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## Highlights

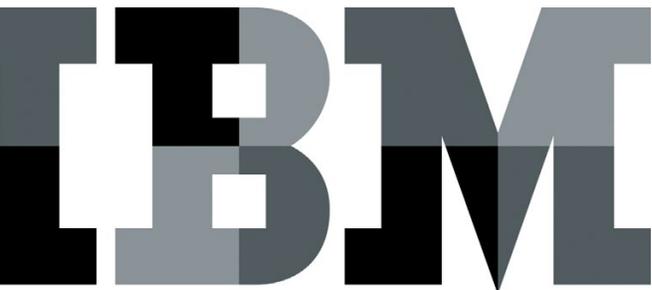
- Optimize data economics with a powerful combination of flash and storage virtualization
  - Deploy the right all-flash solution to solve your unique business and IT requirements
  - Revitalize your existing storage with a combination of IBM® Spectrum Virtualize™ and IBM Storwize® or IBM FlashSystem®
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# Revitalize your business opportunities

*IBM all-flash solutions built with IBM Spectrum Virtualize can revitalize your data center*

In a recent market survey conducted by analyst firm Enterprise Strategy Group (ESG), storage virtualization ranked as the number-one technology for improving the efficiency (reduced capital and/or operating costs) of primary data storage infrastructure.<sup>1</sup> Storage virtualization is rapidly becoming a foundational solution component of enterprise data centers worldwide. At the same time, flash-based storage has also experienced explosive adoption rates. From the perspective of enterprise storage innovation and adoption, these two technologies certainly rank near the top of the list in the 21<sup>st</sup> century.

Given their success and all the benefits they bring individually—lower costs, higher performance and much easier management, among many others—integrating flash and virtualization in one storage platform would seem to be an unbeatable combination. In fact, the engineering challenges are significant. For most technology providers, storage virtualization is still new and unproven. Many vendors have only recently incorporated basic storage services and management features into their flash-based products. For them, adding heterogeneous external storage virtualization is likely still years away. But not for IBM.



IBM Spectrum Virtualize, a member of the IBM Spectrum Storage™ family of software-defined storage solutions, “...is one of the industry’s strongest virtualization platforms,” according to IT analyst firm Taneja Group. “It has been solidly vetted with more than a decade in production and tens of thousands of installations that have achieved over five-nines (99.999 percent) of documented uptime at customer sites.”<sup>2</sup> IBM FlashSystem and the IBM Storwize family also bring significant maturity and accomplishments. Within these offerings, enterprises of all types—with all sizes of application workloads, business uses and budget constraints—can find leading all-flash storage solutions available for active data sets.

### IBM all-flash solutions built with IBM Spectrum Virtualize

The central purpose of the all-flash solutions built with IBM Spectrum Virtualize technology is to provide choice. In today’s rapidly evolving business and IT environments, no single all-flash storage solution can address every application workload and user requirement. Some business-critical use cases demand extreme performance and consistent microsecond latency. At the other end of the spectrum, many entry-level and midsized workload environments can greatly benefit from all-flash performance and operational advantages, though economics are also a key consideration. The Storwize all-flash offerings and IBM FlashSystem V9000 provide solutions to each of these use cases, providing industry-leading storage virtualization and data services in the bargain.

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*IBM Spectrum Virtualize “...is one of the industry’s strongest virtualization platforms.”<sup>2</sup>*

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The flash storage component of these systems is supplied by IBM Storwize or IBM FlashSystem platforms. The defining ingredient is each platform member’s reliance on IBM Spectrum Virtualize technologies to provide storage services and virtualization capabilities. The IBM Spectrum Virtualize foundation is custom tailored and deeply integrated to complement and enhance the particular characteristics of each IBM FlashSystem or Storwize-based system, all of which share one code base across all platforms, one set of storage management and virtualization functions, and one customer experience. Currently, the IBM Spectrum Virtualize-based all-flash series consists of three members, two leveraging the economic and ease-of-installation advantages of the IBM Storwize family, and one utilizing the enterprise-grade performance and reliability of IBM FlashSystem.



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IBM Storwize

### Low-cost flash for entry-level and midsized workloads

The V5000 members of the Storwize family are highly flexible, easy to use storage solutions that enable organizations of all types and sizes with midrange application workloads to efficiently and affordably meet the challenges of rapid data growth and limited IT budgets. Next-generation IBM Storwize V5000 is built around a new hardware platform that provides increased performance and affordable, nondisruptive upgrade paths across three second-generation models that deliver a range of performance, scalability and functional capabilities.

