IBM System Storage DS8870
IBM Redbooks Product Guide

This IBM® Redbooks® Product Guide explains the IBM System Storage® DS8870 product. Built on over 50 years of enterprise disk storage expertise, the IBM System Storage DS8000® series is the flagship disk storage platform within the IBM System Storage portfolio. The new IBM System Storage DS8870 system represents the latest in this series of high-performance, high-capacity, flexible, and resilient disk storage systems, aimed at addressing the needs of the most demanding clients.

The DS8870 system represents another generational leap for the DS8000 series: It offers up to three times faster performance and 20% higher energy efficiency than its direct predecessor, the DS8800. The DS8000 architecture is server-based. Powerful IBM POWER7® processor-based servers manage the cache to minimize disk I/Os to maximize performance and throughput. The DS8870 is tremendously scalable, has broad server support, and virtualization capabilities. These features can help simplify the storage environment by consolidating multiple storage systems. The DS8870 excels in supporting the IBM zEnterprise® EC12 and high-end 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 IBM System Storage DS8870 product.

![Figure 1. DS8870 front view](image-url)
Did you know?

IBM Easy Tier®, a well-proven DS8000 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 for organizations that have not yet deployed solid-state drives (SSDs) or nearline drives.

Easy Tier, now in its fifth generation, offers additional features, still at no charge: Easy Tier Server, Easy Tier Application, and Easy Tier Heat Map Transfer. These additional features are briefly described in the Scalability and performance section.

Product highlights

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

Scalability and performance

The DS8870 model features IBM POWER7 p740 server technology to help support high performance.


The DS8870 model offers the following scalability and performance benefits:

- Simultaneous multithreading mode, SMT4, enables the POWER7 processor to maximize the throughput of the processor core.
- The DS8870 product is available with different processor options ranging from a dual 2-core system up to total of 16 cores covering a wide range of performance needs.
- Cache configurations are available that range from 16 GB up to 1 TB cache. The server architecture of the DS8870 product with its powerful POWER7 processors makes it possible to manage large caches with small cache segments of 4 KB (and therefore large segment tables) without the need to partition the cache. The POWER7 processors have enough power to implement sophisticated caching algorithms. These algorithms and the small cache segment size optimize cache hits. Therefore, the DS8870 product provides excellent I/O response times.

Write data is always protected by maintaining a copy of write-data in nonvolatile storage until the data is destaged to disks.

- The Adaptive Multi-stream Prefetching (AMP) caching algorithm can dramatically improve sequential performance, therefore reducing times for backup, processing for business intelligence, and 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 affecting each other.
• Advanced Easy Tier capabilities manage the SSD storage as a large and low latency cache for the hottest data, while preserving advanced disk system functions, such as RAID protection and remote mirroring. Easy Tier also includes these features:

  o Easy Tier Server, a unified storage caching and tiering solution across IBM AIX® servers and SAN storage. Easy Tier Server manages the data placement across Direct Attached Flash within IBM POWER® servers and DS8870 storage tiers by moving the hottest data to the Direct Attached Flash, while maintaining advanced feature functions.

  o The Easy Tier Application enables clients to assign distinct application volumes to a particular tier in the Easy Tier pool, disregarding the advanced Easy Tier data migration function. This provides a flexible option for clients that want to ensure certain applications remain on a particular tier to meet performance and cost requirements.

  o Easy Tier Heat Map Transfer is able to provide the data placement algorithm that 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 when failover occurs through the Easy Tier Heat Map Transfer utility. With this capability, DS8000 systems 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.

• I/O Priority Manager. This 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 IBM I/O Priority Manager allows increased interaction with the host side.

• Peripheral Component Interconnect Express (PCI Express Generation 2) I/O improves I/O operations per second (IOPS) and sequential read/write throughput. The I/O enclosures are directly connected to the internal servers with point-to-point PCI Express cables.

• Eight Gbps host adapters (HAs). The DS8870 model offers enhanced connectivity with 4-port and 8-port Fibre Channel/IBM FICON® host adapters located in the I/O enclosures that are directly connected to the internal processor complexes. The 8 Gbps Fibre Channel/FICON host adapter also supports FICON attachment to IBM System zEC12, IBM zEnterprise 196 (z196), IBM System z114, and IBM System z10®.

  Each port can be configured by the user to operate as a Fibre Channel port, a FICON port, or a Fibre Channel port used for mirroring.

• High Performance FICON for IBM System z® (zHPF). zHPF is the new z/OS I/O architecture. The z/OS access methods have been converted to use the new I/O commands. zHPF is an optional feature of the DS8870. The DS8870 is at the most up-to-date support level for zHPF. Recent 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.

• The system scales to more than 2.3 PB gross drive capacity and supports multiple drive tiers. The DS8870 supports a broad range of disk drives starting from very fast 400 GB SSDs fast 146 GB 15 K RPM SAS disk drives, to high-capacity Nearline-SAS 3 TB drives.

• Enhancements for System z environments are PAVs, HyperPAV, Multiple Allegiance, I/O priority queuing, I/O Priority Manager, and zHPF.

