Platinum HDD Drive Performance Evaluation: White paper

June 2008

Mcell is a hybrid hard disk with built in cache with intelligent caching algorithm to manage bulk data read and write effectively to improve IO performance of computing systems. Performance of CPU has been increasing 50% / year while that of storage system has been merely increasing 8%/ year over the last few decades. The increasing disparity between CPU speed and performance of storage devices pose special challenge to utilize the CPU cycles effectively as in most servers the utilization of CPU is 10 to 15% only. Mcell supports high IO demands of the applications and improve the performance of the system through proper utilization of computing resources. However, it is important to measure the performance of Mcell for the applications with the data actually stored (write) on secondary storage and then read from the secondary storage. If the applications uses only main memory and does not read and write on the storage system, the performance of the actual hard disk cannot be measured.

Mcell computing model:

The Mcell has special computing model to support high IO intensive data read and write on the storage. Mcell unit can be of 80 to 160 GBs hard disk drive, with associated built in cache size of 1GB. Mcell should perform very well when the computing system has balanced computing hierarchy profile (Fig 1). In this balance hierarchy, the cache size near to the CPU is faster but smaller than the cache near to the storage. In unbalanced computing hierarchy profile, the layer close to CPU has larger cache size and Mcell does not give optimum performance (Fig 2). In this particular case, the performance of read transactions of both the system (with SATA HDD and Mcell HDD) will be the same almost. However, in case of write operations performed to store the data on the storage, Mcell will significantly outperform the SATA HDD. In the performance evaluation, we will categorize the performance with respect to read, write and read/write operations.

