3-2-1 Backups With Limited Hardware

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Use Case

Backup Important Documents

Backup Documents with Personally Identifiable Information

Documents too sensitive to store on Google or Dropbox

Disclaimer

RTO

Recovery Time Objective

How long can the server be down before causing hardship?

~=2 Weeks

$$$

RPO

Recovery Point Objective

How many hours of data are you willing to lose?

24 Hours (1 Day)

$

Retention Time

Retention Time

How much time do you have to realize you shouldn’t have deleted a file?

30 Days (1 Month)

$

Retention Time

What is the Retention Time of RAID?

If you delete a file off of a RAID array, how much time do you have to realize that was a mistake and undo it?

Bitrot Protection

Bitrot Detection / Correction

Phantom Writes

Bugs in Hard Drive Firmware

Aging Hard Drives

Bit flips

$$

More Information

Summary

RTO = 2 Weeks

RPO = 1 Day

Retention Time = 1 Month

Bitrot Protection on all files

3-2-1 Backups

3 Copies of your data

2 On different storage devices

1 Offsite

Minimum Requirements

2 Hard Drives

1 Cloud Provider

2 Hard Drives

OS Drive

Partitions

- BOOT
- ROOT
- SRV (ZFS)

Backup Drive

Partition

- Backup (ZFS)

