

IBM DS8870 with Firmware Release 7.5 Product Guide

IBM Redbooks Product Guide

Quick and reliable data access is the driving force behind important data initiatives, such as business analytics, cloud, and mobile computing. The IBM DS8870 is designed to manage a broad scope of storage workloads that exist in today's complex data infrastructure, and do it effectively and efficiently.

This IBM Redbooks® Product Guide is an overview of the features and functions offered by the IBM DS8870 with firmware Release 7.5.

The IBM DS8870 is designed to support the most demanding business applications with its exceptional all-around performance and data throughput. The IBM DS8870 architecture is server-based. Powerful IBM POWER7+™ processor-based servers manage the cache to streamline disk input/outputs (I/Os), maximizing performance and throughput. These capabilities are further enhanced with the availability of 16Gbps Fibre Channel host adapters, High-Performance Flash Enclosures (HPFEs), and a high-performance All Flash configuration option. The IBM DS8870 excels in supporting the IBM z Systems server and IBM Power® server environments and ensures that clients are taking full advantage of the integration delivered by these high-end enterprise systems.

Figure 1 shows the frontal view of an IBM DS8870 high-performance All Flash configuration.



Figure 1. IBM DS8870 high-performance All Flash frame

Did you know?

Here are some particular features of the IBM DS8870 worth mentioning:

- The IBM DS8870 features a HPFE that provides outstanding flash performance. The HPFE is directly attached to the Peripheral Component Interconnect Express (PCIe) fabric, enabling increased bandwidth and transaction processing capability. This 1U storage enclosure contains a pair of powerful flash Redundant Array of Independent Disks (RAID) adapters and up to thirty 400 gigabyte (GB) encryption capable flash cards in each enclosure, for a maximum of 240 flash cards in the IBM DS8870 high performance All-Flash configuration.
- The IBM Storage Driver for OpenStack is a software component that integrates with the OpenStack cloud environments and enables usage of storage resources provided by supported IBM storage systems.
- The DS8870 offers a RESTful API implementation, allowing improved cloud deployments by enabling automated custom DS8870 storage operations on volumes, pools, I/O ports, and some copy services operations.
- The IBM Storage Mobile Dashboard, now available for the DS8870 Release 7.5, uses the REST API for its communications with the DS8870.
- IBM Easy Tier®, a well-proven IBM DS8870 feature, is available at no charge. It dynamically optimizes performance for multi-tiered systems. It can also rebalance data within a single tier to help maintain optimal performance. Now in its eighth generation, Easy Tier provides additional user control at the pool and volume level, the ability to pause and resume migration at the pool level, and full support of the HPFE and associated flash cards, while maintaining additional features such as Easy Tier Server, Easy Tier Application, and Easy Tier Heat Map Transfer. These additional features are briefly described below in the Scalability and Performance section.

Product highlights

The IBM DS8870 Model 961 and associated IBM DS8870 Expansion Unit Model 96E can be ordered with a one-year, two-year, three-year, or four-year support period. The IBM DS8870 is designed to meet the biggest challenges with a unique combination of high-end scalability, performance, and reliability.

Scalability and performance

The IBM DS8870 features POWER7+ server technology to help support outstanding performance.

Tip: IBM proves the performance of its storage systems by publishing standardized benchmark results. For benchmark results of the IBM DS8870, see the following website:

<http://www.storageperformance.org>

The IBM DS8870 offers the following scalability and performance capabilities:

- The IBM DS8870 is available with different processor options, which range from dual 2-core systems up to dual 16-cores, and which cover a wide-range of performance needs. Simultaneous multithreading (SMT) mode, SMT4, enables the POWER7+ processor to maximize the throughput of the processor core.
- With the multi-thread performance accelerator feature, analytic data processing clients can achieve up to 940,000 IOPS in Database Base Open (DBO) environments (70% read, 30% write, 50% hit ratio). This optional feature allows the use of 64 threads with the POWER7+ processors, instead of the 32 threads default.

- Cache configurations are available that range from 16 GB up to 1 TB total system cache. The storage server architecture of the IBM DS8870 with its powerful POWER7+ processors makes it possible to manage large caches with small cache segments of 4 KB (kilobytes), and hence large segment tables, without the need to partition the cache. The POWER7+ processors have enough processing power to implement sophisticated caching algorithms. These algorithms and the small cache segment size optimize cache hits. Therefore, the IBM DS8870 provides excellent I/O response times.
- Write data is always protected by maintaining a copy of modified data in nonvolatile storage (NVS) until the data is destaged to hardened storage.
- The Adaptive Multi-stream Prefetching (AMP) caching algorithm can dramatically improve sequential performance, thereby reducing times for backup, processing for business intelligence, and processing for streaming media. Sequential Adaptive Replacement Cache is a caching algorithm that allows you to run different workloads, such as sequential and random workloads, without negatively impacting each other.
- The High-Performance Flash Enclosure (HPFE) provides the IBM DS8870 with a true flash architecture. By bypassing the classical device adapters (DAs), the PCIe-based architecture of the HPFE enables it to meet extreme input/output operations per second (IOPS) and response time requirements, in ultra-dense packaging. For the most demanding workloads, the IBM DS8870 high-performance All Flash configuration option provides up to eight HPFEs.
The HPFE is equipped with 1.8 inch encryption capable 400 GB flash cards, which outperform the Fibre Channel (FC) flash drives (solid-state drives or SSDs). Each HPFE can contain 16 or thirty 400 GB flash cards.
- The IBM DS8870 scales to more than 30 PB of raw drive capacity and supports multiple storage tiers. The IBM DS8870 supports a broad range of drives using different technologies. There are five types of drives managed in up to three different tiers (flash cards and flash drives as tier 0, FC serial-attached Small Computer System Interface (SCSI), or FC-SAS, 15,000 and 10,000 revolutions per minute (RPM) drives as tier 1, and near-line SAS drives as tier 2).
- The IBM DS8870 also provides an entry system, designated the *Business Class configuration* option, which supports up to 1056 small form-factor (SFF) drives or flash drives, plus up to 240 high-performance flash cards. The Business Class configuration offers performance and scalability, while reducing the initial cost of acquisition.
- The IBM DS8870 has an improved high-density frame design. The IBM DS8870 can support 1536 drives, plus 240 flash cards, in a small, high-density footprint (base frame and three expansion frames) that helps to preserve valuable raised floor space in data center environments.
- Peripheral Component Interconnect Express (PCIe Generation 2) improve IOPS and sequential read/write throughput. The I/O enclosures are directly connected to the DS8870 storage servers with point-to-point PCI Express cables.
- The IBM DS8870 provides large volume support for LUN sizes up to 16 TB. This configuration simplifies storage management tasks. In a z/OS environment, extended address volumes (EAVs) with sizes up to 1 TB are supported.
- Additionally, the DS8870 offers end-to-end I/O priorities, cooperative caching, long busy wait host tolerance, or automatic port queues.
- The IBM DS8870 offers enhanced connectivity, with 4-port and 8-port host adapters (HA) in the I/O enclosures that are directly connected to the processor complexes. There are two different types of HAs available (8 Gbps and 16 Gbps).
- The host adapters support FICON attachment to IBM z Systems z13, EC12 (zEC12), IBM zEnterprise 196 (z196), IBM zEnterprise 114 (z114), and IBM System z10[®]. You can configure each port to operate as a Fibre Channel Protocol (FCP) port, a FICON port, or Fibre Channel Arbitrated Loop (FC-AL).

