IBM Systems

Technology and engineering to power the future of business

IBM FlashSystem Family

IBM

Maturity and innovation in one family

When your business must have the highest levels of data storage performance, cost-efficiency, reliability and comprehensive virtualization features, you turn to IBM® FlashSystem®, a market-leading family of all-flash storage arrays engineered to address the most demanding enterprise storage requirements.

The family currently includes IBM FlashSystem 900, the workhorse base model designed to provide extreme performance, low latency and data protection for business-critical application acceleration. IBM FlashSystem V9000 adds the advanced storage services and virtualization capabilities of IBM Spectrum Virtualize™ to create a complete storage solution for all active data sets. The new IBM FlashSystem A9000 is based on IBM Spectrum Accelerate™ and uses an innovative, highly parallel architecture that eliminates most traditional storage management tasks and costs. Finally, IBM FlashSystem A9000R offers all the advantages of IBM FlashSystem A9000 in a rack configuration for extreme performance and capacity scalability that can meet nearly any cloud environment or big-data analytics storage requirement.

Though each IBM FlashSystem platform is intended to solve specific enterprise data storage challenges, they all share many architecture and technology elements. All the family members leverage the suite of innovations and engineering solutions known as IBM FlashCore™ technology. At the architecture level, a key focus of IBM FlashCore technology is a commitment to a hardware-based data path that results in extremely low storage response latency. While IBM teams from around the globe participate in IBM FlashSystem research and development, the majority of engineering done on all models is still accomplished by the original engineering teams and some individuals who have participated in the evolution of these market-leading enterprise storage platforms for decades.

A core of engineering advantages

IBM FlashCore technology is the DNA of the IBM FlashSystem family. It refers to the IBM innovations that enable IBM FlashSystem storage to deliver extreme performance, ultra-low latency, enterprise-grade reliability and a wide range of operational and cost efficiencies. These technologies and innovations are realized in the IBM FlashSystem hardware-accelerated architecture, IBM MicroLatency® modules and many other advanced flash management features and capabilities. IBM FlashCore technology truly defines IBM FlashSystem and differentiates it from competing all-flash appliances and hybrid storage architectures. To make IBM FlashSystem one of the most powerful and efficient storage arrays available, IBM simply continued along the existing engineering trajectory. While competitors are fixing bugs in the first generations of their solutions, IBM engineers are adding cutting-edge features to a mature flash storage platform with years of successful deployments in the most mission-critical environments.

Several factors differentiate IBM FlashCore technology from other flash storage competitors, beginning with its engineering focus. Unlike flash platforms adapted from disk storage architectures, IBM FlashCore technology is purpose-engineered from the chip to the chassis to optimize flash storage performance. For example, most flash storage solutions rely heavily on software when processing data, but the more software a solution uses directly in the data path, the slower the storage response times will be. The data path and RAID controllers in IBM FlashSystem storage arrays, by contrast, are hardware-oriented and thus significantly faster.

Fundamental to this technology are many hardware-accelerated input/output (I/O) features—redundant backplanes, non-blocking crossbars, advanced switch fabrics, hardware-based encryption/decryption and largely hardware-based RAID controllers—designed to deliver very high performance with the data protection essential to a modern enterprise-class storage device. IBM FlashCore technology also includes advanced flash management features such as IBM Variable Stripe RAID™ technology, IBM-engineered error correction codes, overprovisioning capabilities, ultra-fast write buffers and hardware-based data offloads. Proprietary flash media wear leveling (spreading data evenly among flash cells to increase flash life) and garbage collection (reclaiming flash capacity by aggregating valid data in the flash chips) techniques help ensure that IBM FlashSystem data integrity is preserved, write endurance meets enterprise requirements and performance is maintained while leveraging the cost and density benefits of multi-level cell (MLC) flash as the storage medium.

To further accelerate performance, IBM FlashCore-based arrays offload storage management tasks to a special, dedicated CPU. This means that the main processors in the data path are exclusively used to read and write data. Giving array management chores a processor of their own increases reliability as well as system performance by enabling administrators to perform code updates and other maintenance procedures without taking the array offline.