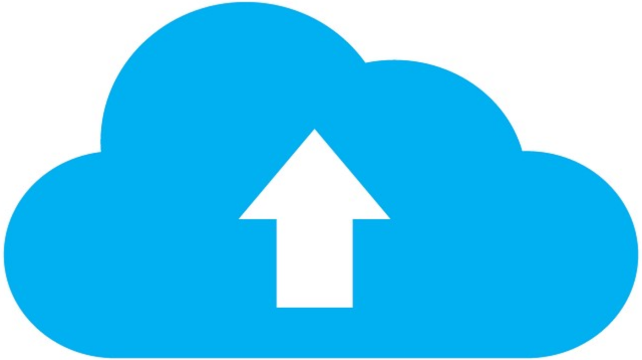
Onsite Backup

ZFS Snapshot

1 Cloud Provider

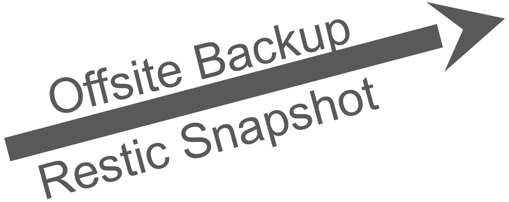
OS Drive

Cloud Storage



Partitions

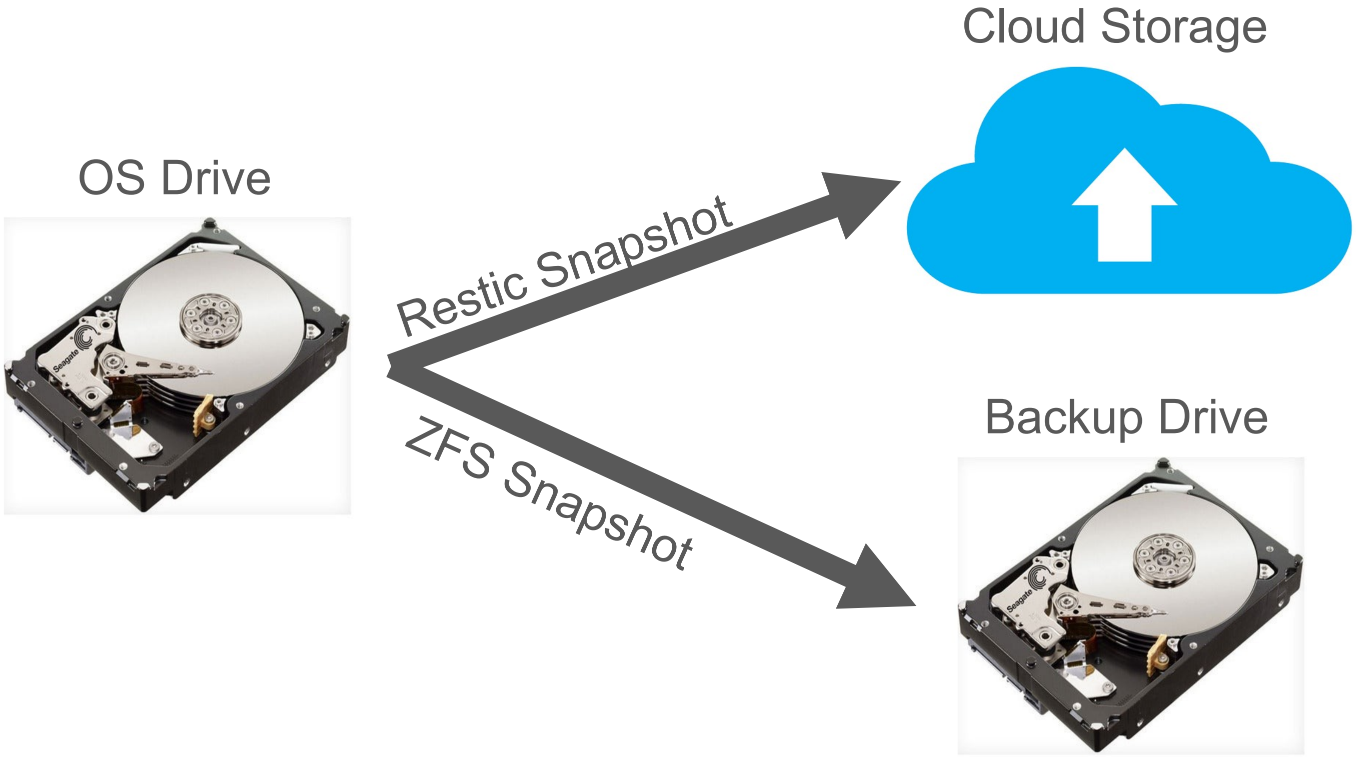
- BOOT
- ROOT
- SRV


Offsite Backup

Restic Snapshot

S3 Compatible Bucket

Full Picture



OS Drive

Restic Snapshot

ZFS Snapshot

Cloud Storage

Backup Drive

ZFS

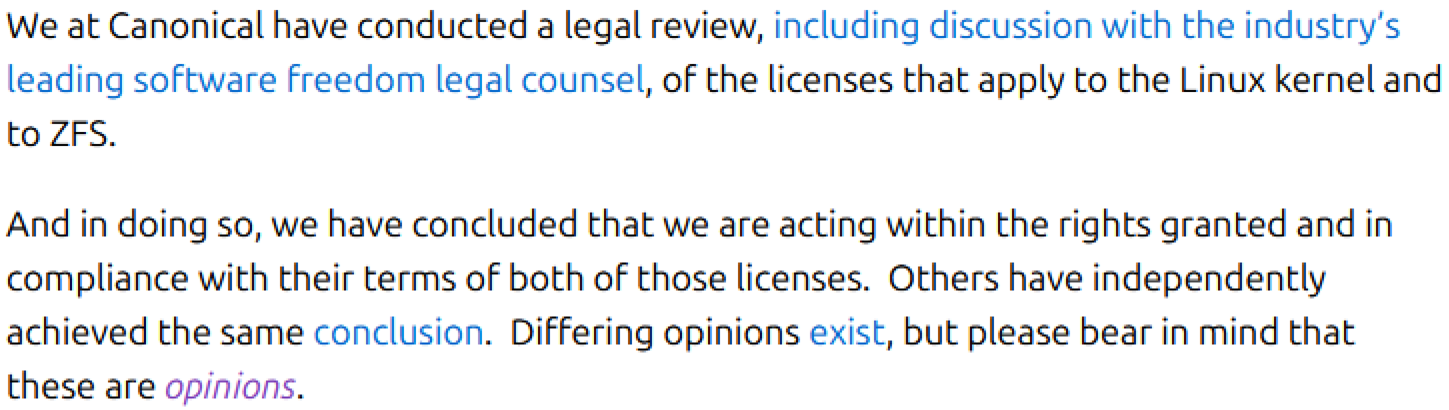
ZFS

- File System and Logical Volume Manager
- Originally Developed By Sun Microsystems
- Development Started in 2001
- Source Code Released in 2005

ZFS

Common Development and Distribution License (CDDL)

ZFS

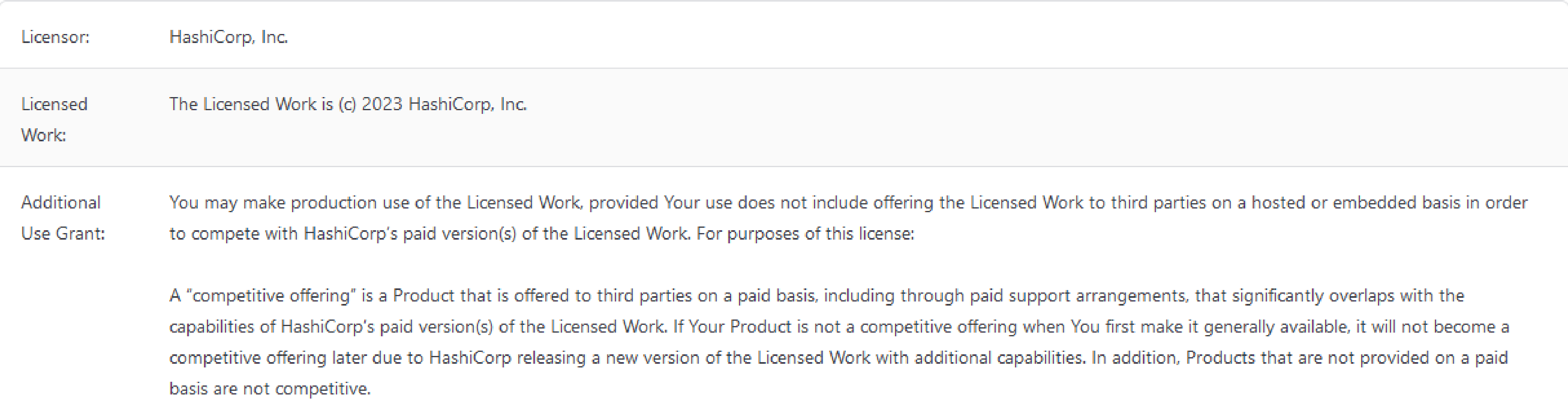


We at Canonical have conducted a legal review, including discussion with the industry's leading software freedom legal counsel, of the licenses that apply to the Linux kernel and to ZFS.

