IBM Storage for Data & AI
Solution Brief

Accelerating Workloads with IBM Storage Scale & Storage Scale System

Distributed file and object storage for AI, high-performance computing, analytics, and other data-intensive applications

Highlights
Storage Scale software provides a global data platform for distributed file and object storage

A single Storage Scale System 6000 hardware delivers up to 310GB/s throughput and up to 13 millions IOPS

Primary use cases include GPU-accelerated AI, analytics and data lakehouses, and high-performance computing

Also widely used for IT modernization, data backup, and long-term archiving

Organizations today are reassessing their data storage strategies to adapt to a new generation of data-intensive workloads, especially those used for artificial intelligence (AI) and machine learning (ML).

With a mandate from leadership to leverage AI to unlock the value of their organizational data, IT leaders face challenges that include:

- Accessing and analyzing data and workloads scattered across the globe;
- The increasing time needed by AI training and inferencing workloads;
- The cost and scarcity of resources, especially NVIDIA graphic processing units (GPUs).

Addressing these challenges requires specialized software and hardware:

- **IBM Storage Scale** is software-defined file and object storage optimized for unstructured data;
- **IBM Storage Scale System 6000** is a hardware implementation of Storage Scale software that is optimized for the most data-intensive workloads.

Storage Scale
IBM Storage Scale is designed to provide a global data platform that addresses these challenges, with global data abstraction services that provide connectivity from multiple data sources and multiple locations to bring together data from IBM and non-IBM storage environments. It's based on a massively parallel file system and can be deployed on multiple platforms including x86, IBM Power, IBM zSystem mainframes, ARM-based POSIX client, virtual machines, and Kubernetes.

Storage Scale System 6000
Storage Scale System 6000 is a hardware platform that's designed to be the simplest and fastest way for organizations to build a global data platform around their file and object data. It leverages the power of Storage Scale software combined with NVMe flash and hybrid flash/disk technology to deliver high-performance storage for AI, data analytics, and file and object use cases.

Figure 1 – The IBM Storage Scale System 6000 can deliver up to 310GB/s throughput, up to 13M IOPS, and up to 1.8PBe (effective capacity) in a 4U rack.

Storage Scale System 6000 is available in all-flash and hybrid configurations providing:

- Up to 310 gigabytes per second (GB/S) throughput with low latency;
- Up to 13 millions IOPS using NVMeoF;
- Up to 1.8PBe (effective capacity) in a standard 4U rack space.

Storage Scale software is designed to enable the Storage Scale System 6000 to scale linearly, so that throughput increases proportionally as more systems are added to a cluster. For sequential data and workloads requiring access to massive data sets, Storage Scale System supports up to nine SAS hard disk drive expansion enclosures, providing a more cost-effective alternative to flash storage.

Use Cases
Storage Scale and Scale System are used by organizations worldwide across nearly every vertical industry, especially in financial services, universities and research organizations, automotive, computer services, telecom, and government.

The most common use cases include:

- GPU-accelerated AI;
- Analytics and data lakehouses;
- High performance computing;
- IT modernization;
- Archive and data backup.

GPU-Accelerated AI

Today's most demanding workloads are often found in AI and advanced analytics environments, where massive data sets are the norm. Training large generative AI models requires major investments in clusters of compute, storage, and networking hardware and software, not to mention the skills and resources to manage, optimize, and scale the cluster and keep it secure and highly available.

High data throughput is required to support the massive data access demands of AI training processes, driving faster time to results. To unlock the full potential of AI, organizations need a storage architecture that can ensure fast GPUs aren't being starved by slow IO.

This is especially important during AI model training, a process that can take days or months. If the training were to be interrupted by a power outage, hardware failure, or other error, the entire training run would need to be started again from scratch. To safeguard against this, the training process is designed to stop from time to time to save a checkpoint – a snapshot of a model's entire internal state, including its weights, learning rate, and other variables.

Checkpointing provides fault tolerance; if something unfortunate happens, the process can be resumed from a known state. However, it's a synchronous process, so training stops during this phase. And as model sizes increase, so do checkpoint sizes – the checkpoints required for a large language model (LLM) with one trillion parameters can be on the order of 14TB each.

This is where the Storage Scale provides a significant advantage, leveraging its POSIX-style file system optimized for multi-threaded read and write operations across multiple nodes. Storage Scale can be deployed as both primary storage and as a high-performance tier in front of an object tier. By acting as an intermediate caching mechanism between the GPUs and object storage, Storage Scale's active file management (AFM) capability allows the data to be loaded into the GPUs much faster whenever a training job is started or restarted, and model weights can be checkpointed to the file system much more quickly than when checkpointing directly to object storage. With AFM, the checkpointed data can be asynchronously sent to object storage in a way that does not gate progress of the training job.

