **/etc/fstab** file to configure automount at startup. For details, see **Configuring Auto Mount at Startup**.

----End

Configuring Auto Mount at Startup

The **fstab** file controls what disks are automatically mounted at server startup. You can configure the **fstab** file of a server that has data. This operation will not affect the existing data.

The following example uses UUIDs to identify disks in the **fstab** file. You are advised not to use device names (like **/dev/vdb1**) to identify disks in the file because device names are assigned dynamically and may change (for example, from **/dev/vdb1** to **/dev/vdb2**) after a server stop or start. This can even prevent your server from booting up.

NOTE

UUID is the unique character string for disk partitions in a Linux system.

Step 1 Query the partition UUID.

blkid *Disk partition*

In this example, the UUID of the **/dev/vdb1** partition is queried.

blkid /dev/vdb1

Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# blkid /dev/vdb1
/dev/vdb1: UUID="0b3040e2-1367-4abb-841d-ddb0b92693df" TYPE="ext4"
```

Carefully record the UUID, as you will need it for the following step.

Step 2 Open the **fstab** file using the vi editor.

vi /etc/fstab

Step 3 Press **i** to enter editing mode.

Step 4 Move the cursor to the end of the file and press **Enter**. Then, add the following information:

```
UUID=0b3040e2-1367-4abb-841d-ddb0b92693df /mnt/sdc              ext4    defaults        0 2
```

In this example, the line starting with "UUID" is the information added. Edit this line to match the following format:

- UUID: The UUID obtained in **Step 1**.
- Mount point: The directory on which the partition is mounted. You can query the mount point using **df -TH**.
- Filesystem: The file system format of the partition. You can query the file system format using **df -TH**.
- Mount option: The partition mount option. Usually, this parameter is set to **defaults**.

- Dump: The Linux dump backup option.
  - **0**: Linux dump backup is not used. Usually, dump backup is not used, and you can set this parameter to **0**.
  - **1**: Linux dump backup is used.
- fsck: The fsck option, which means whether to use fsck to check the disk during startup.
  - **0**: The fsck option is not used.
  - If the mount point is the root partition (**/**), this parameter must be set to **1**.

    If this parameter is set to **1** for the root partition, this parameter for other partitions must start with **2** because the system checks the partitions in the ascending order of the values.

Step 5 Press **Esc**, enter **:wq**, and press **Enter**.

The system saves the configurations and exits the vi editor.

Step 6 Verify that the disk is auto-mounted at startup.

1. Unmount the partition.

   umount *Disk partition*

   Example command:

   umount /dev/vdb1
2. Reload all the content in the **/etc/fstab** file.

   mount -a
3. Query the file system mounting information.

   mount | grep *Mount point*

   Example command:

   mount | grep /mnt/sdc

   If information similar to the following is displayed, auto mount has taken effect:

   ```
   root@ecs-test-0001 ~]# mount | grep /mnt/sdc
   /dev/vdb1 on /mnt/sdc type ext4 (rw,relatime,data=ordered)
   ```

----End

4.3 Extending Data Disk Partitions and File Systems (Linux Kernel Earlier Than 3.6.0)

Scenarios

After a disk is expanded on the management console, the disk size is enlarged, but the additional space cannot be used directly.

In Linux, you must allocate the additional space to an existing partition or a new partition.

This section uses CentOS 7.4 64bit as the sample OS to describe how to extend an MBR or GPT partition. The way you allocate additional space depends on the OS.

This example is used for reference only. For detailed operations and differences, see the corresponding OS documentations.

- **Creating a New MBR Partition**
- **Extending an Existing MBR Partition**
- **Creating a New GPT Partition**
- **Extending an Existing GPT Partition**

NOTICE

- Exercise caution when expanding the disk capacity. Incorrect operations may lead to data loss or exceptions. So you are advised to back up the disk data using backups or snapshots before expansion. For details about backups, see **Managing EVS Backups**. For details about snapshots, see **Creating a Snapshot (OBT)**.
- If the OS kernel version is earlier than 3.6.0, the extension of an existing MBR partition and file system takes effect only after a system reboot, and services will be interrupted. After you run **reboot**, the additional space is automatically added to the partition at the end of the system disk.
- If you do not want to reboot your ECS, you can migrate data from the system disk to a data disk on the same ECS, detach the data disk, and attach it to an ECS whose OS kernel version is later than 3.6.0. In this case, the disk partition and file system can be extended without a reboot. You can then detach and attach back the extended disk to the original ECS, and migrate data back to the system disk. There are risks in migrating data. Back up the data before migration. To extend partitions and file systems on an ECS whose kernel version is greater than 3.6.0, see **Expanding Disk Partitions and File Systems (Linux)**.

Prerequisites

- You have expanded the system disk capacity and attached the disk to a server on the console. For details, see **Expand Disk Capacity**.
- You have logged in to the server.
  - For how to log in to an ECS, see **Logging in to an ECS**.
  - For how to log in to a BMS, see **Logging in to a BMS**.

Creating a New MBR Partition

Originally, data disk **/dev/vdb** has 100 GB and one partition (**/dev/vdb1**), and then 50 GB is added to the disk. The following procedure shows you how to create a new MBR partition **/dev/vdb2** with this 50 GB.

Step 1 Run the following command to view the disk partition information:

fdisk -l

Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# fdisk -l

Disk /dev/vda: 42.9 GB, 42949672960 bytes, 83886080 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
```

```
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk label type: dos
Disk identifier: 0x000bcb4e

   Device Boot      Start         End      Blocks   Id  System
/dev/vda1   *        2048    83886079    41942016   83  Linux

Disk /dev/vdb: 161.1 GB, 161061273600 bytes, 314572800 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk label type: dos
Disk identifier: 0x38717fc1

   Device Boot      Start         End      Blocks   Id  System
/dev/vdb1            2048   209715199   104856576   83  Linux
```

Step 2 Run the following command to enter fdisk:

fdisk *Disk*

In this example, run the following command:

fdisk /dev/vdb

Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# fdisk /dev/vdb
Welcome to fdisk (util-linux 2.23.2).

Changes will remain in memory only, until you decide to write them.
Be careful before using the write command.


Command (m for help):
```

Step 3 Enter **n** and press **Enter** to create a new partition.

Information similar to the following is displayed:

```
Command (m for help): n
Partition type:
   p   primary (1 primary, 0 extended, 3 free)
   e   extended
Select (default p):
```

There are two types of disk partitions:

- Choosing **p** creates a primary partition.
- Choosing **e** creates an extended partition.

NOTE

If the MBR partition style is used, a maximum of 4 primary partitions, or 3 primary partitions and 1 extended partition can be created. The extended partition cannot be used directly and must be divided into logical partitions before use.

Disk partitions created using GPT are not categorized.

Step 4 In this example, a primary partition is created. Therefore, enter **p** and press **Enter** to create a primary partition.

Information similar to the following is displayed:

```
Select (default p): p
Partition number (2-4, default 2):
```

Partition number indicates the serial number of the primary partition. Because partition number 1 has been used, the value ranges from **2** to **4**.

Step 5 Enter the serial number of the primary partition and press **Enter**. Partition number **2** is used in this example. Therefore, enter **2** and press **Enter.**

Information similar to the following is displayed:

```
Partition number (2-4, default 2): 2
First sector (209715200-314572799, default 209715200):
```

First sector indicates the start sector. The value ranges from **209715200** to **314572799**, and the default value is **209715200**.

Step 6 Enter the new partition's start sector and press **Enter**. In this example, the default start sector is used.

The system displays the start and end sectors of the partition's available space. You can customize the value within this range or use the default value. The start sector must be smaller than the partition's end sector.

Information similar to the following is displayed:

```
First sector (209715200-314572799, default 209715200):
Using default value 209715200
Last sector, +sectors or +size{K,M,G} (209715200-314572799, default 314572799):
```

Last sector indicates the end sector. The value ranges from **209715200** to **314572799**, and the default value is **314572799**.

Step 7 Enter the new partition's end sector and press **Enter**. In this example, the default end sector is used.

The system displays the start and end sectors of the partition's available space. You can customize the value within this range or use the default value. The start sector must be smaller than the partition's end sector.

Information similar to the following is displayed:

```
Last sector, +sectors or +size{K,M,G} (209715200-314572799, default 314572799):
Using default value 314572799
Partition 2 of type Linux and of size 50 GiB is set

Command (m for help):
```

Step 8 Enter **p** and press **Enter** to view the new partition.

Information similar to the following is displayed:

```
Command (m for help): p

Disk /dev/vdb: 161.1 GB, 161061273600 bytes, 314572800 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk label type: dos
Disk identifier: 0x38717fc1

   Device Boot      Start         End      Blocks   Id  System
/dev/vdb1            2048   209715199   104856576   83  Linux
/dev/vdb2       209715200   314572799    52428800   83  Linux

Command (m for help):
```

Step 9 Enter **w** and press **Enter** to write the changes to the partition table.

Information similar to the following is displayed:

```
Command (m for help): w
The partition table has been altered!

