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A Review on Raid Levels Implementation and Comparisons

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ABSTRACT

Redundant array of independent disks (RAID) is the technology of grouping several physical drives in a computer into an array that you can define as one or more logical drives. With RAID technology, data is stripped across an array of physical drives. The data distribution scheme complements the way for the operating system which requests data. Disk arrays are used to improve performance and reliability. The improvement in its quality depends upon the application programs that you run on the server and the RAID levels that you allocate to the logical drives. Each RAID level provides different levels of fault-tolerance (data redundancy), read and write performance and utilization of physical drive capacity. Where ever, the RAID levels differ in view to the minimum and maximum number of physical drives that are supported. We are focused on data redistribution that is necessary to be performed after adding disks to the volume. In this paper we analyze some software's and implement the steps for RAID Technologies and their implementation steps.

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INTRODUCTION

RAID enhances the reliability of storage systems by using redundant data and improves the performance by interleaving data across numerous disks. This includes several levels of RAIDs; RAID-0 uses only the interleaving technique without redundant data which does not improve the reliability. RAID-4 and RAID-5 use an extra disk to hold redundant information that is necessary to recover user data in occurrence of failure in disk. Then RAID-4 and RAID-5 stripe data across numerous drives, with the parity stored on one of the numerous drives. In RAID-5, each stripe stores the parity on a different drive to prevent one of the disks from being blockage. As a result, RAID-5 provides high read and write performances due to parallel access to numerous disks.

RAID level-0:

RAID level-0 stripes the data across all the drives in the array. This offer extensive speed enhancement but provides no data redundancy. Therefore, RAID level-0 provides the leading storage capacity of the RAID levels that has been offered and does not take any room for data redundancy or data-parity storage.

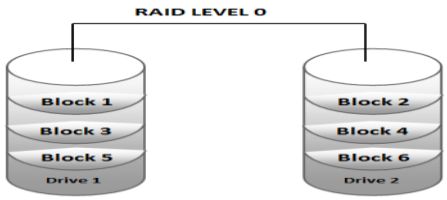

Fig. 1: RAID-0(Stripping).

RAID level-1:

RAID level-1 is used for the purpose of mirroring the data. Two physical drives are combined into an array and the data is striped across an array. The First half of a stripe is an original data and the second half of a stripe is a *mirror* (copy) of the data that is written to the other drive in the RAID level-1 array.

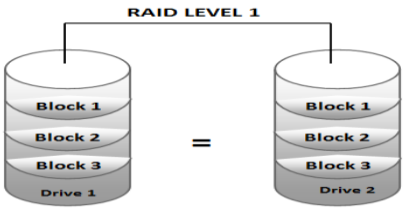

Fig. 2: RAID-1(Mirroring).

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RAID Level-5:

RAID level 5 uses minimum of 3 disks for storage the data's. The performance of raid 5 is based on as blocks are striped, and redundancy depends on the distributed parity .The best cost effective option provides both performance and redundancy. Use this option for database that is heavily read oriented, while write operations will be slow.

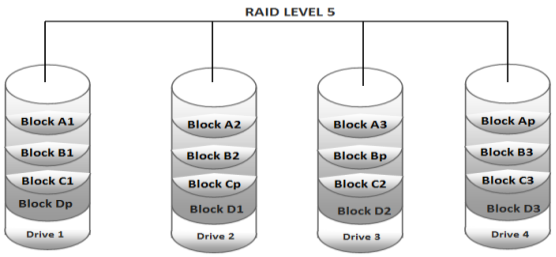


Fig. 3: RAID-5(Striping with Parity).

RAID Level-6:

This does block level striping as like as RAID 5 and uses dual parity. The figure shows that A, B, C are blocks. p1, p2, p3 are parities, which are creates two parity blocks for each data block. The raid 6 can handle two disk failures for providing highly data protection method. The RAID 6 configuration is complex to implement in a RAID controller, since it has to calculate two parity data for each data block.

