Linux® Unified Host Utilities 7.1

Recommended Host Settings for Linux® Unified Host Utilities 7.1

August 2016 | 215-11445_A0
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Contents

Recommendations for the host settings

It is best to use certain values for host parameters when you run the Linux Unified Host Utilities. These recommendations are based on research, working with Linux providers such as Red Hat and SUSE, and internal testing done at NetApp. The recommended values might differ depending on your system environment and the version of the operating system that you are using.

Before you set up the Linux Unified Host Utilities, it is a good practice to check the following information:

- For information to help you install, configure, and use the Host Utilities, you can see the Linux Unified Host Utilities documentation in the NetApp Support Site.
- The Interoperability Matrix, which is online at *NetApp Interoperability* to verify that the Host Utilities support your system setup.

For detailed information about the DM-Multipath parameters, see the Red Hat documentation on the `multipath.conf` file. At the time this document was prepared, that information was available at `http://docs.redhat.com/docs/en-US/Red_Hat_Enterprise_Linux/6/html/DM_Multipath/config_file_defaults.html`.

This information on the `multipath.conf` parameters applies to both Red Hat Enterprise Linux and SUSE Linux.

You can find examples of the `multipath.conf` files in the document *Using Linux Hosts with ONTAP Storage*.

Improving I/O performance on Red Hat Enterprise Linux/Oracle Linux hosts

Red Hat Enterprise Linux/Oracle Linux 6 and 7 now have a tuned package with a `tuned-adm` command to set different server profiles on the host depending on the environment. This includes an enterprise-storage profile for configurations where LUNs from enterprise storage arrays are used.

The enterprise-storage profile enables a number of performance fine-tuning measures, such as switching the I/O scheduler to “deadline” from the default “cfq” scheduler, as well as increasing the readahead, setting the CPU governor to performance mode, and so on.

Note: You can use the virtual-guest profile for Red Hat Enterprise Linux/Oracle Linux as a guest virtual machine. The virtual guest profile is based on the enterprise-storage profile.

Recommended server profiles on Red Hat Enterprise Linux/Oracle Linux

Profile Settings	Value	Descriptions
Current active profile **Supported RHEL/OL Versions:** RHEL/OL 6 and 7 series	`enterprise-storage`	**Red Hat Enterprise Linux/Oracle Linux 6 and 7**: set this value to `enterprise-storage`
Current active profile **Supported RHEL/OL Versions:** RHEL/OL 6 and 7 series	`virtual-guest`	**Red Hat Enterprise Linux/Oracle Linux 6 and 7**: set this value to `virtual-guest`

Red Hat Enterprise Linux/Oracle Linux: Recommended default settings for DM-Multipath

You need to know the recommended settings for the default section of the DM-Multipath `multipath.conf` file on hosts running Red Hat Enterprise Linux/Oracle Linux. In most cases, the Red Hat settings also apply to Oracle Linux. If Oracle Linux requires a different value, that value is listed.

The parameters and values you supply in the devices section of the `multipath.conf` file override the values specified in the default section of the file.

Red Hat Enterprise Linux DM-Multipath recommended default parameters		
Parameter	**Value**	**Recommendation**
`flush_on_last_del` **Supported versions:** • RHEL/OL 7 series, RHEL/OL 6 series, 5.2 and later, 4.7 • RHEL 5 update 3 and later • RHEL 4 update 7 and later	**RHEL/OL:** `yes`	**Red Hat Enterprise Linux**: Set this value to **`yes`**. The default value is **`no`**.
`max_fds` **Supported versions:** • RHEL 7 series, 6 series, and OL 7 series, OL 6 series • RHEL 5.2 and later • RHEL 4 update 7 and later	**RHEL/OL 7 series, RHEL/OL 6, 5.2 and later, 4.7**:**`max`**	**RHEL/OL 7 series, RHEL/OL 6 series, 5.2 and later, 4.7**: Set this value to **`max`**.
`pg_prio_calc` **Supported Red Hat versions:** • RHEL 5 update 6 and later	**`avg`**	Set this value to **`avg`**.
`queue_without_daemon` **Supported versions:** • RHEL 7 series, 6 series, and OL 7 series, OL 6 series • RHEL 5 update 3 and later	**RHEL/OL**: **`no`**	**Red Hat Enterprise Linux/Oracle Linux**: Set this value to **`no`**. The default value is **`yes`**.

