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### ***Rocky Enterprise Linux 9.2 Manual Pages on command 'lvmcache.7'***

***\$ man lvmcache.7***

LVMCACHE(7)

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NAME

lvmcache ? LVM caching

DESCRIPTION

lvm(8) includes two kinds of caching that can be used to improve the performance of a Logical Volume (LV). When caching, varying subsets of an LV's data are temporarily stored on a smaller, faster device (e.g. an SSD) to improve the performance of the LV.

To do this with lvm, a new special LV is first created from the faster device. This LV will hold the cache. Then, the new fast LV is attached to the main LV by way of an lvconvert command. lvconvert inserts one of the device mapper caching targets into the main LV's i/o path. The device mapper target combines the main LV and fast LV into a hybrid device that looks like the main LV, but has better performance. While the main LV is being used, portions of its data will be temporarily and transparently stored on the special fast LV.

The two kinds of caching are:

? A read and write hot-spot cache, using the dm-cache kernel module. This cache tracks access patterns and adjusts its content deliberately so that commonly used parts of the main LV are likely to be found on the fast storage. LVM refers to this using the LV type cache.

? A write cache, using the dm-writocache kernel module. This cache can be used with SSD or PMEM devices to speed up all writes to the main LV. Data read from the main LV is not stored in the cache, only newly written data. LVM refers to this using the LV type writocache.

## USAGE

### 1. Identify main LV that needs caching

The main LV may already exist, and is located on larger, slower devices. A main LV would be created with a command like:

```
$ lvcreate -n main -L Size vg /dev/slow_hhd
```

### 2. Identify fast LV to use as the cache

A fast LV is created using one or more fast devices, like an SSD. This special LV will be used to hold the cache:

```
$ lvcreate -n fast -L Size vg /dev/fast_ssd
```

```
$ lvs -a
```

```
LV Attr    Type  Devices
fast -wi----- linear /dev/fast_ssd
main -wi----- linear /dev/slow_hhd
```

### 3. Start caching the main LV

To start caching the main LV, convert the main LV to the desired caching type, and specify the fast LV to use as the cache:

using dm-cache:

```
$ lvconvert --type cache --cachevol fast vg/main
```

using dm-writecache:

```
$ lvconvert --type writecache --cachevol fast vg/main
```

using dm-cache (with cachepool):

```
$ lvconvert --type cache --cachepool fast vg/main
```

### 4. Display LVs

Once the fast LV has been attached to the main LV, lvm reports the main LV type as either cache or writecache depending on the type used. While attached, the fast LV is hidden, and renamed with a \_cvol or \_cpool suffix. It is displayed by lvs -a. The \_corig or \_wcorig LV represents the original LV without the cache.

using dm-cache:

```
$ lvs -a
```

```
LV      Pool    Type  Devices
main    [fast_cvol] cache  main_corig(0)
[fast_cvol]      linear /dev/fast_ssd
[main_corig]     linear /dev/slow_hhd
```

using dm-writecache:

```
$ lvs -a

LV      Pool   Type   Devices
main    [fast_cvol] writecache main_wcorig(0)
[fast_cvol]      linear /dev/fast_ssd
[main_wcorig]    linear /dev/slow_hhd
```

using dm-cache (with cachepool):

```
$ lvs -a

LV      Pool   Type   Devices
main    [fast_cpool] cache   main_corig(0)
[fast_cpool]      cache-pool fast_pool_cdata(0)
[fast_cpool_cdata] linear /dev/fast_ssd
[fast_cpool_cmeta] linear /dev/fast_ssd
[main_corig]      linear /dev/slow_hhd
```

5. Use the main LV

Use the LV until the cache is no longer wanted, or needs to be changed.

