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## Highlights

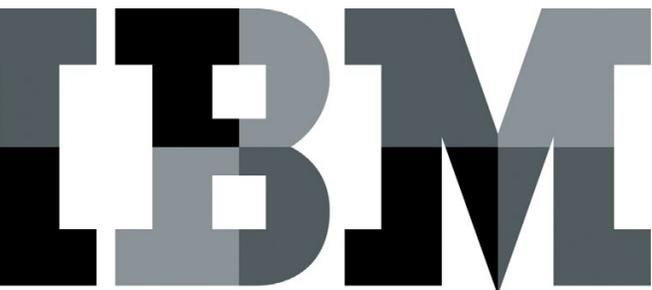
- Accelerate your business with all-flash IBM® FlashSystem® A9000 and IBM FlashSystem A9000R
  - Leverage the efficiency and reliability of IBM FlashCore™ technology for cloud
  - Enable your cloud with secure multi-tenancy and quality-of-service (QoS) capabilities
  - Elevate the value of your cloud with flash-optimized data reduction
  - Innovate for competitive advantage thanks to the broad IBM ecosystem
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# Powering the high-performance cloud

*IBM FlashSystem storage makes deploying high-performance cloud solutions elegantly simple*

According to industry analysts, more than 50 percent of IT spending will be cloud-based by 2018.<sup>1</sup> IBM research confirms that 75 percent of enterprises in the US plan to increase cloud investment, which means they already have made some initial investments in this technology.<sup>2</sup> Skyrocketing demand for cloud services has brought many different types of technology suppliers into the cloud IT services delivery game, ratcheting up competition. To meet demand and ward off competitors, cloud service providers (CSPs) must be able to deploy and scale rapidly without compromising performance or service levels.

On the enterprise data storage front, CSPs must provide reliable storage with consistent performance while reducing operational costs. They also need ease of implementation, integration with existing infrastructure, and freedom to support constant change and rapid growth. A new approach is needed to help CSPs address cloud requirements. Traditional storage infrastructure is inefficient in today's world where the value of each piece of data is changing all the time.





IBM FlashSystem A9000

IBM FlashSystem A9000 and IBM FlashSystem A9000R all-flash storage systems are specifically designed to help build CSP-like capabilities in virtually any business. IBM FlashSystem A9000 is engineered for CSPs as well as enterprises that must extend the capabilities of their cloud infrastructures with high-performance, cost-effective flash storage in an compact modular platform. IBM FlashSystem A9000R is designed for the global enterprise with data-at-scale challenges. The rack-based system enables large organizations to implement cloud-based solutions with quality of service and multi-tenancy features that can easily scale into the petabyte range.

### Challenges with the cloud

Already, the cloud storage market has become highly competitive. Customers are pushing service providers to meet new demands created by virtualization and the exponentially increasing volume of data that needs to be managed—even while they face almost flat IT budgets. Because of these shifts, service

providers are forced to look for new storage solutions and new ways to differentiate their businesses with high-performance offerings. Providing reliable storage with consistent performance while reducing operational costs—not just for one customer, but for all customers—can be a formidable task.

A global study of 500 IT decision makers recently revealed that organizations are increasingly integrating cloud resources with traditional IT to accommodate dynamic needs and specific business priorities. This is hybrid cloud. Today, 64 percent of cloud adopters are using some form of hybrid cloud,<sup>3</sup> and more than 80 percent of enterprise IT organizations are expected to commit to hybrid cloud architectures by 2017.<sup>1</sup> This means that the challenges of cloud storage and the opportunities the cloud offers involve both the pure cloud environments found within CSPs and the ever-evolving hybrid cloud scenarios being developed and adopted by enterprises around the globe. To meet these challenges and take advantage of the opportunities, leading companies are turning to a new class of all-flash storage solutions from IBM.