Red Hat Enterprise Linux DM-Multipath recommended default parameters		
Parameter	**Value**	**Recommendation**
`user_friendly_names` **Supported versions:** • RHEL 7 series, 6 series, and OL 7 series, OL 6 series • RHEL 5 series and OL 5 series • RHEL 4 series	**no**	Set this value to **no**. Entering **no** forces both the host and the target to use the WWID for naming the DM-Multipath devices, which ensures that the host and the target use a consistent attribute that persists across reboots and does not require a separate mpath bindings file for naming purposes. In addition, by setting this value to **no**, you avoid some of the problems that have been seen when `user_friendly_names` is set to **yes**. There have been several Red Hat Bugzilla reports about these issues. **Note:** Red Hat Enterprise Virtualization Hypervisor nodes require that you set this value to **no**.
`dev_loss_tmo` **Supported versions:** • RHEL 7 series, 6 update 1 and later, and OL 7 series, OL 6 series	**RHEL/OL 6.1**: **2147483647** **RHEL/OL 6.2 and later**:**infinity**	This parameter is turned on by default and specifies the number of seconds before a link is marked lost. The value you supply depends on your version of Red Hat Enterprise Linux. **Red Hat Enterprise Linux/Oracle Linux 6.1** : Set this value to **2147483647** seconds. **Red Hat Enterprise Linux/Oracle Linux 6.2 and later** : Set this value to **infinity**, so that the link is never lost.
`fast_io_fail_tmo` **Supported versions:** • RHEL 7 series, 6 update 1 and later, and OL 7 series, OL 6 series	**5**	Set this value to **5**. **Related parameters**: This value works with the value for `dev_loss_tmo`.

Red Hat Enterprise Linux/Oracle Linux: Recommended device settings for DM-Multipath

You need to know the recommended settings for the devices section of the DM-Multipath `multipath.conf` file when you are running Red Hat enterprise Linux. In most cases, the Red Hat settings also apply to Oracle Linux. If Oracle Linux requires a different value, that value is listed.

Red Hat Enterprise Linux/Oracle Linux DM-Multipath recommended device parameters		
Parameter	**Value**	**Recommendation**
`failback` **Supported Red Hat versions:** • RHEL 7 series, RHEL 6 series, and OL 7 series, OL 6 series • RHEL 5 series and OL 5 series. • RHEL 4 series	**`immediate`**	Set this value to **`immediate`**. **Related parameters**: `failback` also works with `path_grouping_policy`.
`features` **Supported Red Hat versions:** • RHEL 7 series, RHEL 6 series, and OL 7 series, OL 6 series • RHEL 5 series and OL 5 series • RHEL 4 series	**RHEL 6.1/OL 6.1 and later, RHEL 5.7 and later: `3 queue_if_no_path pg_init_retries 50`** **RHEL 6.0/OL 6.0, 5.1-5.6 and 4 series:`1 queue_if_no_path`**	**Red Hat Enterprise Linux/Oracle Linux 6.1 and later, Red Hat Enterprise Linux 5.7 and later**: Set this value to **`3 queue if no path pg_init_retries 50`**. Internal testing has shown that using this value reduces possible path failures that can occur if a delayed controller failover exceeds the default time of 60 seconds. **Red Hat Enterprise Linux/Oracle Linux 6.0, Red Hat Enterprise Linux prior to 5.7**: Set this value to **`1 queue_if_no_path`** **Related parameters**: If you specify**`path_no_retry`** in the default section of the `multipath.conf` file, that value overrides the `features` value and could cause an operating system crash during a takeover/giveback procedure.

Red Hat Enterprise Linux/Oracle Linux DM-Multipath recommended device parameters		
Parameter	**Value**	**Recommendation**
`getuid_callout` **Supported Red Hat versions:** • RHEL 7 series and OL 7 series • RHEL 6 series and OL 6 series • RHEL 5 series and OL 5 series • RHEL 4 series	**RHEL 7/OL 7 series**:uid_attribute “ID_SERIAL” **RHEL 6/OL 6 series**: **`/lib/udev/scsi_id -g - u -d /dev/%n`** **RHEL 5 and 4 series:** **`/sbin/scsi_id -g -u -s /block/%n`**	**Red Hat Enterprise Linux/Oracle Linux 7 series**: uid_attribute “ID_SERIAL” **Red Hat Enterprise Linux/Oracle Linux 6 series**: Set this value to **`/lib/udev/scsi_id -g -u -d /dev/%n`**. **Red Hat Enterprise Linux 5 series and 4 series**: Set this value to **`/sbin/scsi_id -g -u -s /block/%n`**
`hardware_handler` **Supported Red Hat versions:** • RHEL 7 series, RHEL 6 series, and, OL 7 series, OL 6 series • RHEL 5 series and OL 5 series • RHEL 4 series	**ALUA environments (RHEL 6/Oracle Linux 6 series and 5 series)**: **`1 alua`** **Non-ALUA environments (RHEL 4 series)**: **`0`**	**Red Hat Enterprise Linux/Oracle Linux 6 series and 5 series**: Set this value to **`1 alua`**. **Red Hat Enterprise Linux 4 series**: Set this value to **`0`**. **Related parameters**: This value works with the value for **`prio`**or **`prio_callout`**.