And in doing so, we have concluded that we are acting within the rights granted and in compliance with their terms of both of those licenses. Others have independently achieved the same conclusion. Differing opinions exist, but please bear in mind that these are *opinions*.

https://ubuntu.com/blog/zfs-licensing-and-linux

Discussion: Business Source Licenses



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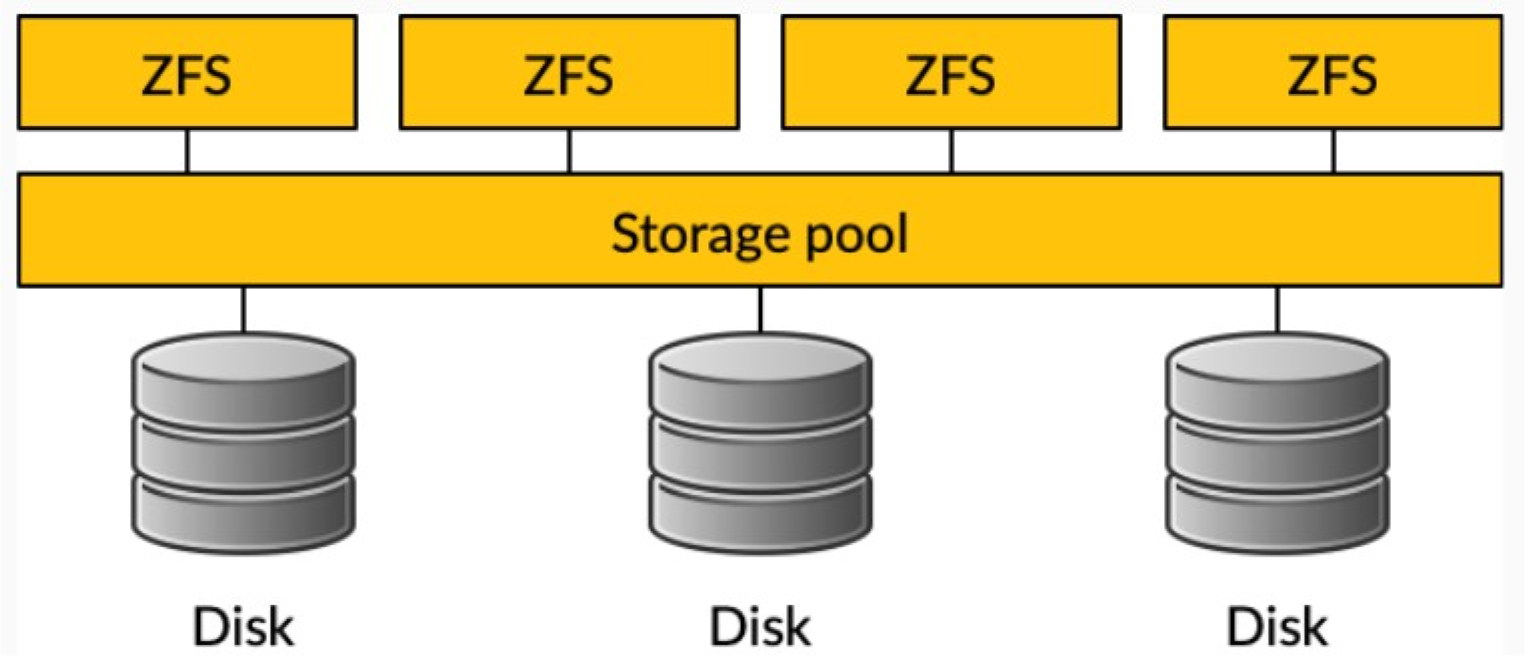
ZFS



Demo

- Show Disks on Ubuntu VM
  - lsblk | grep sd
- Create 3rd partition on OS Drive
  - fdisk /dev/sda
- Install zfs
  - apt install zfsutils-linux -y
- Create /srv zpool
  - zpool create srv /dev/sda3
- Create file on srv
  - truncate -s 5M /srv/file_2023-12-21.dat
- Create Partition on Backup Drive
  - fdisk /dev/sdb
- Create /backup zpool
  - zpool create backup /dev/sdb1

ZFS - Bitrot Protection / Correction

zfs set copies=2 srv

ZFS Scrub

First Sunday of Every Month

Demo

- Show Disks on Ubuntu VM
  - zfs set copies=2 srv
  - zfs get copies

2 Hard Drives

OS Drive

Partitions

- BOOT
- ROOT
- SRV (ZFS)

Onsite Backup

ZFS Snapshot

Backup Drive

Partition

- Backup(ZFS)

ZFS

Copy on Write (COW)

Snapshots

ZFS - Snapshots

- Read Only
- Take up no space initially
- Only begin to take up space when changes are made

Demo

- Create files on /srv
  - truncate -s 5M /srv/file_2023-12-21.txt
  - truncate -s 5M /srv/file_2023-12-21.json
- Take snapshot (first daily)
  - zfs snapshot srv@2023-12-21
- Show snapshot taking 0 space
  - zfs list -t snapshot