Calling ioctl() to re-read partition table.
```

```
WARNING: Re-reading the partition table failed with error 16: Device or resource busy.
The kernel still uses the old table. The new table will be used at
the next reboot or after you run partprobe(8) or kpartx(8)
Syncing disks.
```

NOTE

In case that you want to discard the changes made before, you can exit fdisk by entering **q**.

Step 10 Run the following command to synchronize the new partition table to the OS:

partprobe

Step 11 Run the following command to set the file system format for the new partition:

mkfs -t *File system Disk partition*

- Sample command of the ext* file system:

  mkfs -t ext4 /dev/vdb2

  Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# mkfs -t ext4 /dev/vdb2
mke2fs 1.42.9 (28-Dec-2013)
Filesystem label=
OS type: Linux
Block size=4096 (log=2)
Fragment size=4096 (log=2)
Stride=0 blocks, Stripe width=0 blocks
3276800 inodes, 13107200 blocks
655360 blocks (5.00%) reserved for the super user
First data block=0
Maximum filesystem blocks=2162163712
400 block groups
32768 blocks per group, 32768 fragments per group
8192 inodes per group
Superblock backups stored on blocks:
        32768, 98304, 163840, 229376, 294912, 819200, 884736, 1605632, 2654208,
        4096000, 7962624, 11239424

Allocating group tables: done
Writing inode tables: done
Creating journal (32768 blocks): done
Writing superblocks and filesystem accounting information: done
```

- Sample command of the xfs file system:

  mkfs -t xfs /dev/vdb2

  Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# mkfs -t xfs /dev/vdb2
meta-data=/dev/vdb2              isize=512    agcount=4, agsize=3276800 blks
         =                       sectsz=512   attr=2, projid32bit=1
         =                       crc=1        finobt=0, sparse=0
data     =                       bsize=4096   blocks=13107200, imaxpct=25
         =                       sunit=0      swidth=0 blks
naming   =version2               bsize=4096   ascii-ci=0 ftype=1
log      =internal log           bsize=4096   blocks=6400, version=2
         =                       sectsz=512   sunit=0 blks, lazy-count=1
realtime =none                   extsz=4096   blocks=0, rtextents=0
```

The formatting takes a while, and you need to observe the system running status. Once **done** is displayed in the command output, the formatting is complete.

Step 12 (Optional) Run the following command to create a mount point:

Perform this step if you want to mount the partition on a new mount point.

mkdir *Mount point*

In this example, run the following command to create the **/mnt/test** mount point:

mkdir /mnt/test

Step 13 Run the following command to mount the new partition:

mount *Disk partition Mount point*

In this example, run the following command to mount the new partition **/dev/vdb2** on **/mnt/test**:

mount /dev/vdb2 /mnt/test

NOTE

If the new partition is mounted on a directory that is not empty, the subdirectories and files in the directory will be hidden. Therefore, you are advised to mount the new partition on an empty directory or a new directory. If the new partition must be mounted on a directory that is not empty, move the subdirectories and files in this directory to another directory temporarily. After the partition is successfully mounted, move the subdirectories and files back.

Step 14 Run the following command to view the mount result:

df -TH

Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# df -TH
Filesystem     Type      Size  Used Avail Use% Mounted on
/dev/vda1      ext4       43G  1.9G   39G   5% /
devtmpfs       devtmpfs  2.0G     0  2.0G   0% /dev
tmpfs          tmpfs     2.0G     0  2.0G   0% /dev/shm
tmpfs          tmpfs     2.0G  9.1M  2.0G   1% /run
tmpfs          tmpfs     2.0G     0  2.0G   0% /sys/fs/cgroup
tmpfs          tmpfs     398M     0  398M   0% /run/user/0
/dev/vdb1      ext4      106G   63M  101G   1% /mnt/sdc
/dev/vdb2      ext4       53G   55M   50G   1% /mnt/test
```

NOTE

If the server is restarted, the mounting will become invalid. You can modify the **/etc/fstab** file to configure automount at startup. For details, see **Configuring Auto Mount at Startup**.

----End

Extending an Existing MBR Partition

NOTICE

If the additional space is allocated to an existing partition, data on the disk will not be cleared but you must use **umount** to unmount the existing partition. In this case, services will be affected.

Originally, data disk **/dev/vdb** has 150 GB and two partitions (**/dev/vdb1** and **/dev/vdb2**, and then 80 GB is added to the disk. The following procedure shows you how to add this 80 GB to the existing MBR partition **/dev/vdb2**.

NOTICE

During an expansion, the additional space is added to the end of the disk. Therefore, if the disk has multiple partitions, the additional space can only be allocated to the partition at the disk end.

Step 1 Run the following command to view the disk partition information:

fdisk -l

Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# fdisk -l

Disk /dev/vda: 42.9 GB, 42949672960 bytes, 83886080 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk label type: dos
Disk identifier: 0x000bcb4e

   Device Boot      Start         End      Blocks   Id  System
/dev/vda1   *        2048    83886079    41942016   83  Linux

Disk /dev/vdb: 247.0 GB, 246960619520 bytes, 482344960 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk label type: dos
Disk identifier: 0x38717fc1

   Device Boot      Start         End      Blocks   Id  System
/dev/vdb1            2048   209715199   104856576   83  Linux
/dev/vdb2       209715200   314572799    52428800   83  Linux
```

In the command output, take note of the partition's start and end sectors. In this example, **/dev/vdb2**'s start sector is **209715200**, and its end sector is **314572799**.

View the **/dev/vdb** capacity and check whether the additional space is included.

- If the additional space is not included, refresh the capacity according to **Extending SCSI Data Disk Partitions and File Systems (Linux Kernel Earlier Than 3.6.0)**.
- If the additional space is included, take note of the start and end sectors of the target partition and then go to **Step 2**. These values will be used in the subsequent operations.

Step 2 Run the following command to unmount the partition:

umount *Disk partition*

In this example, run the following command:

umount /dev/vdb2

Step 3 Run the following command to enter fdisk:

fdisk *Disk*

In this example, run the following command:

fdisk /dev/vdb

Information similar to the following is displayed:


```
[root@ecs-test-0001 ~]# fdisk /dev/vdb
Welcome to fdisk (util-linux 2.23.2).

Changes will remain in memory only, until you decide to write them.
Be careful before using the write command.


Command (m for help):
```

Step 4 Run the following command to delete the partition to be extended:

1. Enter **d** and press **Enter** to delete the partition.

   Information similar to the following is displayed:

   ```
   Command (m for help): d
   Partition number (1,2, default 2):
   ```

2. Enter the partition number and press **Enter** to delete the partition. In this example, enter **2**.

   Information similar to the following is displayed:

   ```
   Partition number (1,2, default 2): 2
   Partition 2 is deleted

   Command (m for help):
   ```

   NOTE

   After deleting the partition, recreate the partition according to the following steps, and data on this disk will not be lost.

Step 5 Enter **n** and press **Enter** to create a new partition.

Information similar to the following is displayed:

```
Command (m for help): n
Partition type:
   p   primary (1 primary, 0 extended, 3 free)
   e   extended
Select (default p):
```

There are two types of disk partitions:

- Choosing **p** creates a primary partition.
- Choosing **e** creates an extended partition.

NOTE

If the MBR partition style is used, a maximum of 4 primary partitions, or 3 primary partitions and 1 extended partition can be created. The extended partition cannot be used directly and must be divided into logical partitions before use.

Disk partitions created using GPT are not categorized.

Step 6 Ensure that the entered partition type is the same as the partition had before. In this example, a primary partition is used. Therefore, enter **p** and press **Enter** to create a primary partition.

Information similar to the following is displayed:

```
Select (default p): p
Partition number (2-4, default 2):
```

Partition number indicates the serial number of the primary partition.

Step 7 Ensure that entered partition number is the same as the partition had before. In this example, partition number **2** is used. Therefore, enter **2** and press **Enter**.

Information similar to the following is displayed:

```
Partition number (2-4, default 2): 2
First sector (209715200-482344959, default 209715200):
```

In the command output, **First sector** specifies the start sector.

NOTE

Data will be lost if the following operations are performed:

- Select a start sector other than the partition had before.
- Select an end sector smaller than the partition had before.

Step 8 Ensure that the entered start sector is the same as the partition had before. In this example, start sector **209715200** is recorded in **Step 1**. Therefore, enter **209715200** and press **Enter**.

Information similar to the following is displayed:

```
First sector (209715200-482344959, default 209715200):
Using default value 209715200
Last sector, +sectors or +size{K,M,G} (209715200-482344959, default 482344959):
```

In the command output, **Last sector** specifies the end sector.

Step 9 Ensure that the entered end sector is greater than or equal to the end sector recorded in **Step 1**. In this example, the recorded end sector is **314572799**, and the default end sector is used. Therefore, enter **482344959** and press **Enter**.

Information similar to the following is displayed:

```
Using default value 209715200
Last sector, +sectors or +size{K,M,G} (209715200-482344959, default 482344959):
Using default value 482344959
Partition 2 of type Linux and of size 130 GiB is set

Command (m for help):
```

The partition is created.

Step 10 Enter **p** and press **Enter** to view the partition details.

Information similar to the following is displayed:

```
Command (m for help): p

Disk /dev/vdb: 247.0 GB, 246960619520 bytes, 482344960 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk label type: dos
Disk identifier: 0x38717fc1

   Device Boot      Start         End      Blocks   Id  System
/dev/vdb1            2048   209715199   104856576   83  Linux
/dev/vdb2       209715200   482344959   136314880   83  Linux

Command (m for help):
```

Step 11 Enter **w** and press **Enter** to write the changes to the partition table.

Information similar to the following is displayed:

```
Command (m for help): w
The partition table has been altered!

