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White Paper

Snapshots on SimpliStor using RHEL7/CentOS7

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Using Snapper on Thin-Provisioned LVM Volumes

Introduction

You can use Snapper to create and manage snapshots, to restore files, and undo changes on file systems. Snapper supports snapshotting on Btrfs file systems and on thin-provisioned LVM volumes (snapshots on regular LVM volumes are not supported) formatted as ext3 or XFS. With thin-provisioned LVs, snapshots will use storage space from the volume pool used to create the logical volumes.

Creating Thin-Provisioned XFS Logical Volumes

To use snapper on XFS file system volumes, you must first create thin-provisioned Logical Volumes. If a logical volume is not already thin-provisioned, you must backup your data and then restore it to a newly created thin-provisioned logical volume. There is no way to “convert” an existing logical volume to thin-provisioned. The steps to create thin-provisioned LVs are as follows:

- 1) Create a typical Volume Groups if one is not already available.

```
# vgcreate datavg /dev/sdb
```

- 2) Create a thin volume pool in this Volume Group using the “--thinpool” option.

```
# lvcreate -L 20T --thinpool datapool1 datavg
```

- 3) Create a thin-provisioned Logical Volume using the volume pool with the “--thin” option.

```
# lvcreate -V 10T --thin -n data1v datavg/datapool1
```

- 4) Now create the XFS file system on this Logical Volume and mount the file system.

```
# mkfs.xfs -i size=512 /dev/mapper/datavg-data1v
```

```
# mount /dev/mapper/datavg-data1v /data
```

The /data file system is now ready to be configured for snapshots using Snapper. To use Snapper on a thin-provisioned LVM volume you need to create a Snapper configuration for it. On LVM it is required to specify the file system with `--fstype=lvm(FILESYSTEM)`. To date ext3 and XFS are supported, so ext3 or xfs are valid values for FILESYSTEM. Example:

```
# snapper -c data1 create-config --fstype="lvm(xfs)" /data
```

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Snapshots/Rollback with Snapper

Being able to do file system snapshots providing the ability to do rollbacks on Linux is a feature that was often requested in the past. Snapper, in conjunction with the Btrfs file system or thin-provisioned LVM volumes now fills that gap.

Snapper lets you compare the two snapshots and provides means to revert the differences between the two snapshots. The tools also provide system backups by creating hourly snapshots of the system subvolumes.

Snapshots and Disk Space

When a snapshot is created, both the snapshot and the original point to the same blocks in the file system. So, initially a snapshot does not occupy additional disk space. If data in the original file system is modified, changed data blocks are copied while the old data blocks are kept for the snapshot. Therefore, a snapshot occupies the same amount of space as the data modified. So, over time, the amount of space a snapshot allocates, constantly grows. As a consequence, deleting files from a file system containing snapshots may not free disk space!

NOTE: Snapshot Location

Snapshots always reside on the same partition or subvolume that has been snapshotted. It is not possible to store snapshots on a different partition or subvolume.

As a result, partitions containing snapshots need to be larger than normal partitions. The exact amount strongly depends on the number of snapshots you keep and the amount of data modifications. As a rule of thumb, you should consider using twice the size than you normally would.

Using Snapper to Restore Files from Hourly Backups

Snapper creates hourly snapshots of the system partition (/). You can use these backup snapshots to restore files that have accidentally been deleted or modified beyond recovery. By making use of Snapper's diff feature you can also find out which modifications have been made at a certain point of time.

Hourly backup snapshots are of the type Single and are marked with the description timeline. To restore files from these snapshots proceed as described in 'Undoing changes using the snapper command'.

NOTE: Storage Time of Snapshots

By default, the first snapshot of the last ten days, months, and years are kept.

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4.2.3 Creating and Modifying Snapper Configurations

The way Snapper behaves is defined in a config file that is specific for each partition or volume. These config files reside under `/etc/snapper/configs/`. The default config installed with Snapper for the `/` directory is named `root`. It creates and manages the on-demand snapshots as well as the hourly backup snapshot for `/`.

