# Configuration limits

ONTAP 9

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# Configuration limits

## Determine the maximum supported nodes and SAN hosts per ONTAP cluster

The number of supported nodes per cluster varies depending on your version of ONTAP, your controller models, and the protocol of your cluster nodes. The maximum number of SAN hosts that can be connected to a cluster also varies based upon your specific configuration.

### Determine the maximum supported nodes per cluster

If any node in the cluster is configured for FC, FC-NVMe, FCoE, or iSCSI, that cluster is limited to the SAN node limits. Node limits based on the controllers in your cluster are listed in the *Hardware Universe*.

**Steps**

1. Go to NetApp Hardware Universe.
2. In the upper left, next to **Home**, select **Platforms**; then select the platform type.
3. Select your version of ONTAP.

   A new column is displayed for you to choose your platforms.

4. Select the platforms used in your solution.
5. Under **Choose Your Specifications**, deselect **Select All**.
6. Select **Max Nodes per Cluster (NAS/SAN)**.
7. Click **Show Results**.

**Results**

The maximum nodes per cluster for your selected platforms is displayed.

### Determine if your cluster can support more FC hosts

For FC and FC-NVMe configurations, you should use the number of initiator-target nexuses (ITNs) in your system to determine whether you can add more hosts to your cluster.

An ITN represents one path from the host's initiator to the storage system's target. The maximum number of ITNs per node in FC and FC-NVMe configurations is 2,048. If you are below the maximum number of ITNs, you can continue to add hosts to your cluster.

To determine the number of ITNs used in your cluster, perform the following steps for each node in the cluster.

**Steps**

1. Identify all the LIFs on a given node.
2. Run the following command for every LIF on the node:

```
fcp initiator show -fields wwpn, lif
```

The number of entries displayed at the bottom of the command output represents your number of ITNs for that LIF.

3. Record the number of ITNs displayed for each LIF.
4. Add the number of ITNs for each LIF on every node in your cluster.

   This total represents the number of ITNs in your cluster.

### Determine if your cluster can support more iSCSI hosts

The number of hosts that can be directly connected to a node or that can be connected through one or more switches depends on the number of available Ethernet ports. The number of available Ethernet ports is determined by the model of the controller and the number and type of adapters installed in the controller. The number of supported Ethernet ports for controllers and adapters is available in the *Hardware Universe*.

For all multi-node cluster configurations, you must determine the number of iSCSI sessions per node to know whether you can add more hosts to your cluster. As long as your cluster is below the maximum number of iSCSI sessions per node, you can continue to add hosts to your cluster. The maximum number of iSCSI sessions per node varies based on the types of controllers in your cluster.

**Steps**

1. Identify all of the target portal groups on the node.
2. Check the number of iSCSI sessions for every target portal group on the node:

   ```
   iscsi session show -tpgroup _tpgroup_
   ```

   The number of entries displayed at the bottom of the command output represents your number of iSCSI sessions for that target portal group.

3. Record the number of iSCSI sessions displayed for each target portal group.
4. Add the number of iSCSI sessions for each target portal group on the node.

   The total represents the number of iSCSI sessions on your node.

# All-Flash SAN Array configuration limits and support

All-Flash SAN Array (ASA) configuration limits and support varies by ONTAP version.

The most current details on supported configuration limits are available in NetApp Hardware Universe.

These limitations apply to ASA systems. If you have an ASA r2 system (ASA A1K, ASA A90, ASA A70, ASA A50, ASA A30, ASA A20, or ASA C30), see ASA r2 system storage limits.

