IBM Spectrum Accelerate
Version 11.5.3

Planning, Deployment, and Operation Guide

SC27-6695-04

Note
Before using this document and the product it supports, read the information in "Notices" on page 113.

Edition notice

Publication number: SC27-6695-04. This publication applies to version 11.5.3 of IBM Spectrum Accelerate and to all subsequent releases and modifications until otherwise indicated in a newer publication.

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About this guide

This guide describes how to prepare for, deploy, configure, and use IBM Spectrum Accelerate™.

Who should use this guide

This guide is intended for network and server administrators who intend to deploy, configure, and operate IBM Spectrum Accelerate.

The following prior knowledge is recommended:

- General familiarity with the IBM® XIV® Storage System.
- Good familiarity with server hardware components (memory, CPU, disks, etc.).
- Good familiarity with VMware ESXi platforms.
- Knowledge in Ethernet network operation and configuration.

Conventions used in this guide

These notices are used in this guide to highlight key information.

Note: These notices provide important tips, guidance, or advice.

Important: These notices provide information or advice that might help you avoid inconvenient or difficult situations.

Attention: These notices indicate possible damage to programs, devices, or data. An attention notice appears before the instruction or situation in which damage can occur.

Related information and publications

You can find additional information and publications related to IBM Spectrum Accelerate on the following information sources.

- IBM Spectrum Accelerate marketing portal (ibm.com/systems/storage/spectrum/accelerate)
- IBM Spectrum Accelerate on IBM Knowledge Center (ibm.com/support/knowledgecenter/STZSWD) – on which you can find the following related publications:
  - IBM Spectrum Accelerate – Release Notes
  - IBM Spectrum Accelerate – Product Overview
  - IBM Spectrum Accelerate – Command-Line Interface (CLI) Reference Guide
  - IBM XIV Management Tools – Release Notes
  - IBM XIV Management Tools – Operations Guide
  - IBM Hyper-Scale Manager – REST API Specifications
- IBM XIV Storage System on IBM Knowledge Center (ibm.com/support/knowledgecenter/STJTAG) – on which you can find the following related publications:

  - IBM XIV Management Tools – Release Notes
  - IBM XIV Management Tools – Operations Guide
  - IBM Hyper-Scale Manager – REST API Specifications
- VMware Documentation (vmware.com/support/pubs)
- VMware Knowledge Base (kb.vmware.com) –
  - VMware KB article on IBM Spectrum Accelerate (kb.vmware.com/kb/2111406)

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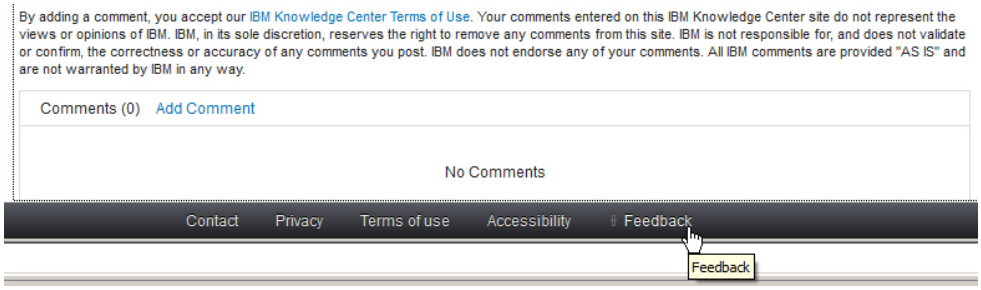

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- IBM Directory of Worldwide Contacts website (ibm.com/planetwide)
- IBM developerWorks Answers website (www.developer.ibm.com/answers)
- IBM service requests and PMRs (ibm.com/support/servicerequest/Home.action)

Use the Directory of Worldwide Contacts to find the appropriate phone number for initiating voice call support. Voice calls arrive to Level 1 or Front Line Support.

Chapter 1. Introduction

IBM Spectrum Accelerate is a software-defined storage (SDS) solution that allows enterprises to use their own server and disk infrastructure for assembling, setting up, and running one or more enterprise-class storage systems that incorporate the proven XIV storage technology.

IBM Spectrum Accelerate is provided as a virtual appliance (pre-configured virtual machine) for VMware ESXi hypervisors. The Spectrum Accelerate virtual appliance software is installed on 3–15 (minimum 3; maximum 15) physical ESXi hosts (servers), which together comprise a single storage system that operates with the XIV microcode.

Each individual ESXi host acts as a storage system module, containing 6 to 12 physical disks that are utilized by the Spectrum Accelerate virtual appliance (see "Concept diagram"). The modules interconnect over 10-Gigabit Ethernet to form a complete mesh and enable the unique data distribution and other advanced features and capabilities.

IBM Spectrum Accelerate can be deployed either on-premises or off-premises on a remote cloud. The ESXi hosts that comprise the storage system can be connected to a vCenter server, although it is not a requirement.

With support for converged infrastructures, IBM Spectrum Accelerate virtual machines can run in parallel to other virtual machines on the same ESXi server, and can be integrated with advanced vSphere cluster features, such as High Availability (HA), Fault Tolerance, and Distributed Resource Scheduling (DRS). The IBM Spectrum Accelerate virtual machines, their virtual switches, and their disk resources on each ESXi host machine can be visually monitored through vSphere Client.

After the IBM Spectrum Accelerate storage system is up and running, it can be used for storage provisioning over iSCSI, and can be managed with the dedicated XIV management tools (GUI or CLI) or through RESTful APIs.

Concept diagram

The following figure provides a general visualization of the IBM Spectrum Accelerate architecture and primary building blocks.

In this example, a single Spectrum Accelerate storage system comprises three modules (the required minimum number of modules).

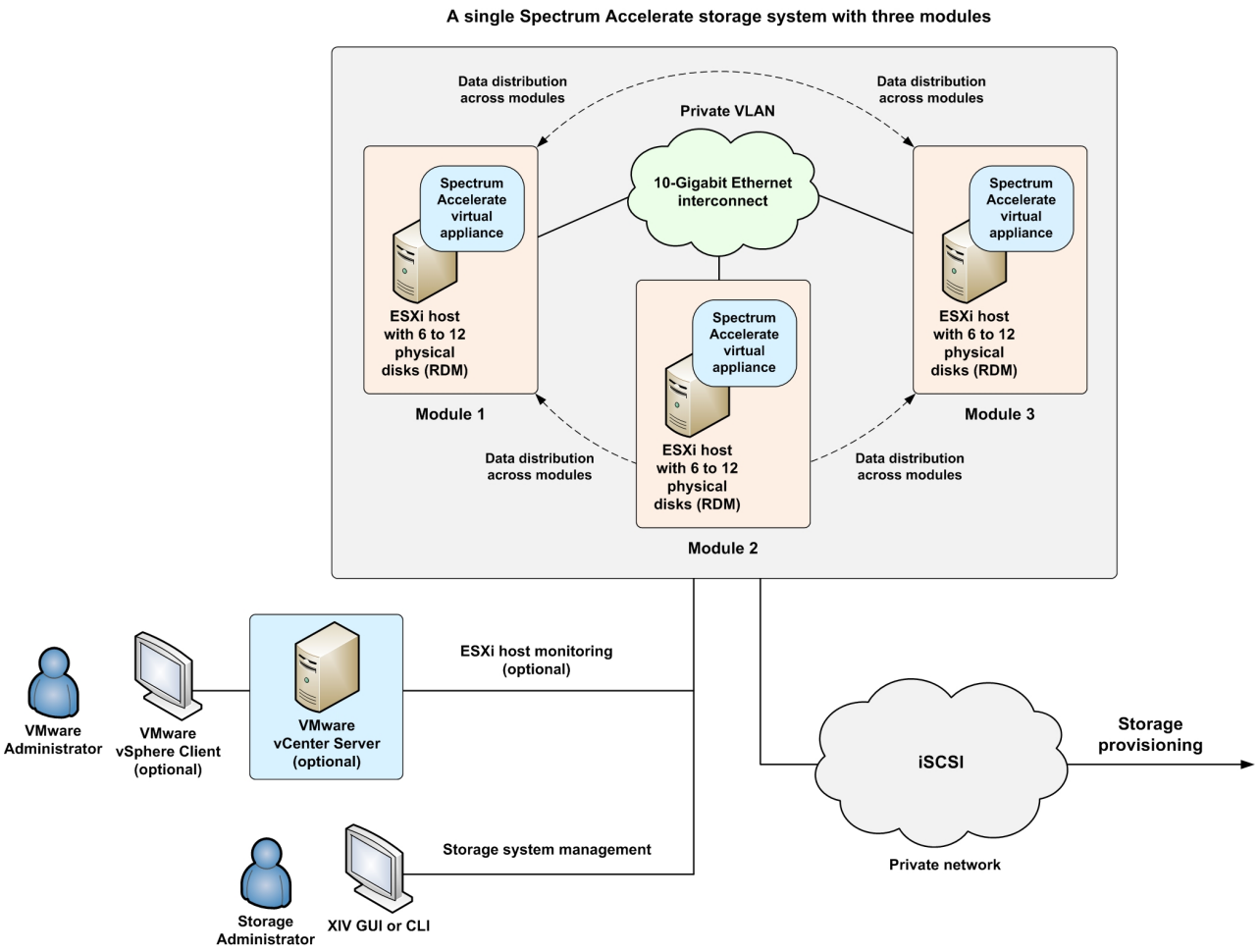


Figure 1. Visualization of the Spectrum Accelerate architecture and primary building blocks

For the overall description of this illustration, see Chapter 1, "Introduction," on page 1.

Key advantages

IBM Spectrum Accelerate offers the following key advantages:

- Builds on the proven power of the XIV storage system technology.
- Accommodates dynamic business requirements through a software-based solution that can utilize commodity storage hardware and allow for custom hardware as well.
- Supports any hardware configuration and components that meet the minimal requirements, and requires no explicit hardware certification. Scaling of modules is linear and non-disruptive.
- Does not require on-premises deployment.
- Runs as a virtual machine on the VMware vSphere ESXi hypervisors, enabling the creation of a server-based storage area network (SAN) from commodity hardware that includes x86-64 servers, Ethernet switches, solid state drives (SSDs), and high-density disk drives.
- Supports hyper-convergence, allowing other virtual machines to run in parallel on the same ESXi hypervisors.

- Efficiently groups virtual nodes with the underlying physical disks and spreading the data evenly across the nodes, creating a single, provisioning-ready virtual array.
- Cost-effectively uses any standard datacenter network for both inter-node and host connectivity.
- Smartly utilizes flash media to provide a superior cache hit ratio, as well as extended cache across all volumes to boost performance while saving the need to manage tiers.
- Delivers hotspot-free performance derived from architectural features that include massive parallelism, and optimal ongoing data distribution and load balancing.
- Delivers high availability through self-healing and fast disk rebuild technology.
- Provides advanced enterprise-class features, including remote replication, multi-tenancy, snapshots, monitoring, security, and management tools, with automation and orchestration through OpenStack, and Representational State Transfer (REST).
- Provides a flexible licensing model based on usable terabytes for optimal utilization and operational agility.

Primary features

IBM Spectrum Accelerate offers the following primary functional features, which are based on the proven XIV storage technology and capabilities.

Table 1. Primary features of IBM Spectrum Accelerate

Feature	Functionality note
Full data redundancy and distribution across modules and disks	Powered by XIV technology
Fast data rebuilding	
Load balancing	
Self-healing mechanisms	
Storage pools and volumes	
Snapshots	
Consistency groups	
Hyper-Scale Consistency	
Thin provisioning and space reclamation	
Synchronous remote mirroring	
Asynchronous remote mirroring	
Offline initialization for mirroring	
Multi-tenancy	
IBM Hyper-Scale Mobility	
Non-disruptive microcode upgrade	
Quality of Service (QoS)	
User access profiles (permission sets) and LDAP authentication	
Remote configuration management	
Event handling and push notifications (e-mail, SNMP, SMS)	
State-of-the-art management and monitoring GUI	Provided from the XIV management tools
IBM Hyper-Scale Manager	
Mobile Dashboard application for mobile devices (iOS and Android)	Realtime monitoring for XIV and Spectrum Accelerate systems
Advanced CLI management	Including hardware servicing commands
RESTful APIs	Web service APIs in adherence to the Representational State Transfer (REST) architecture

Table 1. Primary features of IBM Spectrum Accelerate (continued)

Feature	Functionality note
Management over IPv4 and IPv6	Powered by XIV technology
Management over IPsec	
iSCSI connectivity, including CHAP authentication over iSCSI	
Multiple host access	
IBM remote support and proactive support	Requires use of the Call Home option

For more detailed information about these features, see the IBM Spectrum Accelerate *Product Overview* publication.

Hot-upgrade support

IBM Spectrum Accelerate supports hot upgrade to newer microcode versions without interrupting the constant storage system operation.

Check for newer versions on a regular basis to obtain critical fixes and feature improvements.

For information about direct hot upgrade options (upgrading directly from certain previous versions), see the latest IBM Spectrum Accelerate release notes.

For the upgrade procedure, see "Upgrading a Spectrum Accelerate system" on page 80.

Before you begin

Before acquiring, deploying, and using IBM Spectrum Accelerate, refer to the following up-to-date information:

- The latest IBM Spectrum Accelerate release notes
- The latest IBM XIV Management Tools release notes

The information in the release notes might be more updated than the information in this guide.

You can obtain the latest release notes on the IBM Spectrum Accelerate space on IBM Knowledge Center (ibm.com/support/knowledgecenter/STZSWD).

Chapter 2. Requirements, planning, and best practices

Before IBM Spectrum Accelerate can be deployed, planning and preparation of the target cluster is required as detailed in the following sections.

Hardware and configuration requirements

IBM Spectrum Accelerate requires certain hardware, software, and configurations as detailed in the following sections.

Required VMware ESXi host machines

IBM Spectrum Accelerate requires 3–15 (minimum 3; maximum 15) VMware ESXi host machines (physical servers; see ESXi software requirements below) to be used as the individual modules of the storage system.

Important: The following hardware components and configuration **must be dedicated solely for the IBM Spectrum Accelerate virtual machine**. Additional hardware resources are needed for other virtual machines, applications, or background services that run in parallel, and for the ESXi server functionality.

Required hardware

The following hardware components on the ESXi host machine must be dedicated for the IBM Spectrum Accelerate virtual machine (additional hardware resources must be allocated for the ESXi server functionality):

- x86-64 CPU with 6 physical cores (not counting on Hyper-Threading) or more. If only 4 physical cores are used, their maximum CPU utilization must be dedicated to IBM Spectrum Accelerate. **2 additional cores must be allocated for the ESXi server functionality**.
- At least 24 GB and up to 128 GB of RAM –
  - All ESXi host machines must have the same amount of physical RAM dedicated for the IBM Spectrum Accelerate virtual machine.
  - **Additional and sufficient RAM must be allocated for the ESXi server functionality.**
  - If 4 TB or 6 TB disks are used (see disk options below), at least 48 GB of RAM is required for the Spectrum Accelerate virtual machine.
- 6 to 12 physical hard disk drives (HDDs) –
  - Capacity of at least 1 TB and up to a maximum of 6 TB is required for each HDD.
  - All HDDs should have the same capacity.

  - All ESXi host machines must have the same number of HDDs (6 to 12) dedicated for the IBM Spectrum Accelerate virtual machine.
  - **All HDDs must have up-to-date firmware. Check the HDD manufacturer website to obtain the most updated disk firmware.**
  - If SED capable HDDs (Self-Encrypting Drives) are used, only the global band (Band 0) can be defined. No user bands are allowed.
  - An additional disk is required for the VMware ESXi Server software.
  - For better performance (not mandatory, but recommended) :
    - Any RAID function of the disk controller should be disabled (all HDDs should work in JBOD mode). Instead of RAID functions, use a host bus adapter (HBA). If used, verify the HBA firmware and driver version as specified in VMware KB article 1027206 (kb.vmware.com/kb/1027206).
    - Any SAS controller should function without a cache, and should be compatible with VMware ESXi as specified on the VMware Compatibility Guide (vmware.com/resources/compatibility).
- One solid-state drive (SSD) of 480 GB or larger capacity of up to 800 GB for caching purposes (not mandatory, but recommended).
- At least one 10-Gigabit Ethernet (10 GigE) port for the interconnect network; up to eight ports per ESXi host machine.
- At least one Gigabit Ethernet (1 GigE) port (or of higher capacity) for the management and iSCSI networks.
- Uninterruptible power supply (UPS).

Attention: Accidental power loss or improper system shutdown might result in data loss. In case of power loss, immediate manual shutdown of the storage system is required, followed by at least 30 seconds of continuous backup power to allow graceful shutdown of the storage system.

Required ESXi version and configuration

Each individual ESXi host machine should be pre-configured with:

- **ESXi 5.5 Update 2 or a higher update of version ESXi 5.5 only.** The ESXi platform must run on a 64-bit operating system.
- One datastore with at least 250 GB free space for storing the image of the Spectrum Accelerate virtual appliance. Use a different name for each datastore on each ESXi host machine, to prevent any silent renaming of those datastores by vCenter Server (if used).
- Management IP address for the Spectrum Accelerate virtual machine.
- One or two IP addresses for iSCSI connectivity.
- SSH access enabled (can be disabled after the deployment is completed).
- SSH and ESX Shell services up and running.
- Three separate IP subnets for the following Spectrum Accelerate networks:
  - Management network
  - iSCSI network
  - Interconnect network
- NIC teaming configuration if more than one 10-Gigabit Ethernet port is used.

Required vSwitch, network, and deployment host

The following table provides information about the required vSwitches, interconnect network, and deployment host.

Component	Requirements
vSwitch	One, two, or three vSwitches (virtual switches) with corresponding port groups to which the management, interconnect, and iSCSI networks can connect. As a best practice, the same port group names should be predefined on all ESXi hosts on which you intend to deploy the IBM Spectrum Accelerate virtual appliance.
Interconnect network	Must consist of a 10-Gigabit Ethernet LAN and must include: • One static IP address per module. All IP addresses must reside in the same subnet. • End-to-end MTU setting of 9000 bytes (Jumbo frame). **Note:** Use of a private VLAN for the interconnect network is recommended.
Deployment host	One deployment host from which the Spectrum Accelerate software is to be deployed on the ESXi hosts. Any of the following operating systems can be used on the deployment host: • 64-bit Ubuntu Linux 12.04 or 14.04 • 64-bit Red Hat Enterprise Linux (RHEL) 6.5 • 64-bit Microsoft Windows 7 The deployment host must have root access to the management IP address of the ESXi hosts. A Linux deployment host requires GNU Tar 1.15 or later, which can be obtained from the GNU website (gnu.org/software/tar).

You can use vSphere Client to verify the ESXi configuration, as shown in "Verifying the ESXi configuration from vSphere Client" on page 49.

The following figure provides a general visualization of the ESXi configuration and Spectrum Accelerate software deployment.

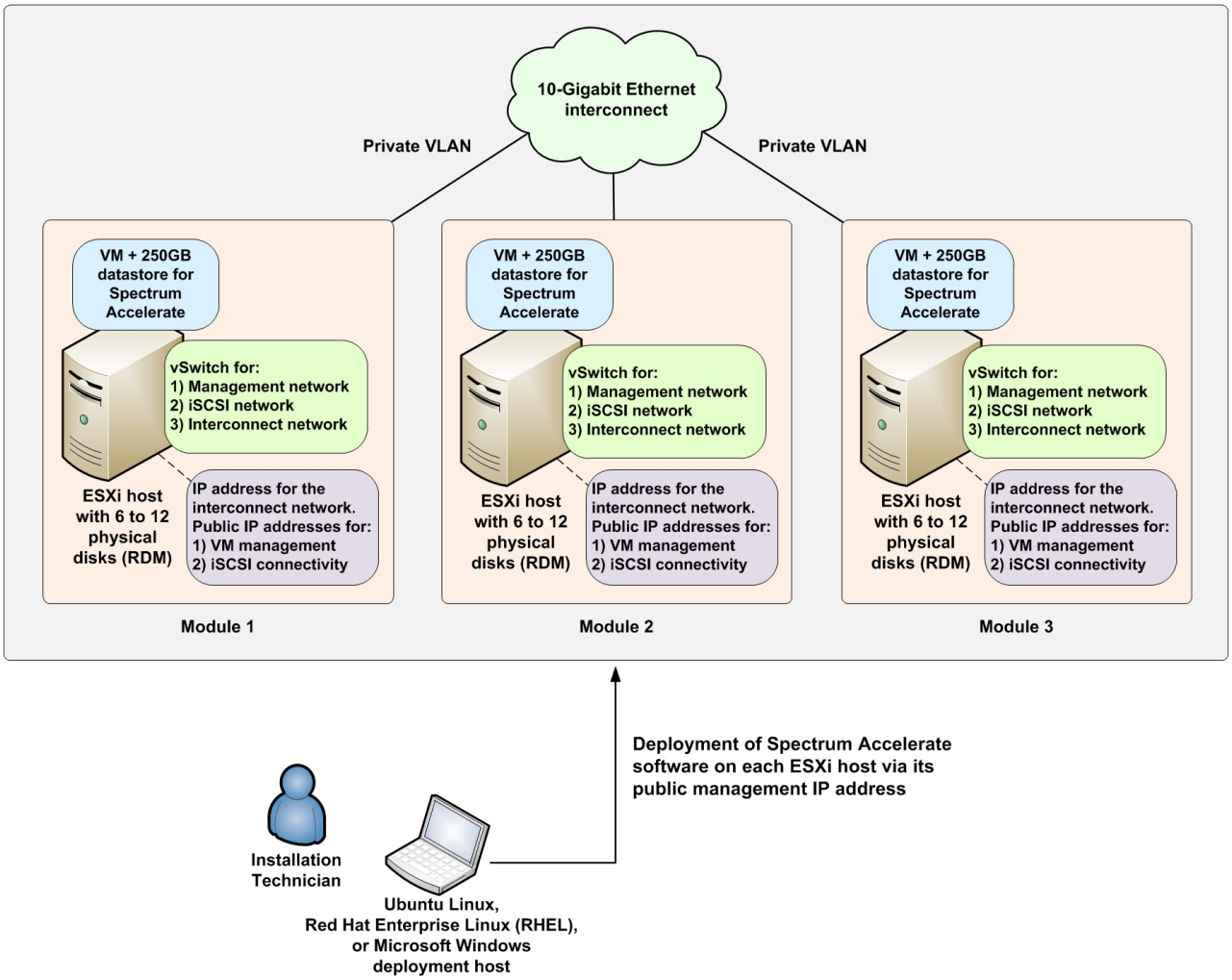


Figure 2. Visualization of the ESXi configuration and Spectrum Accelerate software deployment

ESXi server hardware configurations

The following table provides three ESXi hardware configuration examples for IBM Spectrum Accelerate.

Plan your ESXi server hardware configuration for IBM Spectrum Accelerate based on the intended scale of its use.

Hardware feature	Minimal configuration	Balanced configuration	Optimal configuration
Number of ESXi host machines	3	4-15	15
Number of physical CPU cores per ESXi host machine	6	6	8
RAM per ESXi host machine	32 GB	72 GB	140 GB
Number of hard disk drives (HDDs) per ESXi host machine	6	12	12

Hardware feature	Minimal configuration	Balanced configuration	Optimal configuration
HDD capacity	1 TB	6 TB	6 TB
Number of solid-state drives (SSDs) per ESXi host machine	0	1	1
SSD capacity	0	800 GB	800 GB
Number of 10-Gigabit Ethernet ports for the interconnect network	1	2	4

For the Spectrum Accelerate virtual machine hardware configuration examples, see "Hardware configurations for the virtual machine"

Hardware configurations for the virtual machine

The following table provides specifies hardware configurations that **must be dedicated solely for the IBM Spectrum Accelerate virtual machine**.

Plan your hardware configuration for the IBM Spectrum Accelerate virtual machine based on the intended scale of its use.

Hardware feature	Minimal configuration	Balanced configuration	Optimal configuration
Number of ESXi host machines	3	4-15	15
Number of physical CPU cores per virtual machine	4	4	6
RAM per virtual machine	24 GB	64 GB	128 GB
Number of hard disk drives (HDDs) per virtual machine	6	12	12
HDD capacity	1 TB	6 TB	6 TB
Number of solid-state drives (SSDs) per virtual machine	0	1	1
SSD capacity	0	800 GB	800 GB

For the ESXi hardware configuration examples, see "ESXi server hardware configurations" on page 10

VMware vCenter server requirements

This section provides information about the VMware vCenter server requirements.

Using a VMware vCenter server in the Spectrum Accelerate deployment is optional. If you decide to use a VMware vCenter server, note that currently **only version 5.5** is supported.

Planning and best practices

For optimal performance of IBM Spectrum Accelerate, carefully plan your VMware ESXi cluster configuration in advance.

The planning covers different ESXi environment aspects, including network, storage resources, virtual machine (VM) resources, and general cluster configuration.

Optimal performance results can be achieved by applying best-practice configurations, as detailed in the following sections.

Note: The following sections are intended for VMware administrators who are familiar with ESXi terms and advanced ESXi configuration.

Best practices for the ESXi interconnect network

The following tables summarize the best practices that can be applied when setting up the ESXi interconnect network for IBM Spectrum Accelerate.

Note: The following information is intended for VMware administrators who are familiar with ESXi terms and advanced ESXi configuration.

The interconnect network requires either a vNetwork standard switch (vSwitch) or a vNetwork distributed switch (dvSwitch). Each switch type supports different vSphere features, as detailed in the following table.

Table 2. Best practices for the ESXi interconnect network – vSwitch vs. vdSwitch

vSphere feature	Standard switch (vSwitch) support	Distributed switch (dvSwitch) support	Best practice
Provisioning, administration, and monitoring	Yes – per ESXi server	Yes – centralized	Use a distributed switch for centralized provisioning, administration, and monitoring
NIC teaming	Yes	Yes	Use NIC teaming for better port bandwidth utilization and failure handling
LACP for dynamic link aggregation configuration	No	Yes	Use to detect adjacent node port failure
Shape outbound (TX) traffic	Yes	Yes	Do not use
Shape inbound (RX) traffic	No	Yes	Do not use
Private VLAN	No	Yes	Use a distributed switch and a private VLAN for the interconnect network
NIOC	No	Yes	Do not use

Although using a distributed switch is the best practice, the following table summarizes the best practices when using a standard switch.

Table 3. Best practices for a vNetwork standard switch (vSwitch)

vNetwork standard switch (vSwitch) configuration	Best practice
More than one vSwitch	Create two vSwitches with one or more uplink ports: one for the management and iSCSI networks, and one for the interconnect network
Single vSwitch	Use only if all physical uplink ports are needed for the management, iSCSI, and interconnect traffic (vSwitch0)
ESXi Management Traffic	Associate the management traffic to the same switch if all physical uplink ports are needed
Virtual machines other than Spectrum Accelerate connecting to the switch	Do not allow
Failover order group	Do not use
Port group per VLAN	Required if VLAN assignment is needed
Port group-based rate limiting	Do not use
Foreign guest VM port groups use a VLAN ID that is the same as the interconnect VLAN ID	Do not use

When a distributed switch is used (best practice), apply the following best practices.

Table 4. Best practices for a vNetwork distributed switch (vdSwitch)

vNetwork distributed switch (vdSwitch) configuration	Best practice
Configure distributed switch	Use
Cluster must be gracefully shut down when migrating the Spectrum Accelerate VM from a standard switch to a distributed switch	Use
Use vCenter in deployments that include a distributed switch	Required
If NIOC is enabled, configure Physical Adapter Shares with a different priority for VM traffic	Do not use
If NIOC is enabled, enforce traffic bandwidth limit on the overall VDS set of dvUplinks	Do not use
If NIOC is enabled, configure QoS Tag which overrides of the L2 priority assignment	Use

The following tables provide additional best practices for the ESXi interconnect network.

Table 5. Best practices for a uplink port connections

Uplink port connections configuration	Best practice
Use at least two uplink port connections	Required if High Availability is needed
Use Spectrum Accelerate deployment requirements (may use a planning tool)	Use

Table 5. Best practices for a uplink port connections (continued)

Uplink port connections configuration	Best practice
Same speed on all uplink port connections (link aggregation requires the same speed)	Required
Setting MTU (bytes) to 9000 bytes (maximum) if the network support Jumbo frames for iSCSI and interconnect	Required if jumbo frames are supported in the network
Phase out the module before removing the last physical NIC from the switch	Use
Setting MAC address changes, forged transmits, and Promiscuous Mode on each vSwitch or distributed switch/distributed port group to **Reject**	Use
Flow control	Required
MAC Address Generation on ESXi	Required
NetQueue	Use

Table 6. Best practices for teaming physical adapters

Teaming physical adapter configuration	Best practice
Teaming (at least 2 ports are required)	Required if High Availability is needed
All adapters are active	Use
Route based on IP hash	Use
Enhanced LACP support	Use. EtherChannel can be used as well.
Network failover detection: **Link Status only**	Required if High Availability is needed
Adjacent switch will meet throughput objective while using teaming for its outbound traffic toward the ESXi machine	Use
Multiswitch Link Aggregation Multi-switch link aggregation (MLAG)	Use
Failback is configured to Y	Required if High Availability is needed
The teaming configuration of the adjacent switch must support remote link failure detection if the link is a member in the teaming and immediately exclude the failed link from the teaming.	Required if High Availability is needed
The teaming configuration of the adjacent switch must support remote link recovery detection if the link is a member in the teaming and immediately include the recovered link back to the teaming.	Required if High Availability is needed

Table 7. Best practices for VLAN ID assignment

VLAN ID assignment configuration	Best practice
Virtual Switch Tagging (VST) - performed by the virtual switch before leaving the host	Required if a VLAN is used
Configure the VLAN ID in the port group	Required if a VLAN is used

Table 8. Best practices for TCP parameters

TCP configuration	Best practice
Enabling TCP segmentation offload support for a virtual machine both on virtual NIC and the physical NIC	Use
Enabling TCP large receive offload (LRO)	Do not use
Enabling checksum offloading (TCO) on both the virtual NIC and physical NIC	Use

Table 9. Best practices for ESXi tools

ESXi tool or feature	Best practice
pktcap-uw	Use
ESXi dump collector support: Use the remote **netdump** service instead of allocating a local disk for this purpose	Use
Port mirroring for the Spectrum Accelerate guest distributed ports	Do not use
NetFlow (network analysis tool)	Use
VMware Tools	Use (see "Handling emergency shutdown" on page 103)

Table 10. Best practices for protocols

Protocol configuration	Best practice
Cisco Discovery Protocol (CDP)	Use
Link-Layer Discovery Protocol (LLDP)	Use

Best practices for the ESXi storage resources

The following tables summarize the best practices that can be applied when setting up the ESXi storage resources for IBM Spectrum Accelerate.