You may create your own configurations for other partitions formatted with Btrfs or Thin-provisioned LVM logical volumes. In the following example we will set up a Snapper configuration for backing up the Web server data residing on a separate, XFS thin-provisioned logical volume mounted at `/srv/www`.

To create a new Snapper configuration, run `snapper create-config`:

```
# snapper -c data1❶ create-config --fstype="lvm(xfs)" /data❷
```

❶ Name of config file.

❷ Mount point of the volume to snapshot.

This command will create a new config file `/etc/snapper/config-templates/data` with reasonable default values (taken from `/etc/snapper/config-templates/default`).

HINT: Config Defaults

Default values for a new config are taken from `/etc/snapper/config-templates/default`. To use your own set of defaults, create a copy of this file in the same directory and adjust it to your needs. To use it, specify the `-t` option with the `create-config` command:

```
# snapper -c data1 create-config -t my_defaults --fstype="lvm(xfs)" /data
```

Adjusting the Config File

To adjust the config file, you need to modify it with an editor. It contains key/value pairs in the form of `key=value`. You may only change the value.

SUBVOLUME

Mount point of the partition or subvolume to snapshot. Do not change.

FSTYPE

File system type of the partition. Do not change.

NUMBER_CLEANUP

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Defines whether to automatically delete old snapshots when the total snapshot count exceeds a number specified with NUMBER_LIMIT and an age specified with NUMBER_MIN_AGE. Valid values: yes, no

NOTE: Limit and Age

NUMBER_LIMIT and NUMBER_MIN_AGE are always evaluated both. Snapshots are only deleted when both conditions are met. If you always want to keep a certain number of snapshots regardless of their age, set NUMBER_MIN_AGE to 0. On the other hand, if you do not want to keep snapshots beyond a certain age, set NUMBER_LIMIT to 0.

NUMBER_LIMIT

Defines how many snapshots to keep if NUMBER_CLEANUP is set to yes.

NUMBER_MIN_AGE

Defines the minimum age in seconds a snapshot must have before it can automatically be deleted.

TIMELINE_CREATE

If set to yes, hourly snapshots are created. This is currently the only way to automatically create snapshots, therefore setting it to yes is strongly recommended. Valid values: yes, no

TIMELINE_CLEANUP

Defines whether to automatically delete old snapshots when the snapshot count exceeds a number specified with the TIMELINE_LIMIT_* options and an age specified with TIMELINE_MIN_AGE. Valid values: yes, no

TIMELINE_MIN_AGE

Defines the minimum age in seconds a snapshot must have before it can automatically be deleted.

TIMELINE_LIMIT_HOURLY, TIMELINE_LIMIT_DAILY, TIMELINE_LIMIT_MONTHLY, TIMELINE_LIMIT_YEARLY

Number of snapshots to keep for hour, day, month, year.

Example 4-1 Example time line configuration

```
TIMELINE_CREATE="yes"  
    TIMELINE_CLEANUP="yes"  
    TIMELINE_MIN_AGE="1800"  
    TIMELINE_LIMIT_HOURLY="10"  
    TIMELINE_LIMIT_DAILY="10"
```

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```
TIMELINE_LIMIT_MONTHLY="10"  
TIMELINE_LIMIT_YEARLY="10"
```

This example configuration enables hourly snapshots which are automatically cleaned up. `TIMELINE_MIN_AGE` and `TIMELINE_LIMIT_*` are always evaluated both. In this example, the minimum age of a snapshot, before it can be deleted is set to 30 minutes (1800 seconds). Since we create hourly snapshots, this ensures that only the latest snapshots are kept. If `TIMELINE_LIMIT_DAILY` is set to not zero, this means that the first snapshot of the day is kept, too.

Snapshots to be Kept

- Hourly: The last ten snapshots that have been made.
- Daily: The first daily snapshot that has been made is kept for the last ten days.
- Monthly: The first snapshot made on the last day of the month is kept for the last ten months.
- Yearly: The first snapshot made on the last day of the year is kept for the last ten years.

Using Snapper as Regular User

By default, Snapper can only be used by root. However, there are cases in which certain groups or users need to be able to create snapshots or undo changes by reverting to a snapshot:

- a website administrator wants to snapshot `/srv/www`.
- a database administrator wants to snapshot the databases.
- a user wants to snapshot her home directory.

For these purposes Snapper configurations that grant permissions to users or/and groups can be created. In addition to this configuration change, the corresponding snapshots directory needs to be readable and accessible by the specified users.

Enabling Regular Users to Use Snapper

Note that all steps in this procedure need to be run by root.

1. If not existing, create a Snapper configuration for the partition or subvolume on which the user should be able to use Snapper. Example:

```
# snapper --config data1 create --fstype="lvm(xfs)" /srv/www
```

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2. The configuration file is created under `/etc/snapper/configs/NAME`, where `NAME` is the value you specified with `-c/--config` in the previous step (for example `/etc/snapper/configs/data1`). Adjust it according to your needs.
3. Set values for `ALLOW_USERS` and/or `ALLOW_GROUPS` to grant permissions to users and/or groups, respectively. Multiple entries need to be separated by Space. To grant permissions to the user `www_admin` for example, enter:

```
ALLOW_USERS="www_admin"
```

4. Grant read and access permissions on the snapshot directory `PATH/.snapshots`. `PATH` is to be replaced by the subvolume you specified in the first step of this procedure.

Example:

```
# chmod a+rx /srv/www/.snapshots
```

The given Snapper configuration can now be used by the specified user(s) and/or group(s). You can test it with the list command, for example:

```
www_admin:~ > snapper -c data1 list
```

4.2.4 Disabling Automatic Snapshots

If you have set up the root partition, Snapper automatically creates hourly snapshots of the system. Each of these tasks can be disabled as follows:

Disabling hourly snapshots

Edit `/etc/snapper/configs/root` and set `TIMELINE_CREATE` to no:

```
TIMELINE_CREATE="no"
```

Manually Creating and Managing Snapshots

Snapper is not restricted to creating and managing snapshots automatically by configuration; you can also create snapshot pairs (before and after) or single snapshots manually using either the command line tool.

All Snapper operations are carried out for an existing configuration. You can only snapshot partitions or volumes for which a configuration exists. By default, the system configuration (root) is used. If you want to create or manage snapshots for your own configuration you need to explicitly choose it.

4.3.1 Snapshot Metadata

Each snapshot consists of the snapshot itself and some metadata. When creating a snapshot, you also need to specify the metadata. Modifying a snapshot means changing its metadata—you cannot modify its content. The following metadata is available for each snapshot:

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- Type: Snapshot type, see ‘Snapshot Types’ for details. This data cannot be changed.
- Number: Unique number of the snapshot. This data cannot be changed.
- Pre Number: Specifies the number of the corresponding pre snapshot. For snapshots of type post only. This data cannot be changed.
- Description: A description of the snapshot.
- Userdata: An extended description where you can specify custom data in the form of a comma-separated key=value list: reason=testing_stuff, user=tux
- Cleanup-Algorithm: Cleanup-algorithm for the snapshot, see ‘Cleanup-algorithms’ for details.

Snapshot Types

Snapper knows three different types of snapshots: pre, post, and single. Physically they do not differ, but Snapper handles them differently.

pre

Snapshot of a file system before a modification. Each pre snapshot has got a corresponding post snapshot.

post

Snapshot of a file system after a modification. Each post snapshot has got a corresponding pre snapshot.

single

Stand-alone snapshot. Used e.g. for the automatic hourly snapshots. This is the default type when creating snapshots.

Cleanup-algorithms

Snapper provides three algorithms to clean up old snapshots. The algorithms are executed in a daily cron-job. The cleanup-frequency itself is defined in the Snapper configuration for the partition or subvolume.

number

Deletes old snapshots when a certain snapshot count is reached.

time line

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Deletes old snapshots having passed a certain age, but keeps a number of hourly, daily, monthly, and yearly snapshots.

empty-pre-post

Deletes pre/post snapshot pairs with empty diffs.

4.3.2 Creating Snapshots

Creating a snapshot is done by running snapper. The following examples explain how to create snapshots from the command line.

HINT: Snapshot Description

You should always specify a meaningful description in order to later be able to identify its purpose. Even more information can be specified via the user data option.

