



IBM FlashSystem V840

IBM Redbooks Product Guide

Storage capacity and performance requirements are growing faster than ever before, and the costs of managing this growth are depleting more of the information technology (IT) budget. IBM® FlashSystem™ V840 (FlashSystem V840) has changed the economics of today's data center by eliminating storage bottlenecks, and its software-defined storage features simplify data management, improve data security, and preserve your investments in storage.

This IBM Redbooks® Product Guide describes IBM FlashSystem® V840, which is a comprehensive all-flash enterprise storage solution that delivers a rich set of software-defined storage features, including IBM Real-time Compression[™], dynamic tiering, thin provisioning, snapshots, cloning, replication, data copy services, and IBM HyperSwap® for high availability (HA). With the release of FlashSystem V9000 Software V7.6, extra functions are available, including VMware vSphere Virtual Volumes (vVol) support, and an integrated IBM Comprestimator utility. Support also exists for VMware 6 that enhances and improves scalability in a VMware environment.



FlashSystem V840 Software version 7.6, shown in Figure 1, replaces version 7.5, and is available to all FlashSystem V840 customers with current warranty or software maintenance agreements.

Figure 1. IBM FlashSystem V840

Did you know?

- Scale up to 1.2 million input/output operations per second (IOPS) and 1.6 petabytes (PB) effective capacity when using Real-time Compression
- FlashSystem V840 includes advanced software defined features in the base software, including Real-time Compression, copy services, and replication, and simple licensing for external virtualization.
- FlashSystem V840 with vVOL support allows more efficient operations and control of external storage resources.
- FlashSystem V840 with HyperSwap offers simplified setup and management through a graphical user interface (GUI).
- FlashSystem V840 now incorporates Integrated Comprestimator, the key sizing tool to estimate how much capacity savings the customer can expect with Real-time Compression.
- FlashSystem V840 now includes Internet Protocol (IP) quorum base support for lower-cost IP-attached hosts as a quorum disk.
- FlashSystem V840 support with IBM Virtual Storage Center (VSC) includes performance statistics and metrics of monitored storage systems and switches. These reports can be viewed in the VSC web-based GUI or stand-alone GUI. See the VSC IBM Knowledge Center for more information:

http://ibm.co/1Px9UU6

FlashSystem V840

FlashSystem V840 is a rack-mount shared flash memory device that is based on enterprise multilevel cell (eMLC) flash technology. It provides macro efficiency with 40 terabytes (TB) of protected capacity in a 6U form factor, enterprise reliability through IBM Variable Stripe RAID[™] and two-dimensional (2D) flash Redundant Array of Independent Disks (RAID), and extreme performance with IBM MicroLatency®. FlashSystem V840 provides advanced data services, including business continuity with replication services, data protection with IBM FlashCopy® services, and higher storage efficiency with thin provisioning, Real-time Compression, IBM Easy Tier®, external virtualization, and space-efficient copies. The FlashSystem V840 baseline configuration is composed of the following components:

- Two FlashSystem V840 Control Enclosures
- One FlashSystem V840 Storage Enclosure

FlashSystem V840 provides the performance of IBM FlashSystem technology to ensure effective data management and protection with the following benefits:

- **Extreme performance**. Enable businesses to unleash the power of performance, scaling, and insight to drive services and products to market faster.
- MicroLatency. Deliver microsecond-level response time to accelerate critical applications and achieve competitive advantages.
- **Macro efficiency**. Efficiency that is driven by consolidation of hardware and software, power and cooling savings, and data efficiencies of snapshots, thin provisioning, and advanced copy services.
- Enterprise reliability. Durable and reliable designs that use enterprise class flash with remote mirroring to provide business continuity.

Component overview

This section describes the components of FlashSystem V840.

FlashSystem V840 Control Enclosure

The FlashSystem V840 Control Enclosure is a 2U rack mount unit that provides the primary management interface for the FlashSystem V840 Storage Enclosure and the host interface configuration. The FlashSystem V840 Control Enclosures support Fibre Channel Protocol (FCP), Fibre Channel over Ethernet (FCoE), and Internet Small Computer System Interface (iSCSI) interfaces.

The Control Enclosure includes integrated alternating current (ac) power supplies and battery units, which supply power to the Control Enclosure if there is a sudden power loss or failure. This enables the system to correctly commit all transactions to the storage medium.

IBM FlashSystem V840 Storage Enclosure

FlashSystem V840 Storage Enclosures are 2U rack-mount units that support up to 12 flash modules. Flash modules are offered in 1 TB, 2 TB, and 4 TB capacities. All flash modules within a FlashSystem V840 Storage Enclosure must have the same capacity.

Software-defined flash services:

FlashSystem V840 data services are provided through IBM FlashSystem V840 Software, which offers a rich set of software-defined flash features that include FlashCopy, thin provisioning, remote mirroring (Metro Mirror/Global Mirror), external virtualization, Easy Tier 3rd Generation, Real-time Compression, and HyperSwap capability.

The FlashSystem V840 Software runs on the Control Enclosures.

When they are installed, the components of the FlashSystem V840 are shown in Figure 2, with two FlashSystem V840 (AC1) Control Enclosures **1** and **2**, and one V840 (AE1) storage Enclosure **3**.



Figure 2. Front view of FlashSystem V840 in a compact 6U form factor

IBM FlashSystem V840 highlights

With IBM FlashSystem V840, clients gain the benefits of combining software-defined services with extreme performance, as shown in Figure 3.



Figure 3. FlashSystem V840 benefits

Faster applications

By accelerating applications, both physical and virtual, FlashSystem V840 can help organizations reduce costs, increase revenue, and improve customer satisfaction for all types of applications, including the following categories:

- Transactional
- Enterprise resource planning / supply chain management (ERP/SCM)
- Big data and analytics
- Server and desktop virtualization
- Cloud

Performance

FlashSystem V840 has the following performance features:

- FlashSystem V840 eliminates I/O bottlenecks while generating higher levels of application efficiency (improved performance).
- FlashSystem V840, with an all-hardware data path using a Field Programmable Gate Array (FPGA), is engineered to deliver the lowest possible latency.
- MicroLatency provides latency that is measured in microseconds.
- High aggregate performance (bandwidth) and IOPS.

Reliability, availability, and serviceability

FlashSystem V840 delivers the following enterprise-class reliability features:

- Concurrent code load enables customer applications to remain online during firmware upgrades to all components, including the flash modules.
- Redundant hot-swappable components: The FlashSystem V840 Storage Enclosure has two clustered, hot-swappable canisters that each contain two hot-swappable fan modules, two management controllers, a management Ethernet port, and a Universal Serial Bus (USB) port. Batteries, fans, and power supplies are all redundant and hot-swappable. If a flash module failure occurs, critical customer applications can remain online while the defective module is replaced.
- IBM Variable Stripe RAID (VSR), which is a patented IBM technology that provides an intra-module RAID stripe within each flash module. Variable Stripe RAID technology helps reduce downtime and maintain performance and capacity if partial or full flash chip failures occur.
- Two-dimensional (2D) Flash RAID, which consists of IBM Variable Stripe RAID and system-wide RAID 5.
- The FlashSystem V840 Control Enclosures are an active-active pair, and support concurrent code load.

Flash for less than the cost of disk

By offering extreme performance and MicroLatency, FlashSystem V840 can take the place of multiple racks of hard disk drives (HDDs), in a small footprint. FlashSystem V840 can decrease your total cost of ownership (TCO) by lowering your power, space, and cooling costs, and reducing your software licensing expenses.

