

Solid State Drive (SSD) Cache

Accelerating and Maximizing

Storage System Performance

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Introduction

With the continuous development of enterprise businesses, the performance of workload-intensive applications are often constrained by existing hard disk drives (HDDs). While the capacity of HDDs increased dramatically, the random input/output (I/O) performance has not improved at the same rate. However, now it is possible to accelerate performance of read-intensive workloads, such as On-Line Transaction Processing (OLTP), Web Server, File Server, or Database, by deploying FlashDisk caching technology, SSD Cache, which leverages the high speed and low latency of solid state drives to deliver faster read performance for frequently accessed high demand and vital data. Compared to HDD data read speed, SSD is significantly faster and therefore, SSD Cache can considerably improve random read performance and reduce response time.

Products covered by this document

FlashDisk FX and VX Series RAID Storage Subsystems

What is SSD Cache?

Cache is a component that transparently stores data so that future requests for the data could be served more efficiently. It is fundamental to storage, especially for read-intensive applications. Before the launch of SSD Cache, the capacity of controller memory cache was limited. SSD Cache allows fast SSD to be used to extend the cache pool capacity of storage systems and stores frequently accessed data. While the capacity of SSD Cache has increased, the cache hit rate has also improved. In other words, there might be more and more hot data stored in SSD Cache and the future request for that data could be served more efficiently and hence the read performance could be enhanced.

Why FlashDisk SSD Cache?

In most cases, if an application's workload has a high percentage of reads relative to write behaviors and a small amount of data is repetitively read, SSD Cache may have the following benefits:

1. Read performance Enhancement

SSD Cache leverages an intelligent algorithm to accelerate read-intensive workloads such as On-Line Transaction Processing (OLTP) and Database Applications which have small random read I/Os. In these scenarios, SSD Cache can greatly improve overall read performance. For example, SSD Cache can enhance IOPS in OLTP workload when compared to the same system without SSD Cache. At the same time, latency is also reduced and therefore, the level of performance improvement is based on the application's actual workload and user's access behavior.

2. Intelligent Firmware and Management Algorithm

The intelligent firmware automatically analyzes data access behavior and recognizes sequential or random read/write I/O behaviors. Data from sequential reads or writes is not written to the SSD Cache pool, and only random read data would be stored in the SSD Cache pool in order to make the most effective use of SSDs. More precisely, the firmware would automatically move a copy of the most frequently-accessed read data from controller memory cache to SSD Cache pool at an appropriate time. Those hot data blocks will be read from the SSD Cache if the system receives the same read request in the future. A proprietary write algorithm while copying data to SSDs optimizes its cycle duty, so cost-effective SSDs are also applicable. This solution not only improves read performance but also extends life cycle of hard drives by reducing hard drive reads and writes.

3. Simple and Intuitive GUI Design

The SSD Cache function is fully integrated into Winchester Systems intuitive FlashDisk Global Manager and embedded FlashView GUI. It is simple to set up, manage, and maintain. For example, the user can monitor SSD Cache pool status and check the Life Remaining for each SSD with ease.

SSD Cache Pool Information

SSD cache pool

Size: 1.09 TB
Member Count: 4/8
Status: Enable
SED Status: Disable

Drive List

Slot ID	Model	Size	Life Remaining	Serial No.	Status	SED Drive
Slot 1	Z16IZF2E-200UCU	186.06 GB	100%	STM00016F975	On-Line Drive	No
Slot 2	S842E200M2	186.06 GB	100%	STM000196C7A	On-Line Drive	No
Slot 3	Z16IZF2E-400UCY	372.36 GB	100%	STM00016204E	On-Line Drive	No
Slot 4	Z16IZF2E-400UCV	372.36 GB	100%	STM000151630	On-Line Drive	No

Tasks

- Add Disk**: Add SSD disk(s) to SSD cache pool.
- Remove Disk**: Remove member disk(s) from SSD cache pool.
- Disable**: Disable SSD cache pool function.
- Front View**: Highlight the location of the SSD cache member disk(s) on the front panel.
- SED Security - Enable**: Set a SED password or create a key file to enable SED.

How FlashDisk SSD Cache works

Once SSD Cache has been enabled and running business applications for a while, the intelligent firmware records statistical data and immediately updates the hotness record into controller memory cache. Based on the hotness record, the firmware will automatically copy random and small size frequently-accessed data from controller memory cache to SSD Cache pool at the

appropriate time using the sequential write I/O method to avoid data intensively written onto SSDs and therefore, improve the SSDs' life cycle. Before the SSD Cache Pool is fully filled up with the hot data generated from host applications, a pre-copy method to SSD via zone block prediction speeds up the read performance. For data size that is less than or equal to 16KB, the data will be copied to SSD Cache pool directly even if it has been only read once. When the read data size is larger than 16KB and the firmware recognized it as hot data (has been read a couple of times), it will then be classified as frequently accessed hot data and cached in the SSD Cache pool. This hot data will have two copies, one in SSD Cache and one on the hard drives.

