



Recommended Host Settings for Linux Unified Host Utilities 7.0

Recommendations for the host settings

NetApp recommends that you 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 may 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 available on the NetApp Support Site.
- The Interoperability Matrix, which is online at mysupport.netapp.com/NOW/products/interoperability, to verify that the Host Utilities support your system setup.

For detailed information on 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 DATA ONTAP Storage Guide*.

Improving I/O performance on Red Hat Enterprise Linux hosts

Red Hat Enterprise 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 as a guest virtual machine. The virtual guest profile is based on the enterprise-storage profile.

Recommended Server profiles on Red Hat Enterprise Linux

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

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

The table that follows lists the recommended settings for the default section of the DM-Multipath multipath.conf file on hosts 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 will be listed in this table.

Note— Keep in mind that 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
<code>flush_on_last_del</code> Supported Red Hat versions: • RHEL 7 series, 6 series, and OL 6 series • RHEL 5 update 3 and later • RHEL 4 update 7 and later	RHEL: yes	Red Hat Enterprise Linux: Set this value to yes. The default value is no.
<code>max_fds</code> Supported Red Hat versions: • RHEL 7 series, 6 series, and OL 6 series • RHEL 5.2 and later • RHEL 4 update 7 and later	RHEL 7 series, 6, 5.2 and later, 4.7 and later: max	RHEL 6 series, 5.2 and later, 4.7 and later: Set this value to max.
<code>pg_prio_calc</code> Supported Red Hat versions: • RHEL 5 update 6 and later	avg	Set this value to avg.
<code>queue_without_daemon</code> Supported Red Hat versions: • RHEL 7 series, 6 series, and OL 6 series • RHEL 5 update 3 and later	RHEL: no	Red Hat Enterprise Linux: Set this value to no. The default value is yes.

Red Hat Enterprise Linux DM-Multipath recommended default parameters		
Parameter	Value	Recommendation
<code>user_friendly_names</code> Supported Red Hat versions: • RHEL 7 series, 6 series, and OL 6 series • RHEL 5 series and OL 5 series • RHEL 4 series	no	Set this value to <code>no</code>. Entering <code>no</code> 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 <code>mpath bindings</code> file for naming purposes. In addition, by setting this value to <code>no</code>, you avoid some of the problems that have been seen when <code>user_friendly_names</code> is set to <code>yes</code>. 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 <code>no</code>.
<code>dev_loss_tmo</code> Supported Red Hat versions: • RHEL 7 series, 6 update 1 and later, and OL 6 series	RHEL 6.1: 2147483647 RHEL 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 6.1: Set this value to 2147483647 seconds. Red Hat Enterprise Linux 6.2 and later: Set this value to <code>infinity</code>, so that the link is never lost.
<code>fast_io_fail_tmo</code> Supported Red Hat versions: RHEL 7 series, 6 update 1 and later, and OL 6 series	5	Set this value to 5. Related parameters: This value works with the value for <code>dev_loss_tmo</code>.

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

The table that follows lists 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 will be listed in this table.

