2crsi

WHITE PAPER

Modern RAID Technologies with Growing Data Stocks

Rebuild Time on Traditional RAID Too Long?

RAID (Redundant Array of Independent Disks) is to combine multiple independent physical disks based on a certain algorithm to form a virtual logical disk that provides a larger capacity, higher performance, and better data error tolerance. RAID has been the basic technology of storage system as a mature and reliable data protection standard. However, with the rapid growth in demand of disk drive for data storage and the advent of high-performance applications in recent years, traditional RAID has gradually revealed its defects.

Double Capacity and Double Rebuild Time

As hard disk capacity increases, the amount of time required to rebuild RAID data has also dramatically increased. This makes one of the most troubles for enterprise storage management today. In the past days when the hard disk capacity was only 10GB to 100GB, RAID built was a job that could be completed in 10 minutes or more, which was not yet a problem generally. However, as disk capacity grows to hundreds of GB and even TB, RAID rebuild times have increased to hours or even days, it becomes a major problem in storage management. For example, a traditional RAID 5 with 8 and 1 parity on 6TB NL-SAS disk drives takes 2.5 days to rebuild data.

More and More Disk Drives on Large JBOD

2CRSI recently announced partnerships with Western Digital to support their high density JBODs as the extreme density expansion solutions of 2CRSI SAN storage. Therefore, by connecting 2CRSI 460J and 4102J to build a very large pool with 100TB capacity or much more is not a dream. But you can image whether this pool needs to be rebuilt, which may take more than 2 weeks.

Performance Impact and Risk of Disk Failure during Rebuild

The rebuild process consumes system resources, reducing the overall performance of the application system about 50% to 70%. If users restrict the rebuild priority, the rebuild time will be even longer to slow down the overall operations. Most important of all, during time-consuming rebuilding, a large number of access operations could cause the failure of other disk drives in the pool, dramatically increasing the probability of disk failure and the risk of data loss. In a company, downtime means money. Downtime caused by data loss can adversely impact the company's productivity and profitability. An hour of disruption can cost a small company USD $8,000, a medium company USD$74,000, and larger enterprises roughly USD $700,000[1].

Solutions to Reduce Rebuild Time

To reduce the rebuild time, 2CRSI offers Fast Rebuild and RAID EE technologies.

Fast Rebuild

When executing rebuild, the Fast Rebuild feature skips any partition of the volume where no write changes have occurred, it will focus only on the parts that have changed. This mechanism may reduce the amount of time needed for the rebuild task.

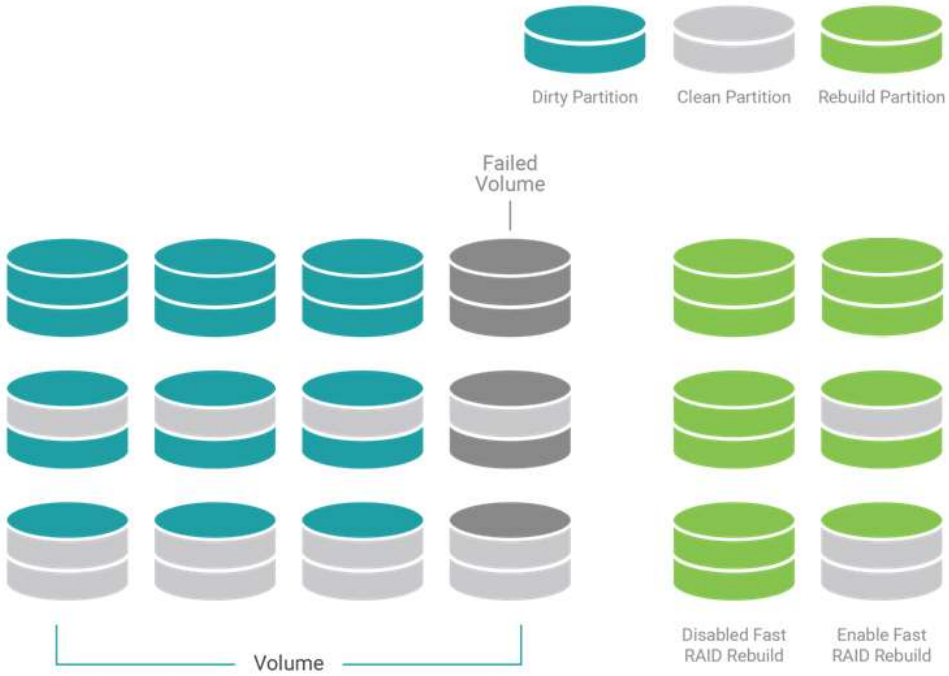

Figure 1 Fast Rebuild

From the test result of Fast Rebuild, the build time can be saved depending on the capacity used. The less capacity used, the faster the build. It is showing linear growth.

