Red Hat Enterprise Linux 8.0 Beta

Configuring device mapper multipath

Using the Device Mapper Multipath feature

Last Updated: 2018-11-16

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Abstract

This documentation collection provides instructions on how to configure and manage the Device Mapper Multipath (DM-Multipath) feature on Red Hat Enterprise Linux 8.

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CHAPTER 1. SETTING UP DM MULTIPATH

Before setting up DM Multipath on your system, ensure that your system has been updated and includes the **device-mapper-multipath** package.

1.1. BASIC DM MULTIPATH SETUP

You set up DM Multipath with the **mpathconf** utility, which creates the multipath configuration file **/etc/multipath.conf**.

- If the **/etc/multipath.conf** file already exists, the **mpathconf** utility will edit it.
- If the **/etc/multipath.conf** file does not exist, the **mpathconf** utility will create the **/etc/multipath.conf** file from scratch.

For more information on the **mpathconf** utility, see the **mpathconf(8)** man page.

If you do not need to edit the **/etc/multipath.conf** file, you can set up DM Multipath for a basic failover configuration by running the following **mpathconf** command. This command enables the multipath configuration file and starts the **multipathd** daemon.

```
# mpathconf --enable --with_multipathd y
```

If you need to edit the **/etc/multipath.conf** file before starting the **multipathd** daemon. use the following procedure to set up DM Multipath for a basic failover configuration.

1. Enter the **mpathconf** command with the **--enable** option specified:

   ```
   # mpathconf --enable
   ```

   For information on additional options to the **mpathconf** command you may require, see the **mpathconf(8)** man page or enter the **mpathconf** command with the **--help** option specified.

   ```
   # mpathconf --help
   usage: /sbin/mpathconf <command>

   Commands:
   Enable: --enable
   Disable: --disable
   Set user_friendly_names (Default y): --user_friendly_names <y|n>
   Set find_multipaths (Default y): --find_multipaths <y|n>
   Load the dm-multipath modules on enable (Default y): --with_module
   <y|n>
   start/stop/reload multipathd (Default n): --with_multipathd  <y|n>
   ```

2. Edit the **/etc/multipath.conf** file if necessary. The default settings for DM Multipath are compiled in to the system and do not need to be explicitly set in the **/etc/multipath.conf** file.
   The default value of **path_grouping_policy** is set to **failover**, so in this example you do not need to edit the **/etc/multipath.conf** file.

   The initial defaults section of the configuration file configures your system so that the names of the multipath devices are of the form **/dev/mapper/mpath***n*; without this setting, the names of

the multipath devices would be aliased to the WWID of the device. / /an alias of your choosing, see configuration file chapter If you do not want to use user friendly names, you can enter the following command:

```
# mpathconf --enable --user_friendly_names n
```

3. Save the configuration file and exit the editor, if necessary.

4. Execute the following command:

```
# systemctl start multipathd.service
```

NOTE

If you find that you need to edit the multipath configuration file after you have started the multipath daemon, you must execute the **systemctl reload multipathd.service** command for the changes to take effect.

1.2. IGNORING LOCAL DISKS WHEN GENERATING MULTIPATH DEVICES

Some machines have local SCSI cards for their internal disks. DM Multipath is not recommended for these devices. If you set the **find_multipaths** configuration parameter to **on**, you should not have to blacklist these devices. For information on the **find_multipaths** configuration parameter and the meaning of the values to which you can set this parameter to, see the **multipath.conf(5)** man page.

If you do not set the **find_multipaths** configuration parameter to **on**, you can use the following procedure to modify the multipath configuration file to ignore the local disks when configuring multipath.

1. Determine which disks are the internal disks and mark them as the ones to blacklist.
   In this example, **/dev/sda** is the internal disk. Note that as originally configured in the default multipath configuration file, executing the **multipath -v2** command shows the local disk, **/dev/sda**, in the multipath map.

