



??

Multipath ? CentOS/RedHat ?????????? port ? HBA ??? Storage ??????????????

????

1. RedHat 4.7
2. NetApp FAS2240
3. SAN Switch x 2
4. HBA Card: QLogic, port x 2
#>lspci
Fibre Channel: QLogic Corp. ISP2532-based 8Gb Fibre Channel to PCI Express HBA (rev 02)

RedHat ? HBA Card ??

???????????? RedHat ??? HBA ????? RedHat ????? HBA ??

???????? RedHat ??? /etc/modprobe.conf??????

alias scsi_hostadapter2 qla2500

TIPs?

scsi_hostadapterX ??????????

?? HBA ?? WWN

#> cat /proc/scsi/qla2xxx/2

SCSI Device Information:

```
scsi-qla0-adapter-node=5001438004253c81;
scsi-qla0-adapter-port=5001438004253c80; <---- WWN
scsi-qla0-target-0=50001fe1500e28fd;
scsi-qla0-target-1=50001fe1500e28f9;
scsi-qla0-target-2=500a09829140a66c;
```

TIPs?

??? HBA port ??? /proc/scsi/qla2xxx/3?????

?? port ??? WWN

NetApp storage ?? LUN ?? WWN ?? Host Mapping ?????

????????

lsmod | grep qla

```
qla2500          209985  0
qla2xxx         203681 13 qla2500
scsi_transport_fc 19521 1 qla2xxx
```

scsi_mod 153489 7 ib_srp,qla2xxx,scsi_transport_fc,sr_mod,libata,cciss,sd_mod

SAN Storage ?????

1. ? NetApp storage?SAN switch?RedHat ????????
2. ?? RedHat ? HBA ? ? port ??? WWN
3. ?? NetApp?? LUNs ????? WWN Hosts

?? Multipath

???RedHat ?????????? multipath.conf ??????????????????????

<https://access.redhat.com/labs/multipathhelper/>

???????

```
rpm -q device-mapper
rpm -q device-mapper-multipath
yum install device-mapper
yum install device-mapper-multipath
```

CentOS 5.x)

?? /etc/multipath.conf

```
# Blacklist all devices by default. Remove this to enable multipathing
# on the default devices.
devnode_blacklist {
#   devnode "*" << ??????
}
```

```
## Use user friendly names, instead of using WWIDs as names.
defaults {
  user_friendly_names yes
}
```

TIPs

????????? multipathd ?????????????? LUNs ????????????????

?? multipathd ??

```
#> service multipathd start
#> chkconfig multipathd on
```

CentOS 6/7)

- ??????? /etc/multipath.conf???????????????????? multipathd ?????????

```
#> mpathconf --enable --with_multipathd y
```

- ??? multipath.conf

?? multipah ???

CentOS 5.x

```
[root@cdb3-b ~]# multipath -ll
mpath1 (360a98000383035537824474d3936556a) dm-4 NETAPP,LUN
[size=700G][features=3 queue_if_no_path pg_init_retries 50][hw_handler=0][rw]
\_ round-robin 0 [prio=4][active]
\_ 1:0:1:0 sdb 8:16 [active][ready]
\_ 2:0:1:0 sdd 8:48 [active][ready]
\_ round-robin 0 [prio=1][enabled]
\_ 1:0:0:0 sda 8:0 [active][ready]
\_ 2:0:0:0 sdc 8:32 [active][ready]
```

CentOS 6.x

```
[root@cdb3 ~]# multipath -ll
mpathb (360a98000383035537824474d39365568) dm-2 NETAPP,LUN
size=700G features='4 queue_if_no_path pg_init_retries 50 retain_attached_hw_handle' hw_handler='0'
wp=rw
|+- policy='round-robin 0' prio=4 status=active
||- 1:0:1:0 sdc 8:32 active ready running
|`- 2:0:1:0 sde 8:64 active ready running
`+- policy='round-robin 0' prio=1 status=enabled
|- 1:0:0:0 sdb 8:16 active ready running
`- 2:0:0:0 sdd 8:48 active ready running
```

?? NetApp ????

?????? LUN ??? - NetApp Linux Host Utilities

yum install libnl

rpm -ivh QConvergeConsoleCLI-1.0.01-32.x86_64.rpm

rpm -ivh netapp_linux_host_utilities-6-2.x86_64.rpm

TIPS?

- ????????????????????? sanlun ??

- ?? CentOS 5.x/6.x

?? LUN ????????