6. Stop caching

To stop caching the main LV, separate the fast LV from the main LV. This changes the type of the main LV back to what it was before the cache was attached.

```
$ lvconvert --splitcache vg/main

$ lvs -a

LV VG Attr   Type   Devices
fast vg -wi----- linear /dev/fast_ssd
main vg -wi----- linear /dev/slow_hhd
```

To stop caching the main LV and also remove unneeded cache pool,

use the --uncache:

```
$ lvconvert --uncache vg/main

$ lvs -a

LV VG Attr   Type   Devices
main vg -wi----- linear /dev/slow_hhd
```

Create a new LV with caching.

A new LV can be created with caching attached at the time of creation using the following command:

```
$ lvcreate --type cache|writecache -n Name -L Size
```

```
--cachedevice /dev/fast_ssd vg /dev/slow_hhd
```

The main LV is created with the specified Name and Size from the slow\_hhd. A hidden fast LV is created on the fast\_ssd and is then attached to the new main LV. If the fast\_ssd is unused, the entire disk will be used as the cache unless the --cachesize option is used to specify a size for the fast LV. The --cachedevice option can be repeated to use multiple disks for the fast LV.

## OPTIONS

option args

```
--cachevol LV
```

Pass this option a fast LV that should be used to hold the cache. With a cachevol, cache data and metadata are stored in different parts of the same fast LV. This option can be used with dm-writecache or dm-cache.

```
--cachepool CachePoolLV|LV
```

Pass this option a cachepool LV or a standard LV. When using a cache pool, lvm places cache data and cache metadata on different LVs. The two LVs together are called a cache pool. This has a bit better performance for dm-cache and permits specific placement and segment type selection for data and metadata volumes. A cache pool is represented as a special type of LV that cannot be used directly. If a standard LV is passed with this option, lvm will first convert it to a cache pool by combining it with another LV to use for metadata. This option can be used with dm-cache.

```
--cachedevice PV
```

This option can be used in place of --cachevol, in which case a cachevol LV will be created using the specified device. This option can be repeated to create a cachevol using multiple devices, or a tag name can be specified in which case the cachevol will be created using any of the devices with the given tag. If a named cache device is unused, the entire device will be used to create the cachevol. To create a cachevol of a specific size from the cache devices, include the --cachesize option.

dm-cache block size

A cache pool will have a logical block size of 4096 bytes if it is created on a device with a logical block size of 4096 bytes.

If a main LV has logical block size 512 (with an existing xfs file system using that size), then it cannot use a cache pool with a 4096 logical block size. If the cache pool

is attached, the main LV will likely fail to mount.

To avoid this problem, use a mkfs option to specify a 4096 block size for the file system, or attach the cache pool before running mkfs.

#### dm-writecache block size

The dm-writecache block size can be 4096 bytes (the default), or 512 bytes. The default 4096 has better performance and should be used except when 512 is necessary for compatibility. The dm-writecache block size is specified with `--cachesettings block_size=4096|512` when caching is started.

When a file system like xfs already exists on the main LV prior to caching, and the file system is using a block size of 512, then the writecache block size should be set to 512.

(The file system will likely fail to mount if writecache block size of 4096 is used in this case.)

Check the xfs sector size while the fs is mounted:

```
$ xfs_info /dev/vg/main
```

Look for `sectsz=512` or `sectsz=4096`

The writecache block size should be chosen to match the xfs `sectsz` value.

It is also possible to specify a sector size of 4096 to `mkfs.xfs` when creating the file system. In this case the writecache block size of 4096 can be used.

#### dm-writecache settings

Tunable parameters can be passed to the dm-writecache kernel module using the `--cachesettings` option when caching is started, e.g.

```
$ lvconvert --type writecache --cachevol fast \  
    --cachesettings 'high_watermark=N writeback_jobs=N' vg/main
```

Tunable options are:

? `high_watermark = <percent>`

Start writeback when the writecache usage reaches this percent (0-100).

? `low_watermark = <percent>`

Stop writeback when the writecache usage reaches this percent (0-100).

? `writeback_jobs = <count>`

Limit the number of blocks that are in flight during writeback. Setting this value reduces writeback throughput, but it may improve latency of read requests.

? `autocommit_blocks = <count>`

When the application writes this amount of blocks without issuing the FLUSH request, the

blocks are automatically committed.