   This examples specifies the **-d** option of the **multipath** command to indicate that this is a dry run that will not create the multipath devices.

```
# multipath -v2 -d
: SIBM-ESXSST336732LC____F3ET0EP0Q000072428BX1 undef WINSYS,SF2372
size=33 GB features="0" hwhandler="0" wp=undef
`-- policy='round-robin 0' prio=1 status=undef
  |- 0:0:0:0 sda 8:0  [---------

: 3600a0b80001327d80000006d43621677 undef WINSYS,SF2372
size=12G features='0' hwhandler='0' wp=undef
`-- policy='round-robin 0' prio=1 status=undef
  |- 2:0:0:0 sdb 8:16  undef ready  running
  `- 3:0:0:0 sdf 8:80 undef ready  running

: 3600a0b800013275100000009a436215ec undef WINSYS,SF2372
size=12G features='0' hwhandler='0' wp=undef
`-- policy='round-robin 0' prio=1 status=undef
  |- 2:0:0:1 sdc 8:32 undef ready  running
```

```
  `- 3:0:0:1 sdg 8:96 undef ready  running

: 3600a0b80001327d800000070436216b3 undef WINSYS,SF2372
size=12G features='0' hwhandler='0' wp=undef
`-- policy='round-robin 0' prio=1 status=undef
  |- 2:0:0:2 sdd 8:48 undef ready  running
  `- 3:0:0:2 sdg 8:112 undef ready  running

: 3600a0b800013275100000009b4362163e undef WINSYS,SF2372
size=12G features='0' hwhandler='0' wp=undef
`-+- policy='round-robin 0' prio=1 status=undef
  |- 2:0:0:3 sdd 8:64 undef ready  running
  `- 3:0:0:3 sdg 8:128 undef ready  running
```

2. In order to prevent the device mapper from mapping **/dev/sda** in its multipath maps, edit the blacklist section of the **/etc/multipath.conf** file to include this device. Although you could blacklist the **sda** device using a **devnode** type, that would not be a safe procedure since **/dev/sda** is not guaranteed to be the same on reboot. To blacklist individual devices, you can blacklist using the WWID of that device.
   Note that in the output to the **multipath -v2** command, the WWID of the **/dev/sda** device is SIBM-ESXSST336732LC____F3ET0EP0Q000072428BX1. To blacklist this device, include the following in the **/etc/multipath.conf** file.

```
blacklist {
      wwid SIBM-ESXSST336732LC____F3ET0EP0Q000072428BX1
}
```

3. After you have updated the **/etc/multipath.conf** file, you must manually tell the **multipathd** daemon to reload the file. The following command reloads the updated **/etc/multipath.conf** file.

```
# systemctl reload multipathd.service
```

1.3. CONFIGURING ADDITIONAL STORAGE DEVICES

By default, DM Multipath includes support for the most common storage arrays that themselves support DM Multipath. For information on the default configuration value, including supported devices, run either of the following commands.

```
# multipathd show config
# multipath -t
```

If you need to add a storage device that is not supported by default as a known multipath device, edit the **/etc/multipath.conf** file and insert the appropriate device information.

For example, to add information about the HP Open-V series the entry looks like this. This example sets the device to queue for a minute (or 12 retries and 5 seconds per retry) after all paths have failed.

```
devices {
        device {
                vendor "HP"
                product "OPEN-V"
```

```
                no_path_retry 12
        }
}
```

1.4. SETTING UP MULTIPATHING IN THE INITRAMFS FILE SYSTEM

You can set up multipathing in the **initramfs** file system. After configuring multipath, you can rebuild the **initramfs** file system with the multipath configuration files by executing the **dracut** command with the following options:

```
# dracut --force --add multipath --include /etc/multipath
```

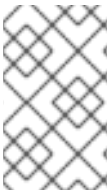
If you run multipath from the **initramfs** file system and you make any changes to the multipath configuration files, you must rebuild the **initramfs** file system for the changes to take effect.