ZFS - Rollback

- Rollback entire dataset
- Mount snapshot to recover specific files

Demo

- Delete files from working directory
  - rm /srv/file_2023-12-21.dat
  - rm /srv/file_2023-12-21.txt
  - rm /srv/file_2023-12-21.json
- Show snapshot taking space
  - zfs list -t snapshot
- Rollback snapshot
  - zfs rollback srv@2023-12-21
- Show files are restored
- Delete single file from working directory
  - rm /srv/file_2023-12-21.txt
- Mount snapshot
  - mount -t zfs srv@2023-12-21 /mnt
- Copy single file from snapshot
  - cp /mnt/file_2023-12-21.txt /srv/
- Unmount
  - umount /mnt

2 Hard Drives

OS Drive

Backup Drive

Partitions

- BOOT
- ROOT
- SRV (ZFS)

Onsite Backup

ZFS Snapshot

Partition

- Backup(ZFS)

ZFS - Send

- ZFS Send / Recv
- Send snapshot to another zpool

Demo

- Send snapshot to backup
  - zfs send srv@2023-12-21 | zfs recv backup/srv
- Show snapshot on backup
  - zfs list -t snapshot
- Simulate next day
  - truncate -s 5m /srv/file_2023-12-22.dat
  - zfs snapshot srv@2023-12-22
  - zfs send -I srv@2023-12-21 srv@2023-12-22 | zfs recv backup/srv
- Simulate several more days (pretend we have 31, retention period is only 30)
- Delete oldest snapshot on both zpools
  - zfs destroy srv@2023-12-21
  - zfs destroy backup/srv@2023-12-21
- Simulate next day, including deleting oldest backup

zfs_autobackup

- zfs_autobackup
- Open Source - Python
- Backup, Snapshot and Replication

zfs_autobackup

- autobackup property on datasets

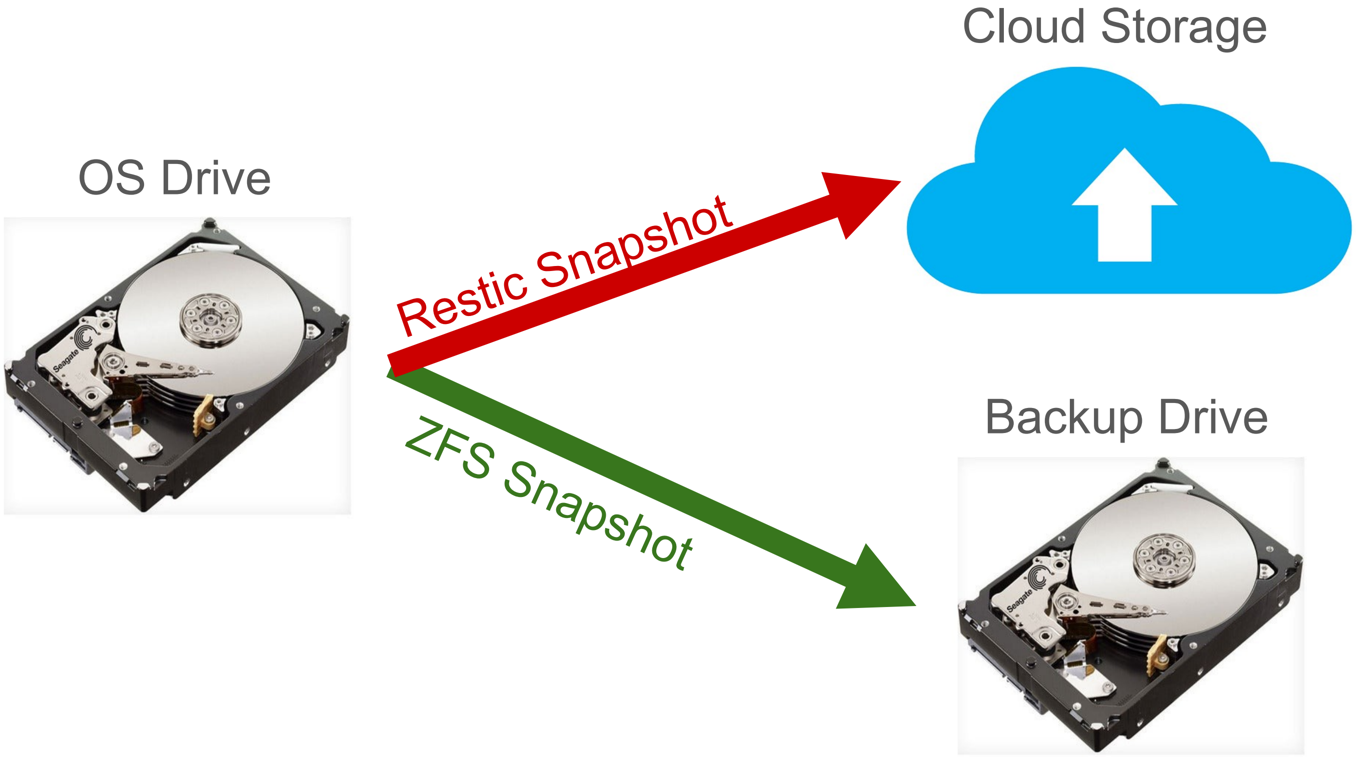
Demo

- Install zfs_autobackup from pip
  - apt install python3-pip -y
  - pip install --upgrade zfs_autobackup
- Set autobackup property on srv dataset
  - `zfs set autobackup:srv=true srv`
- Check autobackup property
  - zfs get autobackup:srv
- Create snapshot and send to backup zpool
  - zfs-autobackup --verbose --clear-mountpoint --keep-source=30 --keep-target=30 --snapshot-format "{}-%Y-%m-%d" srv backup

Discussion: What is a backup?