- High Performance FICON for System z (zHPF) is the z/OS new I/O architecture. Progressively, z/OS access methods have been converted to use the new I/O commands. zHPF is an optional feature of the IBM DS8870. The IBM DS8870 is at the most up-to-date support level for zHPF. Enhancements to zHPF include Extended Distance capability, zHPF List pre-fetch support for IBM DB2® and utility operations, and zHPF support for sequential access methods. All DB2 I/O is now zHPF-capable. With the introduction of 16 Gbps host adapters on DS8870 and z Systems server z13 channels, which increases the write throughput with 50% or better, zHPF Extended Distance II can support heavy write I/Os over an extended distance of up to 100 km.
- Performance features for System z environments are parallel access volumes (PAVs), HyperPAV, Multiple Allegiance, I/O priority queuing, I/O Priority Manager, or zHPF. You can read details in *IBM DS8870 and z Systems synergy*, REDP-5186.
- Storage Pool Striping (rotate extents) provides a mechanism to distribute a volume's or logical unit number's (LUN's) data across many RAID arrays. Storage Pool Striping helps maximize performance without special tuning and greatly reduces hot spots in arrays.
- I/O Priority Manager is an optional feature that provides application-level quality of service (QoS) for workloads that share a storage pool. This feature provides a way to manage QoS for I/O operations associated with critical workloads, and gives them priority over other I/O operations associated with non-critical workloads. For IBM z/OS®, the I/O Priority Manager allows increased interaction with the host side.
- IBM Easy Tier, a no charge feature, offers capabilities, such as manual volume capacity rebalance, auto performance rebalancing in both homogeneous and hybrid pools, hot spot management, rank depopulation, manual volume migration, and thin provisioning support (Extent Space Efficient (ESE) volumes only). Easy Tier determines the appropriate tier of storage that is based on data access requirements and then automatically and nondisruptively moves data, at the volume or extent level, to the appropriate tier in the storage system. Recent versions of Easy Tier include additional reporting improvements, such as workload skew curve, workload categorization, and a data movement daily report, as well as intra-tiering and micro-tiering support for storage tier with more than one drive technology (mixed high performance flash cards and flash drives, or mixed Enterprise 15,000 and 10,000 RPM drives).
- Now in its eighth generation with Release 7.5, Easy Tier provides the ability to control its monitoring (learning) at the pool and volume level, and to pause and resume migration at the pool level. It is also possible to prevent volumes being assigned to a Near Line tier. Easy Tier also includes the following distinct components:
 - *Easy Tier Server* is a unified storage caching and tiering solution across IBM AIX® servers and storage area network (SAN) storage. Easy Tier Server manages the data placement across direct attached flash within POWER servers and IBM DS8870 storage tiers by moving the hottest data to the direct attached flash, while maintaining advanced feature functions.

Easy Tier can copy frequently accessed data from the IBM DS8870 storage tiers to an IBM Flash Adapter 90 attached to a POWER7+ server, in addition to the EXP30 Ultra SSD that the IBM DS8870 already supports.
 - *Easy Tier Application* enables clients to assign distinct application volumes to a particular tier in the Easy Tier pool, disregarding Easy Tier's advanced data migration function. This provides a flexible option for clients who want to ensure that certain applications remain on a particular tier to meet performance and cost requirements.

Specifically, DB2 applications running on System z can communicate performance requirements for optimal dataset placement, by communicating 'hints' to the Easy Tier Application interface.

- *Easy Tier Heat Map Transfer* is able to provide whatever the data placement algorithm is on the Metro Mirror/Global Copy/Global Mirror (MM/GC/GM) primary site, and re-apply it on the MM/GC/GM secondary site through the Easy Tier Heat Map Transfer utility when failover occurs. With this capability, the IBM DS8870 can maintain application-level performance at an application on the secondary site when it takes over in supporting a workload after a failover from the primary to secondary site. With Release 7.5, the Heat Map Transfer Utility supports 3-site cascaded Metro Global Mirror (MGM) topologies and can transfer the Easy Tier Heat Map to the secondary and third site.
- Storage Tier Advisor Tool (STAT) is a tool that is used with the Easy Tier feature to help clients understand their current storage system workloads. The tool also provides guidance about how much of their existing data is better suited for the various drive types (spinning drives or flash).

Availability and serviceability

The IBM DS8870 is designed and implemented with component redundancy to help avoid potential single points of failure. The IBM DS8870 offers high availability, multiplatform support, and particular synergy with z Systems:

- A nondisruptive upgrade path for the IBM DS8870 configurations allows processors, memory, and storage capacity enhancement to be performed concurrently. The DS8870 supports a scalable upgrade path from the smallest to the largest processor configuration (with certain restrictions).
- The IBM DS8870 features Smart Rebuild, a function designed to help reduce the possibility of secondary failures and data loss in RAID arrays. The IBM DS8870 supports RAID 5, RAID 6, and RAID 10.
- The Dynamic Volume Expansion simplifies management by enabling easier, online volume expansion (for Open Systems and z Systems) to support application data growth, and to support data center migration and consolidation to larger volumes to ease addressing constraints.
- Quick Initialization provides fast volume initialization for open system LUNs and count key data (CKD) volumes. It allows the creation of devices, making them available when the command completes.
- For data protection and availability, the IBM DS8870 supports advanced disaster recovery (DR) and business continuity solutions, such as Copy Services functions, available for thin provisioned volumes as well.
- Resiliency highlights include the following capabilities:
 - FlashCopy handling of volume reservations provides the detection of SCSI reserves that exist for devices in Metro Mirror or Global Mirror environments. It resets the reserve when performing a FlashCopy after it has been identified that it is not a valid reserve for a running server.
 - IBM z/OS SoftFence prevents any system from accessing data from the former remote mirror primary site when an unplanned HyperSwap occurs.
- Active Volume Protection is a feature that prevents the deletion of volumes still in use.
- The DS8870 provides a graphical management interface to configure the DS8870, query status information, and monitor performance of DS8870.
- Support for T10 Data Integrity Field is standard. The Data Integrity Field standard of SCSI T10 enables end-to-end data protection, from the application or host HBA down to the storage drives. Starting from DS8870 Release 7.5, T10 DIF is supported between IBM AIX servers with 16 Gbps HBA and the DS8870.
- The Extended Power Line Disturbance (ePLD) is an optional feature designed to protect your storage unit for 50 seconds, rather than only 4 seconds, from a power-line disturbance.

- Support for IBM System i® variable LUN adds flexibility for volume sizes and can increase capacity usage for IBM i environments. Previously, clients were limited to fixed LUN sizes of 35 GB, 70 GB, 141 GB, and 282 GBs.
- The IBM DS8870 is certified as meeting the requirements of the IPv6 Ready Logo program, which indicates its implementation of IPv6 mandatory core protocols and the ability to interoperate with other IPv6 implementations. The IBM DS8870 can be configured in native IPv6 environments. The logo program provides conformance and interoperability test specifications that are based on open standards to support IPv6 deployment globally. Furthermore, the US National Institute of Standards and Technology (NIST) tested IPv6 with the IBM DS8870, thus granting it support for the USGv6 profile and testing program.

Environmentally positive and energy efficient

The IBM DS8870 has the following energy efficient characteristics:

- The IBM DS8870 includes a power architecture based on a direct current uninterruptible power supply (DC-UPS). DC-UPS converts incoming alternating current (AC) line voltage to rectified AC, and contains an integrated battery subsystem.
- The IBM DS8870 is designed to comply with the ENERGY STAR specifications. ENERGY STAR is a joint program of the US Environmental Protection Agency and the US Department of Energy helping save money and protect the environment through energy efficient products and practices.
- High-density storage enclosures offer a considerable reduction in footprint and energy consumption.
- Hot-aisle and Cold-aisle are designed to optimize airflow, reduce cooling costs, and increase energy efficiency.
- The IBM DS8870 is Restriction of Hazardous Substances (RoHS) compliant.

Security and encryption

Combined with the world-class business resiliency and encryption features, the IBM DS8870 provides a unique combination of HA, performance, and security.

To counteract the growing threat of security breaches, the IBM DS8870 has self-encrypting drives as a standard feature and has security capabilities, such as broad-based access-control and tamper-proof audit logging, as well as other security features needed to comply with regulatory authorities:

- Self-encrypted drives are a standard feature. You just need to activate encryption on drives using IBM Security Key Lifecycle Manager. For more information, see *IBM DS8870 Drive Encryption*, REDP-4500.
- Full Disk Encryption (FDE) can protect business-sensitive data by providing drive-based hardware encryption that is combined with a sophisticated key management software (ISKLM). The Full Disk Encryption is available for all drive types, including flash cards and flash drives (SSDs). Because encryption is done by the drive, it is transparent to host systems and can be used in any environment, including z/OS.
- Lightweight Directory Access Protocol (LDAP) authentication support, which allows single sign-on (SSO) functionality, can simplify user management by allowing the IBM DS8870 to rely on a centralized LDAP directory rather than a local user repository. For more information, see *IBM System Storage DS8000: LDAP Authentication*, REDP-4505.
- Security improvements in the IBM DS8870 enable customers to become compliant with the Special Publication (SP) number 800-131a, which is an NIST directive that provides guidance for protecting sensitive data by using cryptographic algorithms that have key strengths of 112 bits. For more information, see *IBM DS8870 and NIST SP 800-131a Compliance*, REDP-5069.

- The following specific features of encryption key management help address Payment Card Industry Data Security Standard (PCI DSS) requirements:
 - Encryption deadlock recovery key option. When enabled, this option enables you to restore access to an IBM DS8870 when the encryption key for the storage is unavailable because of an encryption deadlock scenario.
 - Dual platform key server support. The IBM Security Key Lifecycle Manager servers are delivered through MT 2421-AP1 IBM Storage Appliance. Feature Code 1762 provides two SKLM isolated servers as a minimum requirement for DS8870 encryption enablement.
 - Recovery key Enabling/Disabling and Rekey data key option for the FDE feature. Both of these enhancements can help clients satisfy PCI security standards.

