Partitioning

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Contents

1 Block devices

Each hard disk or hardware RAID set appears as a so-called block device.

- UNIX-like systems show block devices in the `/dev` directory:
  - Linux show SATA devices as `sd` and a letter, such as `/dev/sda`, `/dev/sdb`.
  - Mac systems show `disk` followed by a number, like `/dev/disk0`.
  - Varies on other unix-like systems (e.g. Xenix, AIX, BSD)
- Windows systems will show block devices in the logical disk manager. They will *NOT* appear as drive letters!

A filesystem is then setup on the block device by formatting it. The filesystem organises the block device into the familiar structure of files and folders. Also the filesystem typically handles permissions and metadata storage.

2 Partitioning

Partitioning allows us to divide a single block device into a number of separate segments that each appear as a separate block device. Each partition can have a different filesystem on it. In almost all cases fixed disks in PC-based systems are partitioned.

There are a number of partitioning schemes. A few common concepts:

- A partition table defines one or more partitions on the disk. This is located in a known location, usually first block on drive.
- The host's OS needs to boot usually from a disk. Partition scheme needs to be compatible with the BIOS or UEFI to achieve this. Also the boot loader may need to be set up.

Most PC-based systems use either MBR or GPT.

2.1 Motivation

1. **OS requirements** such as Linux that generally require multiple partitions:
   - Boot partition for startup files (`/boot`)
   - Root partition for main system files (`/`)
   - Swap partition to support virtual memory (same as Windows page file)
2. **Multi-booting** different operating systems on a single computer.
   - May be different “instances” of the same OS.
   - Less common since virtualisation commonplace but still useful.
3. **Recovery** partitions enabling a installer or cloning tool to restore a system to a known-good configuration.
   - Does depend on the disk itself not failing! (Prefer PXE-based cloning!)

3 Schemes

3.1 Master Boot Record (MBR)

MBR is the most common PC partitioning scheme:

- Introduce circa 1983 with DOS.
- Defines up to four primary partitions on a drive, Figure 1.