Scale System 6000 is a certified storage solution for NVIDIA DGX SuperPOD. Storage Scale System 6000 supports the NVIDIA GPUdirect Storage protocol, which enables a direct data path between GPU memory and local or remote storage, such as NVMe or NVMe over Fabric (NVMe-oF). This GPUDirect architecture removes the host server CPU and DRAM from the data path, so the IO path between storage and the GPU is shorter and faster.

To help customers accelerate their AI deployments, IBM and NVIDIA provide a certified reference architecture for the IBM Scale System 6000 with NVIDIA DGX SuperPOD AI infrastructure, including the NVIDIA DGX A100, H100, H200, and the B200 that incorporates NVIDIA's new Blackwell GPUs. NVIDIA and IBM jointly test, plan, and install the system, with the storage backed by IBM global deployment and support services.

Analytics and Data Lakehouses

Today's advanced analytics workloads generate massive volumes of data from diverse sources, necessitating storage solutions that can scale, support complex processing, and provide rapid access to both real-time and historical data. To meet these demands, organizations increasingly rely on data lakes and data lakehouses, each serving distinct but complementary roles.

Data lakes are designed to store raw, unstructured, and semi-structured data in its native format. They act as a central repository where data from various sources can be ingested at scale, without requiring extensive preprocessing. This makes data lakes ideal for exploratory analytics, machine learning, and AI workloads, where data scientists need the freedom to experiment with large datasets without the constraints of predefined schemas. By contrast, data lakehouses, such as IBM watsonx.data, combine the raw data storage capabilities of data lakes with the structured, performance-oriented approach of data warehouses.

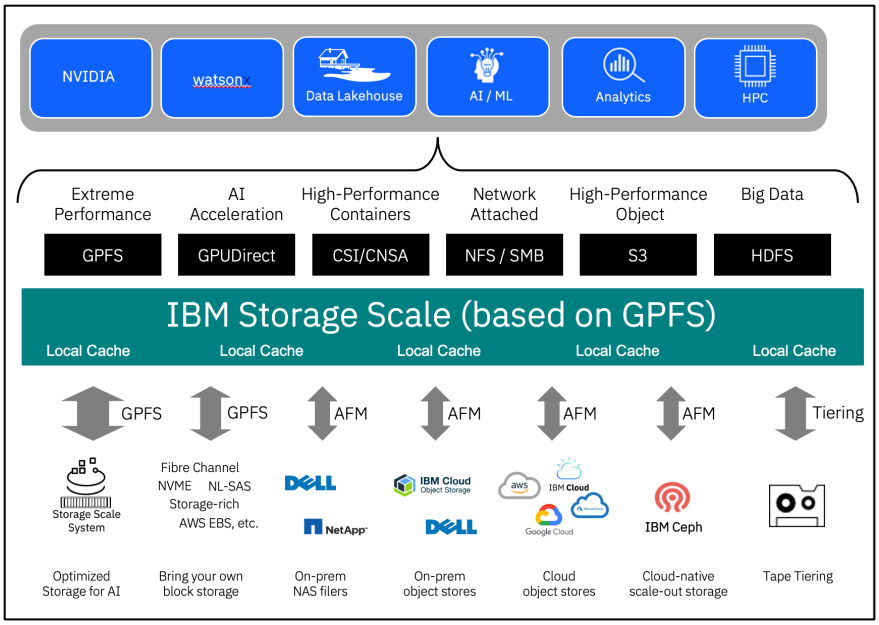

Figure 2 – IBM Storage Scale software provides organizations with a global data platform optimized for today's most demanding unstructured data workloads.

watsonx

IBM watsonx, the IBM AI and data platform for business, has four components:

- watsonx.ai is an interactive studio for building and deploying AI applications;
- watsonx.governance is designed to help organizations direct, manage and monitor their AI activities, including monitoring generative AI and machine learning models for model health, accuracy, drift, and bias;
- watsonx.data provides a data lakehouse that brings together all an organization's business data to scale analytics and AI;
- watsonx Assistant is a conversational platform for building and deploying virtual assistants, chatbots, and other interactive agents across various channels.

Lakehouses are designed to transform, cleanse, and structure data, making it suitable for high-performance analytics and business intelligence applications. They address some of the limitations of data lakes, such as data redundancy and inconsistent quality, by enforcing data management and governance practices while maintaining the scalability and flexibility of a data lake.