### IBM FlashSystem accelerates the cloud

CSPs implementing, extending and updating cloud storage solutions can gain many advantages and benefits from deploying IBM FlashSystem solutions. IBM FlashSystem A9000 and IBM FlashSystem A9000R are purpose-engineered to extend IBM FlashSystem leadership to hybrid cloud workloads and big-data analytics at the largest scales. IBM FlashSystem A9000 integrates the extreme performance of IBM FlashCore technology, highly parallel architecture and comprehensive data reduction in one powerful solution. IBM FlashSystem A9000R is a grid-scale, rack-based solution that provides an excellent platform for rapidly growing cloud storage in large, mixed-workload environments.



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IBM FlashSystem A9000R

IBM FlashSystem A9000 and IBM FlashSystem A9000R are both built using IBM Spectrum Accelerate™ software-defined storage technology. IBM Spectrum Accelerate offers a mature set of storage services that have been developed with cloud and virtualized environments in mind. Thanks to the combination of this software foundation with patented IBM hardware architecture, these solutions provide cloud-critical functionality, including:

- IBM FlashCore technology to ensure consistent and predictable microsecond response times
  - Grid architecture that eliminates many traditional storage management tasks and costs
- IBM Hyper-Scale technologies to simplify growth and storage management
  - A flash-optimized data reduction suite to enhance storage economics
  - Secure multi-tenancy and QoS features to prevent “noisy neighbors”

With IBM FlashSystem A9000 and IBM FlashSystem A9000R, enterprises can deploy and manage cloud architectures, lower storage costs, dramatically increase system performance, quickly and easily integrate all-flash storage with existing systems, and offer hybrid cloud solutions with many competitive advantages.

### IBM FlashCore advantages

IBM FlashSystem A9000 and IBM FlashSystem A9000R, like all IBM FlashSystem solutions, leverage IBM FlashCore technology to deliver market-leading storage response times for data-intensive workloads. IBM FlashCore technology includes advanced flash storage management capabilities, a hardware-accelerated data path (because software only slows data down) and custom IBM MicroLatency® modules. Instead of relying on commodity solid-state drives (SSDs), all IBM FlashSystem models utilize the MicroLatency modules to provide exceptional density, ultra-low latency, and extremely high input/output operations per second (IOPS). In fact, IBM FlashSystem A9000R can generate up to two million IOPS in a single rack with full data reduction enabled. The MicroLatency modules also implement a multi-dimensional data protection regime called IBM Variable Stripe RAID™, which gives IBM FlashSystem arrays the ability to survive flash failures down to the sub-chip level without impacting capacity or performance.

### IBM grid architecture

With IBM FlashSystem A9000 and IBM FlashSystem A9000R, IBM FlashCore technology is now deployed for the first time in a grid architecture, which offers many benefits and advantages over conventional storage systems. Even under the variable workloads generated by the cloud, the IBM grid architecture, by its nature, provides predictable high performance. With no inputs from storage administrators and no offline processes, the grid is specifically designed to evenly distribute performance load and data across the architecture; this is a key advantage of deploying a system with a grid architecture. This means that when you use IBM FlashSystem A9000 and IBM FlashSystem A9000R, you don't have to worry about hotspots within the storage media or constantly tune for performance.

### IBM Hyper-Scale technology

Cloud environments must be able to expand across multiple systems for more storage capacity. To support this level of enterprise scalability, IBM FlashSystem A9000 and IBM FlashSystem A9000R implement IBM Hyper-Scale technologies that can manage more than 100 IBM FlashSystem A9000 or IBM FlashSystem A9000R systems from a single pane of glass to enable centralized, consolidated administration of multi-petabyte environments.

IBM Hyper-Scale Manager comes with an innovative management interface introduced with IBM FlashSystem A9000 and IBM FlashSystem A9000R. It is not a typical table-driven interface, but instead presents a new approach to storage management based on the success of the popular IBM XIV® interface and a series of user studies that helped IBM pinpoint key capabilities that simplify storage management. The web-based user interface can be accessed from any device and provides a holistic, visual representation of the storage

environment. With a comprehensive view that allows you to see all related objects and one year of historical data at a glance, you can quickly identify actions required and make changes from one screen.

