DRAMLESS DOESN'T ALWAYS MEAN LOW BUDGET

As Hyperstone explain, there are other reasons than cost to design an SSD or USB drive without DRAM.

Flash memory controllers are designed either with or without an interface to external DRAM (Dynamic Random Access Memory). Once they are deployed in their application like SSDs and other flash memory devices like e.g. USB drives, devices with DRAM usually provide higher performance.

This is usually mostly the random performance. These performance benefits are a common topic in online communities who are into benchmarking and demand best in class performance. This has led to an overarching misconception that SSDs without DRAM are a low budget solution, since lower cost is obviously one reason to not use DRAM in a storage system. This fits the simple argument 'pay more get more, pay less, get less'. In the consumer market, DRAMless solutions are accepted as the inferior product, but what many people don't know is that this isn't always the case.

SSDs without DRAM may be the inferior option in consumer grade products. However, DRAMless means something very different in the industrial sector where companies require a much higher level of reliability. Also, it should be noted that external DRAM may be cheaper than for instance SRAM that is integrated into the controller itself. On-chip SRAM is costly but has certain advantages compared to off-chip DRAM. At Hyperstone, we are often asked why our controllers are DRAMless.

This is in fact a decision that has been made to achieve a higher level of reliability. Reliability in a DRAMless flash memory controller is boosted through several aspects, one being as simple as one less component that can fail or introduce errors and one less component that can cause issues in the long run. Controller technology is complex and the more we can achieve with less is a feat in itself.

DRAM in the event of a power failure

To understand why DRAM is not beneficial for reliability, we have to understand what function it has. Adding DRAM to a flash memory controller boosts the overall performance. However, to do so, it stores parts of the mapping table, in which the flash memory controller keeps the information on which data is stored in which location, in the DRAM. In the event of a power failure, everything stored on the DRAM at that point in time will result in valuable mapping data being lost.

Flash memory controllers with DRAM are by design more vulnerable. Unlike a NAND flash memory cell, DRAM does not continue to store data once the power has been disconnected. In industrial settings superb power fail management is crucial to ensure valuable networking and automation data is not compromised. Since power failures are by nature unexpected, they can occur during an array of procedures such as writing, reading, erasing, mapping updates and background firmware operations.

The goal of robust power fail management is to avoid corrupted data and failing devices in situations of unexpected power loss, excessive voltage supply variances or hot unplugging. Hyperstone's flash memory controllers without DRAM store the mapping table exclusively

on the flash memory, which does not lose its information when powered off. Therefore it's impossible to corrupt the mapping table in the event of a power failure.

It is possible to achieve stronger power fail robustness in SSDs with flash memory controllers with DRAM through the use of additional capacitors which extend the time for the controller to write the data to the flash memory until it runs out of power. This mitigates the issue somehow, yet not completely. Ultimately, it's a trade-off where one must juggle between reliability and performance demands to achieve the ideal solution.

Hyperstone flash memory controllers utilise several algorithms to protect data in the event of a power failure. By removing DRAM from the equation, Hyperstone controllers ensure a system has a significantly higher chance of maintaining its data's integrity in the event of a power failure. It is invaluable to understand these processes when designing a storage system, especially when it comes to discussing options with your card manufacturer or sourcing flash memory controllers directly.

How does DRAM impact power consumption?

DRAM requires power to boost performance in SSDs and other storage devices. In the consumer market, performance is the top priority which guides design decisions in favour of flash controllers with DRAM. For SSDs and other storage devices running in the industrial sector, low power consumption and above all reliability is integral in achieving a more sustainable, profitable supply chain. This is why DRAMless flash memory controllers are more fitted to serving the industrial sector.

Whether a flash memory controller should have DRAM depends heavily on what industry you're designing for or buying in. For consumer applications, added DRAM in the flash memory controller boosts performance, efficiently caches data and can ultimately improve a product's lifespan. The industrial sector has other requirements. While performance is important, qualifying a product is expensive and lowering the bill of materials for any given product is key in the design process. A DRAMless flash memory controller lowers the risk of issues down the road and is essential in designing a NAND flash-based storage solution where reliability and low power are a must.