

一、磁盘分区FDISK

硬盘接口: IDE/EIDE, SCSI, SATA, SAS

SATA (Serial Advanced Technology Attachment), 串行高级技术附件, 串口硬盘

SAS (Serial Attached SCSI), 串行连接SCSI接口, 串行连接小型计算机系统接口

SSD (Solid State Disk或Solid State Drive) 固态硬盘

硬盘: 温彻斯特 温盘

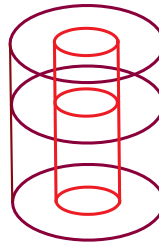
Sector 512Bytes/Sector 扇区

Head (Side) 头 (面) 0-15 16

Cylinder (Track) 柱面 (磁道) 0-62 63

步进电机: 径向

旋转电机:



Partition Table分区表 FDISK

Boot-FAT1/2-FDT(Root)-Data

FAT: File Allocation Table文件分配表: Cluster Chain簇链

FDT: File Directory Table文件目录表: 文件名, 属性HSRA, 起始簇号

NTFS B-树



VS





SATA接口



M.2接口



PCI-E接口



mSATA接口

硬盘接口：IDE，SCSI，SATA，SSD，SAS

Windows：1个主分区+1个扩展分区

1个主(基本)分区：C:

1个扩展分区：多个逻辑分区D:, E:, F:等

A:, B: 软驱

FDISK 分区

FORMAT D: 格式化

512Bytes/Sector 512字节/扇区

磁道, 面, 扇区

Track, Side, Sector

80 2 18

软盘: 2HD 1.44MB软盘 2面*80磁道/面*18扇区/磁道*512B/扇区=1440KB=1.44MB

硬盘: Cylinder柱面, Head头, Sector扇区

```

Disk /dev/vdb: 1073 MB, 1073741824 bytes
16 heads, 63 sectors/track, 2080 cylinders
Units = cylinders of 1008 * 512 = 516096 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk identifier: 0x56fddf9e

    Device Boot      Start         End      Blocks   Id  System
/dev/vdb1           1         2080     1048288+   fd  Linux raid autodetect

16 heads, 63 sectors/track, 2080 cylinders
Units = cylinders of 1008 * 512 = 516096 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
16头(道)*63扇区/磁道*2080柱面*512B/扇区=1008*512*2080B=516096B*2080=1GB
  
```

Linux：主分区+扩展分区<=4

典型分区：3个主分区+1个扩展分区，或4个主分区

hd IDE 40pin 80pin 并口

sd SATA 串口

sd SCSI

sda 第1块硬盘 云平台vda

sdb 第2块硬盘 云平台vdb 1G

sdc 第3块硬盘 云平台vdc 1G

sdd 第4块硬盘 云平台vdd 2G→1G+1G
fdisk /dev/vdd 分区为2个主分区，每个分区1G
fdisk /dev/md10 分区为1个500M的主分区
mkfs.ext4 /dev/vdb1 格式化分区
mkfs.ext4 /dev/md10 格式化磁盘阵列RAID10
mkswap /dev/md10p1 格式化交换分区

实战1：在CentOS7.6中创建一个500M的分区，开机自动挂载在/backup目录下。执行df -hT命令，将命令及其结果进行截图。

sda1	sda2	sda3	sda4	sda5	sda6
/boot	/	swap	extended	/home	/backup
200M	10G	4G	5.6G	500M	500M

```
# fdisk -l                                //查看分区
    磁盘 /dev/sda: 21.5 GB, 21474836480 字节, 41943040 个扇区
    Units = 扇区 of 1 * 512 = 512 bytes
    扇区大小(逻辑/物理): 512 字节 / 512 字节
    I/O 大小(最小/最佳): 512 字节 / 512 字节
    磁盘标签类型: dos
    磁盘标识符: 0x000de7e0

    设备 Boot      Start          End      Blocks    Id  System
    /dev/sda1  *           2048         411647       204800    83  Linux
    /dev/sda2              411648       21383167    10485760    83  Linux
    /dev/sda3          21383168       29771775      4194304    82  Linux swap / Solaris
    /dev/sda4          29771776       41943039      6085632     5  Extended
    /dev/sda5          29773824       30797823      512000     83  Linux

# df -hT                                //查看分区的挂载点
# mount                                //查看分区挂载在哪个目录下
# fdisk /dev/sda                        //分区：先显示p，再添加新分区n，再显示确认p，写入w

    m  print this menu显示这个菜单，获取帮助
    p  print the partition table显示分区表
    n  add a new partition添加一个新分区(sda6)
    d  delete a partition删除一个分区
    l  list known partition types显示已知的分区类型
    q  quit without saving changes不保存退出
    w  write table to disk and exit写入分区表到磁盘并退出
```

命令(输入 m 获取帮助)： **p**

```
    磁盘 /dev/sda: 21.5 GB, 21474836480 字节, 41943040 个扇区
    Units = 扇区 of 1 * 512 = 512 bytes
    扇区大小(逻辑/物理): 512 字节 / 512 字节
    I/O 大小(最小/最佳): 512 字节 / 512 字节
    磁盘标签类型: dos
    磁盘标识符: 0x000de7e0

    设备      Boot      Start          End      Blocks    Id  System
    /dev/sda1  *           2048         411647       204800    83  Linux
    /dev/sda2              411648       21383167    10485760    83  Linux
    /dev/sda3          21383168       29771775      4194304    82  Linux swap / Solaris
    /dev/sda4          29771776       41943039      6085632     5  Extended
    /dev/sda5          29773824       30797823      512000     83  Linux
```

命令(输入 m 获取帮助)： **n**
All primary partitions are in use

添加逻辑分区 6

起始 扇区 (30799872-41943039, 默认为 30799872): **回车**

将使用默认值 30799872

Last 扇区, +扇区 or +size{K,M,G} (30799872-41943039, 默认为 41943039): **+500M**

分区 6 已设置为 Linux 类型, 大小设为 500 MiB

命令 (输入 m 获取帮助): **p**

多了一条记录:

设备	Boot	Start	End	Blocks	Id	System
/dev/sda6		30799872	31823871	512000	83	Linux

命令 (输入 m 获取帮助): **w**

The partition table has been altered!
Calling ioctl() to re-read partition table.

WARNING: Re-reading the partition table failed with error 16: 设备或资源忙.
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)

正在同步磁盘。

命令 (输入 m 获取帮助): **l**

分区类型:

0	空	24	NEC DOS	81	Minix / 旧 Linu	bf	Solaris
1	FAT12	27	隐藏的 NTFS Win	82	Linux 交换	/ So c1	DRDOS/sec (FAT-
2	XENIX root	39	Plan 9	83	Linux	c4	DRDOS/sec (FAT-
3	XENIX usr	3c	PartitionMagic	84	OS/2 隐藏的 C:	c6	DRDOS/sec (FAT-
4	FAT16 <32M	40	Venix 80286	85	Linux 扩展	c7	Syrinx
5	扩展	41	PPC PReP Boot	86	NTFS 卷集	da	非文件系统数据
6	FAT16	42	SFS	87	NTFS 卷集	db	CP/M / CTOS / .
7	HPFS/NTFS/exFAT	4d	QNX4.x	88	Linux 纯文本	de	Dell 工具
8	AIX	4e	QNX4.x 第2部分	8e	Linux LVM	df	BootIt
9	AIX 可启动	4f	QNX4.x 第3部分	93	Amoeba	e1	DOS 访问
a	OS/2 启动管理器	50	OnTrack DM	94	Amoeba BBT	e3	DOS R/O
b	W95 FAT32	51	OnTrack DM6 Aux	9f	BSD/OS	e4	SpeedStor
c	W95 FAT32 (LBA)	52	CP/M	a0	IBM Thinkpad 休	eb	BeOS fs
e	W95 FAT16 (LBA)	53	OnTrack DM6 Aux	a5	FreeBSD	ee	GPT
f	W95 扩展 (LBA)	54	OnTrackDM6	a6	OpenBSD	ef	EFI (FAT-12/16/
10	OPUS	55	EZ-Drive	a7	NeXTSTEP	f0	Linux/PA-RISC
11	隐藏的 FAT12	56	Golden Bow	a8	Darwin UFS	f1	SpeedStor
12	Compaq 诊断	5c	Priam Edisk	a9	NetBSD	f4	SpeedStor
14	隐藏的 FAT16 <3	61	SpeedStor	ab	Darwin 启动	f2	DOS 次要
16	隐藏的 FAT16	63	GNU HURD or Sys	af	HFS / HFS+	fb	VMware VMFS
17	隐藏的 HPFS/NTF	64	Novell Netware	b7	BSDI fs	fc	VMware VMKCORE
18	AST 智能睡眠	65	Novell Netware	b8	BSDI swap	fd	Linux raid 自动
1b	隐藏的 W95 FAT3	70	DiskSecure 多启	bb	Boot Wizard 隐	fe	LANstep
1c	隐藏的 W95 FAT3	75	PC/IX	be	Solaris 启动	ff	BBT
1e	隐藏的 W95 FAT1	80	旧 Minix				

partx -a /dev/sda //创建分区完毕之后, 使用该命令在不重启Linux的情况下, 使新建分区生效
partx: /dev/sda: error adding partitions 1-5

ls /dev/sda*
/dev/sda /dev/sda1 /dev/sda2 /dev/sda3 /dev/sda4 /dev/sda5 **/dev/sda6**

mkfs.ext4 /dev/sda6 //将分区sda6格式化为ext4文件系统
mke2fs 1.42.9 (28-Dec-2013)

文件系统标签=

OS type: Linux

块大小=1024 (log=0)

```

分块大小=1024 (log=0)
Stride=0 blocks, Stripe width=0 blocks
128016 inodes, 512000 blocks
25600 blocks (5.00%) reserved for the super user
第一个数据块=1
Maximum filesystem blocks=34078720
63 block groups
8192 blocks per group, 8192 fragments per group
2032 inodes per group
Superblock backups stored on blocks:
    8193, 24577, 40961, 57345, 73729, 204801, 221185, 401409

Allocating group tables: 完成
正在写入inode表: 完成
Creating journal (8192 blocks): 完成
Writing superblocks and filesystem accounting information: 完成

```

```
# mkdir /backup
```

```
# vi /etc/fstab           //设置开机sda6 分区自动挂载
```

```
添加第13行:
```

```
/dev/sda6    /backup    ext4    defaults    0 0
```

```
# df -h                //查看分区的挂载点, sda6没有挂载
```

文件系统	容量	已用	可用	已用%	挂载点
/dev/sda2	9.8G	4.5G	4.8G	49%	/
devtmpfs	976M	0	976M	0%	/dev
tmpfs	991M	0	991M	0%	/dev/shm
tmpfs	991M	11M	980M	2%	/run
tmpfs	991M	0	991M	0%	/sys/fs/cgroup
/dev/sda5	477M	2.3M	445M	1%	/home
/dev/sda1	190M	132M	45M	75%	/boot
tmpfs	199M	56K	199M	1%	/run/user/0

```
# mount -a             //把 /etc/fstab 文件中所有的分区自动再挂载一次
```