Red Hat Enterprise Linux/Oracle Linux DM-Multipath recommended device parameters		
Parameter	**Value**	**Recommendation**
`path_checker` **Supported Red Hat versions:** • RHEL 7 series, RHEL 6 series, and, OL 7 series, OL 6 series • RHEL 5.1 and later • RHEL 4.7 and later	**RHEL 6.1/OL 6.1 and later, RHEL 5.7 and later**: **`tur`** **RHEL 6.0/OL 6.0, 5.1-5.6, RHEL 4.7 and later**:**`directio`**	**Red Hat Enterprise Linux/Oracle Linux 6.1 and later, Red Hat Enterprise Linux 5.8 and later**: Set this value to **`tur`**. Internal testing has shown that using **`tur`** instead of **`directio`** improves performance. The **`tur`** parameter uses SG_input/output (I/O) requests that are inserted at the head of the request queue. The **`directio`** parameter uses FS block requests, which are added to the end of the request queue. As a result, on a busy device, the **`path_checker tur`** requests are serviced immediately while the **`path_checker directio`** must wait for the current I/O load to complete. **Red Hat Enterprise Linux/Oracle Linux 6.0, 5.1-5.7 and 4.7 and later**: Set this value to **`directio`**, which is the default. **Related parameters**: If you are using Red Hat Enterprise Linux 5 or 4.6 and earlier, the value for this parameter is **`readsector0`**.
`path_checker` **Supported Red Hat versions:** • RHEL 5 and OL 5 series • RHEL 4.6 and earlier	**`readsector0`**	Set this value to **`readsector0`** **Related parameters:** If you are using Red Hat Enterprise Linux 5.1 and later, or 4.7 and later, the value for this parameter is **`directio`**.
`path_grouping_policy` **Supported Red Hat versions:** • RHEL 7 series, RHEL 6 series, and, OL 7 series, OL 6 series • RHEL 5 series and OL 5 series • RHEL 4 series	**`group_by_prio`**	**FC only**: Set this value to **`group_by_prio`**. **Related parameters**: This value works with **`failback`**. If you are using the iSCSI protocol, see the next row for information on the value you should use.

Red Hat Enterprise Linux/Oracle Linux DM-Multipath recommended device parameters		
Parameter	**Value**	**Recommendation**
`path_selector` **Supported Red Hat versions:** • RHEL 7 series, 6 series, and OL 7 series, OL 6 series • RHEL 5 series and OL 5 series • RHEL 4 series	**RHEL/OL 7 series, 6 series, 5 series, and 4 series:** **`round-robin 0`** **RHEL/OL 7 series and 6 series also support:** **`queue-length 0`** **`service-time 0`**	**Red Hat Enterprise Linux/Oracle Linux 6 series, 5 series, and 4 series**: Set this value to **`round-robin 0`**. **Red Hat Enterprise Linux/Oracle Linux 7 series**: Set this value to **`service-time 0`**. This is the recommended value for all versions of Red Hat Enterprise Linux that the Host Utilities support.
`prio` **Supported Red Hat versions**: • RHEL 7 series, RHEL 6 series, and OL 7 series, OL 6 series	**ALUA environments:** **`alua`** **Non-ALUA environments:** **`ontap`**	The recommended value is **`alua`**, which is the value required when you are using ALUA. **Related parameters**: This value works with hardware_handler. If you are using Red Hat Enterprise Linux 5 series or 4 series, see the next row.
`prio_callout` **Supported Red Hat versions**: • RHEL 5 series and OL 5 series • RHEL 4 series	**ALUA environments**: `/sbin/mpath_prio_alua /dev/%n` **Non-ALUA environments:** `/sbin/mpath_prio_ontap /dev/%n`	**Red Hat Enterprise Linux 5.1 and later**: When ALUA is enabled, set this value to **`/sbin/mpath_prio_alua /dev/%n`**. **Red Hat Enterprise Linux 5 series and 4 series**: When ALUA is not enabled, set this value to **`/sbin/mpath_prio_ontap /dev/%n`**. **Related parameters**: This value works with hardware_handler. If you are using Red Hat Enterprise Linux 6 series, see the information about **`prio`**.
`product` **Supported Red Hat versions**: • All	**`LUN`**	**Red Hat Enterprise Linux/Oracle Linux 6.2 and earlier**: **`LUN`** **Red Hat Enterprise Linux/Oracle Linux 6.3 and later**: **`LUN.*`**

Red Hat Enterprise Linux/Oracle Linux DM-Multipath recommended device parameters		
Parameter	**Value**	**Recommendation**
`rr_min_io` **Supported Red Hat versions**: • RHEL 7 series, RHEL 6 series, and, OL 7 series OL 6 series • RHEL 5 series and OL 5 series • RHEL 4 series	**RHEL/OL 6 series, 5 series, or 4 series:`128`** **RHEL/OL 7 series:`1000`**	**Red Hat Enterprise Linux/Oracle Linux 6 series, 5 series, or 4 series**: Set this value to **`128`**. **Red Hat Enterprise Linux/Oracle Linux 7 series**: Set this value to **`1000`**. **Note:** If you are using Red Hat Enterprise Linux 4 update 7 or earlier, place rr_min_io in the default section of the `multlipath.conf` file.
`rr_weight` **Supported Red Hat versions**: • RHEL 7 series, RHEL 6 series, and OL 7 series, OL 6 series • RHEL 5 series and OL 5 series • RHEL 4 series	**`uniform`**	Set this value to **`uniform`**.
`vendor` **Supported Red Hat versions**: • All	**`NETAPP`**	This value is required for the NetApp Host Utilities product.