IBM Storwize V5030F is the entry-level priced all-flash solution. It leverages the cost advantages of new flash drive options for lower deployment costs and features an enhanced, intuitive user interface; synchronous/asynchronous replication; more than 600 Storwize application program interfaces (APIs); thin provisioning and snapshots; and flash-optimized data compression. Storwize V5030F also provides enterprise-grade system availability and data security, including nondisruptive data migration and remote mirroring using IBM HyperSwap® technology, five-nines availability, data-at-rest encryption and a new distributed RAID technology that can reduce disk rebuild times up to 10 times over current RAID solutions. For organizations that need affordable all-flash storage that provides Fortune 500-level functionality plus storage virtualization capabilities, Storwize V5030F offers an outstanding choice.

### Cost-optimized flash for midsized workloads

IBM Storwize V7000 is the platform within the Storwize family that offers the greatest functionality, performance and reliability. Enterprises looking to implement an all-flash solution with a full range of storage services and virtualization capabilities, yet very affordable initial deployment costs, can meet their needs with Storwize V7000F. It's now even faster, with a new CPU with 10 cores instead of the previous eight, plus a data compression accelerator card that, together, improve performance by up to 45 percent.<sup>3</sup> Storwize V7000F can also leverage the cost advantages provided by the new flash drives to create a solution with very competitive deployment costs coupled with very powerful storage capabilities.



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IBM Storwize full rack configuration

### Enterprise-class performance for business-critical applications

When your move to all-flash storage demands extreme performance and ultra-low latency to drive increased revenue, company growth and competitive advantage, deploy IBM FlashSystem V9000, the lead offering from the family of storage systems from which enterprises around the planet have purchased more all-flash capacity than any other brand.<sup>4</sup> IBM FlashSystem V9000 not only offers all the benefits of IBM Spectrum Virtualize, it leverages IBM FlashCore™ technology's hardware-accelerated architecture, purpose-engineered IBM MicroLatency® modules, IBM Variable Stripe RAID™ data protection, and many other advanced flash management

features and capabilities to provide award-winning performance, system agility and data economics. Enhanced with new control nodes, the performance for all compressed workloads can be up to 30 percent faster, with 20 percent better write bandwidth and 10 percent higher performance for uncompressed workloads.<sup>3</sup> When the performance of your storage directly affects the success of your business, turn to IBM FlashSystem V9000.

## IBM Spectrum Virtualize

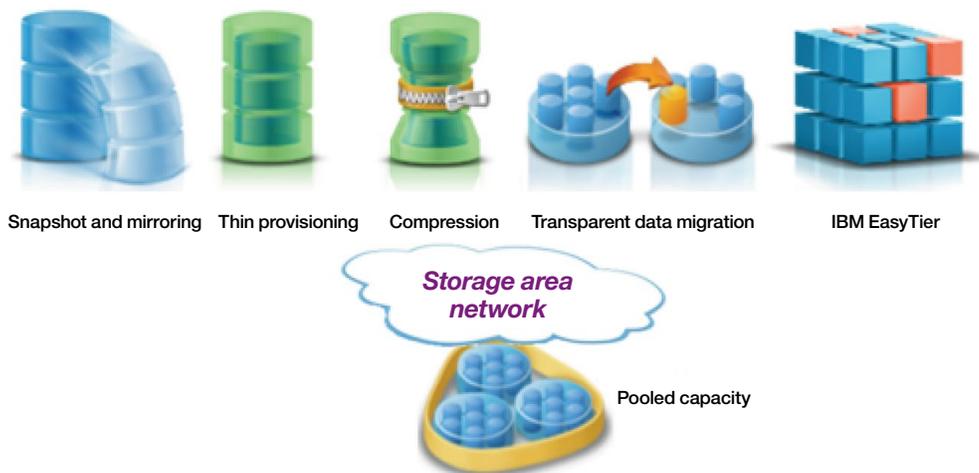
IBM Spectrum Virtualize provides the foundational software-defined storage technologies for each of these all-flash solutions. IBM Spectrum Virtualize is a mature, proven storage virtualization platform that has been improving infrastructure flexibility and data economics for more than a dozen years across more than 172,000 installations. It serves as the block data plane backbone for the IBM Spectrum Storage family of software-defined storage solutions. IBM Spectrum Virtualize provides the capability to virtualize both IBM products and more than 380 different systems from other vendors. It greatly improves storage economics by establishing a single management point for all virtualized storage—and by enabling

better utilization and performance from existing storage hardware through increased ability to move data as needed. IBM Spectrum Virtualize functionality is automatically extended to virtualized systems, enhancing their capabilities and increasing their useful lifespans. IBM Spectrum Virtualize enables you to:

- Enhance data-storage functions, economics and flexibility with sophisticated virtualization
- Leverage a new data engine with accelerated data compression to help improve efficiency
- Store up to five times more active primary data using IBM Real-time Compression™<sup>3</sup>
- Move data among virtualized storage systems without disruptions
- Optimize tiered storage—including flash storage—automatically with IBM Easy Tier®
- Improve network utilization for remote mirroring with innovative replication technology
- Implement multi-site configurations for high availability and data mobility between data centers

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## IBM Spectrum Virtualize



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Some of the many IBM Spectrum Virtualize features and capabilities



IBM FlashSystem V9000

IBM Spectrum Virtualize offers the advantage of deep integration with the IBM Spectrum Storage family of industry-leading software-defined storage solutions. Along with providing a very wide spectrum of storage services, functionality and virtualization capabilities, IBM Spectrum Virtualize technology enables these all-flash solutions to integrate with many hypervisors, open-systems products and VMware APIs, which provides even more storage-side functionality, enhanced performance and coordinated management.

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*IBM Spectrum Virtualize functionality is automatically extended to all virtualized systems, enhancing their capabilities and increasing their useful life spans.*

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## IBM FlashSystem V9000

IBM FlashSystem V9000 is designed for enterprises that need the highest levels of dynamic performance, agile integration and enduring storage economics. IBM FlashSystem V9000 offers the advantages of software-defined storage at the speed of flash. This all-flash storage platform 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 such as dynamic tiering, thin provisioning, data copy services and high-availability configurations. The platform includes powerful data reduction capabilities—such as IBM Real-time Compression—based on more than 70 patents that can deliver flash for less than the cost of conventional enterprise storage.

IBM FlashSystem V9000 accelerates a full range of applications and infrastructures. It can function as a feature-rich, software-defined storage layer that virtualizes and extends the functionality of managed storage. 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 agile integration into existing storage environments with seamless data migration between IBM FlashSystem V9000 and legacy storage systems.

Beyond making fast storage simple, IBM FlashSystem offers many additional benefits:

- *Versatile performance:* Allows the performance, reliability and efficiency benefits of flash to be used for any active data set or workload. Cognitive applications such as cloud, analytics, and mobile and social systems of engagement scale simply and cost-effectively. At the same time, more traditional database and transaction processing workloads benefit from consistent microsecond response times and massive throughput.

- *Enduring economics*: Provides cost benefits in the short term through greater storage density and powerful data reduction capabilities to reduce capacity requirements and system footprint. Additionally, it provides ongoing, long-term benefits through dramatic increases in system operational efficiencies. And it delivers the enduring value of technology that transforms storage from a limiting factor into an engine of business innovation and competitive advantage.
- *Agile integration*: Enables enterprises to tailor storage deployment architectures to specific workloads, including data access that bypasses the storage virtualization layer for low latency, or data access through the feature-rich software-defined storage stack—all managed down to the granularity of individual data volumes.

## Storwize family

Application workloads vary dramatically from one business to the next, and even among various groups or organizations within a single company. Many organizations have data sets and resulting storage requirements that might be described as midsized or even entry-level. Quite often these same organizations labor under limited IT budgets. The Storwize family is designed specifically to meet the unique data storage requirements of business groups or organizations with midsized application workloads and constrained IT budgets but that also need storage with the features and capabilities demanded in the largest, most business-critical environments.

The Storwize family offers enhanced Storwize V7000F and Storwize V5030F systems as all-flash, virtualized, enterprise-class storage systems designed to deliver the high performance needed to derive real-time insights from business data

combined with advanced management functions. These systems exemplify the Storwize focus on enterprise-grade functionality, performance and reliability at very affordable pricing.

### Accelerating affordability

In June 2016, Storwize V5000F and V7000F added a new category of lower-cost solid-state drives (SSDs) to their configuration options. The new flash drives epitomize the evolution in flash storage as well as demonstrate the IBM commitment to the foundational Storwize value proposition—maximizing data economics.