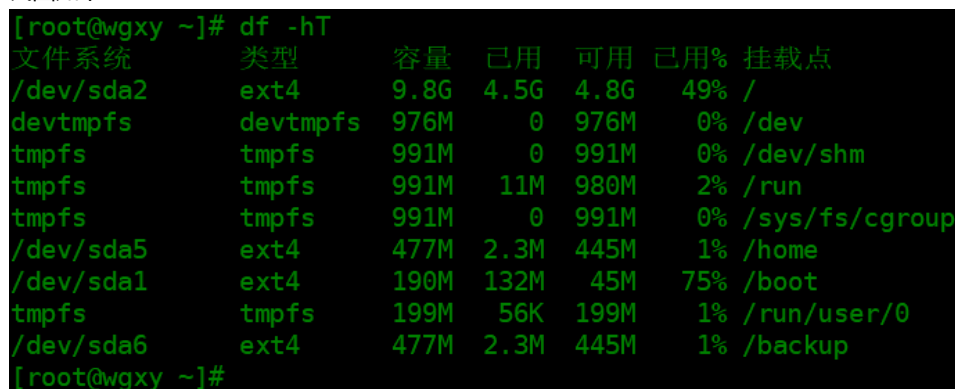
```
# mount                //查看分区挂载在哪个目录下
```

```
/dev/sda6 on /backup type ext4 (rw,relatime,seclabel,data=ordered)
```

```
# df -hT               //查看分区的挂载点和类型
```

文件系统	类型	容量	已用	可用	已用%	挂载点
/dev/sda2	ext4	9.8G	4.5G	4.8G	49%	/
devtmpfs	devtmpfs	976M	0	976M	0%	/dev
tmpfs	tmpfs	991M	0	991M	0%	/dev/shm
tmpfs	tmpfs	991M	11M	980M	2%	/run
tmpfs	tmpfs	991M	0	991M	0%	/sys/fs/cgroup
/dev/sda5	ext4	477M	2.3M	445M	1%	/home
/dev/sda1	ext4	190M	132M	45M	75%	/boot
tmpfs	tmpfs	199M	56K	199M	1%	/run/user/0
/dev/sda6	ext4	477M	2.3M	445M	1%	/backup

截图如下:



```

[root@wgxy ~]# df -hT
文件系统      类型      容量  已用  可用  已用% 挂载点
/dev/sda2     ext4       9.8G  4.5G  4.8G   49%  /
devtmpfs      devtmpfs   976M    0  976M    0%  /dev
tmpfs         tmpfs      991M    0  991M    0%  /dev/shm
tmpfs         tmpfs      991M   11M  980M    2%  /run
tmpfs         tmpfs      991M    0  991M    0%  /sys/fs/cgroup
/dev/sda5     ext4       477M   2.3M  445M    1%  /home
/dev/sda1     ext4       190M  132M   45M   75%  /boot
tmpfs         tmpfs      199M   56K  199M    1%  /run/user/0
/dev/sda6     ext4       477M   2.3M  445M    1%  /backup

```

【截图】

二、磁盘阵列RAID

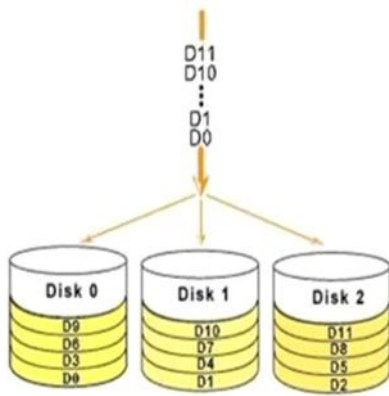


磁盘阵列，RAID: Redundant Arrays of Independent Disks，独立磁盘构成的具有冗余能力的阵列
磁盘阵列就是一种把多块独立（即单个）的硬盘按不同的方式组合起来形成一个大的硬盘，从而提供比单个硬盘更大的存储空间、更快的存取速度和提供数据冗余的一种技术。

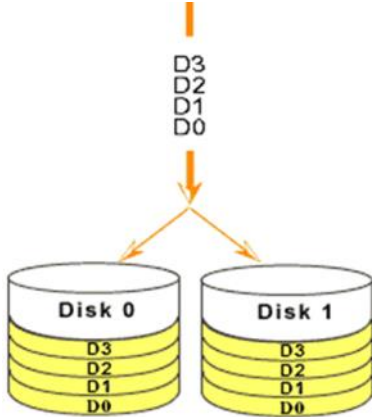
磁盘阵列RAID的几个级别及其工作原理：

RAID0、RAID1、RAID1+0(RAID10)、RAID 5

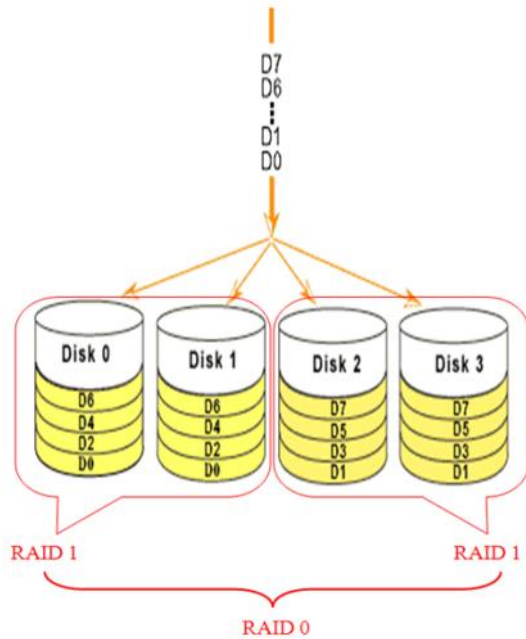
(1)RAID0: 高速，至少2块硬盘或分区，无冗余、容错



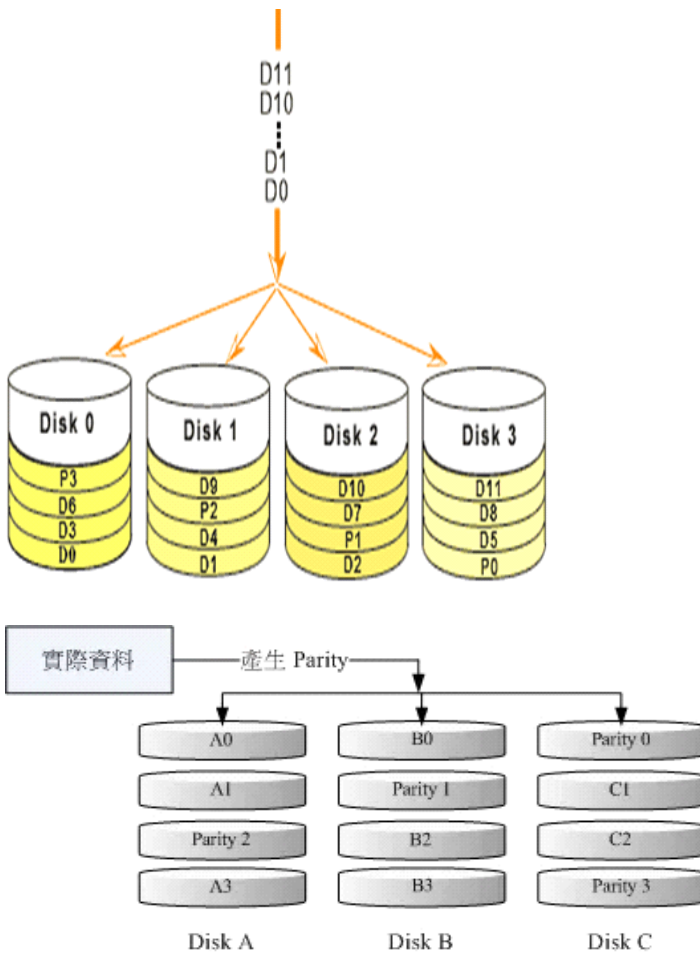
(2)RAID1: 安全, 至少2块硬盘或分区, 冗余、容错, 磁盘空间利用率为50%



(3)RAID10: 高速+安全, 至少4块硬盘或分区, 磁盘空间利用率为50%



(4)RAID5: 可靠, 至少3块硬盘或分区, 磁盘空间利用率为67%



Linux自帶LVM逻辑卷管理及磁盘阵列RAID的软件功能，无需任何硬件设备。

Multiple Devices Administrator

RAID10:

```
# mdadm -C /dev/md10 -l 10 -n 4 /dev/vdb1 /dev/vdc1 /dev/vdd1 /dev/vdd2
```

RAID5:

```
# mdadm -C /dev/md5 -l 5 -n 3 /dev/vdb1 /dev/vdc1 /dev/vdc2
```

1.创建磁盘阵列RAID10

```
# mdadm -C /dev/md10 -l 10 -n 4 /dev/vdb1 /dev/vdc1 /dev/vdd1 /dev/vdd2
```

mdadm的主要参数:

-a 检测设备名称

-C 创建 # mdadm -C /dev/md10 -l 10 -n 4 /dev/vdb1 /dev/vdc1 /dev/vdd1 /dev/vdd2

-n 指定设备数量 -n 4

-l 指定 RAID 级别 -l 10

-v 显示过程

-f 模拟设备损坏 # mdadm /dev/md10 -f /dev/vdb1

-r 移除设备 # mdadm /dev/md10 -r /dev/vdb1

-Q 查看摘要信息

-D 查看详细信息 # mdadm -D /dev/md10

-S 停止 RAID 磁盘阵列 # madadm -S /dev/md10

-A 激活RAID 磁盘阵列 # madadm -A /dev/md10

-x 1 /dev/sde 添加一个热备盘

2.移除磁盘阵列RAID10

```
# umount /dev/md10
```

```
# mdadm -S /dev/md0
```



```
# mdadm --misc --zero-superblock /dev/vdd{1,2} //删除磁盘分区
```

删除或注销配置文件mdadm.conf和fstab等

3.检查

```
# lsblk
```

```
# df -hT
```

```
# mount
```

```
# fdisk /dev/md10
```

```
# file /dev/md10
```

```
/dev/md10: block special
```

```
# lsblk
```

```
# blkid //查看生成好的md10等磁盘的文件系统格式及UUID
```

```
# echo '- - -' > /sys/class/scsi_host/host1/scan //添加硬盘，使用命令让系统识别
```

实战2：在云主机Centos-C1中创建RAID10，设备名：md10，挂载点：/raid10

【Centos-C1】RAID10，3个云硬盘(卷)，需要4个分区

IP: 192.168.11.40(192.168.133.7)

Centos-C1: hd6 vdb 1G 需分1个区

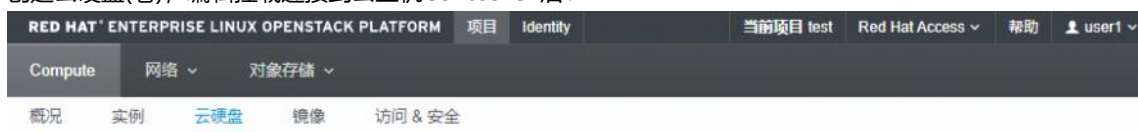
hd7 vdc 1G 需分1个区

hd8 vdd 2G 需分2个区

●准备工作：将3个云硬盘(卷)变成等分的4个分区

```
[root@host-192-168-133-7 ~]# lsblk
NAME                                MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
loop0                              7:0      0   4.2G  1 loop /media
vda                                252:0      0   40G   0 disk
├─vda1                             252:1      0   500M   0 part /boot
├─vda2                             252:2      0  29.5G   0 part
│   └─VolGroup-lv_root (dm-0) 253:0      0  26.5G   0 lvm /
│   └─VolGroup-lv_swap (dm-1) 253:1      0    3G   0 lvm [SWAP]
```

创建云硬盘(卷)，编辑挂载连接到云主机Centos-C1后：



云硬盘

云硬盘

云硬盘快照

云硬盘

筛选

筛选

+ 创建云硬盘

删除卷

<input type="checkbox"/>	名称	描述	配置	状态	类型	连接到	可用域	可启动	加密的	动作
<input type="checkbox"/>	hd8		2GB	In-Use	-	在设备/dev/vdd上连接到Centos-C1	nova	False	不	<div>编辑卷</div>
<input type="checkbox"/>	hd7		1GB	In-Use	-	在设备/dev/vdc上连接到Centos-C1	nova	False	不	<div>编辑卷</div>
<input type="checkbox"/>	hd6		1GB	In-Use	-	在设备/dev/vdb上连接到Centos-C1	nova	False	不	<div>编辑卷</div>