SUSE Linux Enterprise Server: Recommended default settings for DM-Multipath

You need to know the recommended settings for the default section of the DM-Multipath `multipath.conf` file on hosts running SUSE Linux Enterprise Server.

The parameters and values you supply in the devices section of the `multipath.conf` file override the values specified in the defaults section of the file.

SUSE Linux Enterprise Server DM-Multipath recommended default parameters		
Parameter	**Value**	**Recommendation**
`flush_on_last_del` **Supported SUSE versions:** • SLES 11 SP1 and later • SLES 12 series	**`yes`**	Set this value to **`yes`**. The default value is **`no`**.
`queue_without_daemon` **Supported SUSE versions:** • SLES 11 SP2 and later • SLES 12 series	**`no`**	Set this value to **`no`**.
`max_fds` **Supported SUSE versions:** • SLES 11 SP1 and later • SLES 10 SP4 • SLES 12 series	**`max`**	**SUSE Linux Enterprise Server 11 SP1 and later and 10 SP4 and SUSE Linux Enterprise Server 12 series**: Set this value to **`max`**. **Related parameters**: If you are using SUSE Linux Enterprise Server 11 or 10 SP3 and earlier, see the next row.
`max_fds` **Supported SUSE versions:** • SLES 11 • SLES 10 SP3 and earlier	**`8192`**	**SUSE Linux Enterprise Server 11 and 10 SP3 and earlier:** Set this value to **`8192`**.
`user_friendly_names` **Supported SUSE versions:** • SLES 12 series • SLES 11 series • SLES 10 series	**`no`**	Set this value to **`no`**. This is the default.

SUSE Linux Enterprise Server: Recommended device settings for DM-Multipath

You need to know the recommended SUSE Linux Enterprise Server settings for the devices section of the DM-Multipath `multipath.conf` file.

SUSE Linux Enterprise Server DM-Multipath recommended device parameters		
Parameter	**Value**	**Recommendation**
`failback` **Supported SUSE versions**: • SLES 12 series • SLES 11 series • SLES 10 series	**`immediate`**	Set this value to **`immediate`**. **Related parameters**: The value works with Path Group priorities.
`features` **Supported SUSE versions**: • SLES 12 series • SLES 11 series • SLES 10 series	**SUSE Linux Enterprise Server 11 SP2 and later**: **`3 queue_if_no_path pg_init_retries 50`** **SUSE Linux Enterprise Server 10 - 11 SP1**: **`1 queue_if_no_path`**	**SUSE Linux Enterprise Server 11 SP2 and later**: Set this value to **`3 queue_if_no_path pg_init_retries 50`**. **SUSE Linux Enterprise Server 10-11 SP1**: Set this value to **`1 queue_if_no_path`**. **Related parameters**: If you specify **`path_no_retry`** in the default section of the `multipath.conf` file, that value overrides the `features` value and could cause an operating system crash during a takeover/giveback procedure.
`getuid_callout` **Supported SUSE versions**: • SLES 12 series • SLES 11 series • SLES 10 series	**SLES 12 and 11 series**: **`/lib/udev/scsi_id -g -u -d /dev/%n`** **SLES 10 series: `/sbin/scsi_id -g -u -s/block/%n`**	**SUSE Linux Enterprise Server 12 and 11 series**: Set this value to**`/lib/udev/scsi_id -g -u -d/dev/%n`**. **SUSE Linux Enterprise Server 10 series**: Set this value to **`/sbin/scsi_id -g - u -s/block/%n`**.
`hardware_handler` **Supported SUSE versions**: • SLES 12 series • SLES 11 series • SLES 10 with SP4 and later	**ALUA environments**: **`1 alua`** **Non-ALUA environments**: **`0`**	**ALUA environments**: If you use ALUA, set this value to **`1 alua`**. **Non-ALUA environments**: If you are not using ALUA, set this value to **`0`**. **Related parameters**: This value works with prio or prio_callout.

SUSE Linux Enterprise Server DM-Multipath recommended device parameters		
Parameter	**Value**	**Recommendation**
`path_checker` **Supported SUSE versions**: • SLES 12 series • SLES 11 series • SLES 10 with SP2 and later	**`tur`**	Set this value to **`tur`**.
`path_grouping_policy` **Supported SUSE versions**: • SLES 12 series • SLES 11 series • SLES 10 series	**`group_by_prio`**	**FC only:** Set this value to **`group_by_prio`**. **Related parameters**: This value works with failback. If you are using the iSCSI protocol, see the next row for information on the value you should use.
`path_grouping_policy` **Supported SUSE versions**: • SLES 12 series • SLES 11 series • SLES 10 SP3 and later • SLES 10 SP2 and earlier	**SLES 12, 11 series, and 10 SP3 and later**: **`group_by_prio`** **SLES 10 SP2 and earlier**: **`multibus`**	**iSCSI only with SUSE Linux Enterprise Server 12, 11 series, and 10 SP3 and later:** Set this value to **`group_by_prio`**. **iSCSI only with SUSE Linux Enterprise Server 10 SP2 and earlier**: Set this value to **`multibus`**. **Related parameters**: This value works with failback. If you are using the FC protocol, see the previous row for information on the value you should use.
`path_selector` **Supported SUSE versions**: • SLES 11 SP1 and later • SLES 12 series • SLES 11 series • SLES 10 series	**SLES 12, 11, and 10 series**: **`round-robin 0`** **SLES 11 SP1 and later, SLES 12 series later also supports:** **`least-pending`** **`length-load-balancing`** **`service-time`**	Set this value to **`round-robin 0`**. This is the recommended value for all versions of SUSE Linux Enterprise Linux Server that the Host Utilities support.