CHAPTER 2. MODIFYING THE DM-MULTIPATH CONFIGURATION FILE

By default, DM Multipath provides configuration values for the most common uses of multipathing. In addition, DM Multipath includes support for the most common storage arrays that themselves support DM Multipath. For information on the default configuration values, including supported devices, run either of the following commands.

```
# multipathd show config
# multipath -t
```

You can override the default configuration values for DM Multipath by editing the **/etc/multipath.conf** configuration file. If necessary, you can also add a storage array that is not supported by default to the configuration file.



NOTE

You can run set up multipathing in the **initramfs** file system. If you run multipath from the **initramfs** file system and you make any changes to the multipath configuration files, you must rebuild the **initramfs** file system for the changes to take effect.

In the multipath configuration file, you need to specify only the sections that you need for your configuration, or that you wish to change from the default values. If there are sections of the file that are not relevant to your environment or for which you do not need to override the default values, you can leave them commented out, as they are in the initial file.

The configuration file allows regular expression description syntax.

Further information about the configuration file can be found on the **multipath.conf**(5) man page.

2.1. CONFIGURATION FILE OVERVIEW

The multipath configuration file is divided into the following sections:

blacklist

Listing of specific devices that will not be considered for multipath.

blacklist_exceptions

Listing of multipath candidates that would otherwise be blacklisted according to the parameters of the blacklist section.

defaults

General default settings for DM Multipath.

multipaths

Settings for the characteristics of individual multipath devices. These values overwrite what is specified in the **overrides**, **devices**, and **defaults** sections of the configuration file.

devices

Settings for the individual storage controllers. These values overwrite what is specified in the **defaults** section of the configuration file. If you are using a storage array that is not supported by default, you may need to create a **devices** subsection for your array.

overrides

Settings that are applied to all devices. These values overwrite what is specified in the **devices** and **defaults** sections of the configuration file.

When the system determines the attributes of a multipath device, first it checks the multipath settings, then the devices settings, then the multipath system defaults.

2.2. BLACKLISTING DEVICES FROM DM MULTIPATH

The **blacklist** section of the multipath configuration file specifies the devices that will not be used when the system configures multipath devices. Devices that are blacklisted will not be grouped into a multipath device.

If the **find_multipaths** configuration parameter is set to **off**, multipath always tries to create a multipath device for every path that is not explicitly blacklisted. If the **find_multipaths** configuration parameter is set to **on**, then multipath will create a device only if one of three conditions are met:

- There are at least two paths that are not blacklisted with the same WWID.
- The user manually forces the creation of the device by specifying a device with the **multipath** command.
- A path has the same WWID as a multipath device that was previously created (even if that multipath device does not currently exist). Whenever a multipath device is created, multipath remembers the WWID of the device so that it will automatically create the device again as soon as it sees a path with that WWID. This allows you to have multipath automatically choose the correct paths to make into multipath devices, without have to edit the multipath blacklist.
  If you have previously created a multipath device without using the **find_multipaths** parameter and then you later set the parameter to **on**, you may need to remove the WWIDs of any device you do not want created as a multipath device from the **/etc/multipath/wwids** file. The following shows a sample **/etc/multipath/wwids** file. The WWIDs are enclosed by slashes (/):

```
# Multipath wwids, Version : 1.0
# NOTE: This file is automatically maintained by multipath and
multipathd.
# You should not need to edit this file in normal circumstances.
#
# Valid WWIDs:
/3600d0230000000000e13955cc3757802/
/3600d0230000000000e13955cc3757801/
/3600d0230000000000e13955cc3757800/
/3600d02300069c9ce09d41c31f29d4c00/
/SWINSYS  SF2372         0E13955CC3757802/
/3600d0230000000000e13955cc3757803/
```

In addition to **on** and **off**, you can also set **find_multipaths** to the following values:

- **strict**: multipath never accepts paths that have not previously been multipathed and are therefore not in the **/etc/multipath/wwids** file.
- **smart**: multipath always accepts non-blacklisted devices in udev as soon as they appear but if **multipathd** does not create the device within a timeout set with the **find_multipaths_timeout** parameter, it will release its claim on the device. For information on the **find_multipaths_timeout** parameter, see the **multipath.conf**(5) man page.