With the Real-time Compression feature, FlashSystem V840 can increase the effective capacity of your flash memory up to 5x, decreasing the cost for effective capacity up to 80%. Real-time Compression supports active data, unlike other data reduction solutions. The Model AC1 Control Enclosure offers several features for Real-time Compression workloads, including a second Xeon E5 v2 Series eight-core processor with 32 gigabytes (GB) of memory and up to two optional compression accelerator cards for hardware-assisted compression.

Software-defined storage services

FlashSystem V840 merges IBM software-defined storage with the scalable performance of IBM FlashSystem technology to help make your entire storage environment easier to manage, while preserving your investments in storage. Software-defined storage services enable you to use the following features across all of your storage:

- Thin provisioning. Enables dynamic growth; purchase only the storage you need when you need it.
- Easy Tier flash memory management . Optimized performance at lower overall cost.
- High availability configurations. Enable near-continuous data availability.
- Copy Services. Space efficient backups.
- Practice disaster recovery techniques . Validate business continuity plans.
- Simple GUI. Allow storage to be quickly deployed and efficiently managed.
- HyperSwap capability.

Note: The IBM Mobile Storage Dashboard version 1.5.4 supports the IBM FlashSystem V840 GUI. It is a no-charge application that can be downloaded from iTunes:

https://itunes.apple.com/us/app/ibm-storage-mobile-dashboard/id677826483?mt=8

Deep application integration

FlashSystem V840 includes the following features, which enable tight integration with VMware:

- vCenter plug-in. Enables monitoring and self-service provisioning of the system from within VMware vCenter.
- vStorage application programming interfaces (APIs) for Array Integration (VAAI) support. Supports hardware-accelerated virtual machine (VM) copy and migration, supports hardware-accelerated VM initiation, and accelerates Virtual Machine File System (VMFS).
- SRM for Site Recovery Manager. Supports automated storage and host failover, failover testing, and failback.
- vVOLs integration for better usability. The migration of space-efficient volumes between storage containers maintains the space efficiency of volumes. Cloning a virtual machine achieves a full independent set of virtual volumes and resiliency has been improved for VMs in case volumes start running out of space.

vVOL

Before the availability of vVOLs, a virtual machine (VM) in a VMware environment would be presented a disk in the form of a file called a *VMware disk* (VMDK). This file represented a physical disk to the VM, and could then be accessed by the operating system installed on the VM in the same way a physical volume on a regular server was. The VMDK file was then placed onto a file system called VMFS hosted by a standard logical unit volume (LUN), for example implemented on an external storage system, such as FlashSystem V9000. With the availability of the vSphere Virtual Volume technology, each VM disk can now be mapped to an external storage volume (for example, a FlashSystem V840 volume).

With vVOL, FlashSystem V840 becomes aware of individual VMDK files, and data operations, such as snapshot and replication, can be performed directly by FlashSystem V9000, at the VMDK level rather than the entire VMFS data store.

Note: The integration of vVOL with FlashSystem V840 is based on the VMware APIs for Storage Awareness (VASA). The IBM support for VASA is delivered as part of IBM Spectrum[™] Control. VASA version 2 is required to use vVOL capability.

IBM Spectrum Control Base Edition

FlashSystem V840 supports Integration of VASA and VAAI by using IBM Spectrum Control[™] Base 2.1. This is a centralized server system that consolidates a range of IBM storage provisioning, virtualization, cloud, automation, and monitoring solutions through a unified server platform. IBM Spectrum Control provides *insight and awareness* to VMware and vSphere about the *configurations, capabilities and storage health,* and *events* of a storage system. With this capability, VMware administrators are able to independently and centrally manage their storage resources on IBM storage systems.

Latest release functions

Several new functions are available with this release.

HyperSwap for FlashSystem V 840

HyperSwap capability allows each volume to be presented by two I/O groups. The configuration tolerates combinations of node and site failures, by using the same flexible choices of host multipathing driver interoperability, as is currently available for the IBM FlashSystem V9000. The use of FlashCopy helps maintain a *golden image* during automatic resynchronization. Because remote mirroring is used to support the HyperSwap capability, Remote Mirroring licensing is a requirement for using HyperSwap.

IBM FlashSystem V840 Software V7.6 includes Remote Mirroring for the internal enclosures (AE2s). IBM Spectrum Virtualize[™] Software is used to provide functionality for externally virtualized storage.

The HyperSwap function uses a *hyperswap* topology by spreading the nodes of the system across two sites, with storage at a third site acting as a tie-breaking quorum device:

- The hyperswap topology locates both nodes of an I/O group in the same site. Therefore, to get a volume resiliently stored on both sites, at least two I/O groups are required.
- The hyperswap topology uses additional system resources to support a full independent cache on each site, enabling full performance even if one site is lost. In some environments, a hyperswap topology provides better performance than a *stretched* topology.
- The HyperSwap function can now be configured through a new command-line interface (CLI), which greatly simplifies the setup process to a handful of commands. You can also configure and manage local HyperSwap through the GUI for simpler configuration and operation.
- Hosts, FlashSystem V840 control enclosures, and FlashSystem V840 storage enclosures are in one of two failure domains or sites.
- Volumes are visible as a single object across both sites (I/O groups).

Figure 4 shows how the HyperSwap function works.



Figure 4. HyperSwap function

Each primary volume shown in Figure 4 (Denoted by the "p" in the volume name) has a secondary volume (Denoted by the "s" in the volume name) on the opposite I/O group.

The secondary volumes are not mapped to the hosts. The dual write to the secondary volumes is handled by the FlashSystem V840 HyperSwap function, and is not apparent to the hosts.

The following list describes some of the HyperSwap characteristics:

- HyperSwap function is available on a FlashSystem V840 running software V 7.6 and with 2 or more I/O groups.
- Multiple step CLI-based configuration on single system; simple object creation through GUI and CLI.
- Data is stored on two sites in parallel.
- Maximum distance between sites is 300 km.
- Two independent copies of data are maintained (4 if additionally Volume Mirroring to two pools in each site).
- Uses standard host multipathing driver.
- Cache data is retained if only one site online.
- Automatic synchronization and resynchronization of copies.
- Automatic host-to-storage-system path optimization based on host site (requires Asymmetric Logical Unit Access/Target Port Groups Support (ALUA/TPGS) support from multipathing driver).
- Stale consistent data retained during resynchronization for disaster recovery.
- Number of maximum highly available volumes is 1024.
- Requires Remote Mirroring license for volumes. Exact license requirements can vary by product.

IP quorum base support

For lower implementation and operation costs for a high availability solution, IP quorum base support enables the use of lower-cost IP network-attached hosts as a quorum disk.

HyperSwap implementations require Fibre Channel (FC) storage on a third site to cope with tie-break situations if the intersite link fails, when connectivity between sites 1 and 2 is lost. In a HyperSwap setup, a quorum disk at the third site is needed. The quorum disk on the third site must be the active quorum disk. Only the active quorum disk acts as a tie-breaker.

Note: Fibre Channel over IP (FCIP) connectivity is not supported between nodes when a HyperSwap system is configured without using inter-switch links (ISLs).

Integrated Comprestimator

Real-time Compression is a key differentiator of FlashSystem V9000. Comprestimator is its key sizing tool to estimate how much capacity savings the customer can expect. Comprestimator can recognize the patterns of the actual customer data, and estimate the compressibility of data per volume. The integration of Comprestimator in FlashSystem V9000 software eases the process of estimating capacity savings by having this sizing tool natively in FlashSystem V9000, avoiding the need to install Comprestimator, and enabling estimates of Real-time Compression effectiveness from a central console.

Increased maximum quantity of iSCSI hosts

For more scalable iSCSI host support, release 7.6 increases the maximum number of iSCSI host sessions from 256 to 1024 per node, offering more fanout for each FlashSystem V9000 I/O group.