### Flash-optimized data reduction

IBM FlashSystem A9000 and IBM FlashSystem A9000R come with a flash-optimized data reduction and efficiency suite that maximizes storage economics, including:

- *Pattern removal:* IBM uses a pattern database to quickly look up and remove common, known patterns from incoming input/output (I/O). This is the first step in the data reduction process.
- *Deduplication:* A feature recently added to IBM FlashSystem, the global data deduplication process happens inline and upfront—an improvement over other uses of the technology that use deduplicating background scrubs that threaten system performance.
- *Compression:* The inline compression solution leverages a proprietary algorithm that produces extraordinary results in just one cycle. This is in contrast to other uses that utilize “re-compressions.” If performed well enough the first time, a second compression cycle is not needed and can actually impede performance. Moreover, all IBM FlashSystem grid controllers come with data reduction hardware acceleration cards that speed up compression.
- *Data efficiency functions:* Thin provisioning and space-efficient snapshots further maximize storage capacity. IBM thin provisioning and redirect-on-write snapshots produce better results by breaking data into smaller units and managing them at a more granular level.

These features have been designed together and complement one another to support 250 microsecond response times with full data reduction enabled. This consistent microsecond latency is achieved because the processing of pattern removal, deduplication and compression is distributed across the grid architecture and across all IBM FlashSystem resources. For example, within a fully scaled-out IBM FlashSystem A9000R system, 240 CPU cores process every volume's I/O. IBM designed this data reduction suite to support IBM FlashCore technology speeds by capitalizing on the inherent advantages of grid architecture. In cloud environments, the benefits are even more significant because ultra-low storage latency can offset some of the inherent network latency of cloud solutions, multiplying the competitive advantages to those service providers that deploy IBM FlashSystem A9000 and IBM FlashSystem A9000R.

### **Cloud-scale quality of service**

For service providers wishing to offer differentiated performance options to their customers, increase revenue, eliminate the impact of “noisy neighbors,” and ensure that no service level agreement (SLA) is ever missed, IBM FlashSystem A9000 and IBM FlashSystem A9000R provide the QoS and secure multi-tenancy features required in cloud environments. These IBM FlashSystem platforms include multi-tenancy support that allows CSPs to offer direct-access system administration capabilities to customer administrators while keeping data logically

or even physically separate. Advanced QoS features eliminate “noisy neighbors” by ensuring that tenant service levels are never compromised within complex cloud environments. IBM FlashSystem QoS supports up to 500 performance classes. You can define IOPS and/or bandwidth for each class, plus QoS levels per volume, pool or host.

### **Agile integration**

The cloud computing resource-sharing model uses large pools of virtual servers and storage, requiring tight integration between front-end application hosts and back-end data systems. All too often, organizations deploying server virtualization don't take into account the storage that underlies their virtual IT systems. The resulting challenges quickly become evident in the form of unevenly distributed workloads, performance degradation and compromised reliability.

These issues are elegantly bypassed by the IBM Spectrum Accelerate-based architecture of IBM FlashSystem A9000 and IBM FlashSystem A9000R, as well in the tight integration of these solutions with virtualization offerings. These IBM FlashSystem platforms support numerous hypervisors, including VMware, IBM PowerVM®, Microsoft Hyper-V and Citrix Xen. With their grid-scale design and VMware and Hyper-V interoperability, IBM FlashSystem A9000 and IBM FlashSystem A9000R provide an ideal storage complement to these host-side virtualization platforms.

IBM software-defined storage technologies complement IBM FlashSystem solutions and simplify construction of cloud infrastructures by providing a unified point of deployment for host platforms, including:

- *OpenStack*: IBM is one of the leading contributors to OpenStack Cinder, and OpenStack users can leverage all the advanced features of these IBM FlashSystem models.
- *Representational State Transfer (REST) application programming interface (API)*: Internet-based integration helps organizations customize their cloud solutions with native IBM Spectrum Accelerate-based monitoring and provisioning.
- *IBM Spectrum Control™ base edition*: IBM Spectrum Control is a member of the IBM Spectrum Storage™ family that enables enterprises to enhance and centralize management across their entire infrastructure. The base edition is included in IBM FlashSystem A9000 and IBM FlashSystem A9000R and provides key VMware integration points, including support for VMware web client plug-in, VMware vSphere Storage APIs for Array Integration (VAAI), VMware vSphere API for Storage Awareness (VASA), and more.