The built-in default value of **find_multipaths** is **off**. The default **multipath.conf** file created by **mpathconf**, however, will set the value of **find_multipaths** to **on**.

For more information on the values you can set for **find_multipaths**, see the **multipath.conf**(5) man page.

With the **find_multipaths** parameter set to **on**, you need to blacklist only the devices with multiple paths that you do not want to be multipathed. Because of this, it will generally not be necessary to blacklist devices.

If you do need to blacklist devices, you can blacklist devices by WWID, device name, device type, property, and protocol. For every device, these five blacklist criteria are evaluated in the the order "property, devnode, device, protocol, wwid". If a device turns out to be blacklisted by any criterion, it is excluded from handling by **multipathd**, and the later criteria are not evaluated. For each criterion, the whitelist takes precedence over the blacklist if a device matches both.

By default, a variety of device types are blacklisted, even after you comment out the initial blacklist section of the configuration file. For information, see Section 2.2.2, “Blacklisting by device name”.

2.2.1. Blacklisting by WWID

You can specify individual devices to blacklist by their World-Wide IDentification with a **wwid** entry in the **blacklist** section of the configuration file.

The following example shows the lines in the configuration file that would blacklist a device with a WWID of 26353900f02796769.

```
blacklist {
       wwid 26353900f02796769
}
```

2.2.2. Blacklisting by device name

You can blacklist device types by device name so that they will not be grouped into a multipath device by specifying a **devnode** entry in the **blacklist** section of the configuration file.

The following example shows the lines in the configuration file that would blacklist all SCSI devices, since it blacklists all sd* devices.

```
blacklist {
       devnode "^sd[a-z]"
}
```

You can use a **devnode** entry in the **blacklist** section of the configuration file to specify individual devices to blacklist rather than all devices of a specific type. This is not recommended, however, since unless it is statically mapped by **udev** rules, there is no guarantee that a specific device will have the same name on reboot. For example, a device name could change from **/dev/sda** to **/dev/sdb** on reboot.

By default, the following **devnode** entries are compiled in the default blacklist; the devices that these entries blacklist do not generally support DM Multipath. To enable multipathing on any of these devices, you would need to specify them in the **blacklist_exceptions** section of the configuration file, as described in Section 2.2.6, “Blacklist exceptions”.

```
blacklist {
       devnode "^(ram|raw|loop|fd|md|dm-|sr|scd|st)[0-9]*"
       devnode "^(td|ha)d[a-z]"
}
```

2.2.3. Blacklisting by device type

You can specify specific device types in the **blacklist** section of the configuration file with a **device** section. The following example blacklists all IBM DS4200 and HP devices.

```
blacklist {
       device {
              vendor  "IBM"
              product "3S42"       #DS4200 Product 10
       }
       device {
              vendor  "HP"
              product ".*"
       }
}
```

2.2.4. Blacklisting by udev property

The **blacklist** and **blacklist_exceptions** sections of the **multipath.conf** configuration file support the **property** parameter. This parameter allows users to blacklist certain types of devices. The **property** parameter takes a regular expression string that is matched against the **udev** environment variable name for the device.

The following example blacklists all all devices with the udev property **ID_ATA**.

```
blacklist {
        property "ID_ATA"
}
```

2.2.5. Blacklisting by device protocol

You can specify the protocol for a device to be excluded from multipathing in the **blacklist** section of the configuration file with a **protocol** section. The protocol strings that multipath recognizes are scsi:fcp, scsi:spi, scsi:ssa, scsi:sbp, scsi:srp, scsi:iscsi, scsi:sas, scsi:adt, scsi:ata, scsi:unspec, ccw, cciss, nvme, and undef. The protocol that a path is using can be viewed by running the command **multipathd show paths format "%d %P"**.