Calling ioctl() to re-read partition table.

WARNING: Re-reading the partition table failed with error 16: Device or resource busy.
The kernel still uses the old table. The new table will be used at
the next reboot or after you run partprobe(8) or kpartx(8)
Syncing disks.
```

NOTE

In case that you want to discard the changes made before, you can exit fdisk by entering **q**.

Step 12 Run the following command to synchronize the new partition table to the OS:

partprobe

Step 13 Perform the following operations based on the file system of the disk:

- For the **ext***file system
  a. Run the following command to check the correctness of the file system on the partition:

     e2fsck -f *Disk partition*

     In this example, run the following command:

     e2fsck -f /dev/vdb2

     Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# e2fsck -f /dev/vdb2
e2fsck 1.42.9 (28-Dec-2013)
Pass 1: Checking inodes, blocks, and sizes
Pass 2: Checking directory structure
Pass 3: Checking directory connectivity
Pass 4: Checking reference counts
Pass 5: Checking group summary information
/dev/vdb2: 11/3276800 files (0.0% non-contiguous), 251790/13107200 blocks
```

  b. Run the following command to extend the file system of the partition:

     resize2fs *Disk partition*

     In this example, run the following command:

     resize2fs /dev/vdb2

     Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# resize2fs /dev/vdb2
resize2fs 1.42.9 (28-Dec-2013)
Resizing the filesystem on /dev/vdb2 to 34078720 (4k) blocks.
The filesystem on /dev/vdb2 is now 34078720 blocks long.
```

  c. (Optional) Run the following command to create a mount point:

     Perform this step if you want to mount the partition on a new mount point.

     mkdir *Mount point*

     In this example, run the following command to create the **/mnt/test** mount point:

     mkdir /mnt/test

  d. Run the following command to mount the partition:

     mount *Disk partition Mount point*

     In this example, run the following command to mount the partition **/dev/vdb2** on **/mnt/test**:

     mount /dev/vdb2 /mnt/test

NOTE

If the new partition is mounted on a directory that is not empty, the subdirectories and files in the directory will be hidden. Therefore, you are advised to mount the new partition on an empty directory or a new directory. If the new partition must be mounted on a directory that is not empty, move the subdirectories and files in this directory to another directory temporarily. After the partition is successfully mounted, move the subdirectories and files back.

- For the **xfs** file system
  a. (Optional) Run the following command to create a mount point:

     Perform this step if you want to mount the partition on a new mount point.

     mkdir *Mount point*

     In this example, run the following command to create the **/mnt/test** mount point:

     mkdir /mnt/test

  b. Run the following command to mount the partition:

     mount *Disk partition Mount point*

     In this example, run the following command to mount the partition **/dev/vdb2** on **/mnt/test**:

     mount /dev/vdb2 /mnt/test

     NOTE

     If the new partition is mounted on a directory that is not empty, the subdirectories and files in the directory will be hidden. Therefore, you are advised to mount the new partition on an empty directory or a new directory. If the new partition must be mounted on a directory that is not empty, move the subdirectories and files in this directory to another directory temporarily. After the partition is successfully mounted, move the subdirectories and files back.

  c. Run the following command to extend the file system of the partition:

     sudo xfs_growfs *Disk partition*

     In this example, run the following command:

     sudo xfs_growfs /dev/vdb2

     Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# sudo xfs_growfs /dev/vdb2
meta-data=/dev/vdb2              isize=512    agcount=4, agsize=3276800 blks
         =                       sectsz=512   attr=2, projid32bit=1
         =                       crc=1        finobt=0, spinodes=0
data     =                       bsize=4096   blocks=13107200, imaxpct=25
         =                       sunit=0      swidth=0 blks
naming   =version2               bsize=4096   ascii-ci=0 ftype=1
log      =internal               bsize=4096   blocks=6400, version=2
         =                       sectsz=512   sunit=0 blks, lazy-count=1
realtime =none                   extsz=4096   blocks=0, rtextents=0
data blocks changed from 13107200 to 34078720.
```

Step 14 Run the following command to view the mount result:

df -TH

Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# df -TH
Filesystem     Type      Size  Used Avail Use% Mounted on
/dev/vda1      ext4       43G  1.9G   39G   5% /
```



```
devtmpfs      devtmpfs  2.0G     0  2.0G   0% /dev
tmpfs         tmpfs     2.0G     0  2.0G   0% /dev/shm
tmpfs         tmpfs     2.0G  9.1M  2.0G   1% /run
tmpfs         tmpfs     2.0G     0  2.0G   0% /sys/fs/cgroup
tmpfs         tmpfs     398M     0  398M   0% /run/user/0
/dev/vdb1     ext4      106G   63M  101G   1% /mnt/sdc
/dev/vdb2     ext4      138G   63M  131G   1% /mnt/test
```

NOTE

If the server is restarted, the mounting will become invalid. You can modify the **/etc/fstab** file to configure automount at startup. For details, see **Configuring Auto Mount at Startup**.

----End

Creating a New GPT Partition

Originally, data disk **/dev/vdb** has 100 GB and one partition (**/dev/vdb1**), and then 50 GB is added to the disk. The following procedure shows you how to create a new GPT partition **/dev/vdb2** with this 50 GB.

Step 1 Run the following command to view the disk partition information:

lsblk

Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# lsblk
NAME   MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
vda    253:0    0   40G  0 disk
└─vda1 253:1    0   40G  0 part /
vdb    253:16   0  150G  0 disk
└─vdb1 253:17   0  100G  0 part /mnt/sdc
```

Step 2 Run the following command to enter parted:

parted *Disk*

In this example, run the following command:

parted /dev/vdb

Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# parted /dev/vdb
GNU Parted 3.1
Using /dev/vdb
Welcome to GNU Parted! Type 'help' to view a list of commands.
(parted)
```

Step 3 Enter **unit s** and press **Enter** to set the measurement unit of the disk to sector.

Step 4 Enter **p** and press **Enter** to view the disk partition information.

Information similar to the following is displayed:

```
(parted) unit s
(parted) p
Error: The backup GPT table is not at the end of the disk, as it should be.  This might mean that another operating system believes the
disk is smaller.  Fix, by moving the backup to the end (and removing the old backup)?
Fix/Ignore/Cancel? Fix
Warning: Not all of the space available to /dev/vdb appears to be used, you can fix the GPT to use all of the space (an extra 104857600
blocks) or continue with the current setting?
Fix/Ignore? Fix
Model: Virtio Block Device (virtblk)
Disk /dev/vdb: 314572800s
```

```
Sector size (logical/physical): 512B/512B
Partition Table: gpt
Disk Flags:

Number  Start  End         Size        File system  Name  Flags
 1      2048s  209713151s  209711104s  ext4         test

(parted)
```

In the command output, take note of the partition's end sector. In this example, the end sector of the **/dev/vdb1** partition is **209713151s**.

- If the following error information is displayed, enter **Fix**.

  ```
  Error: The backup GPT table is not at the end of the disk, as it should be.  This might mean that another operating system believes the
  disk is smaller.  Fix, by moving the backup to the end (and removing the old backup)?
  ```

  The GPT partition table information is stored at the start of the disk. To reduce the risk of damages, a backup of the information is saved at the end of the disk. When you expand the disk capacity, the end of the disk changes accordingly. In this case, enter **Fix** to move the backup file of the information to new disk end.

- If the following warning information is displayed, enter **Fix**.

