



Solaris

SAN hosts and cloud clients

NetApp
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Table of Contents

- Solaris 1
 - Use Solaris 11.4 with ONTAP..... 1
 - Use Solaris 11.3 with ONTAP..... 7

Solaris

Use Solaris 11.4 with ONTAP

You can use the ONTAP SAN host configuration settings to configure Solaris 11.4 with ONTAP as the target.

Install the Solaris Host Utilities

You can download the compressed file containing the Host Utilities software packages from the [NetApp Support Site](#). After you download the file, you must extract the zip file to get the software packages you need to install the Host Utilities.

Steps

1. Download a copy of the compressed file containing the Host Utilities from the [NetApp Support Site](#) to a directory on your host.
2. Go to the directory containing the download.
3. Decompress the file.

The following example decompresses files for a SPARC system. For x86-64 platforms, use the x86/x64 package.

```
gunzip netapp_solaris_host_utilities_6_2N20170913_0304_sparc.tar.gz
```

4. Use the `tar xvf` command to extract the file.

```
tar xvf netapp_solaris_host_utilities_6_2N20170913_0304_sparc.tar
```

5. Add the packages that you extracted from the `.tar` file to your host.

```
pkgadd -d NTAPSANTool.pkg
```

The packages are added to the `/opt/NTAP/SANToolkit/bin` directory.

To complete the installation, you must configure the host parameters for your environment (Oracle Solaris I/O Multipathing or MPxIO in this case) by using the `host_config` command.

The `host_config` command has the following format:

```
/opt/NTAP/SANToolkit/bin/host_config <setup> <protocol fcp|iscsi|mixed>  
<multipath mpxio|dmp| non> [-noalua] [-mcc 60|90|120]
```

The `host_config` command does the following:

- Changes the FC and SCSI driver settings for x86 and SPARC systems
- Provides SCSI timeout settings for both MPxIO configurations
- Sets the VID/PID information
- Enables or disables ALUA

- Configures the ALUA settings used by MPxIO and the SCSI drivers for both x86 and SPARC systems

6. Reboot the host.

SAN toolkit

The tool kit is installed automatically when you install the NetApp Host Utilities package. This kit provides the `sanlun` utility, which helps you manage LUNs and HBAs. The `sanlun` command returns information about the LUNs mapped to your host, multipathing, and information necessary to create initiator groups.

Example

In the following example, the `sanlun lun show` command returns LUN information.

```
#sanlun lun show

controller(7mode) /                               device
host                lun
vservers(Cmode)     lun-pathname  filename
adapter protocol   size  mode
-----
data_vserver        /vol/vol1/lun1
/dev/rdisk/c0t600A098038314362692451465A2F4F39d0s2  qlc1  FCP          60g  C
data_vserver        /vol/vol2/lun2
/dev/rdisk/c0t600A098038314362705D51465A626475d0s2  qlc1  FCP          20g  C
```

SAN booting

What you'll need

If you decide to use SAN booting, it must be supported by your configuration. You can use the [NetApp Interoperability Matrix Tool](#) to verify that your OS, HBA, HBA firmware and the HBA boot BIOS, and ONTAP version are supported.

SAN booting is the process of setting up a SAN-attached disk (a LUN) as a boot device for a Solaris host.

You can set up a SAN boot LUN to work in a Solaris MPxIO environment using the FC protocol and running Solaris Host Utilities. The method you use to set up a SAN boot LUN can vary depending on your volume manager and file system. See [Install Solaris Host Utilities](#) for details on a SAN boot LUNs in a Solaris MPIO (Multipath I/O) environment.

Multipathing

Multipathing enables you to configure multiple network paths between the host and storage systems. If one path fails, traffic continues on the remaining paths. Oracle Solaris I/O Multipathing or MPxIO is enabled by default for Solaris 11.4. The default setting in `/kernel/drv/fp.conf` changes to `mpxio-disable="no"`.