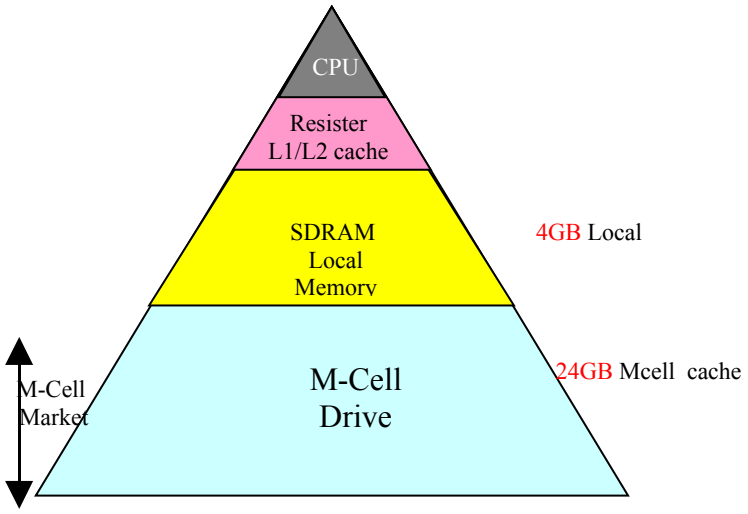

Fig 1. Balanced shape of Computer hierarchy profile

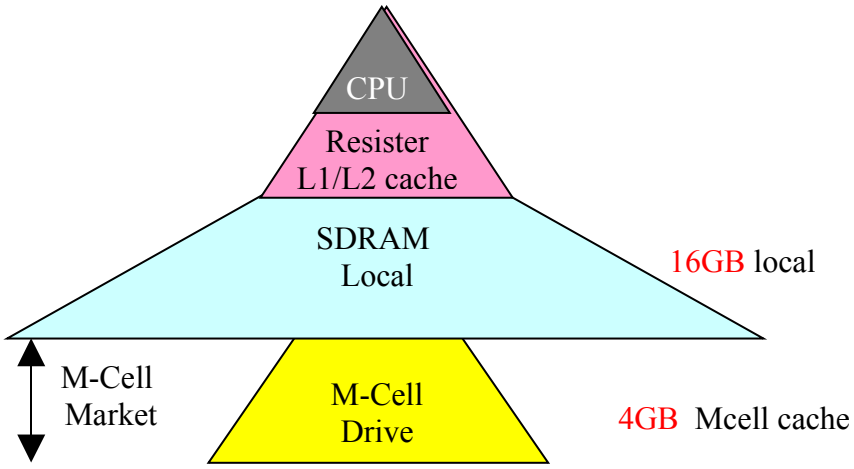

Fig 2. Unbalanced shape of Computer hierarchy profile

Performance Evaluation:
The performance evaluation has been carried out with the following configurations:
System Processor: 2 x Dual core Opteron 2.2 GHz
System memory: 16 GB
Areca 1210 hardware RAID controller
Tool: IOtest, a Unix-based software package featuring a suite of tools, has been used to measure the performance of the Mcell and SATA. IOtest objectively compares the performance of various storage devices such as hard disks, RAID systems, or Solid-State Disk (SSD) systems.

Evaluation Metrics: The metrics for the performance comparison of the two hard disk systems (SATA vs Mcell) are as follows:
ET (Estimated Time) is the time system takes to complete read /write operation with 512 bytes of data size for 10000 iterations.
IOs (Number of Input Output per second)
Data rate is the data transfer rate between CPU and storage.
In the current case study, all these metrics values are available but we shall focus on IOs for the detailed discussion.

Experiment for Evaluation:
We shall divide the IO with into three categories, random read, random write and random read/write. In the random read/write, we assume that the number of read and write are equal.
Random Read IOs:
The graphs in Fig 3 and Fig 4 show the IO performance of the PlatinumHDD and Raptor WD HDD respectively. These results show that the overall read performance is better in Platinum HDD as compared to the raptor WD. Remembering that these results are in the worst-case situation for the PlatinumHDD (if the read data on PlatinumHDD cache area, the performance will increase significantly). The performance of the PlatiunumHDD increases as the number of iteration increases. For example, for 512 byte data, one

process, the IOs Platinum drive has 131578 IO/second, which is much greater than the corresponding 14727 IOs/second for raptor HDD. Similarly for the 8 processes with data size of 65536 bytes, there are 65500 IOs /second for Platinum HDD which is fairly greater than the corresponding 48183 IOs/second for raptor HDD. Average performance of the PlatinumHDD is much better than the raptor HDD (Fig 5)

