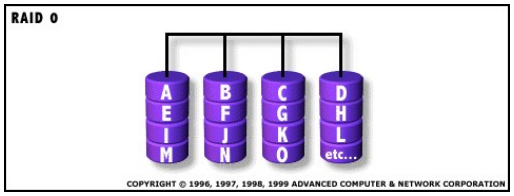
RAID 0: Striped Disk Array without Fault Tolerance



RAID Level 0 requires a minimum of 2 drives to implement

Characteristics/Advantages

RAID 0 implements a striped disk array, the data is broken down into blocks and each block is written to a separate disk drive

I/O performance is greatly improved by spreading the I/O load across many channels and drives

Best performance is achieved when data is striped across multiple controllers with only one drive per controller

No parity calculation overhead is involved

Very simple design

Easy to implement

Disadvantages

Not a "True" RAID because it is NOT fault-tolerant

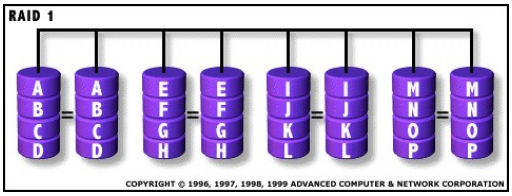
The failure of just one drive will result in all data in an array being lost

Should never be used in mission critical environments

Recommended Applications

- Video Production and Editing
- Image Editing
- Pre-Press Applications
- Any application requiring high bandwidth

RAID 1: Mirroring and Duplexing



For Highest performance, the controller must be able to perform two concurrent separate Reads per mirrored pair or two duplicate Writes per mirrored pair.

RAID Level 1 requires a minimum of 2 drives to implement

Characteristics/Advantages

One Write or two Reads possible per mirrored pair

Twice the Read transaction rate of single disks, same Write transaction rate as single disks

100% redundancy of data means no rebuild is necessary in case of a disk failure, just a copy to the replacement disk

Transfer rate per block is equal to that of a single disk

Under certain circumstances, RAID 1 can sustain multiple simultaneous drive failures

Simplest RAID storage subsystem design

Disadvantages

Highest disk overhead of all RAID types (100%) - inefficient

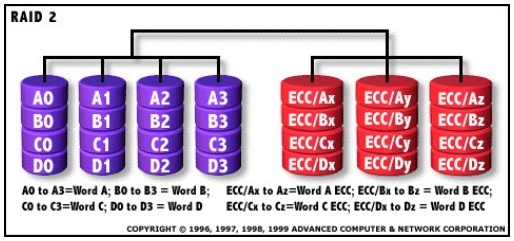
Typically the RAID function is done by system software, loading the CPU/Server and possibly degrading throughput at high activity levels. Hardware implementation is strongly recommended

May not support hot swap of failed disk when implemented in "software"

Recommended Applications

- Accounting
- Payroll
- Financial
- Any application requiring very high availability

RAID 2: Hamming Code ECC



Each bit of data word is written to a data disk drive (4 in this example: 0 to 3). Each data word has its Hamming Code ECC word recorded on the ECC disks. On Read, the ECC code verifies correct data or corrects single disk errors.

Characteristics/Advantages

"On the fly" data error correction

Extremely high data transfer rates possible

The higher the data transfer rate required, the better the ratio of data disks to ECC disks

Relatively simple controller design compared to RAID levels 3,4 & 5

Disadvantages

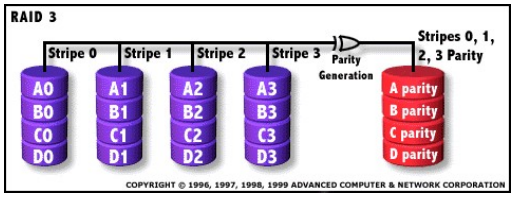
Very high ratio of ECC disks to data disks with smaller word sizes - inefficient

Entry level cost very high - requires very high transfer rate requirement to justify

Transaction rate is equal to that of a single disk at best (with spindle synchronization)

No commercial implementations exist / not commercially viable

RAID 3: Parallel transfer with parity



The data block is subdivided ("striped") and written on the data disks. Stripe parity is generated on Writes, recorded on the parity disk and checked on Reads.