Note: The following information is intended for VMware administrators who are familiar with ESXi terms and advanced ESXi configuration.

Table 11. Best practices for ESXi images and internal file storage configuration

ESXi images and internal file storage configuration	Best practice
ESXi image storage on SD cards	Use
Spectrum Accelerate image storage on SD card	Use
Internal files on VMFS volume on a remote device	Use

Table 12. Best practices for ESXi physical configuration

ESXi physical configuration	Best practice
Physical storage is local	Required
ESXi Storage devices: SCSI based devices (SAS or SATA)	Use
Use of JBOD mode in a RAID capable controller	Use

Table 12. Best practices for ESXi physical configuration (continued)

ESXi physical configuration	Best practice
Use of non-JBOD mode in a RAID capable controller	Do not use

Table 13. Best practices for ESXi virtual disk configuration

ESXi virtual disk configuration	Best practice
SCSI path through mapping; VMFS pass-through RDM (physical mode). For direct access to the storage device for a non-RAID scheme. RDM can be used if real vendor and model number of the disk is exposed.	Use
Thick Provision Lazy for virtual disks	Use
Symmetric configuration: all modules in the cluster are configured identically.	Use

Table 14. Best practices for physical disk configuration

Physical disk configuration	Best practice
Disks used for the Spectrum Accelerate data when RAID is not used: minimum 6; maximum 12	Required
Disk groups Spectrum Accelerate data when RAID is used: minimum 6; maximum 12	Required
Adding more disks to module after cluster and module are in operational state	Do not use
All disks with the same size	Use
Added disk capacity must be higher or equal to the system disk size. If smaller, the system rejects the disk.	Required
Disk similarity: RPM, disk type, interface	Use
The following parameters must be set as **false**: **`VMkernel.Boot.terminateVMOnPDL`**	Required
Detach storage devices without Spectrum Accelerate Phase out	Do not use

Table 15. Best practices for storage hardware acceleration configuration

Storage hardware acceleration configuration	Best practice
All machines in the cluster have an SSD of at least 480 GB	Use
Targeting a flash read-cache size of approximately 4% of the available capacity of the HDDs	Use
Same size SSDs in all machines in the cluster	Use
Use the latest firmware with SSD devices	Use
VMware Flash Read Cache (vFRC) usage	Do not use
Define virtual disks on SSD	Do not use

Table 16. Best practices for storage tool configuration

Storage tool configuration	Best practice
ESXTOP to report the various latencies	Use
VMware I/O Analyzer (with I/O Analyzer Listening-Mode Tests)	Use
VMware Tools (`vmkfstools`)	Use
Storage I/O control (SIOC)	Do not use

Best practices for the ESXi CPU, memory, and power resources

The following tables summarize the best practices that can be applied when setting up the ESXi CPU, memory, and power resources for IBM Spectrum Accelerate.

Note: The following information is intended for VMware administrators who are familiar with ESXi terms and advanced ESXi configuration.

Table 17. Best practices for CPU configuration

CPU configuration	Best practice
At least 4 physical cores dedicated for the Spectrum Accelerate virtual machine; at least 2 additional cores for the ESXi server functionality	Required
If all cores are selected, the CPU cycles reserved for the Spectrum Accelerate VM should be at minimum of 75% of the total cycles. If only part of the cores are allocated for the Spectrum Accelerate, the CPU cycles reserved for the Spectrum Accelerate VM should be 100%.	Use
Enable Hyper-Threading in the BIOS	Use
Working in guest mode	Use
Virtual sockets and the number cores per socket should have same layout as in physical	Required
CPU hot-plugging feature	Do not use
Increase reserved resources (for example, CPU capacity) while the Spectrum Accelerate VM is powered on and I/O traffic is running	Do not use
CPU with virtualization technology	Use
The VMM chooses the appropriate combination of CPU and MMU virtualization modes.	Use
Same CPU hardware type for all modules	Required

Table 18. Best practices for memory configuration

Memory (RAM) configuration	Best practice
Up to 128 GB for the Spectrum Accelerate VM	Use

Table 18. Best practices for memory configuration (continued)

Memory (RAM) configuration	Best practice
48 GB or more when 4 TB or 6 TB disks are used	Required
Symmetric configuration: all modules with the same amount of memory	Use
Changing memory size while VM is powered on and I/O traffic is running	Do not use
Memory Reservation mode (avoid hypervisor swapping)	Use
Limit should be equal to or greater than reserved memory	Required
Server with hardware-assisted memory virtualization	Use
The VMM chooses the appropriate combination of CPU and MMU virtualization modes	Use
Memory compression	Do not use

Table 19. Best practices for power configuration

Power configuration	Best practice
BIOS configured with high performance	Required
The hypervisor should be configured with high performance	Required
Dual-feed power supply	Use
Dual separated substations (dual sources)	Use
Gold-rated PSU	Use
Battery time for graceful shutdown (UPS or BBU)	Use
Battery time for grace time	Use
"Margin" period time	Use

Best practices for the ESXi cluster configuration

The following tables summarize the best practices that can be applied when setting up the ESXi cluster configuration for IBM Spectrum Accelerate.

Note: The following information is intended for VMware administrators who are familiar with ESXi terms and advanced ESXi configuration.

Table 20. Best practices for vSphere clustering

vSphere clustering configuration	Best practice
Datastore cluster features	Do not use
Same hardware in all host machines	Use
vMotion for the Spectrum Accelerate VM	Do not use

Table 21. Best practices for network latency

Network latency configuration	Best practice
Packet loss rate below 0.01% rate in the interconnect network	Required
Packet delay is below 5 milliseconds	Required

Table 22. Best practices for cluster stability

Cluster stability configuration	Best practice
No I/O failures (by activating I/O simulation)	Required

System capacity with a three-node cluster

The following explains how to calculate the system's usable capacity for three-node clusters.

The usable capacity calculation is based on the worst-case scenario. In a three node system, this scenario is a failure of a node, and in addition a failure of three disks in one of the remaining nodes. The system capacity in this scenario, and therefore the system's usable capacity, is approximately the capacity of a single node minus three disks. To understand why this is the system capacity in this scenario, consider that after one node failure, the data in each remaining node is backed up on the other remaining node. If one of the remaining nodes has three failed disks, then this node's capacity determines the amount of data it can back up, and therefore the usable capacity of the whole system.

Chapter 3. Licensing and download

IBM Spectrum Accelerate is a downloadable software product that must be licensed per storage capacity.

The licensed storage capacity can be used by several Spectrum Accelerate deployments (several Spectrum Accelerate storage systems) as long as the total storage capacity of all deployments does not exceed the licensed storage capacity.

For more information about the available download and licensing options for IBM Spectrum Accelerate, check the IBM Passport Advantage® website (ibm.com/software/passportadvantage).

Important:

- Using the product is allowed for the licensed capacity. Consult with an authorized IBM representative to obtain information about the required IBM Spectrum Accelerate licensing for your organization.
- The license is associated with your IBM customer number (ICN). Contact IBM to obtain your ICN. After your Spectrum Accelerate is deployed, you can retrieve your ICN at any time as described in "Retrieving your IBM Customer Number (ICN)" on page 112.

License types

IBM Spectrum Accelerate has two license types:

- **Perpetual** – Never expires.
- **Fixed Lease** – Expires after a predefined period, usually after a fixed number of months.

Both license types are issued for a specified Terabytes capacity that can be used for storage.

License use measuring and reporting

Information regarding the actual storage capacity usage (in Terabytes) on all your IBM Spectrum Accelerate deployments can be monitored from IBM Hyper-Scale Manager.

Important: Always make sure that the total storage capacity of all Spectrum Accelerate deployments and newly added modules does not exceed the licensed storage capacity. If such exceeding is required, additional Spectrum Accelerate storage capacity must be licensed in advance.

The following figure illustrates the license use measuring and reporting concept:

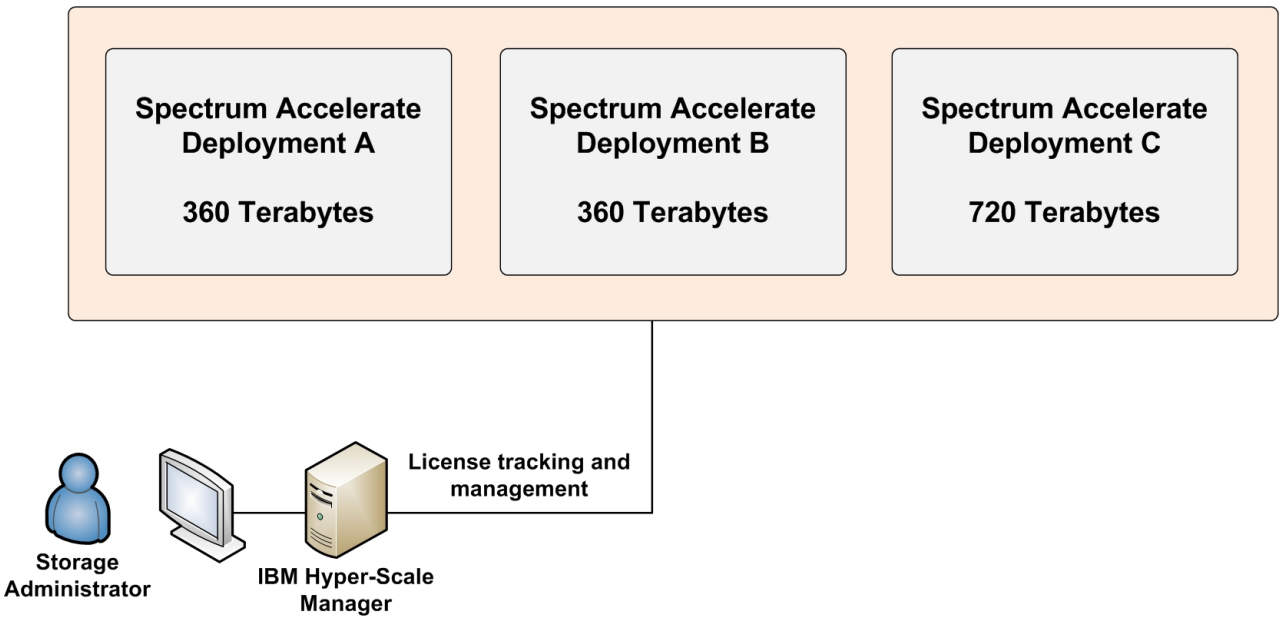


Figure 3. IBM Spectrum Accelerate licensing and reporting concept

For more information, see "Managing and tracking Spectrum Accelerate licenses" on page 75.

License Metric Reporting

Spectrum Accelerate generates IBM® Software License Metric Tag (SLMT) files. Versions of IBM License Metric Tool that support IBM Software License Metric Tag can generate License Consumption Reports. Read this section to interpret these reports for Spectrum Accelerate.

If you have not installed a version of IBM License Metric Tool that supports IBM Software License Metric Tag, you can monitor the license usage from IBM Hyper-Scale Manager.

Each instance of a running Spectrum Accelerate runtime environment generates an IBM Software License Metric Tag file. The metric monitored is CAPACITY. It represents the system's hard capacity in Terabytes. The value is measured and refreshed every 7 days.

As long as the value of CAPACITY is smaller than the capacity allocated by your Spectrum Accelerate license, no action is required. If the value of CAPACITY exceeds the capacity allocated by your Spectrum Accelerate license, a new license must be obtained.

The system hard capacity (in Megabytes) can be also retrieved by issuing the command **system_capacity_list**.

License management

After IBM Spectrum Accelerate is deployed, you can manage and track your licenses through IBM Hyper-Scale Manager.

For more information, see "Managing and tracking Spectrum Accelerate licenses" on page 75.

IBM Spectrum Accelerate license on IBM XIV Gen3 systems

IBM Spectrum Accelerate storage capacity can be licensed on IBM XIV Gen3 systems in order to enable early shipment of newly acquired IBM XIV Gen3 systems.

When such licensing model is used, it is defined at the factory level based on the intended capacity of the IBM XIV Gen3 storage system, and must be converted to regular XIV Gen3 licensing prior to making the storage system fully operational.

Note: Although IBM Spectrum Accelerate storage capacity can be licensed on IBM XIV Gen3 systems, IBM Spectrum Accelerate cannot be used on IBM XIV Gen3 storage systems, as it is designed to be deployed on VMware ESXi servers and on customer-provided hardware of choice.

The licensing of IBM Spectrum Accelerate on IBM XIV Gen3 systems is labeled as '**HW attached with Spectrum Accelerate**' in the XIV management tools:

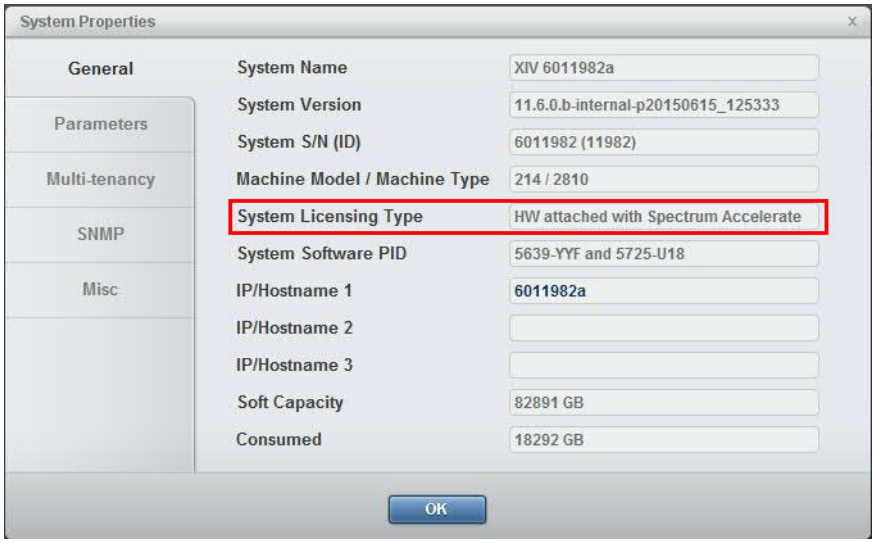


Figure 4. IBM Spectrum Accelerate licensing on IBM XIV Gen3 – System Properties dialog box

Figure 5. IBM Spectrum Accelerate licensing on IBM XIV Gen3 – System list

When IBM Spectrum Accelerate is licensed in the regular manner (not on an XIV Gen3 system), it is labeled as '**Spectrum Accelerate**':

Figure 6. IBM Spectrum Accelerate licensing on IBM XIV Gen3 – System Properties dialog box

Downloading the IBM Spectrum Accelerate software package

The IBM Spectrum Accelerate software deployment package for VMware ESXi servers can be downloaded initially from the IBM Passport Advantage website, after logging in with a valid IBM ID and after completing the Spectrum Accelerate licensing registration.

Note: Files that are downloaded from the IBM Passport Advantage website (ibm.com/software/passportadvantage) are provided in compressed ZIP format. You must first extract the software package files from the compressed ZIP files.

After the initial product download, subsequent software updates can be downloaded from the IBM Fix Central website (ibm.com/support/fixcentral).

Chapter 4. Deployment

After preparing the required VMware ESXi cluster environment, you can start deploying the IBM Spectrum Accelerate virtual appliance from either a Windows host or a Linux host, as detailed in the following sections.

Preparation tasks

Before starting with the IBM Spectrum Accelerate deployment steps, the following pre-deployment preparation tasks are required.

Note: If this is the first time you are deploying IBM Spectrum Accelerate, it is recommended to simulate the deployment in diagnostics mode. For more information, see the **--diagnostic-only** option in "Step 1: Copying the deployment utility to the deployment host" on page 28, or see "Simulating a deployment from the XIV GUI" on page 47.

Confirming the ESXi host hardware

Follow the VMware guidance regarding certified system, storage, and I/O devices, as detailed in VMware KB article 1003916 (kb.vmware.com/kb/1003916).

Configuring advanced ESXi options

The following two ESXi advanced configuration parameters affect the proper handling of disk failures or disk replacements by the Spectrum Accelerate virtual machine:

- **VMKernel.boot.terminateVMOnPDL** – PDL conditions and High Availability (for more information, see the relevant topic on the VMware vSphere 5.5 Documentation Center). By default, this parameter is set to disabled and must remain disabled. However, if it is not already disabled, issue the following ESXi CLI command to disable it:

```
esxcli system settings kernel set -s terminateVMOnPDL -v FALSE
```

- **Misc.APDHandlingEnable** – Storage APD handling (for more information, see the relevant topic on the VMware vSphere 5.5 Documentation Center). By default, this parameter is enabled, and you must disable it by issuing the following ESXi CLI command (or see the vSphere Web Client procedure in the VMware vSphere 5.5 Documentation Center link):

```
esxcli system settings advanced set -o /Misc/APDHandlingEnable -i 0
```

- **FailVMIOonAPD** – Fast fail VM I/Os on APD Timeout. By default, this parameter is disabled, and you must enable it by issuing the following ESXi CLI command:

```
esxcli system settings advanced set -o /Scsi/FailVMIOonAPD -i 1
```

For more information about how to configure advanced ESXi options, see VMware KB article 1038578 (kb.vmware.com/kb/1038578).

Updating the SAS driver

If you are using a SAS controller, make sure that the latest SAS driver is installed on the ESXi host. If the `lsi_mr3` driver is currently installed, update it to `megaraid_sas-6.603.55.00` or later.

To update the SAS driver:

1. Download the SAS driver ZIP file from the VMWare website to `/tmp/d` on the ESXi host.
2. Issue the following ESXi CLI commands (where `megaraid_sas-6.603.55.00-*.zip` stands for the ZIP filename) :

```
esxcli system module set --enabled=false --module=lsi_mr3
esxcli software vib install -d /tmp/d/megaraid_sas-6.603.55.00-*.zip --no-sig-check
```

3. Reboot the ESXi host.
4. Issue the following command and verify that the relevant HBA is now reported using the `megaraid-sas` driver:

```
esxcfg-scsidevs -a
```

Updating the storage controller firmware

The firmware and driver version of the storage controller on the ESXi host must be up-to-date. Follow the VMware guidance as detailed in VMware KB article 1027206 (kb.vmware.com/kb/1027206).

Disabling cluster virtual machine monitoring

If you intend to deploy IBM Spectrum Accelerate on an HA ESXi cluster, set the cluster virtual machine (VM) monitoring option to **Disabled**, as demonstrated in the following figure:

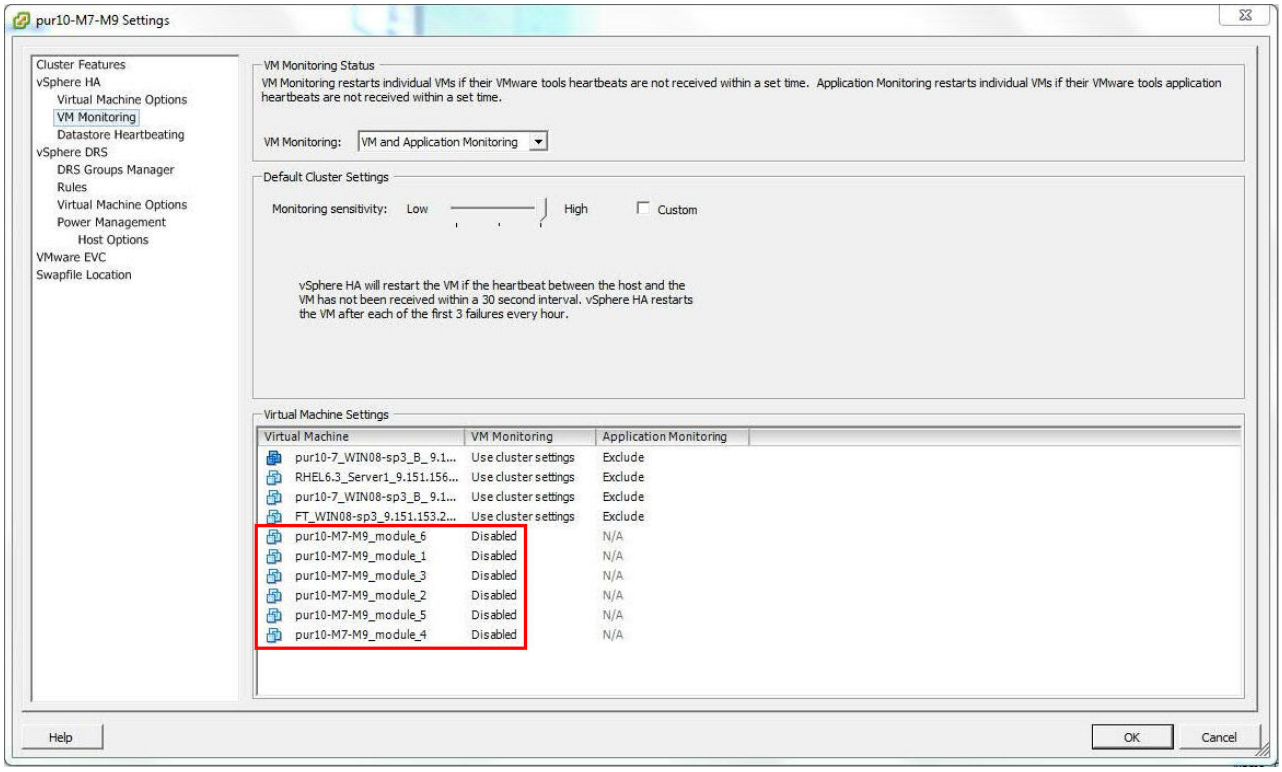


Figure 7. Cluster VM monitoring is set to Disabled

Collecting individual disk IDs

If needed, you can configure IBM Spectrum Accelerate to use specific data and cache disks on each individual ESXi host machine, and identify those disks by their unique manufacturer ID or serial number. This provides you with flexibility in choosing which of the existing server disks should be dedicated to IBM Spectrum Accelerate, and helps you avoid disk misplacement when replacing disks (see “Replacing a disk” on page 98).

In addition, if any disk fails, the IBM Spectrum Accelerate system reports the ID of the failed disk. This helps replacing the specific disk without phasing out the whole module and then looking for the failed disk.

Accordingly, the unique IDs of all the disks that you intend to choose must be collected before the deployment, so that you could specify these disk IDs in the deployment steps.

You can use VMware vSphere Client panel to view the disks that are available per ESXi server, and also view the details of each individual disk.

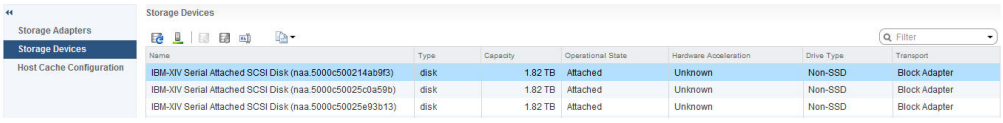


Figure 8. ESXi disk IDs (manufacturer-assigned IDs)

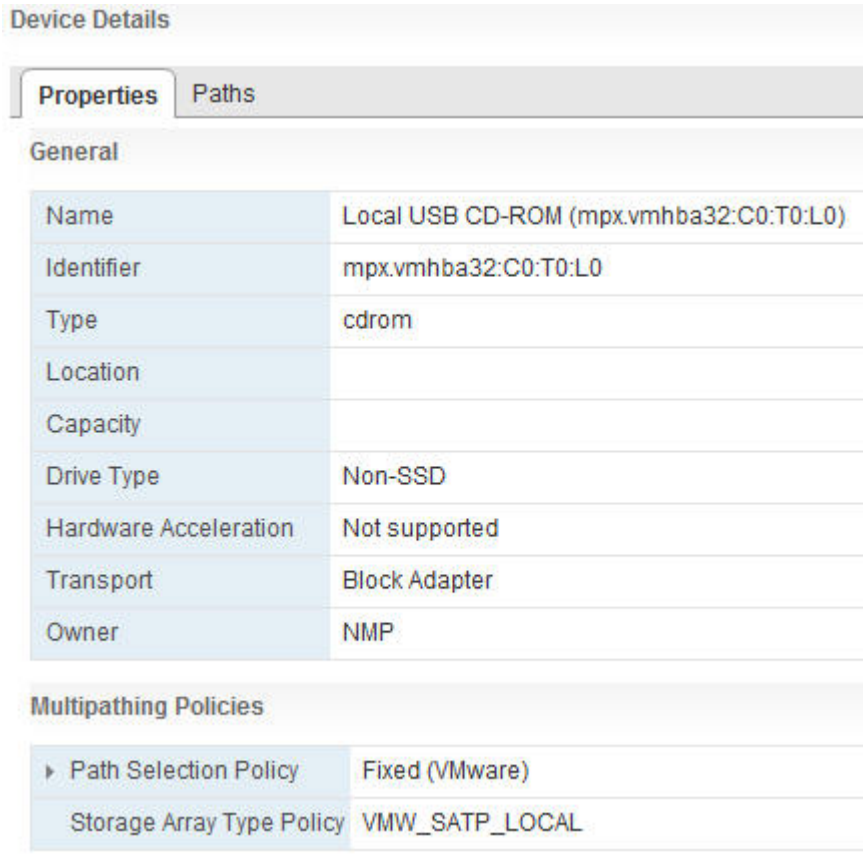


Figure 9. Individual disk details

Deploying from a Linux host

If you are using a Linux deployment host, complete the following steps to deploy and activate the IBM Spectrum Accelerate virtual appliance on the dedicated ESXi hosts that are to be used as the storage system modules.

- Step 1: Copying the deployment utility to the deployment host
- Step 2: Creating and editing the XML configuration file
- Step 3: Issuing the deployment command

Step 1: Copying the deployment utility to the deployment host

The first step is to copy the IBM Spectrum Accelerate software deployment utility to the Linux deployment host.

About this task

The deployment utility is a one-file application that transparently includes a set of essential files, including the image file of the IBM Spectrum Accelerate virtual appliance, Python script files, OVF files, XML configuration file, and other components. It allows you to extract the XML configuration file, issue the deployment command, and perform additional operations (see Table 23 on page 29).

The deployment utility must be placed locally on the deployment host.

Procedure

After obtaining the deployment utility file:

1. Copy the deployment utility file (`xiv_sds_deployment_kit.bash`) to a clean folder on the Linux deployment host.
2. Issue the following command to verify that the deployment utility is functional:

   `./xiv_sds_deployment_kit.bash -h`

   The following prompt is displayed:

```
Usage: ./xiv_sds_deployment_kit.bash [option]
Options:
-c|--config XML_PATH : Deploy based on the specified XML configuration file (full path).
-n|--no-startup      : Deploy on the ESXi hosts without turning on the virtual machines.
-f|--force           : Allows the deployment script to delete existing VMs that have the same name.
-a|--add-module(s)   : Add one or more modules. Can be used only with -c|--config.
-e|--examples        : Extract the XML template file.
-V|--verbose         : Run in verbose mode. Can be used only with -c|--config.
-h|--help            : Display this help text.
-v|--version         : Display the version number of the embedded XIV microcode.
-d|--diagnostic-only : Run system diagnostics and then clean up.
-i|--get-ilmt-tag    : Returns ILMT tag and exits.
```

The following table summarizes the CLI arguments (options) that can be used with the deployment utility.

Table 23. CLI arguments for the deployment utility

Argument	Purpose
`-c` or **`--config`**	Deploy the IBM Spectrum Accelerate software on the ESXi hosts based on the specified XML configuration file. The full path of the XML file must be specified.
`-n` or **`--no-startup`**	Deploy without turning on the IBM Spectrum Accelerate virtual machines.
`-f` or **`--force`**	Allows the deployment script to delete on the ESXi hosts existing Spectrum Accelerate VMs that have the same name.
`-a` or **`--add-module(s)`**	Add a single storage system module. Can be used only when the **`-c`** or **`--config`** argument is used. For more information, see "Adding a new module from a Linux deployment host" on page 58.
`-e` or **`--examples`**	Extract an XML configuration file template. You can then edit the file as described in "Step 2: Creating and editing the XML configuration file" on page 30.

Table 23. CLI arguments for the deployment utility (continued)

Argument	Purpose
-V or **--verbose**	Run in verbose mode, which displays detailed prompts during the deployment. Can be used only when the **-c** or **--config** argument is used.
-h or **--help**	Display the help text.
-v or **--version**	Display the version number of the XIV microcode that is included in the deployment utility.
-d or **--diagnostic-only**	Simulate a deployment on the ESXi hosts based on the specified XML configuration file (see "Step 2: Creating and editing the XML configuration file"), report about any deployment error, and then return to the original pre-deployment state. You can also simulate a deployment from the XIV GUI, as described in "Simulating a deployment from the XIV GUI" on page 47.
-i or **--get-ilmt-tag**	Obtain an IBM License Metric Tool (ILMT) tag, which may be required for different IBM Spectrum Accelerate licensing options.

What to do next

Step 2: Creating and editing the XML configuration file

Step 2: Creating and editing the XML configuration file

If a Linux deployment host is used, the IBM Spectrum Accelerate software deployment requires an XML configuration file that contains a list of essential parameters that define the ESXi cluster environment.

About this task

You can either extract a sample XML configuration file from the deployment utility (`sds_machine_template.xml`), or create a new file manually. The sample XML configuration file is provided either without specified values for the required parameters, or with values that were pre-entered in advance by IBM technicians for your specific ESXi environment.

Any value that was not pre-entered appears in the file as an uppercase (all caps) description string. Accordingly, review the sample XML file and fill-in the parameter values as needed.

Procedure

1. Issue the following command:

   ./xiv_sds_deployment_kit.bash -e

   The sample XML configuration file is extracted to the directory in which the deployment utility is located.

   ```
   Searching embedded archive for example files... Please wait.
   SDS_Deploy/deploy/sds_machine_template.xml
   ```

2. Open the extracted `sds_machine_template.xml` file in a text editor. The following example shows an XML template file that has no pre-entered values.