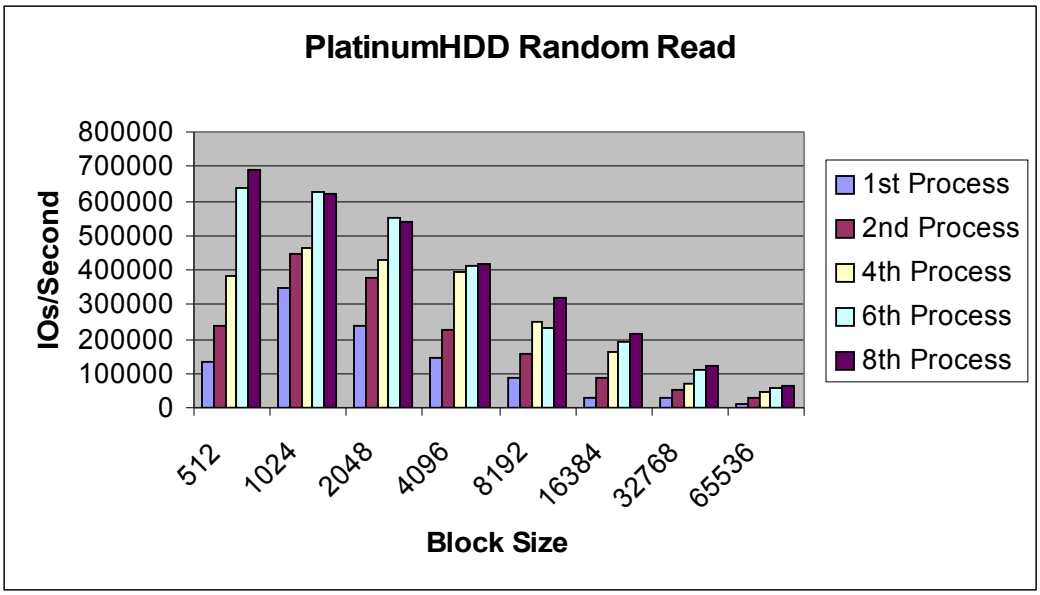

Fig 3. PlatinumHDD Random Read

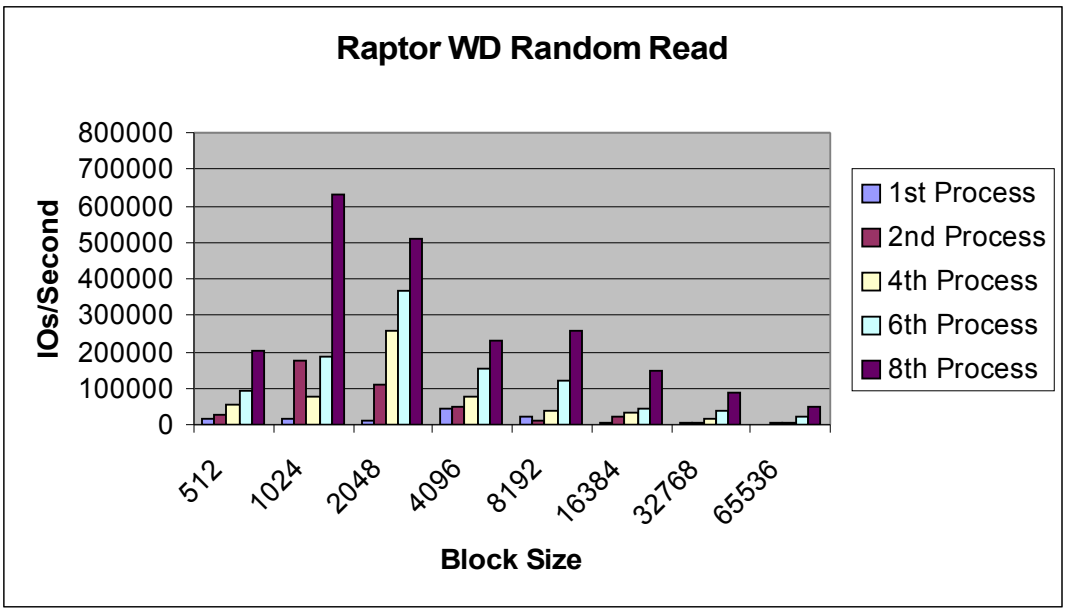

Fig 4. Raptor WD Random Read

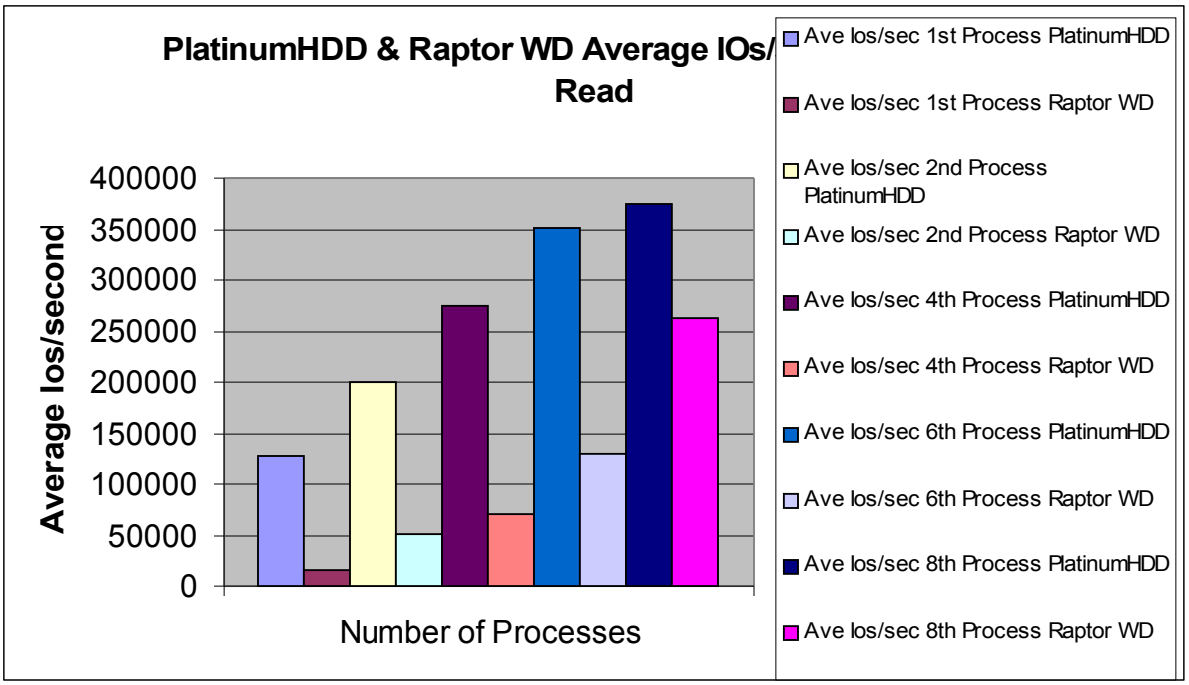

Fig 5. Platinum drive vs Raptor WD Random Read comparison: average performance of the PlatinumHDD is much better than the raptor HDD

Random Read/Write IOs: In random read/write, we assume that the read and write operations are equal. The performance in this case is quite good in the Platinum Drive as

compared to the raptor WD HDD. For example, for 512 byte data, one process, the IOs for Platinum HDD are 357142 IO/second, which is much greater than the corresponding 73529IOs/second for raptor HDD. Similarly for the 8 processes with data size of 65536 bytes, there are 45196 IOs /second for Platinum HDD which is much greater than the corresponding 5180 IOs/second for raptor HDD.