Though MLC flash has lower endurance and less reliability than other flash chip types, the way that IBM incorporated MLC through the implementation of various IBM FlashCore technologies has actually resulted in greater reliability and endurance of IBM FlashSystem storage. In order to facilitate flash management functions such as wear leveling and garbage collection, every flash storage product designates some amount of its otherwise usable flash capacity to support these management functions. This "overprovisioning" adds cost to the overall product because customers pay for storage capacity that cannot be used to store their data. This drives one of the classic flash storage engineering trade-offs between controlling costs and enabling vital management functions that deliver higher performance and reliability. Every enterprise flash storage vendor settles on the ratio of "raw" to usable capacity that best meets their objectives. Thanks to the deep integration of MLC by IBM FlashCore technology, the IBM FlashSystem ratio of overprovisioning has gained added flexibility because flash media costs are not quite the severe constraint they once were. IBM engineers have used this added flexibility to increase the endurance and reliability of IBM FlashSystem storage, while still decreasing cost.

IBM FlashCore-based arrays deliver high efficiency too, thanks to the innovative architecture that enables the use of denser-capacity MLC flash chips. This allows IBM to offer higher storage capacity per rack unit, leading to less consumption of floor space. To increase storage density and efficiency even further, IBM FlashCore technology includes leading-edge data reduction technologies. Based on dozens of patents, IBM data reduction can deliver flash for less than the cost of a disk array.[1] And because flash inherently uses less electricity than systems with moving parts, solutions based on IBM FlashCore technology are designed to consume less power than disk-based storage systems.

Finally, as part of our IBM FlashCore technology, IBM uses its own error-correction code (ECC) "hard-decision" algorithm to deliver very high correction strength with lower processing overhead compared to "soft-decision" algorithms. Soft-decision ECC logic is very complex and thus adds significant latency and significant controller cost to systems that employ it.

Hard-decision ECC schemes have traditionally been viewed as less robust for a given level of capacity overhead. IBM research efforts, however, have resulted in a very resilient hard-decision ECC scheme that allows for much better performance with less processing overhead and latency. The overall result is that IBM can incorporate MLC flash and still use its own error-correction solutions to drive up performance, reliability and throughput while driving down complexity and cost.

The engineering in IBM FlashCore technology is not only powerful but flexible as well. This gives IBM the freedom to equip current and future IBM FlashSystem solutions with engineering innovations that leverage the latest flash chip technologies, as they emerge, creating extremely attractive density and cost benefits with no compromise in system performance or reliability. As a result, IBM continues to deliver IBM FlashSystem products that are even more efficient and cost-competitive than ever before.

The IBM FlashSystem family members

Building on decades of storage leadership, IBM offers a comprehensive portfolio of flash-optimized storage solutions that can propel organizations into the future of IT and thus of business itself. These proven, easily integrated flash storage platforms accelerate critical applications for faster decision making, come with enterprise-grade reliability, and deliver new cost-efficiencies across the entire business environment for a faster return on investment. IBM flash storage solutions can provide enterprises with the storage performance you need to compete, innovate and grow.

IBM FlashSystem 900

IBM FlashSystem 900

IBM FlashSystem 900 is designed to address application acceleration requirements in the most challenging, mission-critical environments. Key features include:

- IBM FlashCore technology, which is designed to deliver consistent high performance and lower storage costs
- IBM-enhanced MLC flash for higher storage density and improved endurance
- ENERGY STAR-certified efficiency
- Improved availability with Variable Stripe RAID, redundant and hot-swappable components, and concurrent code load

IBM FlashSystem 900 is composed of up to 12 massively parallel MicroLatency modules that provide extremely high storage density with ultra-low latency in the 100 microsecond range.

IBM FlashSystem 900 can scale usable capacity from as low as 2 TB to as much as 57 TB in a single system. MicroLatency modules also support an off-load AES-256 encryption engine, high-speed internal interfaces and full hot-swap and storage capacity scale-out capabilities, enabling enterprises to achieve lower cost per capacity with the same enterprise reliability.

IBM FlashSystem 900 uses enterprise-class, two-dimensional flash RAID technology, supporting both Variable Stripe RAID at the MicroLatency module level, plus system-level RAID 5 as well. Variable Stripe RAID maintains system performance and capacity in the event of partial or full flash chip failures, helping reduce downtime and forestall system repairs. System-wide RAID 5 also helps prevent data loss and improves availability.

