

FlashSystem 900 Product Guide

IBM Redbooks Product Guide

Today's global organizations depend upon the ability to unlock business insights from massive volumes of data. Now, with IBM FlashSystem 900, they can make faster decisions based on real-time insights and unleash the power of the most demanding applications, including online transaction processing (OLTP) and analytics databases, virtual desktop infrastructures (VDIs), technical computing applications, and cloud environments.

Easy to deploy and manage, the IBM FlashSystem 900 is designed to accelerate the applications that drive business. Powered by IBM FlashCore™ Technology, IBM FlashSystem provides the following characteristics:

- Extreme performance with IBM MicroLatency™ delivers 90 μ s write latency and 155 μ s read latency
- Macro efficiency lowers operating costs and increases efficiency of IT infrastructure by using much less power and space than traditional hard disk drive (HDD) and solid-state disk (SSD) solutions
- Enterprise reliability protects critical assists with two-dimensional RAID protection, IBM Variable Stripe RAID, redundant and hot-swappable components, and concurrent code loads

FlashSystem 900 can be configured in capacity points as low as 2.4 TB usable after RAID 5 protection. Coupled with 10 Gbps iSCSI, FlashSystem is positioned to bring extreme performance to small and medium businesses (SMBs) and growth markets. Figure 1 shows FlashSystem 900.



Figure 1. FlashSystem 900

At the heart of FlashSystem 900 is IBM FlashCore Technology, which consists of the following three key elements:

- Hardware-accelerated architecture that is engineered for flash, with hardware only data path
- IBM MicroLatency modules that are designed for low latency, density, and reliability
- IBM Advanced Flash Management that improves MLC flash endurance 9x over standard implementations without sacrificing latency

Figure 2 shows IBM FlashCore Technology

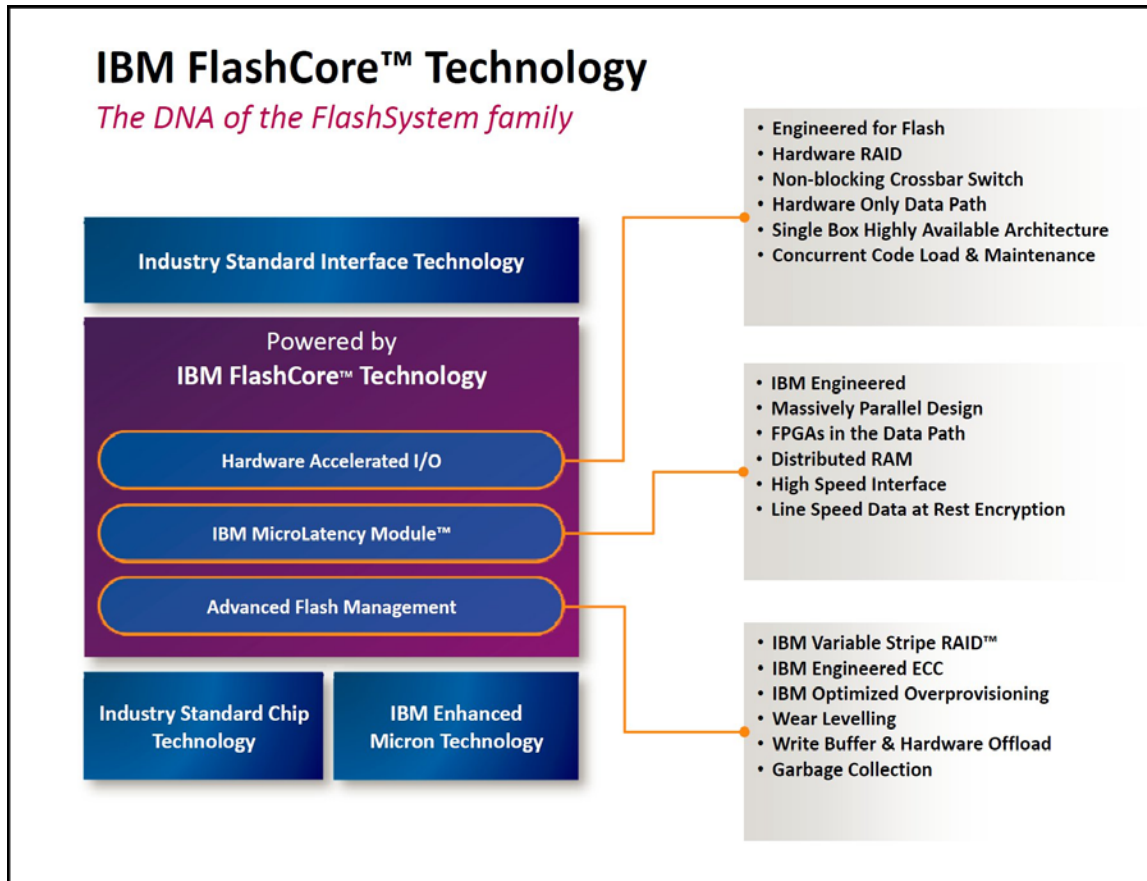


Figure 2. IBM FlashCore Technology

Did you know?

FlashSystem 900 has these characteristics:

- FlashSystem 900 is configurable with 2.4 - 57 TB of usable capacity for scalability and flexibility.
- FlashSystem 900 provides flexible interface types including Fibre Channel, Fibre Channel over Ethernet (FCoE), iSCSI, and InfiniBand to easily integrate into existing SAN environments.
- FlashSystem 900 offers hardware-based AES 256 data-at-rest encryption with no performance impact.

Key features

FlashSystem 900 provides extreme performance with IBM MicroLatency™, macro efficiency, and enterprise reliability.

Scalability and performance

FlashSystem 900 has the following scalability and performance features:

- IBM FlashCore technology for consistently high performance at lower cost
 - 90us/155us read/write latency
 - Up to 1.1 million random read 4 K IOPS
 - Up to 10 GB/second read bandwidth
- IBM-enhanced Micron MLC technology for higher storage density and improved endurance
- Flexible interface types of Fibre Channel, Fibre Channel over Ethernet (FCoE), iSCSI, and InfiniBand
 - Up to 16 ports of 8 Gbps or eight ports of 16 Gbps Fibre Channel
 - Up to 16 ports of 10 Gbps FCoE
 - Up to 16 ports of 10 Gbps iSCSI
 - Up to eight ports of 40 Gbps quad data rate (QDR) InfiniBand
- Slots for up to 12 hot-swappable IBM MicroLatency storage modules (1.2 TB, 2.9 TB, or 5.7 TB)
- Configurable 2.4 - 57 TB of capacity for increased flexibility

Enterprise-class reliability features

FlashSystem 900 delivers the following enterprise-class reliability features:

- Concurrent code load enables customer applications to remain online during firmware upgrades to all components, including the IBM MicroLatency modules.
- Hot-swappable IBM MicroLatency modules by way of tool-less front panel access. If a MicroLatency module failure occurs, critical customer applications can remain online while the defective module is replaced.
- All active components are redundant and hot-swappable, including IBM MicroLatency modules, RAID controllers, management modules, interface, batteries, fans, and power supplies.
- All components are easily accessible through the front or rear of the enclosure, so IBM FlashSystem 900 does not need to be moved in the rack and no top access panels or cables need to be extended.
- Two-dimensional (2D) Flash RAID, which consists of IBM Variable Stripe RAID and system-wide RAID 5. Variable Stripe RAID technology helps reduce downtime and maintain performance and capacity in the event of partial or full flash chip failures. System-wide RAID 5, with easily accessed hot swappable flash modules, helps prevent data loss and promote availability.
- IBM Advanced Flash Management improves flash endurance 9x over standard implementations with IBM engineered ECC, advanced wear leveling, and proprietary garbage collection, relocation, and block picking algorithms.

