KIOXIA

Technical Brief

KIOXIA Software-Enabled Flash™ Technology:

Flash Storage Devices Can Now Manage 'Uncommon' Workloads

Software-defined is the driving force in the rapid evolution of hyperscale data center applications. It enables developers to adapt quickly and efficiently to constant changes in application requirements and hardware. Software-defined storage falls into this category with the advent of Software-Enabled Flash technology – a new technology that provides hyperscale data center developers with tools and capabilities to unlock the full potential of flash memory.

Software-Enabled Flash technology utilizes an open source software-defined application programming interface (API) that enables developers to access and control the supported storage devices with unique and uncommon capabilities. The technology provides a new approach to flash media without having to follow any legacy hard drive protocols that may exist. Use cases and application workloads can also be modified quickly through the Software-Enabled Flash API.

One powerful benefit of Software-Enabled Flash technology is the ability to do on-demand application customization. This enables Software-Enabled Flash devices to be customized, modified or repurposed to address changing demands and workloads whenever needed. For hyperscale data centers that utilize many different storage devices with varying performance profiles and protocols, the ability to customize hardware rapidly is very important.

A challenge that many data centers often face involves hardware changes that can have a negative impact on total cost of ownership (TCO). For example, when managing an inventory of flash memory generational transitions from SLC, MLC, TLC and QLC[1], the task can be challenging. Software-Enabled Flash technology enables hyperscale data center developers to improve flash storage device lifecycles by repurposing them and modifying them quickly as use-cases and workloads change.

In a hyperscale data center, many different applications run simultaneously and the requirements of these applications will vary over time. Workloads will start and stop, and increase or decrease in activity. These applications can also have many differing storage requirements with different combinations of workloads that use a variety of hardware. To enable this wide range of available storage to meet current, specific and future needs, hyperscale storage developers may need to deploy varied and more efficient storage hardware.

Flash to the Future

Software-Enabled Flash technology fundamentally redefines the relationship between hyperscale data center applications and solid-state storage media. It consists of purpose-built, media-centric flash hardware (Figure 1) that enables storage developers to modify flash storage device capabilities through a software-defined approach.

For example, some devices may require high-performance random access, while others may store data and operate on log-based data files. There may be devices that implement their own storage layers for specific applications, but those needs will change over time.

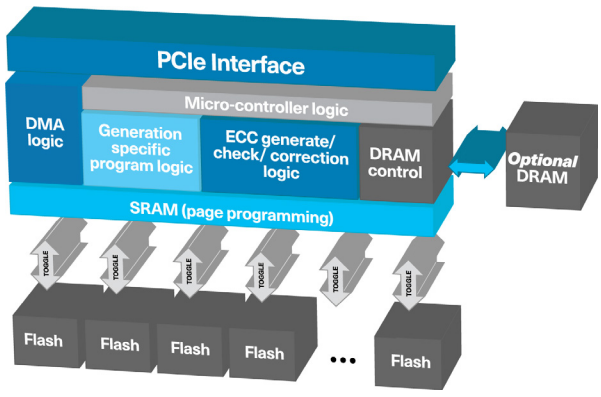

Figure 1: Software-Enabled Flash technology consists of purpose-built, media-centric flash hardware

Software-Enabled Flash technology enables hyperscale data centers to quickly manage the requirements of multiple flash storage use-cases and workloads through an open source, software-defined, multi-protocol API (Figure 2). It also provides the capabilities to easily transition to the latest flash memory technology, including from TLC to QLC, as flash storage devices can require massive amounts of application rework for a transition. By unlocking new levels of flash memory control, Software-Enabled Flash technology enables a fast transition to newer and more cost-effective usages across commonly-used devices.

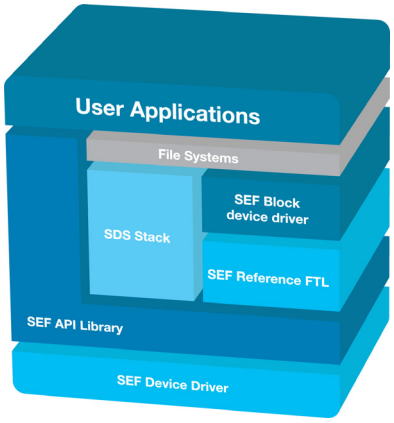

Figure 2: Software-Enabled Flash technology API

The Benefits of Repurposing Storage Devices

Software-Enabled Flash technology enables storage devices to be repurposed with unique capabilities versus forecasting the quantity of different device types that may be required to run future applications. The task of predicting, pre-purchasing and stockpiling the variety of potentially required future hardware is a very difficult one. In these instances, the benefits of Software-Enabled Flash technology can be seen over time as purchases of different types of flash storage devices can be greatly reduced in favor of repurposing them as single type flexible/adaptable flash devices with new capabilities driven by software. The domino effect is that the total number of different part numbers associated with new flash storage device purchases will decline and the inventory pool will be simplified.

A significant cost benefit of repurposing storage devices relates to SKU reduction. Software-Enabled Flash technology enables data center developers to optimize the flash memory of their Software-Enabled Flash storage devices for specific tasks regardless of the flash memory generation. These devices can be tuned specifically for read operations, write operations, access latency or combinations of the three.

The hyperscale data center storage ecosystem has diversified from a simple, HDD-based block interface into a full spectrum of interface options that can include Zoned Namespaces (ZNS), Key-Value (KV) and others. From low-level flash die control to abstract object-based interfaces, flash devices can be tuned to the needs of each application through Software-Enabled Flash technology. As it relates to servers however, they cannot be easily repurposed, and managing single-purpose flash storage devices in multiple server configurations can be expensive and can lead to SKU sprawl and capacity planning nightmares. In these circumstances, varying interface options and server inflexibilities often require complicated and error-prone inventory management. Software-Enabled flash technology and its benefits can assist hyperscale data centers in reducing TCO, minimizing SKUs and simplifying these tasks.

Summary

Software-Enabled Flash technology can help consolidate hardware requirements in the ever-expanding hyperscale data center storage area. Software-Enabled Flash devices can provide time-to-market advantages and potential TCO savings through application control methods that address total storage capacity as application needs grow. Under application control, a single Software-Enabled Flash device can be modified quickly to address volatile use-case and workload requirements and can operate in many different storage scenarios, enabling data centers to reduce TCO and simplify management tasks. Software-Enabled Flash technology future-proofs commonly used storage devices for current and future generations of flash memory while unlocking their untapped potential.

The technology is developed by KIOXIA Corporation as an open source project that aligns the capabilities of flash memory with the specific requirements of hyperscale environments. The project includes the KIOXIA Software-Enabled Flash technology home page with white papers, presentations and demonstrations, available at https://softwareenabledflash.com, as well as the open source API definition and specification document downloadable from the KIOXIA repositories on the GitHub® site.

Notes:
[1] Flash memory SSD generations include Single-Level Cell (SLC) at one bit per cell - Multi-Level Cell (MLC) at two-bits per cell - Triple Level Cell (TLC) at three-bits per cell - and Quad-Level Cell (QLC) at four bits per cell.