Note: Because the XML template parameters are explained on the next step (see step 3 on page 32), the following XML template example does not contain some explanatory notes that appear in the actual XML template file.

```
<!-- This is a template for defining the software-defined storage (SDS)
machine and server parameters for the deployment script (deploy_sds.py).
Replace the uppercase strings with values that match your environment. -->

<sds_machine
 name="UNIQUE_NAME_FOR_THE_MACHINE"
 interconnect_mtu="A_NUMBER_1500_TO_9000
 vm_gateway="GATEWAY_FOR_MGMNT_NETWORK"
 vm_netmask="NETMASK_FOR_MGMENT_NETWORK"
 data_disks="NUMBER_OF_RDM_DATA_DISKS"
 ssd_disks="NUMBER_OF_RDM_SSD_DISKS"
 data_disks_size_gb="WANTED_DISK_SIZE_IN_GB"
 ssd_disks_size_gb="WANTED_SSD_SIZE_IN_GB"
 memory_gb="MEMORY_FOR_VM_IN_GB"
 num_cores="NUMBER_OF_CORES"
 icn="SEVEN_DIGIT_IBM_CUSTOMER_NUMBER"
 off_premise="False"
 enable_diagnostic_mode="YES_OR_NO"

 <vcenter_host
  name="VCENTER_HOSTNAME_OR_IP"
  username="VCENTER_ADMIN_USERNAME"
  password="VCENTER_ADMIN_PASSWORD"
  datacenter="NAME_OF_EXISTING_DATACENTER_ON_VCENTER"
  </vcenter_host>

  <esx_servers
   <server
   hostname="NAME_OR_IP_OF_ESX_SERVER"
   username="root"
   password="ESX_ROOT_PASSWORD"
   datastore="DATASTORE_NAME_ON_SERVER"
   mgmt_network="NAME_OF_INTERFACE_TO_BE_USED_AS_MGMT_NETWORK"
   interconnect_network="NAME_OF_INTERFACE_TO_BE_USED_AS_INTERCONNECT_NETWORK"
   iscsi_network="NAME_OF_INTERFACE_TO_BE_USED_AS_ISCSI_NETWORK"
   vm_mgmt_ip_address="IP_ADDRESS_TO_BE_GIVEN_TO_THE_MGMT_NETWORK"
   interconnect_ip_address="IP ADDRESS"
   interconnect_ip_netmask="IP NETMASK">

  <!-- Optional server element <disk> may appear 6-12 times or not at all. -->
    <disk
     identifier="DISK_IDENTIFIER_FROM_ESX_DEVICE_LIST"
     index="DISK_INDEX_FROM_1_TO_12">
    </disk>

    <ssd
     identifier="SSD_IDENTIFIER_FROM_ESX_DEVICE_LIST"
    </ssd>

  </server>

  <!-- You can add additional server entries here (at least 3 are required).
  Make sure that the VM IP address and datacenter names are unique. -->

  </esx_servers>
</sds_machine>
```

3. For each parameter, replace the uppercase description string with a real value as detailed in the following tables, and then save the modified XML file.

Table 24. XML parameters for Spectrum Accelerate storage system (`sds_machine`)

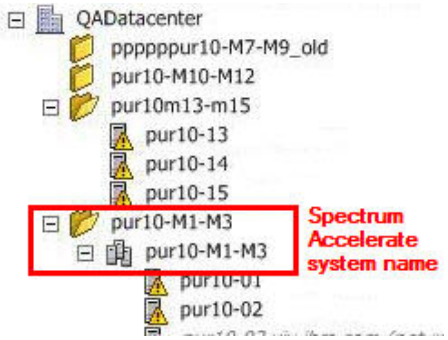
Parameter	Purpose	Possible value
`name`	Name (alias) of the Spectrum Accelerate storage system. **Important:** If you are deploying Spectrum Accelerate on an existing ESXi cluster that contains other virtual machines, the name of the Spectrum Accelerate storage system must match the name of the **cluster**, which must also be identical to the **name of the vSphere folder** that contains the cluster. For example:  	Alphanumerical string
`interconnect_mtu`	Maximum transmission unit (MTU) setting of the interconnect network, in bytes. Jumbo frames are required for performance purposes.	9000 or any value that is higher than or equal to the MTU of the iSCSI network (including, for example, 8500, 8700, or any applicable value)
`vm_gateway`	Gateway address for the management IP address.	IP address
`vm_netmask`	Netmask address of the Spectrum Accelerate storage system.	IPv4 netmask
`data_disks`	Total number of data disks, or hard disk drives (HDDs), per ESXi host machine (storage system module). **Note:** You can assign a unique ID to each disk, as described in Table 27 on page 37.	Integer from 6 to 12
`ssd_disks`	Total number of solid-state drives (SSDs) per ESXi host machine. **Note:** If a solid-state drive is used, you can assign a unique ID to it, as described in Table 28 on page 37.	0 or 1

*Table 24. XML parameters for Spectrum Accelerate storage system (**sds_machine**) (continued)*

Parameter	Purpose	Possible value
data_disks_size_gb	Capacity in Gigabytes (GB) of the data disks that are to be used by IBM Spectrum Accelerate. This parameter is used for the automatic selection of disks. The parameter value is expected to be in 1GB=2^30 bytes, also sometimes referred to as GiB. Many hardware manufacturers report disk size in metric GB (1GB=10^9 bytes). For example, for a 2TB disk, the value of **data_disks_size_gb** should be 1907GB, for a 4TB disk - 3810GB, and so on. **Important:** All data disks much have the same capacity and must be identical to the actual disk size on all target ESXi host machines.	Integer from 1000 to 4000
ssd_disks_size_gb	Capacity in Gigabytes (GB) of the SSD cache disk (if used) for IBM Spectrum Accelerate on each ESXi host machine.	Integer from 500 to 800
memory_gb	Total memory (RAM) that should be allocated for the Spectrum Accelerate virtual machine on each ESXi host machine, in Gigabytes. **Important:** The specified memory size for the Spectrum Accelerate virtual machine must be at least 4 GB less than the total size of the physical memory on each ESXi host machine.	Integer from 24 to 128
num_cores	Number of physical CPU cores (not counting on Hyper-Threading) that should be dedicated for the Spectrum Accelerate virtual machine on the ESXi host machine.	Integer from 4 to **one core less** than the total number of available physical CPU cores on the ESXi host machine
icn	IBM customer number (ICN). Contact IBM to obtain your ICN. If you already obtained an ICN in the past and you have a working IBM Spectrum Accelerate system, you can retrieve your ICN as described in “Retrieving your IBM Customer Number (ICN)” on page 112.	A valid 7-digit number
off_premise	Indicates whether the Spectrum Accelerate storage system is deployed on local ESXi servers at the customer premises, or off-premise on cloud-based servers.	`Yes` (off-premise system) `No` (local system)

*Table 24. XML parameters for Spectrum Accelerate storage system (**sds_machine**) (continued)*

Parameter	Purpose	Possible value
enable_diagnostic_mode	When enabled (with a value of `Yes`), diagnostic mode provides a boot sequence in which the network environment and disk performance are analyzed prior to the deployment. During this analysis, relevant warnings or errors are issued. Warnings allow the deployment to continue, while any detected error stops the deployment. However, warnings should be evaluated carefully before starting to use the storage system. After a successful diagnostic run (without errors), the storage system reboots and then the Spectrum Accelerate processes are prepared to be turned on but not started. **Important:** As a best practice, always deploy with diagnostic mode enabled, unless your environment has been tested and you are sure that no diagnostic is needed.	`Yes` (default) `No`

*Table 25. Optional XML parameters for a vCenter server (**vcenter_host**)*

Parameter	Purpose	Possible value
name	Hostname or IP address of the vCenter server that is used to monitor and control the ESXi hosts.	Hostname or IP address
username	Username for accessing the vCenter server.	A valid username
password	Password for accessing the vCenter server. **Attention:** Since the password is saved in the XML file as cleartext, you can avoid exposing the password in the file by omitting the **password** parameter altogether. If you omit the **password** parameter, you will be prompted for the password during the deployment process (after issuing the deployment command). The password is masked when it is entered during the deployment process.	A valid password
datacenter	Name of an existing datacenter entity (vCenter entity) in which the Spectrum Accelerate storage system should be defined.	Alphanumerical string

Important: If a vCenter server is not used, delete the **vcenter_host** parameters (the entire section) from the XML file.

*Table 26. XML parameters for a single ESXi host (**server**; storage system module)*

Parameter	Purpose	Required value
hostname	Hostname or IP address (management IP address) of the ESXi host that should be used as a storage system module.	Hostname or IP address
username	Username for accessing the ESXi host.	A valid username
password	Password for accessing the ESXi host. **Attention:** Since the password is saved in the XML file as cleartext, you can avoid exposing the password in the file by omitting the **password** parameter altogether. If you omit the **password** parameter, you will be prompted for the password during the deployment process (after issuing the deployment command). The password is masked when it is entered during the deployment process.	A valid password
datastore	Name of the pre-configured datastore (requires 250 GB of free space; see "Required VMware ESXi host machines" on page 7) in which the image of the Spectrum Accelerate virtual appliance should be stored.	Alphanumerical string
mgmt_network	Name of the management network on the ESXi host. For more information, see "Required VMware ESXi host machines" on page 7.	Alphanumerical string
interconnect_network	Name of the network that the ESXi host uses for port group mapping and interconnecting with the other ESXi hosts. For more information, see "Required vSwitch, network, and deployment host" on page 9.	Alphanumerical string
iscsi_network	Name of the iSCSI network that the ESXi host makes available for storage provisioning. For more information, see "Required VMware ESXi host machines" on page 7.	Alphanumerical string
vm_mgmt_ip_address	IP address that should be assigned to the Spectrum Accelerate virtual machine (VM) on the management network.	IP address
interconnect_ip_address	Static IP address that is used for interconnecting the storage system module with the other modules. **Important:** All interconnect IP addresses must reside in the same subnet.	A valid IP address
interconnect_ip_netmask	Netmask IP address of the interconnect network.	A valid IP address

Important: The **server** set of parameters must be repeated in the XML file for each ESXi host that is to be used as a Spectrum Accelerate module. Add a separate set of **server** parameters in the XML file for each ESXi host, within the **esx_servers** section. At least 3 servers are required.

*Table 27. Optional XML parameters for server HDDs (**disk**)*

Parameter	Purpose	Possible value
identifier	Unique ID for the hard disk drive (HDD), as recognized by the ESXi server. The ID of a certain disk is embedded to it during manufacturing, and can be viewed on the relevant ESXi server **Disks** panel in VMware vSphere Client (see "Collecting individual disk IDs" on page 27). Example: **identifier=naa.50934983** **Attention:** Specifying disk IDs is optional. However, if you specify the ID of a certain disk, you must specify the ID of all HDDs that are used by the ESXi host machine.	Alphanumerical string
index	Sequential number of the hard disk drive.	Integer from 1 to 12

Important: The **disk** parameters must be repeated in the XML file for each disk that is used by the ESXi host machine. Add a separate section of **disk** parameters within the relevant **server** section. At least 6 disks are required per server (ESXi host machine).

*Table 28. Optional XML parameter for server SSD (**ssd**; if used)*

Parameter	Purpose	Possible value
identifier	Unique ID for the solid-state drive (SSD), as recognized by the ESXi server. The ID of the SSD is embedded to it during manufacturing, and can be viewed on the relevant ESXi server **Disks** panel in VMware vSphere Client (see "Collecting individual disk IDs" on page 27).	Alphanumerical string

What to do next

Step 3: Issuing the deployment command

Step 3: Issuing the deployment command

After the XML configuration file has been edited to contain the required information, you can issue the deployment command on the Linux deployment host.

Before you begin

If a vCenter server is not used, make sure that no ESXi host is currently defined on any vCenter server. If any such definition exists, delete it from the vCenter server before issuing the deployment command.

Procedure

When you are ready to start the deployment on the relevant ESXi hosts, issue the following command:

```
./xiv_sds_deployment_kit.bash -c sds_machine_template.xml
```

Note:

- If the deployment utility and the XML configuration file are not located in the same directory, specify the full path of the XML configuration file on the command line.
- If you want to run the deployment in verbose mode, include the **-V** argument (dash with capital 'V') on the command line as well.
- If a vCenter server is used in the ESXi configuration, the deployment script creates a dedicated folder under the specified datacenter (specified in the XML configuration file; see "Step 2: Creating and editing the XML configuration file" on page 30), and then adds and moves all ESXi hosts into that folder before starting the deployment.

The deployment process starts and the relevant prompts are displayed until the deployment on all relevant ESXi hosts is successfully completed and the Spectrum Accelerate storage system becomes operational.

Deploying from a Windows host

If you are using a Windows deployment host, you can deploy the Spectrum Accelerate software from either the XIV GUI or from the Windows command prompt environment, as described in the following sections.

Important: Only a single deployment process can be run on a Windows deployment host. You must wait until the deployment process is completed before initiating a new deployment. Parallel deployment processes are not supported.

Deploying from the XIV GUI

If you are using a Windows deployment host, you can deploy IBM Spectrum Accelerate systems from any local installation of XIV Management Tools version 4.7 (or later). Alternatively, you can use the server-based IBM Hyper-Scale Manager version 1.8 (or later) as the deployment host.

The **Deploy Spectrum Accelerate System** option (see Figure 10 on page 39 and Figure 11 on page 39) invokes the IBM Spectrum Accelerate deployment wizard, which allows you to easily enter the required configuration parameters in different tabs, and then issue the deployment command.

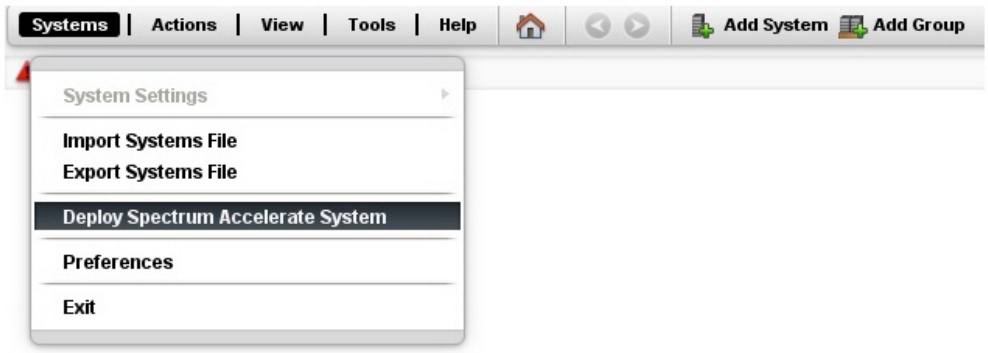


Figure 10. XIV GUI – Deploy Spectrum Accelerate System option

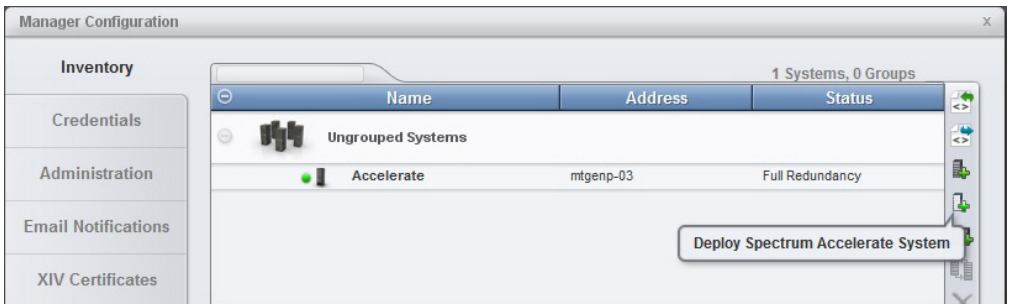


Figure 11. IBM Hyper-Scale Manager – Deploy Spectrum Accelerate System option

The **General** tab of the deployment wizard (see Figure 12 on page 40) allows you to:

- Specify the location of the deployment command file (`xiv_sds_deployment_win.cmd` that is required for the deployment).
- Import an existing Spectrum Accelerate system configuration by using the **Import** option, or export the current configuration by using the **Export** option. All configurations are saved in XML format, as described in "Step 2: Creating and editing the XML configuration file" on page 30.

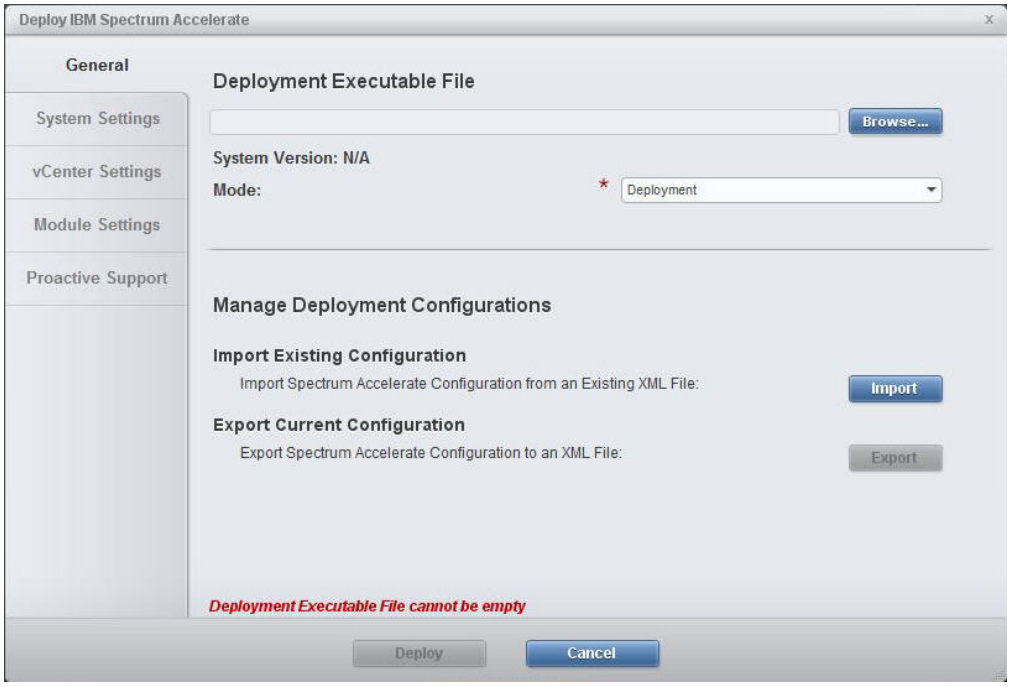


Figure 12. XIV GUI – Spectrum Accelerate deployment wizard – General optional tab

The **System Settings** tab (see Figure 13) allows you to specify the IBM Spectrum Accelerate storage system settings, which include:

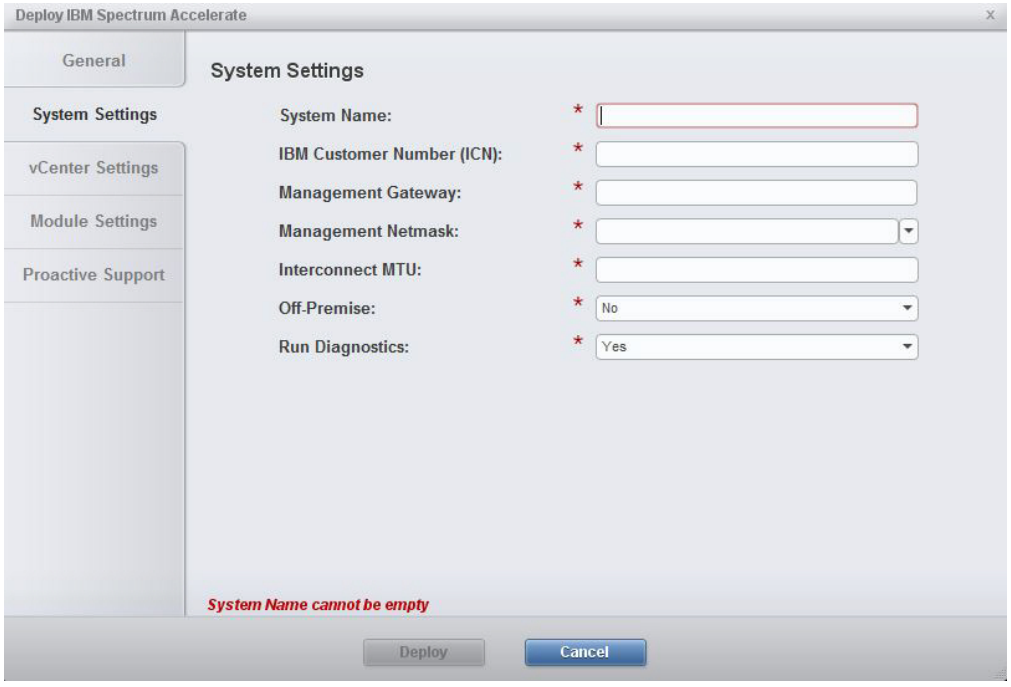


Figure 13. XIV GUI – Spectrum Accelerate deployment wizard – System Settings tab

- **System name** – Name (alias) of the Spectrum Accelerate storage system.

Important: If you are deploying Spectrum Accelerate on an existing ESXi cluster that contains other virtual machines, the name of the Spectrum Accelerate storage system must match the name of the **cluster**, which must also be identical to the **name of the vSphere folder** that contains the cluster. For example, see Figure 14.

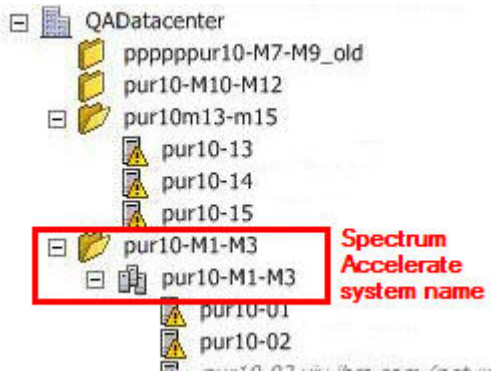


Figure 14. Spectrum Accelerate system name – ESXi folder and cluster name

- **IBM customer number** – Your IBM customer number (ICN). Contact IBM to obtain your ICN. If you already obtained an ICN in the past and you have a working IBM Spectrum Accelerate system, you can retrieve your ICN as described in "Retrieving your IBM Customer Number (ICN)" on page 112.
- **Management gateway** – Management IP address of the Spectrum Accelerate storage system.
- **Management netmask** – Netmask IP address of the Spectrum Accelerate storage system.
- **Interconnect MTU** – Maximum transmission unit (MTU) setting of the interconnect network, in bytes.
- **Off-premise** – Indicates whether the Spectrum Accelerate storage system is deployed at the customer premises, or off-premise on cloud-based ESXi servers.
- **Run Diagnostics** – When this option is enabled with a value of `Yes`, it provides a boot sequence in which the network environment and disk performance are analyzed prior to the deployment. During this analysis, relevant warnings or errors are issued. Warnings allow the deployment to continue, while any detected error stops the deployment. After a successful diagnostic run (without errors), the storage system reboots and then the Spectrum Accelerate processes are prepared to be turned on but not started.

Important: As a best practice, always deploy with the **Run Diagnostics** option enabled, unless your environment has been tested and you are sure that no diagnostic is needed. This option also informs you about the minimum required time for a graceful system shutdown that might be required in any case of an emergency shutdown (see "Handling emergency shutdown" on page 103).

The **vCenter Server Settings** tab (see Figure 15 on page 42) is optional and allows you to specify whether a vCenter server is used to control or monitor the ESXi hosts that are to be used as modules. You can select **vCenter Enabled** to indicate that a vCenter server is used, and then fill the following details:

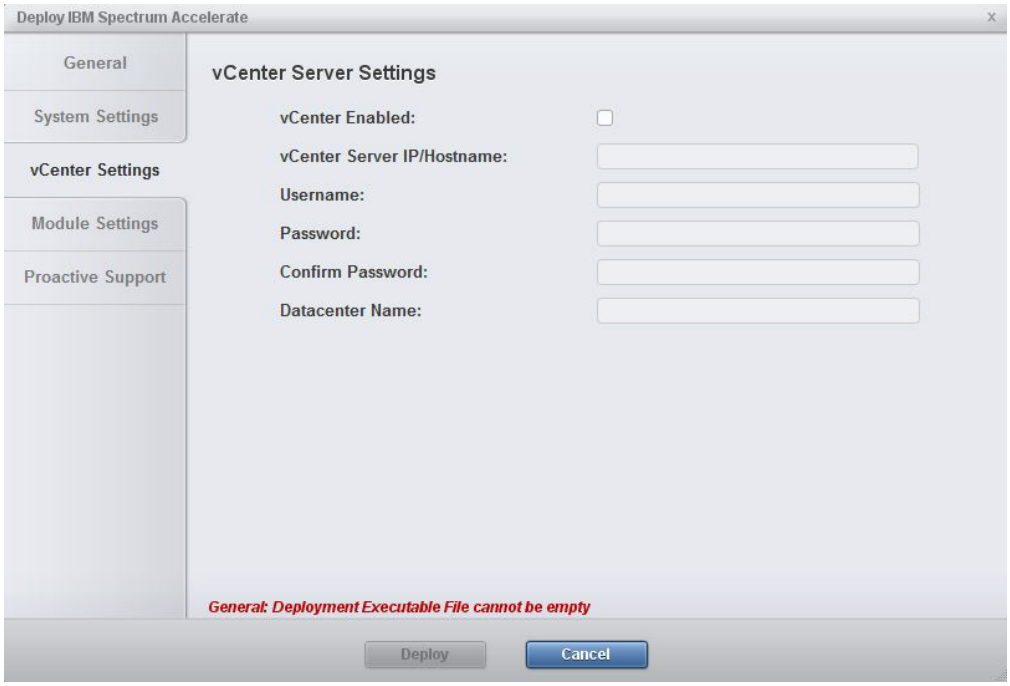


Figure 15. XIV GUI – Spectrum Accelerate deployment wizard – vCenter Server Settings tab

- **vCenter Server IP/Hostname** – Hostname or IP address of the vCenter server that is used to monitor and control the ESXi hosts.
- **Username** – Username for accessing the vCenter server.
- **Password** and **Confirm Password**– Password for accessing the vCenter server.
- **Datacenter Name** – Name of an existing datacenter entity (vCenter entity) in which the Spectrum Accelerate storage system should be defined.

The **Module Settings** tab (see Figure 16 on page 43) allows you to define each individual ESXi host that is to be used as a Spectrum Accelerate storage system module. This includes:

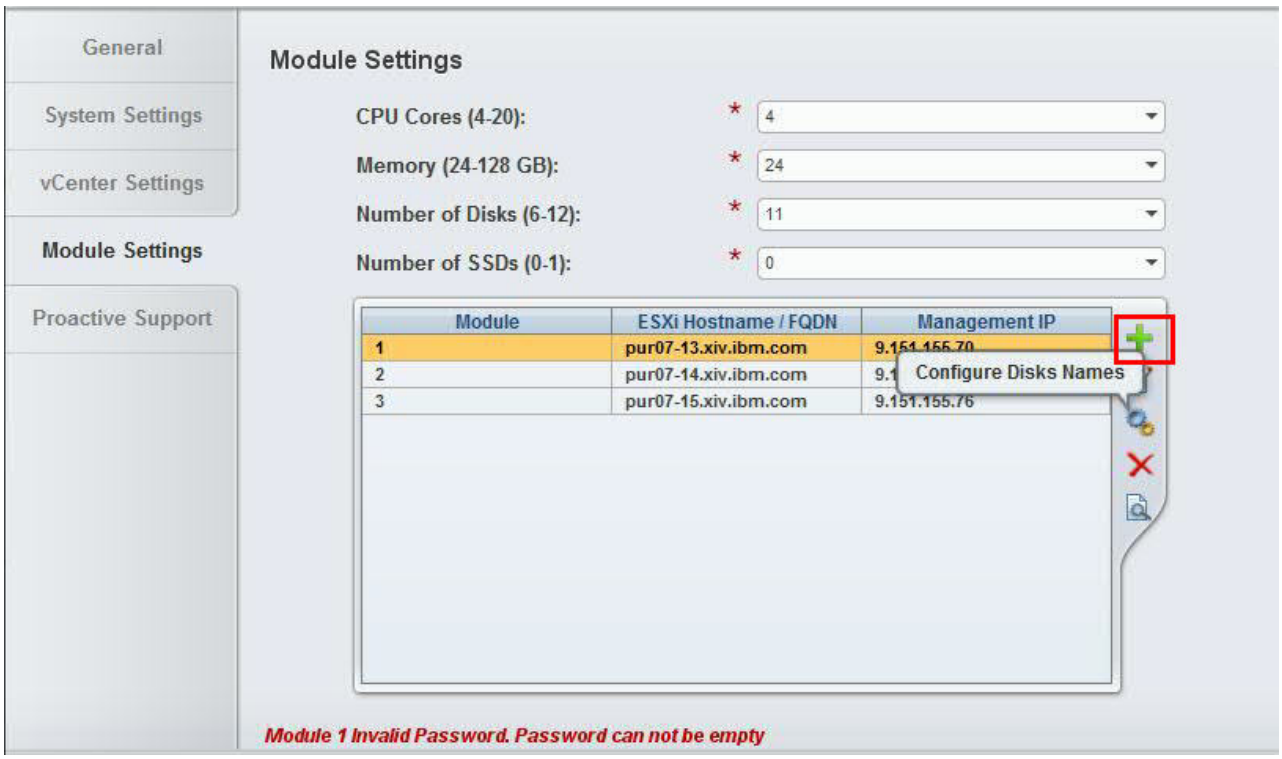


Figure 16. XIV GUI – Spectrum Accelerate deployment wizard – Module Settings tab

- Configuration details that must be the same for all modules –
  - **CPU Cores (4–20)** – Number of physical CPU cores (not including Hyper-Threading) that should be dedicated for the Spectrum Accelerate virtual machine on each ESXi host machine.
  - **Memory (24–128 GB)** – Total memory (RAM) that should be allocated for the Spectrum Accelerate virtual machine on each ESXi host machine, in Gigabytes.
  - **Number of Disks** – Total number of data disks, or hard disk drives (HDDs).
  - **Number of SSDs** – Total number of solid-state drives (SSDs).