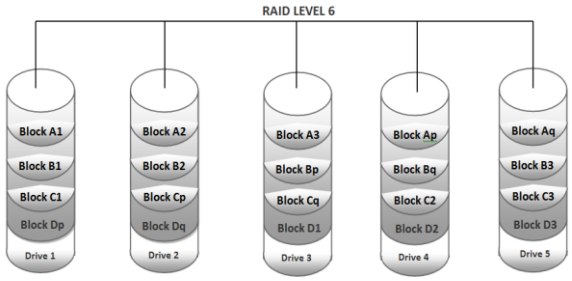


Fig. 4: RAID-6(Striping with Double Parity).

RAID Level-10:

The RAID level 10 uses minimum of 4 disks and this is also called as "stripe of mirrors", these method is the combination of raid1 and raid 0.The below diagram shows blocks are mirrored it provides excellent redundancy and as blocks are striped it gives excellent performance, The best option for any mission critical applications is affording dollar especially for databases.

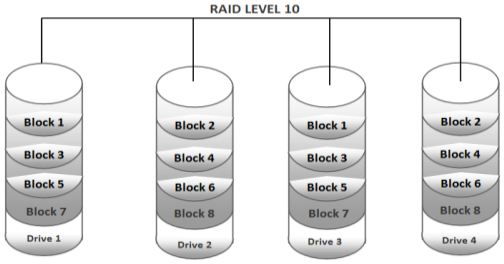


Fig. 5: RAID-6 (combining mirroring and striping).

Here the comparison of all raid levels is given in table 1.

Table 1: RAID Levels Comparisons.

Level	Minimum Disks	Space Efficiency	Read Performance	Write Performance	Fault Tolerance
RAID 0	*Two*	*100%*	*high*	*high*	*None*
RAID 1	*Two*	*50%*	*high*	*medium*	*n-1disk failure*
RAID 3	*Three*	*68%*	*medium*	*medium*	*Single disk*
RAID 4	*Three*	*68%*	*medium*	*low*	*Single disk*

RAID 5	*Three*	*68%*	*high*	*low*	*Single disk*
RAID 5EE	*Four*	*75%*	*high*	*low*	*Single disk*
RAID 6	*Four*	*50%*	*high*	*low*	*Two disk*
RAID 10	*Four*	*50%*	*high*	*medium*	*One disk(array)*

Implementation:

RAID supporting OS:

Windows:

Windows7, windows 8.1 supports only raid level 0 without any raid controllers. Windows server 2003,2008,2012 also support without any raid controllers for raid 0,and raid 1 but other raid levels supports only in server operating systems .The levels need to run raid method are controlled by software raid or hardware raid systems.

Linux:

This operating system also supports the raid methods with the use of Linux software Raid controllers

RAID controllers:

The RAID controllers have two types which depend on software and hardware method.

Software RAID controllers:

The software RAID controllers used to maintain the raid technology with the basics available system hardware. The software RAID methods are available for open source as well as payable. We provide commonly used software's for RAID method are as follows.

Serve RAID manager –IBM products that has the following versions

1. IBM ServeRAID-4H Ultra160 SCSI controller
2. IBM ServeRAID-4Mx Ultra160 SCSI controller
3. IBM ServeRAID-4Lx Ultra160 SCSI controller
4. IBM ServeRAID-5i Ultra320 SCSI controller
5. IBM ServeRAID-6M Ultra320 SCSI controller
6. IBM ServeRAID-6i Ultra320 SCSI controller
7. IBM ServeRAID-7t SATA Controller
8. IBM ServeRAID-8s Serial Attached SCSI (SAS) controller
9. IBM ServeRAID-8k/8k-l Serial Attached SCSI (SAS) controller
10. IBM ServeRAID-8i Serial Attached SCSI (SAS) controller
11. IBM ServeRAID-9.00 Controller

IBM ServeRAID-7t SATA Controller features:

- Cache memory is 64 MB.
- Hard disk drives (max.)4.
- Channels/Ports 4 Serial ATA.
- Transfer speed (max.) 1.5 Gb per sec.
- Supported RAID levels 0, 1, 5, 10, simple volume.