显示3个条目

```
[root@host-192-168-133-7 ~]# lsblk
NAME                                MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
loop0                               7:0      0   4.2G  1 loop /media
vda                                  252:0     0   40G   0 disk
├─vda1                               252:1     0   500M   0 part /boot
└─vda2                               252:2     0  29.5G   0 part
   ├─VolGroup-lv_root (dm-0) 253:0     0  26.5G   0 lvm /
   └─VolGroup-lv_swap (dm-1) 253:1     0     3G   0 lvm [SWAP]
vdb                                  252:16     0     1G   0 disk
vdc                                  252:32     0     1G   0 disk
vdd                                  252:48     0     2G   0 disk
[root@host-192-168-133-7 ~]#
```

```
[root@host-192-168-133-7 ~]# lsblk
NAME                                MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
loop0                               7:0      0   4.2G  1 loop /media
vda                                  252:0     0   40G   0 disk
├─vda1                               252:1     0   500M   0 part /boot
└─vda2                               252:2     0  29.5G   0 part
   ├─VolGroup-lv_root (dm-0) 253:0     0  26.5G   0 lvm /
   └─VolGroup-lv_swap (dm-1) 253:1     0     3G   0 lvm [SWAP]
vdb                                  252:16     0     1G   0 disk //hd6 1G需分为1个区vdb1
vdc                                  252:32     0     1G   0 disk //hd7 1G需分为1个区vdc1
vdd                                  252:48     0     2G   0 disk //hd8 2G需分为2个区vdd1,vdd2
```

【分析】

RAID10: vdb1, vdc1, vdd1, vdd2

LVM: VolGroup-lv_root (dm-0), VolGroup-lv_swap (dm-1)

vda2→pv→→→→vg 卷组VolGroup→→→lv 逻辑卷lv_root, lv_swap

vdb1→pv→→→→vg

pvdisplay	vgdisplay	lvdisplay	查看
pvcreate	vgcreate	lvcreate	新建
pvscan	vgscan	lvscan	扫描
pvremove	vgremove	lvremove	删除
	vgextend	lvextend	扩大
	vgreduce	lvreduce	缩小
	合	分	

形同:

172.16.0.0/16-172.31.0.0/16 16个网段

→172.16.0.0/20 CIDR聚合

→172.16.0.0/24,, 172.16.255.0/24 256个网段 子网划分

云硬盘(卷)vdb、vdc、vdd分区:

```
[root@host-192-168-133-7 ~]# fdisk /dev/vdd //将云硬盘(卷)vdd分为2个区
Device contains neither a valid DOS partition table, nor Sun, SGI or OSF disklabel
Building a new DOS disklabel with disk identifier 0x8a436b65.
Changes will remain in memory only, until you decide to write them.
After that, of course, the previous content won't be recoverable.

Warning: invalid flag 0x0000 of partition table 4 will be corrected by w(rite)

WARNING: DOS-compatible mode is deprecated. It's strongly recommended to
switch off the mode (command 'c') and change display units to
sectors (command 'u').

Command (m for help): m
Command action
  a toggle a bootable flag
  b edit bsd disklabel
```

```

c toggle the dos compatibility flag
d delete a partition
l list known partition types
m print this menu
n add a new partition
o create a new empty DOS partition table
p print the partition table
q quit without saving changes
s create a new empty Sun disklabel
t change a partition's system id
u change display/entry units
v verify the partition table
w write table to disk and exit
x extra functionality (experts only)

Command (m for help): //主要用到 m p n n d l t w, 若输入错误Ctrl+Backspace删除
Command (m for help): n
Command action
  e extended
  p primary partition (1-4)

```

```

P
Partition number (1-4): 1
First cylinder (1-4161, default 1):
Using default value 1
Last cylinder, +cylinders or +size{K,M,G} (1-4161, default 4161): +1G

```

```

Command (m for help): n
Command action
  e extended
  p primary partition (1-4)

```

```

P
Partition number (1-4): 2
First cylinder (2083-4161, default 2083):
Using default value 2083
Last cylinder, +cylinders or +size{K,M,G} (2083-4161, default 4161):
Using default value 4161

```

```

Command (m for help): p

```

```

Disk /dev/vdd: 2147 MB, 2147483648 bytes
16 heads, 63 sectors/track, 4161 cylinders
Units = cylinders of 1008 * 512 = 516096 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk identifier: 0x34d7c594

```

Device	Boot	Start	End	Blocks	Id	System
/dev/vdd1		1	2082	1049296+	83	Linux
/dev/vdd2		2083	4161	1047816	83	Linux

注意: 若是分区, 分区的类型, 要修改为 "fd Linux raid auto"

```

Command (m for help): l
0 Empty                24 NEC DOS               81 Minix / old Lin bf Solaris
1 FAT12                 39 Plan 9                82 Linux swap / So c1 DRDOS/sec (FAT-
2 XENIX root            3c PartitionMagic        83 Linux              c4 DRDOS/sec (FAT-
3 XENIX usr             40 Venix 80286            84 OS/2 hidden C:  c6 DRDOS/sec (FAT-
4 FAT16 <32M           41 PPC PReP Boot         85 Linux extended  c7 Syrix
5 Extended              42 SFS                   86 NTFS volume set da Non-FS data
6 FAT16                 4d QNX4.x                87 NTFS volume set db CP/M / CTOS / .
7 HPFS/NTFS            4e QNX4.x 2nd part       88 Linux plaintext  de Dell Utility
8 AIX                   4f QNX4.x 3rd part       8e Linux LVM          df BootIt
9 AIX bootable         50 OnTrack DM             93 Amoeba            e1 DOS access
a OS/2 Boot Manag     51 OnTrack DM6 Aux       94 Amoeba BBT        e3 DOS R/O
b W95 FAT32            52 CP/M                  9f BSD/OS            e4 SpeedStor
c W95 FAT32 (LBA)     53 OnTrack DM6 Aux      a0 IBM Thinkpad hi eb BeOS fs
e W95 FAT16 (LBA)     54 OnTrackDM6           a5 FreeBSD           ee GPT
f W95 Ext'd (LBA)     55 EZ-Drive              a6 OpenBSD           ef EFI (FAT-12/16/
10 OPUS                 56 Golden Bow           a7 NeXTSTEP          f0 Linux/PA-RISC b
11 Hidden FAT12         5c Priam Edisk           a8 Darwin UFS        f1 SpeedStor
12 Compaq diagnost    61 SpeedStor             a9 NetBSD            f4 SpeedStor
14 Hidden FAT16 <3     63 GNU HURD or Sys      ab Darwin boot       f2 DOS secondary
16 Hidden FAT16         64 Novell Netware        af HFS / HFS+        fb VMware VMFS
17 Hidden HPFS/NTF     65 Novell Netware        b7 BSDI fs            fc VMware VMKCORE
18 AST SmartSleep      70 DiskSecure Mult      b8 BSDI swap          fd Linux raid auto
1b Hidden W95 FAT3     75 PC/IX                 bb Boot Wizard hid fe LANstep
1c Hidden W95 FAT3     80 Old Minix             be Solaris boot      ff BBT
1e Hidden W95 FAT1

```

```

Command (m for help): t
Partition number (1-4): 1
Hex code (type L to list codes): fd
Changed system type of partition 1 to fd (Linux raid autodetect)

Command (m for help): t
Partition number (1-4): 2
Hex code (type L to list codes): fd
Changed system type of partition 2 to fd (Linux raid autodetect)

Command (m for help): p

```

```

Disk /dev/vdd: 2147 MB, 2147483648 bytes
16 heads, 63 sectors/track, 4161 cylinders
Units = cylinders of 1008 * 512 = 516096 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk identifier: 0x34d7c594

```

Device	Boot	Start	End	Blocks	Id	System
/dev/vdd1		1	2082	1049296+	fd	Linux raid autodetect
/dev/vdd2		2083	4161	1047816	fd	Linux raid autodetect

```

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

Calling ioctl() to re-read partition table.
Syncing disks.

```

partx -a /dev/vdd //创建分区完毕之后，使用该命令在不重启Linux的情况下，使新建分区生效

call: **partx -opts [device] wholedisk**

```

BLKPG: Device or resource busy
error adding partition 1
BLKPG: Device or resource busy
error adding partition 2

```

[root@host-192-168-133-7 ~]# **lsblk**

NAME	MAJ:MIN	RM	SIZE	RO	TYPE	MOUNTPOINT
vda	252:0	0	40G	0	disk	
├─vda1	252:1	0	500M	0	part	/boot
└─vda2	252:2	0	29.5G	0	part	
├─VolGroup-lv_root (dm-0)	253:0	0	26.5G	0	lvm	/
└─VolGroup-lv_swap (dm-1)	253:1	0	3G	0	lvm	[SWAP]
vdb	252:16	0	1G	0	disk	
└─vdb1	252:17	0	1023.7M	0	part	
vdc	252:32	0	1G	0	disk	
└─vdc1	252:33	0	1023.7M	0	part	
vdd	252:48	0	2G	0	disk	
├─vdd1	252:49	0	1G	0	part	
└─vdd2	252:50	0	1023.3M	0	part	

```

[ root@host-192-168-133-7 ~]# lsblk
NAME                                MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
loop0                               7:0      0   4.2G  1 loop /media
vda                                  252:0    0   40G   0 disk
├─vda1                              252:1    0   500M   0 part /boot
└─vda2                              252:2    0  29.5G   0 part
    ├─VolGroup-lv_root (dm-0)       253:0    0  26.5G   0 lvm  /
    └─VolGroup-lv_swap (dm-1)       253:1    0     3G   0 lvm  [SWAP]
vdb                                  252:16   0     1G   0 disk
└─vdb1                              252:17   0 1023.7M   0 part
vdc                                  252:32   0     1G   0 disk
└─vdc1                              252:33   0 1023.7M   0 part
vdd                                  252:48   0     2G   0 disk
├─vdd1                              252:49   0     1G   0 part
└─vdd2                              252:50   0 1023.3M   0 part
[ root@host-192-168-133-7 ~]#

```

●1.创建RAID10

```
# mdadm -C /dev/md10 -l 10 -n 4 /dev/vdb1 /dev/vdc1 /dev/vdd1 /dev/vdd2
```

```
mdadm: Defaulting to version 1.2 metadata
mdadm: array /dev/md10 started.
```

其中: -C Create创建, -l level级别, -n 硬盘或分区个数

若显示:

```
-bash: mdadm: command not found
```

需配置本地yum源, 安装mdadm: # yum install mdadm -y

●2.1查看状态

```
# ll /dev/md*
```

```
brw-rw----. 1 root disk 9, 10 May 10 19:28 /dev/md10
```

```
# lsblk
```

