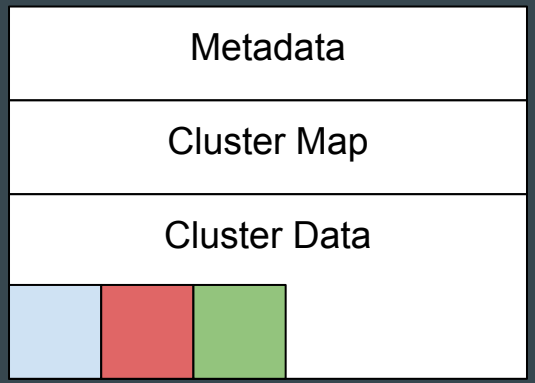
Customizing Virtual Machine Images

Javier Fontán - OpenNebula Developer

- There are other ways to create your images:
  - virt-install
  - packer.io
  - foreman
  - etc...
- Sometimes modifying already created images is convenient
- Even if you use other image formats you can convert them

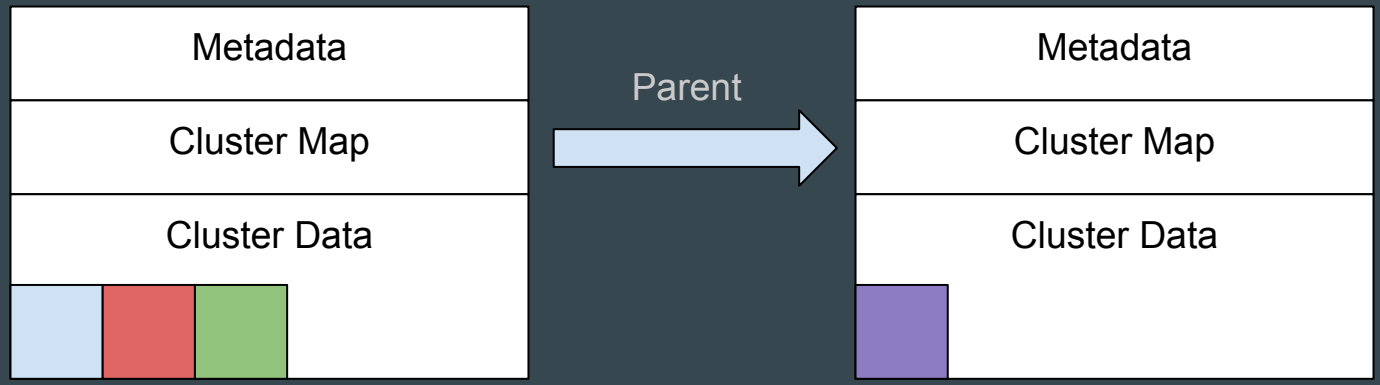
qcow2 Format

```
$ qemu-img create -f qcow2 image.qcow2 10G
```



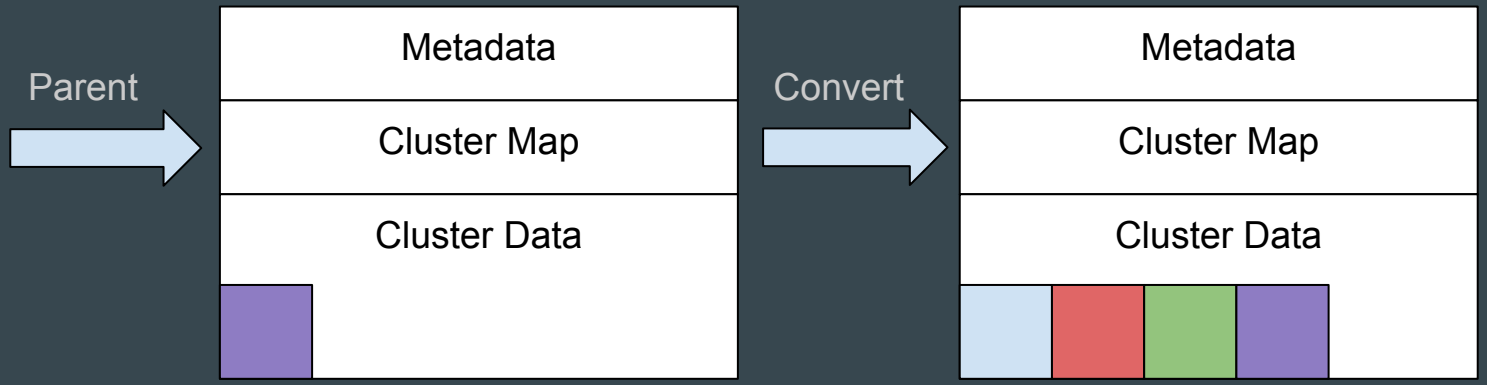
qcow2 Image With Parent

```
$ qemu-img create -f qcow2 -o backing_file=base.qcow2 image.qcow2
```