Red Hat Enterprise Linux DM-Multipath recommended device parameters		
Parameter	Value	Recommendation
failback Supported Red Hat versions: • RHEL 7 series, 6 series, and 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, 6 series, and OL 6 series • RHEL 5 series and OL 6 series • RHEL 4 series	RHEL 6.1 and later, RHEL 5.7 and later: "3 queue if no path pg_init_retries 50" RHEL 6.0, 5.1-5.6 and 4 series: "1 queue_if_no_path"	Red Hat Enterprise 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 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 DM-Multipath recommended device parameters		
Parameter	Value	Recommendation
getuid_callout Supported Red Hat versions: • RHEL 7 series • RHEL 6 series and OL 6 series • RHEL 5 series and OL 6 series • RHEL 4 series	RHEL 7 series: uid_attribute “ID_SERIAL” RHEL 6 series: "/lib/udev/scsi_id -g -u -d /dev/%n" RHEL 5 and 4 series: "/sbin/scsi_id -g -u -s /block/%n"	RHEL 7 series: uid_attribute “ID_SERIAL” Red Hat Enterprise 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, 6 series, and OL 6 series • RHEL 5 series and OL 6 series • RHEL 4 series	ALUA environments (RHEL 6 series and 5 series): "1 alua" Non-ALUA environments (RHEL 4 series): "0"	Red Hat Enterprise 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 DM-Multipath recommended device parameters		
Parameter	Value	Recommendation
<code>path_checker</code> Supported Red Hat versions: • RHEL 7 series, 6 series, and OL 6 series • RHEL 5.1 and later • RHEL 4.7 and later	RHEL 6.1 and later, RHEL 5.7 and later: <code>tur</code> RHEL 6.0, 5.1-5.6, RHEL 4.7 and later: <code>directio</code>	Red Hat Enterprise Linux 6.1 and later, Red Hat Enterprise Linux 5.8 and later: Set this value to <code>tur</code>. Internal testing has shown that using <code>tur</code> instead of <code>directio</code> improves performance. The <code>tur</code> parameter uses SG_input/output (I/O) requests that are inserted at the head of the request queue. The <code>directio</code> parameter uses FS block requests, which are added to the end of the request queue. As a result, on a busy device, the <code>path_checker tur</code> requests are serviced immediately while the <code>path_checker directio</code> must wait for the current I/O load to complete. Red Hat Enterprise Linux 6.0, 5.1-5.7 and 4.7 and later: Set this value to <code>directio</code>, 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 <code>readsector0</code>.
<code>path_checker</code> Supported Red Hat versions: • RHEL 5 and OL 5 series • RHEL 4.6 and earlier	<code>readsector0</code>	Set this value to <code>readsector0</code>. 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 <code>directio</code>.

Red Hat Enterprise Linux DM-Multipath recommended device parameters		
Parameter	Value	Recommendation
path_grouping_policy Supported Red Hat versions: • RHEL 7 series, 6 series, and 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.
path_selector Supported Red Hat versions: • RHEL 7 series, 6 series, and OL 6 series • RHEL 5 series and OL 5 series • RHEL 4 series	RHEL 7 series, 6 series, 5 series, and 4 series: "round-robin 0" RHEL 7 series and 6 series also support: "queue-length 0" "service-time 0"	RHEL 6 series, 5 series, and 4 series: Set this value to "round-robin 0". RHEL 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, 6 series, and 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.

Red Hat Enterprise Linux DM-Multipath recommended device parameters		
Parameter	Value	Recommendation
prio_callout Supported Red Hat versions: - RHEL 5.1 and later - RHEL 5 series and OL 5 series - RHEL 4 series	ALUA environments: <code>"/sbin/mpath_prio_alua /dev/%n"</code> Non-ALUA environments: <code>"/sbin/mpath_prio_ontap /dev/%n"</code>	Red Hat Enterprise Linux 5.1 and later: When ALUA is enabled, set this value to <code>"/sbin/mpath_prio_alua /dev/%n"</code>. Red Hat Enterprise Linux 5 series and 4 series: When ALUA is not enabled, set this value to <code>"/sbin/mpath_prio_ontap /dev/%n"</code>. Related parameters: This value works with <code>hardware_handler</code>. If you are using Red Hat Enterprise Linux 6 series, see the information about <code>prio</code>.
product Supported Red Hat versions: All	<code>"LUN"</code>	RHEL 6.2 and earlier: <code>"LUN"</code> RHEL 6.3 and later: <code>"LUN.*"</code>
rr_min_io Supported Red Hat versions: - RHEL 7 series, 6 series, and OL 6 series - RHEL 5 series and OL 5 series - RHEL 4 series	RHEL 6 series, 5 series, or 4 series: 128 RHEL 7 series: 1000	RHEL 6 series, 5 series, or 4 series: Set this value to 128. RHEL 7 series: Set this value to 1000 Note_____ If you are using Red Hat Enterprise Linux 4 update 7 or earlier, place <code>rr_min_io</code> in the default section of the <code>multipath.conf</code> file. _____

Red Hat Enterprise Linux DM-Multipath recommended device parameters		
Parameter	Value	Recommendation
<code>rr_weight</code> Supported Red Hat versions: - RHEL 7 series, 6 series, and OL 6 series - RHEL 5 series and OL 5 series - RHEL 4 series	uniform	Set this value to <code>uniform</code> .
<code>vendor</code> 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

The table that follows lists the recommended settings for the default section of the DM-Multipath `multipath.conf` file on hosts running SUSE Linux Enterprise Server.