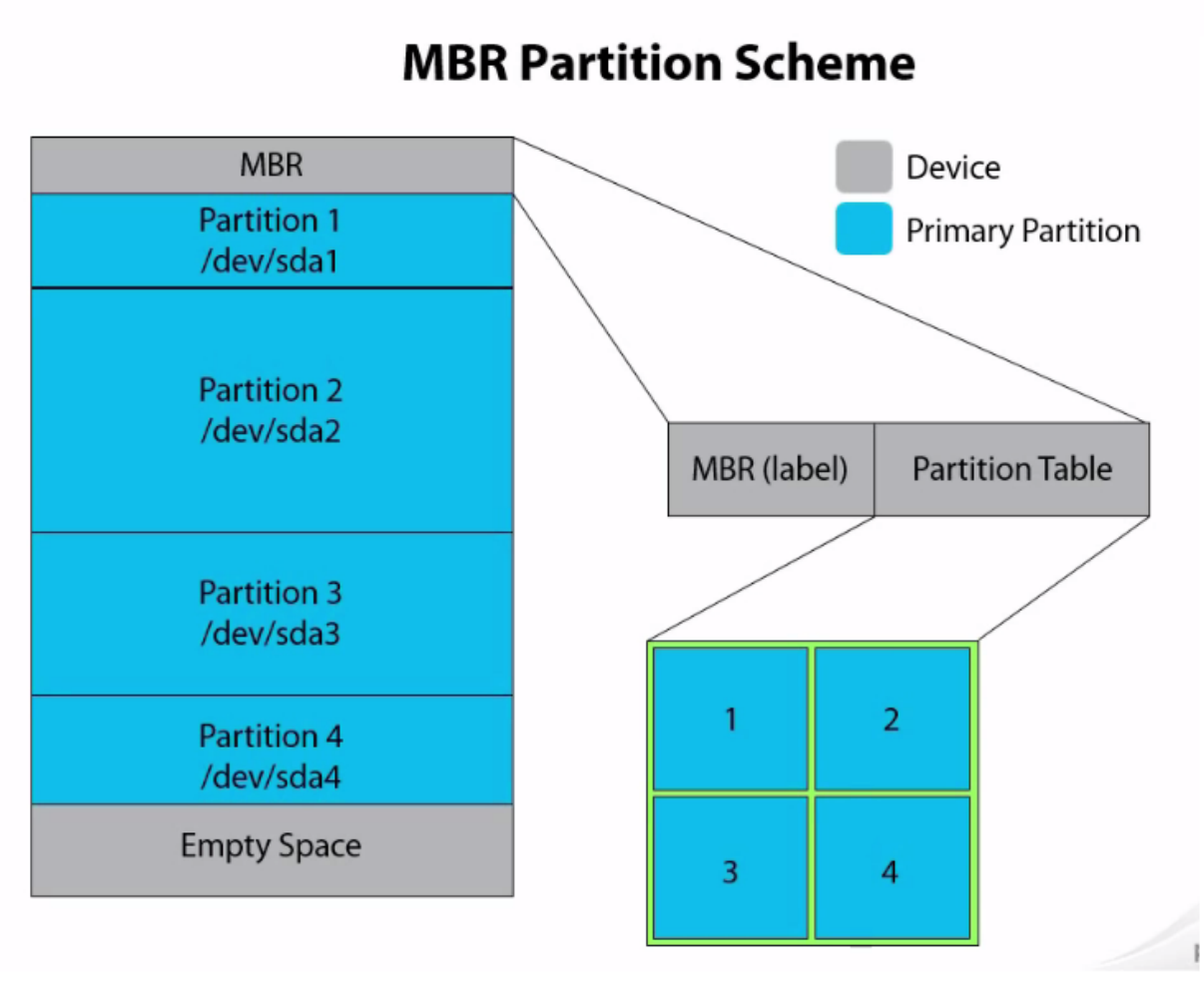

Figure 1: MBR partition scheme

Key points:

- MBR layout closely linked with BIOS boot process. One partition marked “active”.
- The MBR scheme stores the partition table at the beginning of the first 512 bytes of the drive.
  - 446 bytes bootloader
  - 64 bytes partition table
  - 2 bytes “magic number” (`0xAA55`)
- MBR limited to drives less than approx 2.2 TB.

3.2 Extended Boot Record (EBR)

EBR allows more than four partitions on a drive:

- One MBR partition is designated as an extended partition.
- This *extended partition* can hold one or more *logical partitions*, Figure 2.