Scale up and scale out

FlashSystem V840 has a scalable architecture that allows flash capacity to be added (scaled up) to support multiple applications. The virtualized system can also be expanded (scaled out) to support higher IOPS and bandwidth, or the solution can be simultaneously scaled up and out to improve capacity, IOPS, and bandwidth while maintaining MicroLatency. As a result, your organization can gain a competitive advantage through a more flexible, responsive, and efficient storage environment. FlashSystem V840 has the following scalability features per building block:

- Slots for up to 12 hot-swappable flash memory modules (1 TB, 2 TB, or 4 TB modules)
- Configurable 2 40 TB of capacity for increased flexibility per storage enclosure
- FlashSystem V840 has the following flexible scalability configuration options:
 - o Base configuration
 - o Scale up: Add capacity
 - o Scale out: Add controllers and capacity

FlashSystem V840 is orderable in scalable configurations from a single *building block* (BB) and up to three additional scalable building blocks. A single FlashSystem V840 storage platform consists of two FlashSystem V840 Control Enclosures directly cabled to one FlashSystem V840 Storage Enclosure (SE), representing a BB. For balanced increase of performance and scale, up to four FlashSystem building blocks can be clustered into a single storage system, multiplying performance and capacity with each addition.

The scalable building blocks require dedicated internal Fibre Channel switches. The scalable building block configurations also allow for the addition of up to four individual FlashSystem SEs to be added to the storage system. If 160 TB from four building blocks isn't enough capacity, up to four additional SEs can then be added. In total, a FlashSystem V840 Storage System can contain a maximum of eight FlashSystem V840 SEs, offering a potential storage capacity of 320 TB, and up to 1.6 PB effective capacity is available at 80% compression. Real-time Compression is available as an optional software feature that allows users to choose to deploy Real-time Compression where it is wanted.

Figure 5 illustrates the scalable capacity of FlashSystem V840. It also shows that additional SEs can be added to a single building block BB, as well as to two, three, or four BBs.

				ity -
↑	↑	A H H H H H H H H H	<u>↑</u>	+4 SE SE Capacity Cap
				+2 SE ⊃
				+1 SE s
	 Providence (none that with the second of the	 Provide the state of the state of the state Provide the state of the state of the state Provide the state of the state of the state Provide the state of the state of the state 	 Provide the second secon	
1X	2X	3X	4X	
	Scale Out (p	performance & capac	ity)	

Figure 5. FlashSystem V840 scalable capacity

Table 1 summarizes the minimum and maximum capacity for scalable building blocks (BBs) including the addition of storage enclosures (SEs).

Scalable building blocks	Minimum capacity (TB)	Maximum capacity (TB)	Maximum effective capacity (TB) with Real-time Compression
1 BB	2	40	200
1 BB + 1 SE	4	80	400
1 BB + 2 SE	6	120	600
1 BB + 3 SE	8	160	800
1 BB + 4 SE	10	200	1,000
2 BB	4	80	400
2 BB + 1 SE	6	120	600
2 BB + 2 SE	8	160	800
2 BB + 3 SE	10	200	1,000
2 BB + 4 SE	12	240	1,200
3 BB	6	120	600
3 BB + 1 SE	8	160	800
3 BB + 2 SE	10	200	1,000
3 BB + 3 SE	12	240	1,200
3 BB + 4 SE	14	280	1,400
4 BB	8	160	800
4 BB + 1 SE	10	200	1,000
4 BB + 2 SE	12	240	1,200
4 BB + 3 SE	14	280	1,400
4 BB + 4 SE	16	320	1,600

Table 1. FlashSystem V840 capacities; Scalable building blocks including additional storage enclosures

Table 2 shows the host port count per building block configuration (1, 2, 3, or up to 4 building blocks).

	8 GB FC	16 GB FC	10 GB FCoE	8 GB & 10 GB IP Mirror	16 GB FC & 10 GB Mirror
	10	Fixed	8	N/A	N/A
1 X	16	8	8	8,8	4,8
2X	32	16	16	16,16	8,16
3X	48	24	24	24,24	12,24
4X	64	32	32	32,32	16,32

Table 2. Host port count per building blocks

Improving what you have for both IBM and non -IBM resources

FlashSystem V840 offers software-defined storage virtualization technology that helps you manage other IBM or third-party storage arrays with thin provisioning, space-efficient copies, and disaster recovery (DR) tools, such as data replication. Software-defined storage virtualization also helps ease the migration of data from one storage device to another. Virtualization of FlashSystem V840 Storage Enclosures enables rapid and flexible provisioning and simple configuration changes.

FlashSystem V840 enables you to manage the capacity of other disk systems with external storage virtualization. When FlashSystem V840 virtualizes a storage system, its capacity becomes part of the FlashSystem V840 system, and is managed in the same way as the capacity on internal flash modules within FlashSystem V840. Capacity in external storage systems inherits all the rich functions and ease of use of FlashSystem V840.

FlashSystem V840 enables you to preserve your existing investments in storage, centralize management, and ease storage migrations with storage virtualization and Easy Tier.

FlashSystem V840 provides nondisruptive operations, thanks to storage virtualization. Virtualization helps insulate applications from changes that are made to the physical storage infrastructure. When you add storage capacity or a new tier of storage, for example, the changes are transparent to applications, so you have minimal downtime.

Deploying quickly and flexibly

Flexible deployment options enable organizations to tailor the deployment architecture to the workload. This tailoring includes data access that bypasses the storage virtualization layer for low latency, data access through EasyTier, data compression using Real-time Compression, and data replication to disaster recovery sites. Clients can implement optimal business performance and enterprise features, and choose how to deploy the following items:

- Sets of data that are dedicated flash capacity for the lowest possible latency
- Sets of data that participate in Easy Tier
- Sets of data that are compressed using Real-time Compression
- Sets of data for replication to disaster recovery sites
- All of the previous items, or any combination

Driving new business opportunities

Clients can drive new business opportunities with IBM FlashSystem V840:

- Improve workforce productivity
- Lower power consumption
- Enable data center consolidation
- Run mixed workloads
- Accelerate Infrastructure
- Accelerate latency sensitive applications
- Accelerate virtualization and virtual desktop infrastructure (VDI)
- Accelerate databases and data warehousing

Manageability and security

FlashSystem V840 offers the following manageability and security features:

- Advanced security for data at rest with hardware-accelerated AES-XTS 256 encryption.
- GUIs, one that runs on the FlashSystem V840 Control Enclosure and one that runs on the FlashSystem V840 Storage Enclosure. GUIs are available in any supported browser. Also included is the FlashSystem V840 CLI, which is a collection of commands that you can use to manage the FlashSystem V840.
- Email alerts.
- Syslog redirect to send system log messages to another host.

FlashSystem V840 components

The following sections provide detailed descriptions of the FlashSystem V840 components.

Table 3 lists the part numbers that are associated with FlashSystem V840.

Table 3. FlashSystem V840 components

Description	Machine type-model
FlashSystem V840 Control Enclosure	9846-AC1 or 9848-AC1
FlashSystem V840 Storage Enclosure	9846-AE1 or 9848-AE1

Note: The Ordering System (eConfig) has a convenience function. With a single tick mark, the additional Fibre Channel switches can be added to the order easily and quickly to create a scalable configuration.

Warranty

FlashSystem V840 is available with either one-year or three-year warranties, so clients can select the warranty period that best addresses their business and financial needs:

- Models that are ordered using machine type 9846 have a one-year warranty
- Models that are ordered using machine type 9848 have a three-year warranty

The models that are offered under both machine types for each component are functionally identical.

Flash media within IBM FlashSystem V840 is covered in full during the warranty and maintenance period.