Note

Keep in mind that 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
<code>flush_on_last_del</code> Supported SUSE versions: SLES 11 SP1 and later	yes	Set this value to <code>yes</code> . The default value is <code>no</code> .
<code>queue_without_daemon</code> Supported SUSE versions: SLES 11 SP2 and later	no	Set this value to <code>no</code> .

SUSE Linux Enterprise Server DM-Multipath recommended default parameters		
Parameter	Value	Recommendation
<code>max_fds</code> Supported SUSE versions: - SLES 11 SP1 and later - SLES 10 SP4	<code>max</code>	SUSE Linux Enterprise Server 11 SP1 and later and 10 SP4: Set this value to <code>max</code> . Related parameters: If you are using SUSE Linux Enterprise Server 11 or 10 SP3 and earlier, see the next row.
<code>max_fds</code> Supported SUSE versions: - SLES 11 - SLES 10 SP3 and earlier	<code>8192</code>	SUSE Linux Enterprise Server 11 and 10 SP3 and earlier: Set this value to <code>8192</code> . Related parameters: If you are using SUSE Linux Enterprise Server 11 SP1 or 10 SP4, see the previous row.
<code>user_friendly_names</code> Supported SUSE versions: - SLES 11 series - SLES 10 series	<code>no</code>	Set this value to <code>no</code> . This is the default.

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

The table that follows lists 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
<code>failback</code> Supported SUSE versions: - SLES 11 series - SLES 10 series	<code>immediate</code>	Set this value to <code>immediate</code> . Related parameters: The value works with Path Group priorities.

SUSE Linux Enterprise Server DM-Multipath recommended device parameters		
Parameter	Value	Recommendation
features Supported SUSE versions: - SLES 11 series - SLES 10 series	SUSE Linux Enterprise Server 11 SP2: "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: 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 11 series - SLES 10 series	SLES 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 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 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.
path_checker Supported SUSE versions: - SLES 11 series - SLES 10 SP2 and later	tur	Set this value to tur.

SUSE Linux Enterprise Server DM-Multipath recommended device parameters		
Parameter	Value	Recommendation
path_grouping_policy Supported SUSE versions: - 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 11 series - SLES 10 SP3 and later - SLES 10 SP2 and earlier	SLES 11 series, 10 SP3 and later: group_by_prio SLES 10 SP2 and earlier: multibus	iSCSI only with SUSE Linux Enterprise Server 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	SUSE 11 and 10 series: "round-robin 0" SLES 11 SP1 and 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 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 11 series - SLES 10 series	128	Set this value to 128.
rr_weight Supported SUSE versions: - SLES 11 series - SLES 10 series	uniform	Set this value to uniform.

SUSE Linux Enterprise Server DM-Multipath recommended device parameters		
Parameter	Value	Recommendation
vendor Supported SUSE versions: All	"NETAPP"	This value is required for the NetApp Host Utilities product.

