Storage & Filesystem Troubleshooting Case Studies for CloudOps Engineers

10 Real-world Linux Storage and Filesystem Scenarios with Commands, Outputs, and Best Practices

Case 1: Disk Full Due to Log Accumulation

Problem: Application stopped writing data due to insufficient disk space.
Investigation:

```
$ df -h
/dev/sda1 100% full
$ du -sh /var/log/* | sort -h
/var/log/app.log 25G
$ lsof | grep deleted
```

Root Cause: Unrotated application logs filled up /var partition.
Resolution: Cleared old logs and configured logrotate with compression.
Prevention: Enable log rotation and disk usage alerts with Prometheus node exporter.

Case 2: Filesystem Mounted Read-Only Due to I/O Error

Problem: Server suddenly switched / to read-only mode, causing app failure.
Investigation:

```
$ dmesg | tail -10
EXT4-fs error (device sda1): ext4_find_entry: reading directory #2 offset 0
$ mount | grep 'ro,'
```

Root Cause: Kernel detected disk I/O errors and remounted root as read-only.
Resolution: Rebooted to single-user mode and ran `fsck -y /dev/sda1`.
Prevention: Run SMART checks regularly and replace failing disks proactively.

Case 3: ext4 Filesystem Corruption Recovery

Problem: System dropped into maintenance shell with ext4 corruption message.
Investigation:

```
(initramfs) fsck /dev/sdb1
Inode 22345 has illegal block(s)... FIX? yes
```

Root Cause: Unclean shutdown caused partial metadata corruption.
Resolution: Repaired with `fsck -y /dev/sdb1` and rebooted successfully.
Prevention: Schedule fsck checks and ensure clean shutdowns via UPS.

Case 4: LVM Snapshot Space Exhaustion

Problem: System performance degraded; snapshot volume reported 100% usage.
Investigation:

```
$ lvs
snap vgdata [100.00g] 100.00
```

Root Cause: LVM snapshot filled up and froze origin volume writes.
Resolution: Removed and recreated snapshot after merging changes.
Prevention: Monitor snapshot space and use thin provisioning alerts.

Case 5: Stale NFS Mount Causing Process Hang

Problem: Processes stuck in D-state, unkillable after NFS server outage.
Investigation:

```
$ ps aux | grep D
$ mount | grep nfs
```

```
$ nfsstat -m
```
Root Cause: Stale NFS handle caused kernel to hang during I/O retries.
Resolution: Remounted NFS with `soft,timeo=5,retrans=3` options and restarted service.
Prevention: Use automount and soft mounts to handle NFS timeouts gracefully.

Case 6: RAID Array Degraded Due to Disk Failure

Problem: Monitoring alerted degraded RAID-1 array.
Investigation:
```
$ cat /proc/mdstat
md0 : active raid1 sda1[0] sdb1[1](F)
$ mdadm --detail /dev/md0
```
Root Cause: One RAID member disk failed hardware diagnostics.
Resolution: Replaced faulty disk and rebuilt array using `mdadm --add`.
Prevention: Enable mdadm email alerts and monitor SMART status daily.

Case 7: XFS Metadata Corruption Detected

Problem: Mounting /data failed with metadata corruption error.
Investigation:
```
$ dmesg | grep XFS
XFS (sdb1): Corruption detected. Unmount and run xfs_repair.
```
Root Cause: Abrupt termination during write operation caused inconsistent metadata.
Resolution: Unmounted and repaired using `xfs_repair /dev/sdb1`.
Prevention: Schedule backups and enable write barriers for XFS volumes.

Case 8: Mount Failure Due to SELinux Context Mismatch

Problem: Mount failed with 'permission denied' error despite correct fstab.
Investigation:
```
$ dmesg | tail -5
SELinux: mount on /data denied.
$ ls -Z /data
```
Root Cause: Mount point mislabeled after manual directory recreation.
Resolution: Fixed SELinux context using `restorecon -Rv /data`.
Prevention: Label persistent mount points correctly with `semanage fcontext`.

Case 9: Lost+Found Directory After Unclean Unmount

Problem: After power loss, multiple files appeared under /lost+found.
Investigation:
```
$ ls /lost+found
file12345, dir6789...
```
Root Cause: Filesystem inconsistencies moved orphaned inodes to lost+found.
Resolution: Recovered essential files manually and validated data integrity.
Prevention: Implement journaling FS and backup critical data regularly.

Case 10: Device Name Changed After Reboot (UUID Fix)

Problem: System failed to mount /data after reboot.

Investigation:

```
$ lsblk
sdb renamed to sdc after reboot
$ blkid
UUID mismatch detected
```

Root Cause: Dynamic device naming changed due to hotplug events.

Resolution: Updated /etc/fstab to use UUID instead of /dev/sdX.

Prevention: Always reference devices by UUID or labels for stable mounts.