FlashSystem V840 Control Enclosure features

FlashSystem V840 Control Enclosure provides advanced data services for flash memory. It is a 2U, 19-inch rack-mount enclosure. The FlashSystem V840 includes two Control Enclosures, also called *controller nodes*, for redundant host access. The Control Enclosures include up to 16 ports that are used for connectivity, with options for 8 gigabit (Gb) Fibre Channel, 16 Gb Fibre Channel, or 10 Gb Ethernet (FCoE) and iSCSI.

Two control enclosures in each FlashSystem V840 provide redundancy. Each control enclosure consists of the following items:

- 2U server node
- Dual eight-core processor
- 64 GB memory
- Options for connectivity, including four host interface cards (8 Gb FC, 16 Gb FC, and 10 Gb Ethernet)
- Optional compression accelerator feature (#AH1A), required to run Real-time Compression (must purchase a quantity of two)
- Two integrated ac power supplies and battery units

The Control Enclosure also runs the FlashSystem V840 software, providing a rich set of software-defined storage features, including FlashCopy, thin provisioning, remote mirroring, external virtualization, Easy Tier, and Real-time Compression.

FlashSystem V840 Control Enclosures support Fibre Channel Protocol 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. Full active-active multipathing across all interfaces is supported, although host software support for this function might vary.

System management

Because FlashSystem V840 Control Enclosures cluster together to form a system, a single management interface is used for all Control Enclosures. FlashSystem V840 Storage Enclosure also has its own management module, which is independently accessible by the user to perform certain service-oriented tasks. Each FlashSystem V840 node is an individual server in a FlashSystem V840 clustered system on which the FlashSystem V840 software runs.

FlashSystem V840 GUIs

FlashSystem V840 includes easy-to-use management GUIs, one of which runs on the FlashSystem V840 Control Enclosure and one of which runs on the FlashSystem V840 Storage Enclosure to help you to monitor, manage, and configure your system. You can access the GUIs by opening any supported web browser and entering the management IP addresses. You can connect from any workstation that can communicate with the system.

Figure 6 shows a generalized view of storage area network (SAN) host connectivity topology in a FlashSystem V840 environment. The host fabric can consist of Fibre Channel switches that are zoned so that each FlashSystem V840 Control Enclosure (AC1) cannot see the other FlashSystem V840 Control Enclosure.



Figure 6. FlashSystem V840: Generalized view of host connectivity topology

FlashSystem V840 Storage Enclosure features

FlashSystem V840 Storage Enclosure is a purpose-built, all-flash storage shelf. It is a 2U 19-inch rack-mount enclosure with 12 slots for flash modules. The Storage Enclosure provides sixteen 8 Gb Fibre Channel ports to connect to FlashSystem V840 Control Enclosures, either directly or through dedicated internal switches (with the scalable building block). Flash modules within any individual building block are available in 1 TB, 2 TB, or 4 TB capacity, and capacities cannot be inter-mixed.

The FlashSystem V840 Storage Enclosure has the following attributes and components:

- Provides Flash memory.
- FlashSystem V840 Storage Enclosure has full internal redundancy:
 - o Redundant and hot-swappable Flash interface controllers
 - o Redundant and hot-swappable batteries
 - o Redundant and hot-swappable power and cooling
- Twelve Flash modules in 1 TB, 2 TB, or 4 TB capacities:
 - o Orderable in 4, 6, 8, 10, or 12 module configuration.
 - o All Flash modules must be the same capacity.
- Up to 40 TB RAID 5 configuration, up to 200 TB effective capacity with optional Real-time Compression.

IBM FlashSystem V840 Storage Enclosures include two RAID controller modules, two battery modules, one power interposer, two power supplies, four interface cards, four fan modules, four - twelve flash memory modules, and one mid-plane. As viewed from the front of the Storage Enclosure (Figure 7), there are two battery modules on the far left of the enclosure and 12 flash module slots to the right of the battery modules. The front bezel of the systems contains status LEDs.



Figure 7. Front view of FlashSystem V840 Storage Enclosure

The rear of the FlashSystem V840 Storage Enclosure (Figure 8) includes four Fibre Channel interface cards at the top, four fan modules in the middle, and two RAID modules at the bottom. To the right of the fans, there are two power supply modules that provide redundant power to the system. All components are concurrently maintainable except the mid-plane and power interposer, which have no active components. Interface maintenance requires the removal of a RAID module. All external connections are from the rear of the system.



Figure 8. Rear view of FlashSystem V840 Storage Enclosure

Each flash memory module contains twenty or forty 24 nanometer (nm) negative logic AND gate (NAND) flash chips, one or two flash controller field programmable gate array (FPGA) chips, one gateway FPGA. one IBM PowerPC® based general-purpose processor, and several dynamic random access memory (DRAM) devices that are connected to the flash controllers and processor. Each flash controller manages a set of 20 flash chips. Each flash controller implements a sophisticated flash translation layer (FTL) incorporating error correction code (ECC) error correction, address translation, and IBM patented Variable Stripe RAID self-healing data protection that handles failures at the flash page level or higher. ECC checksums, which are used to reconstruct subpage failures, are stored in manufacturer-reserved areas of the flash chips that are not included in specifications for usable capacity.

Product specifications

Table 4 lists the specifications for the base configuration of FlashSystem V840.

Table 4. IBM FlashSystem V840: Base configuration specifications (part 1 of 2)

IBM FlashSystem V840 - Base configuration	
Models	9846/8-AC1 and 9846/8-AE1
Flash type	eMLC
Form Factor	6U rack-mount
Flash module configuration	4 x 1 TB, 6 x 1 TB, 8 x 1 TB, 10 x 1 TB, 12 x 1 TB, 8 x 2 TB, 10 x 2 TB, 12 x 2 TB, 12 x 2 TB, 8 x 4 TB, 10 x 4 TB, and 12 x 4 TB
Maximum storage capacity	 Internal storage enclosure. Scalable from 2 TB (usable) up to 320 TB with full scale-out of control and storage enclosures. Effective internal. From 10 TB to 1.6 PB with full scale-out of control and storage enclosures (@ 80% reduction, requires Real-time Compression). External: Up to 32 PB usable capacity (requires External Virtualization)
Maximum Performance: Fixed building block (100% rea	ad, cache miss)
Minimum latency (4K)	200 microseconds (μs)
IOPS (4K)	526,000
Bandwidth (128K)	6.2 GBps
Maximum Performance: Scalable building block (100%	read, cache miss)
Latency (4K)	200 µs
IOPS (4K)	630,000
Bandwidth (128K)	6.2 GBps
Maximum Performance: Scaled out (100% read, 4 build	ling blocks)*
Latency (4K)	200 µs
IOPS (4K)	2,520,000
Bandwidth (128K)	19.2 GBps
Data reduction IOPS (4K)	1,200,000
Reliability, availability, and serviceability (RAS) features	 Two-dimensional flash RAID Module-level IBM Variable Stripe RAID™ System-level RAID 5 across modules Hot-swappable flash modules Tool-less module installation/replacement Concurrent code load Redundant and hot-swappable components

Table 4. IBM FlashS	system V840: Base	configuration s	pecifications ((part 2 of 2))
	J = = = = = = = = = = = = = = = = = = =			di /	/

IBM FlashSystem V840 - Base configuration	
Supported platforms	Information about servers, operating systems, host adapters, and connectivity products that are supported by FlashSystem products is available at the SSIC website: http://www-03.ibm.com/systems/support/storage/config/ssi c
Encryption	AES-XTS 256
FlashSystem V840 fixed building block: Host connectivity options	 8 x 16 Gb Fibre Channel 10 x 8 Gb Fibre Channel 8 x 10 Gb Fibre Channel over Ethernet (FCoE) 8 x 10 Gb iSCSI
FlashSystem V840 scalable building block: Host connectivity options	 8 x 16 Gb Fibre Channel 16 x 8 Gb Fibre Channel 8 x 10 Gb Fibre Channel over Ethernet (FCoE) 8 x 10 Gb iSCSI
Virtualization software model	5639-FS7
Shared symmetric multiprocessor (SMP) processor configuration	Two Intel Xeon E5 v2 Series eight-core processor
Processor memory	64 GB
Dimensions (height x width x depth)	6U x 445 mm x 761 mm (6U x 17.5 in. x 29.96 in.)
Weight	78 kg (171.8 lb) fully loaded

Options and features codes

This section describes the options and features codes of IBM FlashSystem V840.