The distributed file and object capabilities of Storage Scale are ideal for supporting both data lakes and lakehouses. Storage Scale supports a wide variety of data formats, can scale to handle vast amounts of data across distributed environments, and integrates seamlessly with big data frameworks like Apache Hadoop and Spark. It delivers the throughput and low-latency access that are essential for accommodating multiple concurrent users and applications.

The unique global data abstraction services in Storage Scale can help organizations run analytics workloads against data regardless of its format or location, breaking down traditional data silos and enabling seamless access to both structured and unstructured data. Only Storage Scale software provides shared multi-protocol data access – the ability to ingest data via one protocol and make it available to multiple workloads simultaneously, even in different data protocols.

Tiered Storage
Analytics workloads often require access to two different kinds of storage systems – some that use high-performance media for quickly reading and writing active data, and others that provide more cost-effective storage for less frequently accessed data. Storage Scale System 6000 is designed to allow organizations to dial in the exact balance of performance and capacity required by their workloads.

Scale System 6000 can be configured with standard NVMe flash drives for maximum performance or with IBM FlashCore Modules when data density and compression are higher priority.

For workloads where storage capacity is important, Scale System 6000 supports up to nine expansion enclosures. The IBM Storage Scale Expansion Enclosure is an enterprise-class, fully redundant storage enclosure, containing up to 91 20TB or 22TB self-encrypting SAS hard disk drives (HDDs). Attaching eight expansion enclosures to the Storage Scale System 6000 expands the maximum storage capacity to 18PB of HDD storage per rack (using 24Gb SAS drives).

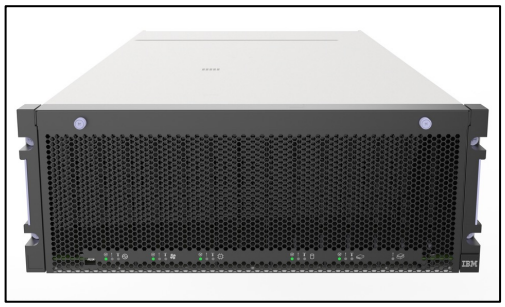

Figure 3 – The IBM Storage Scale System Expansion Enclosure enables organizations to cost-effectively deploy workloads operating on massive data sets.

High-Performance Computing

The combination of Storage Scale software and Storage Scale System hardware has been widely used in high-performance computing (HPC) environments for years. Indeed, the main reason systems optimized for HPC workloads are also widely used for AI workloads is that the two share many characteristics:

– **High data volume and throughput:** Both types of workloads often deal with massive datasets, sometimes ranging from terabytes to petabytes. Whether running complex scientific simulations or data-intensive computations, HPC and AI both require storage systems that can provide high throughput to move large volumes of data quickly and efficiently to computing resources. Data transfer between the storage systems and GPU infrastructure is especially important.

– **Low latency access:** HPC and AI workloads both demand low-latency access to data. In HPC, quick data retrieval is essential for maintaining high performance in simulations and real-time analyses, where delays can significantly the quality and business value of results. AI models, particularly deep learning models, require vast amounts of data to train effectively.

  During training, these models repeatedly access large datasets to learn from the data. Low-latency storage ensures that data can be quickly retrieved and fed into the training process to accelerate the overall training cycle. Also, many AI applications, such as advanced driver assistance systems (ADAS), fraud detection, and recommendation systems, rely on real-time or near-real-time inference. Low-latency storage minimizes the time it takes to access the necessary data, enabling faster and more responsive AI models.

– **Parallel processing and concurrency:** Both HPC and AI workloads often involve parallel processing across multiple compute nodes. This necessitates storage systems that support high IOPS (input/output operations per second) and can handle many simultaneous read and write operations, ensuring smooth data flow across distributed environments.

– **Scalability:** As with AI workloads, HPC applications need storage systems that can scale seamlessly to meet increasing demands. As the complexity and scale of simulations or computations grow, storage must scale in both capacity and performance to avoid bottlenecks and maintain efficiency.

– **Data integrity and reliability:** Maintaining data integrity is vital in HPC, as it is in AI workloads. Accurate data is critical for valid simulation outcomes and reliable results. Therefore, HPC storage systems must include robust data protection features to prevent data loss and ensure high reliability.

Together, Storage Scale and Storage Scale System check off every item on this list – they're designed for high data volume and throughput, with low latency access, supporting parallel processing and concurrency, and providing massive scalability, data integrity, and reliability.

