Virtual machine snapshots
(Overview and illustration of different types of snapshots with libvirt/QEMU)

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Kashyap Chamarthy – {kashyap@redhat.com}
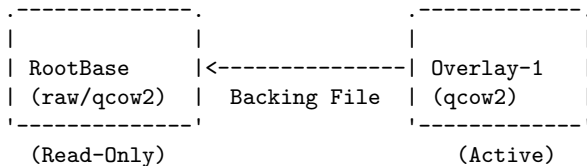
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Agenda

Section 1
Virtual disk image file basics

Common representation of virtual disk images

- ## RAW:
    - Storage *preallocated* ahead of time
    - Best performance for **I/O** intensive guests

- ## QCOW2 (**Q**emu **C**opy-**O**n-**W**rite):
    - Sparse by nature – storage allocated as needed
    - Supports base images & overlays
    - Very useful for – 'thin-provisioning' guests; snapshots

QCOW2: backing files and overlays

- QCOW2 allows a disk image to *refer* to another image('backing file/base image')
- Overlays record only the **difference** from its (read-only) backing file

```
.-------------.                    .------------.
|             |                    |            |
| RootBase    |<---------------|   Overlay-1  |
| (raw/qcow2) |   Backing File   | (qcow2)     |
'-------------'                    '------------'
  (Read-Only)                        (Active)
```

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Section 2
Snapshots overview

Snapshot flavours

- Internal Snapshots
  - Internal **disk snapshot** – {Live/Offline}
  - Internal **system checkpoint** – {Live}

- External Snapshots
  - External **disk snapshot** – {Live/Offline}
  - External **system checkpoint** – {Live}

- VM State
  - Saves memory, device state (*not* disk-state) to a file

Internal snapshots

- A *single* QCOW2 file holds everything {original & its delta}

- Very handy when moving around machines

- The orignial *must* be a QCOW2 file; guest is *paused* for more than a couple of seconds while taking snapshot

External snapshots

- Uses **overlays** – Everytime a snapshot is taken, the current disk becomes a 'backing file' & a *new* QCOW2 overlay is created to track the 'delta'

- Snapshots are created instantaneously

- Excellent for **live** backups

External snapshots(2)

- Multiple files to track; 'revert/delete' operations become a little tricky (more on this next..)

```
.-----------.    .--------.    .--------.    .----------.
|           |    |        |    |        |    |          |
| RootBase  |<---| Snap-1 |<---| Snap-2 |<---| Current  |
|           |    |        |    |        |    | (Active) |
'-----------'    '--------'    '--------'    '----------'
```
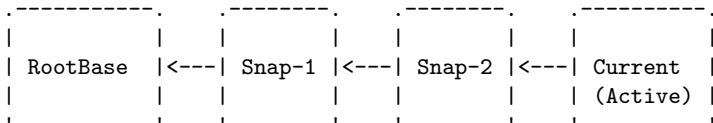
Section 3
Managing multiple snapshot files
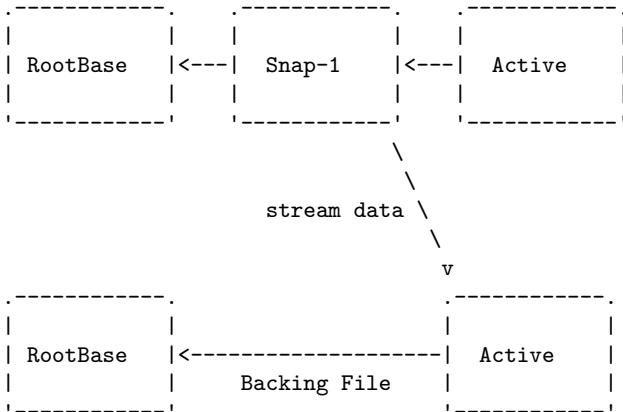
With external snapshots..

- Problem: – Lots of snapshot disk image files accumulate over time

- Solution: – Merging snapshot disk image files:
  - **blockpull** – (Live) merges data from **base** into **top**

  - **blockcommit** – (Live) merges data from **top** into **base**

blockpull: shorten image chain w/ 'partial' pull

- Merge data from **Snap-1** into **Active**
    - **RootBase** will now be the backing file of **Active**; (**Snap-1** remains valid & can be reused)

```
.-----------.      .-----------.      .-----------.
|           |      |           |      |           |
| RootBase  |<---| Snap-1     |<---| Active    |
|           |      |           |      |           |
'-----------'      '-----------'      '-----------'
                                            \
                                             \
                         stream data \
                                               \
                                                v
.-----------.                          .-----------.
|           |                          |           |
| RootBase  |<-------------------| Active    |
|           |       Backing File |           |
'-----------'                          '-----------'
```