NAME	MAJ:MIN	RM	SIZE	RO	TYPE	MOUNTPOINT
loop0	7:0	0	4.2G	1	loop	/media
vda	252:0	0	40G	0	disk	
└─vda1	252:1	0	500M	0	part	/boot
└─vda2	252:2	0	29.5G	0	part	
└─┬─VolGroup-lv_root (dm-0)	253:0	0	26.5G	0	lvm	/
└─└─VolGroup-lv_swap (dm-1)	253:1	0	3G	0	lvm	[SWAP]
vdb	252:16	0	1G	0	disk	
└─vdb1	252:17	0	1023.7M	0	part	
└─└─md10	9:10	0	2G	0	raid10	
vdc	252:32	0	1G	0	disk	
└─vdc1	252:33	0	1023.7M	0	part	
└─└─md10	9:10	0	2G	0	raid10	
vdd	252:48	0	2G	0	disk	
└─vdd1	252:49	0	1023.7M	0	part	
└─└─md10	9:10	0	2G	0	raid10	
└─└─vdd2	252:50	0	1G	0	part	
└─└─└─md10	9:10	0	2G	0	raid10	

```
[root@host-192-168-133-7 ~]# lsblk
NAME MAJ:MIN RM SIZE RO TYPE MOUNTPOINT
loop0 7:0 0 4.2G 1 loop /media
vda 252:0 0 40G 0 disk
└─vda1 252:1 0 500M 0 part /boot
└─vda2 252:2 0 29.5G 0 part
└─┬─VolGroup-lv_root (dm-0) 253:0 0 26.5G 0 lvm /
└─└─VolGroup-lv_swap (dm-1) 253:1 0 3G 0 lvm [SWAP]
vdb 252:16 0 1G 0 disk
└─vdb1 252:17 0 1023.7M 0 part
└─└─md10 9:10 0 2G 0 raid10
vdc 252:32 0 1G 0 disk
└─vdc1 252:33 0 1023.7M 0 part
└─└─md10 9:10 0 2G 0 raid10
vdd 252:48 0 2G 0 disk
└─vdd1 252:49 0 1G 0 part
└─└─md10 9:10 0 2G 0 raid10
└─└─vdd2 252:50 0 1023.3M 0 part
└─└─└─md10 9:10 0 2G 0 raid10
[root@host-192-168-133-7 ~]#
```

```
# cat /proc/mdstat //查看阵列创建进度, 最后等进度结束后再格式化
```

```
Personalities : [raid10]
md10 : active raid10 vdd2[3] vdd1[2] vdc1[1] vdb1[0]
      2094080 blocks super 1.2 512K chunks 2 near-copies [4/4] [UUUU] //4个U
      [=====>.....] resync = 71.1% (1489472/2094080) finish=0.2min
      speed=46546K/sec

unused devices: <none>
```

```
# cat /proc/mdstat //查看阵列创建进度, 最后等进度结束后再格式化
```

●2.2查看详细信息

```
# mdadm -D /dev/md10
```

其中: -D Detail 详细

```
/dev/md10:
```

```

Version : 1.2
Creation Time : Sun May 10 19:28:15 2020
Raid Level : raid10 //RAID级别10
Array Size : 2094080 (2045.34 MiB 2144.34 MB) //大小为2G
Used Dev Size : 1047040 (1022.67 MiB 1072.17 MB) //磁盘阵列中的成员
                                                    (单个硬盘或分区) 的空间大小

Raid Devices : 4
Total Devices : 4
Persistence : Superblock is persistent

Update Time : Sun May 10 19:29:36 2020
State : clean

Active Devices : 4 //4个设备
Working Devices : 4
Failed Devices : 0
Spare Devices : 0

Layout : near=2
Chunk Size : 512K

Name : host-192-168-133-7:10 (local to host host-192-168-133-7)
UUID : df61cc44:ff670145:a24e2d60:7626cc7a
Events : 17

Number   Major   Minor   RaidDevice State
0         252     17      0         active sync /dev/vdb1
1         252     33      1         active sync /dev/vdc1
2         252     49      2         active sync /dev/vdd1
3         252     50      3         active sync /dev/vdd2

```

●3.写入配置文件

```
# mdadm -Ds
```

其中: -s: scan

```

ARRAY /dev/md10 metadata=1.2 name=host-192-168-133-7:10
UUID=df61cc44:ff670145:a24e2d60:7626cc7a

```

```
# mdadm -Ds >/etc/mdadm.conf
```

```
# cat /etc/mdadm.conf
```

```

ARRAY /dev/md10 metadata=1.2 name=host-192-168-133-7:10
UUID=df61cc44:ff670145:a24e2d60:7626cc7a

```

●4.格式化

```
# mkfs.ext4 /dev/md10
```

●5.挂载点/raid10, 设置开机自动挂载

```
# mkdir /raid10
```

设置开机自动挂载RAID10:

```
# vi /etc/fstab
```

```

/dev/md10                                /raid10                                ext4      defaults      0 0

```

```
# mount -a
```

```
# mount
```

```

/dev/mapper/VolGroup-lv_root on / type ext4 (rw)
proc on /proc type proc (rw)
sysfs on /sys type sysfs (rw)
devpts on /dev/pts type devpts (rw,gid=5,mode=620)
/dev/vdal on /boot type ext4 (rw)
tmpfs on /dev/shm type tmpfs (rw,rootcontext="system_u:object_r:tmpfs_t:s0")
/opt/CentOS-6.5.iso on /media type iso9660 (ro,loop=/dev/loop0)
/dev/md10 on /raid10 type ext4 (rw)

```

```
# cd /raid10
```

```
# touch file1
```

```
# cd
```

```
# umount /dev/md10
```

```
# mount 或 df -hT
```

```
# mount -a
```

```
# mount
```

```
# lsblk
```

NAME	MAJ:MIN	RM	SIZE	RO	TYPE	MOUNTPOINT
loop0	7:0	0	4.2G	1	loop	/media
vda	252:0	0	40G	0	disk	
└─vda1	252:1	0	500M	0	part	/boot
└─vda2	252:2	0	29.5G	0	part	
└─VolGroup-lv_root (dm-0)	253:0	0	26.5G	0	lvm	/
└─VolGroup-lv_swap (dm-1)	253:1	0	3G	0	lvm	[SWAP]
vdb	252:16	0	1G	0	disk	
└─vdb1	252:17	0	1023.7M	0	part	
└─md10	9:10	0	2G	0	raid10	/raid10
vdc	252:32	0	1G	0	disk	
└─vdc1	252:33	0	1023.7M	0	part	
└─md10	9:10	0	2G	0	raid10	/raid10
vdd	252:48	0	2G	0	disk	
└─vdd1	252:49	0	1G	0	part	
└─md10	9:10	0	2G	0	raid10	/raid10
└─vdd2	252:50	0	1023.3M	0	part	
└─md10	9:10	0	2G	0	raid10	/raid10

```
[root@host-192-168-133-7 ~]# lsblk
NAME                                MAJ:MIN RM   SIZE RO TYPE  MOUNTPOINT
loop0                              7:0      0    4.2G  1 loop  /media
vda                                252:0     0    40G   0 disk
├─vda1                            252:1     0    500M   0 part  /boot
└─vda2                            252:2     0   29.5G   0 part
   ├─VolGroup-lv_root (dm-0) 253:0     0   26.5G   0 lvm    /
   └─VolGroup-lv_swap (dm-1) 253:1     0     3G   0 lvm    [SWAP]
vdb                                252:16    0     1G   0 disk
├─vdb1                            252:17    0 1023.7M   0 part
│   └─md10                        9:10     0     2G   0 raid10 /raid10
vdc                                252:32    0     1G   0 disk
├─vdc1                            252:33    0 1023.7M   0 part
│   └─md10                        9:10     0     2G   0 raid10 /raid10
vdd                                252:48    0     2G   0 disk
├─vdd1                            252:49    0     1G   0 part
│   └─md10                        9:10     0     2G   0 raid10 /raid10
└─vdd2                            252:50    0 1023.3M   0 part
    └─md10                        9:10     0     2G   0 raid10 /raid10
[root@host-192-168-133-7 ~]#
```

df -hT

Filesystem	Type	Size	Used	Avail	Use%	Mounted on
/dev/mapper/VolGroup-lv_root	ext4	27G	5.0G	20G	21%	/
tmpfs	tmpfs	1.9G	0	1.9G	0%	/dev/shm
/dev/vda1	ext4	485M	33M	427M	8%	/boot
/opt/CentOS-6.5.iso	iso9660	4.2G	4.2G	0	100%	/media
/dev/md10	ext4	2.0G	35M	1.9G	2%	/raid10

大小2G，4个分区共4G，磁盘利用率2/5=50%

```
[root@host-192-168-133-7 ~]# df -hT
Filesystem                                Type      Size  Used Avail Use% Mounted on
/dev/mapper/VolGroup-lv_root              ext4      27G   5.1G   20G  21% /
/dev/vda1                                ext4      485M   33M  427M   8% /boot
tmpfs                                      tmpfs      1.9G     0   1.9G   0% /dev/shm
/opt/CentOS-6.5.iso                      iso9660    4.2G  4.2G     0 100% /media
/dev/md10                                ext4       2.0G   35M   1.9G   2% /raid10
[root@host-192-168-133-7 ~]#
```

【截图】

■移除磁盘阵列RAID10

不正确移除阵列会引起各种问题

1.卸载raid设备

```
# umount /dev/md10
```


2.停止阵列

```
# mdadm -S /dev/md10
mdadm: stopped /dev/md10
PS: 重启阵列
# mdadm -A -s /dev/md10 //重启阵列
mdadm: /dev/md10 has been started with 4 drives and 1 spare.
# mdadm -S /dev/md0 //停止阵列
```

3.删除磁盘

```
# mdadm --misc --zero-superblock /dev/vdd2
# mdadm --misc --zero-superblock /dev/vdd1
# mdadm --misc --zero-superblock /dev/vdc1
# mdadm --misc --zero-superblock /dev/vdb1
```

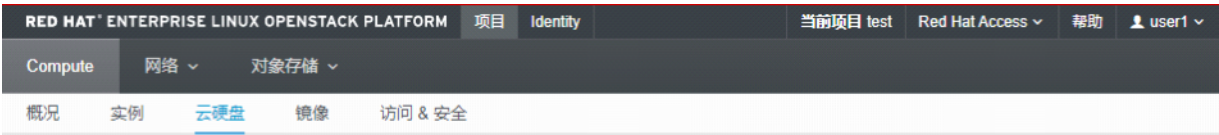
```
[root@host-192-168-133-7 ~]# lsblk
NAME                                MAJ:MIN RM   SIZE RO TYPE MOUNTPOINT
loop0                               7:0      0    4.2G  1 loop /media
vda                                 252:0      0    40G   0 disk
├─vda1                             252:1      0   500M   0 part /boot
├─vda2                             252:2      0   29.5G   0 part
│   └─VolGroup-lv_root (dm-0) 253:0      0   26.5G   0 lvm /
│       └─VolGroup-lv_swap (dm-1) 253:1      0     3G   0 lvm [SWAP]
vdb                                 252:16     0     1G   0 disk
└─vdb1                             252:17     0 1023.7M   0 part
vdc                                 252:32     0     1G   0 disk
└─vdc1                             252:33     0 1023.7M   0 part
vdd                                 252:48     0     2G   0 disk
├─vdd1                             252:49     0     1G   0 part
└─vdd2                             252:50     0 1023.3M   0 part
[root@host-192-168-133-7 ~]#
```

4.删除或注销配置文件mdadm.conf和fstab等

```
# rm /etc/mdadm.conf
# vi /etc/fstab
# /dev/md10          /raid10             ext4      defaults      0 0
```

■在CentOS中对RAID10增加一个备用磁盘防止意外某块磁盘损坏，备用磁盘自动替换

在Centos-C1中添加云硬盘hd(vde)



云硬盘

云硬盘 云硬盘快照

云硬盘

<input type="checkbox"/>	名称	描述	配置	状态	类型	连接到	可用域	可启动	加密的	动作
<input type="checkbox"/>	hd		1GB	In-Use	-	在设备/dev/vde上连接到Centos-C1	nova	False	不	<input type="button" value="编辑卷"/> <input type="button" value="↓"/>
<input type="checkbox"/>	hd8		2GB	In-Use	-	在设备/dev/vdd上连接到Centos-C1	nova	False	不	<input type="button" value="编辑卷"/> <input type="button" value="↓"/>
<input type="checkbox"/>	hd7		1GB	In-Use	-	在设备/dev/vdc上连接到Centos-C1	nova	False	不	<input type="button" value="编辑卷"/> <input type="button" value="↓"/>
<input type="checkbox"/>	hd6		1GB	In-Use	-	在设备/dev/vdb上连接到Centos-C1	nova	False	不	<input type="button" value="编辑卷"/> <input type="button" value="↓"/>

