RAID

Redundant Array of Independent Disks

By: Hashmatullah Pashaye

Introduction

RAID is the use of multiple disks and data distribution techniques to get better Resilience and/or Performance.

RAID stands for:

Redundant

Array of

Inexpensive / Independent

Disks

RAID Levels

We now consider three important RAID designs: RAID Level 0 (striping), RAID Level 1 (mirroring), and RAID Level 4 (parity based redundancy). The naming of each of these designs as a "level" stems from the pioneering work of Patterson, Gibson, and Katz at Berkeley.

U.C Berkeley (led by Professors David Patterson and Randy Katz and then student Garth Gibson).

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Reasons for implementing RAID:

- Capacity
- Reliability
- Performance (read & write)

RAID 0 Striping

The first RAID level is actually not a RAID level at all, in that there is no redundancy. However, RAID level 0, or striping as it is better known, serves as an excellent upper-bound on performance and capacity and thus is worth understanding.

Array Capacity= (Capacity x n)

(n) Is the number of disks in the array.

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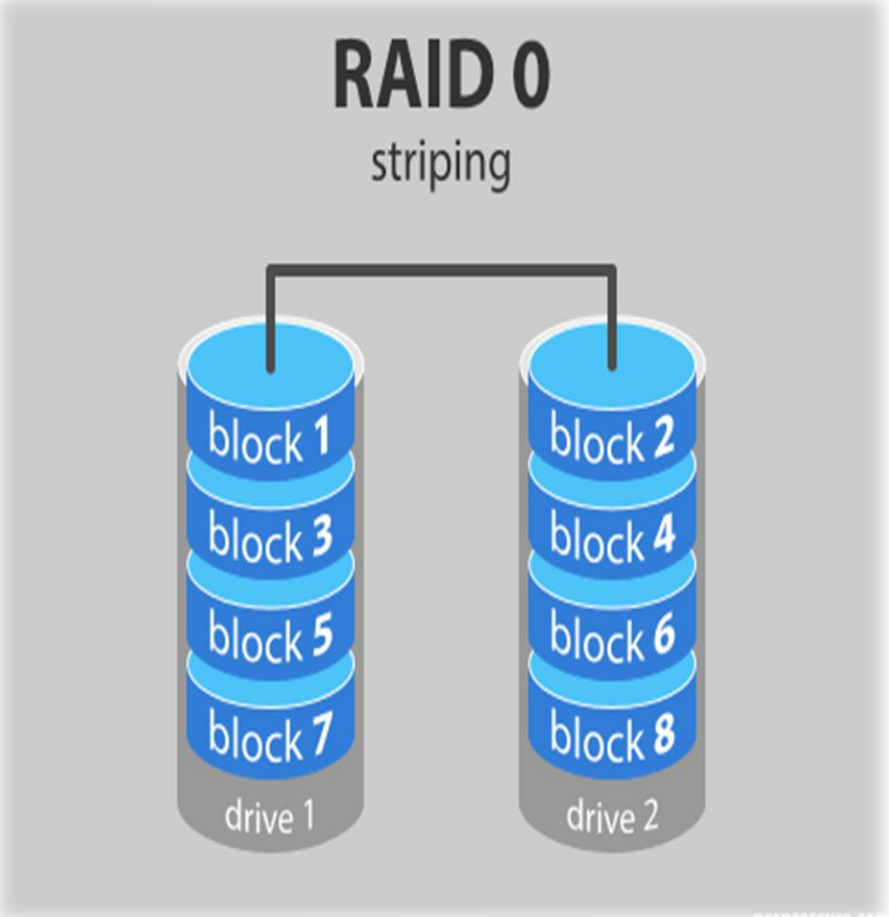
The simplest form of striping will stripe blocks across the disks of the system as follows (assume here a 2-disks):



RAID 1 Mirroring

With a mirrored system, we simply make more than one copy of each block in the system; each copy should be placed on a separate disk, of course. By doing so, we can tolerate disk failures.

Array Capacity= (Capacity x n/2)

(n) Is the number of disks in the array.