blockpull: shorten image chain w/ 'complete' pull

- Merge data from **RootBase** and **Snap-1** into **Active** – which will now be *standalone* w/o any backing file
    - **RootBase** & **Snap-1** remain valid & can be reused

```
.-----------.     .-----------.     .-----------.
|           |     |           |     |           |
| RootBase  |<---|   Snap-1   |<---|   Active   |
|           |     |           |     |           |
'-----------'     '-----------'     '-----------'
      |                      \
      |                       \
      |                        \ stream data
      | stream data             \
      |                          v
      |                    .-----------.
      '------------------------>|           |
                           |   Active   |
                           |           |
                           '-----------'
                           'Standalone'
                           (w/o backing file)
```
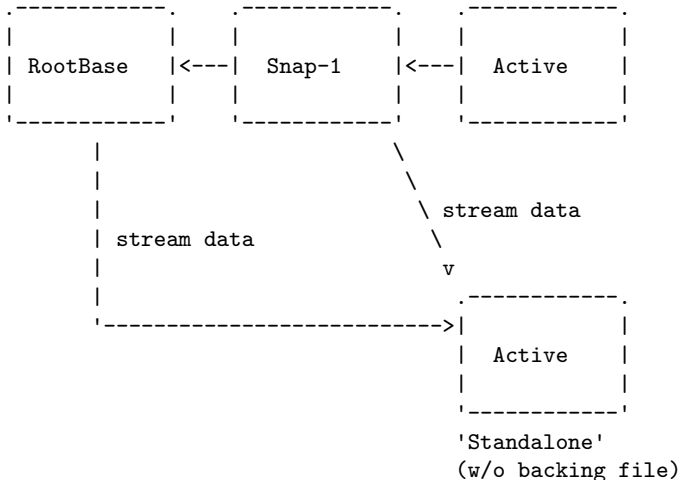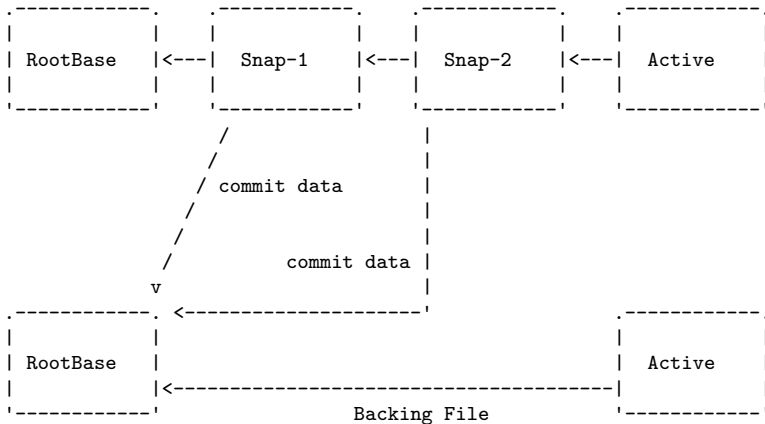
blockcommit: commits 'top' into 'base' – shortens image chain length

- Merge data from **Snap-1** & **Snap-2** into **RootBase**
  - **RootBase** will now be the backing file of **Active**
  - **Snap-1** & **Snap-2** will be invalidated

```
.------------.    .------------.    .------------.    .------------.
|            |    |            |    |            |    |            |
| RootBase   |<---|  Snap-1    |<---|  Snap-2    |<---|  Active    |
|            |    |            |    |            |    |            |
'------------'    '------------'    '------------'    '------------'
                       /                 |
                      /                  |
                     / commit data       |
                    /                     |
                   /                      |
                  /           commit data |
                 v                        |
.------------.  <-----------------------'       .------------.
|            |                                  |            |
| RootBase   |                                  |  Active    |
|            |<---------------------------------|            |
'------------'          Backing File            '------------'
```

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Section 4
Demonstration

URL to demonstration info

- http://kashyapc.fedorapeople.org/virt/lc-2012/
  snapshots-illustration.txt

- http://kashyapc.fedorapeople.org/virt/lc-2012/
  live-backup-with-external-disk-snapshots-and-blockpull.
  txt

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Section 5
Upcoming...

What's next

- Quite a few interesting things:
  - External [system checkpoint/offline] snapshots in Libvirt
  - Snapshot revert/delete improvements for external snapshots
  - Live/Offline **blockcommit** enhancements
  - QEMU Live **blockcopy** (for storage migration)
  - Plenty other bug fixes & updates. . .

References

📄 More notes on snapshots, blockcommit, blockpull
`http://kashyapc.fedorapeople.org/virt/lc-2012/`

📄 Libvirt website
`http://www.libvirt.org/`

📄 QEMU website
`http://www.qemu.org/`

📄 KVM website
`http://www.linux-kvm.org/`

📄 libguestfs
`http://libguestfs.org/`

📄 Blog
`https://kashyapc.wordpress.com`

The end.

Thanks for listening.