? autocommit\_time = <milliseconds>

The data is automatically committed if this time passes and no FLUSH request is received.

? fua = 0|1

Use the FUA flag when writing data from persistent memory back to the underlying device.

Applicable only to persistent memory.

? nofua = 0|1

Don't use the FUA flag when writing back data and send the FLUSH request afterwards.

Some underlying devices perform better with fua, some with nofua. Testing is necessary to determine which. Applicable only to persistent memory.

? cleaner = 0|1

Setting cleaner=1 enables the writecache cleaner mode in which data is gradually flushed from the cache. If this is done prior to detaching the writecache, then the splitcache command will have little or no flushing to perform. If not done beforehand, the splitcache command enables the cleaner mode and waits for flushing to complete before detaching the writecache. Adding cleaner=0 to the splitcache command will skip the cleaner mode, and any required flushing is performed in device suspend.

#### dm-cache with separate data and metadata LVs

When using dm-cache, the cache metadata and cache data can be stored on separate LVs. To do this, a "cache pool" is created, which is a special LV that references two sub LVs, one for data and one for metadata.

To create a cache pool from two separate LVs:

```
$ lvcreate -n fast -L DataSize vg /dev/fast_ssd1
```

```
$ lvcreate -n fastmeta -L MetadataSize vg /dev/fast_ssd2
```

```
$ lvconvert --type cache-pool --poolmetadata fastmeta vg/fast
```

Then use the cache pool LV to start caching the main LV:

```
$ lvconvert --type cache --cachepool fast vg/main
```

A variation of the same procedure automatically creates a cache pool when caching is started. To do this, use a standard LV as the --cachepool (this will hold cache data), and use another standard LV as the --poolmetadata (this will hold cache metadata). LVM will create a cache pool LV from the two specified LVs, and use the cache pool to start caching the main LV.

```
$ lvcreate -n fast -L DataSize vg /dev/fast_ssd1
```

```
$ lvcreate -n fastmeta -L MetadataSize vg /dev/fast_ssd2
```

```
$ lvconvert --type cache --cachepool fast --poolmetadata fastmeta vg/main
```

#### dm-cache cache modes

The default dm-cache cache mode is "writethrough". Writethrough ensures that any data written will be stored both in the cache and on the origin LV. The loss of a device associated with the cache in this case would not mean the loss of any data.

A second cache mode is "writeback". Writeback delays writing data blocks from the cache back to the origin LV. This mode will increase performance, but the loss of a cache device can result in lost data.

With the --cachemode option, the cache mode can be set when caching is started, or changed on an LV that is already cached. The current cache mode can be displayed with the cache\_mode reporting option:

```
lvs -o+cache_mode VG/LV
```

```
lvm.conf(5) allocation/cache_mode
```

defines the default cache mode.

```
$ lvconvert --type cache --cachevol fast \  
--cachemode writethrough vg/main
```

#### dm-cache chunk size

The size of data blocks managed by dm-cache can be specified with the --chunksize option when caching is started. The default unit is KiB. The value must be a multiple of 32KiB between 32KiB and 1GiB. Cache chunks bigger than 512KiB shall be only used when necessary.

Using a chunk size that is too large can result in wasteful use of the cache, in which small reads and writes cause large sections of an LV to be stored in the cache. It can also require increasing migration threshold which defaults to 2048 sectors (1 MiB). Lvm2 ensures migration threshold is at least 8 chunks in size. This may in some cases result in very high bandwidth load of transferring data between the cache LV and its cache origin LV.

However, choosing a chunk size that is too small can result in more overhead trying to manage the numerous chunks that become mapped into the cache. Overhead can include both excessive CPU time searching for chunks, and excessive memory tracking chunks.

Command to display the chunk size:

```
lvs -o+chunksize VG/LV
```

```
lvm.conf(5) cache_pool_chunk_size
```

controls the default chunk size.