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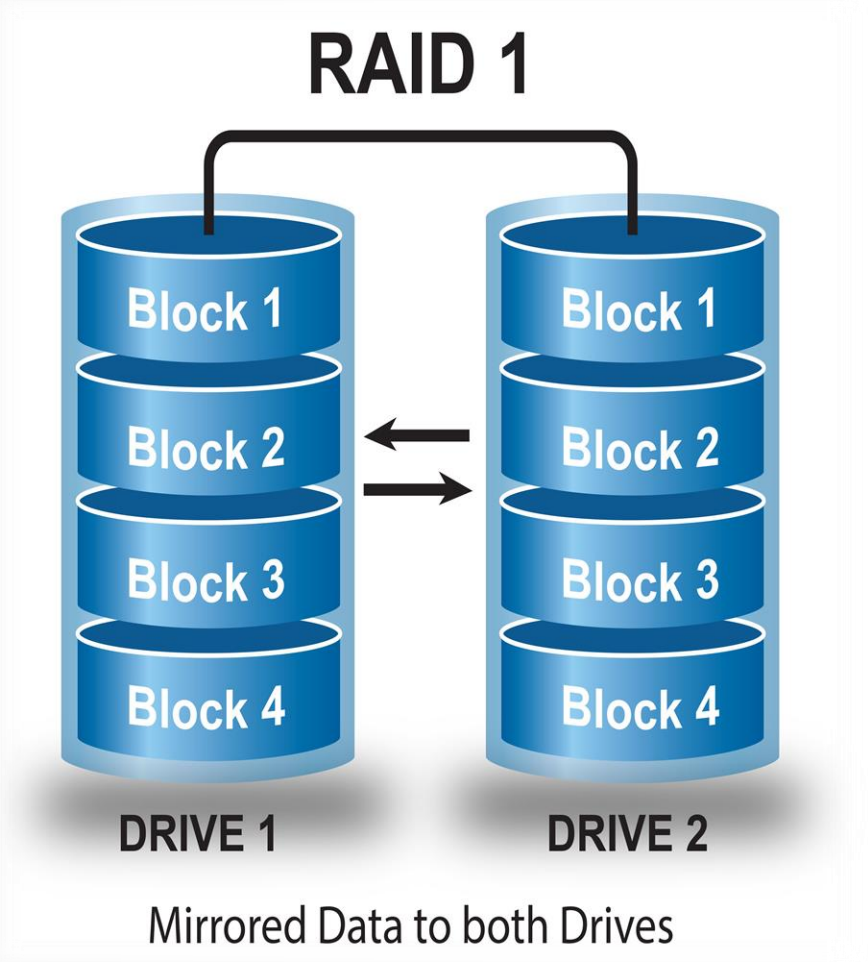
In a typical mirrored system we will assume that for Each logical block, the RAID keeps two physical copies of it.
Here is an example:



RAID 4

RAID 4 consists of block-level striping with a dedicated parity disk. As a result of its layout, RAID 4 provides good performance of random reads, while the performance of random writes is low due to the need to write all parity data to a single disk.

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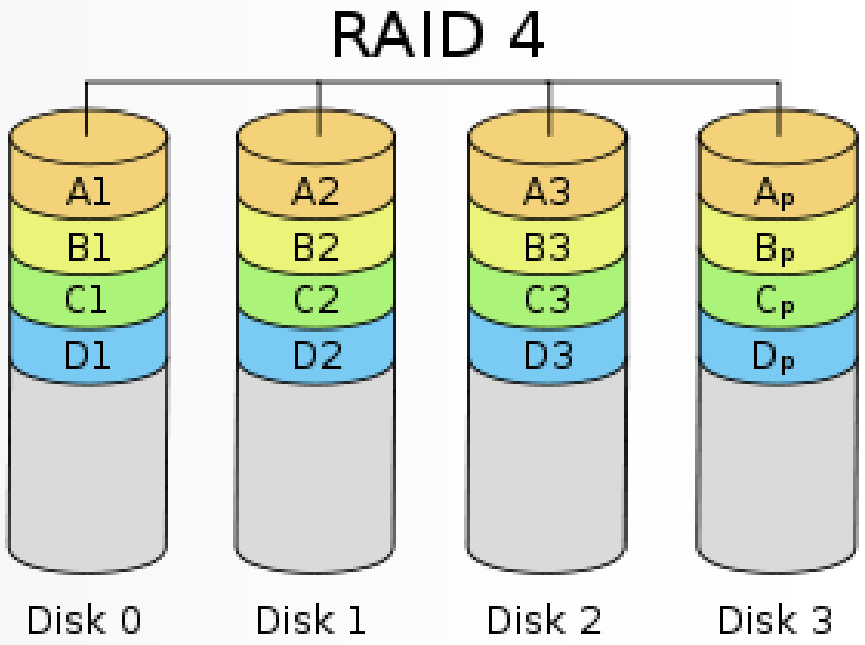
In diagram , a read request for block A1 would be serviced by disk 0. A simultaneous read request for block B1 would have to wait, but a read request for B2 could be serviced concurrently by disk 1.



Parity Drive

A **parity drive** is a hard drive used in a RAID array to provide fault tolerance. For example, RAID 4 uses a parity drive to create a system that is fault tolerant. XOR of all bits from (C0-C3) is taken and placed into the parity drive.

C0	C1	C2	C3	P
0	0	1	1	XOR(0,0,1,1) = 0
0	1	0	0	XOR(0,1,0,0) = 1

Continue…

Imagine the column labeled C2 is lost. To figure out what values must have been in the column, we simply have to read in all the other values in that row (including the XOR'd parity bit) and reconstruct the right answer. For a given set of bits, the XOR of all of those bits returns a 0 if there are an even number of 1's in the bits, and a 1 if there are an odd number of 1's.

Your Turn: Time to hear from you!

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