Non-ASA configurations

For non-ASA configurations, there should be two groups of paths with different priorities. The paths with the higher priorities are Active/Optimized, meaning they are serviced by the controller where the aggregate is

located. The paths with the lower priorities are active but are non-optimized because they are served from a different controller. The non-optimized paths are only used when no optimized paths are available.

Example

The following example displays the correct output for an ONTAP LUN with two Active/Optimized paths and two Active/Non-Optimized paths:

The path priorities are displayed against the **Access State** section for each LUN in the OS native `mpathadm show lu <LUN>` command.

All SAN Array configurations

In All SAN Array (ASA) configurations, all paths to a given LUN are active and optimized. This improves performance by serving I/O operations through all paths at the same time.

Example

The following example displays the correct output for an ONTAP LUN:

The output for the `sanlun` command is the same for ASA and non-ASA configurations.

The path priorities are displayed against the **Access State** section for each LUN in the OS native `mpathadm show lu <LUN>` command.

```
#sanlun lun show -pv sparc-s7-16-49:/vol/solaris_vol_1_0/solaris_lun

          ONTAP Path: sparc-s7-16-
49:/vol/solaris_vol_1_0/solaris_lun
          LUN: 0
          LUN Size: 30g
          Host Device:
/dev/rdisk/c0t600A098038314362692451465A2F4F39d0s2
          Mode: C
          Multipath Provider: Sun Microsystems
          Multipath Policy: Native
```



All SAN Arrays (ASA) configurations are supported beginning ONTAP 9.8 for Solaris hosts.

Recommended settings

NetApp recommends using the following parameter settings for Solaris 11.4 SPARC and x86_64 with NetApp ONTAP LUNs. These parameter values are set by Host Utilities. For additional Solaris 11.4 system settings, see Oracle DOC ID: 2595926.1.

Parameter	Value
throttle_max	8
not_ready_retries	300
busy_retries	30

Parameter	Value
reset_retries	30
throttle_min	2
timeout_retries	10
physical_block_size	4096

All Solaris OS versions (including Solaris 10.x and Solaris 11.x) support Solaris HUK 6.2.

- For Solaris 11.4, the FC driver binding is changed from `ssd` to `sd`. The following configuration files get partially updated during the HUK 6.2 installation process:
 - `/kernel/drv/sd.conf`
 - `/etc/driver/drv/scsi_vhci.conf`
- For Solaris 11.3, the FC driver binding uses `ssd`. The following configuration files get partially updated during the HUK 6.2 installation process:
 - `/kernel/drv/ssd.conf`
 - `/etc/driver/drv/scsi_vhci.conf`
- For Solaris 10.x, the following configuration files get fully updated during the HUK 6.2 installation process:
 - `/kernel/drv/sd.conf`
 - `/kernel/drv/ssd.conf`
 - `/kernel/drv/scsi_vhci.conf`

To resolve any configuration issues, see the Knowledge Base article [What are the Solaris host recommendations for supporting HUK 6.2](#).

NetApp recommends the following for a successful 4KB aligned I/O with zpools using NetApp LUNs:

- Verify that you are running a recent enough Solaris OS to ensure that all Solaris features supporting 4KB I/O size alignment are available.
- Verify that the Solaris 10 update 11 is installed with latest kernel patches and Solaris 11.4 with the latest Support Repository Update (SRU).
- The NetApp logical unit must have `lun/host-type` as `Solaris` regardless of the LUN size.

Recommended settings for MetroCluster

By default, the Solaris OS will fail to execute the I/O operations after **20s** if all paths to a LUN are lost. This is controlled by the `fcpx_offline_delay` parameter. The default value for `fcpx_offline_delay` is appropriate for standard ONTAP clusters. However, in MetroCluster configurations the value of `fcpx_offline_delay` must be increased to **120s** to ensure that I/O does not prematurely time out during operations including unplanned fail overs. For additional information and recommended changes to default settings, see the Knowledge Base article [Solaris host support considerations in a MetroCluster configuration](#).