### SAN protocols and supported number of nodes per cluster

The supported SAN protocols and maximum number of nodes per cluster depends on whether you have a non-MetroCluster or MetroCluster configuration:

**Non-MetroCluster configurations**

The following table shows the ASA support for SAN protocols and the supported number of nodes per cluster in non-MetroCluster configurations:

| Beginning with ONTAP… | Protocol support | Maximum nodes per cluster |
|---|---|---|
| 9.11.1 | • NVMe/TCP<br>• NVMe/FC | 12 |
| 9.10.1 | • NVMe/TCP | 2 |
| 9.9.1 | • NVMe/FC | 2 |
| | • FC<br>• iSCSI | 12 |
| 9.7 | • FC<br>• iSCSI | 2 |

**MetroCluster IP configurations**

The following table shows the ASA support for SAN protocols and the supported number of nodes per cluster in MetroCluster IP configurations:

| Beginning with ONTAP… | Protocol support | Maximum nodes per cluster |
|---|---|---|
| 9.15.1 | • NVMe/TCP | 2 nodes per cluster in four-node MetroCluster IP configurations |
| 9.12.1 | • NVMe/FC | 2 nodes per cluster in four-node MetroCluster IP configurations |
| 9.9.1 | • FC<br>• iSCSI | 4 nodes per cluster in eight-node MetroCluster IP configurations |
| 9.7 | • FC<br>• iSCSI | 2 nodes per cluster in four-node MetroCluster IP configurations |

## Support for persistent ports

Beginning with ONTAP 9.8, persistent ports are enabled by default on All-Flash SAN Arrays (ASAs) that are configured to use the FC protocol. Persistent ports are only available for FC and require zone membership identified by World Wide Port Name (WWPN).

Persistent ports reduce the impact of takeovers by creating a shadow LIF on the corresponding physical port of the high-availability (HA) partner. When a node is taken over, the shadow LIF on the partner node assumes the identity of the original LIF, including the WWPNe. Before the status of path to the taken over node is changed

to faulty, the shadow LIF appears as an Active/Optimized path to the host MPIO stack, and I/O is shifted. This reduces I/O disruption because the host always sees the same number of paths to the target, even during storage failover operations.

For persistent ports, the following FCP port characteristics should be identical within the HA pair:

- FCP port counts
- FCP port names
- FCP port speeds
- FCP LIF WWPN-based zoning

If any of these characteristics are not identical within the HA pair, the following EMS message is generated:

```
EMS : scsiblade.lif.persistent.ports.fcp.init.error
```

For more information on persistent ports, see NetApp Technical Report 4080: Best Practices for Modern SAN.

# Configuration limits for FC switches used with ONTAP systems

Fibre Channel switches have maximum configuration limits, including the number of logins supported per port, port group, blade, and switch. The switch vendors document their supported limits.

Each FC logical interface (LIF) logs into an FC switch port. The total number of logins from a single target on the node equals the number of LIFs plus one login for the underlying physical port. Do not exceed the switch vendor's configuration limits for logins or other configuration values. This also holds true for the initiators being used on the host side in virtualized environments with NPIV enabled. Do not exceed the switch vendor's configuration limits for logins for either the target or the initiators being used in the solution.

## Brocade switch limits

You can find the configuration limits for Brocade switches in the *Brocade Scalability Guidelines*.

## Cisco Systems switch limits

You can find the configuration limits for Cisco switches in the Cisco Configuration Limits guide for your version of Cisco switch software.

# Maximum FC and FCoE hop count supported in ONTAP

The hop count is defined as the number of switches in the path between the initiator (host) and target (storage system). The maximum supported FC hop count between a host and storage system varies depending on the switch supplier.

Documentation from Cisco Systems also refers to this value as the *diameter of the SAN fabric*.

For FCoE, you can have FCoE switches connected to FC switches. For end-to-end FCoE connections, the FCoE switches must be running a firmware version that supports Ethernet inter-switch links (ISLs).

| Switch supplier | Supported hop count |
| --- | --- |
| Brocade | • 7 for FC<br>• 5 for FCoE |
| Cisco | • 7 for FC<br>• Up to 3 of the switches can be FCoE switches. |

# Calculate queue depth for ONTAP FC hosts

You might need to tune your FC queue depth on the host to achieve the maximum values for ITNs per node and FC port fan-in. The maximum number of LUNs and the number of HBAs that can connect to an FC port are limited by the available queue depth on the FC target ports.