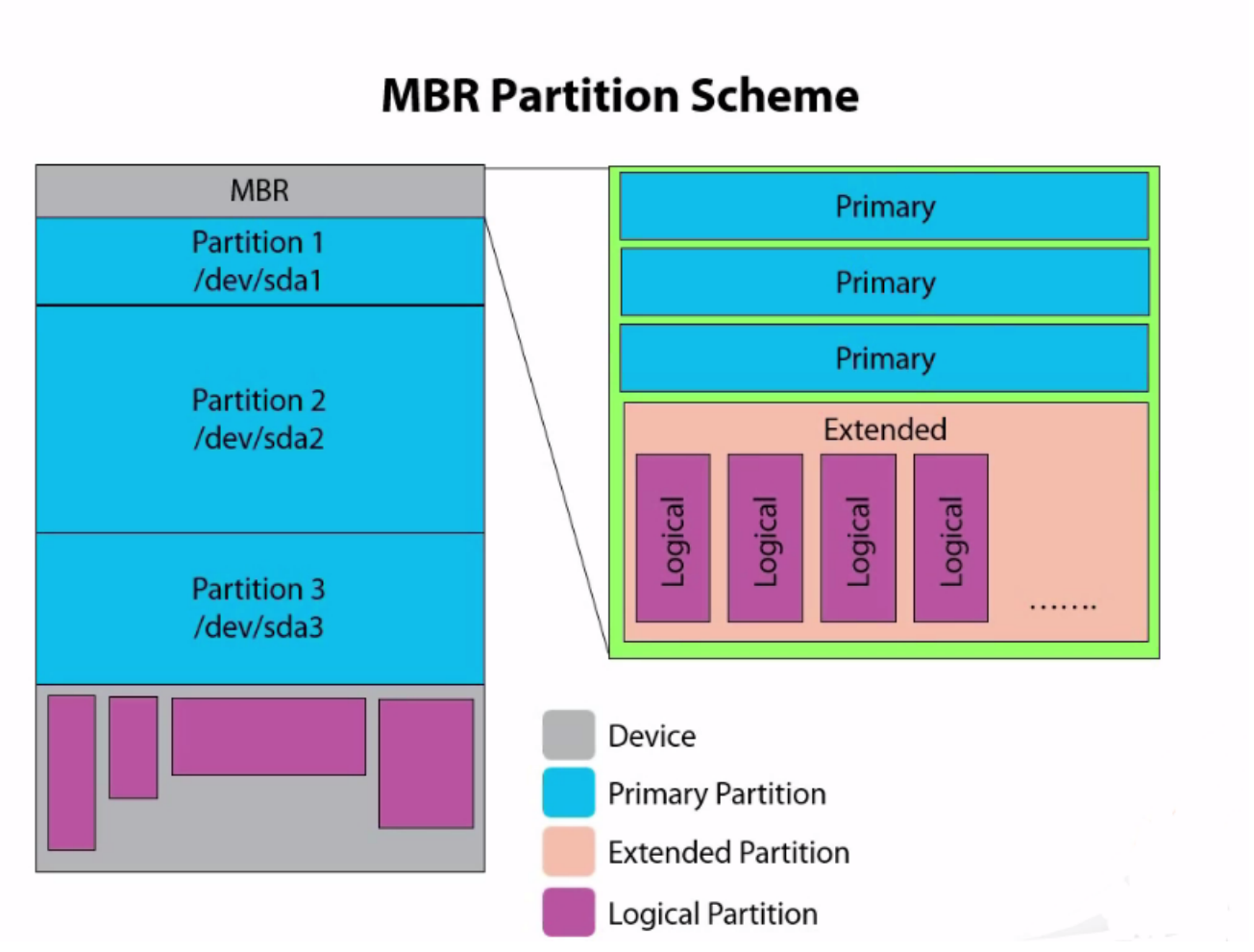

Figure 2: EBR scheme

3.3 GUID Partition Table (GPT)

GUID Partition Table (GPT) is a more modern scheme and is associated with UEFI-based systems.

UEFI is an alternative to BIOS and is used by newer PCs and Apple Macs. GPT layout is shown in Figure 3.

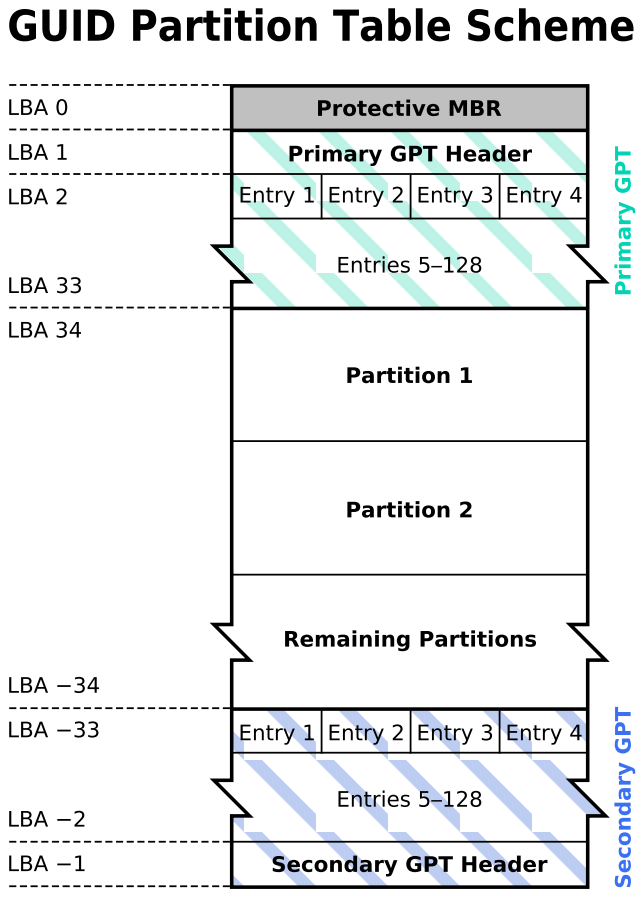

Figure 3: GPT partition table scheme

Points to note:

- GPT can define up to 128 partitions.
- A so-called *protective MBR* is present in the usual MBR location:
  - Indicates entire disk is a single MBR partition.
  - Shows disk partitioning (and other) software that the MBR scheme is not in use.
  - Prevents accidental overwriting by MBR utilities.
- GPT partition table follows protective MBR.
- GPT stores redundant copy of partition table at the end of the drive.
- Boot process more complicated than MBR.

4 Tooling

4.1 Windows

4.1.1 GUI

GUI using *Computer Management*, Figure 4.