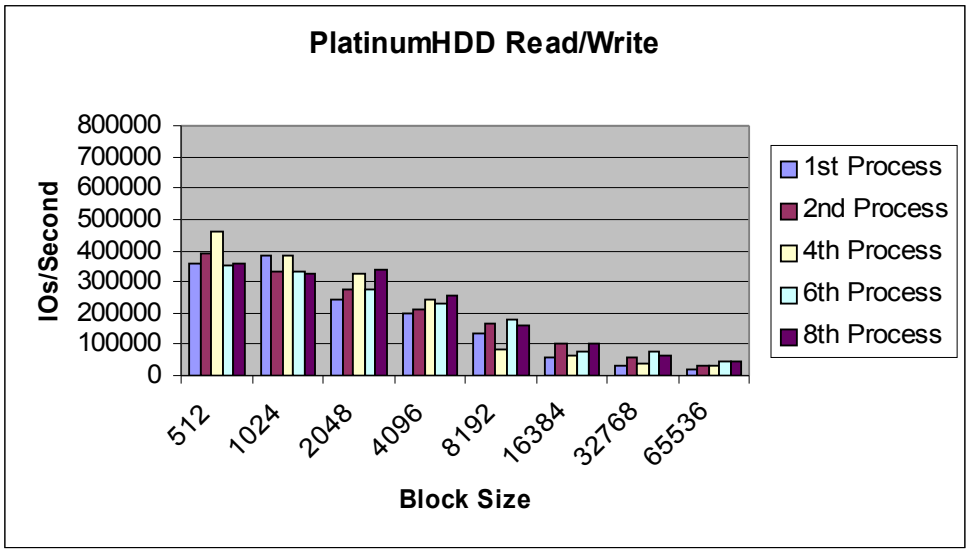

Fig 6. PlatinumHDD Random Read/Write

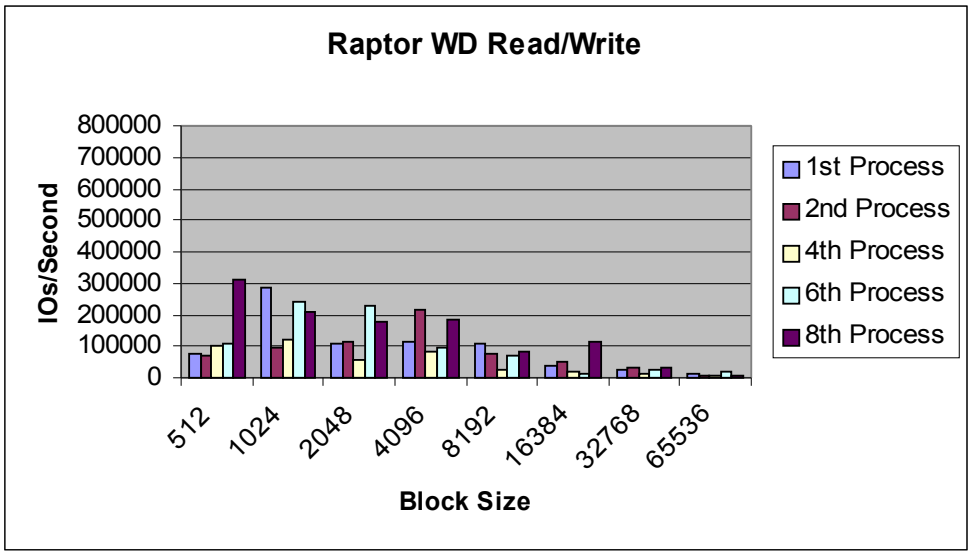

Fig 7. Raptor WD Random Read/Write

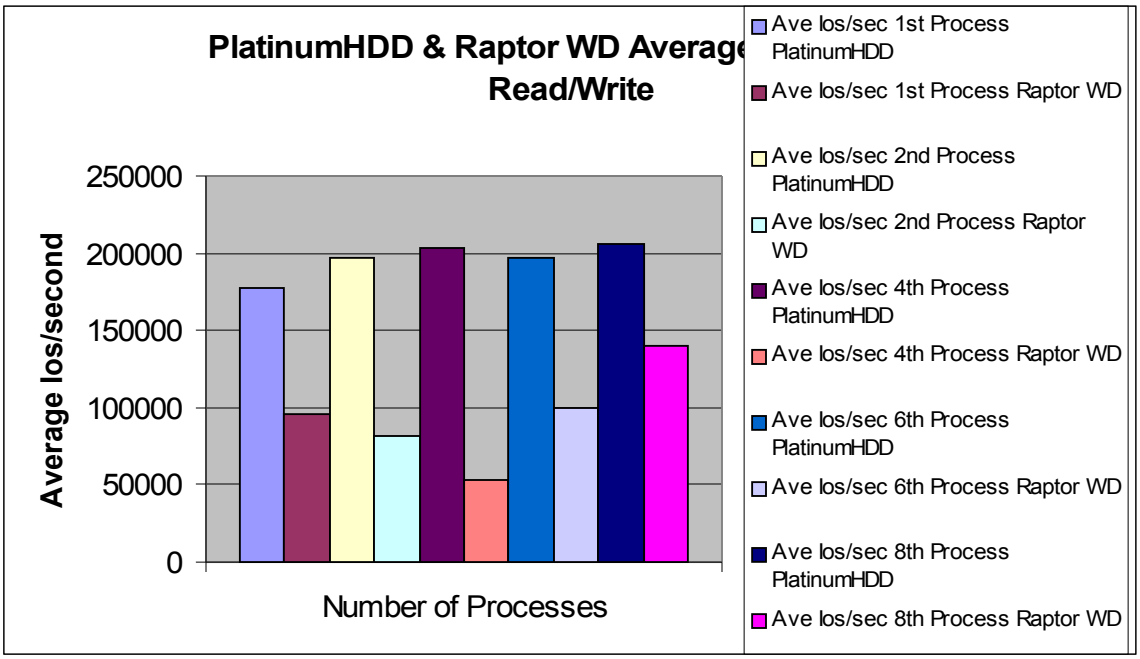

Fig 8. Platinum drive vs Raptor WD Random Read/Write comparison: average performance of the PlatinumHDD is much better than the raptor HDD.

Random Write IOs: In this scenario, the raptor HDD seems to exhibit better IOs but the behavior is unpredictable. However the performance of the Platinum drive shows stable behavior. In this case raptor HDD has 344827 IOs/second while Platinum drive has 263157 IOs/second for 512 byte data and 1 process, and this is small as compared to the raptor IOs. But for the 8 processes, 65536 byte data, raptor HDD has 3325 IOs/second while Platinum drive has 10707, which is more than the double. The important characteristic in this scenario is the stable behavior of Platinum drive as compared to the unpredictable behavior exhibited by the raptor HDD.