**About this task**

Queue depth is the number of I/O requests (SCSI commands) that can be queued at one time on a storage controller. Each I/O request from the host's initiator HBA to the storage controller's target adapter consumes a queue entry. Typically, a higher queue depth equates to better performance. However, if the storage controller's maximum queue depth is reached, that storage controller rejects incoming commands by returning a QFULL response to them. If a large number of hosts are accessing a storage controller, you should plan carefully to avoid QFULL conditions, which significantly degrade system performance and can lead to errors on some systems.

In a configuration with multiple initiators (hosts), all hosts should have similar queue depths. Because of the inequality in queue depth between hosts connected to the storage controller through the same target port, hosts with smaller queue depths are being deprived of access to resources by hosts with larger queue depths.

The following general recommendations can be made about "tuning" queue depths:

- For small to mid-size systems, use an HBA queue depth of 32.
- For large systems, use an HBA queue depth of 128.
- For exception cases or performance testing, use a queue depth of 256 to avoid possible queuing problems.
- All hosts should have the queue depths set to similar values to give equal access to all hosts.
- To avoid performance penalties or errors, the storage controller target FC port queue depth must not be exceeded.

**Steps**

1. Count the total number of FC initiators in all of the hosts that connect to one FC target port.
2. Multiply by 128.
    - If the result is less than 2,048, set the queue depth for all initiators to 128.
      You have 15 hosts with one initiator connected to each of two target ports on the storage controller. 15 × 128 = 1,920. Because 1,920 is less than the total queue depth limit of 2,048, you can set the queue depth for all of your initiators to 128.
    - If the result is greater than 2,048, go to step 3.
      You have 30 hosts with one initiator connected to each of two target ports on the storage controller. 30 × 128 = 3,840. Because 3,840 is greater than the total queue depth limit of 2,048, you should choose

one of the options under step 3 for remediation.

3. Choose one of the following options to add more hosts to the storage controller.
   - Option 1:
     i. Add more FC target ports.
     ii. Redistribute your FC initiators.
     iii. Repeat steps 1 and 2.

     The desired queue depth of 3,840 exceeds the available queue depth per port. To remedy this, you can add a two-port FC target adapter to each controller, then rezone your FC switches so that 15 of your 30 hosts connect to one set of ports, and the remaining 15 hosts connect to a second set of ports. The queue depth per port is then reduced to 15 × 128 = 1,920.
   - Option 2:
     i. Designate each host as “large” or “small” based on its expected I/O need.
     ii. Multiply the number of large initiators by 128.
     iii. Multiply the number of small initiators by 32.
     iv. Add the two results together.
     v. If the result is less than 2,048, set the queue depth for large hosts to 128 and the queue depth for small hosts to 32.
     vi. If the result is still greater than 2,048 per port, reduce the queue depth per initiator until the total queue depth is less than or equal to 2,048.

To estimate the queue depth needed to achieve a certain I/O per second throughput, use this formula:

Needed queue depth = (Number of I/O per second) × (Response time)

For example, if you need 40,000 I/O per second with a response time of 3 milliseconds, the needed queue depth = 40,000 × (.003) = 120.

The maximum number of hosts that you can connect to a target port is 64, if you decide to limit the queue depth to the basic recommendation of 32. However, if you decide to have a queue depth of 128, then you can have a maximum of 16 hosts connected to one target port. The larger the queue depth, the fewer hosts that a single target port can support. If your requirement is such that you cannot compromise on the queue depth, then you should get more target ports.

The desired queue depth of 3,840 exceeds the available queue depth per port. You have 10 “large” hosts that have high storage I/O needs, and 20 “small” hosts that have low I/O needs. Set the initiator queue depth on the large hosts to 128 and the initiator queue depth on the small hosts to 32.

Your resulting total queue depth is (10 × 128) + (20 × 32) = 1,920.

You can spread the available queue depth equally across each initiator.

Your resulting queue depth per initiator is 2,048 ÷ 30 = 68.

# Modify queue depths for ONTAP SAN hosts

You might need to change the queue depths on your host to achieve the maximum values for ITNs per node and FC port fan-in. You can calculate the optimal queue depth for your environment.

## AIX hosts

You can change the queue depth on AIX hosts using the `chdev` command. Changes made using the `chdev` command persist across reboots.