  ```
  Warning: Not all of the space available to /dev/vdb appears to be used, you can fix the GPT to use all of the space (an extra 104857600
  blocks) or continue with the current setting?
  Fix/Ignore? Fix
  ```

  Enter **Fix** as prompted. The system automatically sets the GPT partition style for the additional space.

Step 5 Run the following command and press **Enter**:

mkpart *Partition name Start sector End sector*

In this example, run the following command:

mkpart data 209713152s 100%

In this example, the additional space is used to create a new partition. In **Step 4**, the end sector of partition **dev/vdb1** is **209713151s**. Therefore, the start sector of the new partition **dev/vdb2** is set to **209713152s** and the end sector **100%**. This start and end sectors are for reference only. You can plan the number of partitions and partition size based on service requirements.

Information similar to the following is displayed:

```
(parted) mkpart data 209713152s 100%
(parted)
```

NOTE

The maximum sector can be obtained in either of the following ways:

- Query the disk's maximum end sector. For details, see **Step 2** to **Step 4**.
- Enter **-1s** or **100%**, and the value displayed is the maximum end sector.

Step 6 Enter **p** and press **Enter** to view the new partition.

Information similar to the following is displayed:

```
(parted) p
Model: Virtio Block Device (virtblk)
Disk /dev/vdb: 314572800s
Sector size (logical/physical): 512B/512B
Partition Table: gpt
Disk Flags:
```



```
Number  Start       End         Size        File system  Name  Flags
 1      2048s       209713151s  209711104s  ext4         test
 2      209713152s  314570751s  104857600s               data

(parted)
```

Step 7 Enter **q** and press **Enter** to exit parted.

Step 8 Run the following command to set the file system format for the new partition:

mkfs -t *File system Disk partition*

- Sample command of the ext* file system:

  mkfs -t ext4 /dev/vdb2

  Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# mkfs -t ext4 /dev/vdb2
mke2fs 1.42.9 (28-Dec-2013)
Filesystem label=
OS type: Linux
Block size=4096 (log=2)
Fragment size=4096 (log=2)
Stride=0 blocks, Stripe width=0 blocks
3276800 inodes, 13107200 blocks
655360 blocks (5.00%) reserved for the super user
First data block=0
Maximum filesystem blocks=2162163712
400 block groups
32768 blocks per group, 32768 fragments per group
8192 inodes per group
Superblock backups stored on blocks:
        32768, 98304, 163840, 229376, 294912, 819200, 884736, 1605632, 2654208,
        4096000, 7962624, 11239424

Allocating group tables: done
Writing inode tables: done
Creating journal (32768 blocks): done
Writing superblocks and filesystem accounting information: done
```

- Sample command of the xfs file system:

  mkfs -t xfs /dev/vdb2

  Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# mkfs -t xfs /dev/vdb2
meta-data=/dev/vdb2              isize=512    agcount=4, agsize=3276800 blks
         =                       sectsz=512   attr=2, projid32bit=1
         =                       crc=1        finobt=0, sparse=0
data     =                       bsize=4096   blocks=13107200, imaxpct=25
         =                       sunit=0      swidth=0 blks
naming   =version2               bsize=4096   ascii-ci=0 ftype=1
log      =internal log           bsize=4096   blocks=6400, version=2
         =                       sectsz=512   sunit=0 blks, lazy-count=1
realtime =none                   extsz=4096   blocks=0, rtextents=0
```

The formatting takes a while, and you need to observe the system running status. Once **done** is displayed in the command output, the formatting is complete.

Step 9 (Optional) Run the following command to create a mount point:

Perform this step if you want to mount the partition on a new mount point.

mkdir *Mount point*

In this example, run the following command to create the **/mnt/test** mount point:

mkdir /mnt/test

Step 10 Run the following command to mount the new partition:

mount *Disk partition Mount point*

In this example, run the following command to mount the new partition **/dev/vdb2** on **/mnt/test**:

mount /dev/vdb2 /mnt/test

NOTE

If the new partition is mounted on a directory that is not empty, the subdirectories and files in the directory will be hidden. Therefore, you are advised to mount the new partition on an empty directory or a new directory. If the new partition must be mounted on a directory that is not empty, move the subdirectories and files in this directory to another directory temporarily. After the partition is successfully mounted, move the subdirectories and files back.

Step 11 Run the following command to view the mount result:

df -TH

Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# df -TH
Filesystem     Type      Size  Used Avail Use% Mounted on
/dev/vda1      ext4       43G  1.9G   39G   5% /
devtmpfs       devtmpfs  2.0G     0  2.0G   0% /dev
tmpfs          tmpfs     2.0G     0  2.0G   0% /dev/shm
tmpfs          tmpfs     2.0G  9.1M  2.0G   1% /run
tmpfs          tmpfs     2.0G     0  2.0G   0% /sys/fs/cgroup
tmpfs          tmpfs     398M     0  398M   0% /run/user/0
/dev/vdb1      ext4      106G   63M  101G   1% /mnt/sdc
/dev/vdb2      ext4       53G   55M   50G   1% /mnt/test
```

NOTE

If the server is restarted, the mounting will become invalid. You can modify the **/etc/fstab** file to configure automount at startup. For details, see **Configuring Auto Mount at Startup**.

----End

Extending an Existing GPT Partition

NOTICE

If the additional space is allocated to an existing partition, data on the disk will not be cleared but you must use **umount** to unmount the existing partition. In this case, services will be affected.

Originally, data disk **/dev/vdb** has 150 GB and two partitions (**/dev/vdb1** and **/dev/vdb2**, and then 80 GB is added to the disk. The following procedure shows you how to add this 80 GB to the existing GPT partition **/dev/vdb2**.

During an expansion, the additional space is added to the end of the disk. Therefore, if the disk has multiple partitions, the additional space can only be allocated to the partition at the disk end.

Step 1 Run the following command to view the disk partition information:

lsblk

Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# lsblk
NAME   MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
vda    253:0    0   40G  0 disk
└─vda1 253:1    0   40G  0 part /
vdb    253:16   0  230G  0 disk
├─vdb1 253:17   0  100G  0 part /mnt/sdc
└─vdb2 253:18   0   50G  0 part /mnt/test
```

View the **/dev/vdb** capacity and check whether the additional space is included.

- If the additional space is not included, refresh the capacity according to **Extending SCSI Data Disk Partitions and File Systems (Linux Kernel Earlier Than 3.6.0)**.
- If the additional space is included, go to **Step 2**.

Step 2 Run the following command to unmount the partition:

umount *Disk partition*

In this example, run the following command:

umount /dev/vdb2

Step 3 Run the following command to view the unmount result:

lsblk

Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# lsblk
NAME   MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
vda    253:0    0   40G  0 disk
└─vda1 253:1    0   40G  0 part /
vdb    253:16   0  230G  0 disk
├─vdb1 253:17   0  100G  0 part /mnt/sdc
└─vdb2 253:18   0   50G  0 part
```

Step 4 Run the following command to enter parted:

parted *Disk*

In this example, run the following command:

parted /dev/vdb

Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# parted /dev/vdb
GNU Parted 3.1
Using /dev/vdb
Welcome to GNU Parted! Type 'help' to view a list of commands.
(parted)
```

Step 5 Enter **unit s** and press **Enter** to set the measurement unit of the disk to sector.

Step 6 Enter **p** and press **Enter** to view the disk partition information.

Information similar to the following is displayed:

```
(parted) unit s
(parted) p
Error: The backup GPT table is not at the end of the disk, as it should be.  This might mean that another
operating system believes the
disk is smaller.  Fix, by moving the backup to the end (and removing the old backup)?
```

```
Fix/Ignore/Cancel? Fix
Warning: Not all of the space available to /dev/vdb appears to be used, you can fix the GPT to use all of
the space (an extra 167772160
blocks) or continue with the current setting?
Fix/Ignore? Fix
Model: Virtio Block Device (virtblk)
Disk /dev/vdb: 482344960s
Sector size (logical/physical): 512B/512B
Partition Table: gpt
Disk Flags:

Number  Start       End         Size        File system  Name  Flags
 1      2048s       209713151s  209711104s  ext4         test
 2      209713152s  314570751s  104857600s  ext4         data

(parted)
```

Take note of the start and end sectors of the **/dev/vdb2** partition. These values will be used during the partition recreation. In this example, the partition's start sector is **209713152s**, and its end sector is **314570751s**.

- If the following error information is displayed, enter **Fix**.

  ```
  Error: The backup GPT table is not at the end of the disk, as it should be.  This might mean that
  another operating system believes the
  disk is smaller.  Fix, by moving the backup to the end (and removing the old backup)?
  ```

  The GPT partition table information is stored at the start of the disk. To reduce the risk of damages, a backup of the information is saved at the end of the disk. When you expand the disk capacity, the end of the disk changes accordingly. In this case, enter **Fix** to move the backup file of the information to new disk end.

- If the following warning information is displayed, enter **Fix**.