SUSE Linux Enterprise Server DM-Multipath recommended device parameters		
Parameter	**Value**	**Recommendation**
`prio` **Supported SUSE versions**: • SLES 12 series • SLES 11 series • SLES 10 SP2 and later	**ALUA environments**: **`alua`** **Non-ALUA environments**: **`ontap`**	**ALUA environments**: If you use ALUA, set this value to **`alua`**. **Non-ALUA environments**: If you are not using ALUA, set this value to **`ontap`**. **Related parameters**: This value works with hardware_handler. If you are using SUSE Linux Enterprise Server 10 SP1 and earlier, see the next row.
`prio_callout` **Supported SUSE versions**: • SLES 10 SP1 and earlier	**Non-ALUA environments**: **`sbin/mpath_prio_ontap /dev/%n`**	**Non-ALUA environments**: If you do not use ALUA, set this value to **`sbin/mpath_prio_ontap/dev/%n`**. **Related parameters**: This value works with hardware_handler. If you are using SUSE Linux Enterprise Server 11 series or 10 SP2 and later, see the previous row.
`product` **Supported SUSE versions**: • All	**`LUN`**	Set this value to **`LUN`**.
`rr_min_io` **Supported SUSE versions**: • SLES 12 series • SLES 11 series • SLES 10 series	**`128`**	Set this value to **`128`**.
`rr_weight` **Supported SUSE versions**: • SLES 12 series • SLES 11 series • SLES 10 series	**`uniform`**	Set this value to **`uniform`**.
`vendor` **Supported SUSE versions**: • All	**`NETAPP`**	This value is required for the NetApp Host Utilities product.

Time-out values when using DM-Multipath

You should use the applicable time-out values for the protocols and software in your environment.

FC only: If you are using Fibre Channel, you should use the default values.

iSCSI only: If you are using iSCSI, to use DM-Multipath you must set the time-out value in the iSCSI configuration file to **5**: `node.session.timeo.replacement_timeout = 5`.

Red Hat Enterprise Linux 4: For systems running Red Hat Enterprise Linux 4, you must modify the `/etc/iscsi.conf` file to uncomment `ConnFailTimeoutof` and give it a value of **5**.

Recommendations for Veritas Storage Foundation settings

When you run the Host Utilities with Veritas Volume Manager (VxVM) and Dynamic Multipathing (VxDMP), in most cases you should use the values provided in the Veritas Release Notes.

Note: Check the Interoperability Matrix, which is online at *NetApp Interoperability*, to see which versions of Veritas Storage Foundation the Host Utilities support.

Based on testing done when the version of the Host Utilities was developed, it is best to set the following values when using Veritas Storage Foundation. Details about how to set these values are in the *Linux Unified Host Utilities 7.1 Installation Guide*

Recommendations for Veritas values

You should use the Veritas values recommended by NetApp to get optimum system performance.

For all other settings, use the values recommended in the *Veritas Storage Foundation Release Notes*.

Veritas Storage Foundation recommended settings	
Setting	**Description**
dmp_restore_interval=60	The Veritas DMP restore daemon interval is a tunable that specifies the number of seconds the restore daemon waits before checking the paths between the host and the storage system. The recommended value is 60 seconds. Testing has shown that you get a faster recovery by making the restore daemon poll more often, However, systems set to a longer polling interval take longer to detect path recoveries, which can impact storage system performance during a failover operation.
dmp_restore_policy=disabled	The restore daemon policy tunable specifies which paths the restore daemon checks when it polls the system. The value should be set to **`disabled`**\, which tells the daemon to check only the disabled paths.
For Veritas Storage Foundation 5.1 to 6.0: dmp_lun_retry_timeout=300 **For Veritas Storage Foundation 6 series and InfoScale 7 series**: dmp_lun_retry_timeout=60	Set the VxDMP tunable dmp_lun_retry_timeout to 300 or 60 based on your environment. The tunable dmp_lun_retry_timeout tells VxDMP to continue retrying I/O requests to a LUN when all the paths to the disk have failed. When you set this tunable to 300 or 60, the VxDMP continues to retry paths to the LUN until either the I/O succeeds or 300 or 60 seconds have elapsed. Setting this value to 300 or 60 provides for faster recovery from temporary path failures.
Veritas Storage Foundation 5.1 SP1 and later, Veritas Storage Foundation 6 series and InfoScale 7 series: dmp_path_age=120	If you are using Veritas Storage Foundation 5.1 SP1 and later, Veritas Storage Foundation 6 series and InfoScale 7 series you must set the tunable dmp_path_age to **`120`**. This setting helps minimize the path restoration window and maximize high availability of NetApp storage.