- RAID1 is not a backup
- Snapshots are not a backup
- Is taking a snapshots of a RAID1 considered a backup?

Full Picture



Cloud Storage

OS Drive

Restic Snapshot

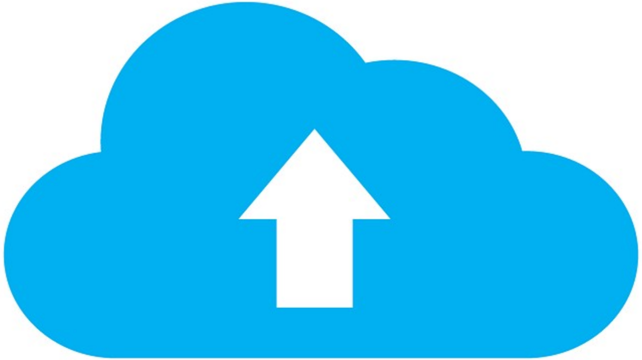
ZFS Snapshot

Backup Drive

1 Cloud Provider

OS Drive

Cloud Storage



Partitions

- BOOT
- ROOT
- SRV

Offsite Backup

Restic Snapshot

S3 Compatible Bucket

Restic

- Restic
- Fast, Efficient and Secure Backups
- Open Source - Go
- Linux / Windows / Mac / *BSD

Restic - Snapshots

- Encrypted by default
- Deduplication
- Many Backends

Backblaze

- B2 - S3 Compatible Object Storage
- Free Tier - 10GB
- Documentation for Restic

Demo

- Install restic
  - apt install restic
  - restic self-update
- Restic config files
  - mkdir -p /etc/restic
  - Insert the following in /etc/restic/env
    - export RESTIC_REPOSITORY="/backup/restic"
    - export RESTIC_PASSWORD_FILE=/etc/restic/password
  - Insert the following in /etc/restic/password
    - 123password123
- Load Restic environment vars (from here on, everything is the same as if using Backblaze)
  - source /etc/restic/env # might want to add this to your .bashrc
- Initialize restic repository
  - mkdir -p /backup/restic
  - restic init
- Create restic snapshot
  - restic backup /srv
- View snapshot
  - restic snapshots
  - ls -l /backup/restic

Restic - Restore

- Restic Restore
  - Equivalent to zfs rollback
- Restic Mount
  - Equivalent to mount -t zfs

Demo

- Delete all files
  - rm /srv/*
  - ls -l /srv
- Restic restore
  - restic restore {snap_id} --target /
- Delete a single file
  - rm /srv/file_2023-12-21.txt
  - ls -l /srv
- Mount restic
  - restic mount /mnt &
- Copy file
  - cp /mnt/hosts/321demo/latest/srv/file_2023-12-21.txt /srv/file_2023-12-21.txt
  - ls -l /srv
  - fg
  - ctrl-c

Restic - Forget

- restic forget --keep-last 30
    - Similar to
        - zfs_autobackup --keep-target=30
    - Doesn’t actually remove data
- restic prune
    - Actually removes data
    - Documentation advises to run `restic check` after prune