Advanced functions

The IBM DS8870 has the following advanced functions:

- The IBM DS8870 provides DS Storage Manager (the graphical user interface, or *GUI*) and DS command-line interface (CLI) management interfaces to configure the system or query status information. The IBM DS8870 DS GUI has the same look and feel as the GUIs of other IBM storage products, making it easier for a storage administrator to work with different IBM storage products. Release 7.4 has introduced the next generation of the GUI, featuring improved speed and usability.
- Thin Provisioning enables the creation of over-provisioned devices for more efficient usage of the storage capacity for Open Systems. Copy Services are now available for Thin Provisioning.
- Quick Initialization provides very fast volume initialization (for Open Systems LUNs and count key data (CKD) volumes) and therefore allows the creation of devices, making them available as soon as the command completes.
- The following list includes advanced Copy Services features in the IBM DS8870:
 - IBM FlashCopy® is an optional feature that allows the creation of volume copies (and data set copies for z/OS) nearly instantaneously. Different options are available to create full copies, incremental copies, or copy-on-write copies. FlashCopy can be used to perform backup operations parallel to production or to create test systems. The IBM FlashCopy SE capability enables more space-efficient capacity usage for copies, enabling improved cost effectiveness.
 - The DS8870 provides the same remote mirroring options as previous models of the DS8000 family. Synchronous remote mirroring (Metro Mirror) is supported up to 300 km. Asynchronous copy (Global Mirror) is supported for unlimited distances. Three-site options are available by combining Metro Mirror and Global Mirror.
 - Metro Mirror, Global Copy, Global Mirror, Metro/Global Mirror, z/OS Global Mirror, z/OS Metro/Global Mirror, and Multiple Target Peer-to-Peer Remote Copy (MT-PPRC) business continuity solutions are designed to provide the advanced functionality and flexibility that is needed to tailor a business continuity environment for almost any recovery point or recovery time objective.
 - Support Multiple Target (MT-PPRC). MT-PPRC provides the capability to have two PPRC relationships on a single primary volume. With this enhancement, there will be another target available to provide additional data protection to act as a backup if a disaster occurs.
 - The Copy Services can be managed and automated with IBM Tivoli® Storage Productivity Center for Replication. For z/OS environments, IBM Geographically Dispersed Parallel Sysplex™ (GDPS®) provides an automated DR solution.

- With AIX operating systems, the DS8870 supports Open IBM HyperSwap® replication. The Open HyperSwap is a special Metro Mirror replication method designed to automatically fail over I/O from the primary logical devices to the secondary logical devices in the event of a primary storage system failure. The swap can be accomplished with minimal disruption to the applications that are using the logical devices.
- In cooperation with z/OS's Data Mover, another option is available for z/OS: Global Mirror for z/OS. Another important feature for z/OS Global Mirror (2-site) and z/OS Metro/Global Mirror (3-site) is Extended Distance FICON, which can help reduce the need for channel extender configurations by increasing the number of read commands in flight.
- Remote Pair FlashCopy enables you to establish a FlashCopy relationship where the target is a remote mirror Metro Mirror primary volume, keeping the pair in the full duplex state.
- The Easy Tier Heat Map Transfer utility is also integrated with Tivoli Storage Productivity Center for Replication and all of the functions are available through Tivoli Storage Productivity Center for Replication. DS8870 Release 7.5 enhanced Easy Tier Heat Map Transfer functionality to support Metro Global Mirror (MGM) to automatically transfer heat map to a tertiary site.
- The Resource Groups feature is a policy-based resource scope limiting function that enables the secure use of Copy Services functions by multiple users on a DS8000 series storage subsystem. Resource Groups are used to define an aggregation of resources and policies for configuration and management of those resources. The scope of the aggregated resources can be tailored to meet each hosted customers' Copy Services requirements for any given operating system platform supported by the IBM DS8870.
- The IBM DS8870 provides support for VMware vStorage application programming interfaces (APIs) for Array Integration (VAAI). VAAI enables certain storage tasks to be offloaded from the server hardware to the storage array. Support is included for the Atomic Test and Set (ATS) primitive, the Cloning Blocks primitive, and the Zeroing Blocks primitive.
- The IBM DS8870 also supports IBM Storage Management Console for VMware vCenter. The IBM Storage Management Console for VMware vCenter is a software plug-in that integrates into the VMware vCenter server platform and enables VMware administrators to independently and centrally manage their storage resources on IBM storage systems. In addition to being a virtualization-related solution, the IBM Storage Management Console is a powerful management solution for VMware administrators who would like to control storage resources primarily from the VMware vSphere Client GUI.

Architecture and key components

This section gives a high-level description of different main elements of the IBM DS8870 architecture.

IBM POWER7+ processor technology

A pair of POWER7+ based System Power servers, also known as *central electronics complex* (CEC), are at the heart of the IBM DS8870.

These two POWER7+ servers share the load of receiving and moving data between the attached hosts and the storage arrays. However, they are also redundant, so that if either server fails, the system operations will fail over to the remaining server and continue to run without any host interruption.

The POWER7+ processors operate at 4.228 gigahertz (GHz) and can scale from 2-core processors to 16-core processors. Among other innovations, the POWER7+ processor includes the SMT mode, SMT4, which allows four instruction threads to be run simultaneously in each processor core.

The POWER7+ processor also features Intelligent Threads that can vary based on the workload demand. The POWER7+ multi-core architecture has been matched with a wide range of related technology innovations to deliver leading throughput, efficiency, scalability, and reliability.

The DS8870 CPCs have one to four memory riser cards, each with a maximum capacity of eight dual inline memory modules (DIMMs). The DS8870 CPCs are a dual socket server and can be populated with either one or two physical processor modules. Each processor module can access all memory DIMMs installed within the server.

Internal PCIe-based fabric

The IBM DS8870 fabric has the following specifications:

- IBM DS8870 POWER7+ servers use point-to-point, high-speed PCI Express (PCIe) connections to the I/O enclosures to communicate with HPFES, device adapters and host adapters. Each PCIe connection has a 2 gigabytes per second (GBps) bidirectional bandwidth. There are up to 16 PCIe connections from the processor complexes to the I/O enclosures.
- The I/O enclosures provide connectivity between the adapters and the POWER7+ processor complexes. The I/O enclosures contain custom intelligent adapters, designed for performance and reliability. The I/O enclosures support three types of adapters: the host adapters, the DAs, and the Flash Interface Card.
- In the IBM DS8870s that are equipped with HPFES, the flash enclosure connects to the I/O enclosures using two Flash Interface Cards (FAs). The Flash Interface Cards extend the I/O enclosure PCIe bus connections to the flash enclosure. Each Flash Interface Card is a PCIe redriver card that plugs into the I/O enclosure and has limited logic and no firmware.

Switched Fibre Channel Arbitrated Loop and device adapters

The IBM DS8870 DAs are configured in the following way:

- The IBM DS8870 uses switched 8 Gbps FC-AL technology to connect the DAs to the standard drive enclosures. Switched FC-AL uses the standard FC-AL protocol, but the physical implementation is different. Switched FC-AL technology includes the following key features:
 - Standard FC-AL communication protocol from DA to drives
 - Point-to-point connections established between DA and drives
 - Isolation capabilities in case of drive failures, providing easy problem determination
 - Predictive failure statistics
 - Simplified expansion, where no cable rerouting is required when another storage enclosure is added
- The IBM DS8870 architecture uses dual redundant switched FC-AL access to each of the storage enclosures. This configuration features the following key benefits:
 - Two independent switched FC-AL networks provide high performance connections to drives.
 - Four access paths are available to each drive.
 - Each DA port operates independently.
 - The configuration provides double the bandwidth of traditional FC-AL loop implementations.
- The standard drive enclosures connect to the processor complexes using 8 Gb four-port FC DAs. These adapters are optimized for Flash Drive (SSD) technology and designed for long-term scalability growth. These capabilities provide significant performance enhancements, with up to a 400% improvement in performance benchmarks over previous generations (DS8700).

Host adapter

The IBM DS8870 offers enhanced connectivity, with 4-port and 8-port host adapters in the I/O enclosures that are directly connected to the processor complexes.

There are two different types of host adapters available (8 Gbps and 16 Gbps). Both can negotiate their data transfer rate.