Time-out values when using DM-Multipath

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

iSCSI only: If you are using iSCSI, you must set the following time-out value in the iSCSI configuration file in order to use DM-Multipath.

```
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` to uncomment `ConnFailTimeoutof` and give it a value of 5.

Recommendations for Veritas Storage Foundation settings

NetApp recommendations for Veritas values

When you run the Host Utilities with Veritas Volume Manager (VxVM) and Dynamic Multipathing (VxDMP), NetApp recommends that, in most cases, you use the values provided in the Veritas Release Notes. The exceptions are listed below.

Note Check the Interoperability Matrix, which is online at mysupport.netapp.com/NOW/products/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, NetApp recommends you set the following values when using Veritas Storage Foundation. Details on how to set these values are in the *Linux Unified Host Utilities Installation and Administration Guide*.

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 NetApp 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. NetApp recommends that you set the value to <code>disabled</code>, which tells the daemon to check only the disabled paths.

Veritas Storage Foundation recommended settings	
Setting	Description
For Veritas Storage Foundation 5.1 till 6.0: dmp_lun_retry_timeout=300 For Veritas Storage Foundation 6.x series and above: 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: dmp_path_age=120	If you are using Veritas Storage Foundation 5.1 SP1, 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.
Timeout values for VxDMP	FC only: If you are using the Fibre Channel protocol, use the default timeout values. iSCSI only: If you are using iSCSI, you must set the following time-out value in the iSCSI configuration file in order to use VxDMP. node.session.timeo.replacement_timeout = 120

Veritas Storage Foundation recommended settings	
Setting	Description
Red Hat Enterprise Linux 6 series: Create the file <code>/etc/udev/rules.d/40-rport.rules</code>	If you are using Red Hat Enterprise Linux 6 series, you must configure it to support Veritas Storage Foundation. At the time this document was prepared, you had to create the file <code>/etc/udev/rules.d/40-rport.rules</code> with the following content line: <pre>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'"</pre> For the latest information, check the Veritas Release Notes for SF5.1SP1PR2.
Red Hat Enterprise Linux 6 series: Set the <code>IOFENCE timeout</code> parameter to 30000.	The default value of the <code>IOFENCE timeout</code> parameter is 15000 milliseconds or 15 seconds. This parameter specifies the amount of time in milliseconds that it takes clients to respond to an <code>IOFENCE</code> message before the system halts. When clients receive an <code>IOFENCE</code> message, they must unregister from the GAB driver within the number of milliseconds specified by the <code>IOFENCE timeout</code> parameter. If they do not unregister within that time, the system halts. To view the value of this parameter, enter the <code>gabconfig -l</code> command on the host. To set the value for this parameter, enter the <code>gabconfig -f 30000</code> command. This value does not persist across host reboots.

Veritas Storage Foundation recommended settings	
Setting	Description
SUSE Linux Enterprise Server 11: Create the file <code>/etc/udev/rules.d/40-rport.rules</code>	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 <code>/etc/udev/rules.d/40-rport.rules</code> with the following content line: <pre> 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'". </pre>

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

Recommendations for Citrix XenServer settings

NetApp recommendations for Citrix XenServer values

When you run the Host Utilities with Citrix XenServer, NetApp recommends that, in most cases, you use the values provided in the Citrix XenServer Release Notes. The exceptions are listed below.

Note

Check the Interoperability Matrix, which is online at mysupport.netapp.com/NOW/products/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, NetApp recommends you set the following values when using Citrix XenServer. Details on how to set these values are in the *Linux Unified Host Utilities Installation and Administration Guide*.

Citrix XenServer DM-Multipath recommended default parameters		
Parameter	Value	Recommendation
<code>flush_on_last_del</code> Supported Citrix XenServer versions: XenServer 6 series	no	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.
<code>max_fds</code> Supported Citrix XenServer versions: XenServer 6 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.
<code>queue_without_daemon</code> Supported Citrix XenServer versions: XenServer 6 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.

Citrix XenServer DM-Multipath recommended default parameters		
Parameter	Value	Recommendation
<code>queue_without_daemon</code> Supported Citrix XenServer versions: XenServer 6 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 <code>hardware_handler</code> .
<code>user_friendly_names</code> Supported Citrix XenServer versions: XenServer 6 series	no	Set this value to no. If set to yes, specifies that the system should use the <code>/etc/multipath/bindings</code> file to assign a persistent and unique alias to the multipath, in the form of <code>mpathn</code> . 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 <code>multipaths</code> section of the configuration file.