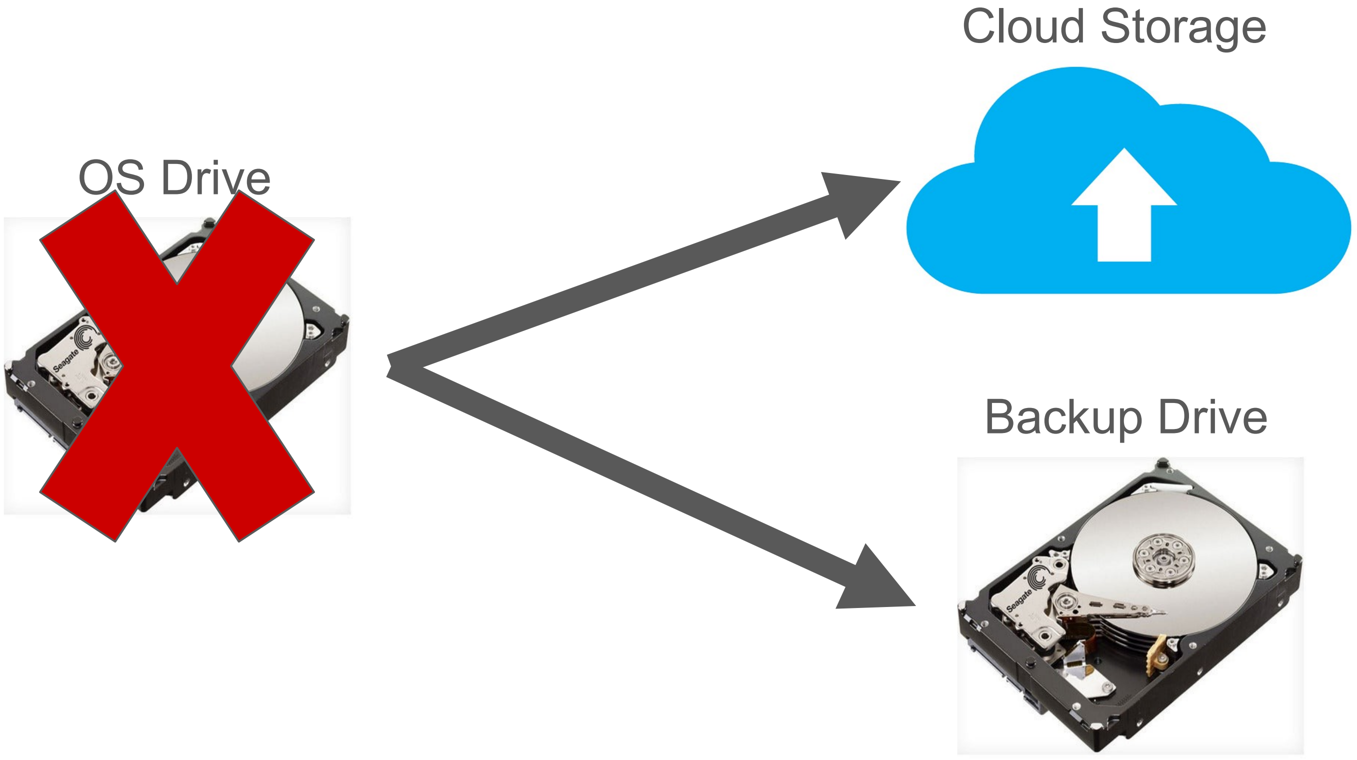
Story Time: Data Loss Stories

Anyone have a good

Data Loss Story

they want to share?