- Configuration details that are specific to each individual module. Click the **green plus icon** (see Figure 16) to specify these details a separate in dialog box (see Figure 17 on page 44) –

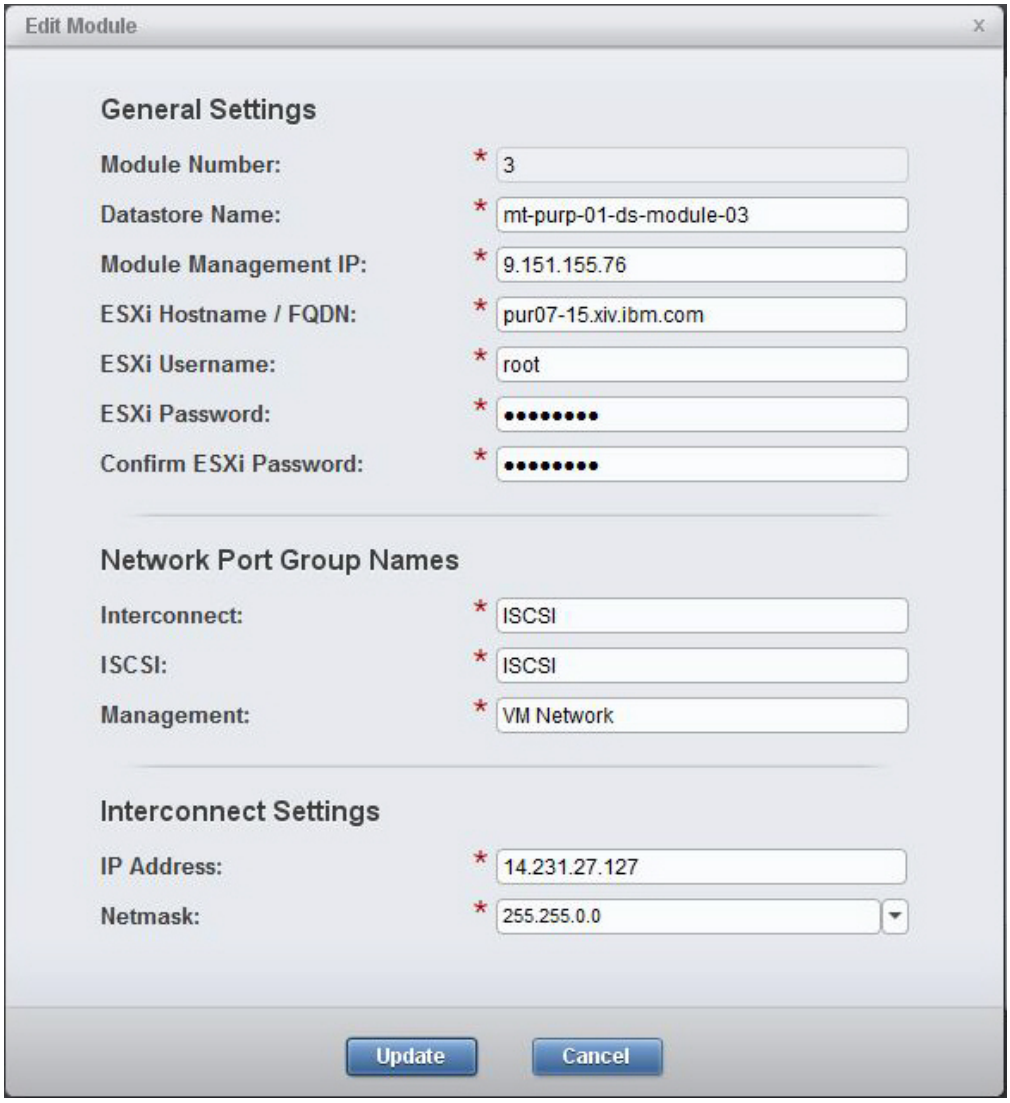


Figure 17. XIV GUI – Spectrum Accelerate deployment wizard – Module details

- **Module number** – The sequential module number. A Spectrum Accelerate storage system requires a minimum of 3 modules, and can contain a maximum of 15 modules.
- **Datastore name** – Name of the pre-configured datastore (requires 250 GB of free space) in which the image of the Spectrum Accelerate virtual appliance should be stored.
- **Module management IP** – IP address that should be assigned to the Spectrum Accelerate virtual machine on the management network.
- **ESXi hostname / FQDN** – Hostname or IP address (management IP address) of the ESXi host that should be used as a storage system module.
- **ESXi username** – Username for accessing the ESXi host.
- **ESXi password** and **Confirm ESXi password** – Password for accessing the ESXi host.
- **Interconnect** – Name of the network that the ESXi host uses for port group mapping and interconnecting with the other ESXi hosts.

- **iSCSI** – Name of the iSCSI network that the ESXi host makes available for storage provisioning.
- **Management** – Name of the management network on the ESXi host.
- **IP address** – Static IP address that is used for interconnecting the storage system module with the other modules.
- **Netmask** – Netmask IP address of the interconnect network.

- Disk identifiers (optional) – Unique identifiers for the disks of a certain module. If you choose to specify IDs for data disks (hard disk drives), all data disks of a certain module must be identified. Use the manufacturer disk ID that the ESXi server recognizes, as explained in "Preparation tasks" on page 25.

  To specify disk identifiers, select and highlight a module that was already added, and then click **Configure Disk Names** (see Figure 16 on page 43). You can then enter the disk identifiers in the **Configure Disk Identifiers** dialog box.

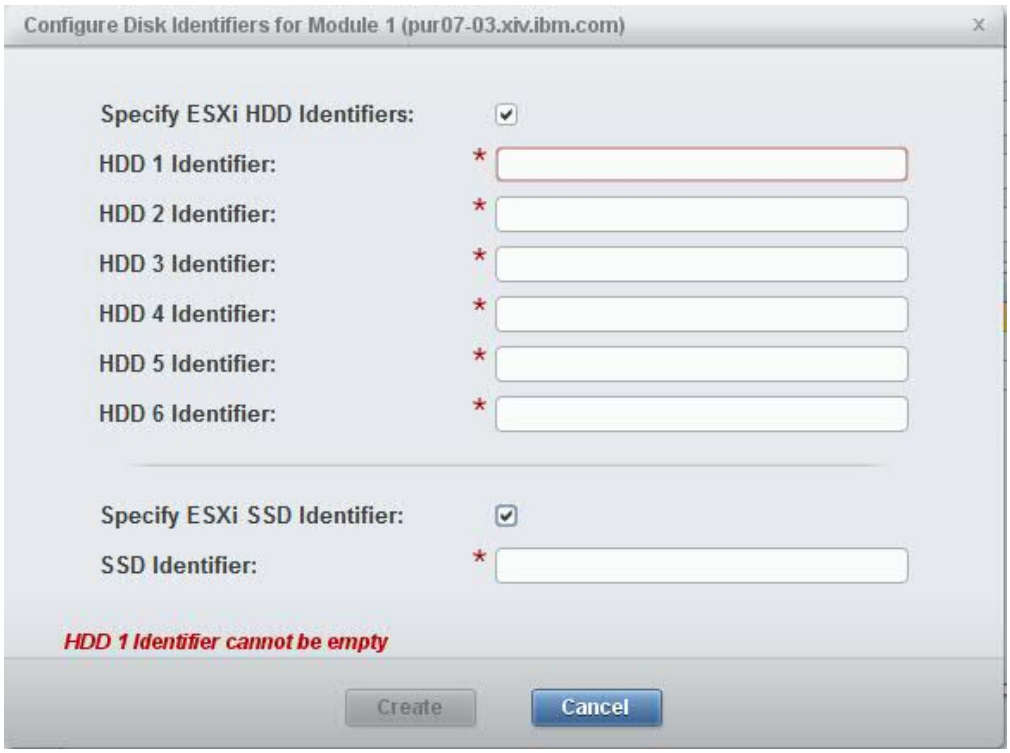


Figure 18. XIV GUI – Spectrum Accelerate deployment wizard – Module details

The last tab, **Proactive Support** (see Figure 19 on page 46), allows you to enable the **Proactive Support Enabled** option after the deployment is completed. This option allows IBM to provide proactive support (problem detection and proactive notifications) for the Spectrum Accelerate system that you deploy. If this option is not enabled as a deployment option, you can enable it later as described in "Enabling the Proactive Support and Remote Support options" on page 53.

As a best practice for any Spectrum Accelerate deployment, select the **Proactive Support Enabled** option and then enter the following details:

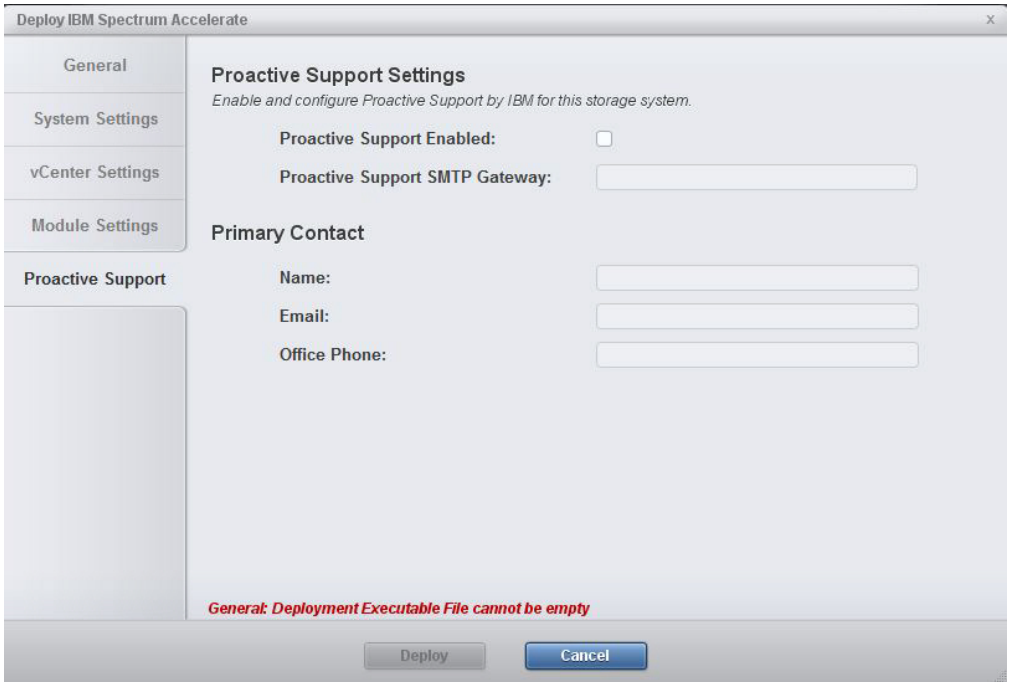


Figure 19. XIV GUI – Spectrum Accelerate deployment wizard – Proactive Support tab

- **Proactive Support SMTP Gateway** – SMTP gateway IP address through which SMTP messages can be sent to the IBM server. The gateway address must be predefined in the **Gateways** configuration panel.

Figure 20. XIV GUI – Gateways definition panel

- **Name** – Name of the contact person whom you want IBM Support to contact in case of a detected problem.
- **Email** – Email address of the contact person.
- **Office Phone** – Work phone number of the contact person.

After you have entered the full details of the IBM Spectrum Accelerate system that you want to deploy, click **Deploy** to start the deployment process based on the information you have entered in the tabs.

Simulating a deployment from the XIV GUI

If you want to simulate and test the deployment on the designated ESXi servers before initiating a real deployment, select the **Diagnostics Only** deployment mode in the Spectrum Accelerate deployment wizard.

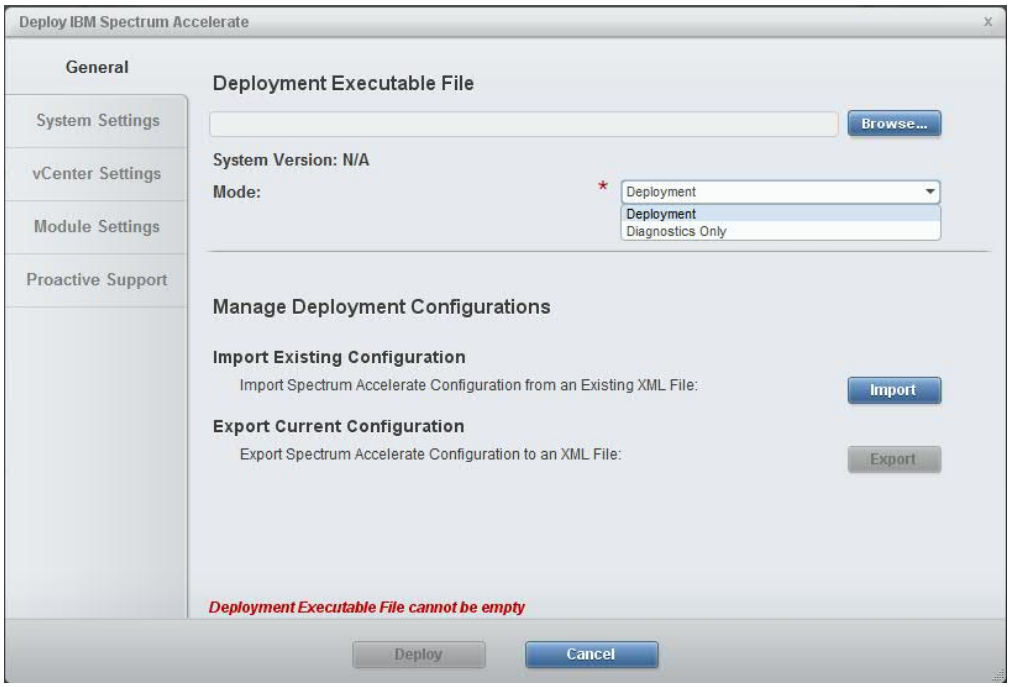


Figure 21. XIV GUI – Deploy IBM Spectrum Accelerate – Mode selection

When **Diagnostics Only** is selected, the deployment wizard switches from real deployment mode to simulated deployment mode. Use the same deployment parameters that you intend to use in the real deployment, as detailed in "Deploying from the XIV GUI" on page 38.

Alternatively, you can import a ready-made XML configuration file, and then test those XML parameters (same parameters as described in "Step 2: Creating and editing the XML configuration file" on page 30).

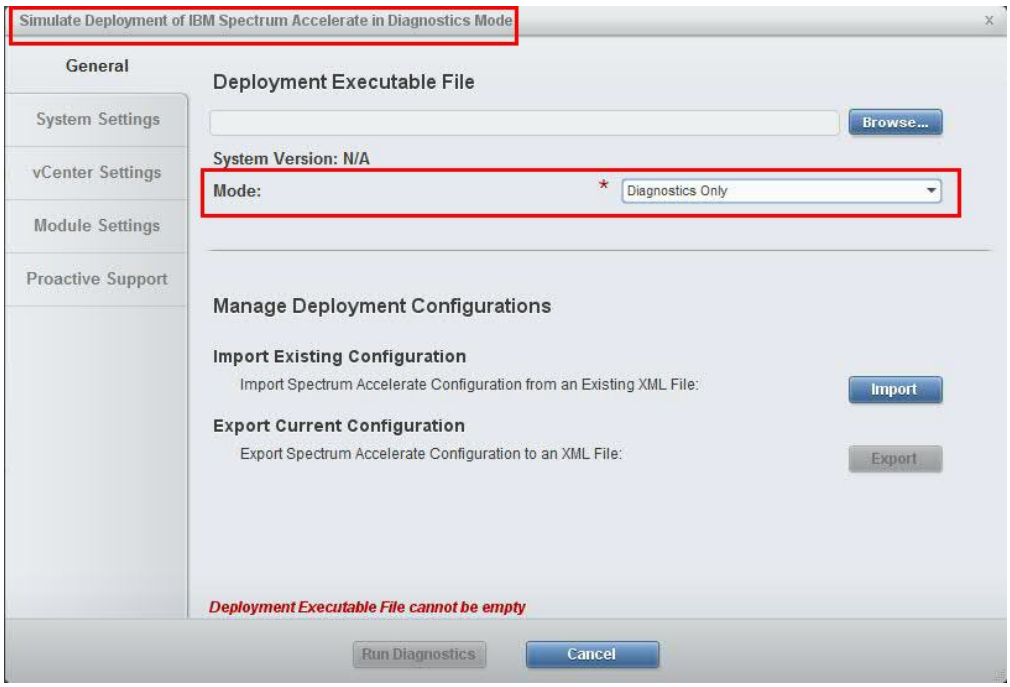


Figure 22. XIV GUI – Deploy Spectrum Accelerate System option

If the deployment simulation fails, check the provided diagnostics information and generated log files to locate the problematic deployment parameter.

The following table provides the most common warnings and error messages in the **Diagnostics Only** mode log and their explanation.

Table 29. Warnings and error messages in the Diagnostics only mode

Warning or error message	Explanation
Task Failed: Adding disk <disk_id> to vm <vm_name> of type <Data|SSD> failed. Error message was: <error-msg-from-vsphere>	A vSphere task failed during deployment. The error message contains the hardware type (disk or SSD), its ID, the name of the target virtual machine, and the error message received from the hypervisor.
ESXi option /Misc/APDHandlingEnable is not '0'	The value of the ESXi parameter /Misc/ APDHandlingEnable has been changed from the default 0 to 1.
Test of 1:Disk:7:9 has failed with error DISK_BAD_SMART_STATUS.	A SMART trip was detected in the **Diagnostics Only** mode. As a result, the disk did not pass the SMART test.
SMART is not supported on all disks	A disk controller or a specific drive does not provide pass through capability or JBOD Mode. As a result, Disk Self Test is not supported. The warning is issued, but the deployment completes successfully.
SMART reading failed	SMART reading has failed. The warning is issued, but the deployment completes successfully.

Deploying from the Windows command prompt

To deploy from the Windows command prompt environment, issue the following deployment command in the same manner that the Linux deployment command is issued:

```
xiv_sds_deployment_win.cmd -c deployment.xml <additional arguments as in
the Linux deployment>
```

For information about the required contents of the XML file and deployment command options, see “Deploying from a Linux host” on page 28.

Deployment-related errors and warnings

The following errors and warnings may appear during deployment.

Table 30. Deployment-related warnings and error messages

Warning or error message	Explanation
Error: %d disks of %d didn't pass SMART test	One or multiple disks that support SMART did not pass the SMART test. The respective disk(s) must be replaced before completing the deployment.
Error: %d disks of %d didn't pass DISK SELF TEST	One or multiple disks that support Disk Self Test did not pass it. The respective disk(s) must be replaced before completing the deployment.
Warning: SMART is not supported on %d disks	The check reveals that one or multiple disks do not support SMART. If you are sure that all your disks support SMART, check the disk controller's configuration in BIOS. If you are using disks or controllers that do not support SMART, you may proceed with the deployment, but consider using SMART-enabled hardware to increase your system's reliability.
Warning: DISK SELF TEST is not supported on %d disks	The check reveals that one or multiple disks do not support Disk Self Test. If you are sure that all your disks support Disk Self Test, check the disk controller's configuration in BIOS. If you are using disks or controllers that do not support Disk Self Test, you may proceed with the deployment, but consider using hardware that supports this feature to increase your system's reliability.

Post-deployment tasks

After IBM Spectrum Accelerate is successfully deployed on the ESXi hosts, several post-deployment operations are required, as detailed in the following sections.

- “Verifying the ESXi configuration from vSphere Client”
- “Changing the storage administrator default password” on page 52
- “Enabling the Proactive Support and Remote Support options” on page 53
- “Defining one or more Support Center connections” on page 55
- “Updating the NTP, DNS, and time zone settings” on page 57

Verifying the ESXi configuration from vSphere Client

You can make the following verifications through vSphere Client after the IBM Spectrum Accelerate virtual appliance is deployed on the ESXi hosts.

Note:

- Apart from the first post-deployment verification (see Figure 23), you can perform the other verifications prior to the deployment.
- If vCenter Server is not used, you can connect vSphere Client directly and separately to each ESXi host in order to check each ESXi host.

On the left Datacenter tree, check whether all the required ESXi hosts are listed as modules under the IBM Spectrum Accelerate storage system entity.

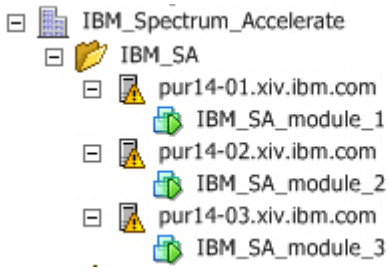


Figure 23. vSphere Client – List of ESXi hosts (modules) and Spectrum Accelerate virtual machines (one VM per module)

Important: If IBM Spectrum Accelerate is deployed on an existing ESXi cluster on which other virtual machines exist, the name of the ESXi cluster must match the IBM Spectrum Accelerate system name, which must also be identical to the name of the vSphere folder in which the ESXi cluster resides.

Click on each ESXi host icon and then click **Configuration** > **Networking** to check the connectivity of the virtual switches that are used by the module.

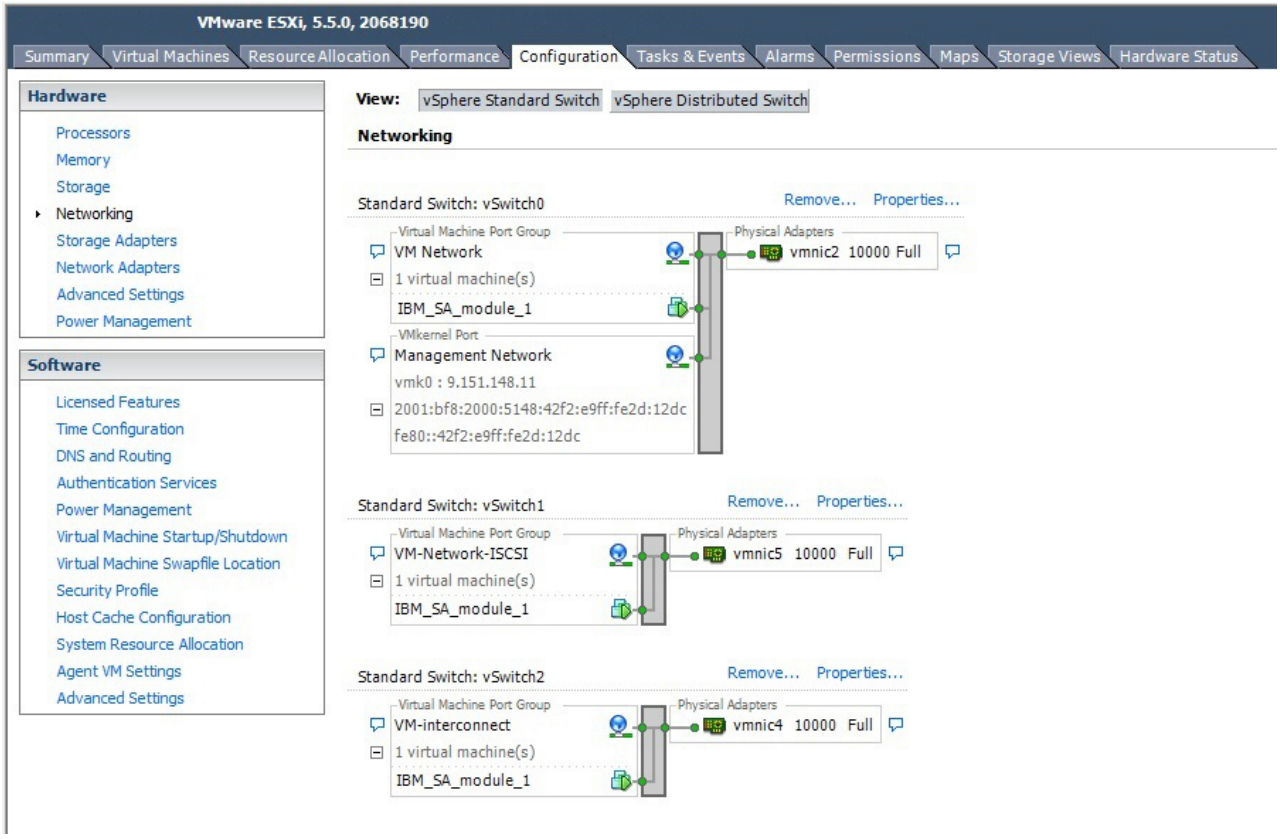


Figure 24. vSphere Client – Networking and connectivity information for a Spectrum Accelerate module

Click on each ESXi host icon and then click **Configuration** > **Storage** to check whether the datastore of the module controller is defined.

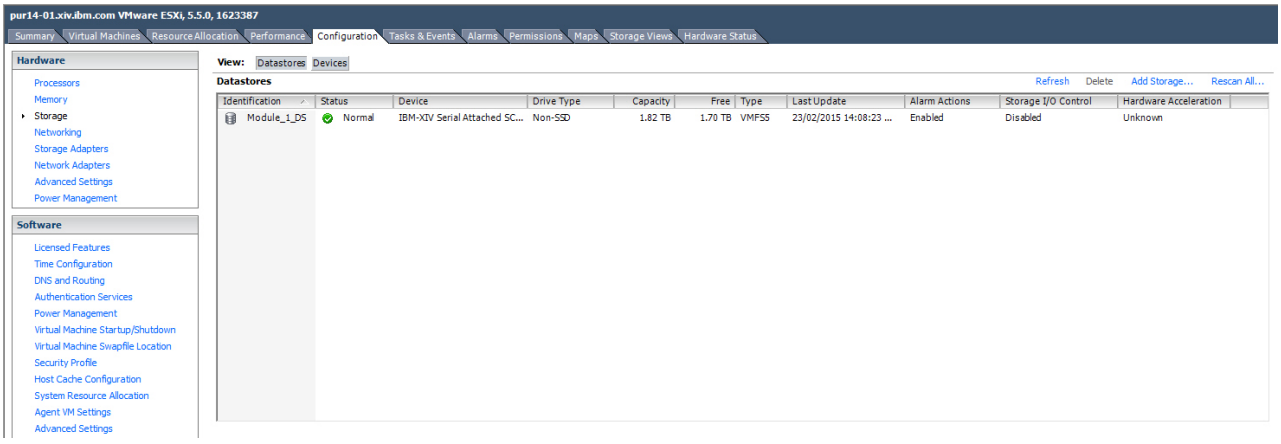


Figure 25. vSphere Client – Datastore of a Spectrum Accelerate module

Under **Configuration** > **Storage** you can also check which physical (raw device mapping) disks are currently attached to the ESXi host.

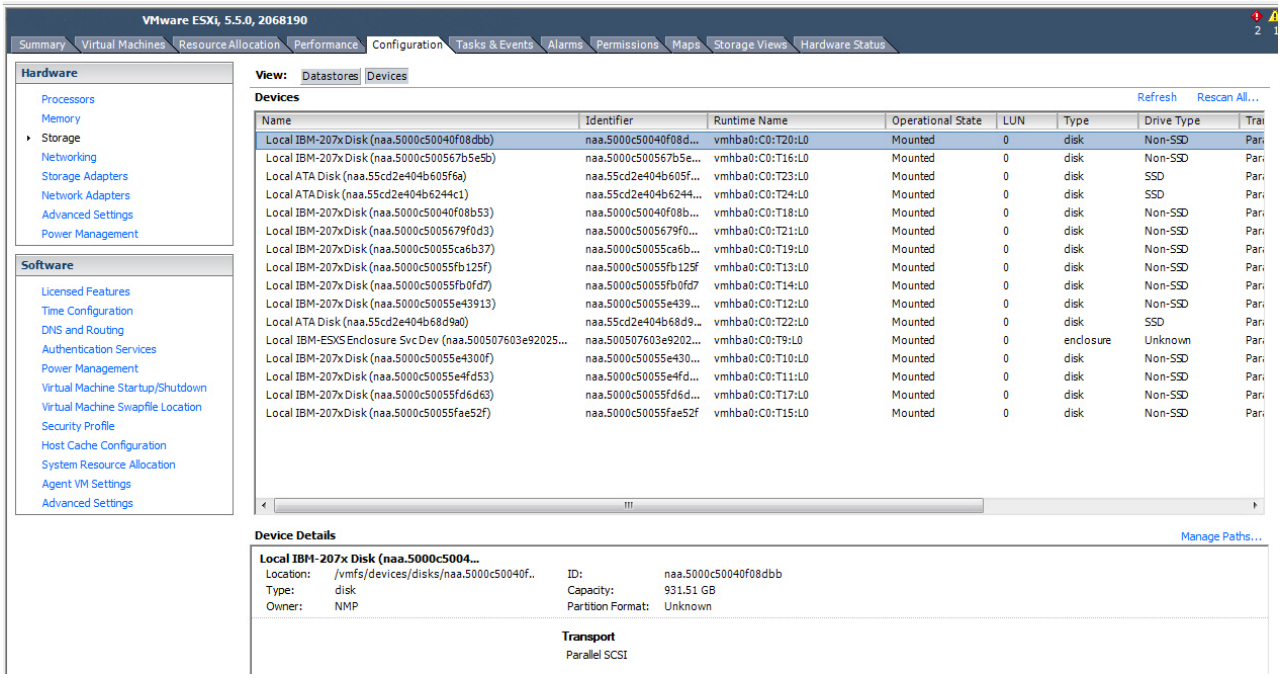


Figure 26. vSphere Client – List of physical disks that are connected to the ESXi host

Note: The list of physical disks might include disks that are not used by the Spectrum Accelerate virtual machine. As a best practice, disconnect any disk that is not used by the Spectrum Accelerate virtual machine.

Changing the storage administrator default password

For better security, after the deployment is completed, use the XIV GUI to change the default password of the storage administrator.

Figure 27. XIV GUI – Change Default Password dialog box

Enabling the Proactive Support and Remote Support options

To allow IBM to provide support for your Spectrum Accelerate deployment, use the XIV GUI to enable and configure the Proactive Support and Remote Support options.

Note: For various preventive and diagnostics support actions relating to IBM Spectrum Accelerate, IBM Support requires customer approval. By enabling the **Proactive Support** option, you minimize the number of interaction cycles with IBM Support. By enabling the **Remote Support** option, you minimize the time it takes to diagnose and remedy your Spectrum Accelerate system.

- **Proactive Support** – Allows proactive notifications regarding the Spectrum Accelerate system health and components to be sent to IBM Support at predefined intervals. Upon detection of any hardware or software error code, both IBM Support and your predefined contact person are notified via email (through the specified SMTP gateway). If IBM Support determines that the detected event requires service or further investigation, a new PMR is created and sent to appropriate IBM Support team.
- **Remote Support** – Allows IBM Support to remotely and securely access your Spectrum Accelerate system when needed during a support call. This option requires IP communication between the Spectrum Accelerate system and the IBM Remote Support Center. If a Spectrum Accelerate system does not have direct access to the Internet (for example, due to a firewall), use the XIV Remote Support Proxy utility to enable the connection.

If Proactive Support was not configured at deployment stage (see "Deploying from the XIV GUI" on page 38), you can use IBM Hyper-Scale Manager to configure proactive support for any licensed system that requires it, as detailed in the **Licensed Systems** tab of **Spectrum Accelerate Licensing** panel.