• Additionally, the machine offers end-to-end I/O priorities, cooperative caching, long busy wait host tolerance, or automatic port queues.
Availability and serviceability

The DS8870 model is designed and implemented with component redundancy to help avoid potential single points of failure. The DS8870 product offers high availability and multiplatform support, including System z:

- The DS8870 system offers up to 128 available host adapter ports. For Model 961, a maximum of eight 8-port host adapters is available, which is equal to 64 host adapter ports. With the first expansion model, 96E, another eight host adapters are available, which is equal to an additional 64 host adapter ports.
- A nondisruptive upgrade path for the DS8870 configurations and additional Model 96E expansion frames allows processor, cache, and storage enhancements to be performed concurrently without disrupting applications. The DS8870 system supports a nondisruptive upgrade from the smallest to the largest configuration.
- The Dynamic Volume Expansion simplifies management by enabling easier, online volume expansion (for Open Systems and System z) to support application data growth, and to support data center migration and consolidation to larger volumes to ease addressing constraints.
- The DS8870 system features Smart Rebuild, a function designed to help reduce the possibility of secondary failures and data loss in RAID arrays. The DS8870 system supports RAID 5, RAID 6, and RAID 10.
- High opportunity components are protected with redundancy and the ability to be repaired concurrently. The DS8870 offers greater-than-five-nines availability.
- For data protection and availability, the DS8870 system provides full sets of Mirroring and Copy functions. Copy Services are also now available for thin-provisioned volumes.
- Recent resiliency improvements include the following enhancements:
  - The improved IBM FlashCopy® handling of volume reservations provides the detection of SCSI reserves that exist for devices in a Metro Mirror or Global Mirror environment and resets the reserve when performing a FlashCopy after it has been identified that it is not a valid reserve for a running server.
  - z/OS Soft Fence prevents any system from accessing data from the former remote mirror primary site when an unplanned IBM HyperSwap® occurs.
- The DS8870 system supports an advanced disaster recovery solution and business continuity solution and also supports Thin Provisioning.
- The DS8870 system provides large volume support and supports LUN sizes up to 16 TB. This helps to simplify storage management tasks. In a z/OS environment, Extended Address Volumes (EAVs) with sizes up to 1 TB are supported.
- The Active Volume Protection feature prevents the deletion of volumes still in use.
- Support for the T10 Data Integrity Field standard is provided. The Data Integrity Field standard of SCSI T10 enables end-to-end data protection from the application or host host bus adapter (HBA) down to the disk drives.
- Support for IBM System i® variable logical unit number (LUN) adds flexibility for volume sizes and can increase capacity utilization for IBM i environments. Before, clients were limited to fixed LUN sizes of 35 GB, 70 GB, 141 GB, and 282 GB.
• Lightweight Directory Access Protocol (LDAP) authentication support allows single sign-on (SSO) functionality, which can simplify user management.

• The DS8870 system has been certified as meeting the requirements of the IPv6 Read Logo program, indicating its implementation of IPv6 mandatory core protocols and the ability to interoperate with other IPv6 implementations. The IBM DS8000 can be configured in native IPv6 environments. The logo program provides conformance and interoperability test specifications based on open standards to support IPv6 deployment globally. Furthermore, the US National Institute of Standards and Technology has tested IPv6 with the DS8000, therefore, granting it support from the USGV6 profile and testing program.

Environmentally friendly and energy efficient

Greater energy efficiency contributes to lower energy costs. The DS8870 system provides new DC uninterruptible power supplies that improve energy efficiency and are designed to support emerging energy-efficiency standards:

• The DS8870 product is designed to comply with the emerging ENERGY STAR specifications.
• High-density storage enclosures offer a considerable reduction in footprint and energy consumption.
• The DS8870 product has both hot-aisle and cold-aisle design to optimize airflow, cooling costs, and energy efficiency.
• The DS8870 product is Restriction of Hazardous Substances (RoHS)-compliant.

Security encryption

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

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

• Self-encrypted drives are a standard feature that can be activated. Consider using an additional IBM Security Key Lifecycle Manager (ISKLM) or IBM Tivoli® Key Lifecycle Manager server.
• The DS8870 product is now equipped with encryption-capable disk drives or SSDs.

Disk encryption key management helps address Payment Card Industry Data Security Standard (PCI-DSS) requirements:

• Encryption deadlock recovery key option: When enabled, this option allows the user to restore access to a DS8000 when the encryption key for the storage is unavailable due to an encryption deadlock scenario.
• Dual platform key server support: This is important if key servers on z/OS share keys with key servers on Open Systems. The DS8000 requires an isolated key server in encryption configurations. The isolated key server currently defined is an IBM System x® server. Dual platform key server support allows two server platforms to host the key manager with either platform operating in either clear key or secure key mode.
• Recovery key Enabling/Disabling and Rekey data key option for the Full Disk Encryption (FDE) feature: Both of these enhancements can help clients satisfy Payment Card Industry (PCI) security standards.
Advanced functions

The DS8870 product provides the following advanced functions:

- The DS8870 product provides an improved DS GUI management interface to configure the DS8870 product or to query status information. The DS8870 DS GUI has the same look-and-feel as the GUIs for other IBM storage products to make it easier for a storage administrator to work with different IBM storage products.
- Storage Pool Striping provides a mechanism to distribute a volume's or LUN's data across many RAID arrays and therefore across many disk drives. Storage Pool Striping helps maximize performance without special tuning and greatly reduces "hot spots" in arrays.
- Thin Provisioning allows 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.
- The Quick Initialization feature 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.
- Support for the VMware Virtual Array Integration Interface (VAAI).
- Like its predecessors, the DS8870 offers advanced Copy Services:
  - The optional FlashCopy feature 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 in parallel to production or to create test systems. The IBM FlashCopy space-efficient (SE) capability enables more space-efficient utilization of capacity for copies, enabling improved cost-effectiveness.
  - The DS8870 Remote Mirroring options provide 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.
  - In cooperation with the z/OS 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 configuring channel extenders by increasing the number of read commands in flight.
  - Metro Mirror, Global Copy, Global Mirror, and z/OS Metro/Global Mirror business continuity solutions are designed to provide the advanced functionality and flexibility needed to tailor a business continuity environment for almost any recovery point or recovery time objective.
  - Copy Services can be managed and automated with IBM Tivoli Storage Productivity Center for Replication. For z/OS environments, IBM Geographically Dispersed Parallel Sysplex™ (IBM GDPS®) provides an automated disaster recovery solution.
  - The Easy Tier Heat Map Transfer utility is also integrated with Tivoli Storage Productivity Center for Replication and all the functions are available through the Tivoli Storage Productivity Center for Replication 5.1.1.1 release.
  - Remote Pair FlashCopy allows 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.
- Resource Groups: This 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 the 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 specific operating system platform that is supported by the DS8870 system.
- Support for VMware vStorage 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.

- Support for IBM Storage Management Console for VMware vCenter: 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, IBM Storage Management Console is a powerful management solution for VMware administrators who want to control storage resources primarily from the VMware vSphere Client GUI.

**Architecture and key components**

The following list describes the main elements of the DS8870 architecture at a high level:

- A pair of POWER7 processor-based System Power servers, also known as Central Electronics Complex (CEC), are at the center of the DS8870 product. These two POWER7 processor-based servers share the load of receiving and moving data between the attached hosts and the disk arrays. However, they are also redundant so that if either server fails, the system operations fail over to the remaining server and continue to run without any host interruption.

  The POWER7 processors operate at 3.55 GHz and can scale from 2-core to 16-core processors. Among other innovations, the POWER7 processor includes a new simultaneous multithreading mode, SMT4, which allows four instruction threads to be executed 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 internal I/O Fabric that interconnects POWER7 processor-based servers with the I/O enclosures is based on and extends Peripheral Component Interconnect Express (PCIe). PCIe is a widely used industry standard for ultra-high performance and scalability and it is built-in hardware enterprise reliability. PCIe allows point-to-point interconnections between CECs and I/O enclosures.

- The I/O enclosures host custom intelligent adapters, designed for performance and reliability. Both the Host Adapter (HA) card for SAN and Device Adapter (DA) card for disk RAID are independent compute engines. They have both multi-core high-performance RISC processors and custom storage application-specific integrated circuits (ASIC). They offer direct high-speed connection to the I/O Fabric by means of PCIe.

- Each Host Adapter card has several ports that can be configured to operate as either a Fibre Channel (FC) port or FICON port. The adapter supports 2 Gbps, 4 Gbps, or 8 Gbps full data transfer over long-wave or shortwave Fibre links. HA cards are installed in pairs, so that it is possible to create redundant paths to HBAs in servers connected to DS8870.

- Each Device Adapter card offers four Fibre Channel Arbitrated Loop (FC-AL) ports. DA cards are configured in pairs in order to create redundancy in accessing disk drives. FC-AL ports are used to connect the CECs, through the I/O enclosures, to the disk enclosures. The adapter is responsible for managing, monitoring, and rebuilding the RAID arrays. DAs feature an 8 Gb Fibre Channel interconnect speed to connect with a 6 Gb SAS connection to the disk drives.
- Data disk drives known as disk drive modules (DDMs) are installed in enclosures called disk enclosures, storage enclosures, or gigapacks that are configured in pairs.

Each DDM in the DS8870 is attached to two Fibre Channel switches. These switches are built into the disk enclosure controller cards. Each disk has two separate connections to the backplane. This allows it to be simultaneously attached to both FC switches. If either disk enclosure controller card is removed from the enclosure, the switch that is included in that card is also removed. However, the FC switch in the remaining controller card retains the ability to communicate with all the disks and both DAs in a pair. Equally, each DA has a path to each switch, so it also can tolerate the loss of a single path. If both paths from one DA fail, it cannot access the switches. However, the partner DA retains connection.

Figure 2 shows the redundancy features of the DS8870 switched Fibre Channel disk architecture.

![DS8870 Storage Enclosure with Switched Dual Loops](image)

- The power subsystem in the DS8870 has been redesigned and enhanced with respect to previous generations of the DS8000 series family in order to have a higher energy efficiency, lower power loss, and improved reliability. The former Primary Power Supply (PPS) has been replaced by a Direct Current Uninterruptible Power Supply (DC-UPS). The DS8870 base frame consumes 20% less power than the DS8800.

All power and cooling components of the power subsystem are fully redundant. DC-UPSs are duplicated in each frame, so that only one DC-UPS, by itself, is able to provide enough power to all components inside that frame.