Failure Scenario 1

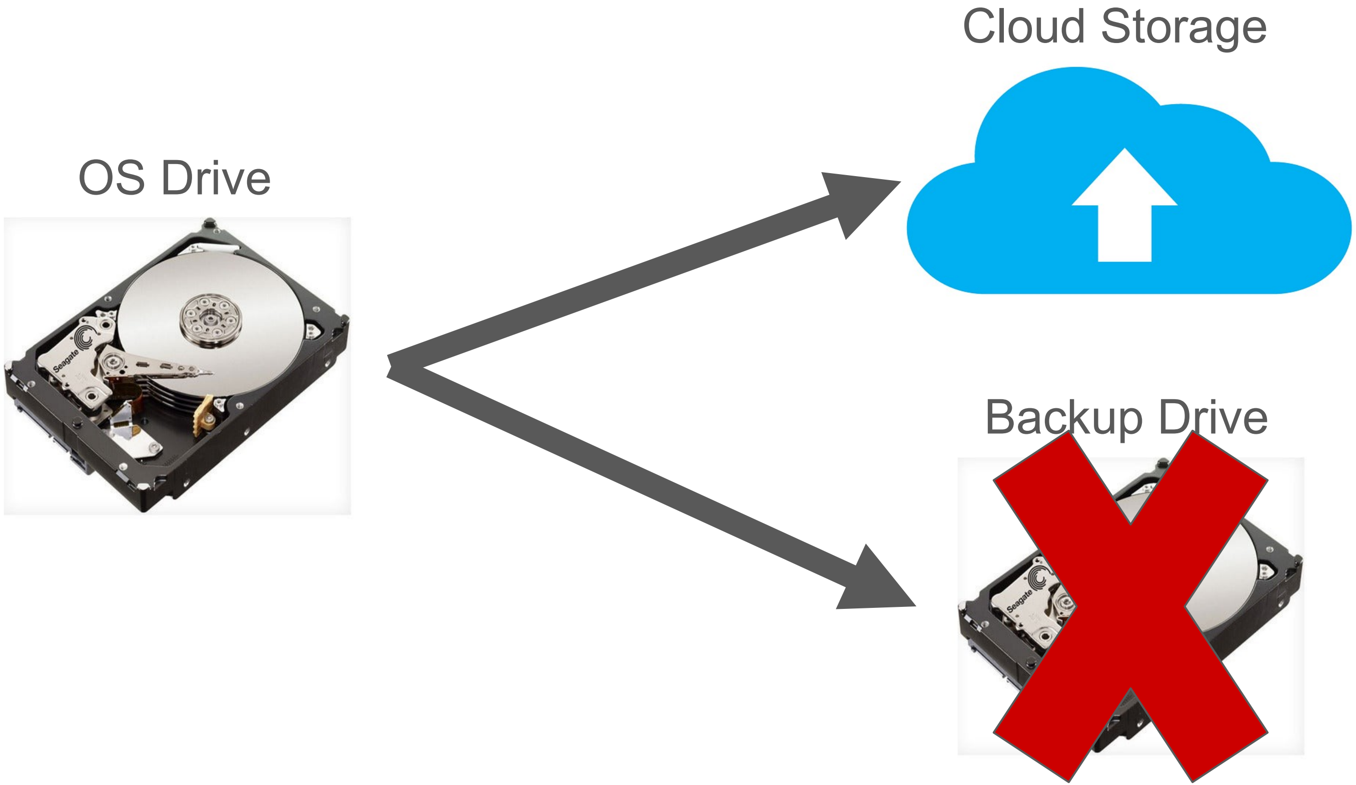


Cloud Storage

OS Drive

Backup Drive

Failure Scenario 2

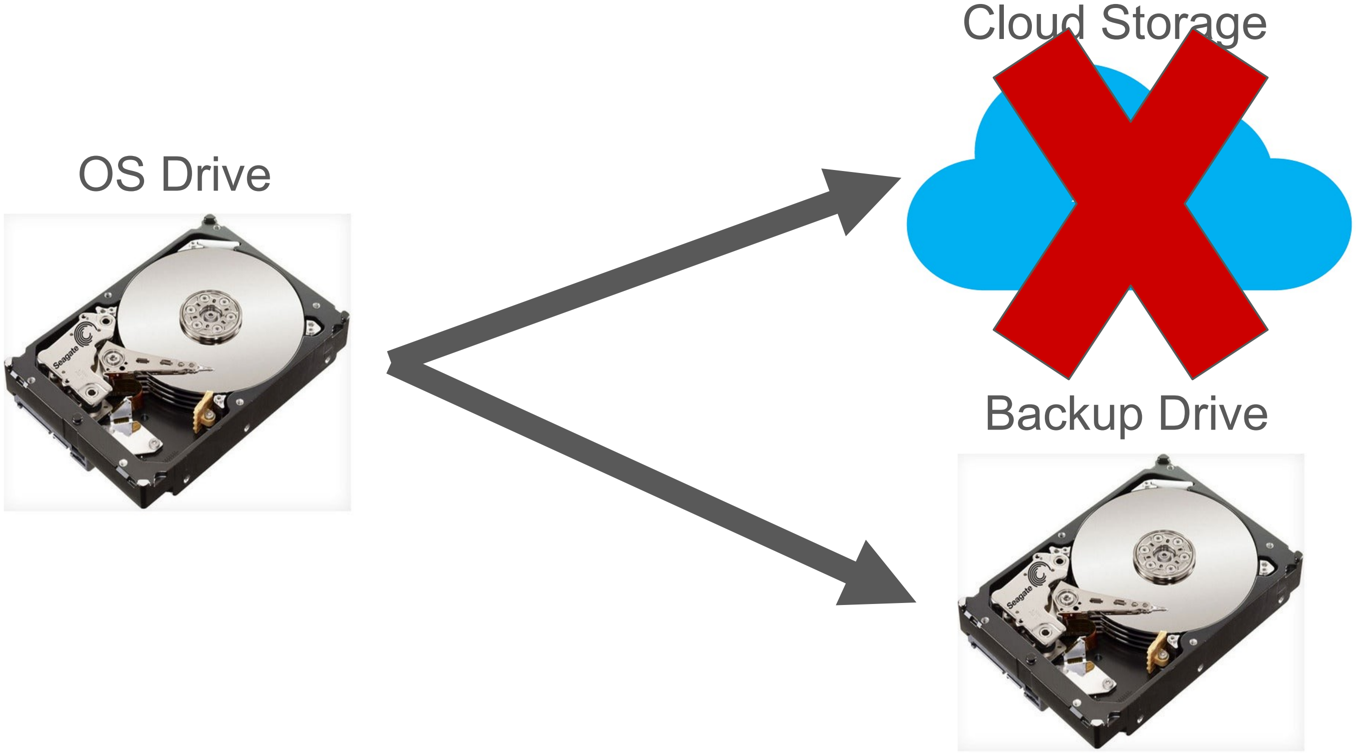


Cloud Storage

OS Drive

Backup Drive

Failure Scenario 3