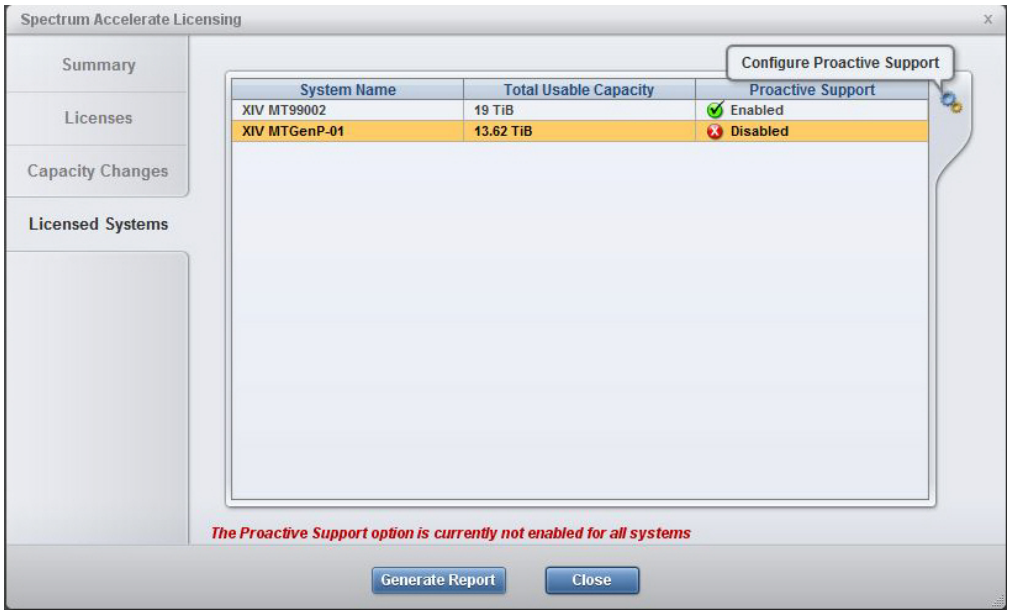


Figure 28. IBM Hyper-Scale Manager – Configure Proactive Support option (per system)

The following figures show the Proactive Support and Remote Support configuration panels, which are available under **System Settings** > **Support**.

To enable proactive support, the **Proactive Support Enabled** option must be selected.

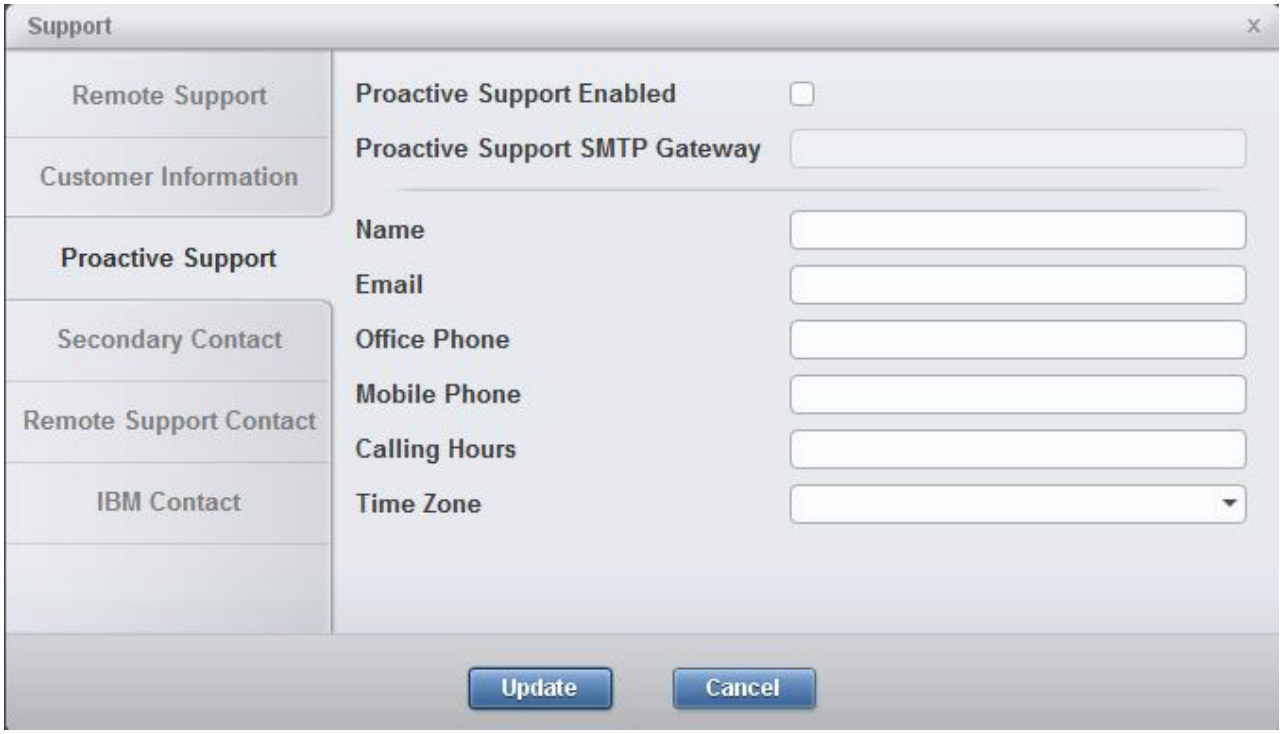


Figure 29. XIV GUI – System support options – Proactive Support tab

In the **Remote Support** tab, enter the primary and secondary IP addresses through which the communication between the Spectrum Accelerate system and IBM Remote Support Center can be established.

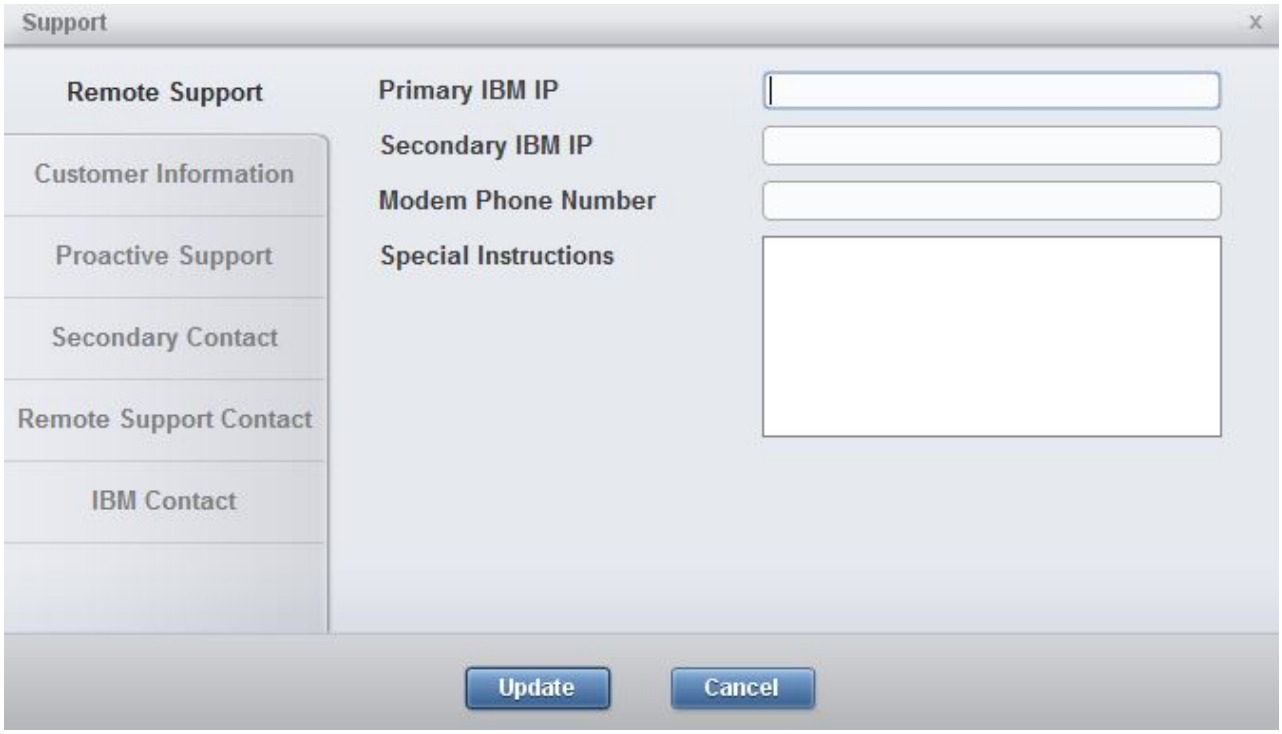


Figure 30. XIV GUI – System support options – Remote Support tab

Defining one or more Support Center connections

Use the XIV GUI to define at least one connection to an IBM Support Center IP address.

The configuration panel for IBM Support Center connections is available under **Tools** > **Support Center**.

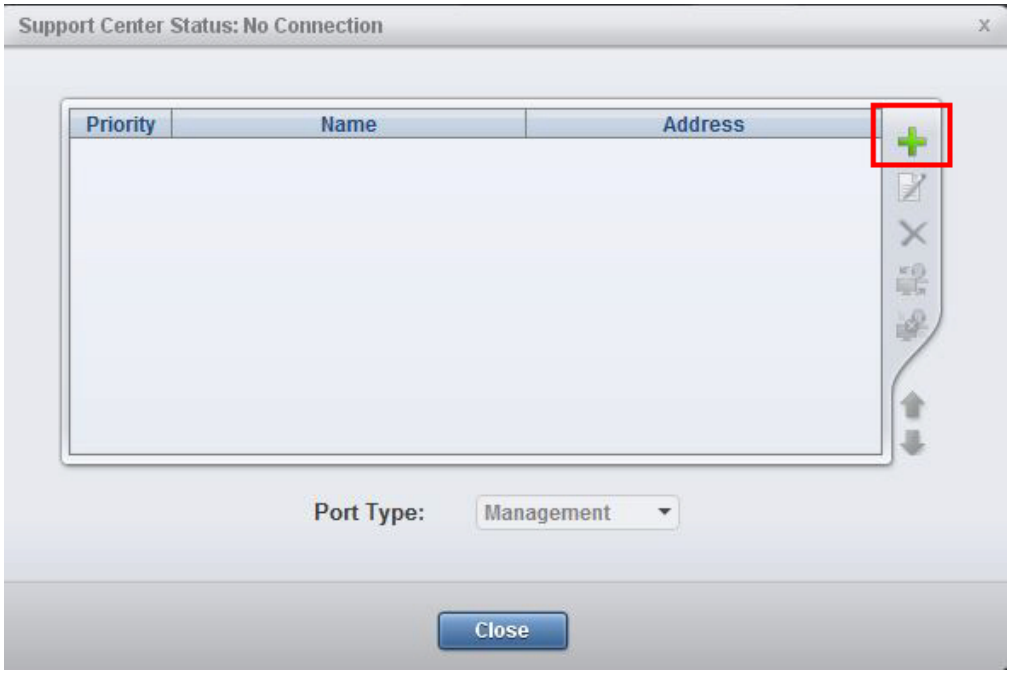


Figure 31. Support Center configuration panel

Select the **Port Type** through which the connection should be established, and then click the **green plus icon** to define a connection that you can later edit or remove from the list of connections.

Each connection can be prioritized and named differently. In **Address**, enter the IP address of the Support Center for establishing communication between the system and the Support Center.

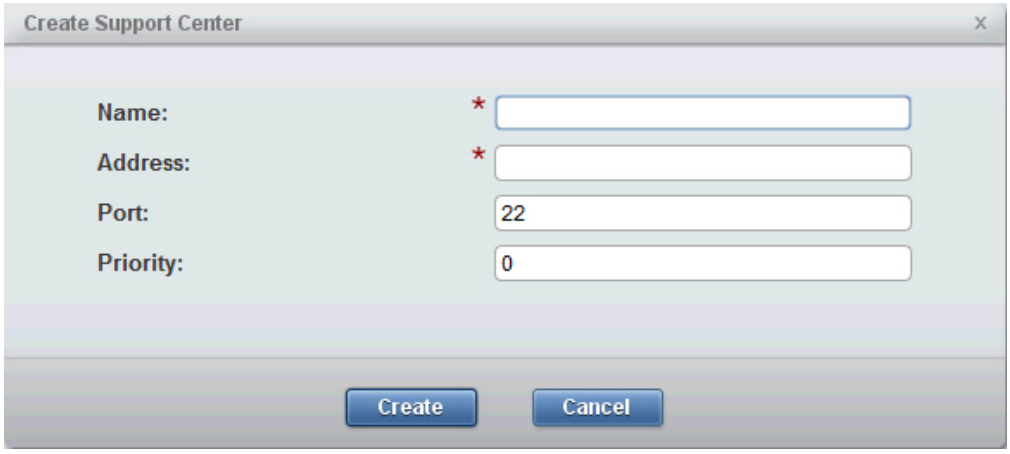


Figure 32. Create Support Center dialog box

Updating the NTP, DNS, and time zone settings

Use the XIV GUI to update the NTP, DNS, and time zone settings after IBM Spectrum Accelerate is deployed.

The following configuration panel is available under **System Settings** > **System** > **Parameters**.

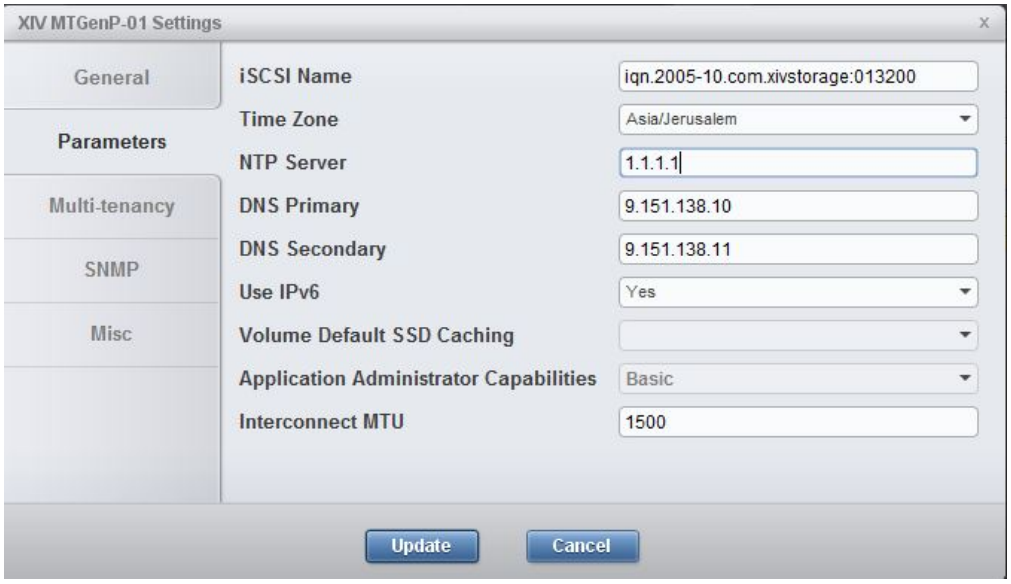


Figure 33. XIV GUI – System parameters configuration tab

Important: All ESXi hosts that are included in the Spectrum Accelerate deployment must also be synchronized with the same time zone settings. For more information, refer to the VMware KB article on ESXi time zone synchronization (kb.vmware.com/kb/1003736).

Enabling SSD caching

Use the **ssd_caching_enable** command to enable SSD caching.

If SSD caching is required, proceed as follows to enable it:

1. Log in as a user with the role of Operations Administrator (a role defined in the Spectrum Accelerate system).
2. Issue the **ssd_caching_enable** command.
3. Phase-in the initialized SSD on each node.

Adding modules

Additional modules (ESXi hosts) increase the overall capacity and data handling capabilities of the IBM Spectrum Accelerate storage system, and also improve its resiliency.

After the IBM Spectrum Accelerate storage system is up and running, you can equip it with additional modules as described in the following sections.

- "Adding a new module from a Linux deployment host"
- "Adding a new module from the XIV GUI" on page 61

Important:

- A Spectrum Accelerate storage system requires a minimum of 3 modules, and can contain a maximum of 15 modules.
- The configuration of an added module must be the same as the configuration of the existing Spectrum Accelerate modules. For more information, see "Required VMware ESXi host machines" on page 7. If the hard disks (HDDs) of the newly added module have greater capacity than the capacity of the existing system HDDs (indicated by the **DISK_LARGER_THAN_SYSTEM_DISK_SIZE** event), the HDDs of the newly added module can be utilized only up to the capacity of the existing system HDDs.
- CLI management connection with the Spectrum Accelerate storage system is required for adding or enabling modules.
- Make sure that the storage capacity of the added module is licensed. For more information, see "License use measuring and reporting" on page 21.

Adding a new module from a Linux deployment host

If you are using a Linux deployment host, you can add a new module to the IBM Spectrum Accelerate storage system by editing the XML template file and issuing the deployment command.

Before you begin

Any new ESXi host that you add as a module must meet the hardware and network requirements as detailed in "Required VMware ESXi host machines" on page 7.

About this task

A newly added module requires a second, yet slightly different deployment procedure that also includes the equip and phase-in CLI commands. For more information about the phase in, phase out, and equip operations, see "Phase-out, equip, test, and phase-in principles" on page 91.

Note: You can add more than one module by repeating steps 2–4 (specifying a few new modules in the XML file) and then steps 6–9 (activating each newly added module).

Procedure

The following procedure describes how to add a single new module from a Linux deployment host.

1. Open the `sds_machine_template.xml` file in a text editor and delete the **server** sections of ESXi hosts that were already deployed.
2. Add a new **server** section for the ESXi host that you want to add (only one should be added). For more information, see Table 26 on page 36.
3. In the XML file, add the following new parameter type in the **server** section: **module_id="MODULE_NUMBER"**.

4. Replace **MODULE_NUMBER** with the actual sequential number of the module that you want to add. For example, if you are adding a fourth module, the number should be 4, as highlighted in the following example:

```
<server
   module_id="4"
   hostname="NAME_OR_IP_OF_ESX_SERVER"
   username="root"
   password="ESX_ROOT_PASSWORD"
   datastore="DATASTORE_NAME_ON_SERVER"
   mgmt_network="NAME_OF_INTERFACE_TO_BE_USED_AS_MGMT_NETWORK"
   interconnect_network="NAME_OF_INTERFACE_TO_BE_USED_AS_INTERCONNECT_NETWORK"
   iscsi_network="NAME_OF_INTERFACE_TO_BE_USED_AS_ISCSI_NETWORK"
   vm_mgmt_ip_address="IP_ADDRESS_TO_BE_GIVEN_TO_THE_MGMT_NETWORK">
   interconnect_ip_address="IP ADDRESS"
   interconnect_ip_netmask="IP NETMASK"
    </server>
```

   Then, save the modified XML file.

5. On the deployment host, issue the following module addition command:

   ./xiv_sds_deployment_kit.bash -c sds_machine_template.xml -a

---

Note: If the deployment utility and the XML configuration file are not located in the same directory, specify the full path of the XML configuration file on the command line.

The deployment process begins and displays various informational prompts. The following example shows prompt for a single storage node (repeated per storage node):

```
Target platform: 'SDS VM : sds-vm-esx'
xtool.py: executing command add_sds_modules on system vm
Converting local image to VMDK
Parsing deploy XML add_module.xml
Executing ESXi verifications before deployment
Verifying ESXi server domain.ibm.com
*** Verifying ESXi SSH port is opened
*** Verifying SSH credentials and connection
*** Verifying memory size on the ESXi host
*** Verifying datastore 04_module existence on the ESXi host
*** Verifying datastore size
*** Verifying Networking configuration validity on ESXi servers
*** Networking configuration verified on ESXi host
SDS ESXi Nodes Verifications Completed Successfully
Updating OVF new_outputs/vmdk/tmp_ovf.ovf Memory Elements
Updating memory element: rasd:ElementName with size: 16384 MB
Updating memory element: rasd:Reservation with size: 16384 MB
Updating memory element: rasd:VirtualQuantity with size: 16384 MB
Saving the updated OVF XML
Connecting to Vcenter server domain.ibm.com
Trying to add ESX server domain.ibm.com to folder el1-s2
Task completed successfully: Add ESX host domain.ibm.com
Creating direct attach disks on ESX server domain.ibm.com: 11 data disks and 0 SSD disks
DIRECT ATTACH SCRIPT OUTPUT:Checking disk write on /vmfs/devices/disks/naa.5000c500214b2d8b
DIRECT ATTACH SCRIPT OUTPUT:Adding Device naa.5000c500214b2d8b as DATA disk
DIRECT ATTACH SCRIPT OUTPUT:Checking disk write on /vmfs/devices/disks/naa.5000c500214dcbeb
DIRECT ATTACH SCRIPT OUTPUT:Adding Device naa.5000c500214dcbeb as DATA disk
DIRECT ATTACH SCRIPT OUTPUT:Checking disk write on /vmfs/devices/disks/naa.5000c50025d2be5f
DIRECT ATTACH SCRIPT OUTPUT:Adding Device naa.5000c50025d2be5f as DATA disk
DIRECT ATTACH SCRIPT OUTPUT:Checking disk write on /vmfs/devices/disks/naa.5000c50025d2de73
DIRECT ATTACH SCRIPT OUTPUT:Adding Device naa.5000c50025d2de73 as DATA disk
DIRECT ATTACH SCRIPT OUTPUT:Checking disk write on /vmfs/devices/disks/naa.5000c50020ef2047
DIRECT ATTACH SCRIPT OUTPUT:Adding Device naa.5000c50020ef2047 as DATA disk
DIRECT ATTACH SCRIPT OUTPUT:Checking disk write on /vmfs/devices/disks/naa.5000c50025d2947f
DIRECT ATTACH SCRIPT OUTPUT:Adding Device naa.5000c50025d2947f as DATA disk
Going to deploy VM el1-s2_module_4
Opening OVF source: new_outputs/vmdk/tmp_ovf.ovf
Opening VI target: vi://administrator@domain.ibm.com:443/dir.domain.ibm.com
Deploying to VI: vi://administrator@domain.ibm.com:443/dir.domain.ibm.com
Transfer completed
Completed successfully
Deployment of all modules completed successfully!
Adding 6 data disks and 0 ssd disks to VM el1-s2_module_4
Adding disks to all VMs completed successfully
Turning on VM el1-s2_module_4
```

6. Start a Spectrum Accelerate command-line interface (CLI) session (for more information, see Chapter 6, "Management from the command-line interface (CLI)," on page 85) and then issue the following **module_equip** command for the newly added module, where **<IP address>** stands for the module's interconnect IP address:

   module_equip module_interconnect_ip=<IP address>

   For example:

```
module_equip  module_interconnect_ip=100.150.200.250
command 0:
administrator:
    command:
        code = "SUCCESS"
        status = "0"
        status_str = "Command completed successfully"
aserver = "DELIVERY_SUCCESSFUL"
```

7. Issue the **module_list** command:

   module_list

The added storage nodes are listed and appear on **Ready** status:

```
Component ID Status Currently Functioning Target Status Type       Data Disks FC Ports iSCSI Ports Temperature
------------ ------ -------------------- ------------- ---------- ---------- -------- ----------- -----------
1:Module:1   OK     yes                                sds_vm_p11 10         0        2           0
1:Module:2   OK     yes                                sds_vm_p11 10         0        2           0
1:Module:3   OK     yes                                sds_vm_p11 10         0        2           0
1:Module:4   Ready  yes                                sds_vm_p11 10         0        2           0
```

8. Issue the following **component_phasein** CLI command for the newly added module, where **<IP address>** stands for the module's interconnect IP address:

   module_phasein module_interconnect_ip=<IP address>

   For example:

```
module_phasein module_interconnect_ip=100.150.200.250
command 0:
administrator:
    command:
        code = "SUCCESS"
        status = "0"
        status_str = "Command completed successfully"
aserver = "DELIVERY_SUCCESSFUL"
```

9. Issue the **module_list** command again:

   module_list

   The added module is listed on **OK** status:

```
Component ID Status Currently Functioning Target Status Type       Data Disks FC Ports iSCSI Ports Temperature
------------ ------ -------------------- ------------- ---------- ---------- -------- ----------- -----------
1:Module:1   OK     yes                                sds_vm_p11 10         0        2           0
1:Module:2   OK     yes                                sds_vm_p11 10         0        2           0
1:Module:3   OK     yes                                sds_vm_p11 10         0        2           0
1:Module:4   OK     yes                   OK           sds_vm_p11 10         0        2           0
```

After the added module is on **OK** status, the IBM Spectrum™ Accelerate system starts a data redistribution process in order to spread data to the newly added module.

Adding a new module from the XIV GUI

If you are logged in as **Operations Administrator** (user account that is defined on the Spectrum Accelerate system), you can use the XIV GUI to add a new module to your Spectrum Accelerate system, by zooming in to the system and then clicking **Define New Module**.

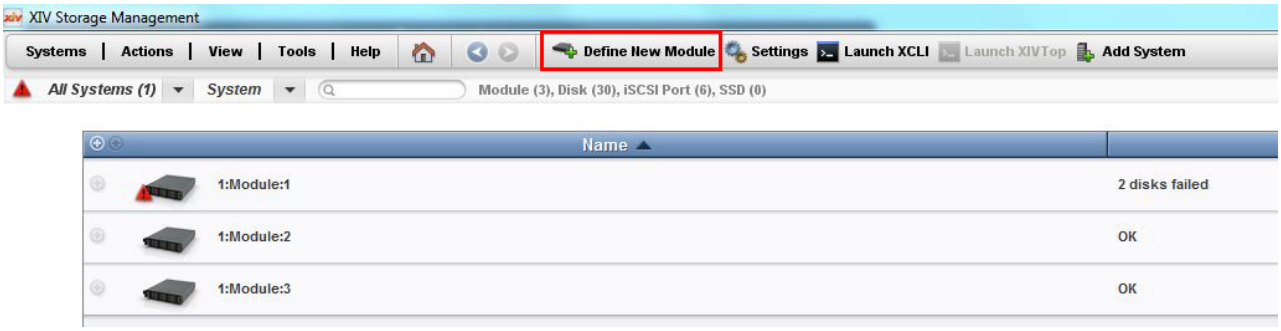


Figure 34. XIV GUI – Define New Module button for Spectrum Accelerate

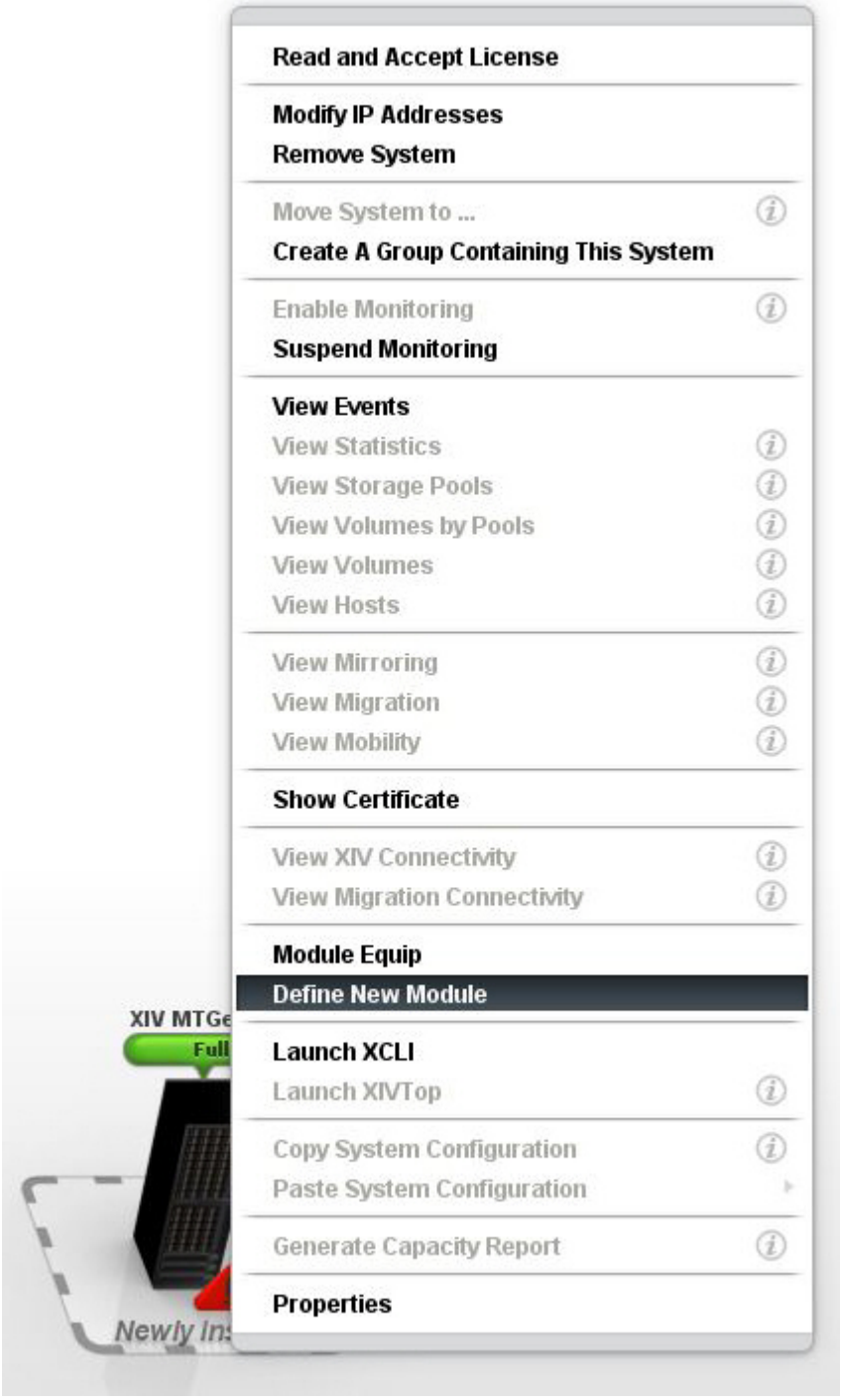


Figure 35. XIV GUI – Define New Module menu option for Spectrum Accelerate

The **Deploy New Module** wizard is similar to the deployment wizard (see "Deploying from the XIV GUI" on page 38) and allows you to enter the configuration details of the newly added module.