Examples:

- To change the queue depth for the hdisk7 device, use the following command:

  ```
  chdev -l hdisk7 -a queue_depth=32
  ```

- To change the queue depth for the fcs0 HBA, use the following command:

  ```
  chdev -l fcs0 -a num_cmd_elems=128
  ```

  The default value for `num_cmd_elems` is 200. The maximum value is 2,048.

  > It might be necessary to take the HBA offline to change `num_cmd_elems` and then bring it back online using the `rmdev -l fcs0 -R` and `makdev -l fcs0 -P` commands.

## HP-UX hosts

You can change the LUN or device queue depth on HP-UX hosts using the kernel parameter `scsi_max_qdepth`. You can change the HBA queue depth using the kernel parameter `max_fcp_reqs`.

- The default value for `scsi_max_qdepth` is 8. The maximum value is 255.

  `scsi_max_qdepth` can be dynamically changed on a running system using the `-u` option on the `kmtune` command. The change will be effective for all devices on the system. For example, use the following command to increase the LUN queue depth to 64:

  ```
  kmtune -u -s scsi_max_qdepth=64
  ```

  It is possible to change queue depth for individual device files using the `scsictl` command. Changes using the `scsictl` command are not persistent across system reboots. To view and change the queue depth for a particular device file, execute the following command:

  ```
  scsictl -a /dev/rdsk/c2t2d0

  scsictl -m queue_depth=16 /dev/rdsk/c2t2d0
  ```

- The default value for `max_fcp_reqs` is 512. The maximum value is 1024.

  The kernel must be rebuilt and the system must be rebooted for changes to `max_fcp_reqs` to take effect. To change the HBA queue depth to 256, for example, use the following command:

```
kmtune -u -s max_fcp_reqs=256
```

## Solaris hosts

You can set the LUN and HBA queue depth for your Solaris hosts.

- For LUN queue depth: The number of LUNs in use on a host multiplied by the per-LUN throttle (lun-queue-depth) must be less than or equal to the tgt-queue-depth value on the host.
- For queue depth in a Sun stack: The native drivers do not allow for per LUN or per target `max_throttle` settings at the HBA level. The recommended method for setting the `max_throttle` value for native drivers is on a per-device type (VID_PID) level in the `/kernel/drv/sd.conf` and `/kernel/drv/ssd.conf` files. The host utility sets this value to 64 for MPxIO configurations and 8 for Veritas DMP configurations.

**Steps**

1. `# cd/kernel/drv`
2. `# vi lpfc.conf`
3. Search for `/tft-queue (/tgt-queue)`

   ```
   tgt-queue-depth=32
   ```

   The default value is set to 32 at installation.

4. Set the desired value based on the configuration of your environment.
5. Save the file.
6. Reboot the host using the `sync; sync; sync; reboot -- -r` command.

## VMware hosts for a QLogic HBA

Use the `esxcfg-module` command to change the HBA timeout settings. Manually updating the `esx.conf` file is not recommended.

**Steps**

1. Log on to the service console as the root user.
2. Use the `#vmkload_mod -l` command to verify which Qlogic HBA module is currently loaded.
3. For a single instance of a Qlogic HBA, run the following command:

   ```
   #esxcfg-module -s ql2xmaxqdepth=64 qla2300_707
   ```

   This example uses qla2300_707 module. Use the appropriate module based on the output of `vmkload_mod -l`.

4. Save your changes using the following command:

   ```
   #/usr/sbin/esxcfg-boot -b
   ```

5. Reboot the server using the following command:

```
#reboot
```

6. Confirm the changes using the following commands:
   a. `#esxcfg-module -g qla2300_707`
   b. `qla2300_707 enabled = 1 options = 'ql2xmaxqdepth=64'`

## VMware hosts for an Emulex HBA

Use the `esxcfg-module` command to change the HBA timeout settings. Manually updating the `esx.conf` file is not recommended.