```
snapper create --description "Snapshot for week 2 2013"
```

Creates a stand-alone snapshot (type single) for the default (root) configuration with a description. Because no cleanup-algorithm is specified, the snapshot will never be deleted automatically.

```
snapper --config home create --description "Cleanup in ~tux"
```

Creates a stand-alone snapshot (type single) for a custom configuration named home with a description. Because no cleanup-algorithm is specified, the snapshot will never be deleted automatically.

```
snapper --config home create --description "Daily data backup" --cleanup-algorithm timeline
```

Creates a stand-alone snapshot (type single) for a custom configuration named home with a description. The file will automatically be deleted when it meets the criteria specified for the time line cleanup-algorithm in the configuration.

```
snapper create --type pre --print-number --description "Before the Apache config cleanup"
```

Creates a snapshot of the type pre and prints the snapshot number. First command needed to create a pair of snapshots used to save a before and after state.

```
snapper create --type post --pre-number 30 --description "After the Apache config cleanup"
```

Creates a snapshot of the type post paired with the pre snapshot number 30. Second command needed to create a pair of snapshots used to save a before and after state.

```
snapper create --command COMMAND --description "Before and after COMMAND"
```

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Automatically creates a snapshot pair before and after running COMMAND. This option is only available when using snapper on the command line.

4.3.3 Modifying Snapshot Metadata

Snapper allows you to modify the description, the cleanup algorithm, and the userdata of a snapshot. All other metadata cannot be changed. The following examples explain how to modify snapshots from the command line.

To modify a snapshot on the command line, you need to know its number. Use `snapper list` to display all snapshots and their numbers.

```
snapper modify --cleanup-algorithm "timeline" 10
```

Modifies the metadata of snapshot 10 for the default (root) configuration. The cleanup algorithm is set to `timeline`.

```
snapper --config home modify --description "daily backup" --cleanup-algorithm "timeline" 120
```

Modifies the metadata of snapshot 120 for a custom configuration named `home`. A new description is set and the cleanup algorithm is unset.

4.3.4 Deleting Snapshots

To delete a snapshot with the command line tool, you need to know its number. Get it by running `snapper list`. To delete a snapshot, run `snapper delete NUMBER`.

HINT: Deleting Snapshot Pairs

When deleting a pre snapshot, you should always delete its corresponding post snapshot (and vice versa).

```
# snapper delete 65
```

Deletes snapshot 65 for the default (root) configuration.

```
# snapper -c data1 delete 89 90
```

Deletes snapshots 89 and 90 for a custom configuration named `data1`.

HINT: Old Snapshots Occupy More Disk Space

If you delete snapshots in order to free space on your hard, make sure to delete old snapshots first. The older a snapshot is the more disk space it occupies.

Snapshots are also automatically deleted by a daily cron-job.

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Limitations

4.4.1 Data Consistency

There is no mechanism to ensure data consistency when creating snapshot. Whenever a file is written (e.g. a database) at the same time the snapshot is created, it will result in a broken or partly written file. Restoring such a file will cause problems. Therefore, it is strongly recommended to always closely review the list of changed files and their diffs. Only restore files that really need to belong to the action you want to roll back.

4.4.3 No Rollback on /boot and Boot Loader Changes

Since /boot does not support snapshots, the following restrictions:

no rollback for any configuration changes on the boot loader

The only file that can be rolled back is the boot loader configuration file in /etc. The main configuration files reside under /boot and cannot be rolled back.

no complete rollback for Kernel installations

The Kernel itself and its initrd are installed in the /boot partition, whereas Kernel modules or sources are installed in /var/lib and /usr/src, respectively. Furthermore, each Kernel installation also changes the boot loader configuration files in /boot. So whenever you do a rollback that involves undoing a Kernel installation, you need to manually remove the Kernel and its initrd from /boot and adjust the boot loader configuration by removing the boot entry for the Kernel.

Snapper was written by SUSE and provided by Red Hat in the RHEL7 distribution. This document emphasizes usage with LVM thin-provisioned XFS volumes and is adapted from: https://www.suse.com/documentation/sled11/book_sle_admin/data/cha_snapper.html

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