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 nonvolatile storage in case of a complete power outage.
The power subsystem offers these other key elements:

- Rack Power Control (RPC) cards manage the power subsystem, providing functions of control, monitoring, 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.

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

Figure 3 displays an overview of the physical components, depicting the architecture elements described previously.

![Figure 3. Front and back of the model 961 base](image)

The model 961 base includes the following elements (the following numbers correspond to the numbers in Figure 3):

1. Space for up to 10 disk enclosures (24 drives per gigapack) or up to 15 small form-factor (SFF) disk "drive sets" (16 drives per disk drive set). You can also install large form-factor (LFF) enclosures. In a maximum configuration, the base model can hold 240 SFF disk drives.
2. The Hardware Management Console (HMC) is located below the drives.
3. The POWER7 processor-based servers contain the processor and memory that drive all functions within the DS8870.

4. The I/O enclosures provide connectivity between the adapters and the storage processors. The adapters contained in the I/O enclosures can be either device adapters (DAs) or host adapters (HAs).

5. The base model contains DC-UPS power supplies. The DC-UPS provides rectified AC power distribution and power switching for redundancy.

6. A redundant pair of integrated Rack Power Control (RPC) cards coordinates the power management within the storage facility. The RPC cards are attached to the service processors in each complex allowing them to communicate with both the HMC and storage facility image logical partitions (LPARs). The RPC is also attached to the primary power system in each rack.

The DS8870 expansion frames, model 96E, have the same layout as the base frame model 961, except for the following differences:

- First expansion frame: It consists of a power subsystem (without RPC cards), I/O enclosures, and storage enclosures.
- Second and third expansion frames: They consist of a power subsystem (without RPC cards) and storage enclosures (no I/O enclosures in the second and third expansion frames).

Models

The DS8870 storage systems include the DS8870 Model 961 base frame and the associated DS8870 expansion frames 96E.

The DS8870 is available in the following configurations:

- **DS8870 Model 961 Business Class model**

  This configuration of the model 961 is available as a dual 2-way processor complex with storage enclosures for up to 144 DDMs and four FC host adapter cards. A Business Class system can be configured with either 16 GB or 32 GB of cache.

  The Business Class model is meant to offer a cost-efficient way to enter the DS8000 sphere for clients that are likely to continue with lower capacity or performance requirements and that use only a small subset of the DS8870 features. However, later upgrades into the Enterprise model are always possible. The use of Copy Services or the I/O Priority Manager feature requires at least a cache size of 32 GB when using the Business Class model.

- **DS8870 Model 961 Enterprise (or standard) model**

  This model is available as either a dual 4-way, dual 8-way, or dual 16-way processor complex with storage enclosures for up to 240 DDMs and eight FC host adapter cards. This standard model is optimized for performance and highly scalable configurations, allowing for large and long-term growth. The cache for this model scales between 64 GB and 1 TB.

- **DS8870 Model 96E**

  This expansion frame for the 961 model includes enclosures for additional DDMs and additional FC adapter cards to allow a maximum configuration of 16 FC adapter cards. The expansion frame 96E can only be attached to the 961 dual 8-way or dual 16-way base frame. Up to three expansion frames can be attached to a model 961. The additional FC adapter cards can only be installed in the first expansion frame.
Additionally, a lower-cost option is available via customer-requested price quotation (RPQ). This low-cost option utilizes a separate cabling scheme to reduce the initial configuration costs while increasing the device adapter utilization, which reduces associated performance. This RPQ cannot be applied to an existing DS8870. This RPQ cannot be converted later to the standard cabling option.

Table 1 summarizes the configuration options.

Table 1. Configuration options

<table>
<thead>
<tr>
<th>Model</th>
<th>Processor</th>
<th>Physical capacity (max.)</th>
<th>Disk drives (max.)</th>
<th>Memory (GB)</th>
<th>Host adapters (max.)</th>
<th>96E attached</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business class</td>
<td>2-core</td>
<td>216 TB</td>
<td>844</td>
<td>16</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Business class</td>
<td>2-core</td>
<td>216 TB</td>
<td>844</td>
<td>82</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Enterprise class</td>
<td>4-core</td>
<td>360 TB</td>
<td>240</td>
<td>54</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Enterprise class</td>
<td>8-core</td>
<td>1584 TB</td>
<td>1056</td>
<td>128</td>
<td>16</td>
<td>0 - 2</td>
</tr>
<tr>
<td>Enterprise class</td>
<td>8-core</td>
<td>2304 TB</td>
<td>1536</td>
<td>256</td>
<td>16</td>
<td>0 - 3</td>
</tr>
<tr>
<td>Enterprise class</td>
<td>16-core</td>
<td>2304 TB</td>
<td>1536</td>
<td>512</td>
<td>16</td>
<td>0 - 3</td>
</tr>
<tr>
<td>Enterprise class</td>
<td>16-core</td>
<td>2304 TB</td>
<td>1536</td>
<td>1024</td>
<td>16</td>
<td>0 - 3</td>
</tr>
<tr>
<td>Enterprise class</td>
<td>16-core</td>
<td>2304 TB</td>
<td>1536</td>
<td>2048</td>
<td>16</td>
<td>0 - 3</td>
</tr>
<tr>
<td>First expansion frame</td>
<td>96E</td>
<td>N/A</td>
<td>504 TB</td>
<td>336</td>
<td>N/A</td>
<td>3</td>
</tr>
<tr>
<td>Second and third expansion frame</td>
<td>96E</td>
<td>N/A</td>
<td>720 TB</td>
<td>480</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>
## Specifications

Table 2 summarizes the DS8870 specifications.