Energy and space efficiency

FlashSystem 900 has the following energy and space efficiency characteristics:

- 40% greater density than previous generation
- 4x greater capacity than competitive all-flash products
- Reduced power, space, and cooling with only 625 watts typical operating power and 2U form factor

Manageability and security

FlashSystem 900 offers the following manageability and security features:

- Hardware-accelerated AES-XTS 256-bit data at rest encryption including Hot Encryption Activation and Hot Encryption Re-key
- Intuitive graphical user interface (GUI) and command-line interface (CLI) which is available in any supported browser
- Simple Network Management Protocol (SNMP)
- Email alerts
- Syslog redirect to send system log messages to another host

Architecture and key components

IBM FlashSystem 900 enclosures include two fully redundant canisters. Each canister contains a RAID controller, two interface cards, and a management controller with an associated 1 Gbps Ethernet port. Each canister also has a USB port and two hot-swappable fan modules.

In addition to the canisters, IBM FlashSystem 900 enclosures include two battery modules and two power supplies, which are all redundant and hot-swappable. All components are easily accessible from the front or rear of the unit, so IBM FlashSystem 900 does not need to be moved in the rack, and any top access panels or cables do not need to be extended. This configuration makes servicing the unit easy. The front of the enclosure has the two battery modules on the far left of the enclosure, a LED indicator panel next to this, and twelve IBM MicroLatency module slots to the right of the panel and battery modules, as shown in Figure 3.

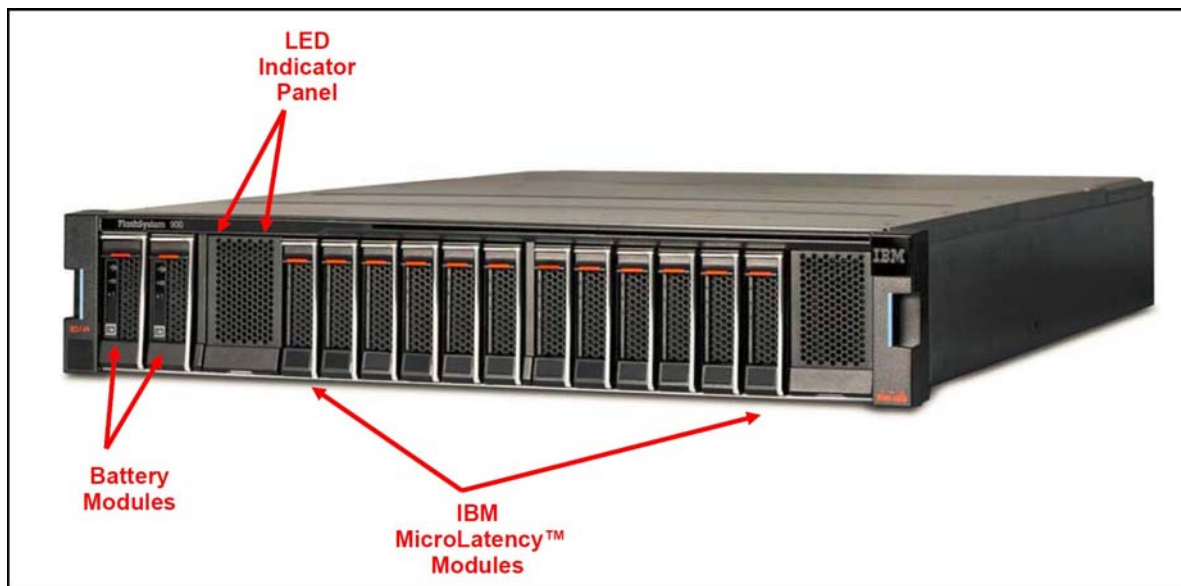


Figure 3. Front view of FlashSystem 900

Figure 4 shows the components of IBM FlashSystem 900 from the rear. One of the two canisters is removed, and you see two interface cards and two fan modules. The power supply unit to the right of the fans provides redundant power to the system. All components are concurrently maintainable except for the passive midplane, enclosure LED board, and power interposer board. All external connections are from the rear of the system.

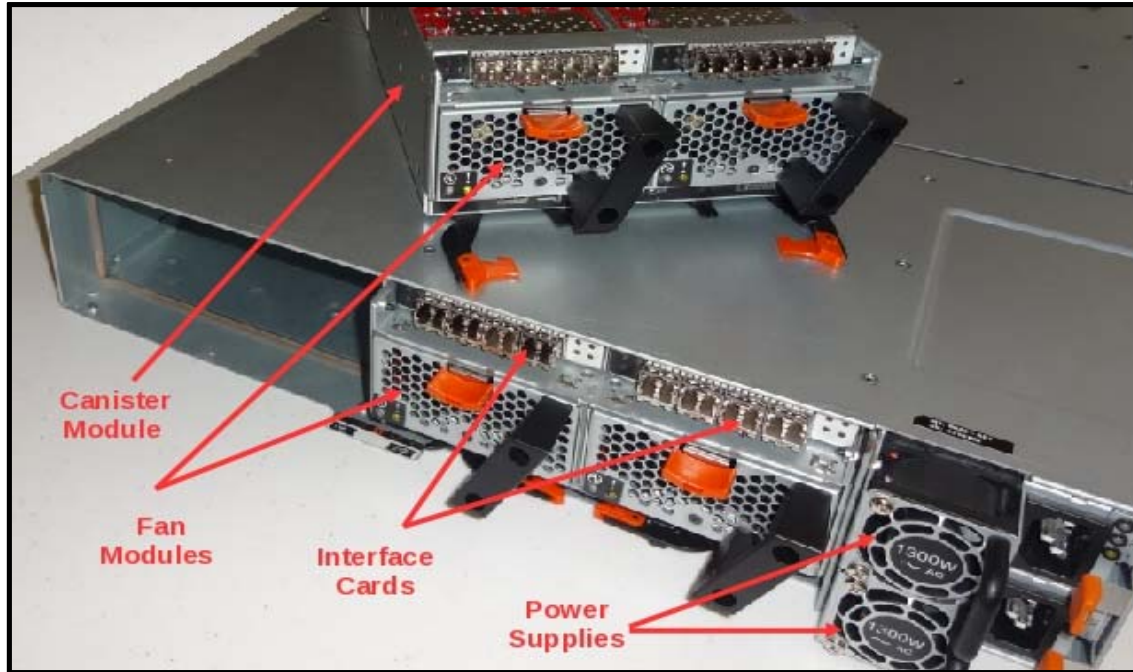


Figure 4. Rear view of FlashSystem 900 with one canister removed

Figure 5 shows a rear view of FlashSystem 900 with Fibre Channel or FCoE interfaces. The canisters are to the left (large units) and the two power supply units are to the right (small units).