- 8 Gbps host adapters can negotiate to 8, 4, or 2 Gbps full-duplex over long wave or short wave fibre links. 8 Gbps host adapters can be either 4-port or 8-port cards
- 16 Gbps host adapters can negotiate to 16, 8, or 4 Gbps full-duplex data transfer over long wave or short wave fibre links. The 16 Gbps host adapters are 4-port cards only.

An intermix of 8 Gbps Fibre Channel host adapters and 16 Gbps Fibre Channel host adapters is supported. Of course, this will influence the maximum number of possible host ports. For example, a configuration with 16 Gbps Fibre Channel host adapters only, each having 4 ports, supports a maximum number of up to 64 host ports.

Each host adapter can be configured as either FC port, FICON port. Fibre Channel Arbitrated Loop (FC-AL) can be configured on 8 Gbps ports only port.

Having multiple host adapters allows the creation of redundant paths to host bus adapters (HBAs) in host servers connected to the IBM DS8870.

Flash memory

To improve data transfer rate (IOPS) and response time, the IBM DS8870 provides support for Flash Drives and High Performance Flash Cards, based on NAND technology:

- Flash drives feature improved I/O transaction-based performance over traditional spinning drives in the same standard drive enclosures. Flash drives are available with 200 GB, 400 GB, and 800 GB, and 1.6 TB encryption-capable drives.
- High-performance flash cards offer even higher throughput using the flash RAID adapters in the HPFE and direct PCIe connections to the processor complexes. The 400 GB flash cards are encryption-capable.

Flash drives and flash cards are high-IOPS class enterprise storage devices that are targeted at Tier 0, I/O-intensive workload applications that can use a high level of fast-access storage. Both types offer a number of potential benefits over spinning drives, including better IOPS, lower power consumption, less heat generation, and lower acoustical noise.

Storage enclosures

The data drives are installed in storage enclosures. The IBM DS8870 integrates two types of storage enclosures, which are the standard drive enclosures and the HPFEs:

The standard drive enclosure is a 2U storage enclosure and comes in two form factors. These enclosures are installed in pairs and can contain up to 24 drives with the short form-factor (SFF) storage enclosure, or 12 drives with the large form-factor (LFF) storage enclosure. The available drives are flash drives (SSDs) and spinning drives, also called hard disk drives (HDDs) or disk drive modules (DDMs). Although both spinning drives or flash drives can be used in the same storage system, they cannot be intermixed within the same storage enclosure pair. Each standard drive enclosure pair contains the following hardware components:

- Up to 12 LFF 3.5-inch SAS drives, or up to 24 SFF 2.5-inch SAS drives

Note: Intermixing drives of different capacities and speeds is supported on a DA pair, but not within a storage enclosure pair. The 2.5-inch and 3.5-inch drives can be intermixed in the same frame (although not within the same storage enclosure pair).

- Two power supplies with integrated cooling fans.

- Two Fibre Channel interconnect cards (FCIC) that connect four 8 Gbps FC interfaces to a pair of device adapters, or to another standard drive enclosure.

The IBM DS8870 base frame supports up to 10 standard drive enclosures (Enterprise and Business Class configuration). Additionally, the base frame can contain up to four HPFEs. In its maximum configuration, the base frame can hold 240 SFF drives or 120 LFF drives and up to an additional 120 flash cards. Figure 2 shows the standard drive enclosures (SFF and LFF configuration).

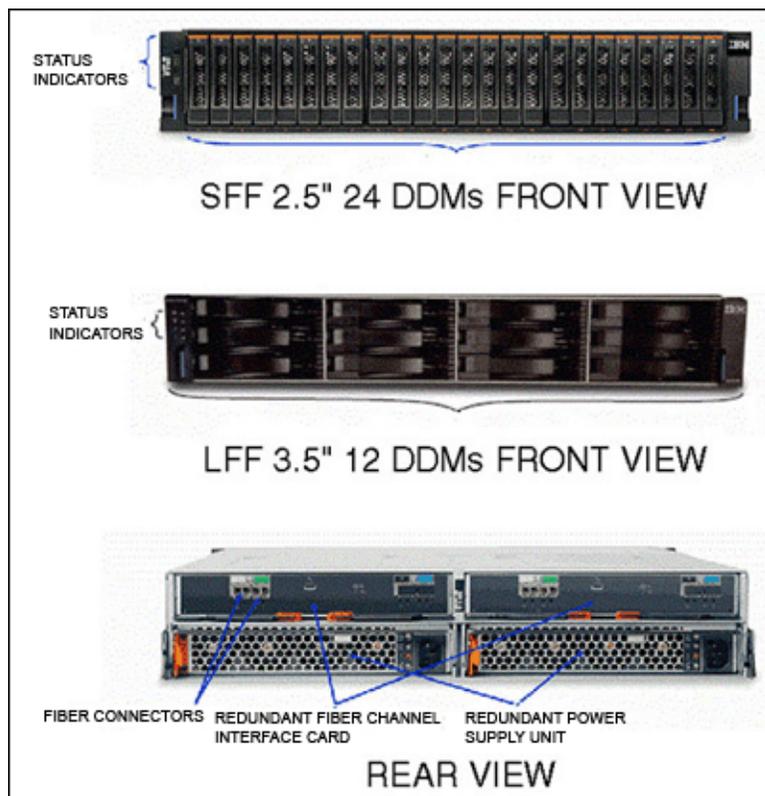


Figure 2. The standard drive enclosures (SFF and LFF configuration)

For the most demanding workloads, the IBM DS8870 features HPFEs. The HPFE is a 1U storage enclosure that can be installed individually. HPFEs do not need to be installed in pairs. Each HPFE contains the following hardware components:

- 16 or 30 400-GB 1.8-inch SAS flash cards, which support IBM FDE
- Two power supplies with integrated cooling fans
- Two flash RAID adapters, which are configured as a pair, that provide redundant data path to the flash cards in the flash enclosure. These adapters also provide enclosure control.

The HPFEs are directly attached to the I/O enclosures by a flash interface card using the PCIe bus fabric, which increases bandwidth and transaction-processing capability compared to standard drive enclosures connectivity (FC-AL). The I/O enclosures connect to the Power servers by using a the same PCIe bus fabric. Each flash enclosure connects to two I/O Enclosures, providing up to 4 GBps data transfer rates to the enclosure.

The flash cards feature a 6-Gbps SAS 2.0 interface, while the flash enclosures are connected to the processor complexes over redundant PCIe v2.0 interfaces.

Up to eight flash enclosures can be installed in the DS8870 high-performance All-Flash configuration, in a single frame footprint. Up to four flash enclosures can be installed in an IBM DS8870 Enterprise or Business Class configuration, and another four HPFEs can be installed in the first expansion frame (model 96E).

Figure 3 shows the HPFE.

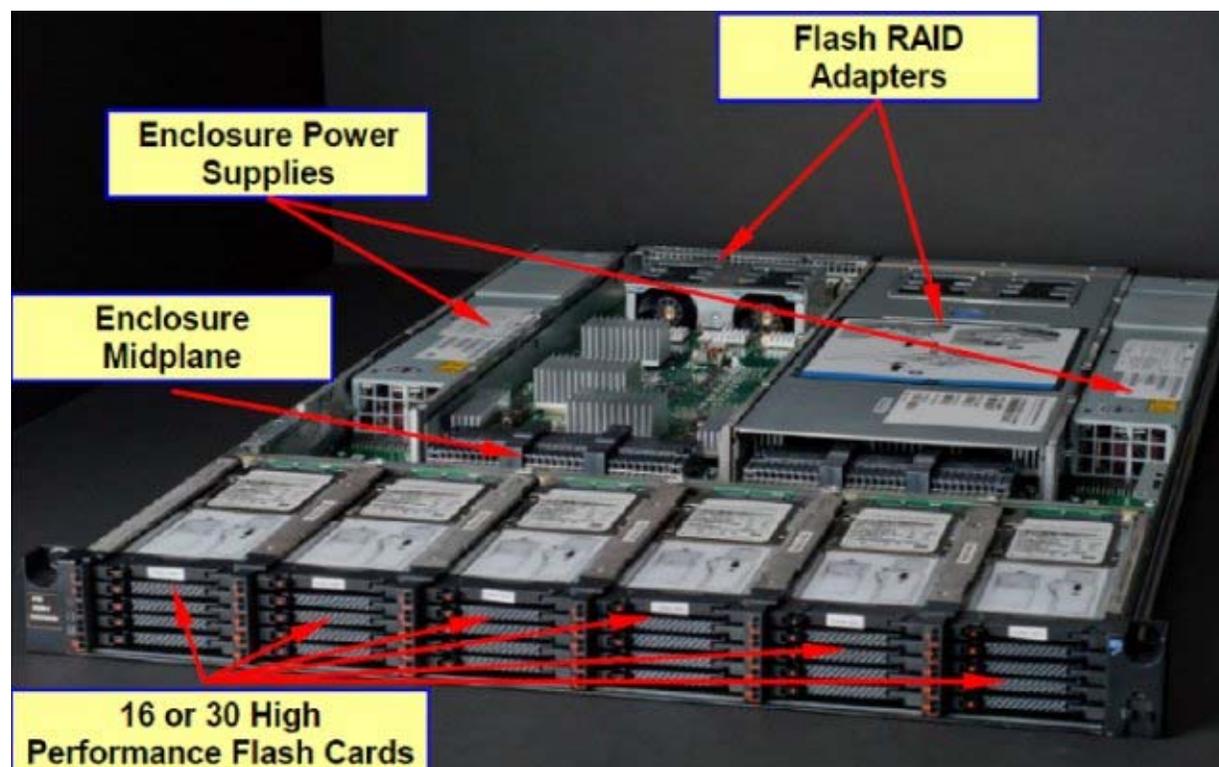


Figure 3. Cut away view of the high-performance flash enclosure, showing key components

For more information about the HPFE, see the *IBM DS8870 High Performance Flash Enclosure*, TIPS1181.