IBM FlashSystem V9000

IBM FlashSystem V9000

IBM FlashSystem V9000 offers the advantages of software-defined storage at the speed of flash memory. This all-flash storage array combines the high performance, ultra-low latency, superior efficiency and extreme reliability of IBM FlashCore technology with a rich set of virtualization and storage features, including IBM Real-time Compression™, dynamic tiering, thin provisioning, data copy services and high-availability configurations.

IBM FlashSystem V9000 can function as a feature-rich, software-defined storage layer that virtualizes all managed storage. In this capacity, it acts as the virtualization layer between the host and other external storage systems, providing flexibility and extending functionality to the virtualized external storage capacity. Up to 32 PB of external storage can be managed by a single IBM FlashSystem V9000 array and because the storage is virtualized, volumes can be nondisruptively moved between external and internal storage capacity. This functionality enables very agile integration into existing storage environments with seamless data migration between IBM FlashSystem V9000 and legacy storage systems.

IBM FlashSystem A9000

IBM FlashSystem A9000

The high-performance, self-tuning, flash-optimized, highly parallel storage architecture of IBM FlashSystem A9000 provides the highest storage performance available while eliminating most traditional storage management tasks and costs. Integrated data reduction with inline data deduplication, compression and thin provisioning optimize storage economics and efficiency to help reduce both acquisition costs and total cost of ownership. Five-nines reliability combined with enterprise-grade encryption and space-efficient snapshots support more granular data protection without increased cost. IBM FlashSystem A9000 and IBM FlashSystem A9000R are built using IBM Spectrum Accelerate software-defined storage technology. In order to achieve all the benefits inherent in grid storage architectures, IBM FlashSystem A9000 utilizes a modular configuration of three grid controllers plus one flash storage enclosure all tightly integrated behind an 8U bezel.

IBM FlashSystem A9000 introduces a new graphical user interface (GUI) with IBM Hyper-Scale Manager designed with cloud-optimized quality of service features that enable agile scale-out and orchestration of multi-tenant cloud storage solutions. Additional IBM FlashSystem A9000 systems can be added and managed from a single IBM Hyper-Scale interface. And thanks to its mature IBM Spectrum Accelerate foundation, the system also integrates well with VMware and other leading application virtualization technologies.

IBM FlashSystem A9000R

IBM FlashSystem A9000R

IBM FlashSystem A9000R is a rack version of the basic IBM FlashSystem A9000 technology that uses grid elements of two grid controllers to every flash storage enclosure, with a minimum four-by-two configuration to achieve grid storage architecture benefits and a maximum twelve-by-six configuration within a single rack. The system comes as a pre-configured, fully-integrated, rack-based platform with InfiniBand switches to enable ultra-low latency scale-out and a "white glove" support model.

With its grid storage architecture that enables multiple-copy, multi-site data protection and high availability while providing easy scale-out capabilities, IBM FlashSystem A9000R is an excellent platform for rapidly growing cloud storage and desktop virtualization environments. Adding IBM Spectrum Scale™ creates a massively parallel, geo-distributed, unstructured data storage solution that could simultaneously support world-class big-data analytics. In this configuration, IBM FlashSystem A9000R gives managed IT services providers and organizations in healthcare, financial services, transportation, telecommunications, e-commerce, rich media, high-performance computing, government and utilities enterprises the storage performance, cost-effectiveness, and simple scalability that make this technology *simply fast*.

Enable innovation

The IBM FlashSystem family provides a full range of comprehensive enterprise storage solutions, but the greatest value of this technology is revealed when you step off the data center floor and into the CIO's office. Where do you want your business to go? What are the information system challenges that constrain you from getting there? IBM FlashSystem can transform your data storage from a business-limiting factor into a technology engine of innovation. Thanks to mature yet ever-evolving IBM FlashCore technology, highly advanced software-defined storage, cost-efficient MLC flash, grid architectures and a host of other industry-leading engineering features, IBM FlashSystem provides the storage resources to drive your business confidently into the future. Most importantly, imagine all the ways you can leverage these powerful new tools to create competitive advantage, make better business decisions, lower operating costs, detect and prevent fraud in real time, and innovate.

For more information

To learn more about IBM FlashSystem storage, please contact your IBM representative or IBM Business Partner, or visit the following website: **ibm.com**/systems/storage/flash

Additionally, IBM Global Financing provides numerous payment options to help you acquire the technology you need to grow your business. We provide full lifecycle management of IT products and services, from acquisition to disposition. For more information, visit: **ibm.com**/financing

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[1] IBM lab measurements