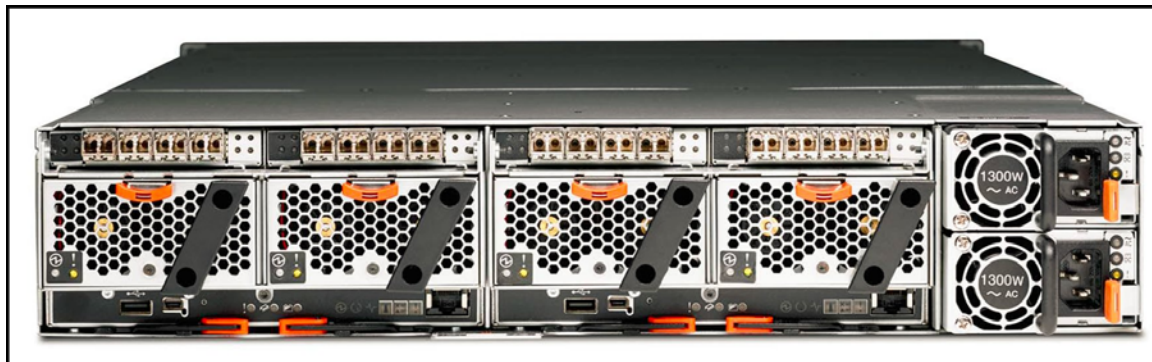


Figure 5. Rear view with Fibre Channel interface cards

Specifications

Table 1 lists the specifications for FlashSystem 900.

Table 1. Specifications (part 1 of 2)

Specification	Description
Model	9840-AE2, 9843-AE2.
Form factor	2U rack-mounted enclosure.
IBM MicroLatency module quantity	Up to 12 IBM MicroLatency modules in increments of 4, 6, 8, 10, or 12 for the 1.2 TB module, and 6, 8, 10, or 12 for the 2.9 TB or 5.7 TB modules. Modules of either 1.2 TB, 2.9 TB, or 5.7 TB cannot be intermixed.
Flash type	IBM-enhanced MLC
Raw capacity (TB/TiB)	7.1 TB/6.6 TiB, 10.7TB/9.7 TiB, 14.2TB/13.0 TiB, 17.8 TB/16.2 TiB, 21.4 TB/19.5 TiB, 26.3 TB/24.0 TiB, 35.1 TB/32.0 TiB, 43.9 TB/40.0 TiB, 52.7 TB/48.0 TiB, 70.3 TB/64.0 TiB, 87.9 TB/80.0 TiB and 105.5 TB/96.0 TiB
RAID 5 usable capacity (TB/TiB)	2.4 TB/2.1 TiB, 4.8 TB/4.3 TiB, 7.2 TB/6.5 TiB, 9.6 TB/8.3 TiB, 11.6 TB/10.5 TiB, 12 TB/10.9 TiB, 17.4 TB/15.8 TiB, 22.8 TB/20.72 TiB, 23.2 TB/21.1 TiB, 29 TB/26.3 TiB, 34.2 TB/31.1 TiB, 45.6 TB/41.4 TiB and 57 TB/51.8 TiB
Maximum capacity	For RAID 5, the maximum capacity is 57 TB. Note that RAID 0 is not supported on the FlashSystem 900.
IBM MicroLatency module protection	ECC error correction, Variable stripe RAID data protection, overprovisioning, and IBM two-dimensional Flash RAID.
RAID support	RAID 5
Host interfaces	Two RJ45 Ethernet connections for management and up to 16 host interface connections, which are either SFP+ FC or QSFP InfiniBand connections, depending on the selected features.
Maximum bandwidth	10 GBps Read (100%, sequential), 4.5 GBps Write (100%, sequential).
Read IOPS (100% Random)	1,100,000.
Write IOPS (100% Random)	600,000.
Read latency	155 μ s.
Write latency	90 μ s.
Maximum volume support (LUNs)	2 K (2048).
System management	<ul style="list-style-type: none"> o IBM FlashSystem 900 GUI is available in any supported browser. o IBM FlashSystem 900 CLI. o SNMP. o Email alerts. o Syslog redirect.

Table 1. Specifications (part 2 of 2)

Specification	Description
Cooling	Four hot-swappable fan modules.
Power supply	1300 watts, high-power version to run at maximum performance for longer durations during power supply servicing. Two redundant hot-swap 200 - 240V AC auto-sensing power supplies.
Input power	1300 watts maximum, 625 watts RAID5 typical operation, per 2U
Heat dissipation	Approximately 2133 BTU (assuming 625W). For maximum configurations, it could go as high as 3753 BTU (maximum configuration using RAID 5).
Hot-swap parts	All active components.
Security features	AES-XTS 256 bit data-at-rest encryption with local key management. Two new functions have been added to the encryption feature and can be accessed by using the FlashSystem 900 GUI: <ul style="list-style-type: none"> o Hot Encryption Activation - Adding an encryption license to a previously initialized system o Encryption Re-key - Changing the encryption key on a previously initialized system
Platforms supported	For specific information, see the IBM System Storage Interoperation Center (SSIC) at http://www.ibm.com/systems/support/storage/ssic/interoperability.wss
Warranty	Set of Machine Types in AAS, 24 X 7 Service level Agreement, 4 hour response time: <ul style="list-style-type: none"> o 9840-AE2 - One year. o 9843-AE2 - Three years.
Service and support	Optional warranty service upgrades and post-warranty services are available on site with 24x7 2-6 hour response, 24x7, or 9x5 same day, or 9x5 next business day response,
Physical Specifications	
Dimensions	Width: 445 mm (17.5 in.) (19-inch Rack Standard) Depth: 761 mm (29.96 in.) Height: 86.2 mm (3.39 in.)
Weight	34 Kg (75 lb) for fully configured machine (12 IBM MicroLatency modules)

Models

The following set of Machine Types are supported in AAS as follows:

- 9840-AE2 - Warranty period 1 year
- 9843-AE2 - Warranty period 3 years

All FlashSystem 900. Storage systems include the IBM MicroLatency modules and blanks, power supplies, fans, and canisters preinstalled. The IBM MicroLatency module type and quantity and the host interface I/O cards must be pre-specified. The batteries are packaged separately and must be installed by the person performing the FlashSystem 900 installation, before powering on the machine.