Mega RAID Manager:

Mega RAID supports SATA and SAS RAID controller cards, this controller have the following features:

- Reliable, trusted RAID data protection for critical applications.
- Performance to support the most demanding server storage workloads and solid state drives.
- Architectural and deployment flexibility with internal and external connectivity options.
- Broad interoperability with server and storage infrastructure to ease integration.

Hardwires for raid configuration:

- SATA port multipliers and power multiplier used for adding additional disks.
- Internal or external SATA/SAS multipliers are used for HDD connection.

Addonics Port Multiplier Ultra:

Support SATA I / II / III storage device, integrated hardware RAID controller used to maximize the performance. This multiplier Supports these methods RAID0 (Striping), RAID1 (Mirroring), RAID3, RAID5 (Parity), RAID10 (Mirrored Striped), JBOD (Concatenation), Clone Mode (*N*-Way Mirror) using built-in hardware RAID. Software utility for Windows, Linux and Mac to monitor RAID status and setting up email notification are done in this Multiplier.

Steps for RAID Implementation:

These following steps are used to make raid configuration methods.

Step 1: In raid implementation how many disks wants to add additional disk using SATA/SAS.

Step 2: Go to command prompt and then type "list disk" and also shows available disks in the system,

Step 3: Initially the disks are basic so we need to convert dynamic for raid configuration.

Step 4: Select particular disk using "Select Disk n" command.

Step 5: Then type "convert dynamic" disk is converted to dynamic disks.

Step 6: Do the same operations of other disks for raid configuration.

Step 7: Close the command prompt and then open disk management

Step 8: select particular disk and delete its volumes. Do the same operation for additional disks for raid methods.

Step 9: For raid 1 implementation select one unallocated disk.

Step 10: Right click the disks for mirroring option

Step 11: It shows disk space and add option for disk mirroring, select one disk and press next, after that operation the raid 1 is successfully implemented.
Step 12: Follow the steps 8-11 for raid 0, 2, 4 methods select stripping, and mirroring.
Step 13: To implement Raid levels 5,6,10 need to install any Raid controller's software.
Step 14: Finishing above steps to successfully run all raid methods for storage disks.

***Ex-OR parity algorithm for RAID-5*:**

Parity is a form of error detection that uses a single bit to represent the odd or even quantities of `1's and `0's in the data. Parity usually consists of one parity bit for each eight bits of data, which can be verified by the receiving end to detect transmission errors.

If ((a=0) && (b=0)) &&((a=1)&&(b=1))
Parity doesn't check the data
Otherwise
Parity checks and reloads the data.

After checking the parity if it results in disk failure, the parity updating model retrieves the losing data.

The disk striping and rotated parity, RAID-5 achieves high performance, large capacity, and data reliability. Parity across the array is computed using the XOR (Exclusive OR) logical operation (fig 3). XOR parity is a special kind of erasure code.

N blocks of data are transformed into N+M blocks such that upon loss of any M blocks of data, they can be recovered from the remaining N blocks, irrespective of which blocks are lost. For example, if the parity information of block A is stored in block C, parity information of B block is stored in D block, similarly D block's parity in A and parity of C in B. So if any data is lost in any of these blocks it can be easily regained from the other blocks using the parity information stored in it.

Parity-based Updating algorithm for RAID:

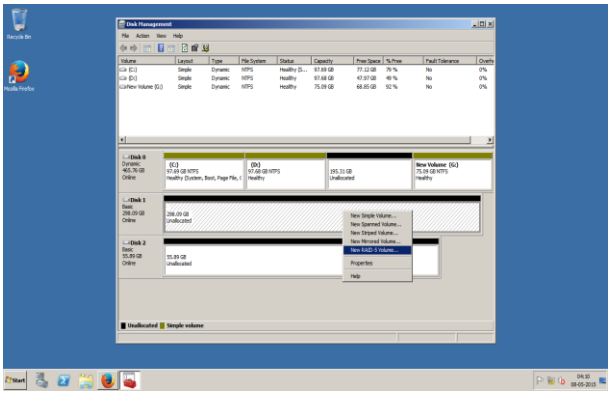
Step 1: Identify a block by its zone number, strip number, and disk number.
Step 2: RAID parity block identifies the disk which is lost in the associated block Sets and then adding as many numbers of new disks as necessary.
Step 3: The amount of updating blocks is calculated using

Updating Ratio = (total num of blocks should be updated) /(total num o f original blocks).
= m/(n+m).

