

## RAID Level 4

In RAID Level 3 and 4, the check disk is only used in writing operations. It does not help with the reads. Moreover, the check disk becomes a bottleneck since it must participate in every write operation.

### RAID Level 4: Block-Interleaved Parity

Uses striping with a 1-block striping unit.

- Logical data block is the same as physical data block.

Computes redundancy as parity bits, and has 1 check disk to store parity bits for all corresponding block in the array.

Reads can be run in parallel

- Works well for both large and small data requests.

Writes require read-modify-write cycle but only involve:

- Data disk for block being modified (target block k)
- Check disk (parity block for block k)

The parity block k is updated incrementally to avoid reading all data blocks k from all data disks.

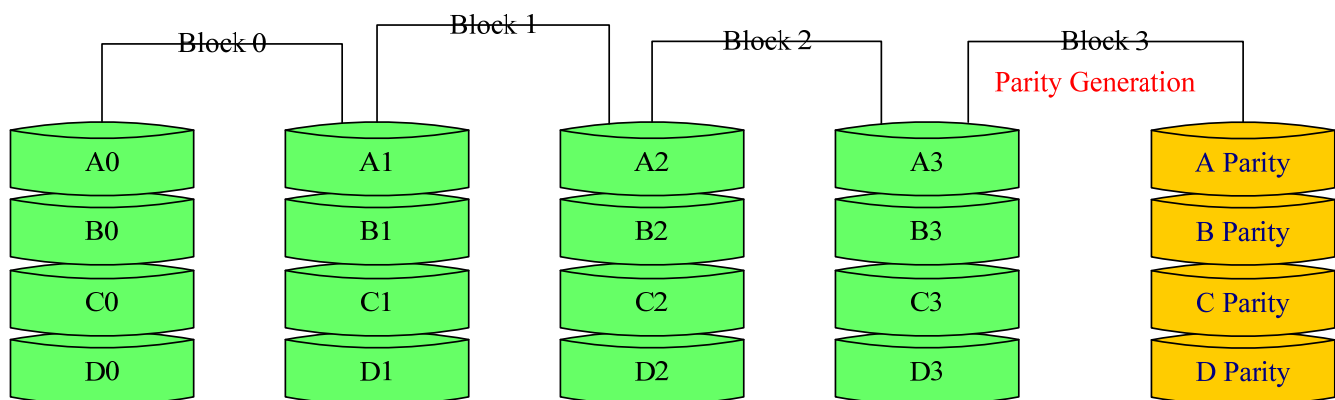
- Only need to read parity block k and block k to be modified
- Parity is computed as follows:

$$\text{New parity block} = ((\text{Old block XOR New block}) \\ \text{XOR Old parity block})$$

In this way Read-modify-write cycle avoids reading the data block in each disk to compute the parity.

Read-modify-write cycle only performs 4I/Os (2 reads and 2 writes of the target data block and parity block)

### RAID Level 4: Block - Level Parity



Stripes 0, 1,2,3 Parity

Note: Space utilization is the same as RAID Level 3.