???????????? LUN disks (? dual path SAN ??????? LUN disks)???????????????????? mpathXX ?????

```
#> multipath -l
mpath1 (360a98000424732615124444150534a35)
[size=100 GB][features="1 queue_if_no_path"][hw_handler="0"]
\_ round-robin 0 [active]
\_ 2:0:2:0 sde 8:64 [active]
\_ 3:0:2:0 sdf 8:80 [active]
```

```
mpath0 (3600508b400068e5c00012000001a0000)
[size=100 GB][features="1 queue_if_no_path"][hw_handler="0"]
\_ round-robin 0 [active]
\_ 2:0:0:1 sda 8:0 [active]
\_ 3:0:0:1 sdc 8:32 [active]
\_ round-robin 0 [enabled]
\_ 2:0:1:1 sdb 8:16 [active]
\_ 3:0:1:1 sdd 8:48 [active]
```

TIPS?

mpathX ?????? LVM ? PV ??????? filesystem??????? /dev/mapper/mpathX

2:0:0:1 ????? host : channel : ID : LUN

Host 2 ? Host 3 ?? HBA ??? port ??? port ???

??/?? LUN ????????

?????

- <https://library.netapp.com/ecmdocs/E...BFEA6BED1.html>
- <https://access.redhat.com/solutions/3941>

CentOS/RedHat 5x ??

? CentOS/RedHat 5 ???? SLES 10 ????????????????

yum install sg3_utils

????????? LUN Disk

????????? LUN Disks

#> sanlun lun show all

???? LUN

#> scsi-rescan

NOTE: ??????? LUN????? -a

#> scsi-rescan -a

?????? LUN Disks

#> sanlun lun show all

?? LUN ???

????? LUN disk ???????????

1. ?? umount ??
2. ?? lvremove ?? LV
3. ?????? vgremove ?? VG
4. ?? pvremove ?? PV
5. ?? multipath -f mpathXX ?? multipathXX
NOTE: ?????????????? LUN ?????? Hang?
6. ? Storage ??????? LUN disk
NOTE: ? LUN ?????? sanlun lun show all????? LUN ??? unknown?
7. ?? scsi-rescan -r ??????? LUN disk
NOTE: ??????????????
4 device(s) removed.
[5:0:1:0]
[5:0:3:0]
[6:0:1:0]
[6:0:3:0]
???? sanlun lun show all??? unknown ??????

CentOS/RedHat 4x?

?????

- [Vmware Linux Guest Add a New Hard Disk Without Rebooting Guest](#)

???????? script

1. remove-LUNs.sh
2. rescan-LUNs.sh

?? LUN disk ??

1. ? NetApp storage ??? LUN Mapping ???

2. ? RedHat ??? rescan-LUNs.sh
3. ? RedHat ??? multipath -l

???? LUN disk

1. ? RedHat ?????? mpathX
2. ? RedHat ??? sanlun lun show all ?? LUN ??? NetApp ???
 ????? sanlun ?????? NetApp ??? netapp_linux_host_utilities-6-2.x86_64.rpm
3. ? NetApp ?????? LUN
4. ? RedHat ??? multipath -l
 ????? LUN disks ? host:channel:id:LUN
 ?? remove-LUNs.sh <host> <channel> <id> <LUN>

LVM ??

? LUN ????? PV

#> pvcreate /dev/mapper/mpath6

NOTE: PV ????? pvdisplay ?????? dm-X?

?? VG

#> vgcreate dbVG /dev/mapper/mpath6

?????

multipath

/etc/init.d/multipathd start	Manually starts the multipathing service on the Linux host.
multipath -ll	Displays the multipathing configuration.
multipath -v2	Creates the initial multipathing configuration.
multipath -f <i>device_map</i>	Removes an existing LUN from the multipathing configuration.
multipath -ll -v2 -d	Displays the multipathing configuration in verbose mode.
multipath -t ? multipathd show config	?????????

Accessing LUNs on host

sanlun fcp show adapter -v	Displays HBA information.
sanlun fcp show adapter	Display WWPN of HBA cards

sanlun lun show all	Lists available LUNs as seen by the sanlun script.
sanlun lun show -p	Provides multipath information for both DM-Multipath and Veritas Storage Foundation TM dynamic multipathing solutions.
ls -lh /dev/mapper/	Lists DM-Multipath devices generated for LUNs.
e2label <i>device label</i>	Creates a persistent label for a file system. device is the partition; label is a unique string up to 16 characters. Not needed with DM-Multipath.