显示4个条目

```
# echo '- - -' > /sys/class/scsi_host/host1/scan //使用命令让系统识别
# lsblk
```

增加了一行:

```
vde 252:64 0 1G 0 disk
```

fdisk /dev/vde

n, p, 1, 回车, 回车, t, fd, p, w

Device	Boot	Start	End	Blocks	Id	System
/dev/vde1		1	2080	1048288+	fd	Linux raid autodetect

mdadm /dev/md10 -a /dev/vde1 //对RAID10增加备用磁盘vde, 1个分区vde1

mdadm: added /dev/vde1

mdadm -D /dev/md10 //查看

Spare Devices : 1

Number	Major	Minor	RaidDevice	State	Sync	Path
4	252	65	-	spare		/dev/vde1 //已成功加入, 称为备用磁盘

mdadm /dev/md10 -f /dev/vdb1 //用-f命令模拟vdb盘vde1分区损坏

mdadm: set /dev/vdb1 faulty in /dev/md10

mdadm -D /dev/md10 //查看

Number	Major	Minor	RaidDevice	State	Sync	Path
4	252	65	0	active	sync	/dev/vde1
1	252	33	1	active	sync	/dev/vdc1
2	252	49	2	active	sync	/dev/vdd1
3	252	50	3	active	sync	/dev/vdd2

Number	Major	Minor	RaidDevice	State	Sync	Path
0	252	17	-	faulty		/dev/vdb1 注: 损坏的sdb已替换下来, 接

下来我们就可以移除它了

mdadm /dev/md10 -r /dev/vdb1 //移除损坏的磁盘

mdadm: hot removed /dev/vdb1 from /dev/md10

mdadm -D /dev/md10 //查看

Number	Major	Minor	RaidDevice	State	Sync	Path
4	252	65	0	active	sync	/dev/vde1
1	252	33	1	active	sync	/dev/vdc1
2	252	49	2	active	sync	/dev/vdd1
3	252	50	3	active	sync	/dev/vdd2

```
Name : host-192-168-133-7:10 (local to host host-192-168-133-7)
UUID : 3611a1be:79da9d57:d9526446:54afdbb7
Events : 38
```

Number	Major	Minor	RaidDevice	State	Sync	Path
4	252	65	0	active	sync	/dev/vde1
1	252	33	1	active	sync	/dev/vdc1
2	252	49	2	active	sync	/dev/vdd1
3	252	50	3	active	sync	/dev/vdd2

```
[root@host-192-168-133-7 ~]# mdadm -D /dev/md10^C
```

【截图】

RAID10的创建过程总结:

```
# fdisk -l
# fdisk /dev/sda
# partx -a /dev/sda
```

①

```
# mdadm -C /dev/md10 -l10 -n4 /dev/sda9 /dev/sda10 /dev/sda11 /dev/sda12
```

②

```
# ls /dev/md*
# cat /proc/mdstat
```

③

```
# mdadm -D /dev/md10
```

④

```
# mdadm -Ds
# mdadm -Ds > /etc/mdadm.conf
# cat /etc/mdadm.conf
```

⑤

```
# mdadm -S /dev/md10
# ls /dev/md*
# cat /proc/mdstat
# mdadm -D /dev/md10
# mdadm -Ds
```

⑥

试验操作

```
# mdadm -A /dev/md10
```

```
# ls /dev/md*
```

```
# cat /proc/mdstat
```

```
# mdadm -Ds
```

⑦
试验操作

```
# mkfs.ext4 /dev/md10
```

```
# mkdir /raid10
```

```
# mount /dev/md10 /raid10
```

```
# cp /etc/passwd passwd-raid10
```

```
# touch 123kangyuanbing-raid10
```

```
# mkdir dir3
```

```
# ls
```

```
# mount
```

```
# df -h
```

```
# vim /etc/fstab
```

⑧

■交换分区

Windows 不会为 swap 单独划分一个分区，而是使用分页文件实现相同的功能，在概念上，Windows 称其为**虚拟内存**。

swap 分区通常被称为交换分区，这是一块特殊的硬盘空间，即当实际内存不够用的时候，操作系统会从内存中取出一部分暂时不用的数据，放在交换分区中，从而为当前运行的程序腾出足够的内存空间。

一般来讲，swap 分区容量应大于物理内存大小，建议是内存的两倍，但不超过 2GB。

【分析】

server-a的交换分区：

```
[root@server-a ~]# free -m
```

	total	used	free	shared	buff/cache	available
Mem:	4947	3171	1416	16	359	1462
Swap:	3967	1123	2844			

```
[root@server-a ~]# lsblk
```

```
NAME        MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
sda           8:0    0 100G  0 disk
├─sda1        8:1    0 500M  0 part /boot
└─sda2        8:2    0 99.5G  0 part
   └─rhel-swap 253:0    0  3.9G  0 lvm  [SWAP]
      └─rhel-root 253:1    0  50G  0 lvm  /
         └─rhel-home 253:2    0 45.6G  0 lvm  /home
sdb           8:16    0   1G  0 disk
sdc           8:32    0   1G  0 disk
sdd           8:48    0   2G  0 disk
sr0          11:0    1 1024M  0 rom
loop0         7:0    0    2G  0 loop /srv/node/swiftloopback
loop1         7:1    0 20.6G  0 loop
└─cinder--volumes-volume--0c916c7d--8d79--4de8--a417--d08519799782
   253:3    0   1G  0 lvm
└─cinder--volumes-volume--9d17bfb7--a77a--44f8--97e5--de2d4f13bafc
   253:4    0   1G  0 lvm
└─cinder--volumes-volume--80e05216--fd00--4952--852a--0b2b09b7bc3b
   53:5    0   2G  0 lvm
```

云主机Centos-C1的交换分区：

```
[root@host-192-168-133-7 ~]# free -m
```

	total	used	free	shared	buffers	cached
Mem:	3832	367	3465	0	2	243
-/+ buffers/cache:		120	3711			
Swap:	3071	0	3071			

```
[root@host-192-168-133-7 ~]# lsblk
```

```
NAME        MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
loop0         7:0    0  4.2G  1 loop /media
vda          252:0    0   40G  0 disk
├─vda1        252:1    0  500M  0 part /boot
└─vda2        252:2    0 29.5G  0 part
   └─VolGroup-lv_root (dm-0) 253:0    0 26.5G  0 lvm  /
```

```

└─VolGroup-lv_swap (dm-1) 253:1 0 3G 0 lvm [SWAP]
vdb 252:16 0 1G 0 disk
└─vdb1 252:17 0 1G 0 part
└─md10 9:10 0 2G 0 raid10 /raid10
vdc 252:32 0 1G 0 disk
└─vdc1 252:33 0 1G 0 part
└─md10 9:10 0 2G 0 raid10 /raid10
vdd 252:48 0 2G 0 disk
└─vdd1 252:49 0 1G 0 part
└─md10 9:10 0 2G 0 raid10 /raid10
└─vdd2 252:50 0 1023.3M 0 part
└─md10 9:10 0 2G 0 raid10 /raid10

```

1.查看目前的交换分区情况

swapon -s

文件名	类型	大小	已用	优先权
Filename	Type	Size	Used	Priority
/dev/dm-1	partition	2064376	0	-1

cat /etc/fstab

```

/dev/mapper/VolGroup-lv_root / ext4 defaults 1 1
/dev/mapper/VolGroup-lv_swap swap swap defaults 0 0

```

lsblk

NAME	MAJ:MIN	RM	SIZE	RO	TYPE	MOUNTPOINT
vda	252:0	0	30G	0	disk	
└─vda1	252:1	0	500M	0	part	/boot
└─vda2	252:2	0	29.5G	0	part	
└─VolGroup-lv_root (dm-0)	253:0	0	27.6G	0	lvm	/
└─VolGroup-lv_swap (dm-1)	253:1	0	2G	0	lvm	[SWAP]

ll /dev/mapper

```

crw-rw----. 1 root root 10, 58 May 11 16:09 control
lrwxrwxrwx. 1 root root 7 May 11 16:09 VolGroup-lv_root -> ../dm-0
lrwxrwxrwx. 1 root root 7 May 11 16:09 VolGroup-lv_swap -> ../dm-1

```

ll /dev/dm*

```

brw-rw----. 1 root disk 253, 0 May 11 16:09 /dev/dm-0
brw-rw----. 1 root disk 253, 1 May 11 16:09 /dev/dm-1

```

原来/dev/mapper/VolGroup-lv_swap是链接到/dev/dm-1，这就和swapon -s命令的结果对上了，但是/dev/dm-1又是什么呢，它不是一个分区设备文件，但是属于块文件。

CentOS可以使用文件作为交换分区，也可以使用一个分区作为交换分区，所以/dev/dm-1是一个分区文件。

2.添加交换分区

umount /dev/md10

(1)swap分区

fdisk /dev/md10

```

Command (m for help): n
Command action
  e   extended
  p   primary partition (1-4)
p
Partition number (1-4): 1
First cylinder (1-523776, default 257):
Using default value 257
Last cylinder, +cylinders or +size{K,M,G} (257-523776, default 523776): +500M

Command (m for help): p

Disk /dev/md10: 2145 MB, 2145386496 bytes
2 heads, 4 sectors/track, 523776 cylinders
Units = cylinders of 8 * 512 = 4096 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 524288 bytes / 1048576 bytes
Disk identifier: 0xe9336d0f

```

Device	Boot	Start	End	Blocks	Id	System
--------	------	-------	-----	--------	----	--------

```

/dev/md10p1          257          128256          512000      83  Linux

Command (m for help): t
Selected partition 1
Hex code (type L to list codes): 82

    Device Boot      Start         End      Blocks   Id  System
/dev/md10p1          257         128256        512000    82  Linux swap / Solaris

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 22: Invalid argument.
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.

```

```

# file /dev/md10p1
/dev/md10p1: block special
# yum install kpartx -y
# kpartx -l /dev/md10
md10p1 : 0 1024000 /dev/md10 2048

```

(2)格式化

```

# mkswap /dev/md10p1
Setting up swspace version 1, size = 511996 KiB
no label, UUID=62fc5eda-845d-4931-a4f2-7cdb00901223

```

使用blkid命令查看一下分区的格式化信息:

```

# blkid
/dev/loop0: LABEL="CentOS_6.5_Final" TYPE="iso9660"
/dev/vda1: UUID="a5fecc6c-d37b-4342-a192-c12b2feaa4e8" TYPE="ext4"
/dev/vda2: UUID="bhf50r-F49f-zNz9-cJui-zxnv-2OrY-IYwB85" TYPE="LVM2_member"
/dev/mapper/VolGroup-lv_root: UUID="ffcb115c-15be-4746-a19f-c48f6db98906" TYPE="t4"
/dev/mapper/VolGroup-lv_swap: UUID="e1f84e33-2237-427f-b26c-1cf096af093d" TYPE="ap"
/dev/vdb1: UUID="8fb6fcd2-b486-9d26-f8cb-817f9b5a84b6" UUID_SUB="4cff8c06-3392-59-eb9c-ca5f2a9a1a42" LABEL="host-192-168-133-7:10" TYPE="linux_raid_member"
/dev/vdc1: UUID="8fb6fcd2-b486-9d26-f8cb-817f9b5a84b6"
UUID_SUB="89d8b787-0797-51-90f4-06e345eea96b" LABEL="host-192-168-133-7:10"
TYPE="linux_raid_member"
/dev/vdd1: UUID="8fb6fcd2-b486-9d26-f8cb-817f9b5a84b6"
UUID_SUB="70a16866-4a89-1b-50bb-6e580bc34e6d" LABEL="host-192-168-133-7:10"
TYPE="linux_raid_member"
/dev/vdd2: UUID="8fb6fcd2-b486-9d26-f8cb-817f9b5a84b6" UUID_SUB="a7956732-cabc-fe-2c81-e02d7ab4138e" LABEL="host-192-168-133-7:10" TYPE="linux_raid_member"
/dev/vdel1: UUID="8fb6fcd2-b486-9d26-f8cb-817f9b5a84b6" UUID_SUB="3f6d796d-e150-c3-3908-a53c93d953d8" LABEL="host-192-168-133-7:10" TYPE="linux_raid_member"
/dev/md10: UUID="e4fd8be1-6253-4cf3-ada6-e5a95ae67d8a" TYPE="ext4"
/dev/md10p1: UUID="62fc5eda-845d-4931-a4f2-7cdb00901223" TYPE="swap"