Drive options

The IBM DS8870 offers five different drives type to meet the requirements of various workloads and configurations:

- 400 GB flash cards for the highest performance requirements
- 200 GB, 400 GB, 800 GB, and 1.6 TB flash drives (SSDs) for higher performance requirements
- 146 GB, 300 GB, and 600 GB 15,000 RPM 2.5 inches SAS Enterprise drives for high performance requirements
- 600 GB and 1.2 TB 10,000 RPM 2.5 inches SAS Enterprise drives for standard performance requirements
- 4 TB 7200 RPM 3.5 inches SAS Nearline drives for large-capacity requirements

Although flash cards and flash drives are treated as the same tier, the Easy Tier intra-tier auto-rebalance function enables you to use the higher IOPS capability of flash cards.

Flash drives provide up to 100 times the throughput and 10 times lower response time than 15,000 RPM spinning drives. They also use less power than traditional spinning drives.

All types of drives are FDE capable. However, you do not need to use encryption unless you want to.

Power subsystem

The IBM DS8870 power subsystem has the following characteristics:

- The IBM DS8870 power subsystem is based on Direct Current Uninterruptible Power Supply (DC-UPS) with integrated battery sets. DC-UPS delivers greater levels of efficiency over the primary power supplies (PPSs) used in previous generations of the DS8000 series. The power subsystem in the IBM DS8870 complies with the current directives for the RoHS, and is engineered to comply with US Energy Star guidelines.
- Each frame contains two DC-UPS power supplies in a redundant active-active configuration. Each frame has two AC power cords, with each cord supplying a single DC-UPS. If input AC is not present on one power cord, the associated DC-UPS will continue to operate using rectified AC from the partner DC-UPS, with no reduction of system power redundancy. If neither AC input is active, the DC-UPSs will switch to battery power. Depending on whether the system has the Extended Power Line Disturbance (ePLD) feature, the system runs on battery power for either 4 or 50 seconds before initiating an orderly shutdown.

Each DC-UPS has its own battery backup functions. Therefore, the battery system also provides 2N redundancy. The battery of a single DC-UPS is able to preserve NVS in case of a complete power outage. The battery module is called a battery service module (BSM). A group of four battery enclosures makes up a BSM set.

The BSM helps protect data in the event of a loss of external power. If there is a complete loss of AC input power, the batteries are used to maintain power to the processor complexes and I/O enclosures for sufficient time to allow the contents of NVS memory (modified data that is not yet destaged to drive from cache) to be written to the drives internal to the processor complexes (not the storage enclosures drives).

Other key elements of the power subsystem include the following components:

- The rack power control (RPC) cards manage the power subsystem, providing functions of control, monitor, and reporting. There are two RPC cards for redundancy.
- The system power control network (SPCN) is used to control the power of the attached I/O subsystem.

Hardware Management Console

The Hardware Management Console (HMC) is a Linux-based notebook program that enables users to interact with the DS8870 via the HMC GUI (for service purposes) or DS Storage Manager/DS CLI (for storage administration or configuration purposes).

Important: The IBM DS8870 HMC supports IPv6 and continues to support the IPv4 standard and mixed IPv4 and IPv6 environments.

Ethernet switches

The IBM DS8870 base frame has two 8-port Ethernet switches. Two switches are supplied to allow the creation of a fully redundant private management network. Each processor complex includes connections to each switch to allow each server to access both private networks. These networks cannot be accessed externally, and no external connections are allowed. External client network connection to the IBM DS8870 system is through a dedicated connection to the HMC. The switches receive power from the Power Junction Assemblies (PJAs), and do not require separate power outlets.

Important: The internal Ethernet switches are for the IBM DS8870 private network only. No client network connection should ever be made directly to these internal switches.

Models

The DS8870 storage systems include the IBM DS8870 Model 961 base frame and the associated IBM DS8870 expansion frames Model 96E. The IBM DS8870 is available in the three following configurations:

- *IBM DS8870 Model 961 high-performance All-Flash configuration*

The DS8870 All Flash configuration is a high-performance configuration that supports up to eight HPFEs. Flash enclosures 1 - 4 are mounted vertically, and flash enclosures 5 - 8 are mounted horizontally. It supports up to 240 flash cards (up to 30 flash cards per enclosure).

This configuration does not support expansion frames (model 96E). This configuration also does not support standard drive enclosures with HDDs or flash drives (SSDs).

The high-performance All Flash configuration provides twice the I/O enclosures and up to twice the host adapters as the standard DS8870 single frame configuration.

This configuration uses 8 Gbps or 16Gbps FC host adapters that run FCP, FICON, or zHPF.

- *IBM DS8870 Model 961 Enterprise Class configuration*

The Enterprise Class configuration is a high-density, high-performance configuration that includes standard drive enclosures and HPFEs. This configuration is scalable to up to 16-core processors, with up to 240 flash cards, and up to 1536 standard drives. Enterprise Class storage systems are optimized and configured for performance and throughput, by maximizing the number of device adapters and paths to the storage enclosures.

This configuration supports the following storage enclosures:

- Up to 10 standard drive enclosures and up to four HPFEs in a base frame (model 961)
- Up to 14 standard drive enclosures and 4 HPFEs in a first expansion frame (model 96E)
- Up to 20 standard drive enclosures in a second expansion frame
- Up to 20 standard drive enclosures in a third expansion frame

This configuration uses 8 Gbps FC host adapters that run FCP, FICON, or HPF.

Restriction: Copy Services and I/O Priority Manager functions require 32 GB system memory.

- *IBM DS8870 Model 961 Business Class configuration*

The Business Class configuration is a high-density, high-performance configuration that includes standard drive enclosures and HPFEs. This configuration is scalable to up to 16-core processors, with up to 240 flash cards, and up to 1,056 standard drives. Business Class storage systems are optimized and configured for cost, by minimizing the number of device adapters and maximizing the number of storage enclosures attached to each frame.

This configuration supports the following storage enclosures:

- Up to 10 standard drive enclosures and up to four HPFEs in a base frame (model 961)
- Up to 14 standard drive enclosures and 4 HPFEs in a first expansion frame (model 96E)
- Up to 20 standard drive enclosures in a second expansion frame

This configuration uses 8 Gbps or 16 Gbps FC host adapters that run FCP, FICON®, or High Performance FICON (zHPF).

Restriction: Copy Services and I/O Priority Manager functions require 32 GB system memory.

- *IBM DS8870 Model 96E Expansion Frame*

The expansion frame for the 961 model includes standard storage enclosures for additional spinning drives (Enterprise or Nearline) and flash drives (SSDs), HPFES for additional flash cards, and additional FC host adapters to allow a maximum configuration of 16 host adapters (up to 128 ports). The expansion frame 96E can only be attached to the model 961 8-core processors or 16-core processors base frame. Up to three expansion frames can be attached to a model 961 (Enterprise Class). The additional FC host adapters and HPFES can only be installed in the first expansion frame.

Important: You cannot add an expansion frame to a DS8870 2-core or 4-core system. However, you *can* first upgrade to an 8-core or 16-core system, and then add expansion frames.

Figure 4 displays an overview of the physical components of a standard configuration (Enterprise or Business Class), depicting the architecture elements described previously.