The following items are also shipped with FlashSystem 900:

- System chassis
- Rack rail kit
- Warranty documentation
- Printed quick start guide
- Selected power cables
- Selected interface cables (if any)
- License CD

Interface cards

IBM FlashSystem 900 supports only one interface type per system. For example, it is not possible to use two Fibre Channel interface cards and two InfiniBand interface cards in the same enclosure.

Interface cards are sold in groups of two feature codes (providing a total of four cards), and supply interfaces of either eight or 16 ports for each system.

IBM FlashSystem 900 supports the following interface protocols and number of connections:

- Fibre Channel (16 ports of 8 Gbps; these ports also support 4 Gbps)
- Fibre Channel (eight ports of 16 Gbps; these ports also support 8 Gbps and 4 Gbps)
- FCoE (16 ports of 10 Gbps FCoE)
- Internet Small Computer System Interface (iSCSI) (16 ports of 10 Gbps iSCSI)
- InfiniBand (eight ports of QDR InfiniBand 40 Gbps)

Fibre Channel support

The Fibre Channel and FCoE protocols use the same interface cards. However, only one protocol is supported per IBM FlashSystem 900 enclosure. Figure 6 shows the Fibre Channel interface card.

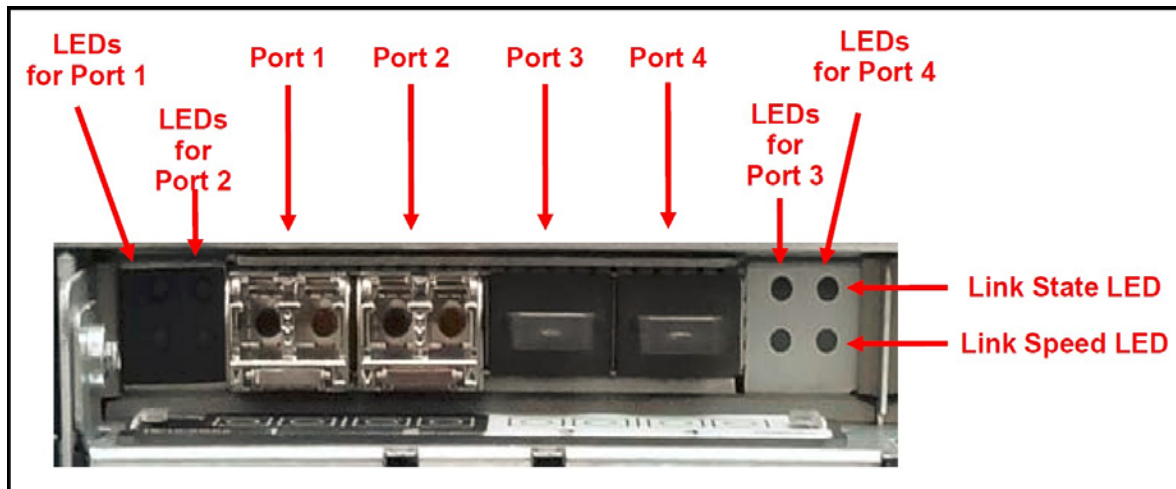


Figure 6. Fibre Channel interface card (example shows a 16 Gbps Fibre Channel card)

IBM FlashSystem 900 supports the 16 Gbps Fibre Channel connection speed through the standard Fibre Channel interface card.

Here are the rules for supporting 16 Gbps Fibre Channel on IBM FlashSystem 900:

- If you use 16 Gbps Fibre Channel, only two (of the four) ports on the Fibre Channel modules can be used. The two left-most ports (1 and 2) on each interface card are used for 16 Gbps support. If your system is configured for 16 Gbps Fibre Channel, only the two leftmost ports (1 and 2) per interface adapter are used. The other two ports are disabled.
- If you use 16 Gbps Fibre Channel, all four of the Fibre Channel modules are configured for 16 Gbps. This configuration supports a total of eight Fibre Channel ports for the system (2 ports x 4 interface cards)
- Four Gbps and 8 Gbps Fibre Channel connections are supported on the same system connecting to 16 Gbps devices, but there are still only a total of eight available active ports (ports 1 and 2 on each interface card). For example, an IBM FlashSystem 900 system can have four Fibre Channel connections at 16 Gbps and four Fibre Channel connections at 8 Gbps.
- Fibre Channel interfaces support Fibre Channel Protocol (FCP) only, with point-to-point (FC-P2P), arbitrated loop (FC-AL), and switched fabric (FC-SW) topologies. FC interfaces can be configured as N_port or NL_port types. It should be noted that FC-AL is not supported for ports connected at 16 Gbps.
- Full active-active multipathing across all interfaces is supported. Host software support for this function might vary.

Fibre Channel over Ethernet support

FlashSystem 900 supports 16 ports of 10 Gbps Fibre Channel over Ethernet. FCoE uses the same interface cards as Fibre Channel.

Fibre Channel and FCoE Interface Cards

Each FlashSystem 900 canister supports two Fibre Channel interface cards for a total of four Fibre Channel interface cards, 8 Gbps Fibre Channel cards support four ports, 16 Gbps cards support two ports.

Table 2 shows the supported interface cards.

Table 2. Fibre Channel/FCoE supported interface cards

Item	Feature code	Ports
FC/FCoE Host Interface Card	AF15 Corequisites: AF18, AF19, or AF1A	-Up to 16 ports of 8 Gbps Fibre Channel (with AF18) -Up to eight ports of 16 Gbps Fibre Channel (with AF19) -Up to 16 ports of 10 Gbps Fibre Channel over Ethernet (with AF1A)
8 Gb FC 8 Port Host Optics	AF18	Up to 16 ports of 8 Gbps Fibre Channel
16 Gb FC 4 Port Host Optics	AF19	Up to eight ports of 16 Gbps Fibre Channel
10 Gb FCoE 8 Port Host Optics	AF1A	Up to 16 ports of 10 Gbps Fibre Channel over Ethernet

iSCSI interface card

FlashSystem 900 supports 16 ports of 10 Gbps iSCSI for clients looking for alternatives to SANs. The iSCSI interface card looks similar to the FC/FCoE cards with fiber optical connections as shown in Figure 5 on page 5.

Table 3 shows the supported iSCSI interface card and port optics.