```

(3)挂载

```

# swapon /dev/md10p1 //挂载
# free -m //查看交换分区情况, 从3071->3571, 增加了500M

```

	total	used	free	shared	buffers	cached
Mem:	3832	367	3465	0	2	243
-/+ buffers/cache:		121	3711			
Swap:	3571	0	3571			

```

# swapon -s
Filename      Type      Size      Used     Priority
/dev/dm-1     partition 3145720    0        -1
/dev/md10p1   partition 511992     0        -2

```

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P4: 在Centos-C1上完成如下操作

(二) 完成磁盘阵列RAID10部署

7.利用已添加的三块虚拟硬盘hd6、hd7、hd8进行设置, hd6、hd7对应硬盘均设置为一个主分区, hd8对应硬盘设置为两个1G大小的逻辑分区, 并完成磁盘阵列RAID10的操作。

8.将RAID10的/dev/md10分区, 分出一个大小为500M的空间, 格式化为swap分区, 设为开机生效。

vi /etc/fstab //开机自动挂载交换分区

```
#/dev/md10          /raid10 ext4    defaults 0 0    //注释掉, 禁止md10开机启动!
/dev/md10p1        swap     swap     defaults 0 0
```

[root@host-192-168-133-7 ~]# vi /etc/fstab

```
1
2 #
3 # /etc/fstab
4 # Created by anaconda on Fri Feb 23 05:35:49 2018
5 #
6 # Accessible filesystems, by reference, are maintained under '/dev/disk'
7 # See man pages fstab(5), findfs(8), mount(8) and/or blkid(8) for more info
8 #
9 /dev/mapper/VolGroup-lv_root /                ext4    defaults 1 1
10 UUID=a5fecc6c-d37b-4342-a192-c12b2feaa4e8 /boot            ext4    defaults 1 2
11 /dev/mapper/VolGroup-lv_swap swap             swap    defaults 0 0
12 tmpfs                  /dev/shm        tmpfs   defaults 0 0
13 devpts                  /dev/pts        devpts  gid=5,mode=620 0 0
14 sysfs                   /sys            sysfs   defaults 0 0
15 proc                    /proc           proc    defaults 0 0
16 /opt/CentOS-6.5.iso     /media           iso9660 defaults,loop,ro 0 0
17 #/dev/md10              /raid10         ext4    defaults 0 0
18 /dev/md10p1            swap            swap    defaults 0 0
```

swapon -s //查看交换分区情况

Filename	Type	Size	Used	Priority
/dev/dm-1	partition	3145720	0	-1
/dev/md10p1	partition	511992	0	-2

[root@host-192-168-133-7 ~]# swapon -s

Filename	Type	Size	Used	Priority
/dev/dm-1	partition	3145720	0	-1
/dev/md10p1	partition	511992	0	-2

[root@host-192-168-133-7 ~]#

lsblk //查看分区及挂载情况

NAME	MAJ:MIN	RM	SIZE	RO	TYPE	MOUNTPOINT
loop0	7:0	0	4.2G	1	loop	/media
vda	252:0	0	40G	0	disk	
├─vda1	252:1	0	500M	0	part	/boot
└─vda2	252:2	0	29.5G	0	part	
├─VolGroup-lv_root (dm-0)	253:0	0	26.5G	0	lvm	/
└─VolGroup-lv_swap (dm-1)	253:1	0	3G	0	lvm	[SWAP]
vdb	252:16	0	1G	0	disk	
└─vdb1	252:17	0	1023.7M	0	part	
└─md10	9:10	0	2G	0	raid10	
└─md10p1	259:0	0	500M	0	md	[SWAP]
vdc	252:32	0	1G	0	disk	
└─vdc1	252:33	0	1023.7M	0	part	
└─md10	9:10	0	2G	0	raid10	
└─md10p1	259:0	0	500M	0	md	[SWAP]
vdd	252:48	0	2G	0	disk	
├─vdd1	252:49	0	1G	0	part	
└─md10	9:10	0	2G	0	raid10	
└─md10p1	259:0	0	500M	0	md	[SWAP]
└─vdd2	252:50	0	1023.3M	0	part	
└─md10	9:10	0	2G	0	raid10	
└─md10p1	259:0	0	500M	0	md	[SWAP]
vde	252:64	0	1G	0	disk	
└─vde1	252:65	0	1023.7M	0	part	

[root@host-192-168-133-7 ~]# lsblk

NAME	MAJ:MIN	RM	SIZE	RO	TYPE	MOUNTPOINT
loop0	7:0	0	4.2G	1	loop	/media
vda	252:0	0	40G	0	disk	
├─vda1	252:1	0	500M	0	part	/boot

```
[root@host-192-168-133-7 ~]# lsblk
NAME                                MAJ:MIN RM   SIZE RO TYPE  MOUNTPOINT
loop0                               7:0      0    4.2G  1 loop  /media
vda                                 252:0      0    40G   0 disk
├─vda1                             252:1      0    500M   0 part  /boot
├─vda2                             252:2      0    29.5G   0 part
│   └─VolGroup-lv_root (dm-0) 253:0      0    26.5G   0 lvm    /
│       └─VolGroup-lv_swap (dm-1) 253:1      0     3G   0 lvm    [SWAP]
vdb                                 252:16     0     1G   0 disk
├─vdb1                             252:17     0 1023.7M   0 part
│   └─md10                         9:10      0     2G   0 raid10
│       └─md10p1                   259:0      0    500M   0 md     [SWAP]
vdc                                 252:32     0     1G   0 disk
├─vdc1                             252:33     0 1023.7M   0 part
│   └─md10                         9:10      0     2G   0 raid10
│       └─md10p1                   259:0      0    500M   0 md     [SWAP]
vdd                                 252:48     0     2G   0 disk
├─vdd1                             252:49     0     1G   0 part
│   └─md10                         9:10      0     2G   0 raid10
│       └─md10p1                   259:0      0    500M   0 md     [SWAP]
├─vdd2                             252:50     0 1023.3M   0 part
│   └─md10                         9:10      0     2G   0 raid10
│       └─md10p1                   259:0      0    500M   0 md     [SWAP]
vde                                 252:64     0     1G   0 disk
└─vde1                             252:65     0 1023.7M   0 part
[root@host-192-168-133-7 ~]#
```

【截图】

有关命令：

```
fdisk -l          #查看系统当下挂载磁盘情况
fdisk /dev/sdb    #对sdb磁盘分区
mkfs.xfs /dev/sdb1 #格式化sdb1分区
mkswap /dev/sdb2  #格式化为交换分区
blkid             #查看磁盘情况
lsblk             #查看分区和磁盘
fdisk /dev/sda    #查看分区、操作分区、格式化分区等
df -hT           #查看分区挂载、容量等
du -sh /backup    #统计当前目录各文件夹大小
dd if=/dev/sda of=/dev/sdb #磁盘拷贝
```

```
# mount /dev/md10
```

```
# partx -l /dev/md10
```

```
# 1:      2048-   1026047 (   1024000 sectors,    524 MB)
# 2:      0-      -1 (         0 sectors,      0 MB)
# 3:      0-      -1 (         0 sectors,      0 MB)
# 4:      0-      -1 (         0 sectors,      0 MB)
```

扩展卷：

```
fdisk /dev/sdb 分区，设置成LVM分区格式，使用partprobe，确保分区有效
pvcreate /dev/sdb3，创建物理卷
vgextend VolGroup /dev/sdb3，扩展卷组
lvextend -l +100%free /dev/mapper/centos-root，扩展逻辑卷
xfs_growfs /dev/mapper/centos-root，扩展文件系统
df -h，检查是否扩展完成
```

==课后练习=====

实战3：在云主机Centos-C4上创建RAID5，设备名：md5，挂载点：/raid5

【Centos-C4】RAID5，2个云硬盘(卷)，需要3个分区

IP: 192.168.11.39(192.168.133.4)

Centos-C4: hd9 vdb 1G

hd10 vdc 2G 需分2个区

●准备工作: 将2个云硬盘(卷)变成等分的3个分区

[root@host-192-168-133-4 ~]# lsblk

NAME	MAJ:MIN	RM	SIZE	RO	TYPE	MOUNTPPOINT
loop0	7:0	0	4.2G	1	loop	/media //已配置开机光盘挂载
vda	252:0	0	40G	0	disk	
└─vda1	252:1	0	500M	0	part	/boot
└─vda2	252:2	0	29.5G	0	part	
└─VolGroup-lv_root (dm-0)	253:0	0	27.6G	0	lvm	/
└─VolGroup-lv_swap (dm-1)	253:1	0	2G	0	lvm	[SWAP]
vdb	252:16	0	1G	0	disk	//hd9 1G需分为1个区
vdc	252:32	0	2G	0	disk	//hd10 2G需分为2个区

云硬盘(卷)vdb、vdc分区:

[root@host-192-168-133-4 ~]# fdisk /dev/vdc //将云硬盘(卷)vdc分为2个区

Device contains neither a valid DOS partition table, nor Sun, SGI or OSF disklabel
Building a new DOS disklabel with disk identifier 0x7a8b56b6.
Changes will remain in memory only, until you decide to write them.
After that, of course, the previous content won't be recoverable.

Warning: invalid flag 0x0000 of partition table 4 will be corrected by w(rite)

WARNING: DOS-compatible mode is deprecated. It's strongly recommended to
switch off the mode (command 'c') and change display units to
sectors (command 'u').