The following example blacklists all all devices with an undefined protocol or an unknown SCSI transport type.

```
blacklist {
        protocol "scsi:unspec"
        protocol "undef"
}
```

2.2.6. Blacklist exceptions

You can use the **blacklist_exceptions** section of the configuration file to enable multipathing on devices that have been blacklisted by default.

For example, if you have a large number of devices and want to multipath only one of them (with the WWID of 3600d0230000000000e13955cc3757803), instead of individually blacklisting each of the devices except the one you want, you could instead blacklist all of them, and then allow only the one you want by adding the following lines to the **/etc/multipath.conf** file.

```
blacklist {
        wwid ".*"
}

blacklist_exceptions {
        wwid "3600d0230000000000e13955cc3757803"
}
```

When specifying devices in the **blacklist_exceptions** section of the configuration file, you must specify the exceptions in the same way they were specified in the blacklist. For example, a WWID exception will not apply to devices specified by a **devnode** blacklist entry, even if the blacklisted device is associated with that WWID. Similarly, **devnode** exceptions apply only to **devnode** entries, and **device** exceptions apply only to device entries.

The **property** parameter works differently than the other **blacklist_exception** parameters. If the parameter is set, the device must have a **udev** variable that matches. Otherwise, the device is blacklisted. This parameter allows users to blacklist SCSI devices that multipath should ignore, such as USB sticks and local hard drives. To allow only SCSI devices that could reasonably be multipathed, set this parameter to **SCSI_IDENT_|ID_WWN)** as in the following example.

```
blacklist_exceptions {
        property "(SCSI_IDENT_|ID_WWN)"
}
```

2.3. MODIFYING MULTIPATH CONFIGURATION FILE DEFAULTS

The **/etc/multipath.conf** configuration file includes a **defaults** section that sets the **user_friendly_names** parameter to **yes**, as follows.

```
defaults {
        user_friendly_names yes
}
```

This overwrites the default value of the **user_friendly_names** parameter.

The configuration file includes a template of configuration defaults. This section is commented out, as follows.

```
#defaults {
#       polling_interval        10
#       path_selector           "round-robin 0"
#       path_grouping_policy    multibus
#       uid_attribute           ID_SERIAL
#       prio                    alua
#       path_checker            readsector0
```

```
#       rr_min_io               100
#       max_fds                 8192
#       rr_weight               priorities
#       failback                immediate
#       no_path_retry           fail
#       user_friendly_names     yes
#}
```

To overwrite the default value for any of the configuration parameters, you can copy the relevant line from this template into the **defaults** section and uncomment it. For example, to overwrite the **path_grouping_policy** parameter so that it is **multibus** rather than the default value of **failover**, copy the appropriate line from the template to the initial **defaults** section of the configuration file, and uncomment it, as follows.

```
defaults {
        user_friendly_names     yes
        path_grouping_policy    multibus
}
```

For information on the attributes that are set in the **defaults** section of the **multipath.conf** configuration file see the **multipath.conf**(5) man page. These values are used by DM Multipath unless they are overwritten by the attributes specified in the **devices**, **multipaths**, or **overrides** sections of the **multipath.conf** file.

2.4. MODIFYING MULTIPATH SETTINGS FOR SPECIFIC DEVICES

The attributes in the **multipaths** section of the **multipath.conf** configuration file apply only to the one specified multipath. These defaults are used by DM Multipath and override attributes set in the **overrides**, **defaults**, and **devices** sections of the **multipath.conf** file.

For information on the attributes that are set in the **multipaths** section of the **multipath.conf** configuration file see the **multipath.conf**(5) man page.