Host connectivity interface cards

Table 5 shows the latest features for host and connectivity on the following models of the IBM System Storage® 9846 and 9848 machine types.

Item	Machine Type	Feature code	Maximum quantity	Description	Ports
FC Host Interface Card	9846/8-AE1	AF15	2	Enclosure connection card for Fibre Channel connectivity	Up to 16 ports of 8 Gbps Fibre Channel (with AF18 or AF19)
8 Gb FC 8 Port Host Optics	9846/8-AE1	AF18	2	Set of 8 Gb Fibre Channel optics to enable 8 ports	Up to 16 ports of 8 Gb Fibre Channel
16 GB FC 4 PORT HOST OPTICS	9846/8-AE1	AF19	2	Set of 16 Gb Fibre Channel optics to enable 4 ports	Up to 8 ports of 16 Gb Fibre Channel
8 Gb FC with 4 port host optics	9846/8-AC1	AF10	3	8 Gb Fibre Channel card with optics to enable 4 ports	Up to 12 ports of 8 Gb Fibre Channel
16 Gb FC with 2 port host optics	9846/8-AC1	AF11	4	16 Gb Fibre Channel card with optics to enable 2 ports	Up to 8 ports of 16 Gb Fibre Channel
10 GB Ethernet with 4 port host optics	9846/8-AC1	AH12	1	10 Gb Fibre Channel card with optics to enable 2 ports	Up to 2 ports of 10 Gb Fibre Channel
8 Gb FC with 4 port host optics	9846/8-AC1	AF10	3	8 Gb Fibre Channel card with optics to enable 4 ports	Up to 12 ports of 8 Gbps Fibre Channel

Table 5. Supported Storage Enclosure and interface components

Flash modules

FlashSystem V840 provides configurable flash module capacity. All modules are hot-swappable. FlashSystem V840 can be populated with four, six, eight, ten, or twelve flash modules. Flash module capacities are 1 TB (feature number AF1B), 2 TB (feature number AF10), or 4 TB (feature number AF11). Capacities cannot be inter-mixed within a single building block.

The following lists provide the usable RAID 5 protected capacity points for 1 TB, 2 TB, and 4 TB modules.

The following capacity points are possible by using (AF1B) 1 TB flash modules:

- 2 TB: Four 1 TB flash modules with RAID 5 protection
- 4 TB: Six 1 TB flash modules with RAID 5 protection
- 6 TB: Eight 1 TB flash modules with RAID 5 protection
- 8 TB: Ten 1 TB flash modules with RAID 5 protection
- 10 TB: Twelve 1 TB flash modules with RAID 5 protection

The following capacity points are possible by using (AF10) 2 TB flash modules:

- 12 TB: Eight 2 TB flash modules with RAID 5 protection
- 16 TB: Ten 2 TB flash modules with RAID 5 protection
- 20 TB: Twelve 2 TB flash modules with RAID 5 protection

The following capacity points are possible using (AF11) 4 TB flash modules:

- 24 TB: Eight 4 TB flash modules with RAID 5 protection
- 32 TB: Ten 4 TB flash modules with RAID 5 protection
- 40 TB: Twelve 4 TB flash modules with RAID 5 protection

Table 6 lists the supported flash modules.

Table 6. Supported flash modules

Description	Machine type	Feature code	Maximum quantity
1 TB eMLC Flash Module	9846/8-AE1	AF1B	12
2 TB eMLC Flash Module	9846/8-AE1	AF10	12
4 TB eMLC Flash Module	9846/8-AE1	AF11	12

IBM Variable Stripe RAID

Variable Stripe RAID data protection is managed independently by each flash controller on each flash module within each building block. With Variable Stripe RAID, every flash controller creates a striped data layout across sets of 10 chips. The Variable Stripe RAID stripe (page) size is 4 KB. When the Variable Stripe RAID algorithm detects a failure affecting one or more regions 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 is detected by Variable Stripe RAID. Further, 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 flash module and system health metrics. FlashSystem V840 modules use 24 nm enterprise multi-level cell (eMLC) flash chips. Each flash chip package incorporates eight flash dies (8DP).

IBM Two-dimensional (2D) Flash RAID

The combination of Variable Stripe RAID and system-level RAID 5 protection across flash modules is called two-dimensional (2D) Flash RAID. Variable Stripe RAID automatically and transparently protects against partial or full flash chip failures within the flash module, with no downtime or maintenance required. System-level RAID 5 adds protection against complete flash module failure and enables hot-swappable flash modules. Additionally, all active components are redundant and hot-swappable with tool-less access from the front or back of the system, enhancing two-dimensional RAID protection.

RAID 5 support

Up to 2048 logical volumes (sometimes referred to as LUNs) can be created in the system, with a minimum size of 1 megabyte (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 data layout.

Network cables and UPS

FlashSystem V840 Control Enclosure supports the network cables and uninterruptible power supply (UPS) features that are listed in Table 7.

FlashSystem V840 Control Enclosure - Data Cables	Feature Code
Trade Agreement Act (TAA) compliance	0983
1m Fibre Cable (LC-LC)	5301
5m Fibre Cable (LC-LC)	5305
25m Fibre Cable (LC-LC)	5325
US 250V/10A 6 ft	9714
Power supplies	Feature Code
1300W power supply	AF1H
900W power supply	AF1L
Priced Optional Features: Power cords for Control Enclosure	Feature Code
Europe, Mid-East, Africa	9716
Austral, N.Z.	9717
Europe, Africa	9718
Europe, Den	9719
Pakistan, S. Africa	9720
Switzerland, Liechtenstein	9721
Chile, Italy, Ethiopia	9722
Israel	9723
Argentina	9725
China	9726
US Group 1: Provides two 2.8 meter 10A/125V, C13 to NEMA 5-15P power cords	9731
Taiwan	9732
Brazil	9733
India	9734
Japan	9735
Korea	9736
Chicago	9737
Priced Optional Features – Other for Control Enclosure	Feature Code
Compression Accelerator	AH1A

Table 7. FlashSystem V840 Control Enclosure data cables and UPS features

FlashSystem V840 Storage Enclosure supports the network cables and UPS features that are listed in Table 8.

FlashSystem V840 Storage Enclosure - Data Cables	Feature Code
1 m Fibre Cable (LC-LC)	3700
5 m Fibre Cable (LC-LC)	3701
Priced Optional Features – Storage Enclosure Data Cables	Feature Code
Power cord - 2.8 m (China)	6210
Power cord - 2.8 m (Aus/NZ)	6211
Power cord - 2.8 m (Europe)	6212
Power cord - 2.8 m (Denmark)	6213
Power cord - 2.8 m (S. Africa)	6214
Power cord - 2.8 m (UK)	6215
Power cord - 2.8 m (Swiss)	6216
Power cord - 2.8 m (Ita/Chile)	6217
Power cord - 2.8 m (Israel)	6218
Power cord - 2.8 m (S Korea)	6219
Power cord - 2.8 m (Argentina)	6222
Power cord - 2.8 m (India)	6269
Power cord - 2.8 m 120V (US)	6313
Power cord - 2.8 m (Japan)	6314
Power cord - 2.8 m (Taiwan)	6386
Power cord - 2.8 m (Brazil)	6532
Base Configuration – Storage Enclosure	Manufacturing Feature Index (MFI)
Rack cable 2.0 m 125 - 250V (WW) (quantity 2)	39Y5532
Priced Optional Features – Other for Storage Enclosure	Feature Code
Building Block Indicator: Indicates this is 1 of potentially 4 building blocks in a scalable cluster	3001
Additional Storage Enclosure Indicator: Indicates this is 1 of potentially 4 additional Storage Enclosures in a scalable 1 cluster	3002

Table 8. FlashSystem V840 Storage Enclosure data cables and UPS features

Encryption

FlashSystem V840 provides support for AES XTS 256 data-at-rest encryption when the Encryption Enablement Pack, feature AF14, is ordered.