Command (m for help): m

Command action

- a toggle a bootable flag
- b edit bsd disklabel
- c toggle the dos compatibility flag
- d delete a partition
- l list known partition types
- m print this menu
- n add a new partition
- o create a new empty DOS partition table
- p print the partition table
- q quit without saving changes
- s create a new empty Sun disklabel
- t change a partition's system id
- u change display/entry units
- v verify the partition table
- w write table to disk and exit
- x extra functionality (experts only)

Command (m for help): //主要用到 m p n n d l t w

Command (m for help): n

Command action

- e extended
- p primary partition (1-4)

p

Partition number (1-4): 1

First cylinder (1-4161, default 1):

Using default value 1

Last cylinder, +cylinders or +size{K,M,G} (1-4161, default 4161): +1G

Command (m for help): n

Command action

- e extended
- p primary partition (1-4)

p

Partition number (1-4): 2

First cylinder (2083-4161, default 2083):

Using default value 2083

Last cylinder, +cylinders or +size{K,M,G} (2083-4161, default 4161):

Using default value 4161

Command (m for help): **p**

Disk /dev/vdc: 2147 MB, 2147483648 bytes
16 heads, 63 sectors/track, 4161 cylinders
Units = cylinders of 1008 * 512 = 516096 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk identifier: 0x7a8b56b6

Device	Boot	Start	End	Blocks	Id	System
/dev/vdc1		1	2082	1049296+	83	Linux
/dev/vdc2		2083	4161	1047816	83	Linux

注意：若是分区，分区的类型，要修改为“fd Linux raid auto”

Command (m for help): **l**

0	Empty	24	NEC DOS	81	Minix / old Lin	bf	Solaris
1	FAT12	39	Plan 9	82	Linux swap / So	c1	DRDOS/sec (FAT-
2	XENIX root	3c	PartitionMagic	83	Linux	c4	DRDOS/sec (FAT-
3	XENIX usr	40	Venix 80286	84	OS/2 hidden C:	c6	DRDOS/sec (FAT-
4	FAT16 <32M	41	PPC PReP Boot	85	Linux extended	c7	Syrinx
5	Extended	42	SFS	86	NTFS volume set	da	Non-FS data
6	FAT16	4d	QNX4.x	87	NTFS volume set	db	CP/M / CTOS / .
7	HPFS/NTFS	4e	QNX4.x 2nd part	88	Linux plaintext	de	Dell Utility
8	AIX	4f	QNX4.x 3rd part	8e	Linux LVM	df	BootIt
9	AIX bootable	50	OnTrack DM	93	Amoeba	e1	DOS access
a	OS/2 Boot Manag	51	OnTrack DM6 Aux	94	Amoeba BBT	e3	DOS R/O
b	W95 FAT32	52	CP/M	9f	BSD/OS	e4	SpeedStor
c	W95 FAT32 (LBA)	53	OnTrack DM6 Aux	a0	IBM Thinkpad hi	eb	BeOS fs
e	W95 FAT16 (LBA)	54	OnTrackDM6	a5	FreeBSD	ee	GPT
f	W95 Ext'd (LBA)	55	EZ-Drive	a6	OpenBSD	ef	EFI (FAT-12/16/
10	OPUS	56	Golden Bow	a7	NeXTSTEP	f0	Linux/PA-RISC b
11	Hidden FAT12	5c	Priam Edisk	a8	Darwin UFS	f1	SpeedStor
12	Compaq diagnost	61	SpeedStor	a9	NetBSD	f4	SpeedStor
14	Hidden FAT16 <3	63	GNU HURD or Sys	ab	Darwin boot	f2	DOS secondary
16	Hidden FAT16	64	Novell Netware	af	HFS / HFS+	fb	VMware VMFS
17	Hidden HPFS/NTF	65	Novell Netware	b7	BSDI fs	fc	VMware VMKCORE
18	AST SmartSleep	70	DiskSecure Mult	b8	BSDI swap	fd	Linux raid auto
1b	Hidden W95 FAT3	75	PC/IX	bb	Boot Wizard hid	fe	LANstep
1c	Hidden W95 FAT3	80	Old Minix	be	Solaris boot	ff	BBT
1e	Hidden W95 FAT1						

Command (m for help): **t**

Partition number (1-4): **1**

Hex code (type L to list codes): **fd**

Changed system type of partition 1 to fd (Linux raid autodetect)

Command (m for help): **t**

Partition number (1-4): **2**

Hex code (type L to list codes): **fd**

Changed system type of partition 2 to fd (Linux raid autodetect)

Command (m for help): **p**

Disk /dev/vdc: 2147 MB, 2147483648 bytes
16 heads, 63 sectors/track, 4161 cylinders
Units = cylinders of 1008 * 512 = 516096 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disk identifier: 0x7a8b56b6

Device	Boot	Start	End	Blocks	Id	System
/dev/vdc1		1	2082	1049296+	fd	Linux raid autodetect
/dev/vdc2		2083	4161	1047816	fd	Linux raid autodetect

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.

partx -a /dev/vdc //创建分区完毕之后，使用该命令在不重启Linux的情况下，使新建分区生效

BLKPG: Device or resource busy

error adding partition 1

BLKPG: Device or resource busy

error adding partition 2

[root@host-192-168-133-4 ~]# lsblk

NAME	MAJ:MIN	RM	SIZE	RO	TYPE	MOUNTPOINT
loop0	7:0	0	4.2G	1	loop	/media
vda	252:0	0	40G	0	disk	
├─vda1	252:1	0	500M	0	part	/boot
└─vda2	252:2	0	29.5G	0	part	
├─VolGroup-lv_root (dm-0)	253:0	0	27.6G	0	lvm	/
└─VolGroup-lv_swap (dm-1)	253:1	0	2G	0	lvm	[SWAP]
vdb	252:16	0	<u>1G</u>	0	disk	
└─vdb1	252:17	0	1G	0	part	
vdc	252:32	0	<u>2G</u>	0	disk	
├─vdc1	252:33	0	1G	0	part	
└─vdc2	252:34	0	1023.3M	0	part	

●1.创建RAID5

mdadm -C /dev/md5 -l 5 -n 3 /dev/vdb1 /dev/vdc1 /dev/vdc2

其中: -C Create创建, -l level级别, -n 硬盘或分区个数

```
mdadm: Defaulting to version 1.2 metadata
mdadm: array /dev/md5 started.
```

●2.1.查看状态

ll /dev/md*

```
brw-rw----. 1 root disk 9, 5 May 10 14:14 /dev/md5
```

cat /proc/mdstat

```
Personalities : [raid6] [raid5] [raid4]
md5 : active raid5 vdc2[3] vdc1[1] vdb1[0]
      2094080 blocks super 1.2 level 5, 512k chunk, algorithm 2 [3/3] [UUU] //3个U!
      [=====>.....] recovery = 44.7% (469384/1047040) finish=1.2min
      speed=7524K/sec

unused devices: <none>
```

●2.2.查看详细信息

mdadm -D /dev/md5

其中: -D: Detail 详细

```
/dev/md5:
  Version : 1.2
  Creation Time : Sun May 10 14:14:23 2020
    Raid Level : raid5 //RAID级别5
    Array Size : 2094080 (2045.34 MiB 2144.34 MB) //大小为2G
  Used Dev Size : 1047040 (1022.67 MiB 1072.17 MB) //磁盘阵列中的成员
                                           (单个硬盘或分区) 的空间大小

  Raid Devices : 3
  Total Devices : 3
 Persistence : Superblock is persistent

 Update Time : Sun May 10 14:16:37 2020
   State : clean

 Active Devices : 3 //3个设备
 Working Devices : 3
 Failed Devices : 0
 Spare Devices : 0


 Layout : left-symmetric
 Chunk Size : 512K


 Name : host-192-168-133-4:5 (local to host host-192-168-133-4)
 UUID : f4970d7d:0fd7b874:ec4d1ed0:9980d6e8
 Events : 18


   Number   Major   Minor   RaidDevice State
     0         252        17           0  active sync  /dev/vdb1
     1         252        33           1  active sync  /dev/vdc1
     2         252        34           2  active sync  /dev/vdc2
```

●3.写入配置文件

mdadm -Ds

其中: -s: scan

```
ARRAY /dev/md5 metadata=1.2 name=host-192-168-133-4:5
UUID=f4970d7d:0fd7b874:ec4d1ed0:9980d6e8
```

mdadm -Ds >/etc/mdadm.conf

cat /etc/mdadm.conf

```
ARRAY /dev/md5 metadata=1.2 name=host-192-168-133-4:5
UUID=f4970d7d:0fd7b874:ec4d1ed0:9980d6e8
```

mdadm -S /dev/md5 //停掉md5

```
mdadm: stopped /dev/md5
```

ls /dev/md* //查看其设备文件

```
brw-rw----. 1 root disk 9, 5 May 10 17:18 /dev/md5
```

cat /proc/mdstat //查看其状态信息

```
Personalities : [raid6] [raid5] [raid4]
unused devices: <none>
```

mdadm -D /dev/md5 //查看其详细信息

```
mdadm: md device /dev/md5 does not appear to be active.
```

mdadm -Ds //查看其配置信息

mdadm -A /dev/md5 //重新激活磁盘阵列, -A : assemble

```
mdadm: /dev/md5 has been started with 3 drives.
```

●4.格式化

mkfs.ext4 /dev/md5

```
mke2fs 1.41.12 (17-May-2010)
Filesystem label=
OS type: Linux
Block size=4096 (log=2)
Fragment size=4096 (log=2)
Stride=128 blocks, Stripe width=256 blocks
131072 inodes, 523520 blocks
26176 blocks (5.00%) reserved for the super user
First data block=0
Maximum filesystem blocks=536870912
16 block groups
32768 blocks per group, 32768 fragments per group
8192 inodes per group
Superblock backups stored on blocks:
    32768, 98304, 163840, 229376, 294912

Writing inode tables: done
Creating journal (8192 blocks): done
Writing superblocks and filesystem accounting information: done

This filesystem will be automatically checked every 36 mounts or
180 days, whichever comes first. Use tune2fs -c or -i to override.
```

●5.挂载点/raid5, 设置开机自动挂载

mkdir /raid5

mount /dev/md5 /raid5 //临时挂载

验证:

mount

```
/dev/md5 on /raid5 type ext4 (rw)
```

df -h

```
Filesystem      Size  Used Avail Use% Mounted on
/dev/md5        2.0G   35M  1.9G   2% /raid5
```

cd /raid5

touch file1

设置开机自动挂载RAID5:

vi /etc/fstab

```
/dev/md5    /raid5    ext4    defaults    0 0
```

mount -a

故障诊断和排错:

umount /dev/md5 //报错! 需退出/raid5目录

```
umount: /raid5: device is busy.
(In some cases useful info about processes that use
the device is found by lsof(8) or fuser(1))
```

```
# cd
# umount /dev/md5
# mount //显示挂载情况, 无/dev/md5
/dev/mapper/VolGroup-lv_root on / type ext4 (rw)
proc on /proc type proc (rw)
sysfs on /sys type sysfs (rw)
devpts on /dev/pts type devpts (rw,gid=5,mode=620)
tmpfs on /dev/shm type tmpfs (rw,rootcontext="system_u:object_r:tmpfs_t:s0")
/dev/vda1 on /boot type ext4 (rw)
/opt/CentOS-6.5.iso on /media type iso9660 (ro,loop=/dev/loop0)
none on /proc/sys/fs/binfmt_misc type binfmt_misc (rw)
gvfs-fuse-daemon on /root/.gvfs type fuse.gvfs-fuse-daemon (rw,nosuid,nodev)

# mount -a
# partprobe
Warning: WARNING: the kernel failed to re-read the partition table on /dev/vda
(Device or resource busy). As a result, it may not reflect all of your changes
until after reboot.
Warning: WARNING: the kernel failed to re-read the partition table on /dev/vdc
(Device or resource busy). As a result, it may not reflect all of your changes
until after reboot.

# mdadm --misc --zero-superblock /dev/sdb1 /dev/vdc1 /dev/vdc2 //删除磁盘
# rm -rf /etc/mdadm.conf //删除配置文件
```

mount

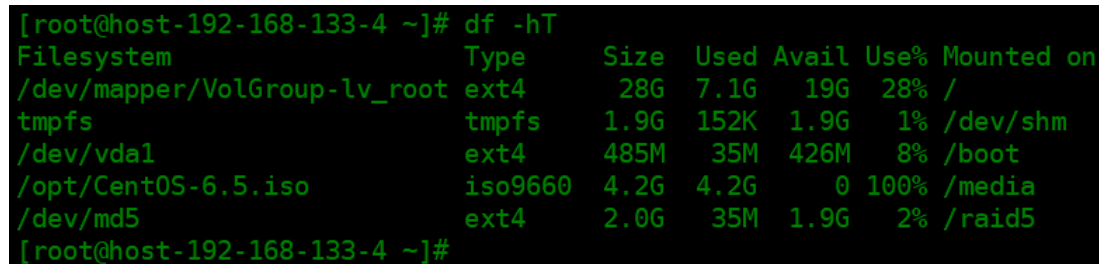
最后一行:

```
/dev/md5 on /raid5 type ext4 (rw)
```

df -hT

Filesystem	Type	Size	Used	Avail	Use%	Mounted on
/dev/mapper/VolGroup-lv_root	ext4	28G	7.1G	19G	28%	/
tmpfs	tmpfs	1.9G	144K	1.9G	1%	/dev/shm
/dev/vda1	ext4	485M	35M	426M	8%	/boot
/opt/CentOS-6.5.iso	iso9660	4.2G	4.2G	0	100%	/media
/dev/md5	ext4	2.0G	35M	1.9G	2%	/raid5