Veritas Storage Foundation recommended settings	
Setting	**Description**
Timeout values for VxDMP	**FC only:** If you are using Fibre Channel, use the default timeout values. **iSCSI only:** If you are using iSCSI, you must set the time-out value to **`120`** in the iSCSI configuration file to use VxDMP: `node.session.timeo.replacement_timeout = 120`.
Red Hat Enterprise Linux 6 series and Red Hat Enterprise Linux 7 series: Create the file `/etc/udev/rules.d/40-rport.rules`.	If you are using Red Hat Enterprise Linux 6 series and Red Hat Enterprise Linux 7 series, you must configure it to support Veritas Storage Foundation. At the time this document was prepared, you had to create the file `/etc/udev/rules.d/40-rport.rules` with the following content line: KERNEL=="rport-*", SUBSYSTEM=="fc_remote_ports", ACTION=="add",RUN+="/bin/sh -c 'echo 20 > /sys/class/fc_remote_ports/%k/fast_io_fail_tmo; echo 864000 >/sys/class/fc_remote_ports/%k/dev_loss_tmo'"
Red Hat Enterprise Linux 6 series: Set the `IOFENCE timeout` parameter to **`30000`**.	The default value of the `IOFENCE timeout` parameter is 15000 milliseconds or 15 seconds. This parameter specifies the amount of time in milliseconds that it takes clients to respond to an IOFENCE message before the system halts. When clients receive an IOFENCE message, they must unregister from the GAB driver within the number of milliseconds specified by the `IOFENCE timeout` parameter. If they do not unregister within that time, the system halts. To view the value of this parameter, enter the `gabconfig -l` command on the host. To set the value for this parameter, enter the `gabconfig -f 30000` command. This value does not persist across host reboots.
SUSE Linux Enterprise Server 11: Create the file `/etc/udev/rules.d/40-rport.rules`	If you are using SUSE Linux Enterprise Server 11 series, you must configure it to support Veritas Storage Foundation. Before you configure anything, you should check Symantec TechNote 124725. It contains the latest information and is available at *http://www.symantec.com/business/support/index?page= content&id=TECH124725*. At the time this document was prepared, you had to create the file `/etc/udev/rules.d/40-rport.rules` with the following content line: KERNEL=="rport-*", SUBSYSTEM=="fc_remote_ports", ACTION=="add",RUN+="/bin/sh -c 'echo 20 > /sys/class/fc_remote_ports/%k/fast_io_fail_tmo; echo 864000 >/sys/class/fc_remote_ports/%k/dev_loss_tmo'".

Recommendations for Citrix XenServer settings

When you run the Host Utilities with Citrix XenServer, in most cases you should use the values provided in the Citrix XenServer Release Notes.

Note: Check the Interoperability Matrix, which is online at *NetApp Interoperability*, to see which versions of Citrix XenServer the Host Utilities support.

Based on testing done when the version of the Host Utilities was developed, it is best to set the following values when using Citrix XenServer. Details about how to set these values are in the *Linux Unified Host Utilities 7.1 Installation Guide*.

Recommendations for Citrix XenServer values

You should use the NetApp recommended default parameter values of Citrix XenServer DM-Multipath to get expected output.

Citrix XenServer DM-Multipath recommended default parameters		
Parameter	**Value**	**Recommendation**
`flush_on_last_del` **Supported Citrix XenServer versions:** • XenServer 6series • XenServer 7 series	**no** **yes**	Set this value to **no**. The default value is `no`. If set to **no**, the multipathd daemon will not disable queueing when the last path to a device has been deleted.
`max_fds` **Supported Citrix XenServer versions:** • XenServer 6 series and 7 series	**max**	Set this value to **max**. Sets the maximum number of open file descriptors that can be opened by multipath and the multipathd daemon.
`queue_without_daemon` **Supported Citrix XenServer versions:** • XenServer 6 series and 7 series	**no**	Set this value to **no**. The default value is **yes**. If set to **no**, the multipathd daemon will disable queueing for all devices when it is shut down.
`user_friendly_names` **Supported Citrix XenServer versions:** • XenServer 6 series and 7 series	**no**	Set this value to **no**. If set to **yes**, specifies that the system should use the `/etc/multipath/bindings` file to assign a persistent and unique alias to the multipath, in the form of mpathn. If set to **no**, specifies that the system should use the WWID as the alias for the multipath. In either case, what is specified here will be overridden by any device-specific aliases you specify in the multipaths section of the configuration file.