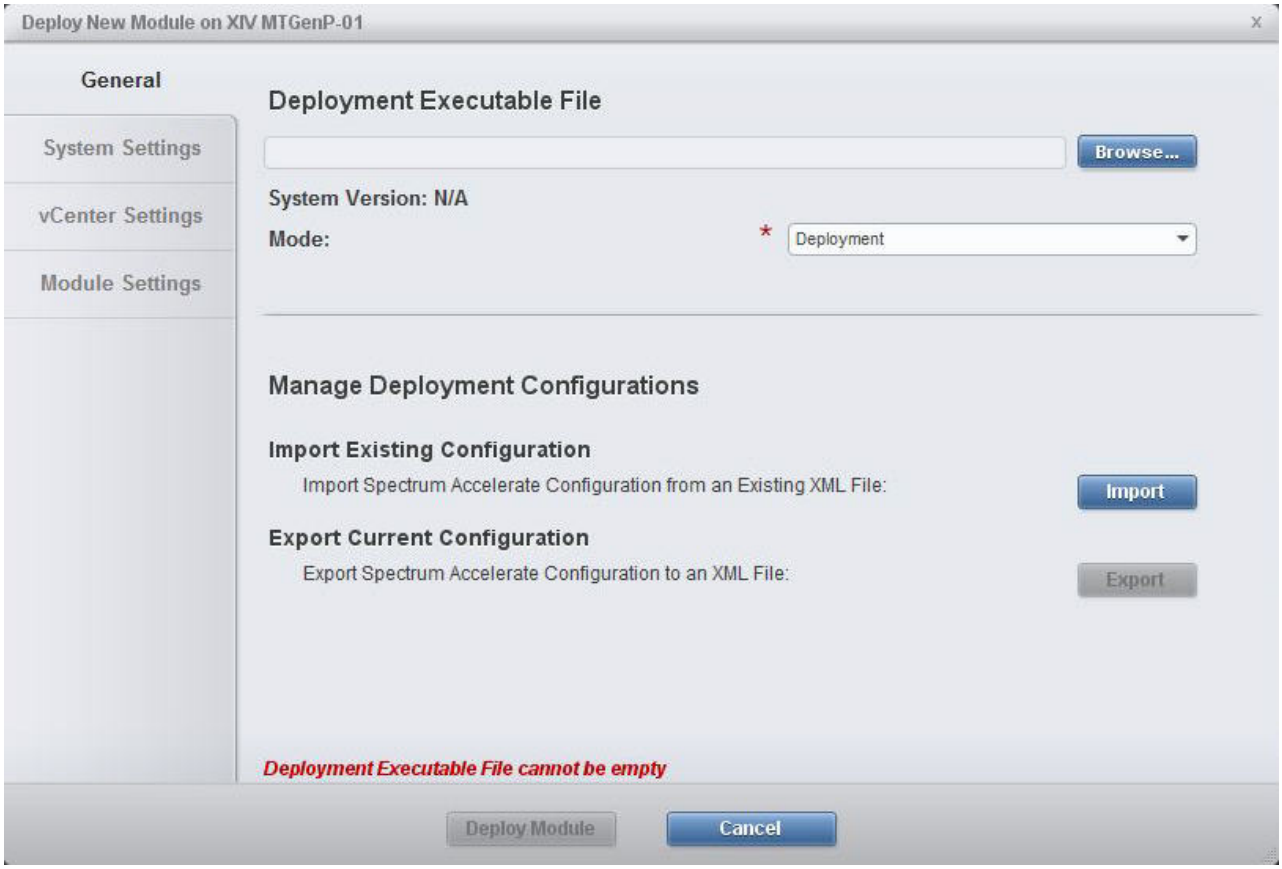


Figure 36. XIV GUI – Deploy New Module wizard

The **Module Settings** panel (see Figure 37 on page 64) allows you to add more than one module to the list of modules, by clicking the **green plus icon**. You can deploy all newly added modules in one operation.

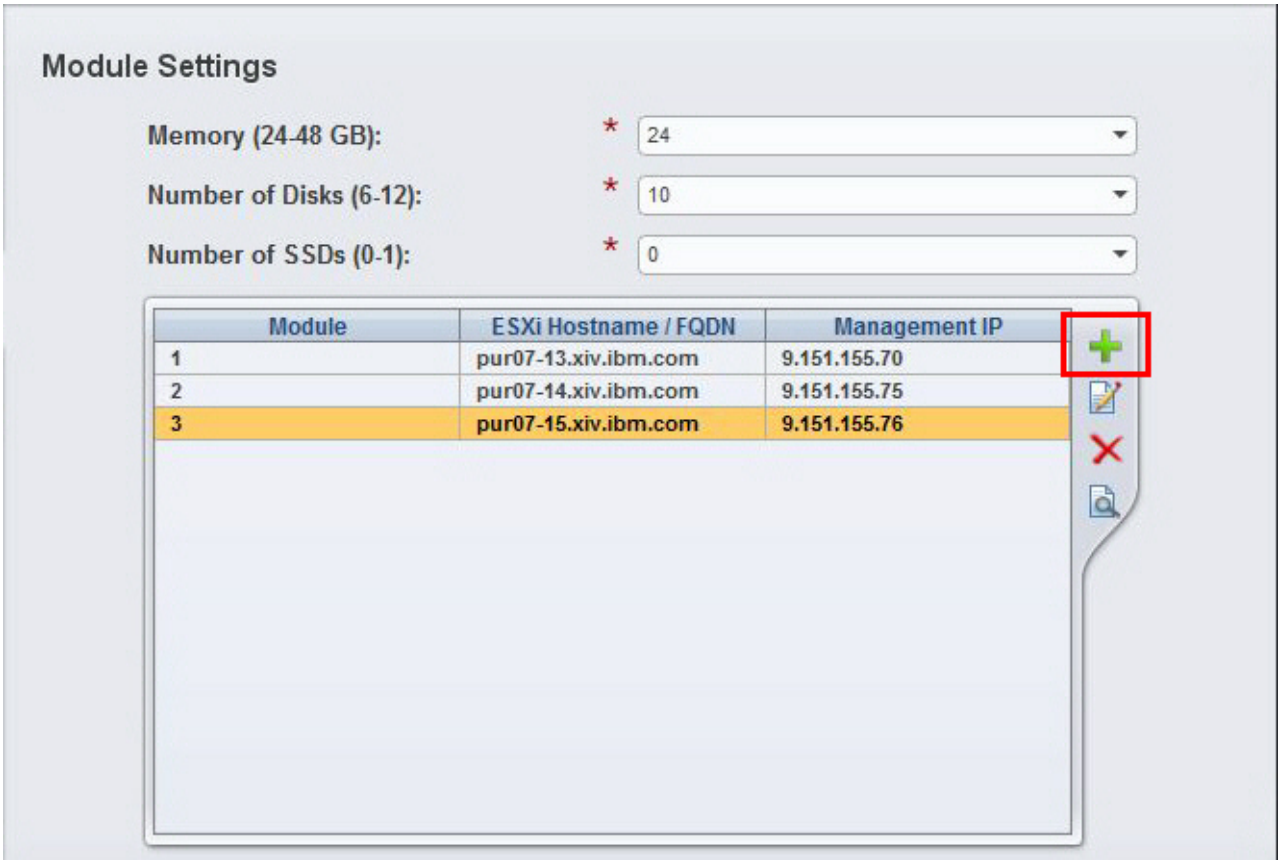


Figure 37. XIV GUI – Module Settings panel

After entering the module configuration details, click **Deploy Module**. You must then phase in the module, as shown in "Phasing out and phasing in modules and disks" on page 82.

Note: When adding a new module from the XIV GUI, the module is automatically equipped and requires only a phase-in procedure. For more information about the phase in, phase out, and equip operations, see "Phase-out, equip, test, and phase-in principles" on page 91.

Chapter 5. Management and monitoring from the XIV graphical user interface (GUI)

IBM Spectrum Accelerate systems can be managed and monitored from the XIV GUI and IBM Hyper-Scale Manager in almost the same way that XIV storage systems are managed and monitored.

Note: For detailed information about the XIV GUI and IBM Hyper-Scale Manager functionality, refer to the IBM XIV Management Tools *Operations Guide* publication.

Important: The management communication is over TCP port 7778, through which all traffic is encrypted. The Spectrum Accelerate system communicates with key servers using the Key Management Interoperability Protocol (KMIP) protocol over TCP port 5696.

You can log in to the XIV GUI and IBM Hyper-Scale Manager and perform different management actions depending on the user account that is defined for you on the Spectrum Accelerate system. Some operations are limited to certain user account types. The available user account types are:

- **Read Only** – Can only list and view system information.
- **Application Administrator** – Can create snapshots of assigned volumes, map an owned snapshot to an assigned host, and deleting an owned snapshot.
- **Storage Administrator** – Can perform all actions except maintenance operations.
- **Operations Administrator** – Can perform only maintenance operations.

Some management and monitoring features in the XIV GUI and IBM Hyper-Scale Manager are available specifically for Spectrum Accelerate systems, as detailed in the following sections.

Identifying Spectrum Accelerate systems on the All Systems view

IBM Spectrum Accelerate systems are identified on the **All Systems** view by purple **SDS** captions, as shown below.

Figure 38. XIV GUI – Spectrum Accelerate (SDS) systems on the All Systems view

When a cloud icon is shown to the left of the system name, it indicates that this Spectrum Accelerate system is deployed on an off-premise cloud.

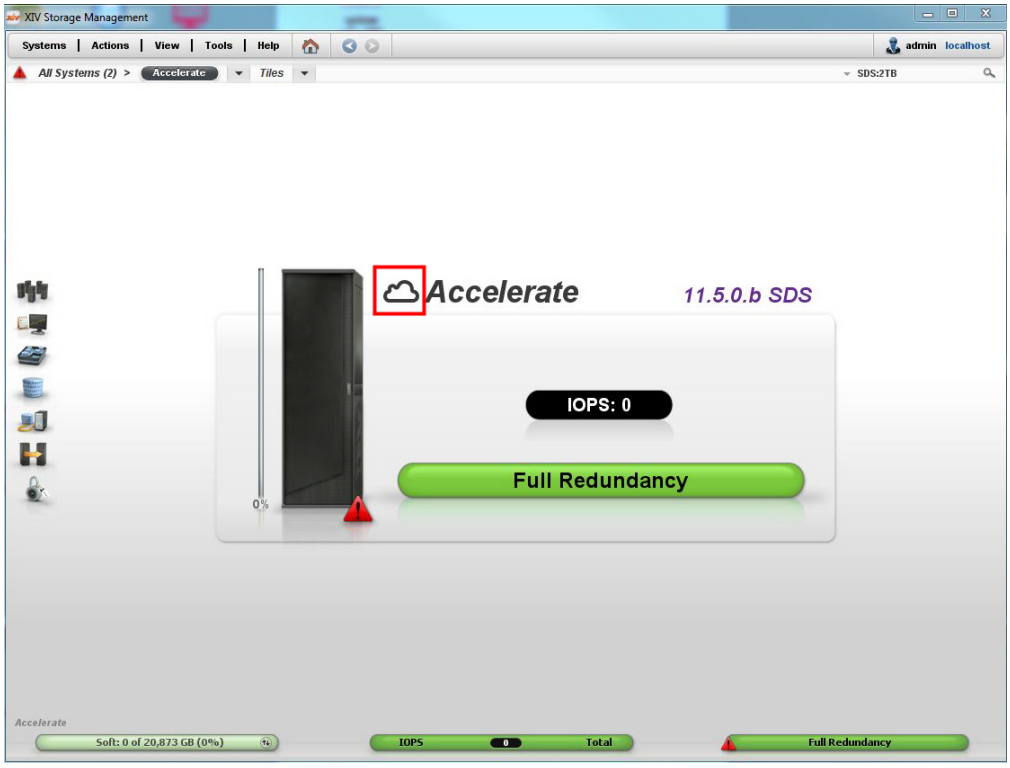


Figure 39. XIV GUI – Off-premise Spectrum Accelerate (SDS) system (indicated by cloud icon) in Tile view

The list view displays all the available systems in a table.

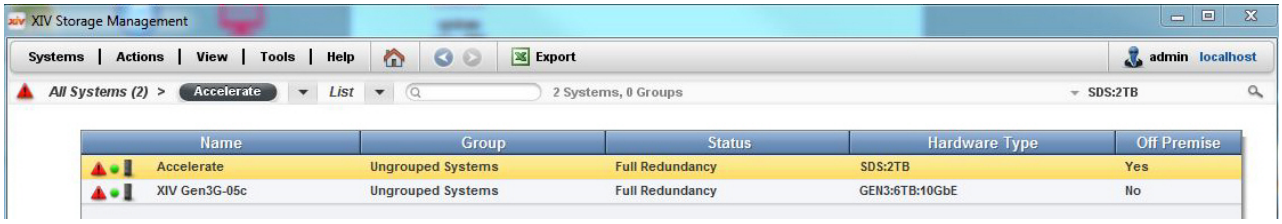


Figure 40. XIV GUI – Spectrum Accelerate on the All Systems list

You can press ALT+S or use the system selector function to quickly find a system.

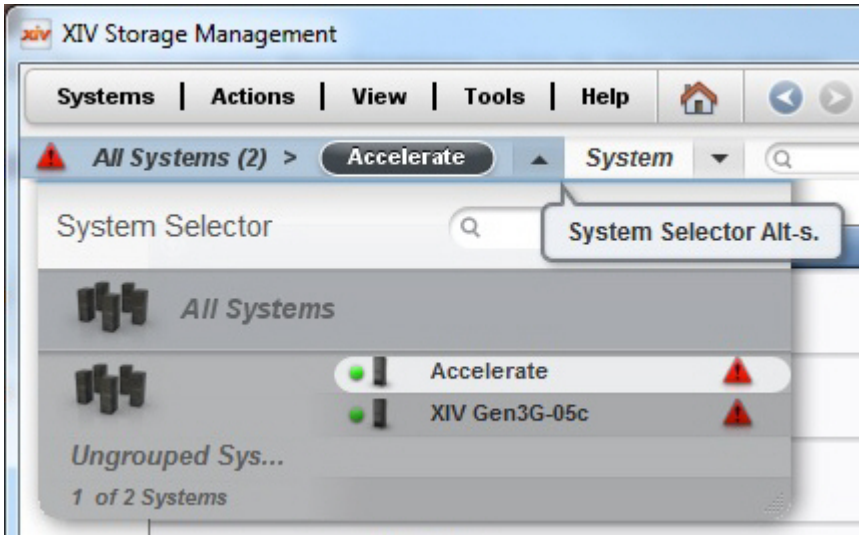


Figure 41. XIV GUI – System Selector function

You can also customize the viewable columns of the systems list as needed.

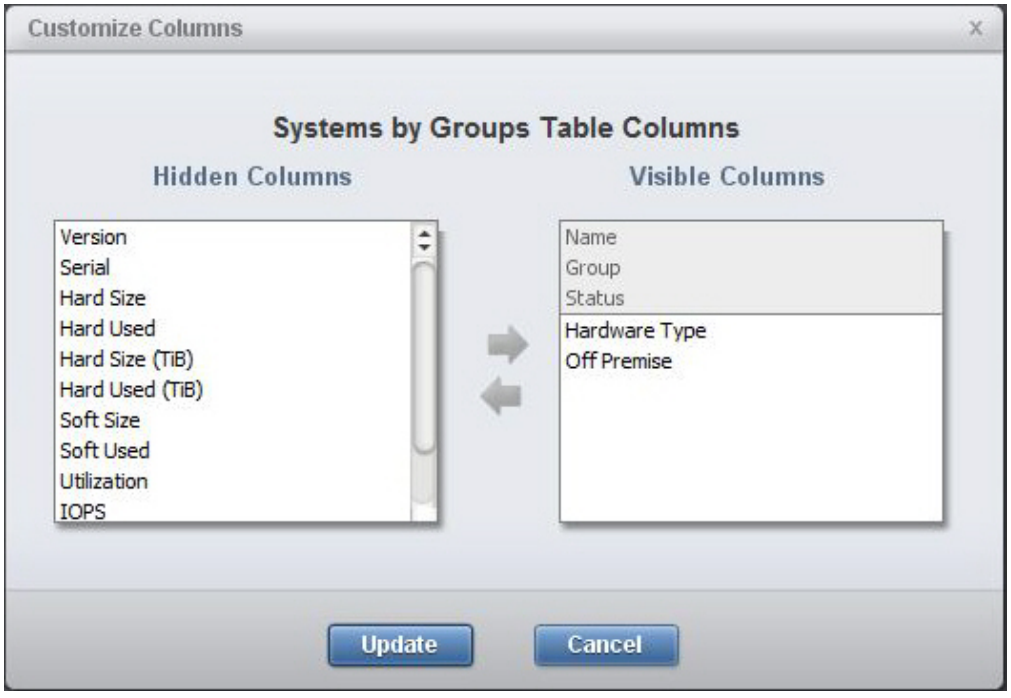


Figure 42. XIV GUI – Customize Columns dialog box

Monitoring Spectrum Accelerate hardware components

You can use the XIV GUI for monitoring the hardware components of your IBM Spectrum Accelerate systems in real time, as shown in the following figures.

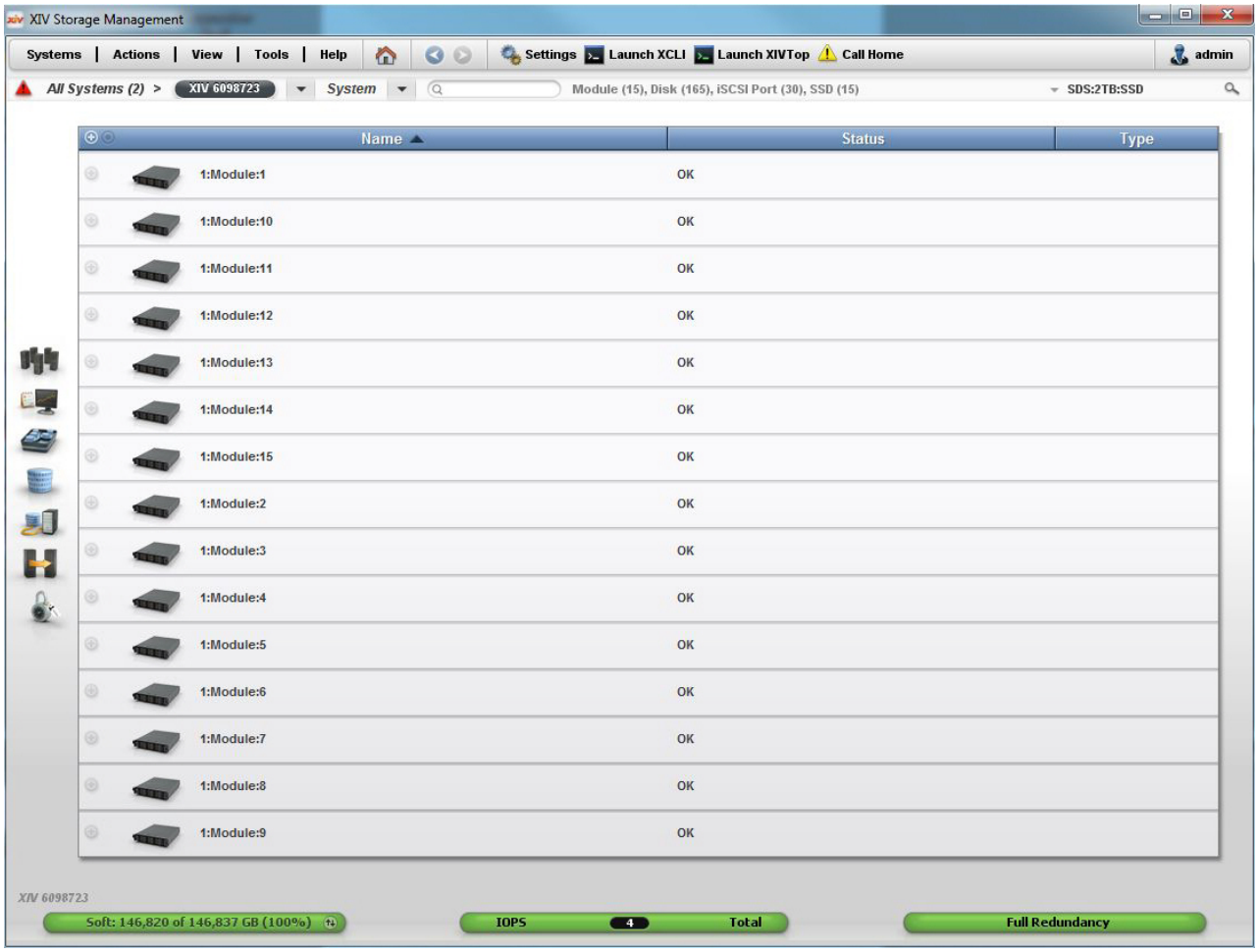


Figure 43. XIV GUI – Modules of a Spectrum Accelerate storage system

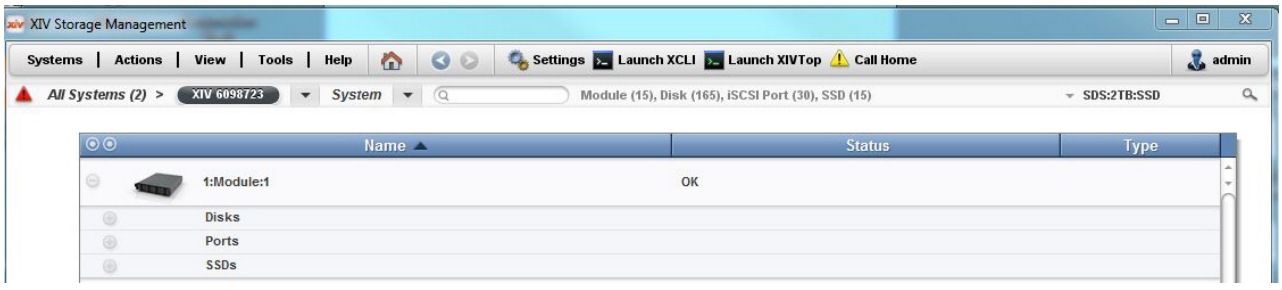


Figure 44. XIV GUI – Hardware component types per module

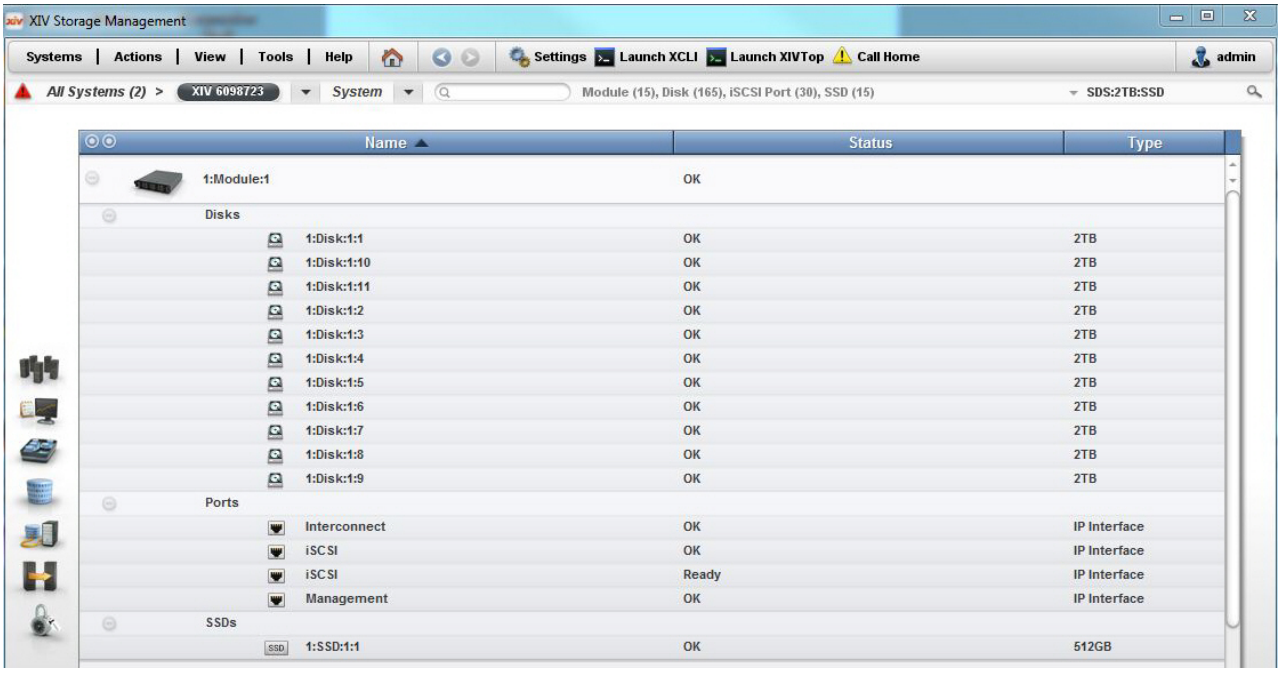


Figure 45. XIV GUI – Hardware components per module – expanded view

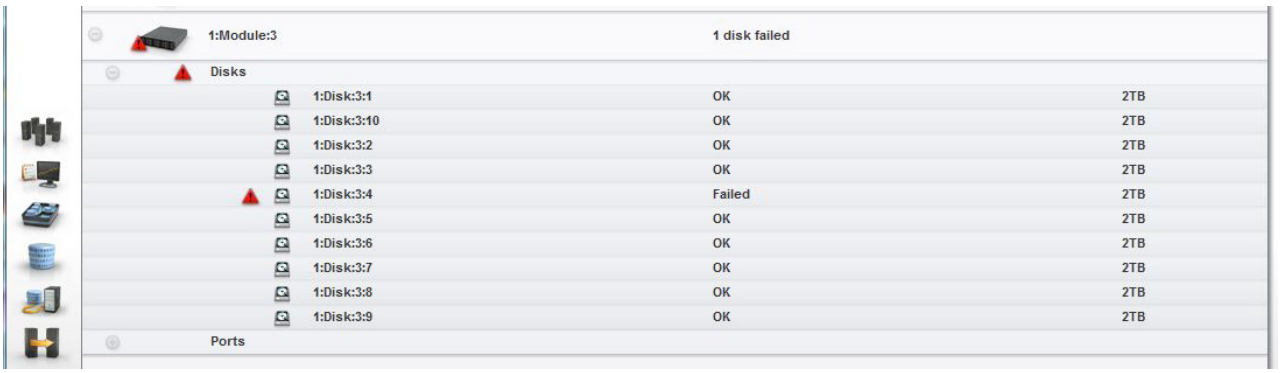


Figure 46. XIV GUI – Disk failure indication

Viewing and modifying Spectrum Accelerate system settings

You can use the XIV GUI for viewing and modifying Spectrum Accelerate storage system settings, as shown in the following figures.

Figure 47. XIV GUI – Storage system settings – General tab

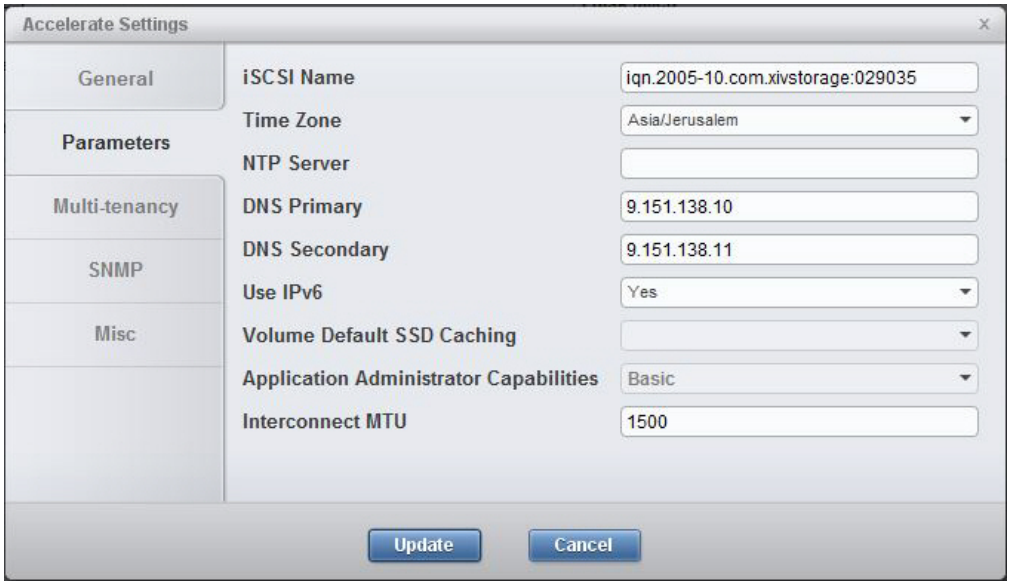


Figure 48. XIV GUI – Storage system settings – Parameters tab

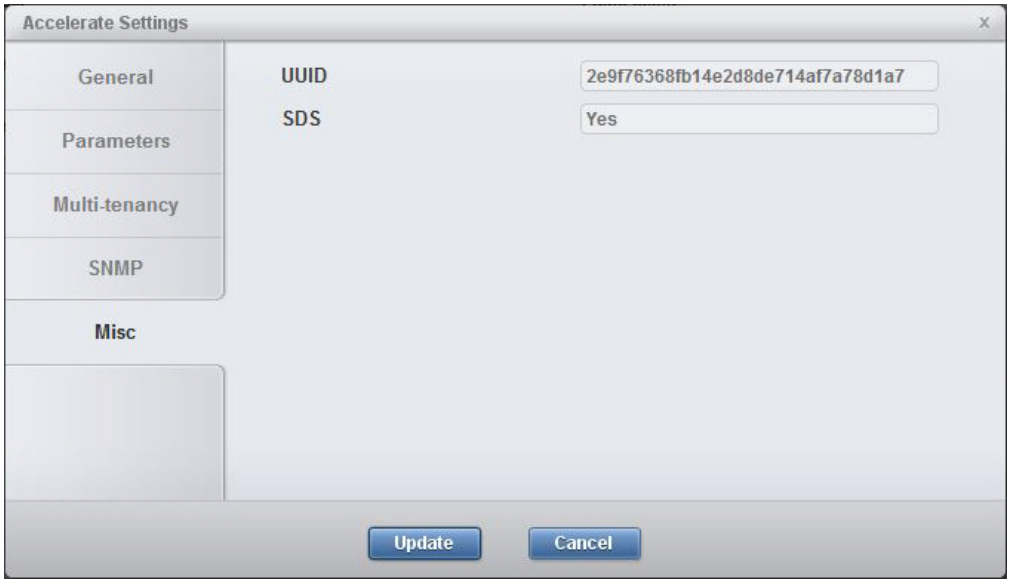


Figure 49. XIV GUI – Storage system settings – Miscellaneous info tab

Setting cross-system connectivity with Spectrum Accelerate systems

You can use the XIV GUI to set cross-system connectivity between IBM Spectrum Accelerate systems, as shown in the following figures.

Note: For detailed information and guidance on how to set cross-system connectivity, refer to IBM XIV Storage System Business Continuity Function on the IBM Redbooks® website (redbooks.ibm.com/abstracts/sg247759.html).