大小2G, 3个分区共3G, 磁盘利用率2/3=67%



```
[root@host-192-168-133-4 ~]# df -hT
Filesystem                                Type      Size      Used      Avail     Use%      Mounted on
/dev/mapper/VolGroup-lv_root              ext4      28G       7.1G      19G       28%      /
tmpfs                                     tmpfs     1.9G      152K      1.9G       1%      /dev/shm
/dev/vda1                                 ext4      485M      35M       426M       8%      /boot
/opt/CentOS-6.5.iso                       iso9660   4.2G      4.2G      0          100%     /media
/dev/md5                                  ext4      2.0G      35M       1.9G       2%      /raid5
[root@host-192-168-133-4 ~]#
```

【截图】

●6.损坏测试

设置磁盘阵列/dev/md5中的一个硬盘 (分区/dev/vdb) 损坏 (模拟坏掉) :

```
# mdadm /dev/md5 -f /dev/vdb1
```

其中: -f: faulty, 模拟硬盘 (/dev/vdb) 或分区损坏

```
mdadm: set /dev/vdb faulty in /dev/md5
```

cat /proc/mdstat

```
Personalities : [raid6] [raid5] [raid4]
md5 : active raid5 vdb1[0](F) vdc2[3] vdc1[1]
      2094080 blocks super 1.2 level 5, 512k chunk, algorithm 2 [3/2] [_UU]
```

```
unused devices: <none>
```

mdadm -D /dev/md5

```
/dev/md5:
Version : 1.2
Creation Time : Sun May 10 17:05:20 2020
Raid Level : raid5
Array Size : 2094080 (2045.34 MiB 2144.34 MB)
Used Dev Size : 1047040 (1022.67 MiB 1072.17 MB)
Raid Devices : 3
Total Devices : 3
Persistence : Superblock is persistent
```

```
Update Time : Sun May 10 18:09:45 2020
State : clean, degraded
Active Devices : 2
Working Devices : 2
Failed Devices : 1
Spare Devices : 0
```

```
Layout : left-symmetric
Chunk Size : 512K
```

```
Name : host-192-168-133-4:5 (local to host host-192-168-133-4)
UUID : f4970d7d:0fd7b874:ec4d1ed0:9980d6e8
Events : 20
```

Number	Major	Minor	RaidDevice	State	
0	0	0	0	removed	
1	252	33	1	active sync	/dev/vdc1
3	252	34	2	active sync	/dev/vdc2
0	252	17	-	faulty	/dev/vdb1

ls /raid5 //查看磁盘阵列/dev/md5中的文件是否还在? 在!

```
file1 lost+found
```

mdadm /dev/md5 -r /dev/vdb1 //已损坏的硬盘(分区/dev/vdb1)从磁盘阵列/dev/md5中移出, -r: remove
mdadm: hot removed /dev/vdb1 from /dev/md5

cat /proc/mdstat

```
Personalities : [raid6] [raid5] [raid4]
md5 : active raid5 vdc2[3] vdc1[1] //无vdb1
      2094080 blocks super 1.2 level 5, 512k chunk, algorithm 2 [3/2] [_UU]
unused devices: <none>
```

mdadm -D /dev/md5

```
/dev/md5:
Version : 1.2
Creation Time : Sun May 10 14:14:23 2020
Raid Level : raid5
Array Size : 2094080 (2045.34 MiB 2144.34 MB)
Used Dev Size : 1047040 (1022.67 MiB 1072.17 MB)
Raid Devices : 3
Total Devices : 2
Persistence : Superblock is persistent

Update Time : Sun May 10 15:21:24 2020
State : clean, degraded
Active Devices : 2
Working Devices : 2
Failed Devices : 0
Spare Devices : 0

Layout : left-symmetric
Chunk Size : 512K

Name : host-192-168-133-4:5 (local to host host-192-168-133-4)
UUID : f4970d7d:0fd7b874:ec4d1ed0:9980d6e8
Events : 23
```

Number	Major	Minor	RaidDevice	State	
0	0	0	0	removed	
1	252	33	1	active sync	/dev/vdc1
3	252	34	2	active sync	/dev/vdc2

往磁盘阵列/dev/md5中加入一个磁盘 (分区/dev/vdb1) , 扩大/dev/md5的空间:

将新创建的硬盘(分区/dev/vdb1)加入到磁盘阵列/dev/md5中, 并查看加入后的/dev/md5的相关信息:

mdadm /dev/md5 -a /dev/vdb1 //-a: add

```
mdadm: added /dev/vdb1
```

cat /proc/mdstat

```
Personalities : [raid6] [raid5] [raid4]
md5 : active raid5 vdb1[4] vdc2[3] vdc1[1]
      2094080 blocks super 1.2 level 5, 512k chunk, algorithm 2 [3/2] [_UU]
[==>.....] recovery = 12.6% (132724/1047040) finish=1.9min
speed=7807K/sec
```

unused devices: <none>

cat /proc/mdstat

```
Personalities : [raid6] [raid5] [raid4]
md5 : active raid5 vdb1[4] vdc2[3] vdc1[1]
      2094080 blocks super 1.2 level 5, 512k chunk, algorithm 2 [3/3] [UUU]
```

unused devices: <none>

mdadm -D /dev/md5

```
/dev/md5:
    Version : 1.2
  Creation Time : Sun May 10 17:05:20 2020
    Raid Level : raid5
    Array Size : 2094080 (2045.34 MiB 2144.34 MB)
  Used Dev Size : 1047040 (1022.67 MiB 1072.17 MB)
    Raid Devices : 3
  Total Devices : 3
 Persistence : Superblock is persistent

Update Time : Sun May 10 18:17:30 2020
  State : clean
Active Devices : 3
Working Devices : 3
Failed Devices : 0
Spare Devices : 0

Layout : left-symmetric
Chunk Size : 512K

Name : host-192-168-133-4:5 (local to host host-192-168-133-4)
UUID : f4970d7d:0fd7b874:ec4dled0:9980d6e8
Events : 44
```

Number	Major	Minor	RaidDevice	State	
4	252	17	0	active sync	/dev/vdb1
1	252	33	1	active sync	/dev/vdc1
3	252	34	2	active sync	/dev/vdc2

lsblk

NAME	MAJ:MIN	RM	SIZE	RO	TYPE	MOUNTPPOINT
loop0	7:0	0	4.2G	1	loop	/media
vda	252:0	0	40G	0	disk	
└─vda1	252:1	0	500M	0	part	/boot
└─vda2	252:2	0	29.5G	0	part	
└─VolGroup-lv_root (dm-0)	253:0	0	27.6G	0	lvm	/
└─VolGroup-lv_swap (dm-1)	253:1	0	2G	0	lvm	[SWAP]
vdb	252:16	0	1G	0	disk	
└─vdb1	252:17	0	1G	0	part	
└─md5	9:5	0	2G	0	raid5	/raid5
vdc	252:32	0	2G	0	disk	
└─vdc1	252:33	0	1G	0	part	
└─md5	9:5	0	2G	0	raid5	/raid5
└─vdc2	252:34	0	1023.3M	0	part	
└─md5	9:5	0	2G	0	raid5	/raid5

将加入的新硬盘(/dev/vdb1)或分区从热备盘(的状态)转换为活动盘(的状态):

mdadm -G /dev/md5 -n 4

```
mdadm: Need 1 spare to avoid degraded array, and only have 0.
Use --force to over-ride this check.
```

cat /proc/mdstat

```
Personalities : [raid6] [raid5] [raid4]
md5 : active raid5 vdb1[4] vdc2[3] vdc1[1]
      2094080 blocks super 1.2 level 5, 512k chunk, algorithm 2 [3/3] [UUU]
```

unused devices: <none>

mdadm -D /dev/md5

Number	Major	Minor	RaidDevice	State	
4	252	17	0	active sync	/dev/vdb1
1	252	33	1	active sync	/dev/vdc1
3	252	34	2	active sync	/dev/vdc2

df -hT

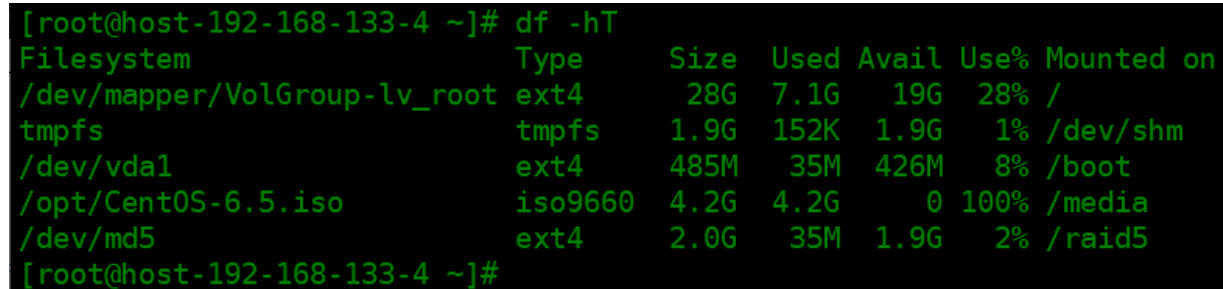
Filesystem	Type	Size	Used	Avail	Use%	Mounted on
/dev/mapper/VolGroup-lv_root	ext4	28G	7.1G	19G	28%	/
tmpfs	tmpfs	1.9G	152K	1.9G	1%	/dev/shm
/dev/vda1	ext4	485M	35M	426M	8%	/boot
/opt/CentOS-6.5.iso	iso9660	4.2G	4.2G	0	100%	/media
/dev/md5	ext4	2.0G	35M	1.9G	2%	/raid5

扩大磁盘阵列/dev/md5上的文件系统的大小，至其空间大小：

resize2fs /dev/md5

```
resize2fs 1.41.12 (17-May-2010)
The filesystem is already 523520 blocks long.  Nothing to do!
```

df -hT



```
[root@host-192-168-133-4 ~]# df -hT
Filesystem                Type      Size  Used Avail Use% Mounted on
/dev/mapper/VolGroup-lv_root ext4       28G   7.1G   19G  28% /
tmpfs                     tmpfs      1.9G  152K   1.9G   1% /dev/shm
/dev/vda1                 ext4      485M    35M  426M   8% /boot
/opt/CentOS-6.5.iso       iso9660    4.2G   4.2G    0 100% /media
/dev/md5                  ext4      2.0G    35M   1.9G   2% /raid5
[root@host-192-168-133-4 ~]#
```

【截图】

=====

作业

1.在云主机Centos-C1上完成磁盘阵列RAID10部署：

(1)利用已添加的三块虚拟硬盘hd6、hd7、hd8进行设置，hd6、hd7对应硬盘均设置为一个主分区，hd8对应硬盘设置为两个1G大小的逻辑分区，并完成磁盘阵列RAID10的操作。

(2)将RAID10 的/dev/md10分区，分出一个大小为500M的空间，格式化为swap分区，设为开机生效。

2.在云主机Centos-C4上完成磁盘阵列RAID5部署：

利用已添加的两块虚拟硬盘hd9、hd10进行设置hd9对应硬盘设置为一个主分区，hd10对应硬盘设置为两个1G大小的逻辑分区，并完成磁盘阵列RAID5的操作。