  ```
  Warning: Not all of the space available to /dev/vdb appears to be used, you can fix the GPT to use all
  of the space (an extra 104857600
  blocks) or continue with the current setting?
  Fix/Ignore? Fix
  ```

  Enter **Fix** as prompted. The system automatically sets the GPT partition style for the additional space.

Step 7 Enter **rm** and the partition number, and then press **Enter**. In this example, partition number **2** is used.

Information similar to the following is displayed:

```
(parted) rm
Partition number? 2
(parted)
```

Step 8 Run the following command to recreate the partition and press **Enter**:

mkpart *Partition name Start sector End sector*

In this example, run the following command:

mkpart data 209713152s 100%

- Ensure that the entered start sector is the same as the partition had before. In this example, start sector **209713152s** is recorded in **Step 6**. Therefore, enter **209713152s**.
- Ensure that the entered end sector is greater than the partition had before. In this example, the end sector recorded in **Step 6** is **314570751s**, and all the additional space needs to be allocated to **dev/vdb2**. Therefore, enter **100%**.

Information similar to the following is displayed:

```
(parted) mkpart data 209713152s 100%
(parted)
```

NOTE

Data will be lost if the following operations are performed:

- Select a start sector other than the partition had before.
- Select an end sector smaller than the partition had before.

Step 9 Enter **p** and press **Enter** to view the partition information.

Information similar to the following is displayed:

```
(parted) p
Model: Virtio Block Device (virtblk)
Disk /dev/vdb: 482344960s
Sector size (logical/physical): 512B/512B
Partition Table: gpt
Disk Flags:

Number  Start       End         Size        File system  Name  Flags
 1      2048s       209713151s  209711104s  ext4         test
 2      209713152s  482342911s  272629760s  ext4         data

(parted)
```

Step 10 Enter **q** and press **Enter** to exit parted.

Step 11 Perform the following operations based on the file system of the disk:

- For the **ext***** file system
  a. Run the following command to check the correctness of the file system on the partition:

     e2fsck -f *Disk partition*

     In this example, run the following command:

     e2fsck -f /dev/vdb2

     Information similar to the following is displayed:

     ```
     [root@ecs-test-0001 ~]# e2fsck -f /dev/vdb2
     e2fsck 1.42.9 (28-Dec-2013)
     Pass 1: Checking inodes, blocks, and sizes
     Pass 2: Checking directory structure
     Pass 3: Checking directory connectivity
     Pass 4: Checking reference counts
     Pass 5: Checking group summary information
     /dev/vdb2: 11/3276800 files (0.0% non-contiguous), 251790/13107200 blocks
     ```

  b. Run the following command to extend the file system of the partition:

     resize2fs *Disk partition*

     In this example, run the following command:

     resize2fs /dev/vdb2

     Information similar to the following is displayed:

     ```
     [root@ecs-test-0001 ~]# resize2fs /dev/vdb2
     resize2fs 1.42.9 (28-Dec-2013)
     Resizing the filesystem on /dev/vdb2 to 34078720 (4k) blocks.
     The filesystem on /dev/vdb2 is now 34078720 blocks long.
     ```

  c. (Optional) Run the following command to create a mount point:

     Perform this step if you want to mount the partition on a new mount point.

     mkdir *Mount point*

In this example, run the following command to create the **/mnt/test** mount point:

mkdir /mnt/test

d. Run the following command to mount the partition:

mount *Disk partition Mount point*

In this example, run the following command to mount the partition **/dev/vdb2** on **/mnt/test**:

mount /dev/vdb2 /mnt/test

NOTE

If the new partition is mounted on a directory that is not empty, the subdirectories and files in the directory will be hidden. Therefore, you are advised to mount the new partition on an empty directory or a new directory. If the new partition must be mounted on a directory that is not empty, move the subdirectories and files in this directory to another directory temporarily. After the partition is successfully mounted, move the subdirectories and files back.

- For the **xfs** file system

a. (Optional) Run the following command to create a mount point:

Perform this step if you want to mount the partition on a new mount point.

mkdir *Mount point*

In this example, run the following command to create the **/mnt/test** mount point:

mkdir /mnt/test

b. Run the following command to mount the partition:

mount *Disk partition Mount point*

In this example, run the following command to mount the partition **/dev/vdb2** on **/mnt/test**:

mount /dev/vdb2 /mnt/test

NOTE

If the new partition is mounted on a directory that is not empty, the subdirectories and files in the directory will be hidden. Therefore, you are advised to mount the new partition on an empty directory or a new directory. If the new partition must be mounted on a directory that is not empty, move the subdirectories and files in this directory to another directory temporarily. After the partition is successfully mounted, move the subdirectories and files back.

c. Run the following command to extend the file system of the partition:

sudo xfs_growfs *Disk partition*

In this example, run the following command:

sudo xfs_growfs /dev/vdb2

Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# sudo xfs_growfs /dev/vdb2
meta-data=/dev/vdb2              isize=512    agcount=4, agsize=3276800 blks
         =                       sectsz=512   attr=2, projid32bit=1
         =                       crc=1        finobt=0, spinodes=0
data     =                       bsize=4096   blocks=13107200, imaxpct=25
         =                       sunit=0      swidth=0 blks
naming   =version2               bsize=4096   ascii-ci=0 ftype=1
```

```
log      =internal               bsize=4096    blocks=6400, version=2
         =                       sectsz=512    sunit=0 blks, lazy-count=1
realtime =none                   extsz=4096    blocks=0, rtextents=0
data blocks changed from 13107200 to 34078720.
```

Step 12 Run the following command to view the mount result:

df -TH

Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# df -TH
Filesystem     Type      Size  Used Avail Use% Mounted on
/dev/vda1      ext4       43G  1.9G   39G   5% /
devtmpfs       devtmpfs  2.0G     0  2.0G   0% /dev
tmpfs          tmpfs     2.0G     0  2.0G   0% /dev/shm
tmpfs          tmpfs     2.0G  9.1M  2.0G   1% /run
tmpfs          tmpfs     2.0G     0  2.0G   0% /sys/fs/cgroup
tmpfs          tmpfs     398M     0  398M   0% /run/user/0
/dev/vdb1      ext4      106G   63M  101G   1% /mnt/sdc
/dev/vdb2      ext4      138G   63M  131G   1% /mnt/test
```

NOTE

If the server is restarted, the mounting will become invalid. You can modify the **/etc/fstab** file to configure automount at startup. For details, see **Configuring Auto Mount at Startup**.

----End

Configuring Auto Mount at Startup

The **fstab** file controls what disks are automatically mounted at server startup. You can configure the **fstab** file of a server that has data. This operation will not affect the existing data.

The following example uses UUIDs to identify disks in the **fstab** file. You are advised not to use device names (like **/dev/vdb1**) to identify disks in the file because device names are assigned dynamically and may change (for example, from **/dev/vdb1** to **/dev/vdb2**) after a server stop or start. This can even prevent your server from booting up.

NOTE

UUID is the unique character string for disk partitions in a Linux system.

Step 1 Query the partition UUID.

blkid *Disk partition*

In this example, the UUID of the **/dev/vdb1** partition is queried.

blkid /dev/vdb1

Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# blkid /dev/vdb1
/dev/vdb1: UUID="0b3040e2-1367-4abb-841d-ddb0b92693df" TYPE="ext4"
```

Carefully record the UUID, as you will need it for the following step.

Step 2 Open the **fstab** file using the vi editor.

vi /etc/fstab

Step 3 Press **i** to enter editing mode.

Step 4 Move the cursor to the end of the file and press **Enter**. Then, add the following information:

```
UUID=0b3040e2-1367-4abb-841d-ddb0b92693df /mnt/sdc              ext4    defaults        0 2
```

In this example, the line starting with "UUID" is the information added. Edit this line to match the following format:

- UUID: The UUID obtained in **Step 1**.
- Mount point: The directory on which the partition is mounted. You can query the mount point using **df -TH**.
- Filesystem: The file system format of the partition. You can query the file system format using **df -TH**.
- Mount option: The partition mount option. Usually, this parameter is set to **defaults**.
- Dump: The Linux dump backup option.
  - **0**: Linux dump backup is not used. Usually, dump backup is not used, and you can set this parameter to **0**.
  - **1**: Linux dump backup is used.
- fsck: The fsck option, which means whether to use fsck to check the disk during startup.
  - **0**: The fsck option is not used.
  - If the mount point is the root partition (**/**), this parameter must be set to **1**.

    If this parameter is set to **1** for the root partition, this parameter for other partitions must start with **2** because the system checks the partitions in the ascending order of the values.

Step 5 Press **Esc**, enter **:wq**, and press **Enter**.

The system saves the configurations and exits the vi editor.

Step 6 Verify that the disk is auto-mounted at startup.

1. Unmount the partition.

   umount *Disk partition*

   Example command:

   umount /dev/vdb1
2. Reload all the content in the **/etc/fstab** file.

   mount -a
3. Query the file system mounting information.

   mount | grep *Mount point*

   Example command:

   mount | grep /mnt/sdc

   If information similar to the following is displayed, auto mount has taken effect:

   ```
   root@ecs-test-0001 ~]# mount | grep /mnt/sdc
   /dev/vdb1 on /mnt/sdc type ext4 (rw,relatime,data=ordered)
   ```

----End

4.4 Extending SCSI Data Disk Partitions and File Systems (Linux Kernel Earlier Than 3.6.0)

Scenarios

After a disk is expanded on the management console, the disk size is enlarged, but the additional space cannot be used directly.