### **Ecosystem vision**

For first-time cloud adopters as well as experienced service providers, one advantage offered by IBM FlashSystem A9000 and IBM FlashSystem A9000R is a broad ecosystem vision and the capabilities, products and services that go with it. For an enterprise planning to implement hybrid cloud, IBM offers targeted solutions that all utilize the same foundational software stack based on IBM Spectrum Accelerate. Whether on IBM XIV, on IBM FlashSystem A9000 and IBM FlashSystem A9000R, or as

a part of IBM Spectrum Accelerate deployed on your own hardware or in IBM SoftLayer®, this common software foundation can dramatically simplify cloud-related storage administration and management.

Another benefit of building hybrid cloud solutions using the integrated IBM software stack involves software license portability. IT decision-makers can stop worrying about stranded software licenses; instead, licenses can be reused on the storage solution that makes the most sense in current or future environments. You can apply IBM Spectrum Storage Suite or IBM Spectrum Accelerate licenses to the software cost of IBM FlashSystem A9000 and IBM FlashSystem A9000R, or even to other IBM products such as XIV. This perpetual software license (attached to the customer and not the system) allows you to leverage the benefits of software-defined storage capabilities combined with IBM FlashSystem performance and efficiency. Additionally, it enables more affordable data backup to the cloud, less complex disaster-recovery options, simplified storage ecosystem management and data mobility, and much more.

### **Choose cloud wisely**

IT service providers are rapidly taking advantage of the significant opportunities afforded by cloud and hybrid cloud solutions. By deploying IBM FlashSystem A9000 and IBM FlashSystem A9000R, both CSPs and internal IT groups can deliver flexible, affordable IT services to their customers using elastic, efficient and cost-effective cloud technologies. Choosing the right storage to support cloud computing is fundamental to ensuring success and customer satisfaction.

IBM FlashSystem A9000 and IBM FlashSystem A9000R solutions are designed from the flash chip to the software licensing model to enable successful, high-performance, cost-effective cloud storage solutions. Their combination of IBM FlashCore and IBM Spectrum Accelerate technologies stretches the horizons of what's easily possible for both organizations on a budget and global enterprises with data-at-scale challenges. And the broad ecosystem vision coupled with IBM worldwide design, installation and support services makes deploying first-time cloud solutions or extending highly profitable ones elegantly simple.

It is no wonder that many service providers and Fortune 500 companies already rely on IBM cloud solutions.

As members of the highly successful IBM storage ecosystem, IBM FlashSystem A9000 and IBM FlashSystem A9000R are essential elements for building cloud infrastructures around the world.

### **For more information**

To learn more about IBM FlashSystem A9000, please contact your IBM representative or IBM Business Partner, or visit:

[ibm.com/systems/storage/flash/a9000/](http://ibm.com/systems/storage/flash/a9000/)

To learn more about IBM FlashSystem A9000R, please contact your IBM representative or IBM Business Partner, or visit:

[ibm.com/systems/storage/flash/a9000r/](http://ibm.com/systems/storage/flash/a9000r/)

Experience the simple-to-use user interface of IBM FlashSystem A9000 today! Please visit:

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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>“IDC FutureScape: Worldwide Cloud 2016 Predictions – Mastering the Raw Material of Digital Transformation,” *IDC FutureScape*, November 2015. <https://www.idc.com/getdoc.jsp?containerid=259840>

<sup>2</sup>Susanne Hupfer, “Global Tech Hot Spots: A country-level look at big data & analytics, cloud, mobile and social,” *IBM Center for Applied Insights blog*, November 3, 2014. <https://ibmcai.com/2014/11/03/global-tech-hot-spots-a-country-level-look-at-big-data-analytics-cloud-mobile-and-social/>

<sup>3</sup>“Don’t Get Left Behind - The Business Benefits of Achieving Greater Cloud Adoption,” *an IDC InfoBrief, sponsored by Cisco*, August 2015. <http://www.cisco.com/c/dam/en/us/solutions/collateral/trends/cloud/cisco-bca-infobrief.pdf>



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