Citrix XenServer DM-Multipath recommended default parameters		
Parameter	**Value**	**Recommendation**
`failback` **Supported Citrix XenServer versions:** • XenServer 6 series and 7 series	**`immediate`**	Set this value to **`immediate`**. A value of **`immediate`** specifies immediate failback to the highest priority path group that contains active path.
`features` **Supported Citrix XenServer versions:** XenServer 6 series and 7 series	**XenServer 6.0, 6.0.2, and 6.1:** "1 queue_if_no_path" **XenServer 6.2, 6.5 and 7.0:** "3 queue_if_no_path pg_init_retries 50"	**XenServer 6.0, 6.0.2, and 6.1**: Set this value to **`1 queue_if_no_path`**. **XenServer 6.2, 6.5 and 7.0**: Set this value to **`3 queue_if_no_path pg_init_retries 50`**
`getuid_callout` **Supported Citrix XenServer versions:** XenServer 6 series and 7 series	`getuid_callout` **`/sbin/scsi_id -g -u -s /block/%n`**	Set this value to **`getuid_callout`**. **`/sbin/scsi_id -g -u -s /block/%n`**
`hardware_handler` **Supported Citrix XenServer versions:** XenServer 6 series and 7 series	**ALUA environments: `1 alua`** **Non-ALUA environments: `0`**	Specifies a module that will be used to perform hardware specific actions when switching path groups or handling I/O errors. **`1 alua:`** hardware handler for SCSI-3 ALUA arrays. **`0`** : For non-alua cases.
`path_checker` **Supported Citrix XenServer versions:** XenServer 6 series and 7 series	**Citrix XenServer 6.0, 6.0.2, and 6.1:`directio`** **Citrix XenServer 6.2 and above:`tur`**	Citrix XenServer 6.0: **`directio`** Citrix XenServer 6.0.2, 6.1, and 6.2 and above: **`tur`** Specifies the default method used to determine the state of the paths. **`directio`**: Read the first sector with direct I/O. **`tur`**: Issue a TEST UNIT READY to the device.
`path_grouping_policy` **Supported Citrix XenServer versions:** XenServer 6 series and 7 series	**`group_by_prio`**	Set **`group_by_prio`**. Specifies the default path grouping policy to apply to unspecified multipaths. **`group_by_prio`**= 1 priority group per path priority value.

Citrix XenServer DM-Multipath recommended default parameters		
Parameter	**Value**	**Recommendation**
`prio_callout` **Supported Citrix XenServer versions:** XenServer 6.0,6.0.2 and 6.1	**XenServer 6.0, 6.0.2, and 6.1:** **`/sbin/mpath_prio_ontap /dev/%n`**	When ALUA is enabled, set this value to **`/sbin/mpath_prio_alua /dev/%n`**. When ALUA is not enabled, set this value to: **`/sbin/mpath_prio_ontap /dev/%n`**. Related parameters: This value works with hardware_handler.
`product` **Supported Citrix XenServer versions:** XenServer 6 series and 7 series	**`LUN`**	**XenServer 6.0, 6.0.2, and 6.1:** Set this value to **`LUN`**. **XenServer 6.2, 6.5 and 7 series**: Set this value to **`LUN.*`**.
`rr_min_io` **Supported Citrix XenServer versions:** XenServer 6 series and 7 series	**`128`**	Set this value to **`128`**. Specifies the number of I/O requests to route to a path before switching to the next path in the current path group.
`rr_weight` **Supported Citrix XenServer versions:** XenServer 6 series and 7 series	**`uniform`**	Set this value to **`uniform`**. If set to uniform, all path weights are equal.
`vendor` **Supported Citrix XenServer versions:** XenServer 6 series and 7 series	**`NETAPP`**	This is required for the NetApp Host Utilities product.
`prio` **Supported Citrix XenServer versions:** XenServer 6.2 and above XenServer 7 series	**ALUA environments**: **`alua`** **Non-ALUA environments**: **`ontap`**	When ALUA is enabled, set this value to **`alua`**. When ALUA is not enabled, set this value to **`ontap`**. **Related parameters**: This value works with hardware_handler.

Recommendations for Oracle VM settings

When you run the Host Utilities with Oracle VM, in most cases you should use the values provided in the Oracle VM Release Notes.

Note: Check the Interoperability Matrix, which is online at *NetApp Interoperability*, to see which versions of Oracle VM the Host Utilities support.

Based on testing done when the version of the Host Utilities was developed, it is best to set the following values when using Oracle VM. Details about how to set these values in the *Linux Unified Host Utilities 7.1 Installation Guide*.

Recommendations for Oracle VM values

You should use the NetApp recommended default parameter values for Oracle VM to get expected output.

Oracle VM DM-Multipath recommended default parameters		
Parameter	**Value**	**Recommendation**
`flush_on_last_del` **Supported Oracle VM versions**: Oracle VM 3.0.1, 3.1.1, and 3.2 series Oracle VM 3.3 series and 3.4 series	**`no`** **`yes`**	Set this value to **`no`**. The default value is no. If set to no, the multipathd daemon will not disable queueing when the last path to a device has been deleted.
`max_fds` **Supported Oracle VM versions**: Oracle VM 3.0.1, 3.1.1, 3.2 series, 3.3 series, and 3.4 series	**`max`**	Set this value to **`max`**. Sets the maximum number of open file descriptors that can be opened by multipath and the multipathd daemon.
`queue_without_daemon` **Supported Oracle VM versions**: Oracle VM 3.0.1, 3.1.1, 3.2 series, 3.3 series, and 3.4 series	**Oracle VM 3.1.1**: **`Yes`** **Oracle VM 3.0.1, 3.2 series, 3.3 series, and 3.4 series**: **`No`**	Set this value to **`no`**. The default value is **`yes`**.