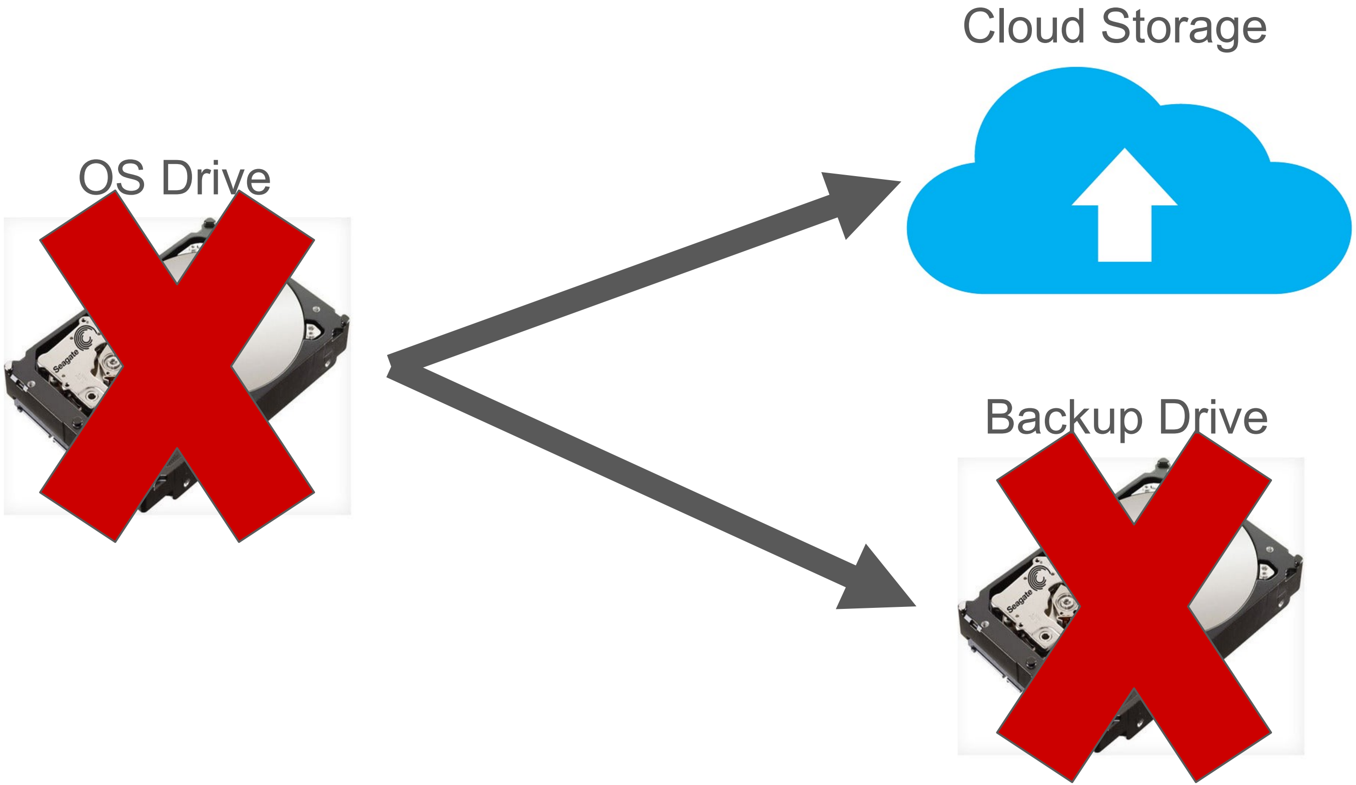


OS Drive

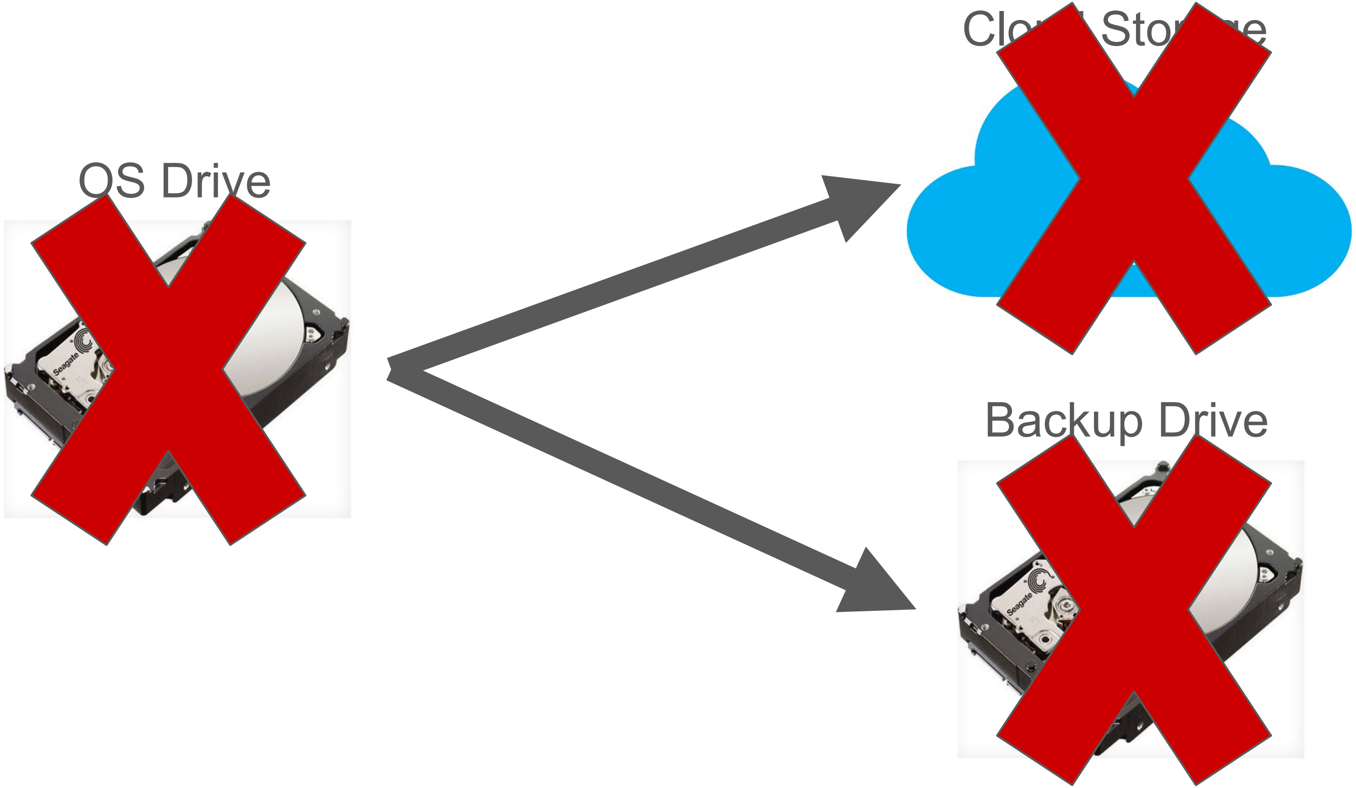
Cloud Storage

Backup Drive

Failure Scenario 4



Failure Scenario 5



Frequent Restore Testing

Backups Always Succeed

Restores don’t!!!!

Monitoring Is Important