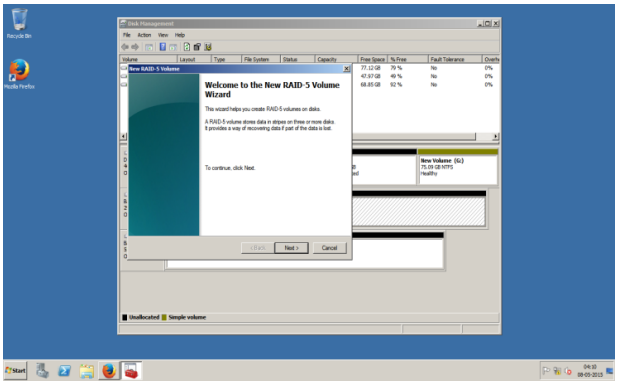
Where, m is the number of new blocks.
n is the number of existing blocks.

The failed disk is identified and it is replaced by the new disk. The data of the failed disk is retrieved using the parity algorithm and placed into the new disk.

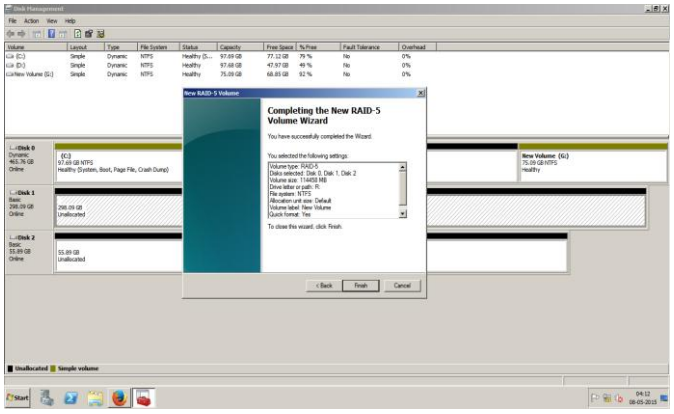
***Outputs*:**



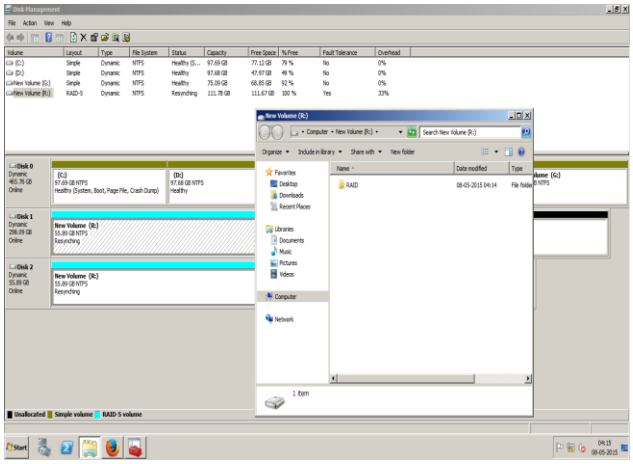
RAID-5: IMPLEMENTATION



RAID-5: CREATION



RAID-5: COMPLETION.



STORAGE IN RAID-5: DISKS

Conclusion:

The RAID methods are used to partition the storages for stripping and duplicating the original data in different disks. In this paper focused on RAID Levels mirroring, stripping, bytes level stripping, blocks level stripping, stripping with parity, stripping with double parity and combination of both stripping and mirroring descriptions for storage methodologies. The RAID implementation is challenging task for data storage management in all operating systems, here we provides easiest way to implement all RAID levels for data storage and protection of data.

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