Table 1 The Test Result of Fast Rebuild

Capacity	Usage	Disable Fast Rebuild	Enable Fast Rebuild	Improved
1TB	250GB	52’20”	13’42”	382%
1TB	500GB	52’18”	25’26”	206%
1TB	750GB	52’32”	38’36”	135%

RAID EE, also called RAID 2.0

RAID EE adds more spare disks in a disk group, we call them **RAID EE spares** to separate the original global, local, and dedicated spares. Spare areas are preserved in each stripe of the disk group and are distributed in the disk group by means of disk rotation. When disks have failed in the disk group, missing data is rebuilt into the preserved spare areas. Since all disks in the set are destination of rebuilt data, the bottleneck of traditional RAID rebuild is gone, rebuild performance dramatically improved. If new disks are added in, data in spare areas are copied back to new joined disks.

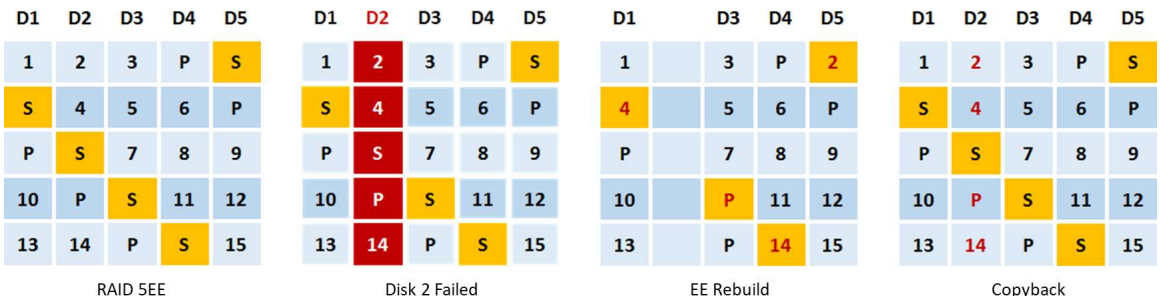

Figure 2 Example of RAID 5EE with 1 RAID EE spare

Based on the test results, we have some conclusions. The more RAID EE spare disks are used, the less rebuild time is. In the best case, RAID EE can improve rebuild time by up to 96% and average around 60% to 90%.

Table 2 The Test Result of RAID 5 and RAID 5EE

	RAID 5 (x16)	RAID 5EE (x16+1)	RAID 5EE (x16+2)	RAID 5EE (x16+4)	RAID 5EE (x16+8)
Sequential Read, 256KB	40'43"	11'39"	10'09"	6'46"	4'58"
Improved		71%	75%	83%	88%
Copyback		34'08"	30'57"	28'30"	30'56"
Sequential Write, 256KB	24'54"	10'37"	9'08"	6'12"	4'02"
Improved		57%	63%	75%	84%
Copyback		22'29"	30'23"	28'50"	31'54"
Database Access Pattern	507'33"	62'23"	53'25"	34'37"	19'50"
Improved		88%	89%	93%	96%
Copyback		1320'37"	1082'21"	829'00"	754'35"
File Server Access Pattern	431'18"	58'24"	45'54"	27"19"	25'42"
Improved		86%	89%	94%	94%
Copyback		1363'17"	1093'20"	736'87"	705'50"

Ultimate Solution: Fast Rebuild + RAID EE

Both technologies operate independently. Combining these two technologies will provide an ultimate solution. From the test result of Fast Rebuild + RAID EE technologies, you can see the build time can be completed in a short time.

Table 3 The Test Result of Fast Rebuild + RAID 5EE

Capacity	Usage	RAID 5	Enable Fast Rebuild	RAID 5EE	Fast Rebuild + RAID 5EE
100TB	25TB	87.22 hrs	22.83 hrs	3.41 hrs	0.89 hrs
100TB	50TB	87.16 hrs	42.39 hrs	3.41 hrs	1.66 hrs
100TB	75B	87.56 hrs	64.33 hrs	3.42 hrs	2.51 hrs

Conclusion

As drive capacity grows and the launch of higher density storage system the RAID rebuild time has been growing exponentially in past decades and such growth will never stop. It will be always exciting to hear new technologies and learn how they can maximize your investment on the storage. However, “back to basics” to emphasize how the valuable data will be well-protected without loss and downtime should be always the core when planning the storage. While calculating the TCO of your storage procurement, the impact of the RAID rebuild time should not be ignored. The smarter way implemented by 2CRSI combining Fast Rebuild and RAID EE technologies will greatly reduce the rebuild time to mitigate the risk of downtime and data loss.