IT Modernization

IT modernization is the process of updating and optimizing an organization's technology infrastructure and applications to be more agile, scalable, and efficient, often by adopting cloud-native technologies and methodologies. In practical terms, this means standardizing on a single platform that supports the development, deployment, and management of modern applications across hybrid and multi-cloud environments.

For many enterprises, that platform is Red Hat OpenShift, because:

– OpenShift supports the shift to containerized, microservices-based architectures, making applications more modular, scalable, and portable.
– It provides a consistent platform across different cloud environments, facilitating the move to hybrid and multi-cloud setups without vendor lock-in.
– It automates deployment and supports CI/CD (continuous integration / continuous delivery) pipelines, accelerating development cycles and enhancing operational efficiency.
– It has robust built-in security features to help ensure that modernization efforts align with evolving security and compliance requirements.
– It optimizes resource usage, reducing costs and improving performance as organizations modernize their IT infrastructure.

Storage Scale software provides distributed file and object storage to help organizations build the scalable, flexible, and resilient data infrastructure they need to support IT modernization efforts powered by platforms like OpenShift.

First and foremost, Storage Scale delivers the scalability and flexibility organizations need to manage unprecedented growth in data volumes across hybrid and multi-cloud environments, complementing OpenShift's flexibility. Its unique data abstraction capabilities, which enable real-time translation between file-based and object-based data, provide the foundation for organizations' global data platforms.

The integration of Storage Scale with OpenShift provides consistent, persistent storage for containerized applications, helping ensure data accessibility across diverse deployment environments. Because Storage Scale operates on structured, semi-structured, and unstructured data, it supports a huge range of modern and traditional applications.

Storage Scale was designed for high availability and resilience, with built-in redundancy to help ensure applications on OpenShift remain reliable, even in distributed environments. It also allows for tiered storage, optimizing resources and aligning with OpenShift's resource management for better cost efficiency.

Storage Scale supports container-native storage. It integrates with Kubernetes and other container orchestration platforms to provide scalable, high-performance storage for containerized applications. Storage Scale offers features such as dynamic provisioning, data sharing, and high availability, which are essential for running stateful applications in containers. This support allows you to use Storage Scale as a storage solution directly within container environments, making it suitable for various workloads that require persistent storage in a container-native format.

Backup & Archive

Data resilience is a crucial part of 21st-century business, as organizations strive to improve their ability to withstand and recover from ransomware, hardware failures, human error, natural disasters, and other threats. They typically need frequent backups of their active data as well as cost-effective storage of their massive archival data sets. In addition, many organizations face rigorous regulatory requirements for data storage, with significant financial penalties for non-compliance.

Figure 4 – The IBM Diamondback Tape Library delivers ultra-high data density, with up to 27.9 PB of native data in a single eight-square-foot library using LTO Ultrium 9 cartridges.

IBM Storage Scale is well-suited for data backup and archiving, providing a scalable, high-performance solution with advanced data management features.

Its key capabilities include:

- **Scalability:** Storage Scale is designed to handle massive amounts of data, scaling easily across distributed environments to accommodate growing backup datasets and archives without compromising performance.
- **Automated data tiering:** To optimized storage costs, Storage Scale automatically moves data to different storage tiers (i.e.: flash, disk, tape, or cloud) based on policies, all managed automatically.
- **Data replication and protection:** Advanced replication capabilities and snapshots help ensure robust data resilience to help mitigate the effects of ransomware and other potential threats to data.
- **Tape integration for long-term archiving:** Storage Scale integrates seamlessly with IBM Tape Storage, using tape as an economical and durable solution for long-term data archiving.

- **High availability and reliability:** Features like erasure coding and automated failover help ensure high data availability and protect against hardware failures.
- **Policy-based data management:** Storage Scale supports policy-based data management, which reduces administrative overhead by automating the movement and retention of data according to predefined rules.
- **Data security and compliance and security:** Storage Scale provides encryption and access controls to help ensure that data meets compliance requirements and is protected against unauthorized access.

Overall, Storage Scale delivers a comprehensive solution for scalable, efficient, and secure data backup and archiving, combining advanced data management capabilities with robust protection and cost optimization.

For more information

To learn more about IBM Storage Scale and IBM Scale System, contact your IBM representative or IBM Business Partner, or, for Storage Scale software go to: https://www.ibm.com/products/storage-scale or download a data sheet at: https://www.ibm.com/downloads/cas/LGPLW1MO

For Storage Scale System go to: https://www.ibm.com/products/storage-scale-system or download a data sheet at: https://www.ibm.com/downloads/cas/JBVQYVXB

IBM Corporation
New Orchard Road
Armonk, NY 10504

Produced in the
United States of America
September 2024