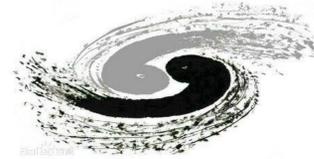


Design and evaluation of Hybrid storage system in HEP Environment

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Hybrid storage system in HEP Environment: aims at providing a high I/O performance with low cost storage system. Hard Disk Drives and Solid State Drives are integrated into a hybrid drive in the system for caching.

Abstract

Computing in High Energy Physics (HEP) is a typical data-intensive application including simulation, reconstruction and physical analysis. Generally, the HEP experiment file is very big and the way of accessing to the files is usually skipping through large data blocks. Therefore, the performance of accessing to big files is one of decisive factors for the HEP computing system. According to analyzing the typical structure of the computing environment in High Energy Physics and the characters of accessing to files, introducing the advantages of Hybrid Storage System in High Energy Physics, summarizing the characteristics of data access mode, evaluating the performance of different Read/Write mode, a new deployment model of Hybrid Storage System in High Energy Physics is proposed, which is proved to have higher I/O performance, at the same time the cost is considered to implement a high-performance system with low cost. Test results show the Hybrid Storage System has good performance in some fields such as HEP. Based on the analysis, it can help to get better I/O performance with lower price in High Energy Physics. At the last, the future of the hybrid storage system is analyzed.



Hybrid Storage System

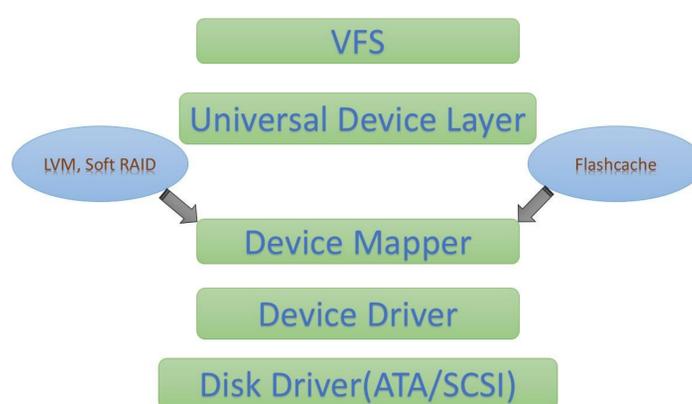
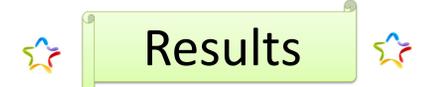


Figure 1: Hybrid Storage module in the kernel

Results

Many tests about the I/O performance have been made. The results show the hybrid storage system really has better performance with low cost. And the important factors of the I/O performance such as SSD/HDD ratio have been tested to get the optimum value. With the values of the factors we can get a storage system with high-performance.



Conclusions

The hybrid storage system in HEP computing system takes the technology named Flashcache. It offers great I/O performance with low cost, but there are two defects of the technology. The first one is the metadata management. Synchronous update and batch update are used, so there will be a time for waiting and the performance is affected. Secondly, it has a mutex lock on the whole, therefore the parallel capabilities of it is poor. Be faced with the two defects above, metadata asynchronous update and some mutex lock for data set should be made to improve the I/O performance. Finally, the tests show that the hybrid storage really has improved the I/O performance in HEP computing environment. With the development of CPU, I/O performance becomes the main bottleneck of computing environment especially in HEP computing environment with data-intensive physical jobs. Hard Disk Drive cannot satisfy the I/O requirement nowadays and the Solid State Drives have high price, so the hybrid storage system comes into being with high-performance and low cost. In the future the storage with ALL-Flash Array may be normal but the hybrid storage is the best choice for now.

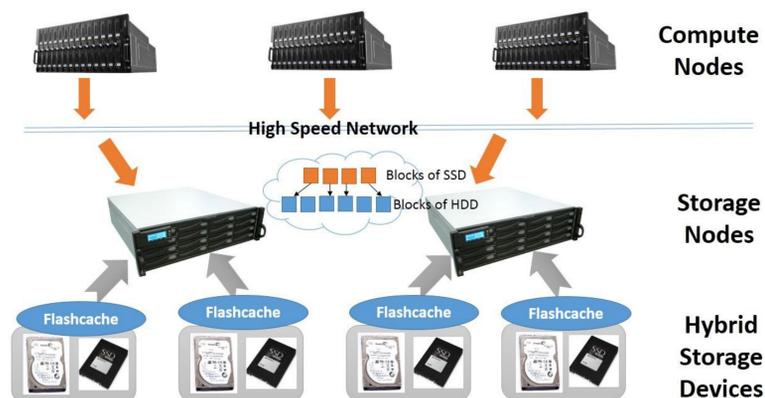
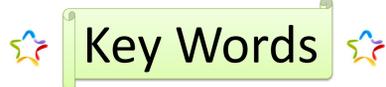


Figure 2: The architecture of the Hybrid Storage System in High Energy Physics

Key Words

mass storage system;
HEP
hybrid storage system
cache
block device
HPC
performance price ratio



Running Efficiency Comparison

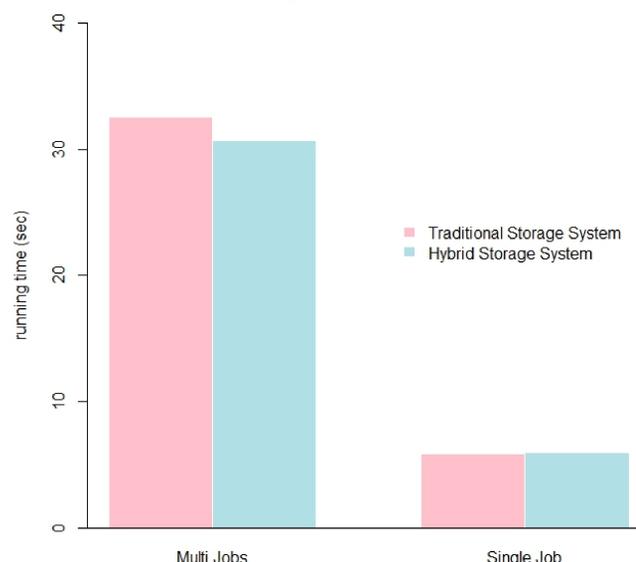


Figure 3: Running Efficiency Comparison on BOSS