The following example shows multipath attributes specified in the configuration file for two specific multipath devices. The first device has a WWID of **3600508b4000156d70001200000b0000** and a symbolic name of **yellow**.

The second multipath device in the example has a WWID of **1DEC_321816758474** and a symbolic name of **red**. In this example, the **rr_weight** attributes is set to **priorities**.

```
multipaths {
       multipath {
              wwid                  3600508b4000156d70001200000b0000
              alias                 yellow
              path_grouping_policy  multibus
              path_selector         "round-robin 0"
              failback              manual
              rr_weight             priorities
              no_path_retry         5
       }
       multipath {
              wwid                  1DEC_321816758474
              alias                 red
```

```
                rr_weight               priorities
        }
}
```

2.5. MODIFYING MULTIPATH SETTINGS FOR STORAGE CONTROLLERS

The **devices** section of the **multipath.conf** configuration file sets attributes for individual storage devices. These attributes are used by DM Multipath unless they are overwritten by the attributes specified in the **multipaths** or **overrides** sections of the **multipath.conf** file for paths that contain the device. These attributes override the attributes set in the **defaults** section of the **multipath.conf** file.

For information on the attributes that are set in the **devices** section of the **multipath.conf** configuration file see the **multipath.conf**(5) man page.

Many devices that support multipathing are included by default in a multipath configuration. For information on the default configuration value, including supported devices, run either of the following commands.

```
# multipathd show config
# multipath -t
```

You probably will not need to modify the values for these devices, but if you do you can overwrite the default values by including an entry in the configuration file for the device that overwrites those values. You can copy the device configuration defaults for the device that the **multipathd show config** command displays and override the values that you want to change.

To add a device that is not configured automatically by default to this section of the configuration file, you need to set the **vendor** and **product** parameters. You can find these values by looking at **/sys/block/*device_name*/device/vendor** and **/sys/block/*device_name*/device/model** where *device_name* is the device to be multipathed, as in the following example:

```
# cat /sys/block/sda/device/vendor
WINSYS
# cat /sys/block/sda/device/model
SF2372
```

The additional parameters to specify depend on your specific device. If the device is active/active, you will usually not need to set additional parameters. You may want to set **path_grouping_policy** to **multibus**. Other parameters you may need to set are **no_path_retry** and **rr_min_io**.

If the device is active/passive, but it automatically switches paths with I/O to the passive path, you need to change the checker function to one that does not send I/O to the path to test if it is working (otherwise, your device will keep failing over). This almost always means that you set the **path_checker** to **tur**; this works for all SCSI devices that support the Test Unit Ready command, which most do.

If the device needs a special command to switch paths, then configuring this device for multipath requires a hardware handler kernel module. The current available hardware handler is **emc**. If this is not sufficient for your device, you may not be able to configure the device for multipath.

The following example shows a **device** entry in the multipath configuration file.

```
# }
# device {
#  vendor   "COMPAQ  "
#  product   "MSA1000         "
#  path_grouping_policy multibus
#  path_checker  tur
#  rr_weight  priorities
# }
#}
```

2.6. SETTING MULTIPATH VALUES FOR ALL DEVICES

The **overrides** section of the **multipath.conf** configuration file allows you to set a configuration value for all of your devices. For example, you may want all devices to set **no_path_retry** to **fail**. This section supports all of the attributes that are supported by both the **devices** and **defaults** section of the **multipath.conf** configuration file, which is all of the **devices** section attributes except **vendor**, **product** and **revision**. These attributes are used by DM Multipath for all devices unless they are overwritten by the attributes specified in the **multipaths** section of the **multipath.conf** file for paths that contain the device. These attributes override the attributes set in the **devices** and **defaults** sections of the **multipath.conf** file.

For information on the attributes that are set in the **devices** and **defaults** sections of the **multipath.conf** configuration file see the **multipath.conf**(5) man page.