Table 3. iSCSI supported interface cards

Item	Feature code	Ports
iSCSI Host Interface Card	AF17 (Corequisite : AF1D)	Up to 16 ports of 10 Gbps iSCSI
10 Gb iSCSI 8 Port Host Optics	AF1D	Up to 16 ports of 10 Gbps iSCSI

InfiniBand interface card

IBM FlashSystem 900 supports four two-port InfiniBand 40 Gbps cards. A total of eight ports of 40 Gbps InfiniBand connections are supported per IBM FlashSystem 900.

The InfiniBand card ports can connect to Quad Data Rate (QDR), Double Data Rate (DDR), or Single Data Rate (SDR) InfiniBand HCAs by using the SCSI RDMA Protocol (SRP). IBM FlashSystem 900 InfiniBand interfaces support SRP only.

Table 4 lists the supported InfiniBand interface card.

Table 4. Supported InfiniBand interface card

Item	Feature code	Ports
QDR IB 4 Port Host Interface Card	AF16	Eight ports of 40 Gbps QDR InfiniBand

IBM MicroLatency modules

FlashSystem 900 provides configurable IBM MicroLatency module capacity. All modules are hot-swappable. It is important to configure the amount of storage needed correctly as it is not possible to dynamically add additional storage.

FlashSystem 900 can be populated with up to 12 x 1.2 TB IBM MicroLatency modules in increments of 4, 6, 8, 10, or 12; or up to 12 x 2.9 TB or 5.7 TB IBM MicroLatency modules in increments of 6, 8, 10, or 12. These modules of either 1.2 TB, 2.9 TB, or 5.7 TB cannot be intermixed. Capacity can be upgraded by purchasing the AF23 (1.2 TB), AF24 (2.9 TB) or AF25 (5.7 TB) IBM MicroLatency module feature codes as MES upgrades. Here are the upgrade paths:

- Using AF23 (1.2 TB)
Start with 2.4 TB and grow to 4.8 TB 7.2 TB 9.6 TB, or 12 TB
- Using AF24 (2.9 TB)
Start with 5.8 TB and grow to 11.6 TB, 17.4 TB, 23.2 TB, or 29 TB
- Using AF25 (5.7 TB)
Start with 11.4 TB and grow to 22.8 TB, 34.2 TB, 45.6 TB, or 57 TB

Table 5 lists the supported IBM MicroLatency modules.

Table 5. Supported IBM MicroLatency modules

Description	Feature code	Maximum quantity supported
1.2 TB MLC IBM MicroLatency Module	AF23	12
2.9 TB MLC IBM MicroLatency Module	AF24	12
5.7 TB MLC IBM MicroLatency Module	AF25	12

IBM Variable Stripe RAID

Variable Stripe RAID data protection is a unique, self-healing data protection that is managed independently by each flash controller on each IBM MicroLatency module. With Variable Stripe RAID, every flash controller creates a striped data layout across its set of chips similar to a $n+1$ RAID 5 array with rotating parity. When the Variable Stripe RAID algorithm detects a failure affecting one or more flash chips in a RAID stripe, the following process happens:

1. Data that is stored in the affected regions is reconstructed from the remaining data/parity elements in the stripe.
2. All pages in the affected stripe, including the reconstructed data, are moved to reserved space (overprovisioned area).
3. Subsequent requests for data in the affected stripe are directed to the new locations (now part of the normal storage area in the system).
4. The original location of the affected stripe is added to the available overprovisioned area as a $(n-1) +$ parity stripe. (For example, if the affected stripe was a $9+1$ stripe, it becomes an $8+1$ stripe.)

No system-level rebuild process is necessary to maintain data protection or usable capacity after a failure caught by Variable Stripe RAID. The entire Variable Stripe RAID recovery process is automatic and transparent to the user and administrator, and typically takes place in less than a second. Variable Stripe RAID activities are not normally tracked in system logs, but the root causes of failures that are typically handled by Variable Stripe RAID-plane failures and block failures are tracked in system counters and reflected in the overall IBM MicroLatency module and system health metrics.

IBM Two-dimensional (2D) Flash RAID

The combination of IBM Variable Stripe RAID and system-level RAID 5 protection across IBM MicroLatency modules is called two-dimensional (2D) Flash RAID.

RAID 5

With RAID 5 mode, up to 2048 logical volumes (sometimes referred to as LUNs) can be created in the system, with a minimum size of 1 MB and a maximum size of the full available system capacity. Under the direction of the management module, RAID module Field Programmable Gate Arrays (FPGAs) can coordinate data transfer between modules, for example, to rebuild the system-level RAID 5 data layout.

Note: FlashSystem 900 does not support a RAID 0 configuration

Scalable configurations

FlashSystem 900 can scale usable capacity from as low as 2.4 TB to as high as 57 TB in its compact 2U enclosure. With FlashSystem 900, many granular capacity points are possible due to the three choices in IBM MicroLatency module capacity: 1.2 TB, 2.9 TB, and 5.7 TB. IBM MicroLatency modules can be added so that IT personnel can expand capacity to support changing needs for organizations and enterprises of all sizes. However, capacity expansion does require reformat of existing RAID 5 arrays to include the new IBM MicroLatency modules.

FlashSystem 900 supports the RAID 5 configurations with the latest capacity points as listed in Table 7.

Table 7. Supported FlashSystem RAID 5 configurations with latest FlashSystem 900 capacity points

Capacity Selection (in TB)	FlashSystem 900 IBM MicroLatency Modules
2.4	4 X 1.2 TB
4.8	6 X 1.2 TB
7.2	8 X 1.2 TB
9.6	10 X 1.2 TB
12	12 X 1.2 TB
11.6	6 X 2.9 TB
17.4	8 X 2.9 TB
23.2	10 X 2.9 TB
29	12 X 2.9 TB
22.8	6 X 5.7 TB
34.2	8 X 5.7 TB
45.6	10 X 5.7 TB
57	12 X 5.7 TB

RAID 5 configurations provide a high degree of redundancy with Variable Stripe RAID and RAID 5 protection.

RAID 5 data protection includes one IBM MicroLatency module dedicated as parity and another as a dedicated hot spare. Maximum capacity utilization for RAID 5 is provided using 12 IBM MicroLatency modules.

Depending on your needs, and if capacity expansion is expected over time, consider initial RAID 5 configurations with 12 IBM MicroLatency modules which provides the least capacity penalty for RAID 5 protection.

Note: Different IBM MicroLatency module sizes cannot be intermixed in the same IBM FlashSystem 900 chassis.

Network cables

FlashSystem 900 supports the network cables that are listed in Table 8.