Oracle Solaris virtualization

- Solaris virtualization options include Solaris Logical Domains (also called LDOMs or Oracle VM Server for SPARC), Solaris Dynamic Domains, Solaris Zones, and Solaris Containers. These technologies have been

re-branded generally as "Oracle Virtual Machines" despite the fact that they are based on different architectures.

- In some cases, multiple options can be used together such as a Solaris Container within a particular Solaris Logical Domain.
- NetApp generally supports the use of these virtualization technologies where the overall configuration is supported by Oracle and any partition with direct access to LUNs is listed on the [NetApp Interoperability Matrix](#) in a supported configuration. This includes root containers, LDOM I/O domains, and LDOM using NPIV to access LUNs.
- Partitions or virtual machines that use only virtualized storage resources, such as a `vdsk`, do not need specific qualifications as they do not have direct access to NetApp LUNs. Only the partition or virtual machine that has direct access to the underlying LUN, such as an LDOM I/O domain, must be found in the [NetApp Interoperability Matrix Tool](#).

Recommended settings for virtualization

When LUNs are used as virtual disk devices within an LDOM, the source of the LUN is masked by virtualization and the LDOM will not properly detect the block sizes. To prevent this issue, the LDOM OS must be patched for *Oracle Bug 15824910* and a `vdc.conf` file must be created that sets the block size of the virtual disk to 4096. See Oracle DOC: 2157669.1 for more information.

To verify the patch do the following:

Steps

1. Create a zpool.
2. Run `zdb -C` against the zpool and verify that the value of **ashift** is 12.

If the value of **ashift** is not 12, verify that the correct patch was installed and recheck the contents of `vdc.conf`.

Do not proceed until **ashift** shows a value of 12.



Patches are available for Oracle bug 15824910 on various versions of Solaris. Contact Oracle if assistance is required in determining the best kernel patch.

Recommended settings for SnapMirror Business Continuity

In order to verify that the Solaris client applications are non-disruptive when an unplanned site failover switchover occurs in a SnapMirror Business Continuity (SM-BC) environment, you must configure the following setting on the Solaris 11.4 host. This setting overrides the failover module `f_tpgs` to prevent the execution of the code path that detects the contradiction.



Beginning with ONTAP 9.9.1, SM-BC setting configurations are supported in the Solaris 11.4 host.

Follow the instructions to configure the override parameter:

Steps

1. Create the configuration file `/etc/driver/drvt/scsi_vhci.conf` with an entry similar to the following for the NetApp storage type connected to the host:

```
scsi-vhci-failover-override =
"NETAPP LUN","f_tpgs"
```

2. Use the `devprop` and `mdb` commands to verify that the override parameter has been successfully applied:

```
root@host-A:~# devprop -v -n /scsi_vhci scsi-vhci-failover-override scsi-vhci-
failover-override=NETAPP LUN + f_tpgs
root@host-A:~# echo "*scsi_vhci_dip::print -x struct dev_info devi_child |
::list struct dev_info devi_sibling| ::print struct dev_info devi_mdi_client|
::print mdi_client_t ct_vprivate| ::print struct scsi_vhci_lun svl_lun_wnn
svl_fops_name"| mdb -k
```

```
svl_lun_wnn = 0xa002a1c8960 "600a098038313477543f524539787938"
svl_fops_name = 0xa00298d69e0 "conf f_tpgs"
```



After `scsi-vhci-failover-override` has been applied, `conf` is added to `svl_fops_name`. For additional information and recommended changes to default settings, refer to the NetApp Knowledge Base article [Solaris Host support recommended settings in SnapMirror Business Continuity \(SM-BC\) configuration](#).

