# NVMe/FC Host Configuration for RHEL 8.1 with ONTAP

**ONTAP SAN Host** 

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## **NVMe/FC Host Configuration for RHEL 8.1** with ONTAP

## **Supportability**

NVMe/FC is supported on ONTAP 9.6 or later for the following versions of RHEL:

• RHEL 8.1

RHEL 8.1 host can run both NVMe & SCSI traffic through the same fibre channel initiator adapter ports. See the Hardware Universe for a list of supported FC adapters and controllers.

For the most current list of supported configurations see the NetApp Interoperability Matrix.

### **Known limitations**

- Native NVMe/FC auto-connect scripts are not available in the nvme-cli package. You can use the HBA vendor provided external auto-connect script.
- By default, NVMe multipath is disabled.
   It must be manually enabled. Steps are provided in the section on Enabling NVMe/FC on RHEL 8.1.
- By default, round-robin load balancing is not enabled.

  You must write a udev rule to enable this functionality. Steps are provided in the section on Enabling NVMe/FC on RHEL 8.1.

### **Enabling NVMe/FC on RHEL 8.1**

- 1. Install Red Hat Enterprise Linux 8.1 on the server.
- 2. After the installation is complete, verify that you are running the specified Red Hat Enterprise Linux kernel. See the NetApp Interoperability Matrix for the most current list of supported versions.

```
# uname -r
4.18.0-147.el8.x86_64
```

3. Install the nvme-cli-1.8.1-3.el8 package.

```
# rpm -qa|grep nvme-cli
nvme-cli-1.8.1-3.el8.x86_64
```

4. Enable in-kernel NVMe multipath.

```
# grubby -args=nvme_core.multipath=Y -update-kernel /boot/vmlinuz-4.18.0-
147.el8.x86_64
```

5. Add the string below as a separate udev rule at /lib/udev/rules.d/71-nvme-iopolicy-netapp-ONTAP.rules. This enables round-robin load balancing for NVMe multipath.

```
# Enable round-robin for NetApp ONTAP
ACTION=="add", SUBSYSTEM=="nvme-subsystem", ATTR{model}=="NetApp ONTAP Controller",
ATTR{iopolicy}="round-robin
```

6. On the RHEL 8.1 host, check the host NQN string at /etc/nvme/hostnqn and verify that it matches the host NQN string for the corresponding subsystem on the ONTAP array.

```
# cat /etc/nvme/hostnqn
nqn.2014-08.org.nvmexpress:uuid:75953f3b-77fe-4e03-bf3c-09d5a156fbcd
```

```
*> vserver nvme subsystem host show -vserver vs_nvme_10
Vserver Subsystem Host NQN
-----
rhel_141_nvme_ss_10_0
nqn.2014-08.org.nvmexpress:uuid:75953f3b-77fe-4e03-bf3c-09d5a156fbcd
```



If the host NQN strings do not match, you should use the vserver modify command to update the host NQN string on your corresponding ONTAP array subsystem to match to host NQN string from /etc/nvme/hostnqn on the host.

7. Reboot the host.

## Configuring the Broadcom FC Adapter for NVMe/FC

1. Verify that you are using the supported adapter. For the most current list of supported adapters see the NetApp Interoperability Matrix.

```
# cat /sys/class/scsi_host/host*/modelname
LPe32002-M2
LPe32002-M2
```

```
# cat /sys/class/scsi_host/host*/modeldesc
Emulex LightPulse LPe32002-M2 2-Port 32Gb Fibre Channel Adapter
Emulex LightPulse LPe32002-M2 2-Port 32Gb Fibre Channel Adapter
```

2. Copy and install the Broadcom lpfc outbox driver and auto-connect scripts.

```
# tar -xvzf elx-lpfc-dd-rhel8-12.4.243.20-ds-1.tar.gz
# cd elx-lpfc-dd-rhel8-12.4.2453.20-ds-1
# ./elx_lpfc_install-sh -i -n
```

#### Note:

The native drivers that come bundled with the OS are called inbox drivers. If you download the outbox drivers (drivers that are not included with the OS release), an auto-connect script is included in the download and should be installed as part of the driver installation process.

- 3. Reboot the host.
- 4. Verify that you are using the recommended Broadcom lpfc firmware, outbox driver & auto-connect package versions.

```
# cat /sys/class/scsi_host/host*/fwrev
12.4.243.20, sil-4.2.c
12.4.243.20, sil-4.2.c
```

```
# cat /sys/module/lpfc/version
0:12.4.243.20
```

```
# rpm -qa | grep nvmefc
nvmefc-connect-12.6.61.0-1.noarch
```

5. Verify that lpfc\_enable\_fc4\_type is set to 3.

```
# cat /sys/module/lpfc/parameters/lpfc_enable_fc4_type
3
```

6. Verify that the initiator ports are up and running.

```
# cat /sys/class/fc_host/host*/port_name
0x10000090fae0ec61
0x10000090fae0ec62
```

```
# cat /sys/class/fc_host/host*/port_state
Online
Online
```