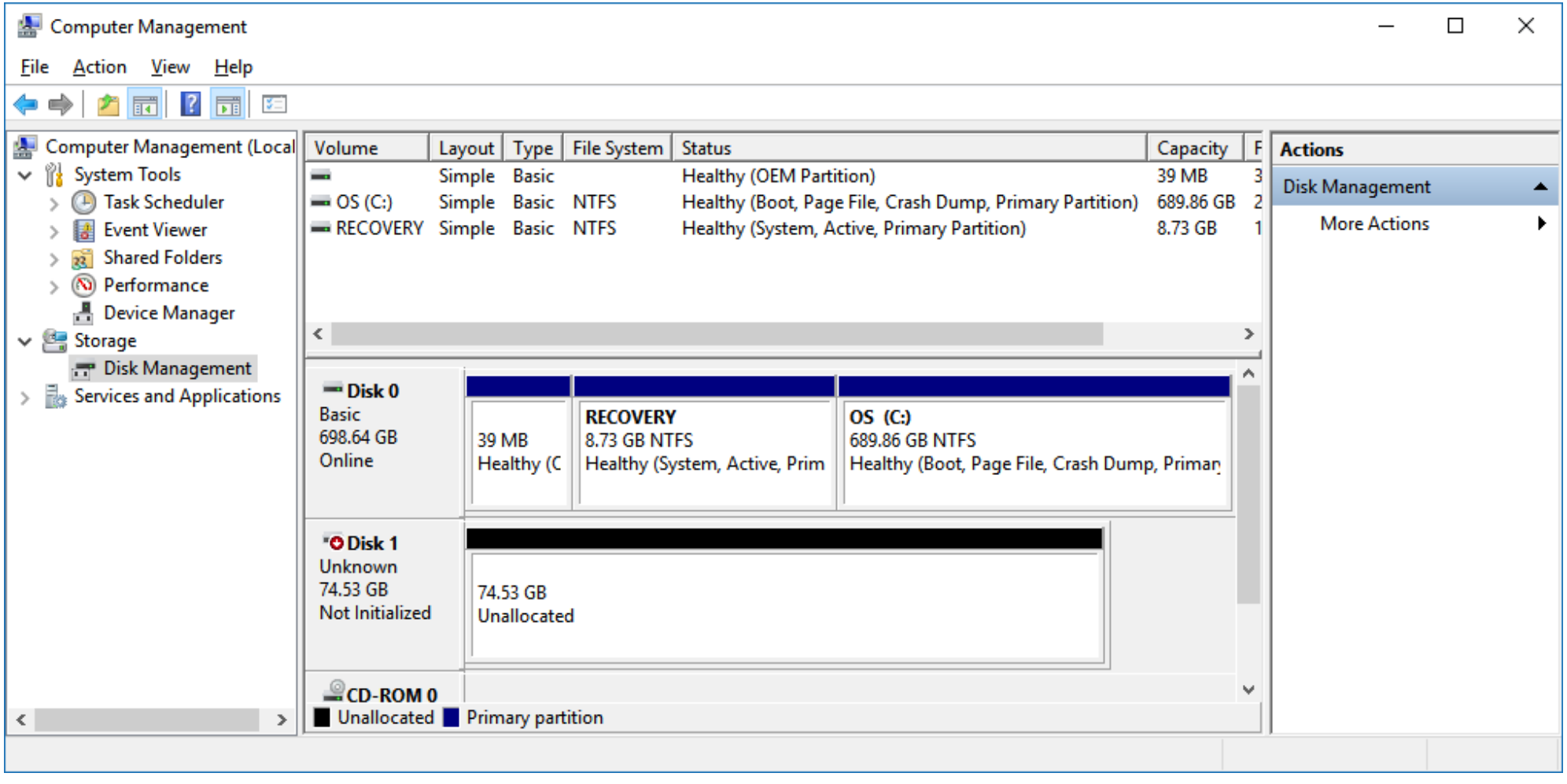

Figure 4: Windows Logical Disk Management

4.1.2 PowerShell

Microsoft are encouraging the use PowerShell in more recent Windows releases to perform system administration tasks:

- Replicability for aiding remote assistance and scripting
- Enables partitioning operations to be done remotely over text links

4.2 Linux

- Relies on `parted` command for both MBR and GPT partitions.
- Other commands such as `lsblk` for listing also.
- Partitions will appear as nodes in the `/dev` directory:
  - Precise names will vary even among linux distributions.
  - Physical disk will appear as `sd` and letter e.g. `/dev/sda`
  - Partitions will appear as `/dev/sda1` etc.
- Same for other UNIX operating systems.