Basically, when receiving a read request, the system will check if relevant data is contained in the controller memory cache. If the requested data is stored in the memory cache, the system will directly return this data to the host. On the other hand, if the requested data is not cached in the memory cache, the system will check the SSD Cache Pool. If the requested data has been copied into the SSD Cache pool based on the real-time hotness record, the storage will directly read the data from the SSD Cache pool and return the data to the host. Otherwise, the requested data will be accessed from a slower device. Therefore, as more cache hits occur, more frequent requests can be served by SSD Cache and overall performance and average response time improves.



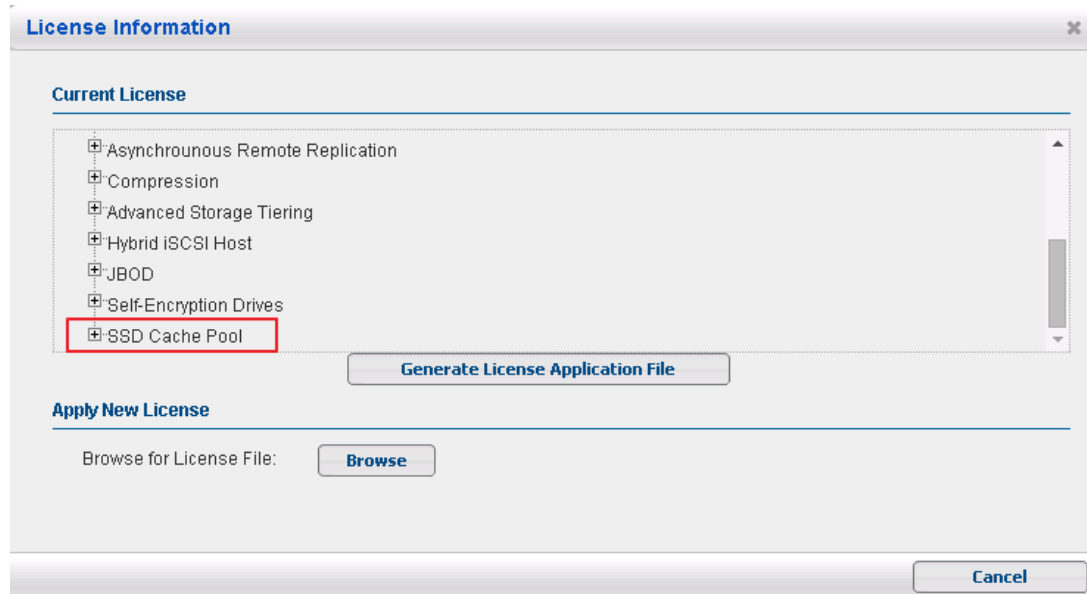
SSD Cache Requirements

1. Firmware and FlashDisk Global Manager Requirements

FlashDisk FX/VX Family	Version
Firmware	512F12 or later
FlashDisk Global Manager	3.0.h.14 or later

2. SSD Cache License

SSD Cache is a licensed feature.



3. Controller Memory Cache Capacity V.S. Maximum SSD Cache Pool Capacity

Once SSD Cache has been enabled, the controller memory cache will use a certain percentage of space to store the hotness record, and the capacity of the hotness record on memory cache will determine the maximum SSD pool size that can be supported. If a user selects the entry combination (2GB per controller), the maximum SSD Cache pool size supported is up to 150GB for the single controller model and 300GB for the redundant model.

DRAM	Max SSD Cache Pool size (per RAID Controller)
2GB	150GB
4GB	400GB
8GB	800GB
16GB	1600GB

Compared with SSD, controller memory cache is more economical. In addition, write cache can also be stored in the controller memory cache. Therefore, we recommend users upgrade their controller memory cache to 16GB per controller and purchase suitable SSDs for the cache pool (according to needs and budget) to gain maximum overall performance benefits.

4. Resetting Controller(s) to Enable the Cache Pool

The final step to enable the SSD Cache function involves resetting the controller(s). By default, the controller memory cache does not allocate any space to store the hotness record. Therefore, the controllers need to be reset and initialized to allocate appropriate space in controller memory cache to store the hotness record. After the initial controller reset and SSD Cache function activation, its management is easy. There's no need to reset or restart the system when adding or removing SSDs to and from the SSD Cache pool. This can be done through the intuitive GUI via FlashDisk Global Manager or FlashView.

5. SSD requirement

Currently, one controller can support up to 4 SSDs. Only SSD's supplied and qualified by Winchester Systems may be utilized in the SSD Read Cache Pool.

Conclusions

Winchester Systems FlashDisk SSD Cache is an intelligent solution that dramatically improves read performance, especially for read-intensive applications, greatly reduces latency, and supports a large capacity cache pool. It is simple to set up, manage and maintain using Winchester's intuitive GUI's. It is highly recommended for use with a system application workload that involves high volume read behaviors and small volume intensely repetitive read requests.

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