**Steps**

1. Log on to the service console as the root user.
2. Use the `#vmkload_mod -l grep lpfc` command to verify which Emulex HBA is currently loaded.
3. For a single instance of an Emulex HBA, enter the following command:

   ```
   #esxcfg-module -s lpfc0_lun_queue_depth=16 lpfcdd_7xx
   ```

   > Depending on the model of the HBA, the module can be either lpfcdd_7xx or lpfcdd_732. The above command uses the lpfcdd_7xx module. You should use the appropriate module based on the outcome of `vmkload_mod -l`.

   Running this command will set the LUN queue depth to 16 for the HBA represented by lpfc0.

4. For multiple instances of an Emulex HBA, run the following command:

   ```
   a esxcfg-module -s "lpfc0_lun_queue_depth=16 lpfc1_lun_queue_depth=16"
   lpfcdd_7xx
   ```

   The LUN queue depth for lpfc0 and the LUN queue depth for lpfc1 is set to 16.

5. Enter the following command:

   ```
   #esxcfg-boot -b
   ```

6. Reboot using `#reboot`.

## Windows hosts for an Emulex HBA

On Windows hosts, you can use the `LPUTILNT` utility to update the queue depth for Emulex HBAs.

**Steps**

1. Run the `LPUTILNT` utility located in the `C:\WINNT\system32` directory.
2. Select **Drive Parameters** from the menu on the right side.
3. Scroll down and double-click **QueueDepth**.

If you are setting **QueueDepth** greater than 150, the following Windows Registry value also need to be increased appropriately:

`HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\lpxnds\Parameters\Device\NumberOfRequests`

## Windows hosts for a Qlogic HBA

On Windows hosts, you can use theand the `SANsurfer` HBA manager utility to update the queue depths for Qlogic HBAs.

**Steps**

1. Run the `SANsurfer` HBA manager utility.
2. Click on **HBA port** > **Settings**.
3. Click **Advanced HBA port settings** in the list box.
4. Update the `Execution Throttle` parameter.

## Linux hosts for Emulex HBA

You can update the queue depths of an Emulex HBA on a Linux host. To make the updates persistent across reboots, you must then create a new RAM disk image and reboot the host.

**Steps**

1. Identify the queue depth parameters to be modified:

   ```
   modinfo lpfc|grep queue_depth
   ```

   The list of queue depth parameters with their description is displayed. Depending on your operating system version, you can modify one or more of the following queue depth parameters:

   - `lpfc_lun_queue_depth`: Maximum number of FC commands that can be queued to a specific LUN (uint)
   - `lpfc_hba_queue_depth`: Maximum number of FC commands that can be queued to an lpfc HBA (uint)
   - `lpfc_tgt_queue_depth`: Maximum number of FC commands that can be queued to a specific target port (uint)

     The `lpfc_tgt_queue_depth` parameter is applicable only for Red Hat Enterprise Linux 7.x systems, SUSE Linux Enterprise Server 11 SP4 systems and 12.x systems.

2. Update the queue depths by adding the queue depth parameters to the `/etc/modprobe.conf` file for a Red Hat Enterprise Linux 5.x system and to the `/etc/modprobe.d/scsi.conf` file for a Red Hat Enterprise Linux 6.x or 7.x system, or a SUSE Linux Enterprise Server 11.x or 12.x system.

   Depending on your operating system version, you can add one or more of the following commands:

   - `options lpfc lpfc_hba_queue_depth=new_queue_depth`
   - `options lpfc lpfc_lun_queue_depth=new_queue_depth`

- `options lpfc_tgt_queue_depth=new_queue_depth`

3. Create a new RAM disk image, and then reboot the host to make the updates persistent across reboots.

   For more information, see the System administration for your version of Linux operating system.

4. Verify that the queue depth values are updated for each of the queue depth parameter that you have modified:

   ```
   cat /sys/class/scsi_host/host_number/lpfc_lun_queue_depthcat
   /sys/class/scsi_host/host_number/lpfc_tgt_queue_depthcat
   /sys/class/scsi_host/host_number/lpfc_hba_queue_depth
   ```

   ```
   root@localhost ~]#cat /sys/class/scsi_host/host5/lpfc_lun_queue_depth
         30
   ```

   The current value of the queue depth is displayed.