In addition FlashSystem V840 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.

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

For more information refer to the FlashSystem V840 Knowledge Center:

http://www.ibm.com/support/knowledgecenter/ST2HTZ/landing/Flashsystem_V840.htm

System management and web interface

FlashSystem V840 includes the IBM CLI, which is also useful for scripting, and an intuitive GUI for simple and familiar management of the product. FlashSystem V840 supports Simple Network Management Protocol (SNMP), email forwarding with Simple Mail Transfer Protocol (SMTP), and syslog redirection for complete enterprise management access. The simple GUI allows storage to be quickly deployed and efficiently managed. The GUI runs on the FlashSystem V840, so there is no need for a separate console. All you need to do is point your web browser to the system.

Note: The IBM Mobile Storage Dashboard, version 1.5.4, supports the IBM FlashSystem V840 GUI. It is a no-charge application that can be downloaded from iTunes:

https://itunes.apple.com/us/app/ibm-storage-mobile-dashboard/id677826483?mt=8

The FlashSystem V840 Storage Enclosure 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 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.

As FlashSystem V840 Control Enclosures cluster together to form a system, a single management interface is used for all Control Enclosures. FlashSystem V840 Storage Enclosure also has its own management module, which is independently accessible by the user to perform certain service-oriented tasks.

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 V840 beyond a web browser or a standard SSH client.

Supported platforms

FlashSystem V840 has extensive interoperability with support for a wide range of operating systems (Microsoft Windows Server 2008 and 2012, Linux, and IBM AIX®), hardware platforms (IBM System x, IBM Power Systems[™], and x86 servers not from IBM), host bus adapters (HBAs), and storage area network (SAN) fabrics. For specific information, see the IBM System Storage Interoperation Center (SSIC):

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

Physical and electrical specifications

FlashSystem V840 Control Enclosure (9846-AC1 or 9848-AC1) has the following physical, electrical, and environmental specifications:

- Dimensions and weight
 - o Width: 445 mm (17.5 in.)
 - o Depth: 746 mm (29.4 in.)
 - o Height: 86 mm (3.4 in.)
 - o Weight:
 - o Empty: 21.1 kg (46.4 lb)
 - o Fully configured: 22.0 kg (48.4 lb)
- Air temperature
 - o Operating: 5 40 °C (41 °F 104 °F) up to 950 m (3,117 ft)
 - o Powered off: 1 60 °C (33.8 °F 140 °F)
 - o Storage: 1 °C 60 °C (34 °F 140 °F) at 0 to 2,133 m (0 to 7,000 ft)
 - o Shipping: -20 °C 60 °C (-4 °F 140 °F) at 0 to 10,668 m (0 to 35,000 ft)
- Relative humidity
 - o Operating: 8% 85%
 - o Non-operating: 8% 85%
- Electrical power
 - o Voltage range: 100 240 V ac
 - o Frequency: 50 60 Hz
 - o Power: 150 watts
- Heat dissipation: (BTU per hour): 512
- Acoustical noise emission: 6.3 bels (idling and operating)

FlashSystem V840 Storage Enclosure (9846-AE1 or 9848-AE1) has the following physical, electrical, and environmental specifications:

- Dimensions and weight
 - o Width: 445 mm (17.6 in.) (19-inch Rack Standard)
 - o Depth: 761 mm (29.96 in.)
 - o Height: 86.2 mm (3.39 in.)
 - o Weight: 34 kg (75 lb fully loaded)
- Air temperature
 - Operating: 5 °C to 40 °C (41 °F to 104 °F) at 30.5 below to 3,000 m above sea level (100 ft below to 9,840 ft above)
 - o Non-operating: 5 °C to 45 °C (41 °F to 113 °F)
- Relative humidity
 - o Operating: 8% 85%
 - o Non-operating: 5% 80%
- Electrical power
 - o Voltage range: 100-240 VAC
 - o Frequency: 50 60 Hz
- Acoustical noise emission: 8.0 bels (LwAd) when operating in a 19-inch system rack
- Power consumption: 900 watts maximum, 625 watts typical operation
- Heat dissipation: 2134 BTU per hour

Software and licensing

FlashSystem V840 uses IBM Storwize® software-defined storage features. FlashSystem V840 data services are provided through FlashSystem V840 Software. FlashSystem V840 has both base and optional software licenses.

Base licensed features

The following functions are provided with the FlashSystem V840 base software license:

- Virtualization of FlashSystem V 840 Storage Enclosures. Enables rapid, flexible provisioning, and simple configuration changes.
- FlashCopy. FlashCopy provides a volume level point-in-time copy function for any storage that is
 virtualized by FlashSystem V840. FlashCopy and snapshot functions enable you to create copies of
 data for backup, parallel processing, testing, and development, and have the copies available almost
 immediately.
- **Thin provisioning**. Helps improve efficiency by allocating disk storage space in a flexible manner among multiple users, based on the minimum space that is required by each user at any given time.
- Data migration. Enables easy and nondisruptive moves of volumes from another storage system onto the FlashSystem V840 system by using Fibre Channel connectivity. Dynamic migration helps speed data migrations from weeks or months to days, eliminating the cost of add-on migration tools and providing continuous availability of applications by eliminating downtime.
- Simple GUI. Simplified management with the intuitive GUI enables storage to be quickly deployed and efficiently managed. The GUI runs on the FlashSystem V840 system, so there is no need for a separate console. All you need to do is point your web browser to the system
- Easy Tier technology. This feature provides a mechanism to seamlessly migrate data to the most appropriate tier within the FlashSystem V840. This migration can be to the internal flash memory within FlashSystem V840 Storage Enclosure, or to external storage systems that are virtualized by FlashSystem V840 Control Enclosure. EasyTier technology adds more blended economy of capacity, and is useful for cost-effective expansion and usage of your existing storage capacity investment.

Easy Tier now allows for up to three tiers of storage. For example, you can set up a storage pool intended for Easy Tier volumes where the pool is composed of the FlashSystem V840 storage enclosures, 15K revolutions per minute (RPM) Fibre Channel disk drives, and serial-attached SCSI (SAS) disk drives.

- Real-time Compression Enhancements. Real-time Compression in FlashSystem V840 software has been enhanced to provide improvements in performance with the delivery of the new IBM FlashSystem V840 Control Enclosure (9846-AC1 or 9848-AC1), including use of the compression accelerator card optional hardware feature. This feature is mandatory and is included with the selection of Real-time Compression software.
- Automatic re-striping of data across storage pools. When growing a storage pool by adding more storage to it, FlashSystem V840 software has the ability to re-stripe your data on pools of storage without having to implement any manual or scripting steps. This helps grow storage environments with greater ease, while retaining the performance benefits that come from striping the data across the disk systems in a storage pool.

FlashSystem Software is installable only on FlashSystem V840 Control Enclosures and Storage Enclosures (9846-AC1, 9846-AE1, 9848-AC1, and 9848-AE1).