Table 8. Supported network cables

Description	Feature code	Maximum quantity supported
Fibre Channel cables (supported on Fibre Channel ports)		
1 m Fiber Cable (LC-LC)	3700	16
5 m Fiber Cable (LC-LC)	3701	16
InfiniBand cables (supported on InfiniBand ports)		
1 m IBM QSFP Cop IB	A0RD	8
3 m IBM QSFP Cop IB	A0RE	8
3 m IBM QSFP Opt QDR IB	5989	8
10 m IBM QSFP Opt QDR IB	5990	8
1 m Mlnx QSFP Cop FDR14 IB	A2YG	8
3 m Mlnx QSFP Cop FDR14 IB	A2YH	8
3 m Mlnx QSFP Opt FDR14 IB	A2YL	8
10 m Mlnx QSFP Opt FDR14 IB	A2YN	8

Encryption

FlashSystem 900 storage system provides support for AES-XTS 256 bit data-at-rest encryption when the Encryption Enablement Pack, feature AF14, is ordered.

In addition, the FlashSystem 900 has the following functions:

- Hot Encryption Activation - Adding an encryption license to a previously initialized system
- Encryption Re-key - Changing the encryption key on a previously initialized system

Both of these operations can be done concurrently and do not cause loss of access to data. Both operations do require that you purchase the Feature Code AF14: Encryption Enablement Pack.

If you are planning to implement either Hot Encryption Activation or Encryption Re-key, inform IBM support so that they can monitor the operation

Hot Encryption Activation

Hot Key Activation allows an unencrypted FlashSystem to be encryption-enabled while the system is running, without impacting customer data in any way.

Note: The system requires that at least two copies of the encryption access key are made, for a total of at least three USB drives containing the key.

Encryption Rekey

Rekeying is the process of creating a new key for the system. To create new keys, encryption must be enabled on the system. However, the rekey operation works whether there are encrypted arrays or not.

Before creating a new key, ensure that the canisters are online and at least one USB port contains a USB flash drive that contains the current key. During the rekey process, new keys are generated and copied to the USB flash drives. These keys are then used instead of the current keys. The rekey operation fails if at least one USB flash drive does not contain the current key. To rekey the system, you need at least three USB flash drives to store the copied key material.

For more information see the FlashSystem 900 Knowledge Center at:

https://ibm.biz/fs_900_kc

Note: The FlashSystem 900 Knowledge Center will be live on 20th March.

Batteries

Battery reconditioning feature that calibrates the gauge that reports the amount of charge on the batteries. On systems that have been installed for 10 months or more, or systems that have experienced several power outages, the recommendation to run "battery reconditioning" will appear in the Event Log shortly after upgrading.

Note: During the battery reconditioning cycle, no concurrent code upgrades can be performed. See the FlashSystem 900 Knowledge Center for more information at https://ibm.biz/fs_900_kc.

System management

The management modules in FlashSystem 900 storage system are processor complexes in the canisters. The management modules are configured for active-passive redundancy. The management modules run a highly customized Linux-based operating system that coordinates and monitors all significant functions in the system.

The management modules provide a Java based web interface, Secure Shell (SSH) access, and SNMP connectivity through external Ethernet interfaces. The web and SSH interfaces allow administrators to monitor system performance and health metrics, configure storage, and collect support data, among other features.

IBM FlashSystem 900 includes the usage of the common IBM FlashSystem 900 CLI and the IBM FlashSystem 900 GUI, which is based on the IBM XIV® GUI. IBM FlashSystem 900 supports SNMP, email forwarding (SMTP), and syslog redirection for complete enterprise management access.

The storage configuration includes defining logical units with capacities, access policies, and other parameters. No software needs to be installed on host computers to administer FlashSystem 900 beyond a web browser with Java support or a standard SSH client.

Web interface

Navigating the management tool is simple. You can hover the cursor over one of the five function icons on the left side of the window, which highlights the function icon and shows a list of options. You can then move the cursor to the wanted option and click it. The GUI has three main sections for navigating through the management tool:

- Function icons (left side)
- Status bars (bottom)
- **Actions** menu (upper left, or right-click the home page)

To the right of the upper middle of the GUI is the function key for managing the security of the user that is logged in. In the upper right corner is the **Help** button, which provides information about licenses and gives access to the FlashSystem 900 Knowledge Center.

On the far left of the window are five function icons, from top to bottom:

- The **Monitoring** menu
- The **Volumes** menu
- The **Hosts** menu
- The **Access** menu
- The **Settings** menu

The management GUI is the primary tool to manage the system. Figure 7 shows an overview of the management GUI and the general location of associated menu options from the front of the machine. At the bottom of the window are three status indicators. These indicators provide information about these characteristics:

- Capacity usage (lower left)
- Throughput in megabytes per second (MBps), IOPS, and latency in a tri-pane indicator (center)
- The health status of the system (lower right)

