High Performance Storage for Mainframes Returns in a Flash


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Data storage devices made from DRAM, flash, or other memory technologies are collectively called Solid State Disks (SSDs), since they have no moving components. The first commercially successful SSD was delivered to the mainframe market in 1978 and cost $8,800 per megabyte. Using today's storage pricing metric, that equates to $8.8 million per gigabyte!

Those first SSDs were channel-attached storage devices based on volatile DRAM chips that lost all their contents when electrical power was out. Soon after their introduction, SSDs addressed the DRAM volatility issue by offering battery and hard disk backup options, and eventually added fault-tolerant designs that protected data from all types of failures. These features increased availability but added to the already perceived high price.

SSDs eliminated the variable length seek and rotational times for disks that cause unpredictable response times. There are no cache misses or back-end data transfers on SSDs. SSDs quickly became a successful mainframe solution for I/O-intensive applications such as paging, swapping, catalogues, queues, indices, and directories. The first mainframe SSD era essentially ended in 1985 when an optional virtual memory feature called Expanded Storage arrived for S/370 processors. No one expected it would take nearly 25 years for SSDs to successfully reappear on mainframes.

Flash Memory Gears Up for the Data Center

Market growth for the early SSD DRAM products was ultimately limited by the relatively high costs compared to disk storage. Flash memory, which was invented in 1984, has fueled the recent revival of numerous SSD solutions supporting connectivity from PCs to mainframes. The name "flash" was supposedly suggested because the erasure process of the memory contents was reminiscent of the flash of a camera.

There are two types of flash cells, Single-Level Cells (SLCs) and Multi-Level Cells (MLCs). SLCs are more reliable and currently about four times more expensive than MLCs, but they support a higher number of erase/write cycles. An SLC operates at about 100,000 erase/write cycles per cell whereas an MLC can support 10,000 cycles per cell. The limitation on writes for flash memory is commonly referred to as "the write cliff." Erase/write operations require more electrical current, thus generating heat stress and causing the flash cells to fatigue. Flash cell wear issues can be managed in several ways and every flash storage vendor must address the issue. Be sure to ask your vendor how they address this.

SSD Considerations

Some mainframe vendors offer flash in a standalone Flash SSD for direct attachment. Others offer an SSD that fits directly as a module into an existing disk array. In either case, it looks like any other disk image to the operating system, except it's much faster.

SSD complements Hard Disk Drives (HDD) storage and offers numerous benefits, including:

- Consistent application performance with significantly faster I/O response times
- Higher channel utilization and data transfer rate
- Eliminates "short-stroking" HDDs, which waste disk capacity and energy
- Lower footprint, power, and cooling
- No moving parts improve reliability over rotating disk drives
- Flash memory devices are portable
- Reduced costs per IOPS and per Watt compared to HDD.

The price per gigabyte for flash memory is falling faster than disk drive pricing. Today's Flash SSDs normally range from $50 to $100 per gigabyte, DRAM is more than $500 per gigabyte, and disk pricing ranges from $1 to $15 per gigabyte, depending on features and configuration.

There's a more meaningful way to price SSDs than using cost per gigabyte. While the capacity-focused HDD industry has always used this as its standard measure to address the high-capacity market, SSD addresses the high-performance market and pricing comparisons using Input/Output Operations Per Second per dollar (IOPs/$) for its standard metric. Don't measure a performance device with a capacity metric or a capacity device with a performance metric, as you will likely reach a wrong conclusion.

Summary

Flash-based SSDs are revitalizing the entire high-performance storage spectrum. Flash can withstand significant pressure, temperature variations, and even water submersion. The steady reduction of flash memory prices will continue to increase the size and appeal of the SSD market. For the first time in nearly 30 years, mainframe storage is again poised to benefit from a high-performance storage solution—only this time it will be economically justifiable. Z

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