failback Supported Citrix XenServer versions: XenServer 6 series	immediate	Set this value to immediate. A value of immediate specifies immediate failback to the highest priority path group that contains active path.
<code>features</code> Supported Citrix XenServer versions: XenServer 6 series	XenServer 6.0, 6.0.2, and 6.1: "1 queue_if_no_path" XenServer 6.2: "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: Set this value to "3 queue_if_no_path pg_init_retries 50" If set, any process that issues I/O will wait until one or more paths are restored.

Citrix XenServer DM-Multipath recommended default parameters		
Parameter	Value	Recommendation
getuid_callout Supported Citrix XenServer versions: XenServer 6 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 Citrix XenServer versions: XenServer 6 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	Citrix XenServer 6.0, 6.0.2, and 6.1: directio Citrix XenServer 6.2: tur	Citrix XenServer 6.0: directio Citrix XenServer 6.0.2, 6.1, and 6.2: 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	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 series	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	"LUN"	XenServer 6.0, 6.0.2, and 6.1: Set this value to "LUN". XenServer 6.2: Set this value to "LUN.*"
rr_min_io Supported Citrix XenServer versions: XenServer 6 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	uniform	Set this value to uniform. If set to uniform, all path weights are equal.
vendor Supported Citrix XenServer versions: XenServer 6 series	"NETAPP"	This is required for the NetApp Host Utilities product.

Citrix XenServer DM-Multipath recommended default parameters		
Parameter	Value	Recommendation
prio Supported Citrix XenServer versions: XenServer 6.2 series and later	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

NetApp recommendations for Oracle VM values

When you run the Host Utilities with Oracle VM, NetApp recommends that, in most cases, you use the values provided in the Oracle VM Release Notes. The exceptions are listed below.

Note

Check the Interoperability Matrix, which is online at mysupport.netapp.com/NOW/products/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, NetApp recommends you set the following values when using Oracle VM. Details on how to set these values are in the *Linux Unified Host Utilities Installation and Administration Guide*

Oracle VM DM-Multipath recommended default parameters		
Parameter	Value	Recommendation
<code>flush_on_last_del</code> Supported Oracle VM versions: Oracle VM 3.0.1, 3.1.1, and 3.2 series	no	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.
<code>max_fds</code> Supported Oracle VM versions: Oracle VM 3.0.1, 3.1.1, and 3.2 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.
<code>queue_without_daemon</code> Supported Oracle VM versions: Oracle VM 3.0.1, 3.1.1, and 3.2 series	Oracle VM 3.1.1: "Yes" Oracle VM 3.0.1 and 3.2: "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.

Oracle VM DM-Multipath recommended default parameters		
Parameter	Value	Recommendation
<code>user_friendly_names</code> Supported Oracle VM versions: Oracle VM 3.0.1, 3.1.1, and 3.2 series	no	Set this value to <code>no</code> . If set to <code>yes</code> , specifies that the system should use the <code>/etc/multipath/bindings</code> file to assign a persistent and unique alias to the multipath, in the form of <code>mpathn</code> . If set to <code>no</code> , specifies that the system should use the <code>WWID</code> 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 <code>multipaths</code> section of the configuration file.
failback Supported Oracle VM versions: Oracle VM 3.0.1, 3.1.1, and 3.2 series	immediate	Set this value to <code>immediate</code> . A value of <code>immediate</code> 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, and 3.2 series	OVM 3.0.1: "1 queue_if_no_path" OVM 3.1.1 and OVM 3.2 series: "3 queue if no path pg_init_retries 50"	Set this value to <code>3 queue if no path pg_init_retries 50</code> . 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.
<code>getuid_callout</code> Supported Oracle VM versions: Oracle VM 3.0.1, 3.1.1, and 3.2 series	<code>getuid_callout "/sbin/scsi_id -g -u -s /block/%n"</code>	Set this value to <code>getuid_callout "/sbin/scsi_id -g -u -s /block/%n"</code> Specifies the default program and arguments to call out to obtain a unique path identifier.

Oracle VM DM-Multipath recommended default parameters		
Parameter	Value	Recommendation
hardware_handler Supported Oracle VM versions: Oracle VM 3.0.1, 3.1.1, and 3.2 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 device parameters		
Parameter	Value	Recommendation
path_checker Supported Oracle VM versions: Oracle VM 3.0.1, 3.1.1, and 3.2 series	Oracle VM 3.0.1: directio Oracle VM 3.1.1 and Oracle VM 3.2.1: tur	Oracle VM 3.0.1: directio Oracle VM 3.1.1 and 3.2.1: 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, and 3.2 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, and 3.2 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.

Oracle VM DM-Multipath recommended default parameters		
Parameter	Value	Recommendation
product Supported Oracle VM versions: Oracle VM 3.0.1, 3.1.1, and 3.2 series	"LUN"	Set this value to "LUN".
rr_min_io Supported Oracle VM versions: Oracle VM 3.0.1, 3.1.1, and 3.2 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, and 3.2 series	uniform	Set this value to <code>uniform</code> . If set to <code>uniform</code> , all path weights are equal.
vendor Supported Oracle VM versions: Oracle VM 3.0.1, 3.1.1, and 3.2 series	"NETAPP"	This is required for the NetApp Host Utilities product.