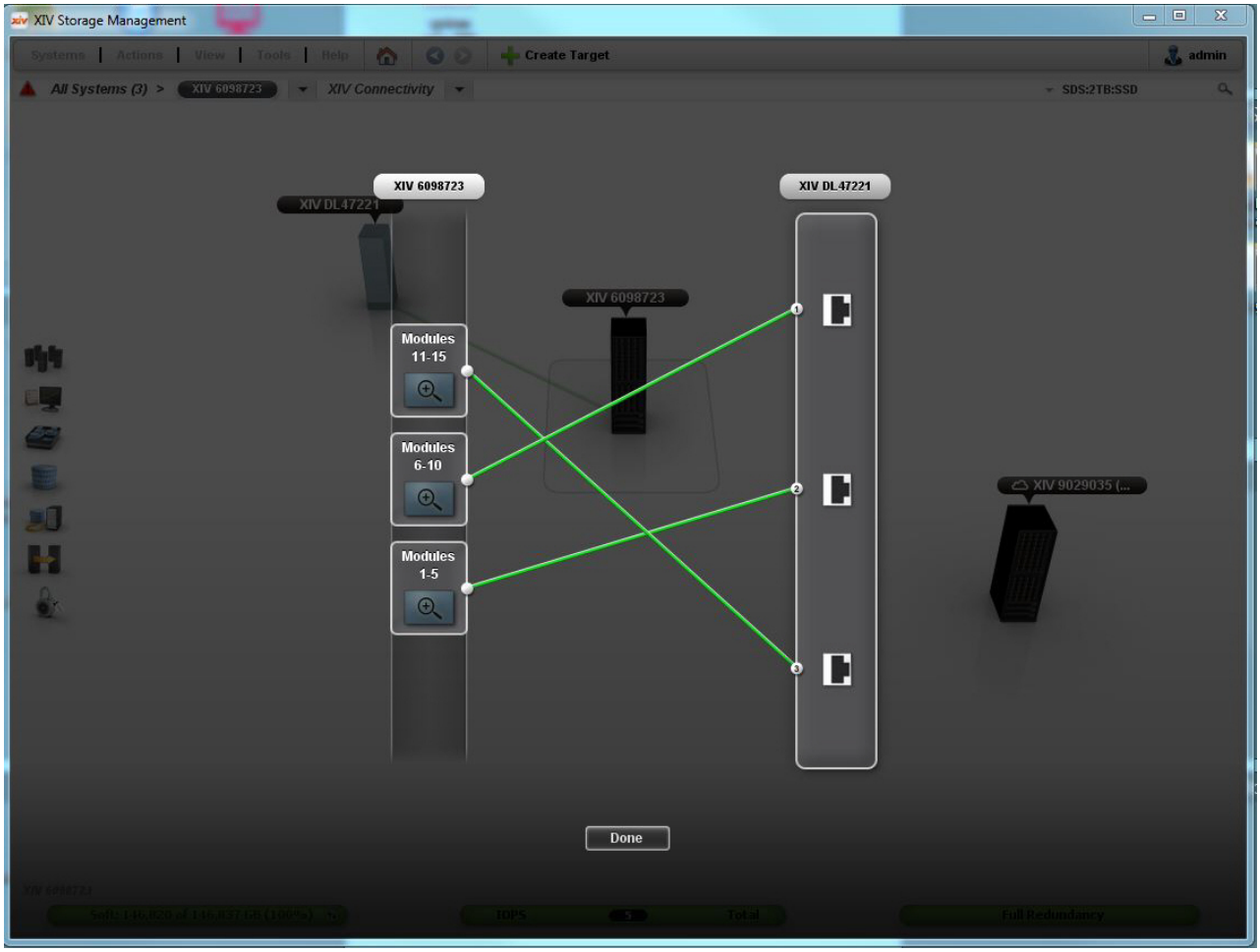


Figure 50. XIV GUI – Cross-system connectivity – Grouped modules view

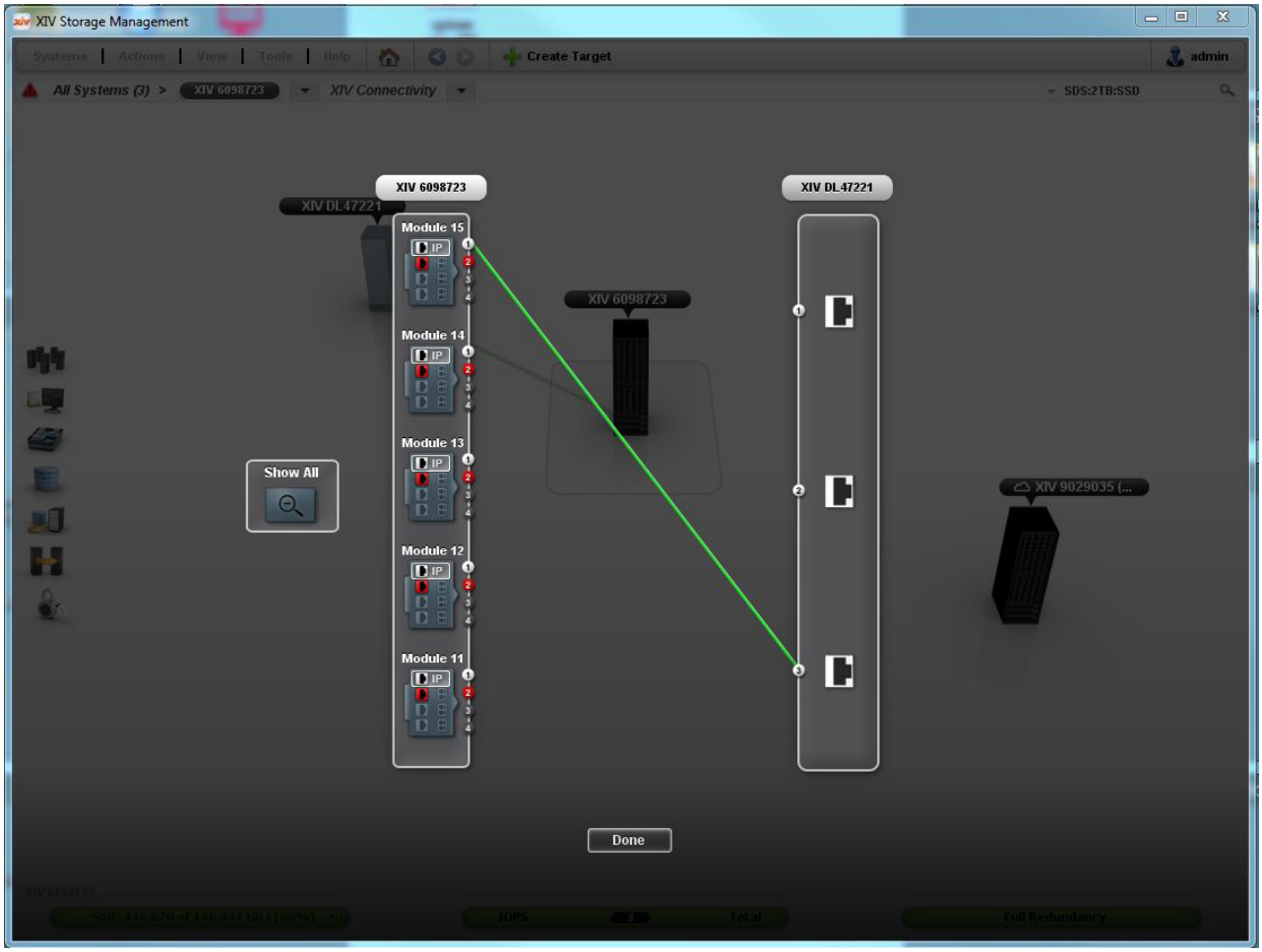


Figure 51. XIV GUI – Cross-system connectivity – Focused module view

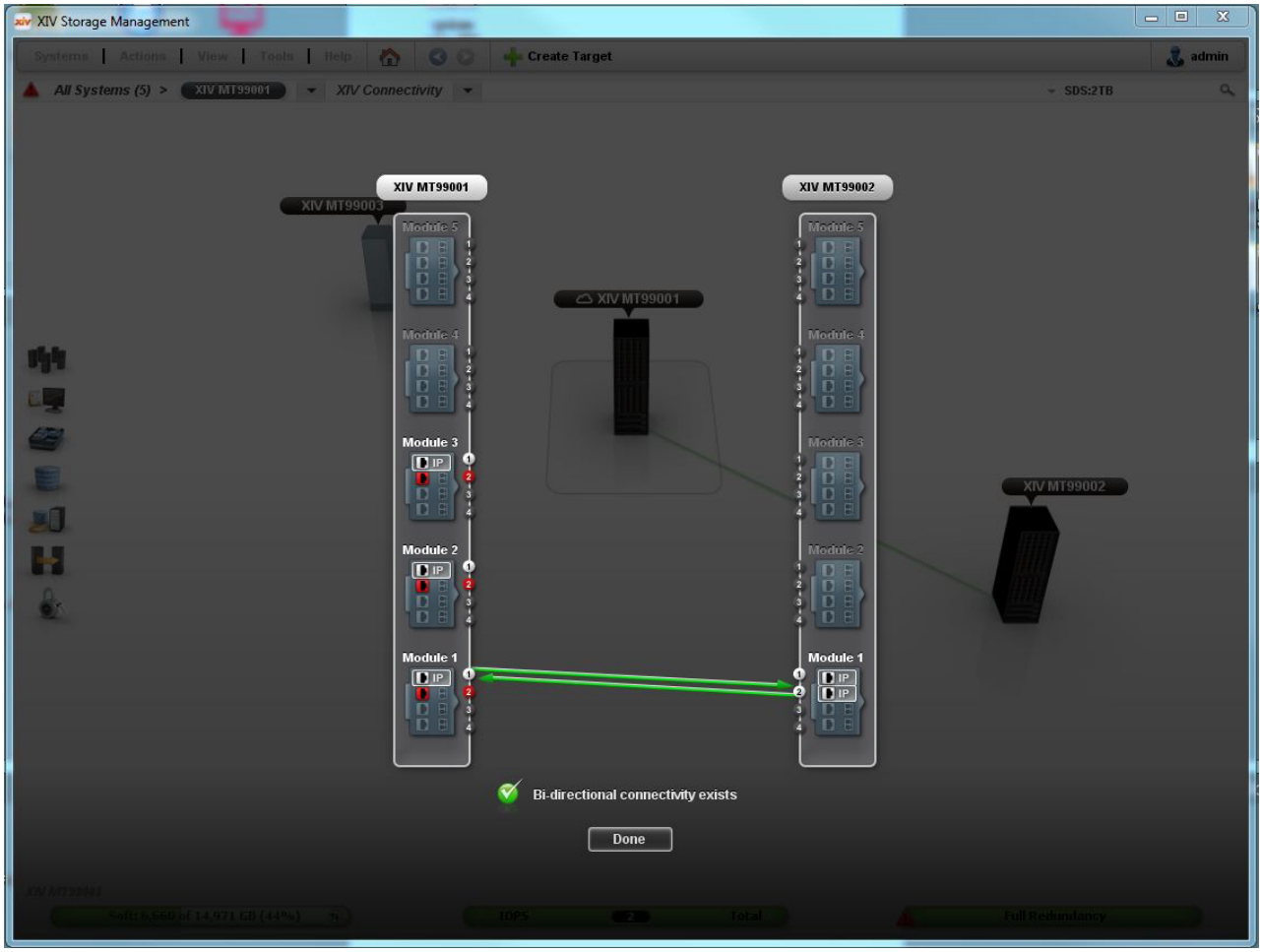


Figure 52. XIV GUI – Cross-system connectivity – Bi-directional connection

Managing and tracking Spectrum Accelerate licenses

You can use IBM Hyper-Scale Manager to manage and track your IBM Spectrum Accelerate licenses, as shown in the following figures.

For information about the Spectrum Accelerate licensing, see "License types" on page 21 and "License use measuring and reporting" on page 21.

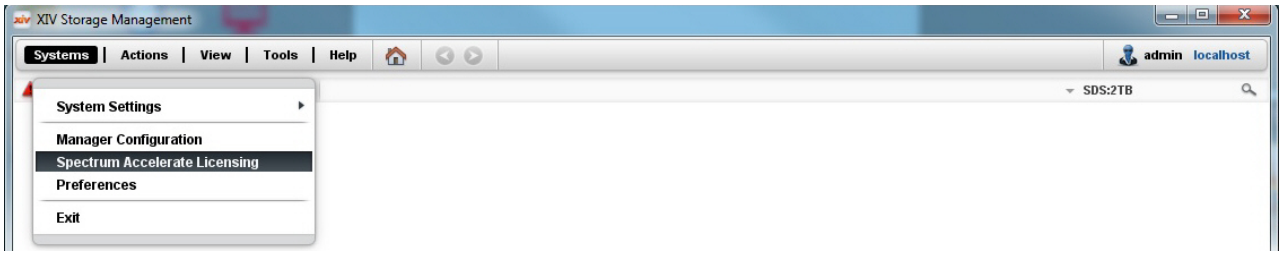


Figure 53. IBM Hyper-Scale Manager – Spectrum Accelerate Licensing option

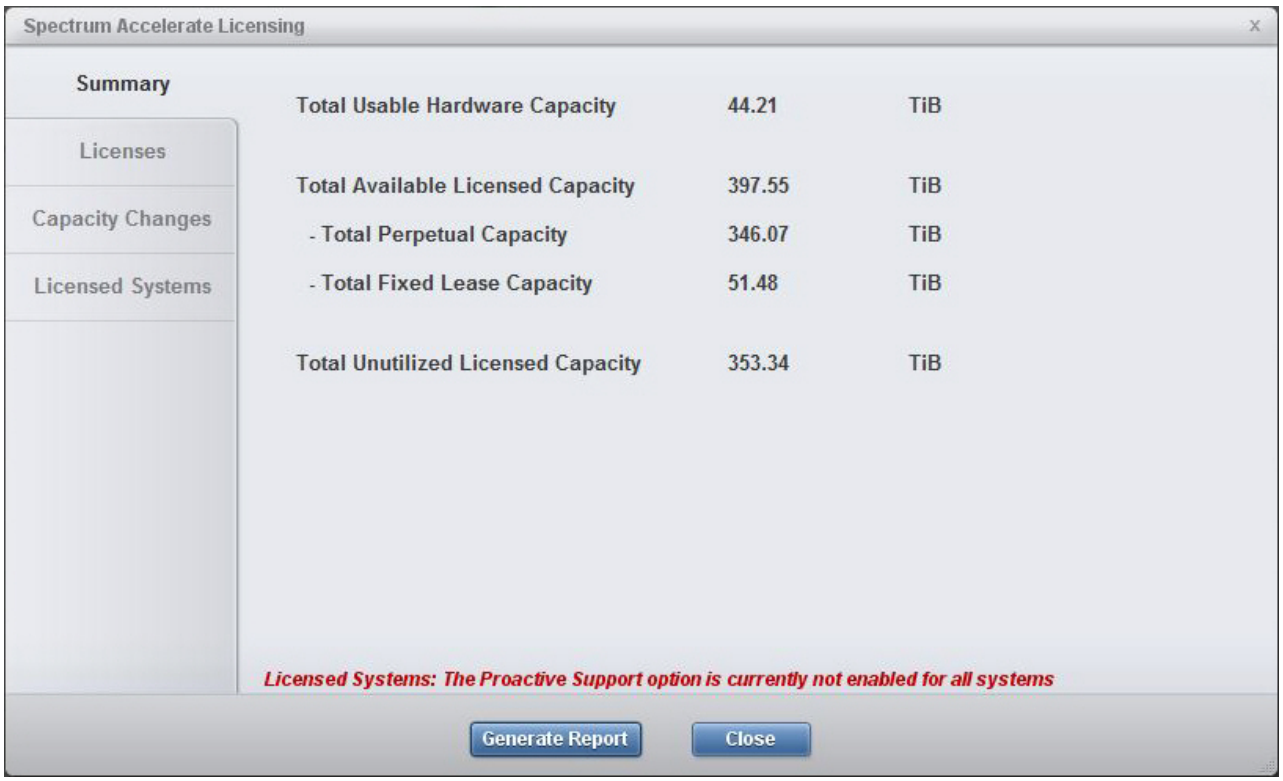


Figure 54. Spectrum Accelerate Licensing – Summary tab

From the Spectrum Accelerate Licensing tab you can add or remove IBM Spectrum Accelerate licenses. Click the green plus icon to add a license.

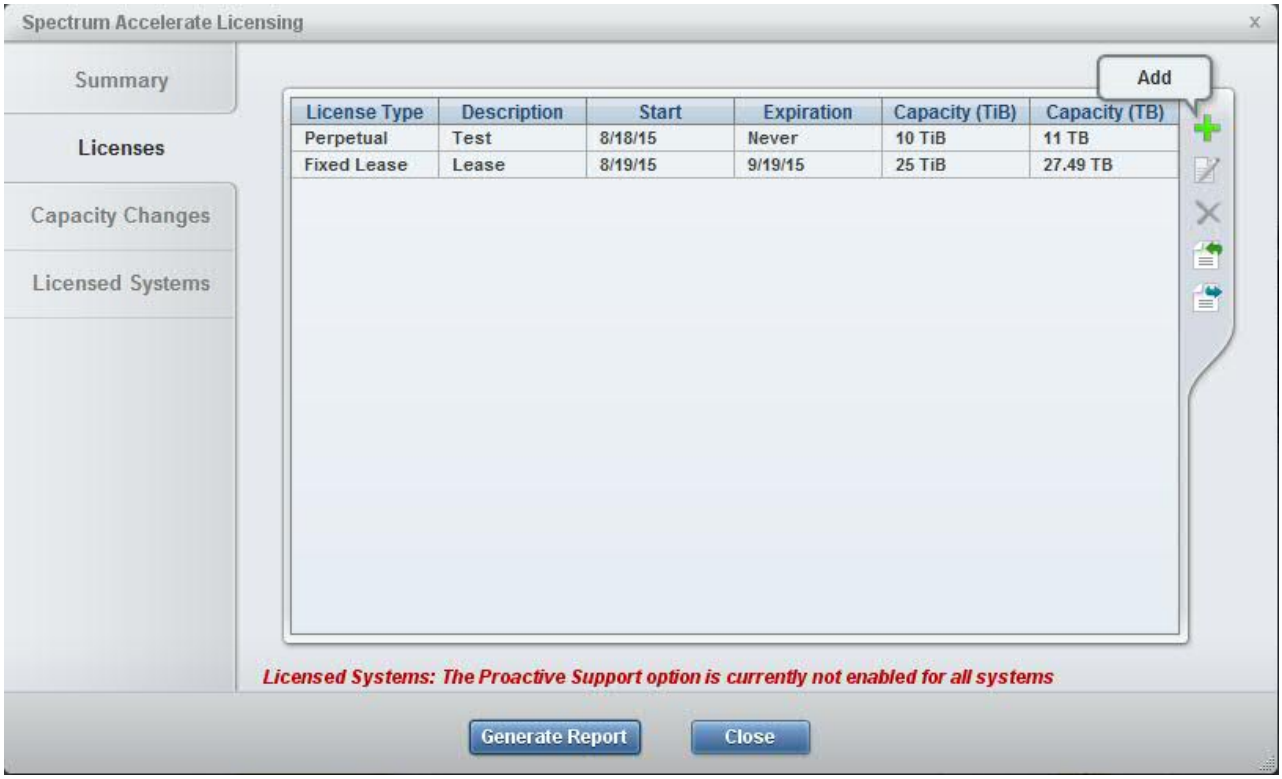


Figure 55. Spectrum Accelerate Licensing – Licenses tab and Add button

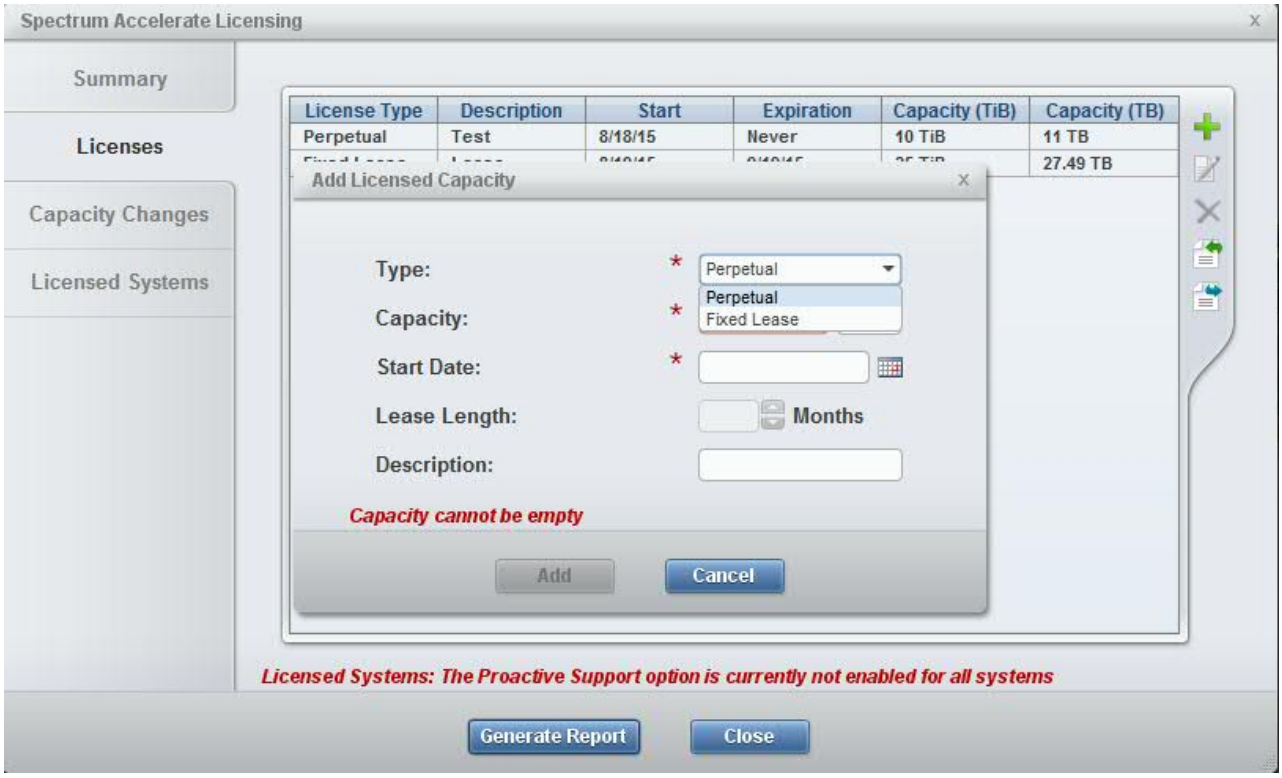


Figure 56. Spectrum Accelerate Licensing – Licenses tab and Add button

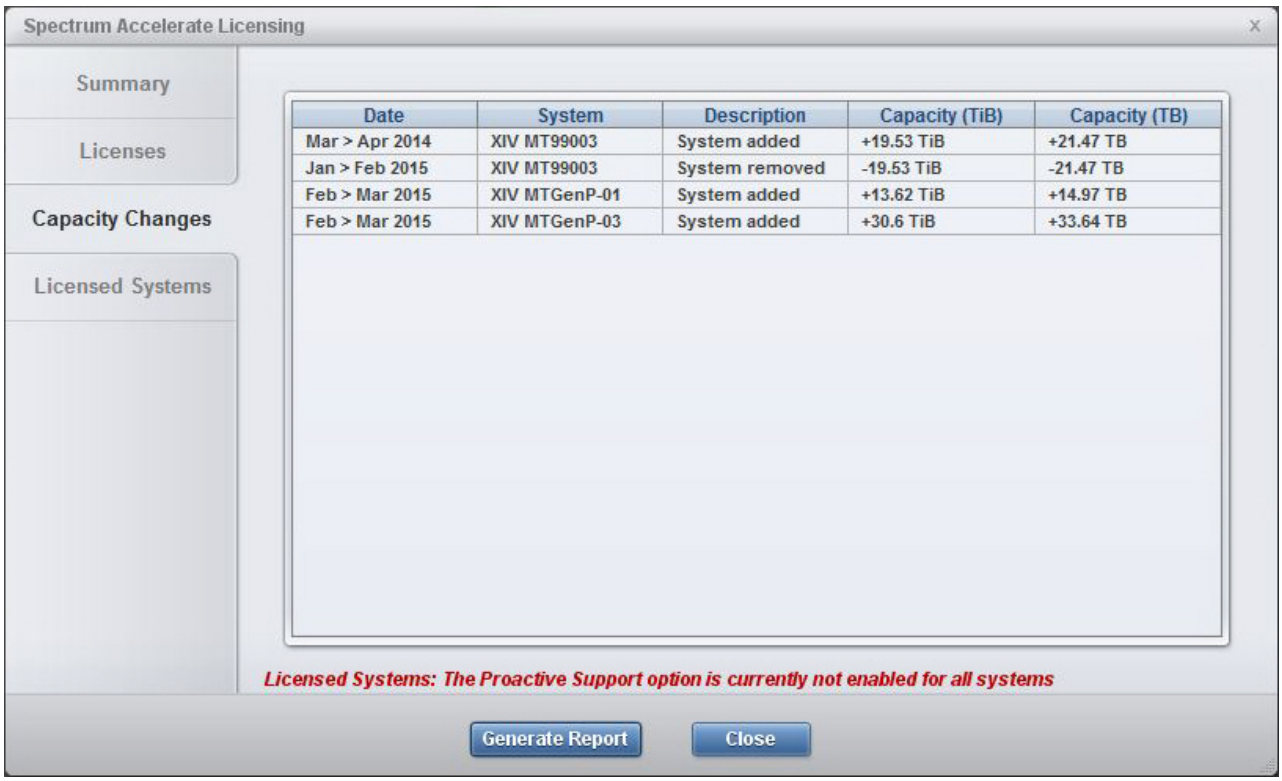


Figure 57. Spectrum Accelerate Licensing – Capacity Changes tab

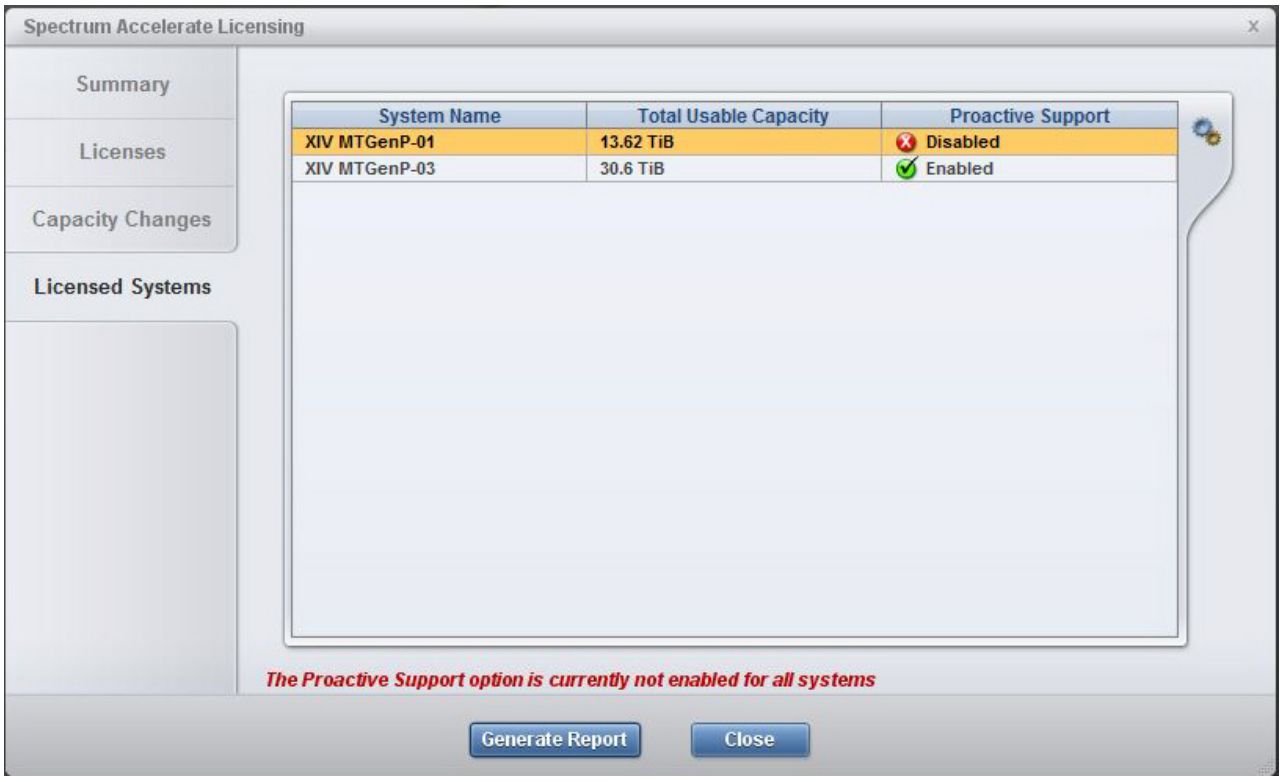


Figure 58. Spectrum Accelerate Licensing – Licensed Systems tab

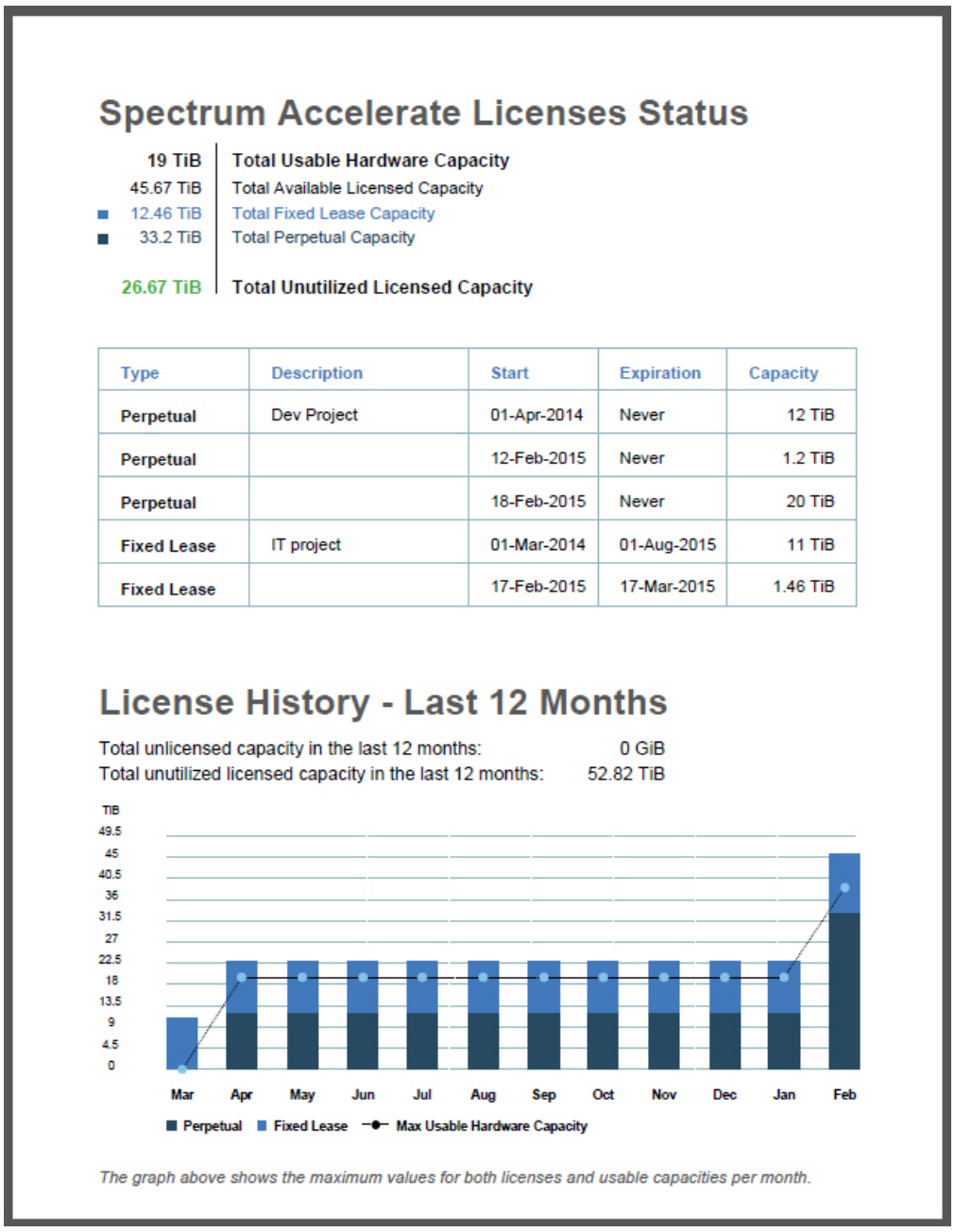
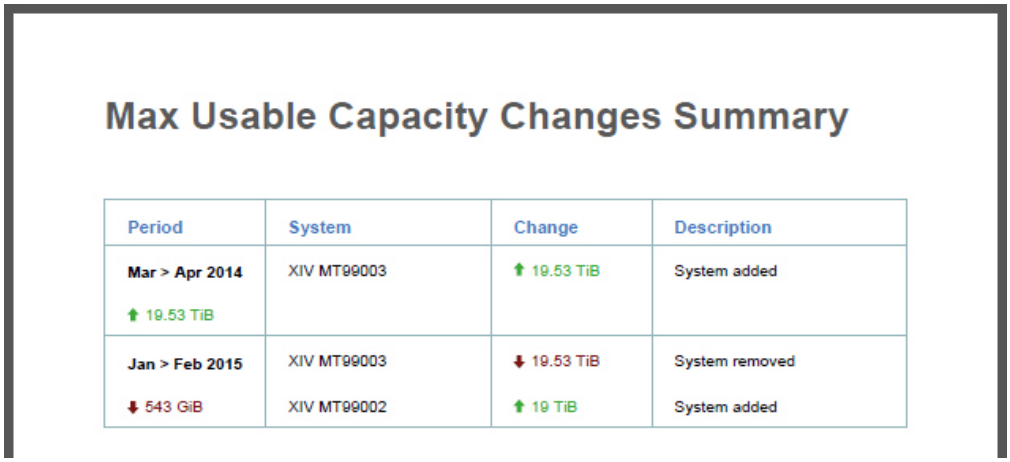


Figure 59. Spectrum Accelerate licensing report – example page 1



Max Usable Capacity Changes Summary

Period	System	Change	Description
Mar > Apr 2014 ⬆ 19.53 TiB	XIV MT99003	⬆ 19.53 TiB	System added
Jan > Feb 2015 ⬇ 543 GiB	XIV MT99003 XIV MT99002	⬇ 19.53 TiB ⬆ 19 TiB	System removed System added

Figure 60. Spectrum Accelerate licensing report – example page 2

Upgrading a Spectrum Accelerate system

When a newer version of IBM Spectrum Accelerate becomes available, you can initiate the upgrade procedure from the XIV GUI.