### Table 2. DS8870 specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>DS8870 (961, 96E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shared SMP processor configuration</td>
<td>POWER7 dual 2-core, 4-core, 8-core, or 16-core</td>
</tr>
<tr>
<td>Other major processors</td>
<td>IBM PowerPC®, application-specific integrated circuits (ASICs)</td>
</tr>
<tr>
<td>Processor memory for cache and nonvolatile storage (minimum/maximum)</td>
<td>16 GB/1,024 GB</td>
</tr>
<tr>
<td>Host adapter interfaces</td>
<td>4-port and 8-port 8 Gbps Fibre Channel/FICON</td>
</tr>
<tr>
<td>Host adapters (minimum/maximum)</td>
<td>2/16</td>
</tr>
<tr>
<td>Host ports (minimum/maximum)</td>
<td>8/128</td>
</tr>
<tr>
<td>Drive interface</td>
<td>5 Gbps point-to-point switched SAS-2 connection to an 8 Gbps Fibre Channel backbone</td>
</tr>
<tr>
<td>Number of disk drives (minimum/maximum)</td>
<td>8/1,536 (small-form factor)</td>
</tr>
<tr>
<td>Number of disk drives (minimum/maximum)</td>
<td>8/768 (large-form factor)</td>
</tr>
<tr>
<td>Device adapters</td>
<td>Up to sixteen 4-port, 8 Gbps Fibre Channel</td>
</tr>
<tr>
<td>Maximum physical storage capacity</td>
<td>2,304 TB (Usable capacity depends on factors, such as data format, RAID level, and spare disks, configured)</td>
</tr>
<tr>
<td>Disk sizes</td>
<td>400 GB SSDs</td>
</tr>
<tr>
<td>Disk sizes</td>
<td>146 GB (15k rpm) SAS</td>
</tr>
<tr>
<td>Disk sizes</td>
<td>300 GB (15k rpm) SAS</td>
</tr>
<tr>
<td>Disk sizes</td>
<td>500 GB (10k rpm) SAS</td>
</tr>
<tr>
<td>Disk sizes</td>
<td>900 GB (10k rpm) SAS</td>
</tr>
<tr>
<td>Disk sizes</td>
<td>3 TB (7.2k rpm and 3.5 in. form factor) SAS drive set</td>
</tr>
<tr>
<td>RAID levels</td>
<td>5, 6, and 10</td>
</tr>
<tr>
<td>Dimensions (height × width × depth)</td>
<td>193.4 cm × 84.8 cm × 122.7 cm (76 in × 33.4 in × 48.3 in) per frame, up to 4 frames total</td>
</tr>
<tr>
<td>Maximum weight of fully configured base models and expansion models</td>
<td>1,324 kg (2,920 lb) base rack</td>
</tr>
<tr>
<td>Maximum weight of fully configured base models and expansion models</td>
<td>1,265 kg (2,790 lb) first expansion</td>
</tr>
<tr>
<td>Maximum weight of fully configured base models and expansion models</td>
<td>1,310 kg (2,890 lb) additional frames</td>
</tr>
<tr>
<td>Dry bulb temperature, operating</td>
<td>16 °C - 32 °C (60 °F - 90 °F)</td>
</tr>
<tr>
<td>Relative humidity</td>
<td>20% - 80%</td>
</tr>
<tr>
<td>Power supply</td>
<td>Configurations: Single-phase or three-phase 50/60 Hz</td>
</tr>
<tr>
<td>Caloric value British thermal units per hour (BTU) (maximum)</td>
<td>20,612 (961 rack)</td>
</tr>
<tr>
<td>Caloric value British thermal units per hour (BTU) (maximum)</td>
<td>19,605 (96E rack)</td>
</tr>
<tr>
<td>Peak electrical power kVA (maximum)</td>
<td>5 (961 rack)</td>
</tr>
<tr>
<td>Peak electrical power kVA (maximum)</td>
<td>5.8 (96E rack)</td>
</tr>
</tbody>
</table>

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

The following list shows the main features, upgrades, and options that can be requested with new DS8870 orders or installed at a later time:

- Expansion frames, model 96E. See Table 3 to see the new maximum capacities when adding expansion frames.
- Processor and Cache. See Figure 4 to check the different options related to processor/cache updates.
- Disk drive modules (DDMs) can be ordered via disk drive sets. A disk drive set contains sixteen identical disk drives, although for solid-state drives (SSDs), the capability exists to order a half drive set of eight DDMs. All DDMs are Full Disk Encrypted (FDE)-capable and small form factor (SFF) in size but the Nearline drives are large form factor (LFF). All DDMs can be installed both in base 961 and expansion 96E models. The following list shows the available DDMs for DS8870:
  - 146 GB and 300 GB (15K rpm) enterprise disks for high performance requirements
  - 600 GB and 900 GB (10K rpm) disk drives for standard performance requirements
  - 3 TB (7200 K rpm) Nearline-SAS disk drives for large-capacity requirements
  - 400 GB solid-state drives (SSDs) for the highest performance demands
- Standby Capacity on Demand (CoD) is an offering that, when ordered, allows up to six Standby CoD disk drive sets (96 disk drives) to be factory-installed or field-installed into your system. To activate, you logically configure the disk drives for use. This is a nondisruptive activity that does not require intervention from IBM. Upon activation of any portion of a Standby CoD disk drive set, you must place an order with IBM to initiate billing for the activated set. Only SSD disk drives cannot support CoD.
- Device Adapter (DA) pairs and disk enclosure pairs can be also ordered when needed to support disk drive sets that have been requested.
- Host Adapters (HAs) can increase connectivity with host servers. HAs are available with four ports or eight ports and HA ports can be configured as Fibre Channel or FICON. The 8 Gb Fibre Channel/FICON host adapter is available for long-wave and shortwave fabrics. It is able to auto-negotiate to either 8 Gb, 4 Gb, or 2 Gb link speeds.
- The Extended Power Line Disturbance (ePLD) option is designed to protect your storage unit for 50 seconds, rather than for only 4 seconds, from a power-line disturbance. If no ePLD option is ordered, one Battery Set Module (BSM) set per Direct Current Uninterruptible Power Supply (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.
- An external Hardware Management Console (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 the encryption capability has been activated.
- If you want to use the DS8870 encryption capability, IBM Tivoli Key Lifecycle Manager servers are available for order. A Tivoli Key Lifecycle Manager server will have a Linux operating system and the Tivoli Key Lifecycle Manager software preinstalled. A Tivoli Key Lifecycle Manager license is required for use with the Tivoli Key Lifecycle Manager software. The software is purchased separately from the Tivoli Key Lifecycle Manager isolated server hardware. The licensing for Tivoli Key Lifecycle Manager includes both an installation license for the Tivoli Key Lifecycle Manager management software and licensing for the encrypting drives.
- The remote IBM zSeries® power control setting allows one or more attached System z hosts to control the power-on and power-off sequences for your DS8870. If you use the remote zSeries power control setting, you must meet the following requirements:
  - Order the remote zSeries power control feature.
  - Allow up to four interfaces for remote zSeries power control.
Overhead cabling: Overhead cabling (top exit) is available for DS8870 as an alternative to the standard rear cable exit.

The shipping weight reduction option allows you to receive delivery of a DS8870 model in multiple shipments. If your site has delivery weight constraints, IBM offers a shipping weight reduction option that ensures that the maximum shipping weight of the initial model shipment does not exceed 909 kg (2,000 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

DS8870 offers the Enterprise Choice warranty of one, two, three, or four years on both the hardware and the advanced function software in the following way:

- Four years on type 2424 models
- Three years on type 2423 models
- Two years on type 2422 models
- One year on type 2421 models

Table 3 shows a capacity comparison of resources depending on the expansion frames installed.

Table 3. Capacity comparison of device adapters, DDMs, and storage capacity (2012)

<table>
<thead>
<tr>
<th>Component</th>
<th>2-way business class base frame</th>
<th>4/8/16-way enterprise class base frame</th>
<th>8-way or 16-way, with one expansion frame</th>
<th>8-way or 16-way, with two expansion frames</th>
<th>8-way (large cache) or 16-way, with three expansion frames</th>
</tr>
</thead>
<tbody>
<tr>
<td>DA pairs</td>
<td>1 or 2</td>
<td>1 to 4</td>
<td>5 to 8</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>HDDs</td>
<td>Up to 144</td>
<td>Up to 240</td>
<td>Up to 576</td>
<td>Up to 1,056</td>
<td>Up to 1,536</td>
</tr>
<tr>
<td>SSDs</td>
<td>N/A</td>
<td>Up to 192</td>
<td>Up to 384</td>
<td>Up to 384</td>
<td>Up to 384</td>
</tr>
<tr>
<td>Physical capacity, gross 2.5&quot; SFF disks (PB/TB definition according to ISO/IEC 80000-13)</td>
<td>Up to 130 TB</td>
<td>Up to 216 TB</td>
<td>Up to 518 TB</td>
<td>Up to 950 TB</td>
<td>Up to 1,38 PB</td>
</tr>
<tr>
<td>Capacity, net RAID-5 2.5&quot; SFF disks</td>
<td>Up to 100 TB</td>
<td>Up to 164 TB</td>
<td>Up to 399 TB</td>
<td>Up to 755 TB</td>
<td>Up to 1.11 PB</td>
</tr>
<tr>
<td>Physical capacity, gross 3.5&quot; LFF disks</td>
<td>Up to 216 TB</td>
<td>Up to 360 TB</td>
<td>Up to 864 TB</td>
<td>Up to 1.58 PB</td>
<td>Up to 2.30 PB</td>
</tr>
<tr>
<td>Physical capacity, net RAID-6 3.5&quot; LFF disks</td>
<td>Up to 130 TB</td>
<td>Up to 213 TB</td>
<td>Up to 521 TB</td>
<td>Up to 1.01 PB</td>
<td>Up to 1.51 PB</td>
</tr>
</tbody>
</table>
Figure 4 shows all available processor/cache upgrade paths.