In Linux, you must allocate the additional space to an existing partition or a new partition.

This section uses CentOS 7.4 64bit as the sample OS to describe how to extend an MBR partition of a SCSI data disk. The way you allocate additional space depends on the OS. This example is used for reference only. For detailed operations and differences, see the corresponding OS documentations.

- **Creating a New MBR Partition**
- **Extending an Existing MBR Partition**

NOTICE

- Exercise caution when expanding the disk capacity. Incorrect operations may lead to data loss or exceptions. So you are advised to back up the disk data using backups or snapshots before expansion. For details about backups, see **Managing EVS Backups**. For details about snapshots, see **Creating a Snapshot (OBT)**.
- If the OS kernel version is earlier than 3.6.0, the extension of an existing MBR partition and file system takes effect only after a system reboot, and services will be interrupted. After you run **reboot**, the additional space is automatically added to the partition at the end of the system disk.
- If you do not want to reboot your ECS, you can migrate data from the system disk to a data disk on the same ECS, detach the data disk, and attach it to an ECS whose OS kernel version is later than 3.6.0. In this case, the disk partition and file system can be extended without a reboot. You can then detach and attach back the extended disk to the original ECS, and migrate data back to the system disk. There are risks in migrating data. Back up the data before migration. To extend partitions and file systems on an ECS whose kernel version is greater than 3.6.0, see **Expanding Disk Partitions and File Systems (Linux)**.

Prerequisites

- You have expanded the system disk capacity and attached the disk to a server on the console. For details, see **Expand Disk Capacity**.
- You have logged in to the server.
  - For how to log in to an ECS, see **Logging in to an ECS**.
  - For how to log in to a BMS, see **Logging in to a BMS**.

Creating a New MBR Partition

Originally, data disk **/dev/sda** has 50 GB and one partition (**/dev/sda1**), and then 50 GB is added to the disk. The following procedure shows you how to create a new MBR partition **/dev/sda2** with this 50 GB.

Step 1 Run the following command to view the disk partition information:

fdisk -l

Information similar to the following is displayed:

```
[root@ecs-scsi ~]# fdisk -l

Disk /dev/vda: 42.9 GB, 42949672960 bytes, 83886080 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk label type: dos
Disk identifier: 0x000bcb4e

   Device Boot      Start         End      Blocks   Id  System
/dev/vda1   *        2048    83886079    41942016   83  Linux

Disk /dev/sda: 107.4 GB, 107374182400 bytes, 209715200 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk label type: dos
Disk identifier: 0x915ffe6a

   Device Boot      Start         End      Blocks   Id  System
/dev/sda1            2048   104857599    52427776   83  Linux
```

View the **/dev/sda** capacity and check whether the additional space is included.

- If the additional space is not included, refresh the capacity according to **Step 2**.
- If the additional space is included, go to **Step 3**.

Step 2 (Optional) Run the following command to update the capacity of the SCSI data disk:

1. Run the following command to update the disk capacity on the server:

   echo 1 > /sys/class/scsi_device/*%d:%d:%d:%d***/device/rescan &**

   In the command, **%d:%d:%d:%d** indicates a folder in the **/sys/class/scsi_device/** directory and can be obtained using **ll /sys/class/scsi_device/**.

   Information similar to the following is displayed: (**2:0:0:0** indicates the folder to be obtained.)

   ```
   cs-xen-02:/sys/class/scsi_device # ll /sys/class/scsi_device/
   total 0
   lrwxrwxrwx 1 root root 0 Sep 26 11:37 2:0:0:0 -> ../../devices/xen/vscsi-2064/host2/target2:0:0/2:0:0:0/
   scsi_device/2:0:0:0
   ```

   In this example, run the following command:

   echo 1 > /sys/class/scsi_device/2:0:0:0/device/rescan &

2. After the disk capacity is updated, run the following command to view the disk partition information again:

   fdisk -l

   If the additional space is included, go to **Step 3**.

Step 3 Run the following command to enter fdisk:

fdisk *Disk*

In this example, run the following command:

fdisk /dev/sda

Information similar to the following is displayed:

```
[root@ecs-scsi ~]# fdisk /dev/sda
Welcome to fdisk (util-linux 2.23.2).

Changes will remain in memory only, until you decide to write them.
Be careful before using the write command.


Command (m for help):
```

Step 4 Enter **n** and press **Enter** to create a new partition.

Information similar to the following is displayed:

```
Command (m for help): n
Partition type:
   p   primary (1 primary, 0 extended, 3 free)
   e   extended
Select (default p):
```

There are two types of disk partitions:

- Choosing **p** creates a primary partition.
- Choosing **e** creates an extended partition.

NOTE

If the MBR partition style is used, a maximum of 4 primary partitions, or 3 primary partitions and 1 extended partition can be created. The extended partition cannot be used directly and must be divided into logical partitions before use.

Disk partitions created using GPT are not categorized.

Step 5 In this example, a primary partition is created. Therefore, enter **p** and press **Enter** to create a primary partition.

Information similar to the following is displayed:

```
Select (default p): p
Partition number (2-4, default 2):
```

Partition number indicates the serial number of the primary partition. Because partition number 1 has been used, the value ranges from **2** to **4**.

Step 6 Enter the serial number of the primary partition and press **Enter**. Partition number **2** is used in this example. Therefore, enter **2** and press **Enter.**

Information similar to the following is displayed:

```
Partition number (2-4, default 2): 2
First sector (104857600-209715199, default 104857600):
```

First sector indicates the start sector. The value ranges from **104857600** to **209715199**, and the default value is **104857600**.

Step 7 Enter the new partition's start sector and press **Enter**. In this example, the default start sector is used.

The system displays the start and end sectors of the partition's available space. You can customize the value within this range or use the default value. The start sector must be smaller than the partition's end sector.

Information similar to the following is displayed:

```
First sector (104857600-209715199, default 104857600):
Using default value 104857600
Last sector, +sectors or +size{K,M,G} (104857600-209715199, default 209715199):
```

Last sector indicates the end sector. The value ranges from **104857600** to **209715199**, and the default value is **209715199**.

Step 8 Enter the new partition's end sector and press **Enter**. In this example, the default end sector is used.

The system displays the start and end sectors of the partition's available space. You can customize the value within this range or use the default value. The start sector must be smaller than the partition's end sector.

Information similar to the following is displayed:

```
Last sector, +sectors or +size{K,M,G} (104857600-209715199, default 209715199):
Using default value 209715199
Partition 2 of type Linux and of size 50 GiB is set

Command (m for help):
```

Step 9 Enter **p** and press **Enter** to view the new partition.

Information similar to the following is displayed:

```
Command (m for help): p

Disk /dev/sda: 107.4 GB, 107374182400 bytes, 209715200 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk label type: dos
Disk identifier: 0x915ffe6a

   Device Boot      Start         End      Blocks   Id  System
/dev/sda1            2048   104857599    52427776   83  Linux
/dev/sda2       104857600   209715199    52428800   83  Linux

Command (m for help):
```

Step 10 Enter **w** and press **Enter** to write the changes to the partition table.

Information similar to the following is displayed:

```
Command (m for help): w
The partition table has been altered!

Calling ioctl() to re-read partition table.

WARNING: Re-reading the partition table failed with error 16: Device or resource busy.
The kernel still uses the old table. The new table will be used at
the next reboot or after you run partprobe(8) or kpartx(8)
Syncing disks.
```

NOTE

In case that you want to discard the changes made before, you can exit fdisk by entering **q**.

Step 11 Run the following command to synchronize the new partition table to the OS:

partprobe

Step 12 Run the following command to set the file system format for the new partition:

mkfs -t *File system Disk partition*

- Sample command of the ext* file system:

  mkfs -t ext4 /dev/sda2

  Information similar to the following is displayed:

```
[root@ecs-scsi ~]# mkfs -t ext4 /dev/sda2
mke2fs 1.42.9 (28-Dec-2013)
Filesystem label=
OS type: Linux
Block size=4096 (log=2)
Fragment size=4096 (log=2)
Stride=0 blocks, Stripe width=0 blocks
3276800 inodes, 13107200 blocks
655360 blocks (5.00%) reserved for the super user
First data block=0
Maximum filesystem blocks=2162163712
400 block groups
32768 blocks per group, 32768 fragments per group
8192 inodes per group
Superblock backups stored on blocks:
        32768, 98304, 163840, 229376, 294912, 819200, 884736, 1605632, 2654208,
        4096000, 7962624, 11239424

Allocating group tables: done
Writing inode tables: done
Creating journal (32768 blocks): done
Writing superblocks and filesystem accounting information: done
```

- Sample command of the xfs file system:

  mkfs -t xfs /dev/sda2

  Information similar to the following is displayed:

```
[root@ecs-scsi ~]# mkfs -t xfs /dev/sda2
meta-data=/dev/sda2              isize=512    agcount=4, agsize=3276800 blks
         =                       sectsz=512   attr=2, projid32bit=1
         =                       crc=1        finobt=0, sparse=0
data     =                       bsize=4096   blocks=13107200, imaxpct=25
         =                       sunit=0      swidth=0 blks
naming   =version2               bsize=4096   ascii-ci=0 ftype=1
log      =internal log           bsize=4096   blocks=6400, version=2
         =                       sectsz=512   sunit=0 blks, lazy-count=1
realtime =none                   extsz=4096   blocks=0, rtextents=0
```

The formatting takes a while, and you need to observe the system running status. Once **done** is displayed in the command output, the formatting is complete.