Known issues

The Solaris 11.4 with ONTAP release has the following known issues:

NetApp Bug ID	Title	Description	Oracle ID
1362435	HUK 6.2 and Solaris_11.4 FC driver binding changes	Refer to Solaris 11.4 and HUK recommendations. FC driver binding is changed from <code>ssd (4D)</code> to <code>sd (4D)</code> . Move the existing configuration from <code>ssd.conf</code> to <code>sd.conf</code> as mentioned in Oracle DOC: 2595926.1). The behavior varies across newly installed Solaris 11.4 systems and systems upgraded from Solaris 11.3 or earlier versions.	(Doc ID 2595926.1)
1366780	Solaris LIF issue noticed during storage failover (SFO) giveback operation with Emulex 32G host bus adapter (HBA) on x86 Arch	Solaris LIF issue noticed with Emulex firmware version 12.6.x and later on the x86_64 platform.	SR 3-24746803021

NetApp Bug ID	Title	Description	Oracle ID
1368957	Solaris 11.x <code>cfgadm -c configure</code> resulting in I/O error with end-to-end Emulex configuration	Running <code>cfgadm -c configure</code> on Emulex end-to-end configuration results in an I/O error. This is fixed in ONTAP 9.5P17, 9.6P14 , 9.7P13, and 9.8P2	Not Applicable
1345622	Abnormal path reporting on Solaris hosts with ASA/PPorts using OS native commands	Intermittent path reporting issues are noticed on Solaris 11.4 with All SAN Array (ASA).	Not Applicable

Use Solaris 11.3 with ONTAP

You can use the ONTAP SAN host configuration settings to configure Solaris 11.3 with ONTAP as the target.

Install the Solaris Host Utilities

You can download the compressed file containing the Host Utilities software packages from the [NetApp Support Site](#). After you have the file, you must extract it to get the software packages you need to install the Host Utilities.

Steps

1. Download a copy of the compressed file containing the Host Utilities from the [NetApp Support Site](#) to a directory on your host.
2. Go to the directory containing the download.
3. Extract the file.

The following example decompresses files for a SPARC system. For x86-64 platforms, use the x86/x64 package.

```
gunzip netapp_solaris_host_utilities_6_2N20170913_0304_sparc.tar.gz
```

4. Use the `tar xvf` command to unzip the file.

```
tar xvf netapp_solaris_host_utilities_6_2N20170913_0304_sparc.tar
```

5. Add the packages that you extracted from the tar file to your host.

```
pkgadd -d NTAPSANTool.pkg
```

The packages are added to the `/opt/NTAP/SANToolkit/bin` directory.

To complete the installation, you must configure the host parameters for your environment (MPxIO in this case) by using the `host_config` command.

The `host_config` command has the following format:

```
/opt/NTAP/SANToolkit/bin/host_config <-setup> <-protocol fcp|iscsi|mixed> <-multipath mpxio|dmp| non> [-noalua] [-mcc 60|90|120]
```

The `host_config` command does the following:

- Changes the Fibre Channel and SCSI driver settings for the X86 and SPARC systems
- Provides SCSI timeout settings for both the MPxIO configurations
- Sets the VID/PID information
- Enables or disables ALUA
- Configures the ALUA settings used by MPxIO and the SCSI drivers for both X86 and SPARC systems.

6. Reboot the host.

SAN toolkit

The tool kit is installed automatically when you install the NetApp Host Utilities package. This kit provides the `sanlun` utility, which helps you manage LUNs and HBAs. The `sanlun` command returns information about the LUNs mapped to your host, multipathing, and information necessary to create initiator groups.