<table>
<thead>
<tr>
<th>DS8870 Upgrade Path</th>
<th>Business Class</th>
<th>Enterprise Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>dual 2 core 16GB</td>
<td>dual 4 core 64GB</td>
</tr>
<tr>
<td>dual 2 core 16GB</td>
<td>YES*</td>
<td>YES</td>
</tr>
<tr>
<td>dual 2 core 32GB</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>dual 4 core 64GB</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>dual 8 core 128GB</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>dual 8 core 256GB</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>dual 16 core 512GB</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

*) All available upgrade paths are direct, step number is just indicated for informational purposes.

YES One-step upgrade

YES Two-step upgrade

YES Three-step upgrade

Figure 4. Processor/cache upgrade paths

It is now possible to model-convert a DS8800 to a DS8870. This conversion utilizes existing storage enclosures, disk drives, host adapters, and device adapters. All other hardware is physically replaced. This conversion process can only be performed by an IBM service representative.

Particular licensed functions

Many of the software optional licensed functions of the 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 OEL licenses the operating environment and is based on the total physical capacity of the 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), Count Key Data (CKD), or both (FB and CKD).

Each 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. For Easy Tier, we need a license key, but because Easy Tier is no-charge, it is usually generally configured. Encryption activation has a special procedure as indicated in the Options section.
Function indicators and authorization feature numbers are listed in Table 4.

Table 4. DS8870 licensed functions

<table>
<thead>
<tr>
<th>Licensed function for DS8000 with Enterprise Choice warranty</th>
<th>IBM 242x indicator feature numbers</th>
<th>IBM 239x function authorization model and feature numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Environment License</td>
<td>0700 and 70xx</td>
<td>239x Model LFA, 703x/705x</td>
</tr>
<tr>
<td>FICON Attachment</td>
<td>0703 and 7091</td>
<td>239x Model LFA, 7091</td>
</tr>
<tr>
<td>Thin Provisioning</td>
<td>0707 and 7071</td>
<td>239x Model LFA, 7071</td>
</tr>
<tr>
<td>Database Protection</td>
<td>0708 and 7080</td>
<td>239x Model LFA, 7080</td>
</tr>
<tr>
<td>High Performance FICON</td>
<td>0709 and 7092</td>
<td>239x Model LFA, 7092</td>
</tr>
<tr>
<td>Easy Tier</td>
<td>0713 and 7083</td>
<td>239x Model LFA, 7083</td>
</tr>
<tr>
<td>Easy Tier Server</td>
<td>0715 and 7084</td>
<td>239x Model LFA, 7084</td>
</tr>
<tr>
<td>z/OS Distributed Data Backup</td>
<td>0714 and 7094</td>
<td>239x Model LFA, 7094</td>
</tr>
<tr>
<td>FlashCopy</td>
<td>0720 and 72xx</td>
<td>239x Model LFA, 725x - 726x</td>
</tr>
<tr>
<td>Space Efficient FlashCopy</td>
<td>0730 and 73xx</td>
<td>239x Model LFA, 735x - 736x</td>
</tr>
<tr>
<td>Metro/Global Mirror</td>
<td>0742 and 74xx</td>
<td>239x Model LFA, 748x - 749x</td>
</tr>
<tr>
<td>Metro Mirror</td>
<td>0744 and 75xx</td>
<td>239x Model LFA, 750x - 751x</td>
</tr>
<tr>
<td>Global Mirror</td>
<td>0746 and 75xx</td>
<td>239x Model LFA, 752x - 753x</td>
</tr>
<tr>
<td>z/OS Global Mirror</td>
<td>0760 and 76xx</td>
<td>239x Model LFA, 765x - 766x</td>
</tr>
<tr>
<td>z/OS Global Mirror Incremental Resync</td>
<td>0763 and 76xx</td>
<td>239x Model LFA, 768x - 769x</td>
</tr>
<tr>
<td>Parallel Access Volumes</td>
<td>0780 and 78xx</td>
<td>239x Model LFA, 782x - 783x</td>
</tr>
<tr>
<td>HyperPAV</td>
<td>0782 and 7899</td>
<td>239x Model LFA, 7899</td>
</tr>
<tr>
<td>I/O Priority Manager</td>
<td>0784 and 784x</td>
<td>239x Model LFA, 784x - 785x</td>
</tr>
</tbody>
</table>

For more details, consult the IBM publication *IBM System Storage DS8870 Introduction and Planning Guide*, GC27-4209.