4.3 Apple

- Macs hava a graphical **Disk Utility** app, Figure 5.
- Also can be managed in Bash/zsh using `diskutil` command.

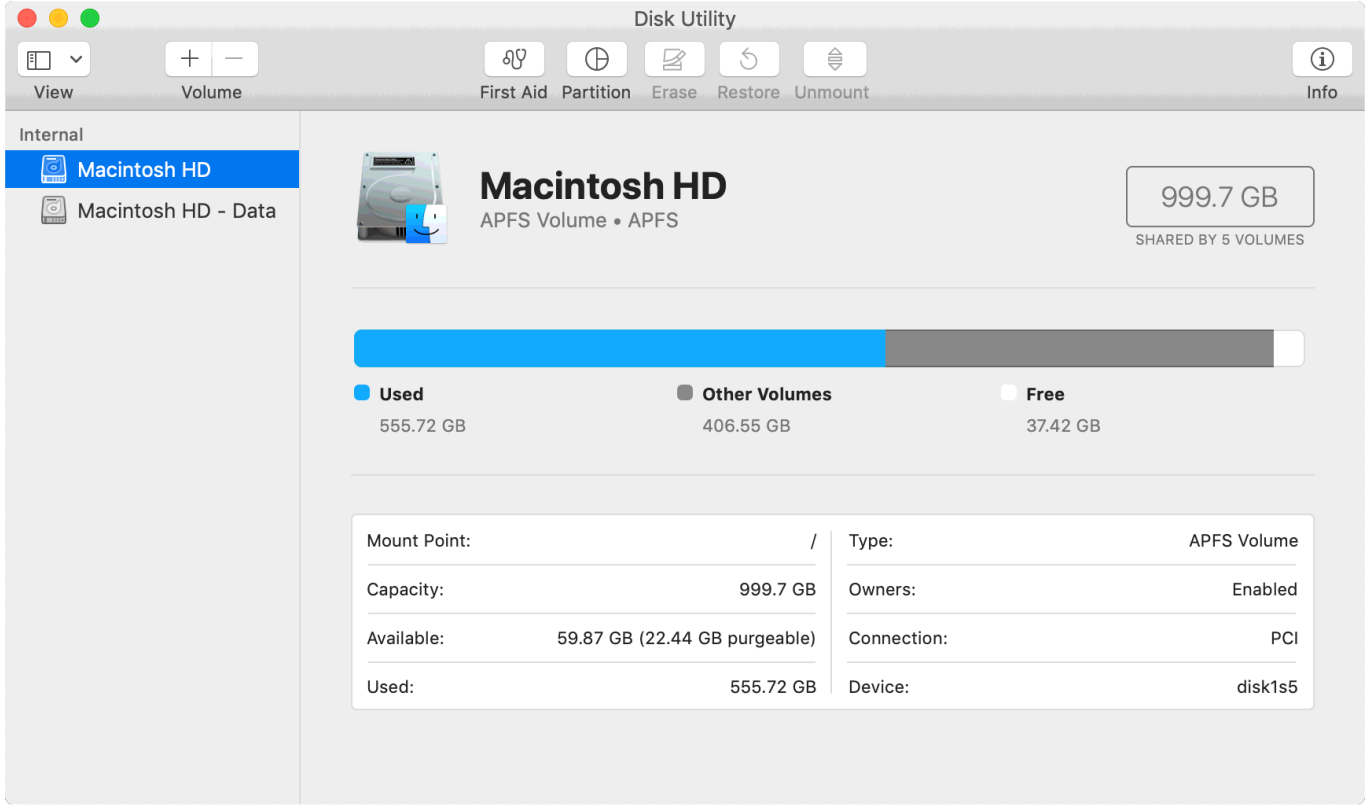

Figure 5: Disk utility

5 Partition operations

5.1 Standard operations

1. Listing availabile block devices
2. Listing existing partitions and free space
3. Creating a partition
4. Deleting a partition

5.2 Resizing

Can shrink or grow a partition:

- must take account of filesystem using it
- Generally avoid doing unless you absolutely have to.

5.2.1 Shrinking

Shrinking a partition has two separate operations:

1. Shrink the filesystem first (see later on!).
2. Then shrink the partition.

5.2.2 Growing

Growing a partition similarly consists of two separate operations:

- Extend the partition.
- Then extend the filesystem.