Step 13 (Optional) Run the following command to create a mount point:

Perform this step if you want to mount the partition on a new mount point.

mkdir *Mount point*

In this example, run the following command to create the **/mnt/test** mount point:

mkdir /mnt/test

Step 14 Run the following command to mount the new partition:

mount *Disk partition Mount point*

In this example, run the following command to mount the new partition **/dev/sda2** on **/mnt/test**:

mount /dev/sda2 /mnt/test

> **NOTE**
>
> If the new partition is mounted on a directory that is not empty, the subdirectories and files in the directory will be hidden. Therefore, you are advised to mount the new partition on an empty directory or a new directory. If the new partition must be mounted on a directory that is not empty, move the subdirectories and files in this directory to another directory temporarily. After the partition is successfully mounted, move the subdirectories and files back.

Step 15 Run the following command to view the mount result:

df -TH

Information similar to the following is displayed:

```
[root@ecs-scsi ~]# df -TH
Filesystem     Type      Size  Used Avail Use% Mounted on
/dev/vda1      ext4       43G  2.0G   39G   5% /
devtmpfs       devtmpfs  509M     0  509M   0% /dev
tmpfs          tmpfs     520M     0  520M   0% /dev/shm
tmpfs          tmpfs     520M  7.2M  513M   2% /run
tmpfs          tmpfs     520M     0  520M   0% /sys/fs/cgroup
tmpfs          tmpfs     104M     0  104M   0% /run/user/0
/dev/sda1      ext4       53G   55M   50G   1% /mnt/sdc
/dev/sda2      ext4       53G   55M   50G   1% /mnt/test
```

> **NOTE**
>
> If the server is restarted, the mounting will become invalid. You can modify the **/etc/fstab** file to configure automount at startup. For details, see **Configuring Auto Mount at Startup**.

----End

Extending an Existing MBR Partition

NOTICE

If the additional space is allocated to an existing partition, data on the disk will not be cleared but you must use **umount** to unmount the existing partition. In this case, services will be affected.

Originally, SCSI data disk **/dev/sda** has 100 GB and two partitions (**/dev/sda1** and **/dev/sda2**, and then 50 GB is added to the disk. The following procedure shows you how to add this 50 GB to the existing MBR partition **/dev/sda2**.

During an expansion, the additional space is added to the end of the disk. Therefore, if the disk has multiple partitions, the additional space can only be allocated to the partition at the disk end.

Step 1 Run the following command to view the disk partition information:

fdisk -l

Information similar to the following is displayed:

```
[root@ecs-scsi ~]# fdisk -l

Disk /dev/vda: 42.9 GB, 42949672960 bytes, 83886080 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
```

```
Disk label type: dos
Disk identifier: 0x000bcb4e

   Device Boot      Start         End      Blocks   Id  System
/dev/vda1   *        2048    83886079    41942016   83  Linux

Disk /dev/sda: 161.1 GB, 161061273600 bytes, 314572800 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk label type: dos
Disk identifier: 0x915ffe6a

   Device Boot      Start         End      Blocks   Id  System
/dev/sda1            2048   104857599    52427776   83  Linux
/dev/sda2       104857600   209715199    52428800   83  Linux
```

In the command output, take note of the partition's start and end sectors. In this example, **/dev/sda2**'s start sector is **104857600**, and its end sector is **209715199**.

View the **/dev/sda** capacity and check whether the additional space is included.

- If the additional space is not included, refresh the capacity according to **Step 2**.
- If the additional space is included, take note of the start and end sectors of the target partition and then go to **Step 3**. These values will be used in the subsequent operations.

Step 2 (Optional) Run the following command to update the capacity of the SCSI data disk:

1. Run the following command to update the disk capacity on the server:

   echo 1 > /sys/class/scsi_device/*%d:%d:%d:%d***/device/rescan &**

   In the command, **%d:%d:%d:%d** indicates a folder in the **/sys/class/scsi_device/** directory and can be obtained using **ll /sys/class/scsi_device/**.

   Information similar to the following is displayed: (**2:0:0:0** indicates the folder to be obtained.)

   ```
   cs-xen-02:/sys/class/scsi_device # ll /sys/class/scsi_device/
   total 0
   lrwxrwxrwx 1 root root 0 Sep 26 11:37 2:0:0:0 -> ../../devices/xen/vscsi-2064/host2/target2:0:0/2:0:0:0/
   scsi_device/2:0:0:0
   ```

   In this example, run the following command:

   echo 1 > /sys/class/scsi_device/2:0:0:0/device/rescan &

2. After the disk capacity is updated, run the following command to view the disk partition information again:

   fdisk -l

   If the additional space is included, take note of the start and end sectors of the target partition and then go to **Step 3**. These values will be used in the subsequent operations.

Step 3 Run the following command to unmount the partition:

umount *Disk partition*

In this example, run the following command:

umount /dev/sda2

Step 4 Run the following command to enter fdisk:

fdisk *Disk*

In this example, run the following command:

fdisk /dev/sda

Information similar to the following is displayed:

```
[root@ecs-scsi ~]# fdisk /dev/sda
Welcome to fdisk (util-linux 2.23.2).

Changes will remain in memory only, until you decide to write them.
Be careful before using the write command.


Command (m for help):
```

Step 5 Run the following command to delete the partition to be extended:

1. Enter **d** and press **Enter** to delete the partition.

   Information similar to the following is displayed:

   ```
   Command (m for help): d
   Partition number (1,2, default 2):
   ```

2. Enter the partition number and press **Enter** to delete the partition. In this example, enter **2**.

   Information similar to the following is displayed:

   ```
   Partition number (1,2, default 2): 2
   Partition 2 is deleted

   Command (m for help):
   ```

   NOTE

   After deleting the partition, recreate the partition according to the following steps, and data on this disk will not be lost.

Step 6 Enter **n** and press **Enter** to create a new partition.

Information similar to the following is displayed:

```
Command (m for help): n
Partition type:
   p   primary (1 primary, 0 extended, 3 free)
   e   extended
Select (default p):
```

There are two types of disk partitions:

- Choosing **p** creates a primary partition.
- Choosing **e** creates an extended partition.

NOTE

If the MBR partition style is used, a maximum of 4 primary partitions, or 3 primary partitions and 1 extended partition can be created. The extended partition cannot be used directly and must be divided into logical partitions before use.

Disk partitions created using GPT are not categorized.

Step 7 Ensure that the entered partition type is the same as the partition had before. In this example, a primary partition is used. Therefore, enter **p** and press **Enter** to create a primary partition.

Information similar to the following is displayed:

```
Select (default p): p
Partition number (2-4, default 2):
```

Partition number indicates the serial number of the primary partition.

Step 8 Ensure that entered partition number is the same as the partition had before. In this example, partition number **2** is used. Therefore, enter **2** and press **Enter**.

Information similar to the following is displayed:

```
Partition number (2-4, default 2): 2
First sector (104857600-314572799, default 104857600):
```

In the command output, **First sector** specifies the start sector.

NOTE

Data will be lost if the following operations are performed:

- Select a start sector other than the partition had before.
- Select an end sector smaller than the partition had before.

Step 9 Ensure that the entered start sector is the same as the partition had before. In this example, start sector **104857600** is recorded in **Step 1** or **Step 2**. Therefore, enter **104857600** and press **Enter**.

Information similar to the following is displayed:

```
First sector (104857600-314572799, default 104857600):
Using default value 104857600
Last sector, +sectors or +size{K,M,G} (104857600-314572799, default 314572799):
```

In the command output, **Last sector** specifies the end sector.

Step 10 Ensure that the entered end sector is greater than or equal to the end sector recorded in **Step 1** or **Step 2**. In this example, the recorded end sector is **209715199**, and the default end sector is used. Therefore, enter **314572799** and press **Enter**.

Information similar to the following is displayed:

```
Last sector, +sectors or +size{K,M,G} (104857600-314572799, default 314572799):
Using default value 314572799
Partition 2 of type Linux and of size 100 GiB is set

Command (m for help):
```

The partition is created.

