In Oracle 19c, \*\*striping\*\*, \*\*mirroring\*\*, and \*\*parity\*\* refer to the different types of \*\*redundancy and data distribution techniques\*\* used in \*\*Automatic Storage Management (ASM)\*\* and in general storage configurations for high availability, performance, and fault tolerance.

1. **STRIPING (DATA STRIPING)**

Striping is a technique where data is divided into smaller chunks (stripes) and distributed across multiple disks. This increases performance by allowing multiple disks to work together to read and write data in parallel.

*Purpose*: Improves I/O performance by spreading the data across multiple physical disks, so that reads and writes can happen in parallel.

How it works :Oracle ASM stripes files (e.g., data files, log files) across multiple disks in an ASM disk group. The data blocks are distributed over the disk group, meaning that portions of a single file can be spread across several disks.

ASM in Oracle 19c:

Fine-grained striping: Used for files that need high-performance access to small data blocks (e.g., redo log files).

Coarse-grained striping: Used for larger files (e.g., data files) where the I/O operations involve larger amounts of data.

Benefits of Striping:

Improved performance: By spreading the load across multiple disks, it enables parallel access, thus speeding up read/write operations.

Scalability: As the number of disks increases, performance improves because more I/O operations can be handled simultaneously.

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1. **MIRRORING (DATA MIRRORING)**

Mirroring is a redundancy technique where identical copies of data are kept on different disks. If one disk fails, the system can use the copy from the other disk(s) to continue operation without data loss.

Purpose: Provides high availability and fault tolerance by storing multiple copies of the same data on different disks.

How it works: ASM can maintain two or more copies of each data block in an ASM disk group, depending on the redundancy level chosen.

>Two-way mirroring: Two copies of the data are maintained. If one disk fails, the data can still be accessed from the other.

>Three-way mirroring: Three copies of the data are maintained for even higher fault tolerance.

ASM Redundancy Levels:

EXTERNAL Redundancy: No mirroring is performed. The underlying storage (e.g., RAID) is responsible for data redundancy.

NORMAL Redundancy: Two-way mirroring is performed (default for most installations). Data is written to two different disks.

HIGH Redundancy: Three-way mirroring is performed. Data is written to three different disks, offering the highest level of fault tolerance.

Benefits of Mirroring:

Fault tolerance: If a disk fails, Oracle ASM automatically retrieves data from the mirrored copies without interrupting database operations.

Data protection: Multiple copies of the data ensure that no data is lost if one disk becomes corrupted.

Example:

If you use NORMAL redundancy in an ASM disk group, each file is mirrored across two disks. If one disk fails, ASM automatically uses the copy of the file on the other disk.

1. **PARITY (PARITY-BASED REDUNDANCY)**

Parity is a method used in RAID (Redundant Array of Independent Disks) configurations, particularly in RAID 5 and RAID 6, to provide redundancy without the full duplication of data (like mirroring). In parity-based systems, the data is distributed across multiple disks along with parity information, which can be used to reconstruct data in the event of a disk failure.

Purpose: Achieves redundancy with less storage overhead compared to mirroring, by using parity blocks to reconstruct lost data.

How it works: Instead of keeping a full copy of the data (as in mirroring), parity blocks are calculated and stored on different disks. In the event of a disk failure, the missing data can be reconstructed using the remaining data and parity information.

Not used by ASM: Oracle ASM \*\*does not use parity-based redundancy\*\*. Instead, ASM uses mirroring to provide redundancy. Parity-based redundancy is more commonly associated with traditional RAID configurations, not with ASM.

Example (RAID 5):

- Data is striped across multiple disks, and a parity block is stored on one of the disks. If a disk fails, the data can be rebuilt using the data from the other disks and the parity information.

**ASM Disk Group Redundancy Levels in 19c:**

**1. EXTERNAL Redundancy:**

- No data redundancy is provided by ASM.

- Suitable for environments where hardware-based redundancy (e.g., RAID) is already in place.

- No disk mirroring is performed, so all disks in the disk group contribute to data storage.

**2. NORMAL Redundancy:**

- ASM maintains two copies of every data block (two-way mirroring).

- Provides protection from a single disk failure.

- Requires more storage space due to the mirrored copy.

**3. HIGH Redundancy:**

- ASM maintains three copies of every data block (three-way mirroring).

- Protects from two simultaneous disk failures.

- Requires more storage space but offers the highest fault tolerance.