These flash drives use commercial-grade flash with a much lower cost per unit of capacity than the enterprise-class SSDs previously deployed in Storwize solutions. Also, the drives feature much greater density, thanks to a smaller flash die size that enables storage of more data per silicon area, resulting in significantly reduced costs. In fact, the new flash drives can lower Storwize capacity purchase prices by up to half,<sup>5</sup> offering a powerful combination of performance and economic benefits for applications such as media streaming, video on demand, web hosting and data warehousing.

The new flash drives provide 270,000 input/output operations per second (IOPS) of sustained random-read storage system acceleration through a 12 Gbs SAS interface. At two million hours mean time to failure (MTTF), the reliability is about twice that expected from mechanical disk.<sup>6</sup> The new drives are optimized for density and cost, which means that they can tolerate a lower number of write cycles, compared to endurance-optimized single-level cell flash. But these are multi-terabyte drives, and with their state-of-the-industry wear leveling they are still able to accommodate a terabyte or more of writes every day for years.

IBM Spectrum Virtualize technology further accelerates the advantages offered by these new drives:

- The write caching inherent in IBM Spectrum Virtualize systems lowers write volumes and improves both performance and flash endurance by combining data into full-block writes, which can significantly increase write efficiency.
- Patented, flash-optimized IBM Real-time Compression technology features a number of characteristics designed to maximize data reduction gains while optimizing for performance, including hardware off-load of all compression/decompression operations, fixed-sized writes and the use of innovative temporal locality techniques. IBM Real-time Compression does not require post-process compression, thus eliminating the need to write more data to flash which would increase flash chip wear and make capacity utilization decisions problematic.
- Distributed RAID technology provides RAID array rebuild times up to 10 times faster than current solutions. It reduces the performance impacts on system input/output (I/O) during rebuilds and, in fact, improves system performance by striping data across all available drives.

With the advantages provided by IBM Spectrum Virtualize technologies, the new flash drives can substantially cut the solution cost of any storage use case where performance counts, writes are not frequent, and data economics provide a competitive advantage.

## **Conclusion**

No single all-flash storage solution can address every application workload and business use case. And very few organizations are able to retire large portions of their existing storage infrastructure to take advantage of new innovations, even when higher performance and lower costs come in the bargain. IBM all-flash solutions built with IBM Spectrum Virtualize offer the way forward. These IBM storage systems combine multiple all-flash storage options with a proven, powerful virtualization engine that enables organizations with many different workloads or budget constraints to gain the benefits of all-flash performance and economics while actually increasing the value of existing storage systems.

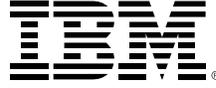
The IBM Storwize family and IBM FlashSystem V9000 bring real, flexible solutions instead of difficult choices. Don't retire outdated storage systems. Revitalize your entire data center with a deeply integrated combination of powerful IBM storage virtualization and dynamic all-flash performance.

## For more information

To learn more about the IBM Storwize family, please contact your IBM representative or IBM Business Partner, or visit: [ibm.com/storwize](http://ibm.com/storwize)

To learn more about IBM FlashSystem V9000, please contact your IBM representative or IBM Business Partner, or visit: [ibm.com/storage/flash/v9000](http://ibm.com/storage/flash/v9000)

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Actual available storage capacity may be reported for both uncompressed and compressed data and will vary and may be less than stated.

<sup>1</sup> “ESG Solution Showcase: Primary Storage Data Reduction Trends,” *Enterprise Strategy Group*, June 2016. <https://www-01.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=TSL03294USEN>

<sup>2</sup> “Technology Brief: Got Mid-size Workloads? Storwize to the Rescue,” *Tenaja Group*, June 2016. <http://www-01.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=TSL03287USEN>

<sup>3</sup> Based on IBM internal lab tests.

<sup>4</sup> Joseph Unsworth and John Monroe, “Market Share Analysis: SSDs and Solid-State Arrays, Worldwide, 2015,” *Gartner*, May 19, 2016. <https://www.gartner.com/doc/3323026/market-share-analysis-ssds-solidstate>

<sup>5</sup> Based on IBM internal lab results and analysis.

<sup>6</sup> Bianca Schroeder and Garth A. Gibson, “Disk failures in the real world: What does an MTTF of 1,000,000 hours mean to you?” *Computer Science Department, Carnegie Mellon University*, February 2007. <http://www.cs.toronto.edu/~bianca/papers/fast07.pdf>



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