## Linux hosts for QLogic HBA

You can update the device queue depth of a QLogic driver on a Linux host. To make the updates persistent across reboots, you must then create a new RAM disk image and reboot the host. You can use the QLogic HBA management GUI or command-line interface (CLI) to modify the QLogic HBA queue depth.

This task shows how to use the QLogic HBA CLI to modify the QLogic HBA queue depth

**Steps**

1. Identify the device queue depth parameter to be modified:

   ```
   modinfo qla2xxx | grep ql2xmaxqdepth
   ```

   You can modify only the `ql2xmaxqdepth` queue depth parameter, which denotes the maximum queue depth that can be set for each LUN. The default value is 64 for RHEL 7.5 and later. The default value is 32 for RHEL 7.4 and earlier.

   ```
   root@localhost ~]# modinfo qla2xxx|grep ql2xmaxqdepth
   parm:       ql2xmaxqdepth:Maximum queue depth to set for each LUN.
   Default is 64. (int)
   ```

2. Update the device queue depth value:
   - If you want to make the modifications persistent, perform the following steps:
     i. Update the queue depths by adding the queue depth parameter to the `/etc/modprobe.conf` file for a Red Hat Enterprise Linux 5.x system and to the `/etc/modprobe.d/scsi.conf` file for a Red Hat Enterprise Linux 6.x or 7.x system, or a SUSE Linux Enterprise Server 11.x or 12.x system: `options qla2xxx ql2xmaxqdepth=new_queue_depth`
     ii. Create a new RAM disk image, and then reboot the host to make the updates persistent across reboots.

For more information, see the System administration for your version of Linux operating system.

- If you want to modify the parameter only for the current session, run the following command:

  `echo new_queue_depth > /sys/module/qla2xxx/parameters/ql2xmaxqdepth`

  In the following example, the queue depth is set to 128.

  ```
  echo 128 > /sys/module/qla2xxx/parameters/ql2xmaxqdepth
  ```

3. Verify that the queue depth values are updated:

   `cat /sys/module/qla2xxx/parameters/ql2xmaxqdepth`

   The current value of the queue depth is displayed.

4. Modify the QLogic HBA queue depth by updating the firmware parameter `Execution Throttle` from the QLogic HBA BIOS.
   a. Log in to the QLogic HBA management CLI:

      `/opt/QLogic_Corporation/QConvergeConsoleCLI/qaucli`

   b. From the main menu, select the `Adapter Configuration` option.

```
[root@localhost ~]#
/opt/QLogic_Corporation/QConvergeConsoleCLI/qaucli
Using config file:
/opt/QLogic_Corporation/QConvergeConsoleCLI/qaucli.cfg
Installation directory: /opt/QLogic_Corporation/QConvergeConsoleCLI
Working dir: /root

QConvergeConsole

        CLI - Version 2.2.0 (Build 15)

    Main Menu

    1:  Adapter Information
    **2:  Adapter Configuration**
    3:  Adapter Updates
    4:  Adapter Diagnostics
    5:  Monitoring
    6:  FabricCache CLI
    7:  Refresh
    8:  Help
    9:  Exit


        Please Enter Selection: 2
```

c. From the list of adapter configuration parameters, select the `HBA Parameters` option.

```
1:  Adapter Alias
    2:  Adapter Port Alias
    **3:  HBA Parameters**
    4:  Persistent Names (udev)
    5:  Boot Devices Configuration
    6:  Virtual Ports (NPIV)
    7:  Target Link Speed (iiDMA)
    8:  Export (Save) Configuration
    9:  Generate Reports
   10:  Personality
   11:  FEC
(p or 0: Previous Menu; m or 98: Main Menu; ex or 99: Quit)
        Please Enter Selection: 3
```

d. From the list of HBA ports, select the required HBA port.

```
Fibre Channel Adapter Configuration

    HBA Model QLE2562 SN: BFD1524C78510
      1: Port   1: WWPN: 21-00-00-24-FF-8D-98-E0 Online
      2: Port   2: WWPN: 21-00-00-24-FF-8D-98-E1 Online
    HBA Model QLE2672 SN: RFE1241G81915
      3: Port   1: WWPN: 21-00-00-0E-1E-09-B7-62 Online
      4: Port   2: WWPN: 21-00-00-0E-1E-09-B7-63 Online


        (p or 0: Previous Menu; m or 98: Main Menu; ex or 99: Quit)
        Please Enter Selection: 1
```

The details of the HBA port are displayed.

e. From the HBA Parameters menu, select the `Display HBA Parameters` option to view the current value of the `Execution Throttle` option.