Step 11 Enter **p** and press **Enter** to view the partition details.

Information similar to the following is displayed:

```
Command (m for help): p

Disk /dev/sda: 161.1 GB, 161061273600 bytes, 314572800 sectors
Units = sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk label type: dos
Disk identifier: 0x915ffe6a

   Device Boot      Start         End      Blocks   Id  System
/dev/sda1            2048   104857599    52427776   83  Linux
/dev/sda2       104857600   314572799   104857600  83  Linux

Command (m for help):
```

Step 12 Enter **w** and press **Enter** to write the changes to the partition table.

Information similar to the following is displayed: (The partition is successfully created.)

```
Command (m for help): w
The partition table has been altered!

Calling ioctl() to re-read partition table.

WARNING: Re-reading the partition table failed with error 16: Device or resource busy.
The kernel still uses the old table. The new table will be used at
the next reboot or after you run partprobe(8) or kpartx(8)
Syncing disks.
```

NOTE

In case that you want to discard the changes made before, you can exit fdisk by entering **q**.

Step 13 Run the following command to synchronize the new partition table to the OS:

partprobe

Step 14 Perform the following operations based on the file system of the disk:

- For the **ext***file system
  a. Run the following command to check the correctness of the file system on the partition:

     e2fsck -f *Disk partition*

     In this example, run the following command:

     e2fsck -f /dev/sda2

     Information similar to the following is displayed:

     ```
     [root@ecs-scsi ~]# e2fsck -f /dev/sda2
     e2fsck 1.42.9 (28-Dec-2013)
     Pass 1: Checking inodes, blocks, and sizes
     Pass 2: Checking directory structure
     Pass 3: Checking directory connectivity
     Pass 4: Checking reference counts
     Pass 5: Checking group summary information
     /dev/sda2: 11/3276800 files (0.0% non-contiguous), 251790/13107200 blocks
     ```

  b. Run the following command to extend the file system of the partition:

     resize2fs *Disk partition*

     In this example, run the following command:

     resize2fs /dev/sda2

     Information similar to the following is displayed:

     ```
     [root@ecs-scsi ~]# resize2fs /dev/sda2
     resize2fs 1.42.9 (28-Dec-2013)
     Resizing the filesystem on /dev/sda2 to 26214400 (4k) blocks.
     The filesystem on /dev/sda2 is now 26214400 blocks long.
     ```

  c. (Optional) Run the following command to create a mount point:

     Perform this step if you want to mount the partition on a new mount point.

     mkdir *Mount point*

     In this example, run the following command to create the **/mnt/test** mount point:

     mkdir /mnt/test

  d. Run the following command to mount the partition:

     mount *Disk partition Mount point*

     In this example, run the following command to mount the partition **/dev/sda2** on **/mnt/test**:

mount /dev/sda2 /mnt/test

NOTE

If the new partition is mounted on a directory that is not empty, the subdirectories and files in the directory will be hidden. Therefore, you are advised to mount the new partition on an empty directory or a new directory. If the new partition must be mounted on a directory that is not empty, move the subdirectories and files in this directory to another directory temporarily. After the partition is successfully mounted, move the subdirectories and files back.

- For the **xfs** file system

  a. (Optional) Run the following command to create a mount point:

  Perform this step if you want to mount the partition on a new mount point.

  mkdir *Mount point*

  In this example, run the following command to create the **/mnt/test** mount point:

  mkdir /mnt/test

  b. Run the following command to mount the partition:

  mount *Disk partition Mount point*

  In this example, run the following command to mount the partition **/dev/vdb2** on **/mnt/test**:

  mount /dev/vdb2 /mnt/test

  NOTE

  If the new partition is mounted on a directory that is not empty, the subdirectories and files in the directory will be hidden. Therefore, you are advised to mount the new partition on an empty directory or a new directory. If the new partition must be mounted on a directory that is not empty, move the subdirectories and files in this directory to another directory temporarily. After the partition is successfully mounted, move the subdirectories and files back.

  c. Run the following command to extend the file system of the partition:

  sudo xfs_growfs *Disk partition*

  In this example, run the following command:

  sudo xfs_growfs /dev/sda2

  Information similar to the following is displayed:

```
[root@ecs-scsi ~]# sudo xfs_growfs /dev/sda2
meta-data=/dev/sda2              isize=512    agcount=4, agsize=3276800 blks
         =                       sectsz=512   attr=2, projid32bit=1
         =                       crc=1        finobt=0, spinodes=0
data     =                       bsize=4096   blocks=13107200, imaxpct=25
         =                       sunit=0      swidth=0 blks
naming   =version2               bsize=4096   ascii-ci=0 ftype=1
log      =internal               bsize=4096   blocks=6400, version=2
         =                       sectsz=512   sunit=0 blks, lazy-count=1
realtime =none                   extsz=4096   blocks=0, rtextents=0
data blocks changed from 13107200 to 26214400df .
```

Step 15 Run the following command to view the mount result:

df -TH

Information similar to the following is displayed:


```
[root@ecs-scsi ~]# df -TH
Filesystem     Type      Size  Used Avail Use% Mounted on
/dev/vda1      ext4       43G  2.0G   39G   5% /
devtmpfs       devtmpfs  509M     0  509M   0% /dev
tmpfs          tmpfs     520M     0  520M   0% /dev/shm
tmpfs          tmpfs     520M  7.2M  513M   2% /run
tmpfs          tmpfs     520M     0  520M   0% /sys/fs/cgroup
tmpfs          tmpfs     104M     0  104M   0% /run/user/0
/dev/sda1      ext4       53G   55M   50G   1% /mnt/sdc
/dev/sda2      ext4      106G   63M  101G   1% /mnt/test
```

NOTE

If the server is restarted, the mounting will become invalid. You can modify the **/etc/fstab** file to configure automount at startup. For details, see **Configuring Auto Mount at Startup**.

----End

Configuring Auto Mount at Startup

The **fstab** file controls what disks are automatically mounted at server startup. You can configure the **fstab** file of a server that has data. This operation will not affect the existing data.

The following example uses UUIDs to identify disks in the **fstab** file. You are advised not to use device names (like **/dev/vdb1**) to identify disks in the file because device names are assigned dynamically and may change (for example, from **/dev/vdb1** to **/dev/vdb2**) after a server stop or start. This can even prevent your server from booting up.

NOTE

UUID is the unique character string for disk partitions in a Linux system.

Step 1 Query the partition UUID.

blkid *Disk partition*

In this example, the UUID of the **/dev/vdb1** partition is queried.

blkid /dev/vdb1

Information similar to the following is displayed:

```
[root@ecs-test-0001 ~]# blkid /dev/vdb1
/dev/vdb1: UUID="0b3040e2-1367-4abb-841d-ddb0b92693df" TYPE="ext4"
```

Carefully record the UUID, as you will need it for the following step.

Step 2 Open the **fstab** file using the vi editor.

vi /etc/fstab

Step 3 Press **i** to enter editing mode.

Step 4 Move the cursor to the end of the file and press **Enter**. Then, add the following information:

```
UUID=0b3040e2-1367-4abb-841d-ddb0b92693df /mnt/sdc              ext4    defaults        0 2
```

In this example, the line starting with "UUID" is the information added. Edit this line to match the following format:

- UUID: The UUID obtained in **Step 1**.
- Mount point: The directory on which the partition is mounted. You can query the mount point using **df -TH**.
- Filesystem: The file system format of the partition. You can query the file system format using **df -TH**.
- Mount option: The partition mount option. Usually, this parameter is set to **defaults**.
- Dump: The Linux dump backup option.
  - **0**: Linux dump backup is not used. Usually, dump backup is not used, and you can set this parameter to **0**.
  - **1**: Linux dump backup is used.
- fsck: The fsck option, which means whether to use fsck to check the disk during startup.
  - **0**: The fsck option is not used.
  - If the mount point is the root partition (**/**), this parameter must be set to **1**.

    If this parameter is set to **1** for the root partition, this parameter for other partitions must start with **2** because the system checks the partitions in the ascending order of the values.

Step 5 Press **Esc**, enter **:wq**, and press **Enter**.

The system saves the configurations and exits the vi editor.

Step 6 Verify that the disk is auto-mounted at startup.

1. Unmount the partition.

   umount *Disk partition*

   Example command:

   umount /dev/vdb1

2. Reload all the content in the **/etc/fstab** file.

   mount -a

3. Query the file system mounting information.

   mount | grep *Mount point*

   Example command:

   mount | grep /mnt/sdc

   If information similar to the following is displayed, auto mount has taken effect:

   ```
   root@ecs-test-0001 ~]# mount | grep /mnt/sdc
   /dev/vdb1 on /mnt/sdc type ext4 (rw,relatime,data=ordered)
   ```

----End