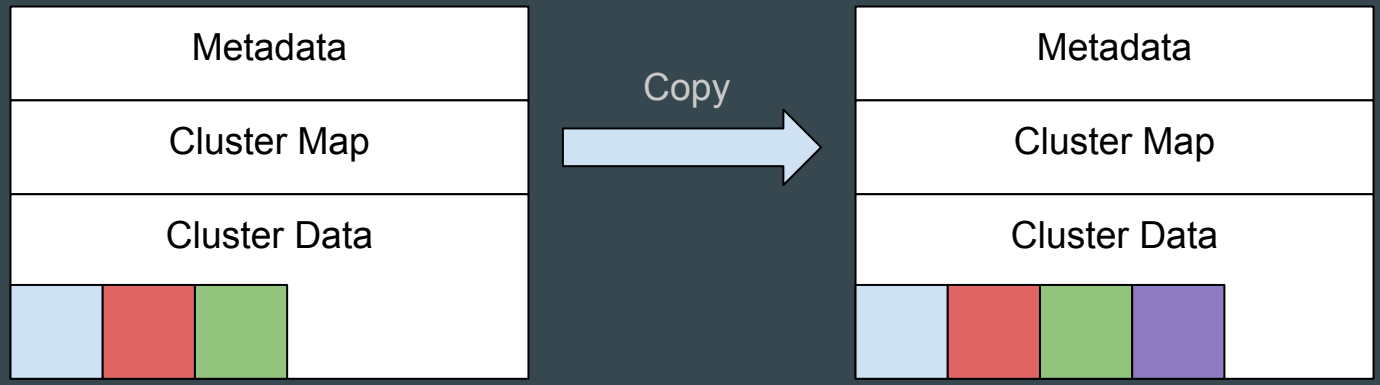
Consolidate qcow2 Image

```
$ qemu-img convert -O qcow2 image.qcow2 new_image.qcow2
```



qcow2 Image After Copy

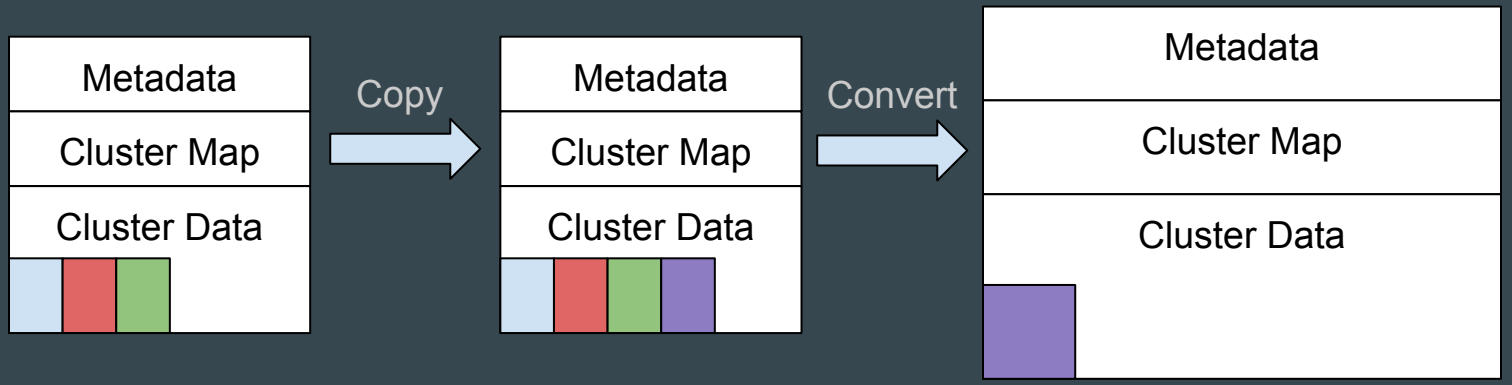
```
$ cp base.qcow2 image.qcow2
```



Create Delta From 2 qcow2 Images

```
$ qemu-img rebase -b base.qcow2 image.qcow2
```

```
$ qemu-img convert -O qcow2 -o backing_file=base.qcow2 image.qcow2
new_image.qcow2
```



Mount Image

- Convert to raw and use mount -o loop
  - `mount -o loop,offset=32256 image.raw /mnt`
- Convert to raw and use losetup
  - `losetup /dev/loop0 image.raw`
  - `kpartx -a /dev/loop0`
  - `mount /dev/loop0p1 /mnt`
- Use nbd
  - `modprobe nbd`
  - `qemu-nbd -c /dev/nbd0 image.qcow2`
  - `mount /dev/nbd0p1 /mnt`

libguestfs

From its webpage http://libguestfs.org:

> **libguestfs is a set of tools for accessing and modifying virtual machine (VM) disk images**. You can use this for viewing and editing files inside guests, scripting changes to VMs, monitoring disk used/free statistics, creating guests, P2V, V2V, performing backups, cloning VMs, building VMs, formatting disks, resizing disks, and much more.