7. Verify that the NVMe/FC initiator ports are enabled, running and able to see the target LIFs.

```
# cat /sys/class/scsi_host/host*/nvme_info
NVME Initiator Enabled
XRI Dist lpfc0 Total 6144 NVME 2947 SCSI 2977 ELS 250
NVME LPORT lpfc0 WWPN x10000090fae0ec61 WWNN x20000090fae0ec61 DID x012000 ONLINE
NVME RPORT WWPN x202d00a098c80f09 WWNN x202c00a098c80f09 DID x010201 TARGET DISCSRVC
ONLINE
NVME RPORT WWPN x203100a098c80f09 WWNN x202c00a098c80f09 DID x010601 TARGET DISCSRVC
ONLINE
NVME Statistics
...
```

## Validating NVMe/FC

1. Verify the following NVMe/FC settings.

```
# cat /sys/module/nvme_core/parameters/multipath
Y
```

```
# cat /sys/class/nvme-subsystem/nvme-subsys*/model
NetApp ONTAP Controller
NetApp ONTAP Controller
```

```
# cat /sys/class/nvme-subsystem/nvme-subsys*/iopolicy
round-robin
round-robin
```

2. Verify that the namespaces are created.

```
# nvme list
Node SN Model Namespace Usage Format FW Rev
-----/dev/nvme0n1 80BADBKnB/JvAAAAAAAC NetApp ONTAP Controller 1 53.69 GB / 53.69 GB 4 KiB
+ 0 B FFFFFFFF
```

3. Verify the status of the ANA paths.

```
# nvme list-subsys/dev/nvme0n1
Nvme-subsysf0 - NQN=nqn.1992-
08.com.netapp:sn.341541339b9511e8a9b500a098c80f09:subsystem.rhel_141_nvme_ss_10_0
+- nvme0 fc traddr=nn-0x202c00a098c80f09:pn-0x202d00a098c80f09 host_traddr=nn-0x20000090fae0ec61:pn-0x10000090fae0ec61 live optimized
+- nvme1 fc traddr=nn-0x207300a098dfdd91:pn-0x207600a098dfdd91 host_traddr=nn-0x200000109b1c1204:pn-0x100000109b1c1204 live inaccessible
+- nvme2 fc traddr=nn-0x207300a098dfdd91:pn-0x207500a098dfdd91 host_traddr=nn-0x200000109b1c1205:pn-0x100000109b1c1205 live optimized
+- nvme3 fc traddr=nn-0x207300a098dfdd91:pn-0x207700a098dfdd91 host traddr=nn-0x200000109b1c1205:pn-0x100000109b1c1205 live inaccessible
```

4. Verify the NetApp plug-in for ONTAP devices.

```
# nvme netapp ontapdevices -o column
Device Vserver Namespace Path
                                            NSID
                                                  UUID Size
/dev/nvme0n1 vs_nvme_10 /vol/rhel_141_vol_10_0/rhel_141_ns_10_0
55baf453-f629-4a18-9364-b6aee3f50dad
                                      53.69GB
# nvme netapp ontapdevices -o json
{
   "ONTAPdevices" : [
       Device" : "/dev/nvme0n1",
        "Vserver": "vs_nvme_10",
        "Namespace Path" : "/vol/rhel 141 vol 10 0/rhel 141 ns 10 0",
        "NSID" : 1,
        "UUID" : "55baf453-f629-4a18-9364-b6aee3f50dad",
        "Size": "53.69GB",
        "LBA_Data_Size" : 4096,
        "Namespace_Size" : 13107200
   }
]
```

## **Enabling 1MB I/O Size for Broadcom NVMe/FC**

The lpfc\_sg\_seg\_cnt parameter must be set to 256 in order for the host to issue 1MB size I/O.

1. Set the lpfc\_sg\_seg\_cnt parameter to 256.

```
# cat /etc/modprobe.d/lpfc.conf
options lpfc lpfc_sg_seg_cnt=256
```

- 2. Run a dracut -f command, and reboot the host.
- 3. Verify that lpfc sq seq cnt is 256.

```
# cat /sys/module/lpfc/parameters/lpfc_sg_seg_cnt
256
```

## **LPFC Verbose Logging**

1. You can set the lpfc\_log\_verbose driver setting to any of the following values to log NVMe/FC events.

```
#define LOG_NVME 0x00100000 /* NVME general events. */
#define LOG_NVME_DISC 0x00200000 /* NVME Discovery/Connect events. */
#define LOG_NVME_ABTS 0x00400000 /* NVME ABTS events. */
#define LOG_NVME_IOERR 0x00800000 /* NVME IO Error events. */
```

- 2. After setting any of these values, run dracut-f and reboot host.
- 3. After rebooting, verify the settings.

```
# cat /etc/modprobe.d/lpfc.conf
lpfc_enable_fc4_type=3 lpfc_log_verbose=0xf00083
# cat /sys/module/lpfc/parameters/lpfc_log_verbose
15728771
```

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