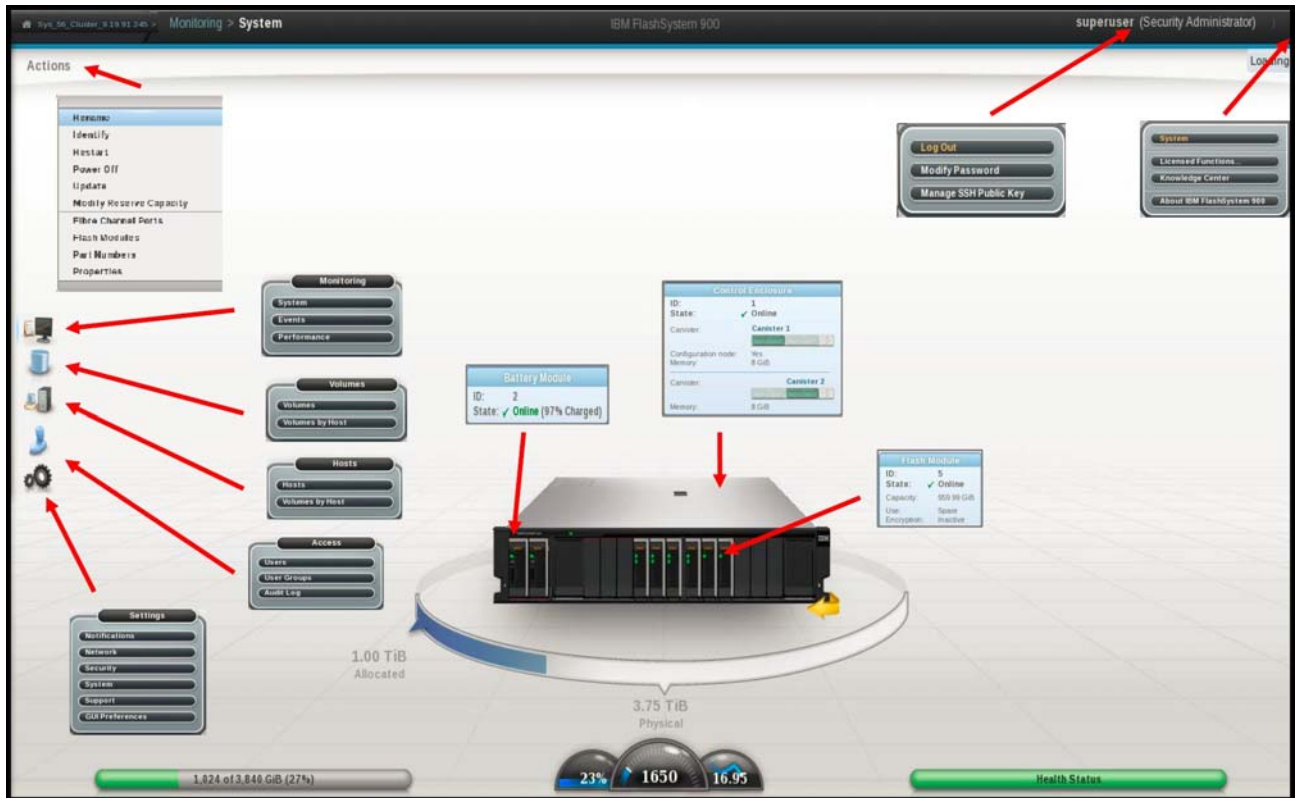


Figure 7. IBM FlashSystem 900 Management GUI (front view of the system)

Figure 8 shows the management GUI and the associated menu options from the rear of the system. Looking at the rear view from left to right, you see the states highlighted for the fan module in canister ID 1, the left canister ID 1, Fibre Channel port ID 1, and the power supply unit ID 1.

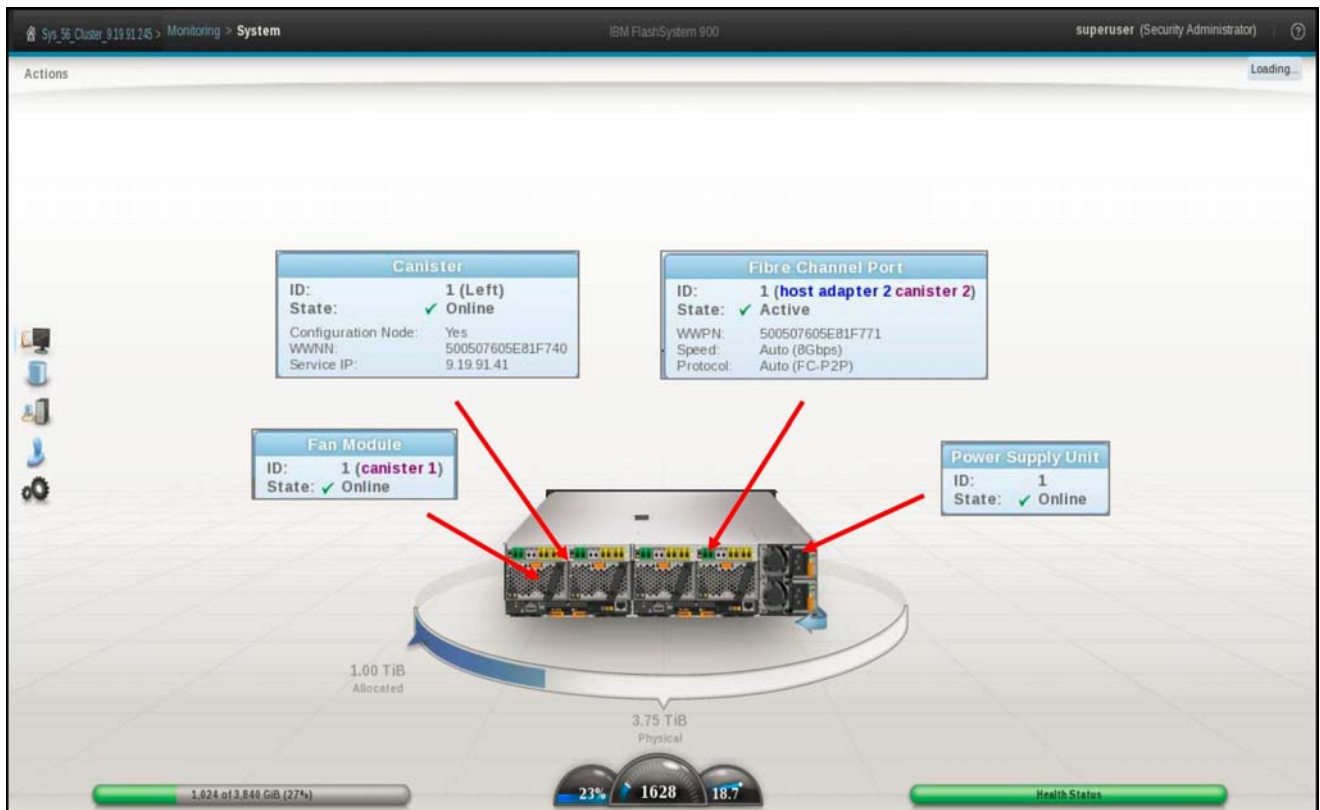


Figure 8. IBM FlashSystem 900 Management GUI (rear view of the machine)

Additional FlashSystem 900 management software improvements make system management and performance health monitoring even more effective in FlashSystem's already intuitive GUI. It includes the following additional features:

- Three hundred days of performance data with span and zoom capability to better identify and research trends
- Five predefined graphs showing System IOPS, Latency, Bandwidth, Total Port IOPS, and Queue Depth

Performance menu overview

Enter the FlashSystem 900 performance monitor by clicking **Monitoring** -> **Performance**. The first time after the browser window is opened, system latency is displayed as shown in Figure 9.