Q & A

Q: RHEL 7 ??? alias path

?? NetApp Storage??? multipath -ll

```
360a98000443437576f2444726e556d76 dm-2 NETAPP ,LUN
size=800G features='4 queue_if_no_path pg_init_retries 50 retain_attached_hw_handle'
hwhandler='1 alua' wp=rw
|+- policy='service-time 0' prio=50 status=active
|`- 6:0:0:0 sdb 8:16 active ready running
`+- policy='service-time 0' prio=10 status=enabled
  `- 6:0:3:0 sdc 8:32 active ready running
```

???? alias name: mpathXX

??????? <https://access.redhat.com/solutions/2061463>

?? multipath ????????

multipath -t

???? NetApp ???

??????? multipath.conf??? NetApp ?????

NOTE???? NetApp Storage

```
defaults {
    user_friendly_names yes
    find_multipaths yes
}
```

```
devices {
```

```

device {
    vendor "NETAPP"
    product "LUN.*"
    path_grouping_policy "group_by_prio"
    path_checker "tur"
    features "3 queue_if_no_path pg_init_retries 50"
    hardware_handler "0"
    prio "ontap"
    failback immediate
    rr_weight "uniform"
    rr_min_io 128
    flush_on_last_del "yes"
    dev_loss_tmo "infinity"
    user_friendly_names yes
    retain_attached_hw_handler yes
    detect_prio yes
}

```

?????

```
#> systemctl reload multipathd
```

```
#> multipath -ll
```

```

mpatha (360a98000443437576f2444726e556d76) dm-2 NETAPP ,LUN
size=800G features='4 queue_if_no_path pg_init_retries 50 retain_attached_hw_handle' hwhandler='1
alua' wp=rw
|+- policy='service-time 0' prio=50 status=active
||- 4:0:0:0 sdb 8:16 active ready running
|^- 6:0:0:0 sdd 8:48 active ready running
`-+- policy='service-time 0' prio=10 status=enabled
  |- 4:0:3:0 sdc 8:32 active ready running
  ` - 6:0:3:0 sde 8:64 active ready running

```

Q: ?? netapp_linux_host_utilities ????????

Warning: libnl.so library not found, some sanlun commands may not work. Refer Linux Host Utilities Installation and Set up Guide for more details

Warning: libHBAAPI.so library not found, some sanlun commands may not work. Refer Linux Host Utilities Installation and Setup Guide for more details

Ans:

??? libnl

```
yum install libnl
```

???????????

?????

1. <http://driverdownloads.qlogic.com/QL...emcatid=111969>
2. <http://driverdownloads.qlogic.com/QL...t+%2864-bit%29>

- QConvergeConsole CLI (x64)
- SANsurfer CLI (x86/x64)

Q: ?? pvscan?vscan ??????????

Found duplicate PV XXXXXXXXXXXXXXXXXXXX: using /dev/sdb not /dev/sda

Ans???????????? multipath ? LVM ??????? CentOS 4/5 ?? LVM ????????????????????????????? multipath ??LVM ??
 ?? mpathX ? dm-X ?????????? sdX ???

?? LVM ??? sdX ?????????? /etc/lvm/lvm.conf????????????????????LVM ??? sdX ?????????????? initrd ??????????
 grub.conf ???????

??????:

1. ?? /etc/lvm/lvm.conf

```
...
filter = [ "r|/dev/sd.*|", "a|/.*|" ]
...
```

NOTE?

r|/dev/sd.*| ?????????? sda, sdb, ...??

????

?? pvscan ? vgscan????????? Warning?????? 2?

2. ?? initrd ??????

```
#> cd /boot
#> mkinitrd -f -v /boot/initrd-$(uname -r).multipath.img $(uname -r)
```

```
?? /boot/grub/grub.conf
?? title ??????????????????????
```

```
title CentOS (2.6.18-398.el5-Multipath)          <== ?? Multipath
    root (hd0,0)
```

```
kernel /vmlinuz-2.6.18-398.....  
initrd /initrd-2.6.18-398.el5.multipath.img <== ???initrd ??????
```

???

3. ?????????????????????????

????????????????????????????????????? grub.conf ? default=1?

???

- [Editing the DM-Multipath configuration file](#)
- [Configuring persistent storage in a Red Hat Enterprise Linux 5 environment](#)
- [DM Multipath](#)
- [Multipathing NetApp LUN on RHEL 5.3](#)