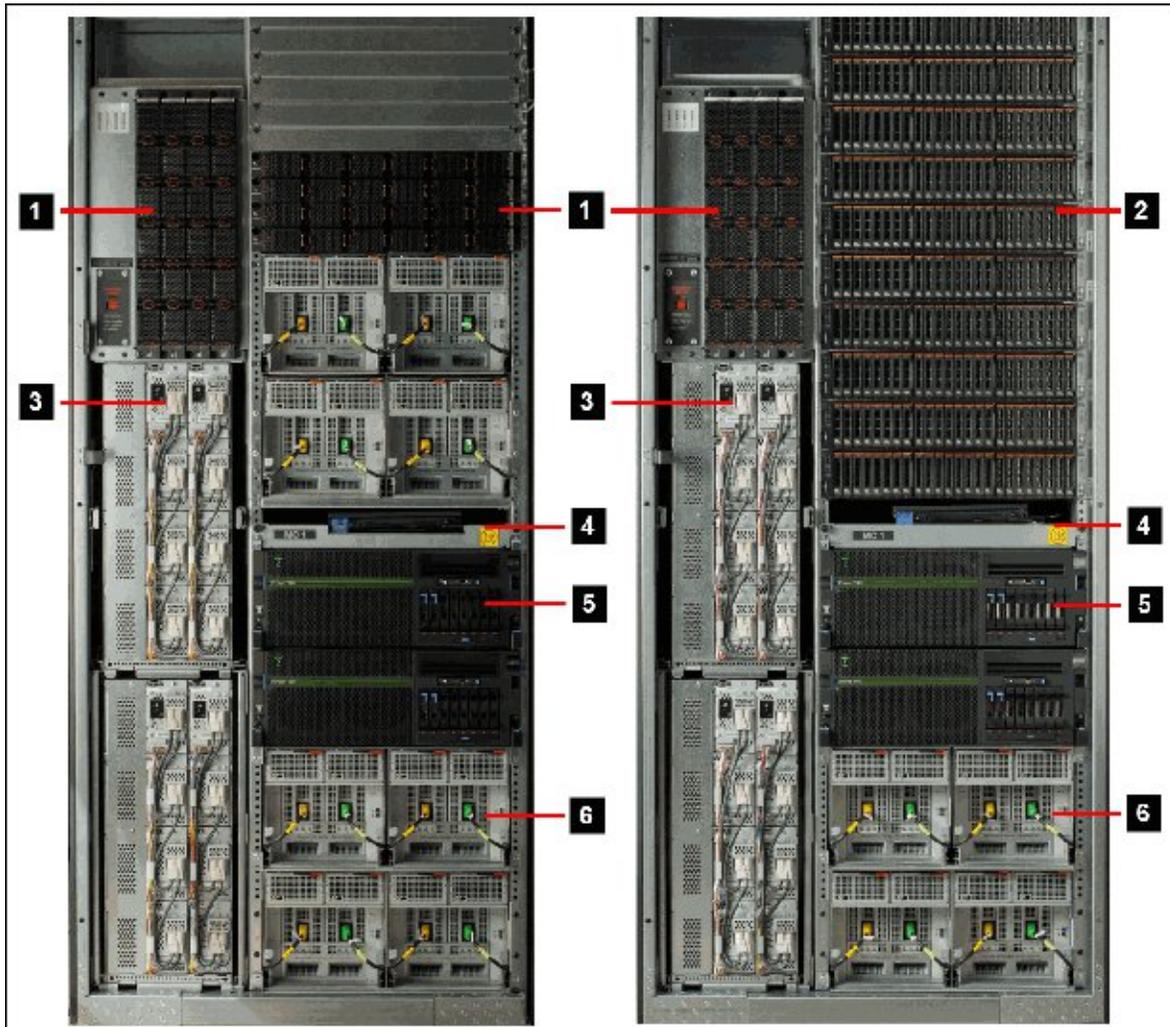


Figure 4. The IBM DS8870 Model 961 High Performance All Flash and Enterprise Class front views

Figure 4 shows the front view of the Model 961 base frame for high-performance All Flash (left) and Enterprise or Business Class configuration (right):

- The high-performance All Flash configuration includes space for up to 8 HPFES (#1), while the Enterprise Class (and Business Class) configuration includes space for up to 4 HPFES (#1), and up to 10 standard disk enclosures (#2).
- The power subsystem is based on DC-UPSs with integrated battery sets. Each frame contains two DC-UPS power supplies in a fully redundant configuration (#3).
- The HMC is located above the processor complexes (#4).
- The POWER7+ processor-based servers (#5) contain the processors and memory that drive all functions within the IBM DS8870. Processor and system memory can be upgraded concurrently.
- The I/O enclosures (#6) provide connectivity between the adapters and the storage complexes (#5). The adapters that are contained in the I/O enclosures can be either DAs or host adapters, or Flash Interface Cards.

Specifications

Table 1 summarizes the IBM DS8870 specifications.

Table 1. DS8870 specifications (part 1 of 2)

Model	DS8870 (961, 96E)
Shared symmetric multiprocessor (SMP) configuration	POWER7+ dual 2-core, 4-core, 8-core, or 16-core
Other major processors	IBM® PowerPC®, application-specific integrated circuits (ASICs)
Processor memory for cache and nonvolatile storage (minimum/maximum)	16 GB/1024 GB
Host adapter interfaces	<ul style="list-style-type: none"> ● 4-port and 8-port 8 Gbps ● 4-port 16 Gbps ● FC/FICON
Host adapters (minimum/maximum)	2/16
Host ports (minimum/maximum)	8/128
Drive interface	6 Gbps point-to-point switched SAS-2 connection to an 8 Gbps FC backbone)
Number of drives (minimum/maximum)	<ul style="list-style-type: none"> ● Enterprise and Business Class configuration <ul style="list-style-type: none"> ● 8/1536 (SFF) ● 8/768 (LFF) ● 0/120 flash cards ● High Performance All-Flash configuration <ul style="list-style-type: none"> ● 16/240 flash cards
Device adapters	Up to 16 4-port, 8 Gbps FC
Maximum physical storage capacity	3168 TB (Usable capacity depends on factors, such as data format, RAID level, and spare drives configured).
Drive sizes	<ul style="list-style-type: none"> ● 400 GB flash cards ● 200 GB flash drives (SSDs) ● 400 GB flash drives (SSDs) ● 800 GB flash drives (SSDs) ● 1.6 TB flash drives (SSDs) ● 146 GB (15,000 RPM) SAS (Enterprise drives) ● 300 GB (15,000 RPM) SAS (Enterprise drives) ● 600 GB (15,000 RPM) SAS (Enterprise drives) ● 600 GB (10,000 RPM) SAS (Enterprise drives) ● 1.2 TB (10,000 RPM) SAS (Enterprise drives) ● 4 TB (7200 RPM and 3.5-in form factor) SAS (Nearline drives)
RAID levels	5, 6, and 10
Dimensions (height × width × depth). (Applies to both 961 and 96E model)	193.4 cm × 84.8 cm × 122.7 cm (76 in × 33.4 in × 48.3 in) per frame, up to 4 frames total
Maximum weight of fully configured base models and expansion models	<ul style="list-style-type: none"> ● 1315 kg (2900 lb) base frame ● 1259 kg (2775 lb) first expansion
Dry bulb temperature, operating	16 °C - 32 °C (60 °F - 90 °F)
Relative humidity	20% - 80%

Table 1. DS8870 specifications (part 2 of 2)

Model	DS8870 (961, 96E)
Power supply	<ul style="list-style-type: none"> ● Configurations: Single-phase or three-phase ● 50/60 hertz (Hz)
Caloric value British thermal units per hour (BTU) (maximum)	<ul style="list-style-type: none"> ● 25,000 (961 frame) ● 19,605 (96E frame)
Peak electrical power kVA (maximum)	<ul style="list-style-type: none"> ● 6.1 (961 frame) ● 5.6 (96E frame)

For more information about specifications, refer to the IBM publication *IBM DS8870 Introduction and Planning Guide*, GC27-4209.

Configuration options

Table 2 lists the base and expansion frame configuration options.

Table 2. IBM DS8870 Configuration options for base and expansion frames

Model number/ Class	Processor	Max. Flash Adapter Pairs	Max. Flash Cards	Max. DA Pairs	Max. Flash Drives/ drives	System memory	Host Adapters	9xE attach
961 Business Class	2-core	0	0	1	144	16 GB	4	0
961 Business Class	2-core	2	60	1	144	32 GB	4	0
961 Business Class	4-core	4	120	2	240	64 GB	8	0
961 Business Class	8-core	4	120	6	1056	128 GB 256 GB	16	0 - 2
961 Business Class	16-core	4	120	6	1056	512 GB 1 TB	16	0 - 2
961 Enterprise Class	2-core	0	0	1	144	16 GB	4	0
961 Enterprise Class	2-core	2	60	1	144	32 GB	4	0
961 Enterprise Class	4-core	4	120	2	240	64 GB	8	0
961 Enterprise Class	8-core	4	120	8	1056	128 GB	16	0 - 2
961 Enterprise Class	8-core	4	120	8	1536	256 GB	16	0 - 3
961 Enterprise Class	16-core	4	120	8	1536	512 GB 1 TB	16	0 - 3
961 All Flash Class	8-core	8	240	0	0	256 GB	16	0
961 All Flash Class	16-core	8	240	0	0	512 GB 1 TB	16	0
96E 1st Expansion Frame	Not applicable (N/A)	4	120	4	336	N/A	8	961
96E 2nd and 3rd Expansion Frames	N/A	0	0	0	480	N/A	0	961

Important: Cache size and the possible processor options (number of cores) are not fully independent. Only certain combinations of both are allowed.