The default value of the `Execution Throttle` option is 65535.

```
HBA Parameters Menu

========================================================
HBA           : 2 Port: 1
SN            : BFD1524C78510
HBA Model     : QLE2562
HBA Desc.     : QLE2562 PCI Express to 8Gb FC Dual Channel
FW Version    : 8.01.02
WWPN          : 21-00-00-24-FF-8D-98-E0
WWNN          : 20-00-00-24-FF-8D-98-E0
Link          : Online
========================================================

    1:  Display HBA Parameters
    2:  Configure HBA Parameters
    3:  Restore Defaults


        (p or 0: Previous Menu; m or 98: Main Menu; x or 99: Quit)
        Please Enter Selection: 1
------------------------------------------------------------------------
-----------
HBA Instance 2: QLE2562 Port 1 WWPN 21-00-00-24-FF-8D-98-E0 PortID
03-07-00
Link: Online
```

```
--------------------------------------------------------------------
-----------
Connection Options              : 2 - Loop Preferred, Otherwise Point-
to-Point
Data Rate                       : Auto
Frame Size                      : 2048
Hard Loop ID                    : 0
Loop Reset Delay (seconds)      : 5
Enable Host HBA BIOS            : Enabled
Enable Hard Loop ID             : Disabled
Enable FC Tape Support          : Enabled
Operation Mode                  : 0 - Interrupt for every I/O
completion
Interrupt Delay Timer (100us)   : 0
**Execution Throttle              : 65535**
Login Retry Count               : 8
Port Down Retry Count           : 30
Enable LIP Full Login           : Enabled
Link Down Timeout (seconds)     : 30
Enable Target Reset             : Enabled
LUNs Per Target                 : 128
Out Of Order Frame Assembly     : Disabled
Enable LR Ext. Credits          : Disabled
Enable Fabric Assigned WWN      : N/A

Press <Enter> to continue:
```

f. Press **Enter** to continue.

g. From the HBA Parameters menu, select the `Configure HBA Parameters` option to modify the HBA parameters.

h. From the Configure Parameters menu, select the `Execute Throttle` option and update the value of this parameter.

```
Configure Parameters Menu

=====================================================
HBA           : 2 Port: 1
SN            : BFD1524C78510
HBA Model     : QLE2562
HBA Desc.     : QLE2562 PCI Express to 8Gb FC Dual Channel
FW Version    : 8.01.02
WWPN          : 21-00-00-24-FF-8D-98-E0
WWNN          : 20-00-00-24-FF-8D-98-E0
Link          : Online
=====================================================

    1:  Connection Options
    2:  Data Rate
    3:  Frame Size
    4:  Enable HBA Hard Loop ID
    5:  Hard Loop ID
    6:  Loop Reset Delay (seconds)
    7:  Enable BIOS
    8:  Enable Fibre Channel Tape Support
    9:  Operation Mode
   10:  Interrupt Delay Timer (100 microseconds)
   11:  Execution Throttle
   12:  Login Retry Count
   13:  Port Down Retry Count
   14:  Enable LIP Full Login
   15:  Link Down Timeout (seconds)
   16:  Enable Target Reset
   17:  LUNs per Target
   18:  Enable Receive Out Of Order Frame
   19:  Enable LR Ext. Credits
   20:  Commit Changes
   21:  Abort Changes


        (p or 0: Previous Menu; m or 98: Main Menu; x or 99: Quit)
        Please Enter Selection: 11
Enter Execution Throttle [1-65535] [65535]: 65500
```

i. Press **Enter** to continue.

j. From the Configure Parameters menu, select the `Commit Changes` option to save the changes.

k. Exit the menu.

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