Oracle VM DM-Multipath recommended default parameters		
Parameter	**Value**	**Recommendation**
`user_friendly_names` **Supported Oracle VM versions**: Oracle VM 3.0.1, 3.1.1, 3.2 series, 3.3 series, and 3.4 series	**`no`**	Set this value to **`no`**. If set to yes, specifies that the system should use the `/etc/multipath/bindings` file to assign a persistent and unique alias to the multipath, in the form of mpathn. If set to no, specifies that the system should use the WWID as the alias for the multipath. In either case, what is specified here will be overridden by any device-specific aliases you specify in the multipaths section of the configuration file.
`failback` **Supported Oracle VM versions**: Oracle VM 3.0.1, 3.1.1, 3.2 series, 3.3 series, and 3.4 series	**`immediate`**	Set this value to **`immediate`**. A value of immediate specifies immediate failback to the highest priority path group that contains active path.
`features` **Supported Oracle VM versions:** Oracle VM 3.0.1, 3.1.1, 3.2 series, 3.3 series, and 3.4 series	**Oracle VM 3.0.1:** **`1 queue_if_no_path`** **Oracle VM 3.1.1 and 3.2 series:** **`3 queue if no path pg_init_retries 50`**	Set this value to **`3 queue if no path pg_init_retries 50`**. Internal testing has shown that using this value reduces possible path failures that can occur if a delayed controller failover exceeds the default time of 60 seconds.
`getuid_callout` **Supported Oracle VM versions:** Oracle VM 3.0.1, 3.1.1, 3.2 series, 3.3 series, and 3.4 series	**`getuid_callout /sbin/scsi_id -g -u -s /block/%n`**	Set this value to **`getuid_callout /sbin/scsi_id -g -u -s /block/%n`** Specifies the default program and arguments to call out to obtain a unique path identifier.
`hardware_handler` **Supported Oracle VM versions**: Oracle VM 3.0.1, 3.1.1, 3.2 series, 3.3 series, and 3.4 series	**ALUA environments:** **`1 alua`** **Non-ALUA environments:** **`0`**	Specifies a module that will be used to perform hardware specific actions when switching path groups or handling I/O errors. **`1 alua`**: hardware handler for SCSI-3 ALUA arrays. **`0`**: For non-alua cases.

Oracle VM DM-Multipath recommended default parameters		
Parameter	**Value**	**Recommendation**
`path_checker` **Supported Oracle VM versions**: Oracle VM 3.0.1, 3.1.1, 3.2 series, 3.3 series, and 3.4 series	**Oracle VM 3.0.1: `directio`** **Oracle VM 3.1.1, 3.2 series, 3.3 series, and 3.4 series: `tur`**	**Oracle VM 3.0.1**: **`directio`** **Oracle VM 3.1.1, 3.2 series, 3.3 series, and 3.4 series**: **`tur`** Specifies the default method used to determine the state of the paths. **`directio`**: Read the first sector with direct I/O. **`tur`**: Issue a TEST UNIT READY to the device.
`path_grouping_policy` **Supported Oracle VM versions**: Oracle VM 3.0.1, 3.1.1, 3.2 series, 3.3 series, and 3.4 series	**`group_by_prio`**	Set **`group_by_prio`**. Specifies the default path grouping policy to apply to unspecified multipaths. **`group_by_prio`** = 1 priority group per path priority value.
`prio` **Supported Oracle VM versions**: Oracle VM 3.0.1, 3.1.1, 3.2 series, 3.3 series, and 3.4 series	**ALUA environments**: **`alua`** **Non-ALUA environments `ontap`**	When ALUA is enabled, set this value to **`alua`**. When ALUA is not enabled, set this value to **`ontap`**. **Related parameters:** This value works with **`hardware_handler`**.
`product` **Supported Oracle VM versions**: Oracle VM 3.0.1, 3.1.1, 3.2 series, 3.3 series, and 3.4 series	**`LUN`**	Set this value to **`LUN.*`**.
`rr_min_io` **Supported Oracle VM versions**: Oracle VM 3.0.1, 3.1.1, 3.2 series, 3.3 series, and 3.4 series	**`128`**	Set this value to **`128`**. Specifies the number of I/O requests to route to a path before switching to the next path in the current path group.
`rr_weight` **Supported Oracle VM versions**: Oracle VM 3.0.1, 3.1.1, 3.2 series, 3.3 series, and 3.4 series	**`uniform`**	Set this value to **`uniform`**. If set to uniform, all path weights are equal.

Oracle VM DM-Multipath recommended default parameters		
Parameter	**Value**	**Recommendation**
`vendor` **Supported Oracle VM versions**: Oracle VM 3.0.1, 3.1.1, 3.2 series, 3.3 series, and 3.4 series	**NETAPP**	This is required for the NetApp Host Utilities product.

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