Optional licensed features

The following optional licensed features are offered with the FlashSystem V840 Software:

- External storage virtualization. Enables FlashSystem V840 to manage capacity in other Fibre Channel SAN storage systems. When FlashSystem V840 virtualizes a storage system, its capacity becomes part of the FlashSystem V840 system, and it is managed in the same way as capacity on internal flash modules within FlashSystem V840. Capacity in external storage systems inherits all the functional richness of the FlashSystem V840.
- **Real-time Compression**. Helps improve efficiency by compressing data by as much as 80%, enabling storage of up to 5x as much data in the same physical space. Unlike other approaches to compression, Real-time Compression is designed to be used with active primary data, such as production databases and email systems, dramatically expanding the range of candidate data that can benefit from compression.
- **Remote Mirroring**. Provides storage system-based data replication by using either synchronous or asynchronous data transfers over Fibre Channel communication links:
 - o Metro Mirror maintains a fully synchronized copy at metropolitan distances (up to 300 km).
 - o Global Mirror operates asynchronously and maintains a copy at much greater distances (up to 8000 km).

Both functions support VMware Site Recovery Manager to help speed disaster recovery. FlashSystem V840 remote mirroring interoperates with other FlashSystem V840 storage systems.

IBM FlashSystem V840 software includes license compatibility with IBM SmartCloud® Virtual Storage Center (VSC).

Table 9 lists the software license descriptions and feature codes.

Program Number / Product ID	License type	Name
5639-FS7	Base	IBM FlashSystem V840 V7, Base, FlashCopy, Thin Provisioning, Easy Tier 3, Single enclosure, system entitled
5639-FV7	Optional	IBM FlashSystem V840 Virtualization Software V7
5639-FR7	Optional	IBM FlashSystem V840 Remote Mirroring Software V7
5639-FC7	Optional	IBM FlashSystem V840 Real-time Compression, 3:1 (average), scoped to individual volumes

Table 9. Base and optional software licenses

How to count and order licenses

This section describes the base and optional licensing features, and helps you to calculate and determine the software licenses to order for your environment. Figure 9 shows the base and the optional software licenses that can be ordered for FlashSystem V840. Also shown in Figure 9 is a color key that maps to the software licenses that are described for the following topics and diagrams.



Figure 9. FlashSystem V840 base and optional software licenses

IBM FlashSystem V840 V7 Base Software (5639-FS7)

IBM FlashSystem V840 V7 Base Software (5639-FS7) provides core software functionality and is required in all FlashSystem V840 offerings. The software includes components that are installed on FlashSystem V840 Control Enclosures (9846-AC1 or 9848-AC1), but licensing is based solely on the quantity of FlashSystem V840 Storage Enclosures that are included in the system. Each FlashSystem V840 Storage Enclosure (9846-AE1 or 9848-AE1) requires *one* 5639-FS7 FlashSystem V840 V7 Base Software license.

Example: A FlashSystem V840 order consisting of two Control Enclosures and one Storage Enclosure requires a quantity of *one* FlashSystem V840 V7 Base Software License. Figure 10 illustrates the FlashSystem V840 Base Software License.



Figure 10. FlashSystem V840 Base Software License

IBM FlashSystem V840 External Virtualization Software V7 (5639-FV7)

Each FlashSystem V840 Control Enclosure (9846-AC1 or 9848-AC1) can attach and manage external storage devices on the SAN in the same way, for example, as the IBM Storwize V7000. To authorize the usage of this function, you must license the IBM FlashSystem V840 External Virtualization feature code. One IBM FlashSystem V840 External Virtualization feature code (5639-FV7) is required for each externally attached Storage Enclosure that is virtualized with FlashSystem V840. FlashSystem V840 Storage Enclosures (9846-AE1 or 9848-AE1) are not considered externally attached Storage Enclosures, and do not require separate licenses.

A Storage Enclosure that is externally managed by FlashSystem V840 is defined as an independently powered, channel-attached device that stores data on magnetic disks or solid-state drives (SSDs), such as disk controllers and their respective expansion units, each constituting a separate enclosure. Therefore, an enclosure can be either the main controller housing disk (or solid-state) drives, or the expansion chassis that house additional disk (or solid-state) drives for the purpose of expanding the total capacity of the storage system. If there is any confusion for an external Storage Enclosure that does not conform to this definition, consult an IBM sales representative for an equivalent measure based on a disk drive count.

Example: If you want to use a FlashSystem V840 to virtualize one IBM Storwize V5000 system consisting of one Control Enclosure and one expansion enclosure, you need *two* IBM FlashSystem V840 External Virtualization licenses to remain compliant, one for the externally attached control enclosure and one for the externally attached expansion enclosure for a total of two FlashSystem V840 External Virtualization licenses (5639-FV7).

This feature code quantity can be applied against any one or more of the FlashSystem V840 Software V7 (5639-FS7) licensed products, as shown in Figure 11.



Figure 11. External virtualization of two Storwize V5000 systems

IBM FlashSystem V840 Real-time Compression V7 (5639-FC7)

To authorize the use of Real-time Compression capabilities of the FlashSystem V840, you must purchase the IBM FlashSystem V840 Real-time Compression V7 license. This license is subject to the following rules that are associated with ordering the number of required licenses for your environment:

- The capacity-bearing storage device is what is counted. FlashSystem V840 always has a Storage Enclosure, and at least has a count of *one* Real-time Compression license.
- Capacity bearing storage devices that are associated with the FlashSystem V840 and being externally virtualized are also counted.

Selecting Real-time Compression automatically selects the hardware compression accelerator (Feature Code AH1A).

Example: Consider a FlashSystem V840 consisting of two FlashSystem V840 Control Enclosures, one FlashSystem V840 Storage Enclosure, and three Storwize V5000 systems. In this example, there are three external virtualization licenses (5639-FV7), and four Real-time Compression licenses (5639-FC7) being used for the three V5000 products, and one more for the FlashSystem V840 Storage Enclosure, as shown in Figure 12.



Figure 12. FlashSystem V840: External virtualization of three V5000 systems

IBM FlashSystem V840 Remote Mirroring Software V7 (5639-FR7)

IBM FlashSystem V840 Remote Mirroring Software is licensed based on the quantity of FlashSystem V840 Storage Enclosures in the client environment, and is subject to the following rules:

- The capacity-bearing storage device is what is counted on both sides of the mirrored pair.
- Capacity-bearing storage devices that are associated with the FlashSystem V840 that are involved in the mirror relationship and being externally virtualized are also counted. They require Remote Mirroring licenses on both sides of the mirror relationship.
- Of the storage devices that are engaged in the mirrored pair, the lesser of the two counts for ordering Remote Mirroring software licenses.

This feature code quantity can be applied against one or more of the IBM FlashSystem V840 V7 Base Software (5639-FS7) licensed products. The following scenarios are examples of how to license Remote Mirroring Software features under the previous licensing rules.

Scenario 1

The primary site, Production 1, shown in Figure 13, has no externally virtualized storage, and the target site, Central DR, employs an IBM XIV® consisting of six capacity-bearing modules/enclosures as needed.

Production 1 is a FlashSystem V840 with two FlashSystem V840 Control Enclosures, one FlashSystem V840 Storage Enclosure, and nothing externally virtualized. Therefore, it has one 5639-FS7 Base Software license for the one FlashSystem V840 Storage Enclosure.

The Central DR system is a FlashSystem V840 storage system with two FlashSystem V840 Control Enclosures, and one FlashSystem V840 Storage Enclosure, with six virtualized XIV enclosures. Therefore, the secondary system has one 5639-FS7 Base Software license, six 5639-FV7 External Virtualization licenses, and seven 5639-FR7 Remote Mirroring licenses.