Example

In the following example, the `sanlun lun show` command returns LUN information.

```
#sanlun lun show

controller(7mode)/                               device
host                lun
vservers(Cmode)      lun-pathname      filename
adapter protocol  size  mode
-----
data_vservers        /vol/vol1/lun1
/dev/rdisk/c0t600A098038314362692451465A2F4F39d0s2  qlc1  FCP      60g  C
data_vservers        /vol/vol2/lun2
/dev/rdisk/c0t600A098038314362705D51465A626475d0s2  qlc1  FCP      20g  C
```

SAN booting

What you'll need

If you decide to use SAN booting, it must be supported by your configuration. You can use the [NetApp Interoperability Matrix Tool](#) to verify that your OS, HBA, HBA firmware and the HBA boot BIOS, and ONTAP version are supported.

SAN booting is the process of setting up a SAN-attached disk (a LUN) as a boot device for a Solaris host.

You can set up a SAN boot LUN to work in a Solaris MPxIO environment using the FC protocol and running the Solaris Host Utilities. The method you use to set up a SAN boot LUN can vary depending on your volume manager and file system. See [Install Solaris Host Utilities](#) for details on SAN Booting LUNs in a Solaris MPIO environment.

Multipathing

Multipathing allows you to configure multiple network paths between the host and storage system. If one path fails, traffic continues on the remaining paths.

Non-ASA configurations

For non-ASA configurations, there should be two groups of paths with different priorities. The paths with the higher priorities are Active/Optimized, meaning they are serviced by the controller where the aggregate is located. The paths with the lower priorities are active but are non-optimized because they are served from a different controller. The non-optimized paths are only used when no optimized paths are available.

Example

The following example displays the correct output for an ONTAP LUN with two Active/Optimized paths and two Active/Non-Optimized paths:

The path priorities are displayed against the **Access State** section for each LUN in the OS native `mpathadm show lu <LUN>` command.

All SAN Array configurations

In All SAN Array (ASA) configurations, all paths to a given LUN are active and optimized. This improves performance by serving I/O operations through all paths at the same time.

Example

The following example displays the correct output for an ONTAP LUN:

The output for the `sanlun` command is the same for ASA and non-ASA configurations.

The path priorities are displayed against the **Access State** section for each LUN in the OS native `mpathadm show lu <LUN>` command.

```
#sanlun lun show -pv sparc-s7-16-49:/vol/solaris_vol_1_0/solaris_lun

                ONTAP Path: sparc-s7-16-
49:/vol/solaris_vol_1_0/solaris_lun
                LUN: 0
                LUN Size: 30g
                Host Device:
/dev/rdisk/c0t600A098038314362692451465A2F4F39d0s2
                Mode: C
                Multipath Provider: Sun Microsystems
                Multipath Policy: Native
```



All SAN Arrays (ASA) configurations are supported beginning in ONTAP 9.8 for Solaris Hosts.

Recommended settings

Following are some parameter settings that are recommended for Solaris 11.3 SPARC and x86_64 with

NetApp ONTAP LUNs. These parameter values are set by Host Utilities.

Parameter	Value
throttle_max	8
not_ready_retries	300
busy_retries	30
reset_retries	30
throttle_min	2
timeout_retries	10
physical_block_size	4096

Recommended settings for MetroCluster

By default, the Solaris operating system will fail I/Os after 20 seconds if all paths to a LUN are lost. This is controlled by the `fcg_offline_delay` parameter. The default value for `fcg_offline_delay` is appropriate for standard ONTAP clusters. However, in MetroCluster configurations, the value of `fcg_offline_delay` must be increased to **120s** to ensure that I/O does not prematurely time out during operations including unplanned failovers. For additional information and recommended changes to default settings, see the Knowledge Base article [Solaris host support considerations in a MetroCluster configuration](#).