Other configuration features

This section highlights the main features, upgrades, or options that can be requested with new IBM DS8870 orders, or installed at a later time:

- An *external HMC* can be ordered as a second HMC to provide continuous availability to the HMC functions. The use of a second HMC can be very useful in storage environments where encryption capability has been activated.
- The *Extended Power Line Disturbance* (ePLD) option is designed to protect your storage unit for 50 seconds, rather than only 4 seconds, from a power-line disturbance. If no ePLD option is ordered, one BSM set per DC-UPS (for both the main and expansion racks) is needed. If the ePLD option is ordered, two BSM sets per DC-UPS (for both the main and expansion racks) are needed.
- The *BSMI certificate for Taiwan* option provides the required Bureau of Standards, Metrology, and Inspection (BSMI) ISO 9001 certification documents for storage system shipments to Taiwan.
- The optional *remote zSeries power control* feature adds a logic card that is used by one or more attached System z or IBM S/390® hosts to control the power-on and power-off sequences for your storage system.
- For environments with nonraised floors, an optional *overhead cabling* feature is available. The overhead cabling option includes a top-exit bracket for fiber cables.
- The *shipping weight reduction* option allows you to receive delivery of an IBM DS8870 model in multiple shipments. If your site has delivery weight constraints, IBM offers a shipping weight reduction option that ensures the maximum shipping weight of the initial model shipment does not exceed 909 kg (2000 lb). The model weight is reduced by removing selected components, which are shipped separately. The IBM service representative installs the components that were shipped separately during the storage unit installation.
- The *Earthquake Resistance Kit* is an optional seismic kit for stabilizing the storage unit rack, so that the rack complies with IBM earthquake resistance standards. The Earthquake Resistance Kit option is available for models 961 and 96E.

Warranty information and upgrades

The IBM DS8870 offers the Enterprise Choice warranty of 1, 2, 3, or 4 years on both the hardware *and* the advanced function software in the following way:

- 4 years on type 2424 models
- 3 years on type 2423 models
- 2 years on type 2422 models
- 1 year on type 2421 models

Capacity

A summary of the capacity characteristics is listed in Table 3. The minimum capacity is achieved by installing one SFF drive group (16 drives) of 146 GB 15,000 RPM enterprise drives.

Table 3. Capacity comparison of device adapters, DDMs, and storage capacity

Component	2-core base frame	8-core or 16-core, All flash	4-core, 8-core, or 16-core base frame	8-core or 16-core, with one expansion frame	8-core or 16-core, with two expansion frames	8-core or 16-core, with three expansion frames
DA pairs	1-2	N/A	1-4	5-8	8	8
Fibre Channel adapter (FA) pairs	1-2	1-8	1-4	1-4	1-4	1-4
HDDs	Up to 144	N/A	Up to 240	Up to 576	Up to 1056	Up to 1536
Flash drives (SSD)	Up to 96	N/A	Up to 192	Up to 384	Up to 384	Up to 384
Flash cards	Up to 60	Up to 240	Up to 120	Up to 120	Up to 120	Up to 120
Raw capacity*, 2.5-inch SFF drives	Up to 173 TB	N/A	Up to 288 TB	Up to 690 TB	Up to 1.27 PB	Up to 1.84 PB
Usable capacity*, RAID-5, 2.5-inch SFF drives	Up to 133 TB	N/A	Up to 218 TB	Up to 532 TB	Up to 1.00 PB	Up to 1.48 PB
Raw capacity*, Flash Cards	Up to 24 TB	Up to 96 TB	Up to 48 TB	Up to 48 TB	Up to 48 TB	Up to 48 TB
Usable capacity*, RAID-5, Flash Cards	Up to 18.5 TB	Up to 74.3 TB	Up to 37.1 TB	Up to 37.1 TB	Up to 37.1 TB	Up to 37.1 TB
Raw capacity*, 3.5-inch LFF drives	Up to 288 TB	N/A	Up to 480 TB	Up to 1152 TB	Up to 1.58 PB	Up to 3.06 PB
Usable capacity*, RAID-6, 3.5-inch LFF drives	Up to 173 TB	N/A	Up to 284 TB	Up to 694 TB	Up to 1.34 PB	Up to 2.01 PB

* TB and PB definition according to ISO/IEC 80000-13

Additional drive types are continuously qualified during the lifetime of the machine.

Leading practice: Although the flash drives (SSDs) can be ordered in full sets (16 drives) or half sets (eight drives), the optimum price-to-performance ratio is achieved by using full drive sets (16).

For more information about comparison values for Model 961 and 96E, see the Overview of physical configurations section on the following web page:

<http://ibm.co/1jO9xaH>

Adding DDMs and Capacity on Demand

The IBM DS8870 includes a linear capacity growth of up to 3 PB gross capacity that uses 3.5-inch Nearline drives. A significant benefit of this capacity growth is the ability to add DDMs without disruption. IBM offers capacity-on-demand (CoD) solutions that are designed to meet the changing storage needs of rapidly growing e-business. The IBM Standby Capacity on Demand (CoD) offering is designed to tap into more storage, and is attractive if you have rapid or unpredictable storage growth.

Up to six standby CoD drive sets (for a total of 96 drives) can be concurrently field-installed into the system. To activate the sets, logically configure the drives for use, which is a nondisruptive activity and does not require intervention from IBM.

Upon activation of any portion of a standby CoD drive set, you must place an order with IBM to initiate billing for the activated set. Then, you can also order replacement Standby CoD drive sets.

Note: Flash Drives (SSDs) and Flash Cards are not available for CoD configurations.

By default, the Enterprise Class Configuration option for the IBM DS8870 includes one pair of DAs per 48 DDMs. If you order a system with, for example, 96 drives, you receive two DA pairs (a total of four DAs).

Ordering 432 drives, you receive eight DA pairs, which is the maximum number of DA pairs. Adding more drives beyond 432 does not add DA pairs. Instead, each DA loop gets bigger.

Having enough DA pairs is important to achieve the high throughput level that is required by certain sequential workloads, such as data-warehouse installations.

Note: The IBM DS8870 *Business Class Configuration* option completely fills each DA pair with DDMs before adding the next DA pair.

Scalable upgrades

With the IBM DS8870 Business Class Configuration option, it is possible to start with a single-frame, two-core configuration with storage enclosures for 48 DDMS, and grow to a full-scale, 1536-drive, 240 Flash Card, four-frame configuration. With the IBM DS8870 Enterprise Class Configuration option, it is also possible to start with a single-frame, two-core configuration, and grow to a 1536-drive, 120 Flash Card, four-frame configuration. All frame and capacity upgrades are concurrent, regardless of configuration type.

Note: A *Business Class Configuration* cannot be upgraded to an *Enterprise Class Configuration*.

Licensed functions

Many of the software optional licensed functions of the IBM DS8870 need a License Key to be activated. In fact, licensed functions are enabled through a licensed function *indicator* feature plus a licensed function *authorization* feature number.

In addition, for every storage unit, an *Operating Environment License* (OEL) must also be ordered, so that the OEL licenses the operating environment and is based on the total physical (raw) capacity of the IBM DS8870.

Licensed functions are activated and enforced within a defined *License Scope*. License scope refers to the type of storage, and therefore the type of servers, that the function can be used with:

- Fixed block (FB)
- CKD
- Both (FB and CKD)

Each IBM DS8870 licensed function can have its own peculiarity in the way that it is ordered or activated. The *Copy Services*, for instance, are licensed by the gross amount of capacity installed. With Easy Tier on the other hand, while you do need a license key, because this feature is available at no cost it is generally always configured.

Functions indicators and authorization feature numbers are listed in Table 4.