Following the rule of counting the lesser of storage devices that are engaged in a mirrored pair, the primary system has one Remote Mirroring license (5639-FR7), and has the lesser quantity of Remote Mirrored licenses, as compared to the secondary Central DR system, which has one Remote Mirroring license (5639-FR7) for the FlashSystem V840 Storage Enclosure, plus six Remote Mirroring licenses for a total of seven Remote Mirroring licenses (5639-FR7). A total of *two* Remote Mirroring licenses (5639-FR7) are required, as shown in Figure 13.



Figure 13. Counting Remote Mirroring Licenses: Scenario 1

Scenario 2

The primary system, Production 2, shown in Figure 14, is performing some external virtualization. The target site. Central DR, employs an XIV consisting of six capacity-bearing modules/enclosures as needed.

Production 2 is a FlashSystem V840 storage system with two FlashSystem V840 Control Enclosures and one FlashSystem V840 Storage Enclosure with two virtualized IBM Storwize V5000 systems. Therefore, the primary system has one 5639-FS7 Base Software license, two 5639-FV7 External Virtualization licenses, plus three 5639-FR7 Remote Mirroring licenses.

The target system, Central DR, is a FlashSystem V840 storage system with two FlashSystem V840 Control Enclosures, one FlashSystem V840 Storage Enclosure, with six virtualized XIV enclosures that are being remotely mirrored. Therefore, the secondary system has one 5639-FS7 base Software license, six 5639-FV7 External Virtualization licenses, plus seven 5639-FR7 Remote Mirroring licenses (one of these licenses pertains to the FlashSystem V840 Storage Enclosure).

Following the rule of counting the lesser of storage devices that are engaged in a mirrored pair, the primary system has three Remote Mirroring licenses (5639-FR7), and has a lesser quantity of Remote Mirrored licenses, as compared to the secondary Central DR system, which has seven Remote Mirroring licenses (5639-FR7).

A total of *six* Remote Mirroring licenses (5639-FR7) are required: *Three* licenses for the primary system plus three licenses for the secondary system, as shown in Figure 14.



Figure 14. Counting Remote Mirroring Licenses: Scenario 2

Scenario 3

The primary system, Production 3, shown in Figure 15, is performing some external virtualization, Real-time Compression, and mirroring. The target site, Central DR, employs an XIV consisting of six capacity-bearing modules/enclosures as needed. Production 3 is a FlashSystem V840 with two FlashSystem V840 Control Enclosures and one FlashSystem V840 Storage Enclosure with three virtualized IBM Storwize V5000 systems, using Real-time Compression. Therefore, the primary system has one 5639-FS7 Base Software license, three 5639-FV7 External Virtualization licenses, four 5639-FC7 Real-time Compression licenses, plus four 5639-FR7 Remote Mirroring licenses.

The target system, Central DR, is a FlashSystem V840 storage system with two FlashSystem V840 Control Enclosures, one FlashSystem V840 Storage Enclosure, with six virtualized XIV enclosures that are being remotely mirrored. Therefore, the secondary system has one 5639-FS7 base Software license, six 5639-FV7 External Virtualization licenses, plus seven 5639-FR7 Remote Mirroring licenses (one of these licenses pertains to the FlashSystem V840 Storage Enclosure).

Following the rule of counting the lesser of storage devices that are engaged in a mirrored pair, the primary system has four Remote Mirroring licenses (5639-FR7), and has a lesser quantity of Remote Mirrored licenses, as compared to the secondary Central DR system, which has seven Remote Mirroring licenses (5639-FR7).

A total of *eight* Remote Mirroring licenses (5639-FR7) are required: *Four* licenses for the primary system plus *four* licenses for the secondary system, excluding the six additional Remote Mirroring licenses for the XIV enclosures, as shown in Figure 15.



Figure 15. Counting Remote Mirroring Licenses: Scenario 3

Warranty information and upgrades

FlashSystem V840 includes a one-year or a three-year warranty.

Technical Advisor support is provided during the warranty period. This support enhances end-to-end support for the client's complex IT solutions. The Technical Advisor uses an integrated approach for proactive, coordinated cross-team support to allow customers to maximize IT availability. Technical Advisor support for FlashSystem V840 is delivered remotely and includes a documented support plan, coordinated problem and crisis management, which reports on the client's hardware inventories and software levels, and consultation regarding FlashSystem software updates. The Technical Advisor conducts a Welcome Call with the client and provides a statement of work for this support.

IBM Global Financing

IBM Global Financing offers competitive financing to credit-qualified customers and IBM Business Partners to assist them in acquiring IT solutions. Our offerings include financing for IT acquisition, including hardware, software, and services, from both IBM and other manufacturers or vendors, and commercial financing (revolving lines of credit, term loans, acquisition facilities, and inventory financing credit lines) for IBM Business Partners. Offerings (for all customer segments: Small, medium, and large enterprise), rates, terms, and availability can vary by country. Contact your local IBM Global Financing organization or go to the following website:

http://www.ibm.com/financing

Related publications and links

For more information, see the following resources:

- Implementing IBM FlashSystem 840, SG24-8189 <u>http://www.redbooks.ibm.com/redpieces/abstracts/sg248189.html?Open</u>
- IBM Redbooks Solution Guides and Product Guides for the IBM FlashSystem family <u>http://www.redbooks.ibm.com/redbooks.nsf/searchsite?SearchView&query=flashss</u>
- FlashSystem V840 IBM Knowledge Center <u>http://www.ibm.com/support/knowledgecenter/ST2HTZ</u>
- IBM FlashSystem family product page <u>http://www.ibm.com/storage/flash</u>
- IBM System Storage Interoperation Center (SSIC) <u>http://www.ibm.com/systems/support/storage/ssic/interoperability.wss</u>
- IBM Support Portal
 <u>http://ibm.com/support/entry/portal/</u>
- IBM Offering Information page (announcement letters and sales manuals): <u>http://www.ibm.com/common/ssi/index.wss?request_locale=en</u>

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

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 2014-2015. All rights reserved.

Note to U.S. Government Users Restricted Rights -- Use, duplication or disclosure restricted by GSA ADP Schedule Contract with IBM Corp.

This document was created or updated on November 23, 2015.

Send us your comments in one of the following ways:

- Use the online Contact us review form found at: ibm.com/redbooks
- Send your comments in an e-mail to: redbooks@us.ibm.com
- Mail your comments to: IBM Corporation, International Technical Support Organization Dept. HYTD Mail Station P099 2455 South Road Poughkeepsie, NY 12601-5400 U.S.A.

This document is available online at http://www.ibm.com/redbooks/abstracts/tips1158.html .

Trademarks

IBM, the IBM logo, and ibm.com are trademarks or registered trademarks of International Business Machines Corporation in the United States, other countries, or both. These and other IBM trademarked terms are marked on their first occurrence in this information with the appropriate symbol (® or ™), indicating US registered or common law trademarks owned by IBM at the time this information was published. Such trademarks may also be registered or common law trademarks in other countries. A current list of IBM trademarks is available on the web at http://www.ibm.com/legal/copytrade.shtml.

The following terms are trademarks of the International Business Machines Corporation in the United States, other countries, or both:

AIX® Easy Tier® FlashCopy® FlashSystem™ HyperSwap® IBM® IBM FlashSystem® IBM SmartCloud® IBM Spectrum™ IBM Spectrum Control™ IBM Spectrum Virtualize™ MicroLatency® Power Systems™ PowerPC® Real-time Compression™ Redbooks® Redbooks (logo)® Storwize® System Storage® Variable Stripe RAID™ XIV®

The following terms are trademarks of other companies:

Intel Xeon, Intel, Intel logo, Intel Inside logo, and Intel Centrino logo are trademarks or registered trademarks of Intel Corporation or its subsidiaries in the United States and other countries.

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

Microsoft, Windows, and the Windows logo are trademarks of Microsoft Corporation in the United States, other countries, or both.

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