The default value is shown by:

```
lvmconfig --type default allocation/cache_pool_chunk_size
```

Checking migration threshold (in sectors) of running cached LV:

```
lvs -o+kernel_cache_settings VG/LV
```

#### dm-cache migration threshold

Migrating data between the origin and cache LV uses bandwidth. The user can set a throttle to prevent more than a certain amount of migration occurring at any one time. Currently dm-cache is not taking any account of normal io traffic going to the devices.

User can set migration threshold via cache policy settings as "migration\_threshold=<#sectors>" to set the maximum number of sectors being migrated, the default being 2048 sectors (1MiB).

Command to set migration threshold to 2MiB (4096 sectors):

```
lvcreate --cachepolicy 'migration_threshold=4096' VG/LV
```

Command to display the migration threshold:

```
lvs -o+kernel_cache_settings,cache_settings VG/LV
```

```
lvs -o+chunksize VG/LV
```

#### dm-cache cache policy

The dm-cache subsystem has additional per-LV parameters: the cache policy to use, and possibly tunable parameters for the cache policy. Three policies are currently available: "smq" is the default policy, "mq" is an older implementation, and "cleaner" is used to force the cache to write back (flush) all cached writes to the origin LV.

The older "mq" policy has a number of tunable parameters. The defaults are chosen to be suitable for the majority of systems, but in special circumstances, changing the settings can improve performance.

With the --cachepolicy and --cachesettings options, the cache policy and settings can be set when caching is started, or changed on an existing cached LV (both options can be used together). The current cache policy and settings can be displayed with the cache\_policy and cache\_settings reporting options:

```
lvs -o+cache_policy,cache_settings VG/LV
```

Change the cache policy and settings of an existing LV.

```
$ lvchange --cachepolicy mq --cachesettings \
'migration_threshold=2048 random_threshold=4' vg/main
```

```
lvm.conf(5) allocation/cache_policy
```



defines the default cache policy.

`lvm.conf(5) allocation/cache_settings`

defines the default cache settings.

#### dm-cache spare metadata LV

See `lvmthin(7)` for a description of the "pool metadata spare" LV. The same concept is used for cache pools.

#### dm-cache metadata formats

There are two disk formats for dm-cache metadata. The metadata format can be specified with `--cachemetadadataformat` when caching is started, and cannot be changed. Format 2 has better performance; it is more compact, and stores dirty bits in a separate btree, which improves the speed of shutting down the cache. With `auto`, `lvm` selects the best option provided by the current dm-cache kernel module.

#### RAID1 cache device

RAID1 can be used to create the fast LV holding the cache so that it can tolerate a device failure. (When using `dm-cache` with separate data and metadata LVs, each of the sub-LVs can use RAID1.)

```
$ lvcreate -n main -L Size vg /dev/slow
```

```
$ lvcreate --type raid1 -m 1 -n fast -L Size vg /dev/ssd1 /dev/ssd2
```

```
$ lvconvert --type cache --cachevol fast vg/main
```

#### dm-cache command shortcut

A single command can be used to create a cache pool and attach that new cache pool to a main LV:

```
$ lvcreate --type cache --name Name --size Size VG/LV [PV]
```

In this command, the specified LV already exists, and is the main LV to be cached. The command creates a new cache pool with the given name and size, using the optionally specified PV (typically an `ssd`). Then it attaches the new cache pool to the existing main LV to begin caching.

(Note: ensure that the specified main LV is a standard LV. If a cache pool LV is mistakenly specified, then the command does something different.)

(Note: the `type` option is interpreted differently by this command than by normal `lvcreate` commands in which `--type` specifies the type of the newly created LV. In this case, an LV with type `cache-pool` is being created, and the existing main LV is being converted to type `cache`.)

SEE ALSO

lvm.conf(5), lvchange(8), lvcreate(8), lvdisplay(8), lvextend(8), lvremove(8), lvre?  
name(8), lvresize(8), lvs(8), vgchange(8), vgmerge(8), vgreduce(8), vgsplit(8)

Red Hat, Inc

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