Table 4. DS8870 licensed functions indicators

Licensed function for DS8000 with Enterprise Choice warranty	IBM 242x indicator feature numbers	IBM 239x function authorization model and feature numbers
Encrypted Drive Activation	1750	239x Model LFA, 1750
Encrypted Drive De-Activation	1754	239x Model LFA, 1754
Operating Environment License	0700 and 70xx	239x Model LFA, 703x/705x
FICON Attachment	0703 and 7091	239x Model LFA, 7091
Thin Provisioning	0707 and 7071	239x Model LFA, 7071
Database Protection	0708 and 7080	239x Model LFA, 7080
High Performance FICON	0709 and 7092	239x Model LFA, 7092
Easy Tier	0713 and 7083	239x Model LFA, 7083
Easy Tier Server	0715 and 7084	239x Model LFA, 7084
z/OS Distributed Data Backup	0714 and 7094	239x Model LFA, 7094
FlashCopy	0720 and 72xx	239x Model LFA, 725x-726x
Space Efficient FlashCopy	0730 and 73xx	239x Model LFA, 735x-736x
Metro/Global Mirror	0742 and 74xx	239x Model LFA, 748x-749x
Metro Mirror	0744 and 75xx	239x Model LFA, 750x-751x
Global Mirror	0746 and 75xx	239x Model LFA, 752x-753x
Multiple Target PPRC	0745 and 7025	NONE
z/OS Global Mirror	0760 and 76xx	239x Model LFA, 765x-766x
z/OS Global Mirror Incremental Resync	0763 and 76xx	239x Model LFA, 768x-769x
Parallel Access Volumes	0780 and 78xx	239x Model LFA, 782x-783x
HyperPAV	0782 and 7899	239x Model LFA, 7899
I/O Priority Manager	0784 and 784x	239x Model LFA, 784x-785x
Security Key Lifecycle Manager isolated-key server	1760	

For more details, see the *IBM DS8870 Introduction and Planning Guide*, GC27-4209.

Call home and Remote Support

Call home is the capability of the HMC to contact IBM support services to report a problem, which is referred to as *call home for service*. The HMC also communicates machine-reported product data (MRPD) to IBM by the call home facility. MRPD data has been enhanced to include more information about logical volume and logical subsystem (LSS) configuration. Call home can use the HMC modem or Secure Sockets Layer (SSL) for Internet connections.

For remote support, the IBM DS8870 HMC can be accessed remotely by IBM Support personnel for many service tasks. IBM Support can offload service data, change configuration settings, and initiate recovery actions over a remote connection. You decide which type of connection you want to allow for remote support. The following options are included:

- Modem-only for inbound and outbound connection
- Virtual private network (VPN) for access to the support interface and outbound data
- Modem and VPN
- Assist On-site (AOS) with port forwarding by SSL and proxy

Remote support is an important item for IBM DS8870 support. As more clients eliminate modems and analog phone lines from their data centers, the usage of a VPN or AOS connection becomes more important. For more information about remote support operations, see *IBM DS8870 Architecture and Implementation*, SG24-8085.

Supported environments

The IBM DS8870 offers connectivity support across a broad range of server environments, including IBM Power Systems™, System z and System x servers, servers from Oracle and Hewlett-Packard, non-IBM Intel, and AMD-based servers.

The DS8000 supports over 90 platforms. For the most current list of supported platforms, see the IBM System Storage Interoperation Center (SSIC) on the following website:

<http://www.ibm.com/systems/support/storage/config/ssic/index.jsp>

IBM System Storage DS8000: Host Attachment and Interoperability, SG24-8887 provides answers to the applicable supported environments is available on the following website:

<http://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/sg248887.html?Open>

This rich support of heterogeneous environments and attachments, along with the flexibility to easily partition the IBM DS8870 storage capacity among the attached environments, can help support storage consolidation requirements and dynamic environments.

Disk Magic

Disk Magic is a Windows-based performance modeling tool that is used by IBM and IBM Business Partners to model storage system performance. It supports storage systems from multiple vendors, and offers detailed support for IBM storage systems.

For the IBM DS8870, Disk Magic provides a capability to advise on data placement with flash memory. Having IBM DS8870 configurations with flash memory and multiple servers, Disk Magic can select a specific server workload that most benefits from running on flash. This feature is called *SSD Advisor* and applies to IBM System z and open systems models.

Important: IBM Disk Magic for Windows is a product of IntelliMagic, which is licensed to IBM and IBM Business Partners to model disk storage system performance. Contact your IBM Representative or IBM Business Partner to discuss a Disk Magic study.

Note: Disk Magic supports the HPFE and two new flash drive (SSD) sizes (200 GB and 800 GB) in DS8870 with LMC 7.7.30.xx.xx (bundle version 87.30.xx.xx) or later.

Related publications and links

- *IBM DS8870 Architecture and Implementation*, SG24-8085:
<http://www.redbooks.ibm.com/redpieces/abstracts/sg248085.html?Open>
- *IBM DS8870 Introduction and Planning Guide*, GC27-4209
- *IBM System Storage DS8000 242x Model 961 Installing a Storage Facility*, GA32-2236
- *IBM System Storage DS8000 Copy Services for Open Systems*, SG24-6788:
<http://www.redbooks.ibm.com/redpieces/abstracts/sg246788.html?Open>
- *IBM System Storage IBM DS8070 Copy Services for IBM z Systems*, SG24-6787:
<http://www.redbooks.ibm.com/redpieces/abstracts/sg246787.html?Open>
- *DS8000 Series Copy Services Fibre Channel Extension Support Matrix*:
<http://www.ibm.com/support/docview.wss?uid=ssg1S7003277>
- *IBM System Storage DS8000 Series: IBM FlashCopy SE*, REDP-4368:
<http://www.redbooks.ibm.com/abstracts/redp4368.html?Open>
- *IBM Systems Storage DS8000 Copy Services Scope Management and Resource Groups*, REDP-4758:
<http://www.redbooks.ibm.com/abstracts/redp4758.html?Open>
- *IBM System Storage DS8000 Easy Tier*, REDP-4667:
<http://www.redbooks.ibm.com/abstracts/redp4667.html?Open>
- *IBM DS78870 and z Systems Synergy*, REDP-5186
<http://www.redbooks.ibm.com/redpieces/abstracts/redp5186.html?Open>
- *IBM System Storage DS8000 Easy Tier Server*, REDP-5013
<http://www.redbooks.ibm.com/abstracts/redp5013.html?Open>
- *IBM DS8070 Easy Tier Application*, REDP-5014
<http://www.redbooks.ibm.com/abstracts/redp5014.html?Open>
- *IBM DS8070 Easy Tier Heat Map Transfer*, REDP-5015
<http://www.redbooks.ibm.com/abstracts/redp5015.html?Open>
- *IBM DS8870 and NIST SP 800-131a Compliance*, REDP-5069
<http://www.redbooks.ibm.com/abstracts/redp5069.html?Open>
- *IBM DS8870 High Performance Flash Enclosure*, TIPS-1181
<http://www.redbooks.ibm.com/abstracts/tips1181.html?Open>
- *DS8000 Thin Provisioning*, REDP-4554:
<http://www.redbooks.ibm.com/abstracts/redp4554.html?Open>
- *DS8000 I/O Priority Manager*, REDP-4760:
<http://www.redbooks.ibm.com/abstracts/redp4760.html?Open>
- *LDAP Authentication for IBM DS8000 Storage*, REDP-4505:
<http://www.redbooks.ibm.com/abstracts/redp4505.html?Open>
- *IBM DS8000 Disk Encryption*, REDP-4500:
<http://www.redbooks.ibm.com/abstracts/redp4500.html?Open>
- *IBM Encrypted Storage Overview and Customer Requirements*:
<http://www-01.ibm.com/support/docview.wss?uid=tss1wp101479>
- *Introduction to Assist On-Site Software for Storage*, REDP-4889:
<http://www.redbooks.ibm.com/abstracts/redp4889.html?Open>
- *IBM Assist On-Site*:
<http://www.ibm.com/support/assistsite/>

- *IBM Tivoli Assist On-site Remote Support Utility User's Guide:*
https://aos.us.ihost.com/AssistOnSiteAdmin/docs/AOS_UTILITY_User_Guide.pdf
- *VPN Security and Implementation:*
<http://www.ibm.com/support/docview.wss?&rs=1114&uid=ssg1S1002693>
- *IBM System Storage DS8000 Host Attachment and Interoperability, SG24-8887:*
<http://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/sg248887.html?Open>
- *IBM DS8870 and VMware Synergy, REDP-4915:*
<http://www.redbooks.ibm.com/abstracts/redp4915.html?Open>
- *IBM DS8000 Command-Line Interface User's Guide for DS8000 Series, GC27-4212:*
<http://www.ibm.com/support/docview.wss?uid=ssg1S7002620>
- IBM DS8000 Information Center:
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