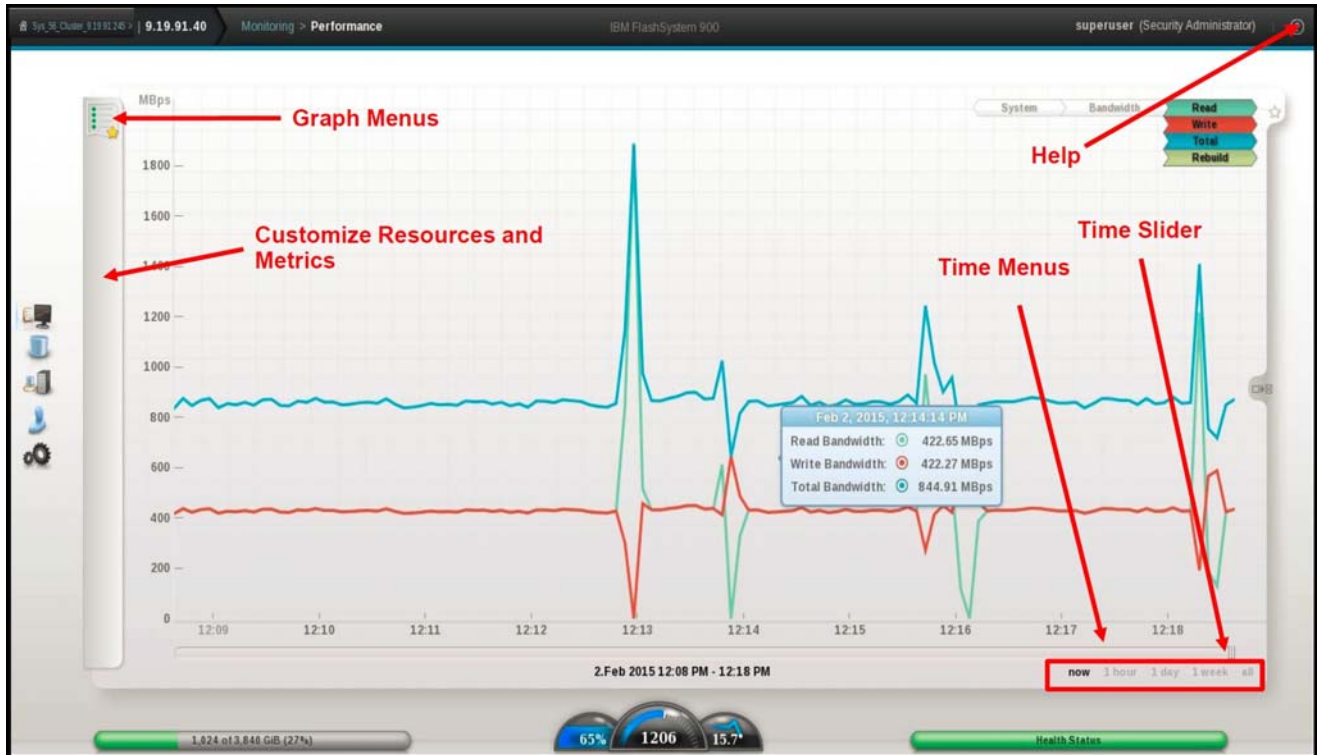


Figure 9. Improved GUI - Performance monitoring window

The horizontal part of the graph displays the timeline. You can slide the timeline to view the past. You can also adjust the granularity of the timeline by selecting one hour, one day, one week, one month, or all. "All" displays the year to date.

Five performance charts can be reviewed from the graphs menu:

- **System IO:**
The System I/O graph displays the average number of read, write, and total I/O operations per second (IOPS) over the sample period. Each request type (read, write, and total) is represented by a different color line.
- **System Latency:**
The System Latency graph displays the average amount of time in milliseconds (ms) read and write I/O requests take over the given sampling period. Each request type (read and write) is represented by a different color line.
- **System Bandwidth:**
The System Bandwidth graph displays the average number of megabytes per second (MBps) of read, write, total, and rebuild bandwidth over the sample period. Each bandwidth type (read, write, total, and rebuild) is represented by a different color line. There is one line graph for each system that is selected.

- **Interface port Total IOPS:**
The Total Port IOPS graph displays average number of read, write, and total IOPS over the sample period. There is one line on the graph for each port in each host adapter in each canister. Each adapter has a different color, and all four ports on an adapter have the same color.
- **Interface port Total Queue Depth:**
The Total Port Queue Depth graph displays the average number of operations of that type over the sample period. There is one line on the graph for each port in each host adapter in each canister. Each adapter has a different color, and all four ports on an adapter have the same color.

Command-line interface

The CLI provides support for the following tasks:

- Managing users
- Configuring event notifications
- Configuring Call Home
- Configuring network settings
- Configuring hosts interface I/O ports
- Configuring a logical unit (volume)
- Setting access policies
- Backing up configuration settings
- Restoring configuration settings

Supported platforms

IBM FlashSystem 900 supports a wide range of operating systems (Windows Server 2003 and 2008, Linux, and IBM AIX®), hardware platforms (IBM System x®, IBM Power Systems™, and x86 servers not from IBM), HBAs, and SAN fabrics. For specific information, see the IBM System Storage Interoperation Center (SSIC) at:

<http://www.ibm.com/systems/support/storage/ssic/interoperability.wss>

Physical and electrical specifications

FlashSystem 900 has the following physical, electrical, and environmental specifications:

- Dimensions and weight
 - Width: 445 mm (17.5 in.) (19-inch rack standard)
 - Depth: 761 mm (29.96 in.)
 - Height: 86.2 mm (3.39 in.)
 - Weight: 17.69 kg (39 lb)
- Air temperature
 - Operating: Minimum of 5°C (50°F) at 30.5 m below to 3,000 m above sea level (100 ft below to 9,840 ft above); Maximum rated up to 40°C (95°F) at 30.5 m below to 950 m above sea level, de-rated 1°C for each 225 m above 950 m up to 3,000 m
 - Non-operating: -10°C to 50°C (14°F to 125°F)
- Relative humidity
 - Operating: 20% - 80%
 - Non-operating: 10% - 90%
- Electrical power
 - Voltage range: 100-240 V AC
 - Frequency: 50 - 60 Hz
- Acoustical noise emission
 - 7.2 bels (idling)
 - 7.2 bels (operating)
- Power consumption
 - 1300 watts PSU, 900 watts maximum, 625 watts RAID5 typical operation, per 2U
- Heat dissipation: 2133 BTU per hour (assuming 625W)

Warranty information and upgrades

IBM FlashSystem 900 is shipped with a one-year and a three-year warranty.

Technical Advisor (TA) support is provided during the warranty period. The TA enhances end-to-end support for the client's complex IT solutions. The TA uses an integrated approach for proactive, coordinated cross-team support to allow customers to maximize IT availability. TA support for FlashSystem is delivered remotely and includes a documented support plan, coordinated problem and crisis management, reporting on the client's hardware inventories and microcode levels, and consultation about FlashSystem microcode updates. The Technical Advisor conducts a Welcome Call with the client and provides a statement of work for this support.

Flash media within IBM FlashSystem is covered in full during the warranty and maintenance period. The system is also Energy Star certified.

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Related publications and links

For more information, see these resources:

- IBM Redbooks Solution Guides and Product Guides for the IBM FlashSystem family
<http://www.redbooks.ibm.com/redbooks.nsf/searchsite?SearchView&query=flashss>
- IBM FlashSystem family product page
<http://www.ibm.com/storage/flash>
- IBM FlashSystem 900 Knowledge Center Welcome page
https://ibm.biz/fs_900_kc Note: FlashSystem 900 Knowledge Center will be live on 20th March
- IBM System Storage Interoperation Center (SSIC)
<http://www.ibm.com/systems/support/storage/ssic/interoperability.wss>
- IBM Support Portal
<http://ibm.com/support/entry/portal/>
- IBM Offering Information page (announcement letters and sales manuals):
http://www.ibm.com/common/ssi/index.wss?request_locale=en

On this page, enter **FlashSystem**, select the information type, and then click **Search**. On the next page, narrow your search results by geography and language

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