guestfish - Read or Edit Files

```
$ guestfish -ia image.qcow2
><fs> cat /var/log/service/error.log
><fs> vi /etc/service.conf

$ guestfish -ia image.qcow2 <<EOF
upload service.conf /etc/service.conf
tar-in ssh-configuration.tar /etc/sshd
EOF

$ guestfish --ro -i -c qemu:///system -d vm-name
><fs> cat /var/log/service/error.log
```

virt-customize

- Starts custom VM and attach disks and connects to network
- Change passwords, create users
- Move files
- Install packages
- Execute scripts

```
virt-customize [--options]
    [ -d domname | -a disk.img [-a disk.img ...] ] [--chmod PERMISSIONS:FILE] [--commands-from-file FILENAME]
    [--copy SOURCE:DEST] [--copy-in LOCALPATH:REMOTEDIR] [--delete PATH] [--edit FILE:EXPR] [--firstboot SCRIPT]
    [--firstboot-command 'CMD+ARGS'] [--firstboot-install PKG,PKG..] [--hostname HOSTNAME] [--install PKG,PKG..]
    [--link TARGET:LINK[:LINK..]] [--mkdir DIR] [--move SOURCE:DEST] [--password USER:SELECTOR] [--root-password SELECTOR]
    [--run SCRIPT] [--run-command 'CMD+ARGS'] [--scrub FILE] [--sm-attach SELECTOR] [--sm-register] [--sm-remove]
    [--sm-unregister] [--ssh-inject USER[:SELECTOR]] [--truncate FILE] [--truncate-recursive PATH] [--timezone TIMEZONE] [--touch FILE]
    [--update] [--upload FILE:DEST] [--write FILE:CONTENT] [--no-logfile] [--password-crypto md5|sha256|sha512]
    [--selinux-relabel] [--sm-credentials SELECTOR]
```

OpenNebula Marketplace Images

- Download CentOS images
- Create CDROM with OpenNebula context packages
- Create script to modify the image
  - Mount CDROM
  - Install context packages
  - Remove cloud-init and NetworkManager packages
  - Install EPEL repository
  - Install growpart packages

OpenNebula Images - Create CDROM

```
# Download context packages from github
curl -s https://api.github.com/repos/OpenNebula/addon-context-
linux/releases | jq -r '.[0].assets[].browser_download_url' |
xargs -L1 wget -P repo

# Create ISO image with label “EXTRA”
genisoimage -o extra-packages.iso -R -J -V EXTRA repo/
```

OpenNebula Images - Prepare Script

```
mkdir /tmp/mount
mount LABEL=EXTRA /tmp/mount

# Install opennebula context package
rpm -Uvh /tmp/mount/one-context*rpm

# Remove cloud-init and NetworkManager
yum remove -y NetworkManager cloud-init

# Install growpart and upgrade util-linux
yum install -y epel-release --nogpgcheck
yum install -y cloud-utils-growpart --nogpgcheck
yum upgrade -y util-linux --nogpgcheck
```

OpenNebula Images - Calling virt-customize

```
# Create an overlay to preserve original image
$ qemu-img create -f qcow2 -b $orig $image

# Run customization
$ virt-customize --attach $ISO_IMAGE --run $script --format qcow2
-v -a $image --root-password disabled
```

Optimizing Images

- qemu-img does not know anything about filesystems
- Blocks not allocated (sparse files) or that contain zeroes are not copied
- Normal file deletion does not zero or deallocate blocks
- Swap partitions contain information if used
- This information can be stripped to make the images smaller
- virt-sparsify to the rescue!

Optimizing Images - virt-sparsify

There are two ways of doing sparsification:

- Normal Sparsification:
  - Occupies the maximum space of the image
- In Place Sparsification:
  - Create an sparse qcow2 file

Optimizing Images - Normal Sparsification

- Create overlay of the image
- Create a file in all filesystems and fill it with zeroes until there is not more space and delete file
- Fill swap partitions with zeroes
- Convert it to a new qcow2 file skipping zero blocks

```
$ TMPDIR=/var/tmp virt-sparsify original.qcow2 new.qcow2
```

Optimizing Images - In Place Sparsification

- Uses trim command, normally used for SSD disks
- Deallocates blocks from filesystem
- Does not require the total amount of disk space
- The qcow2 file contains holes and is not the best one for distribution
- Can be converted to a non sparse qcow2 file
- Can not be used with compression

```
$ virt-sparsify --in-place original.qcow2 new.qcow2
```

Optimizing Images - Compression

- qcow2 images can have the blocks compressed
- Compression rate is less that xz or bzip2
- Is more convenient as it can be directly used as is
- Use of these images trades disk space for CPU consumption
- Can be done directly in virt-sparsify with --compress (not In Place)

qemu-img tips

- There are two qcow2 file formats, pre version 0.10 and newer
  - CentOS 6 does not support post 0.10 version
  - On conversion or creation it can be specified with -o compat=0.10

- qemu-img < 2.4 does not support creation of delta images with compression
  - This tool can be easily compiled manually
  - Download qemu 2.4 code
  - ./configure
  - make qemu-img

Thank You!