RAID Level 3 requires a minimum of 3 drives to implement

Characteristics/Advantages

Very high Read data transfer rate

Very high Write data transfer rate

Disk failure has an insignificant impact on throughput

Low ratio of ECC (Parity) disks to data disks means high efficiency

Disadvantages

Transaction rate equal to that of a single disk drive at best (if spindles are synchronized)

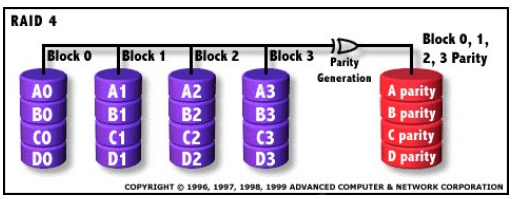
Controller design is fairly complex

Very difficult and resource intensive to do as a "software" RAID

Recommended Applications

- Video Production and live streaming
- Image Editing
- Video Editing
- Prepress Applications
- Any application requiring high throughput

RAID 4: Independent Data disks with shared Parity disk



Each entire block is written onto a data disk. Parity for same rank blocks is generated on Writes, recorded on the parity disk and checked on Reads.

RAID Level 4 requires a minimum of 3 drives to implement

Characteristics/Advantages

Very high Read data transaction rate

Low ratio of ECC (Parity) disks to data disks means high efficiency

High aggregate Read transfer rate

Disadvantages

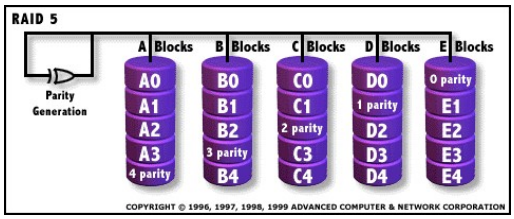
Quite complex controller design

Worst Write transaction rate and Write aggregate transfer rate

Difficult and inefficient data rebuild in the event of disk failure

Block Read transfer rate equal to that of a single disk

RAID 5: Independent Data disks with distributed parity blocks



Each entire data block is written on a data disk; parity for blocks in the same rank is generated on Writes, recorded in a distributed location and checked on Reads.

RAID Level 5 requires a minimum of 3 drives to implement

Characteristics/Advantages

Highest Read data transaction rate

Medium Write data transaction rate

Low ratio of ECC (Parity) disks to data disks means high efficiency

Good aggregate transfer rate

Disadvantages

Disk failure has a medium impact on throughput

Most complex controller design

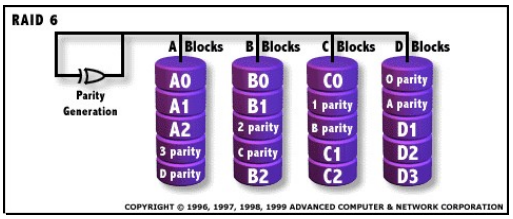
Difficult to rebuild in the event of a disk failure (as compared to RAID level 1)

Individual block data transfer rate same as single disk

Recommended Applications

- File and Application servers
- Database servers
- WWW, E-mail, and News servers
- Intranet servers
- Most versatile RAID level

RAID 6: Independent Data disks with two independent distributed parity schemes



Characteristics/Advantages

RAID 6 is essentially an extension of RAID level 5 which allows for additional fault tolerance by using a second independent distributed parity scheme (two-dimensional parity)

Data is striped on a block level across a set of drives, just like in RAID 5, and a second set of parity is calculated and written across all the drives; RAID 6 provides for an extremely high data fault tolerance and can sustain multiple simultaneous drive failures

Perfect solution for mission critical applications

Disadvantages

Very complex controller design

Controller overhead to compute parity addresses is extremely high

Very poor write performance

Requires N+2 drives to implement because of two-dimensional parity scheme