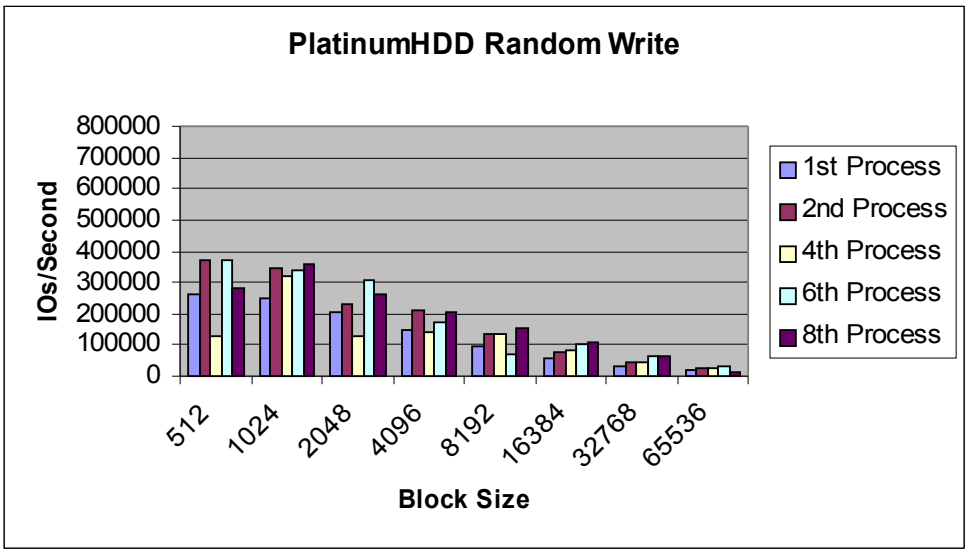

Fig 9. PlatinumHDD Random Write

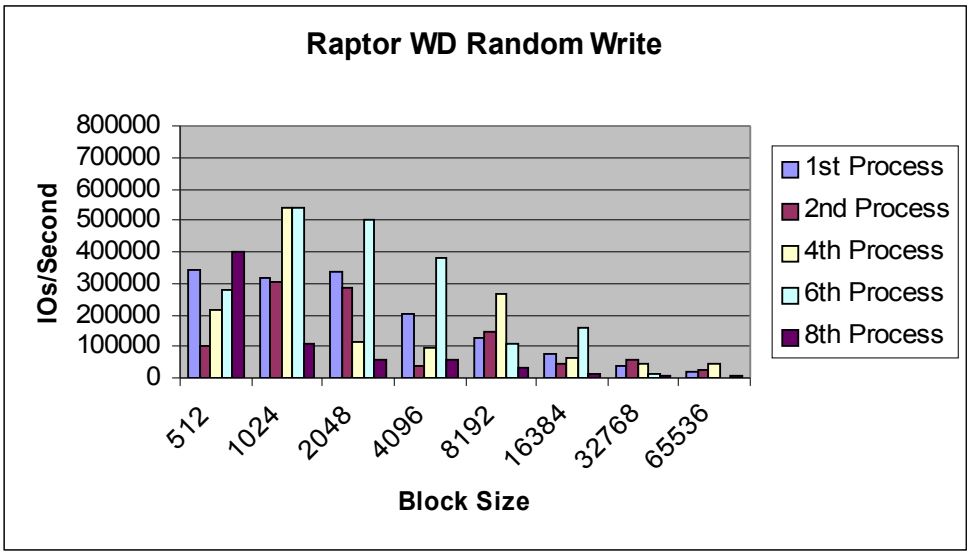

Fig 10. Raptor WD Random Write

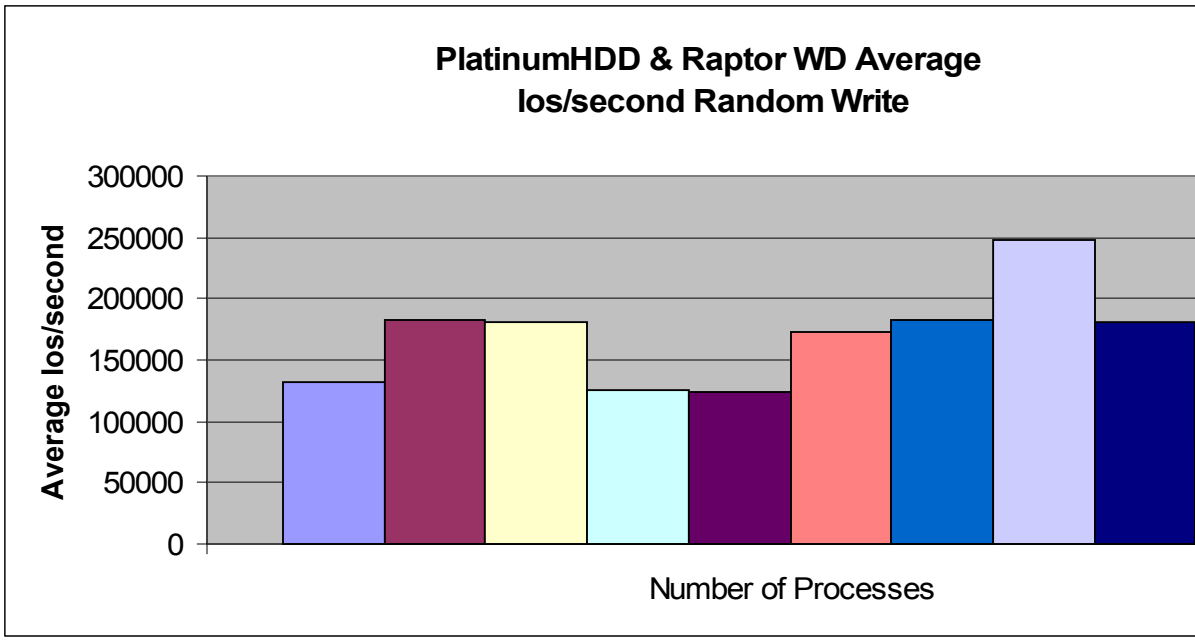

Fig 11. Platinum drive vs Raptor WD Random Write comparison:

Analysis of results:

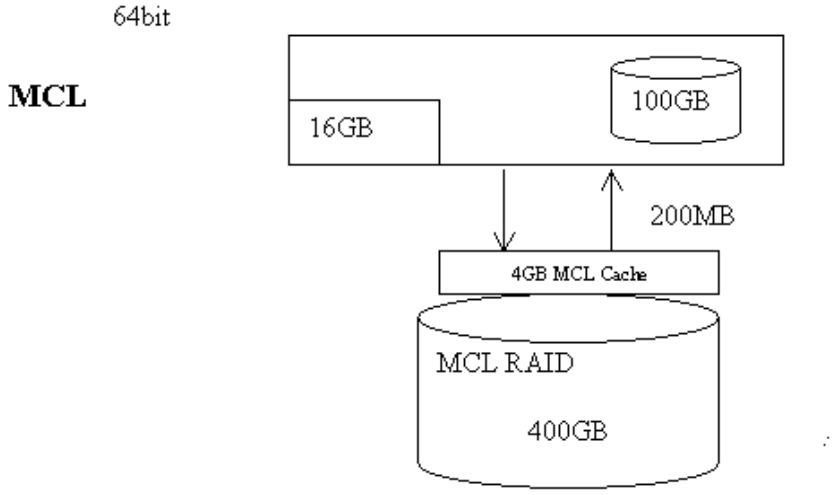

Fig 12. Current System configuration with Mcell at customer site.

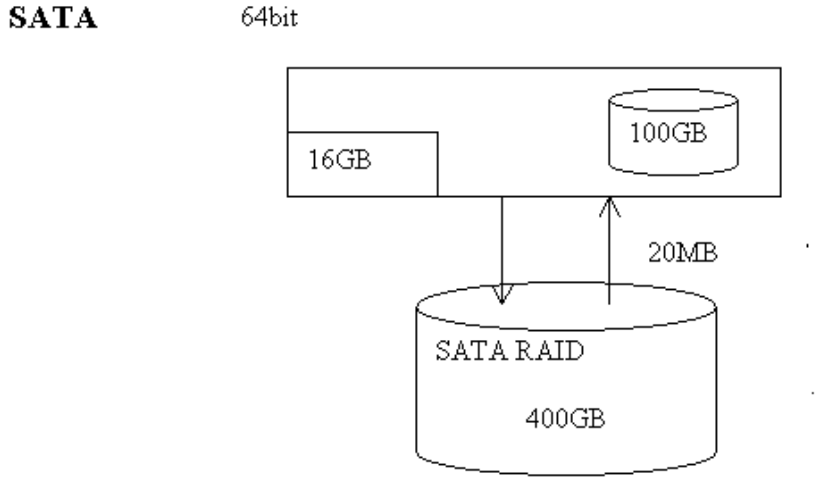

Fig 13. Current System configuration with SATA at customer site.

Applications of Platinum Drive

Database applications with IO intensive operations are good candidate for the Platinum drive.

Web sever

High peak loads

Outcome of the Performance measurement:

The CPU utilization is improved for proper resource utilization with Platinum drive. This improves the response time of the users' applications. CPU cycle utilization can be mainly divided into four categories, percentage idle, percentage user, percentage system and percentage IO wait. Percentage idle is the time CPU is asleep without any outstanding task; percentage user is the actual time used for running the applications. Percentage system is the CPU time used for running the system (kernel) and percentage IO wait is the time CPU cannot do any task due to slow response of IO subsystem. IOs, Data rate and ET are significantly improved in Platinum drive based systems.

Summary

Platinum drive provides IOs for read and read/write operations even in the worst-case scenario of configuration. Average IOs for both of these operations are very large for Platinum drive as compared to the Raptor HDD. However, for the random read operations the performance is not achieved but the behavior of the Platiunm drive is stable as compared to the raptor HDD. The experimental evaluations have been carried out in worst-case scenarios. If the balanced computing hierarchy profile is maintained while carrying out the evaluation, and in this case the overall cache of the PlatinumHDD should be greater than the system cache, the performance will be improved significantly for random read, random read/write and random write operations.