Related publications and links

- DS8870 support  
  [http://ibm.co/UBoMzS](http://ibm.co/UBoMzS)
- IBM Assist On-site  
- IBM Data Storage Feature Activation (DSFA)  
- IBM DS8000 VPN Implementation  
- IBM Encrypted Storage Overview and Customer Requirements  
- IBM Redbooks: *IBM System Storage DS8870 Architecture and Implementation*, SG24-8085  
- IBM Redbooks: *Introduction to Assist On-site for DS8000*, REDP-4889  
- IBM Redbooks: *IBM System Storage DS8000: Copy Services for Open Systems*, SG24-6788  
- IBM Redbooks: *IBM System Storage DS8000: Copy Services for IBM System z*, SG24-6787  
- IBM Redbooks: *IBM System Storage DS8000 Disk Encryption*, REDP-4500  
- IBM Redbooks: *IBM System Storage DS8000 Host Attachment and Interoperability*, SG24-8887
- IBM Redbooks: *IBM System Storage DS8000: LDAP Authentication*, REDP-4505
- IBM Redbooks: *IBM System Storage DS8000 Easy Tier*, REDP-4667
- IBM Redbooks: *IBM System Storage DS8000 Easy Tier Server*, REDP-5013
- IBM Redbooks: *IBM System Storage DS8000 Easy Tier Application*, REDP-5014
- IBM Redbooks: *IBM System Storage DS8000 Easy Tier Heat Map Transfer Server*, REDP-5015
- IBM Redbooks: *IBM System Storage DS8000 Series: Resource Groups*, REDP-4758
- IBM Redbooks: *DS8000 I/O Priority Manager*, REDP-4760
- IBM Redbooks: *DS8000 Thin Provisioning*, REDP-4554
- IBM Redbooks: *DS8870 VMware VAAI support*, REDP-4915
- IBM Redbooks: *IBM Power 720 and 740 Technical Overview and Introduction*, REDP-4797
- IBM Redbooks: *Introduction to PCI Express*, TIPS-0456
  http://www.ibm.com/support/docview.wss?uid=ssg1S7002620
- IBM Redbooks: *IBM System Storage DS8000 242x Model 961 Installing a Storage Facility*, GA32-2236
  http://publib.boulder.ibm.com/infocenter/ds8000ic/index.jsp
- IBM System Storage® DS8000 Information Center
  http://publib.boulder.ibm.com/infocenter/ds8000ic/index.jsp
- IBM System Storage DS8000 series high-performance flagship - Function Authorizations for machine type 239x - Product Announcement (October 3, 2012)
  http://ibm.co/YZFp1b
- IBM System Storage Interoperation Center (SSIC)
  http://www.ibm.com/systems/support/storage/ssic
- IBM System Storage DS8870 (Machine type 2421) Models 961 and 96E with one-year warranty - Product Announcement (October 3, 2012)
  http://ibm.co/127P8kG
- IBM System Storage DS8870 (Machine type 2422) Models 961 and 96E with two-year warranty - Product Announcement (October 3, 2012)
  http://ibm.co/12ToWrW
- IBM System Storage DS8870 (Machine type 2424) Models 961 and 96E with four-year warranty - Product Announcement (October 3, 2012)
  http://ibm.co/U79h4n
- IBM Tivoli Storage Productivity Center Information Center
• IBM Tivoli Storage Productivity Center for Replication Reporter for Disk

• Statement of direction: IBM DS8000 series, Scale Out Network Attached Storage, XIV®, and
  Storwize® V7000 Unified
  http://ibm.co/VVcObw
Notices

This information was developed for products and services offered in the U.S.A.

IBM may not offer the products, services, or features discussed in this document in other countries. Consult your local IBM representative for information on the products and services currently available in your area. Any reference to an IBM product, program, or service is not intended to state or imply that only that IBM product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any IBM intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any non-IBM product, program, or service. IBM may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not give you any license to these patents. You can send license inquiries, in writing, to:

IBM Director of Licensing, IBM Corporation, North Castle Drive, Armonk, NY 10504-1785 U.S.A.

The following paragraph does not apply to the United Kingdom or any other country where such provisions are inconsistent with local law: INTERNATIONAL BUSINESS MACHINES CORPORATION PROVIDES THIS PUBLICATION "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some states do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you. This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. IBM may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

Any references in this information to non-IBM Web sites are provided for convenience only and do not in any manner serve as an endorsement of those Web sites. The materials at those Web sites are not part of the materials for this IBM product and use of those Web sites is at your own risk. IBM may use or distribute any of the information you supply in any way it believes appropriate without incurring any obligation to you. Information concerning non-IBM products was obtained from the suppliers of those products, their published announcements or other publicly available sources. IBM has not tested those products and cannot confirm the accuracy of performance, compatibility or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products. This information contains examples of data and reports used in daily business operations. To illustrate them as completely as possible, the examples include the names of individuals, companies, brands, and products. All of these names are fictitious and any similarity to the names and addresses used by an actual business enterprise is entirely coincidental.

Any performance data contained herein was determined in a controlled environment. Therefore, the results obtained in other operating environments may vary significantly. Some measurements may have been made on development-level systems and there is no guarantee that these measurements will be the same on generally available systems. Furthermore, some measurement may have been estimated through extrapolation. Actual results may vary. Users of this document should verify the applicable data for their specific environment.

COPYRIGHT LICENSE:

This information contains sample application programs in source language, which illustrate programming techniques on various operating platforms. You may copy, modify, and distribute these sample programs in any form without payment to IBM, for the purposes of developing, using, marketing or distributing application programs conforming to the application programming interface for the operating platform for which the sample programs are written. These examples have not been thoroughly tested under all conditions. IBM, therefore, cannot guarantee or imply reliability, serviceability, or function of these programs.

© Copyright International Business Machines Corporation 2013. All rights reserved.

Note to U.S. Government Users Restricted Rights -- Use, duplication or disclosure restricted by GSA ADP Schedule Contract with IBM Corp.
The following terms are trademarks of other companies:

Linux is a trademark of Linus Torvalds in the United States, other countries, or both.

Other company, product, or service names may be trademarks or service marks of others.