Oracle Solaris virtualization

- Solaris virtualization options include Solaris Logical Domains (also called LDOMs or Oracle VM Server for SPARC), Solaris Dynamic Domains, Solaris Zones, and Solaris Containers. These technologies have been rebranded generally as "Oracle Virtual Machines" despite the fact that they are based on very different architectures.
- In some cases, multiple options can be used together such as a Solaris Container within a particular Solaris Logical Domain.
- NetApp generally supports the use of these virtualization technologies where the overall configuration is supported by Oracle and any partition with direct access to LUNs is listed on the [NetApp Interoperability Matrix](#) in a supported configuration. This includes root containers, LDOM IO domains, and LDOM's using NPIV to access LUNs.
- Partitions and/or virtual machines which use only virtualized storage resources, such as a `vdsk`, do not need specific qualification as they do not have direct access to NetApp LUNs. Only the partition/VM that has direct access to the underlying LUN, such as an LDOM IO domain, must be found in the [NetApp Interoperability Matrix](#).

Recommended settings for virtualization

When LUNs are used as virtual disk devices within an LDOM, the source of the LUN is masked by virtualization and the LDOM will not properly detect the block sizes. To prevent this issue, the LDOM operating system must be patched for Oracle Bug 15824910 and a `vdsk.conf` file must be created that sets the block size of the virtual disk to 4096. See Oracle Doc 2157669.1 for more information.

To verify the patch, do the following:

Steps

1. Create a zpool.

2. Run `zdb -C` against the zpool and verify that the value of **ashift** is 12.

If the value of **ashift** is not 12, verify that the correct patch was installed and recheck the contents of `vdc.conf`.

Do not proceed until **ashift** shows a value of 12.



Patches are available for Oracle bug 15824910 on various versions of Solaris. Contact Oracle if assistance is required in determining the best kernel patch.

Recommended settings for SnapMirror Business Continuity

In order to verify that the Solaris client applications are non-disruptive when an unplanned site failover switchover occurs in a SnapMirror Business Continuity (SM-BC) environment, you must configure the following setting on the Solaris 11.3 host. This setting overrides the failover module `f_tpgs` to prevent the execution of the code path that detects the contradiction.



Beginning with ONTAP 9.9.1, SM-BC setting configurations are supported in the Solaris 11.3 host.

Follow the instructions to configure the override parameter:

Steps

1. Create the configuration file `/etc/driver/drv/scsi_vhci.conf` with an entry similar to the following for the NetApp storage type connected to the host:

```
scsi-vhci-failover-override =  
"NETAPP LUN", "f_tpgs"
```

2. Use the `devprop` and `mdb` commands to verify that the override parameter has been successfully applied:

```
root@host-A:~# devprop -v -n /scsi_vhci scsi-vhci-failover-override scsi-vhci-  
failover-override=NETAPP LUN + f_tpgs  
root@host-A:~# echo "*scsi_vhci_dip::print -x struct dev_info devi_child |  
::list struct dev_info devi_sibling| ::print struct dev_info devi_mdi_client|  
::print mdi_client_t ct_vprivate| ::print struct scsi_vhci_lun svl_lun_wnn  
svl_fops_name"| mdb -k
```

```
svl_lun_wnn = 0xa002a1c8960 "600a098038313477543f524539787938"  
svl_fops_name = 0xa00298d69e0 "conf f_tpgs"
```



After `scsi-vhci-failover-override` has been applied, `conf` is added to `svl_fops_name`.

For additional information and recommended changes to default settings, refer to the NetApp KB article [Solaris Host support recommended settings in SnapMirror Business Continuity \(SM-BC\) configuration](#).

Known issues

The Solaris 11.3 with ONTAP release has the following known issues:

NetApp Bug ID	Title	Description	Oracle ID
1366780	Solaris LIF problem during GB with Emulex 32G HBA on x86 Arch	Seen with Emulex Firmware version 12.6.x and later on x86_64 Platform	SR 3-24746803021
1368957	Solaris 11.x 'cfgadm -c configure' resulting in I/O error with End-to-End Emulex configuration	Running <code>cfgadm -c configure</code> on Emulex end-to-end configurations results in I/O error. This is fixed in ONTAP 9.5P17, 9.6P14, 9.7P13 and 9.8P2	Not Applicable

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