The upgrade procedure does not interrupt the continuous operation of the Spectrum Accelerate storage system.

Prior to initiating the upgrade procedure, issue the **module_list** and **service_list** commands to make sure that all modules are up and running, and that their status is OK. Examples of the output of both commands are shown below:

```
>> module_list
Component ID   Status   Currently Functioning   Target Status   Type         Data Disks   FC Ports   iSCSI Ports   Temperature
-------------- -------- ----------------------- --------------- ------------ ------------ ---------- ------------- -------------
1:Module:1     OK       yes                                     sds_vm_p11   11           0          2             0
1:Module:2     OK       yes                                     sds_vm_p11   11           0          2             0
1:Module:3     OK       yes                                     sds_vm_p11   11           0          2             0
1:Module:4     OK       yes                                     sds_vm_p11   11           0          2             0
1:Module:5     OK       yes                                     sds_vm_p11   11           0          2             0
1:Module:6     OK       yes                                     sds_vm_p11   11           0          2             0
```

```
>> service_list
Component ID     Status   Currently Functioning   Target Status
---------------- -------- ----------------------- ---------------
1:Data:1         OK       yes
1:Data:2         OK       yes
1:Data:3         OK       yes
1:Data:4         OK       yes
1:Data:5         OK       yes
1:Data:6         OK       yes
1:Interface:1    OK       yes
1:Interface:2    OK       yes
1:Interface:3    OK       yes
1:Interface:4    OK       yes
1:Interface:5    OK       yes
1:Interface:6    OK       yes
1:Remote:1       OK       yes
1:Remote:2       OK       yes
1:Remote:3       OK       yes
1:Remote:4       OK       yes
1:Remote:5       OK       yes
1:Remote:6       OK       yes
```

If at least one service status is not OK, contact IBM Support.

To upgrade a Spectrum Accelerate system:

1. Copy the upgrade software package to the host from which the upgrade is to be carried out.
2. Verify the upgrade package file size.
3. Verify that the Spectrum Accelerate system is in good state and that there are no failed components.
4. Verify that there are no other on-going upgrade operations.
5. In the XIV GUI, zoom in to the Spectrum Accelerate system that you want to upgrade and then start the **Upgrade** option under **System Settings**

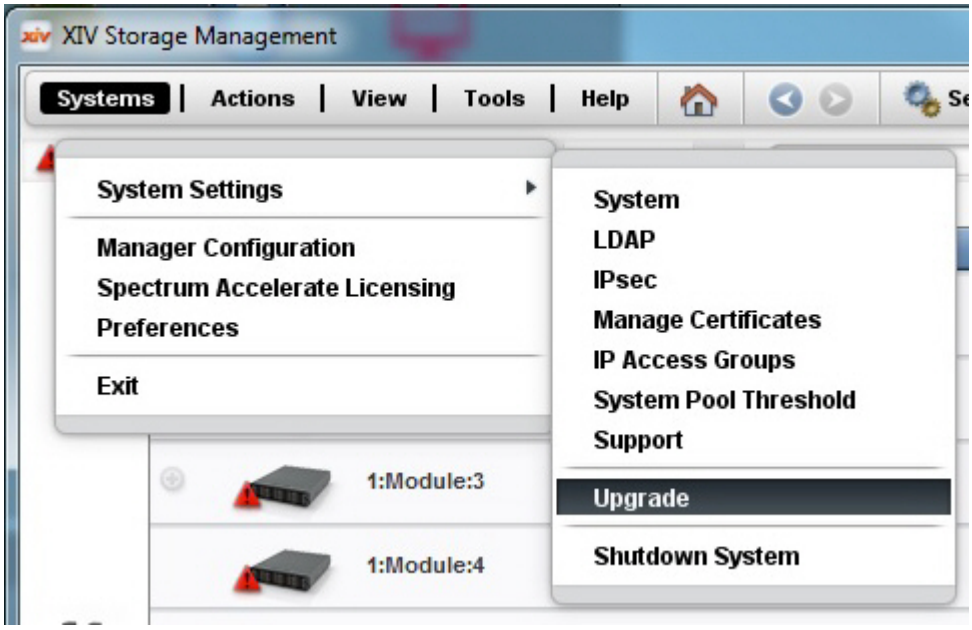


Figure 61. XIV GUI – Upgrade option

The Spectrum Accelerate upgrade wizard is displayed and guides you through the upgrade procedure steps.

The upgrade process might take several minutes to complete. The XIV GUI displays the progress of the upgrade until its completion.

Phasing out and phasing in modules and disks

If you are logged in as **Operations Administrator** (user account that is defined on the Spectrum Accelerate system), you can use the XIV GUI to phase out and phase in modules and disks that are part of a Spectrum Accelerate storage system.

Attention:

- You must always initiate a phase out procedure before any disk or module replacement. This allows the Spectrum Accelerate system to redistribute data to the other disks and modules in an orderly manner.
- **If you are using the minimum of 3 modules per Spectrum Accelerate system, phasing out a module leaves the system with only 2 functional modules, which is below the required minimum**. To avoid such situation, add a module to a three-module system before attempting to phase out any module. For information about how to add a module, see "Adding modules" on page 57. For information about replacing a module, see "Replacing a module" on page 95.
- For more information about the proper procedure, see "Phase-out, equip, test, and phase-in principles" on page 91.

Right-click the hardware component to display the available phase-out, test, or phase-in options for that component, as shown in the following example figures.

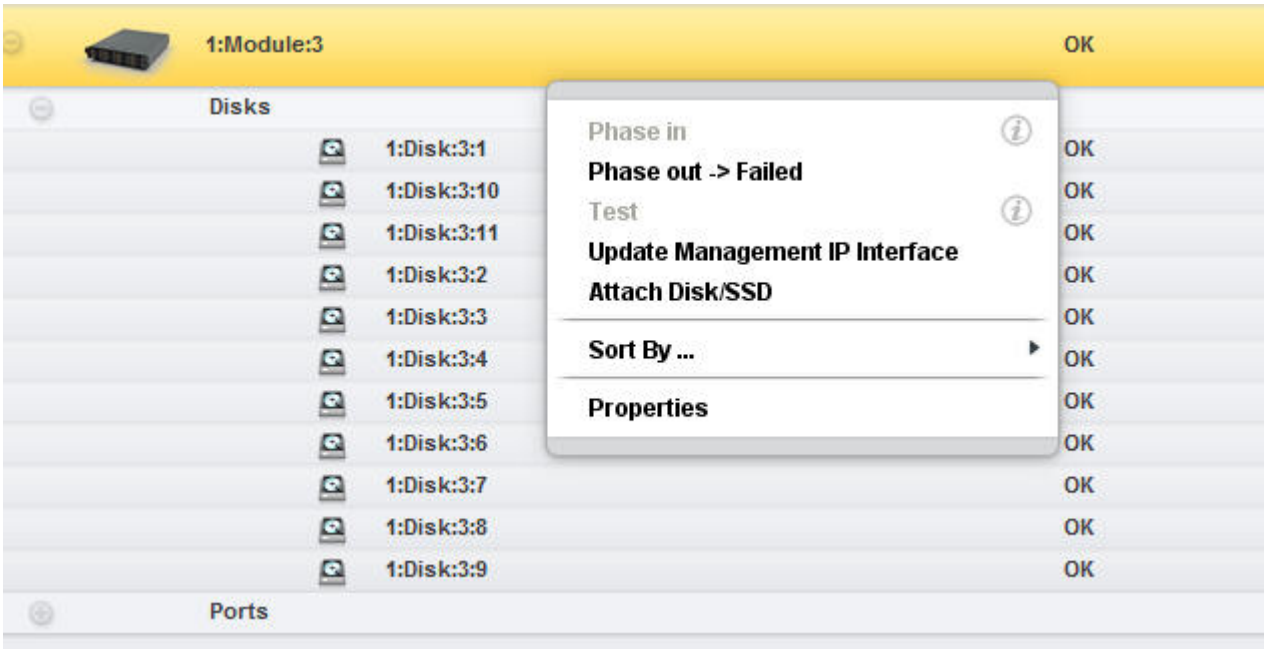


Figure 62. XIV GUI – Phase-out options for a failed module component (module containing one failed disk)

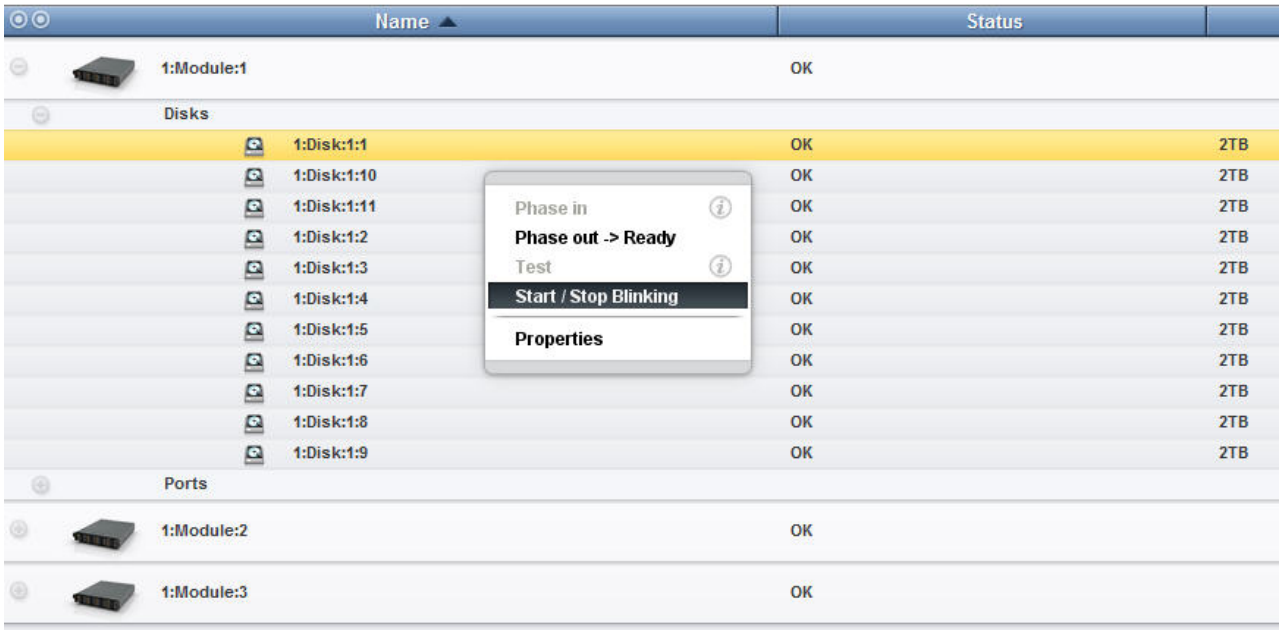


Figure 63. XIV GUI – Phase-out options for a working disk component (disk on OK status)

Management through RESTful APIs

IBM Spectrum Accelerate systems can also be managed through programmable web applications that establish an interface with the IBM Hyper-Scale Manager RESTful APIs. This applies to any IBM Hyper-Scale Manager server that contains IBM Spectrum Accelerate licenses.

For more information, see the IBM Hyper-Scale Manager Representational State Transfer (REST) API Specifications publication.

Chapter 6. Management from the command-line interface (CLI)

Apart of a few new service-related operations for disks and modules, management of a IBM Spectrum Accelerate storage system from the command-line interface (CLI) is similar to XIV system management from the CLI.

The new service-related operations are also available from the XIV GUI.

Important: The management communication is over TCP port 7778, through which all traffic is encrypted. The Spectrum Accelerate system communicates with key servers using the Key Management Interoperability Protocol (KMIP) protocol over TCP port 5696.

Using a CLI management terminal

IBM Spectrum Accelerate systems can be controlled from a CLI management terminal by logging in to the storage system and issuing CLI commands.

Use the XIV CLI (XCLI) terminal application (included in the XIV Management Tools software package) or any conventional terminal application to connect to the management IP address or hostname of the Spectrum Accelerate storage system.

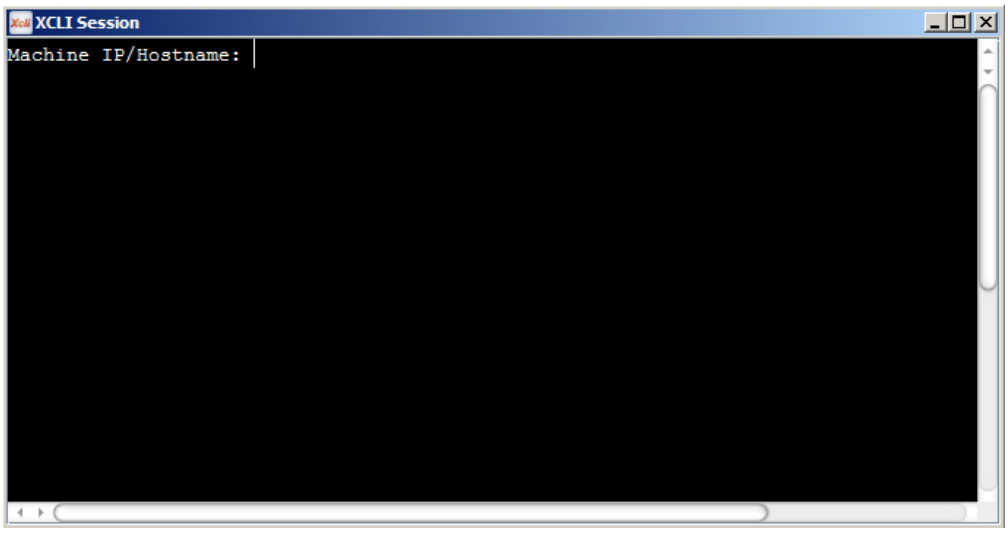


Figure 64. XIV CLI terminal application

Obtaining help information per CLI command

When working from a CLI terminal, you can type **--help** or **-h** argument after any CLI command to obtain usage information regarding that specific command.

In addition, you can use the **help** command to list all commands of a certain CLI command category, as well as the short description, syntax, list of possible parameters, and default values of these commands.

For more information, see the **Printing Help** topic in the IBM Spectrum Accelerate *Command-Line Interface (CLI) Reference Guide* publication.

List of CLI commands

IBM Spectrum Accelerate can be controlled by a range of CLI commands that are based on the XIV CLI (XCLI) commands.

Some commands, however, are different for Spectrum Accelerate and do not apply to both systems.

The following table specifies which XIV commands apply to Spectrum Accelerate systems, and whether there is any difference in their use with Spectrum Accelerate.

Note: The following table only lists the commands. For the complete usage information, refer to the IBM Spectrum Accelerate *Command-Line Interface (CLI) Reference Guide* publication.

Table 31. List of CLI commands

Spectrum Accelerate CLI command or command type (with *)	Different use with XIVsystems?	Note
access_{define,delete,list}	No	
alu_*	No	
appadmin_capabilities_{get,set}	No	
audit_*	No	
cg_*	No	
cluster_*	No	
cod_list	Yes	Different output format
component_attach	Not available for XIV systems	Newly-available hardware service command
component_equip	Yes	Newly-available hardware service command
component_identify	Not available for XIV systems	Newly-available hardware service command
component_list	Yes	Different output
component_phasein	Yes	Newly-available hardware service command
component_phaseout	Yes	Newly-available hardware service command
component_test	Yes	Newly-available hardware service command
config_get	No	
config_set	No	
cpu_list	Yes	Wider set of possible outputs
cr_*	No	
custom_event	No	
designate_msm_user_get	No	
designate_msm_user_set	No	
dest_*	No	
destgroup_*	No	

Table 31. List of CLI commands (continued)

Spectrum Accelerate CLI command or command type (with *)	Different use with XIVsystems?	Note
dimm_list	Yes	Wider set of possible outputs
disk_list	Yes	Wider set of possible outputs
disk_type_list	Yes	Wider set of possible outputs
dm_*	No	
dns_test	No	
domain_*	No	
ethernet_interface_reset	No	
event_*	No	
firmware_upgrade_status	No	
gp_*	No	
gui/changes_get	No	
gui/command_complete_syntax	No	
gui/event_object_type_list	No	
gui/event_severity_list	No	
gui/gui_data_delete	No	
gui/gui_data_list	No	
gui/gui_data_set	No	
gui/gui_statistics_get	No	
gui/inode_get_simple_stats	No	
gui/system_time_get	No	
gui/user_authenticate	No	
heartbeat_usage_info	No	
help	Yes	
host_add_port	Yes	Not including support for Fibre Channel (FC)
host_connectivity_list	Not	
host_define	No	
host_delete	No	
host_list	Yes	Not including support for Fibre Channel (FC)
host_list_ports	Yes	Not including support for Fibre Channel (FC)
host_profile_*	No	
host_profiler_disable	No	
host_profiler_enable	No	
host_remove_port	Yes	Not including support for Fibre Channel (FC)
host_rename	No	
host_update	No	
io_{pause,pause_list,resume}	No	

Table 31. List of CLI commands (continued)

Spectrum Accelerate CLI command or command type (with *)	Different use with XIVsystems?	Note
ip_access_group_*	No	
ipinterface_add_port	Yes	Not including support for Fibre Channel (FC)
ipinterface_create	Yes	Not including support for Fibre Channel (FC)
ipinterface_delete	Yes	
ipinterface_list	Yes	
ipinterface_list_ips	Yes	
ipinterface_list_ports	Yes	
ipinterface_remove_port	Yes	
ipinterface_rename	Yes	
ipinterface_run_arp	Yes	
ipinterface_run_traceroute	Yes	
ipinterface_run_traceroute6	Yes	
ipinterface_update	Yes	
ipsec_*		
ldap_*	No	
local_storage_show		Operations Administrator command
maintenance_urgency_list		Operations Administrator command
mapping_list	No	
map_vol	No	
metadata_*	No	
mfg_config_get	Yes	
mfg_config_set	Yes	
mib_get	No	
mirror_*	No	
module_list	Yes	
module_probe	No	
module_redefine_type	No	This command redefines a module type, and can be used only when the system is shut down. It is used when new ports are added to an existing module.
module_type_define	No	
module_type_list	Yes	
monitor_redist	No	
network_sensor_status_list	No	
nic_list	No	
node_status_list	No	
olvm_*	No	
perf_class_*	No	

Table 31. List of CLI commands (continued)

Spectrum Accelerate CLI command or command type (with *)	Different use with XIVsystems?	Note
pki_*	No	Without a reference to a key server certificate, as SED encryption is not supported
pool_*	No	
process_list	No	Different output
reservation_clear	No	
reservation_key_list	No	
reservation_list	No	
reset_command_service	No	
rpo_thresholds_{get,set}	No	
rule_*	No	
schedule_*	No	
service_*	No	
shutdown	No	
smsgw_*	No	
smtpgw_*	No	
snap_group_*	No	
snapshot_*	No	
special_type_set	No	
ssd_*	No	
ssh_revoke_key	No	
state_change	No	
state_list	Yes	No charging state
statistics_get	No	
support_center_*	No	
sync_job_list	No	
system_capacity_{list,update,upgrade}	Yes	
system_compression_{disable,enable}	No	
system_logs_*	No	
target_*	No	
tcp_sack_{enable,disable}	No	
technician_work_in_progress	No	Operations Administrator command
thread_statuses_list	No	
time_{list,set}	No	
timezone_{list,set}	No	
traces_*	No	Most of **traces_*** commands are available to Operations Administrators only, except **traces_snapshot_list**, which is also available to Storage Administrators.
unmap_vol	No	
unmap_vol_set_default_idle_time	No	

Table 31. List of CLI commands (continued)

Spectrum Accelerate CLI command or command type (with *)	Different use with XIVsystems?	Note
upgrade_*	Yes	Operations Administrator command
usage_get	No	
user_define	No	
user_delete	No	
user_group_add_user	No	
user_group_*	No	
user_list	No	
user_rename	No	
user_update	No	
version_get	No	
vol_*	No	
vpd_config_{get,set}	No	
xcg_*	No	
xiv_support_*	No	
xmpns_*	No	

CLI command automation

All CLI commands for Spectrum Accelerate systems can be automated by using scripts and conventional programming.

For the complete information on command format and return codes, refer to the IBM Spectrum Accelerate *Command-Line Interface (CLI) Reference Guide* publication.

Chapter 7. Servicing modules and disks

IBM Spectrum Accelerate requires customers to monitor their storage system and regularly provide any required physical service to disks, servers, and networks that comprise the storage system.

For more information, see the following sections:

User responsibilities

Because IBM Spectrum Accelerate can be deployed on any commodity hardware of choice, users must furnish its hardware, set up and establish its interconnect network, connect it to other networks as needed, deploy its software, and independently monitor its server configuration and hardware components.

Users must also:

- Maintain the ESXi server health with the most up-to-date drivers, including the use of disk drives (HDD, SSD) and disk controllers with up-to-date firmware. Failure to provide the ESXi servers with the most up-to date drivers and controllers may prevent the IBM support team from recovering the system in case of a critical sev1 issue, and cause a delay in IBM support response time.
- Verify that the cluster/grid interconnect network is in good standing at all times. This includes making sure that no IP address collisions occur.
- Maintain the overall system operation environment, including the operating temperature and continuous power supply for its servers, based on the specifications of the hardware of choice.
- Regularly perform any required maintenance for disks and servers that comprise the storage system. This includes timely replacement and phase-in of failed disks and modules.
- Perform the software upgrade procedure when needed.
- Implement and maintain a UPS with a graceful shutdown in case of power outages to prevent data loss.

A set of maintenance commands are available by both the management GUI and CLI to perform operations such as hardware monitoring (see "Monitoring Spectrum Accelerate hardware components" on page 69) and replacing disks (see "Replacing a disk" on page 98) or ESXi servers (see "Replacing a module" on page 95).

Phase-out, equip, test, and phase-in principles

The phase-out, equip, test, and phase-in maintenance operations (available from the CLI and GUI) allow you to replace hardware components without interrupting the continuous operation of the IBM Spectrum Accelerate storage system.

The following flowchart provides an overview of the different component statues and operations.

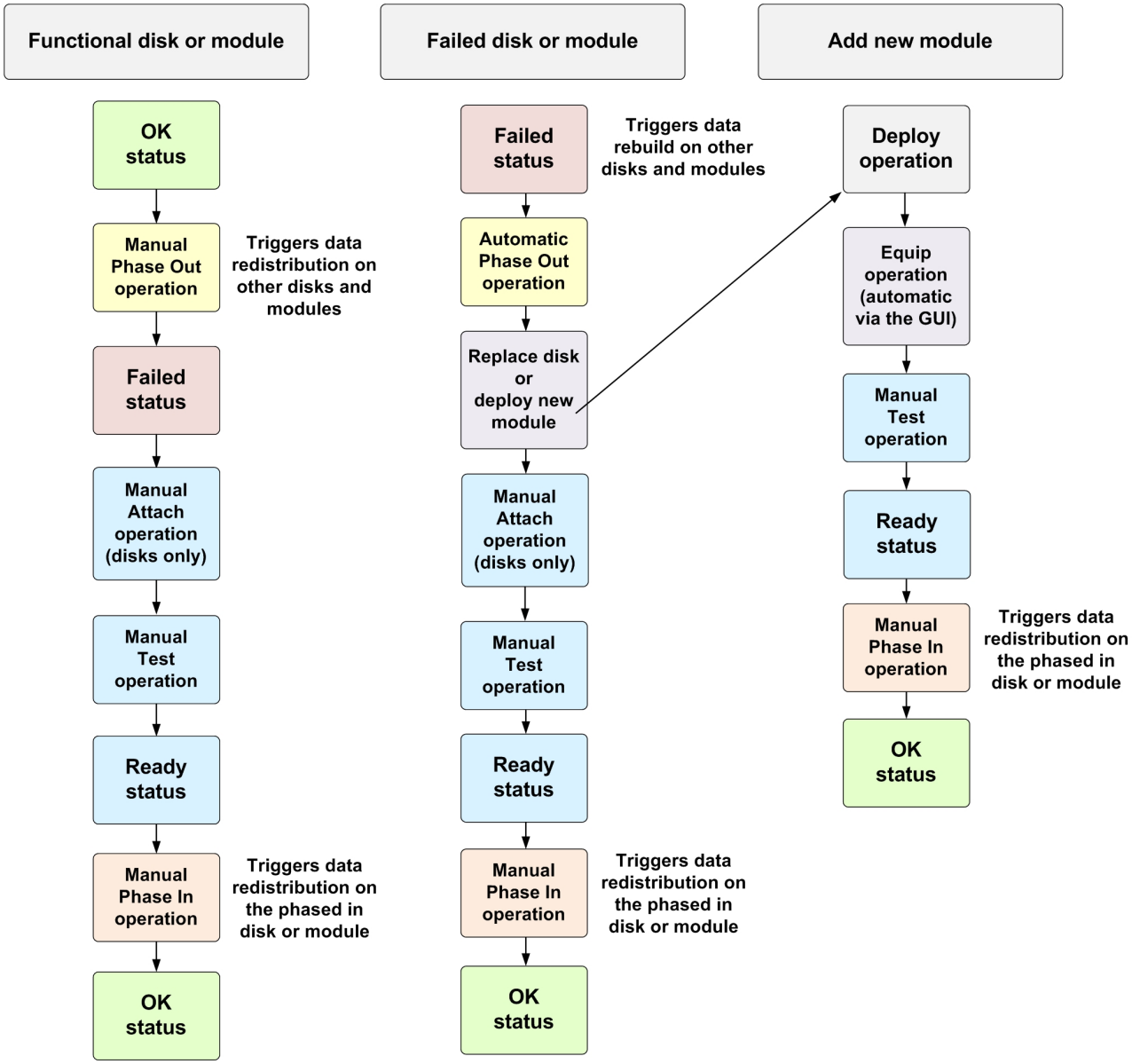


Figure 65. Flowchart of hardware service operations and statuses

Important:

- If, for any reason, the Spectrum Accelerate virtual machine on the ESXi host is to be turned off, you must first phase out the relevant module.
- Always wait until the completion of a successful data redistribution process **before** performing any manual test operation.
- You must have **Operations Administrator** user account (defined on the Spectrum Accelerate system) to carry out hardware component maintenance operations.
- The deployed version of Spectrum Accelerate on a phased-in module must not be newer than the version of the Spectrum Accelerate system to which the module is phased in. Use either the same Spectrum Accelerate version or an earlier Spectrum Accelerate version on the phased-in module.
- The configuration of a phased-in module must be the same as the configuration of the existing Spectrum Accelerate modules. For more information, see "Required VMware ESXi host machines" on page 7.

You can phase out, test, and phase in hardware components from the XIV GUI as described in "Phasing out and phasing in modules and disks" on page 82.

You can equip a module from the CLI as described in "Adding a new module from a Linux deployment host" on page 58, or from the XIV GUI by selecting the **Module Equip** option.

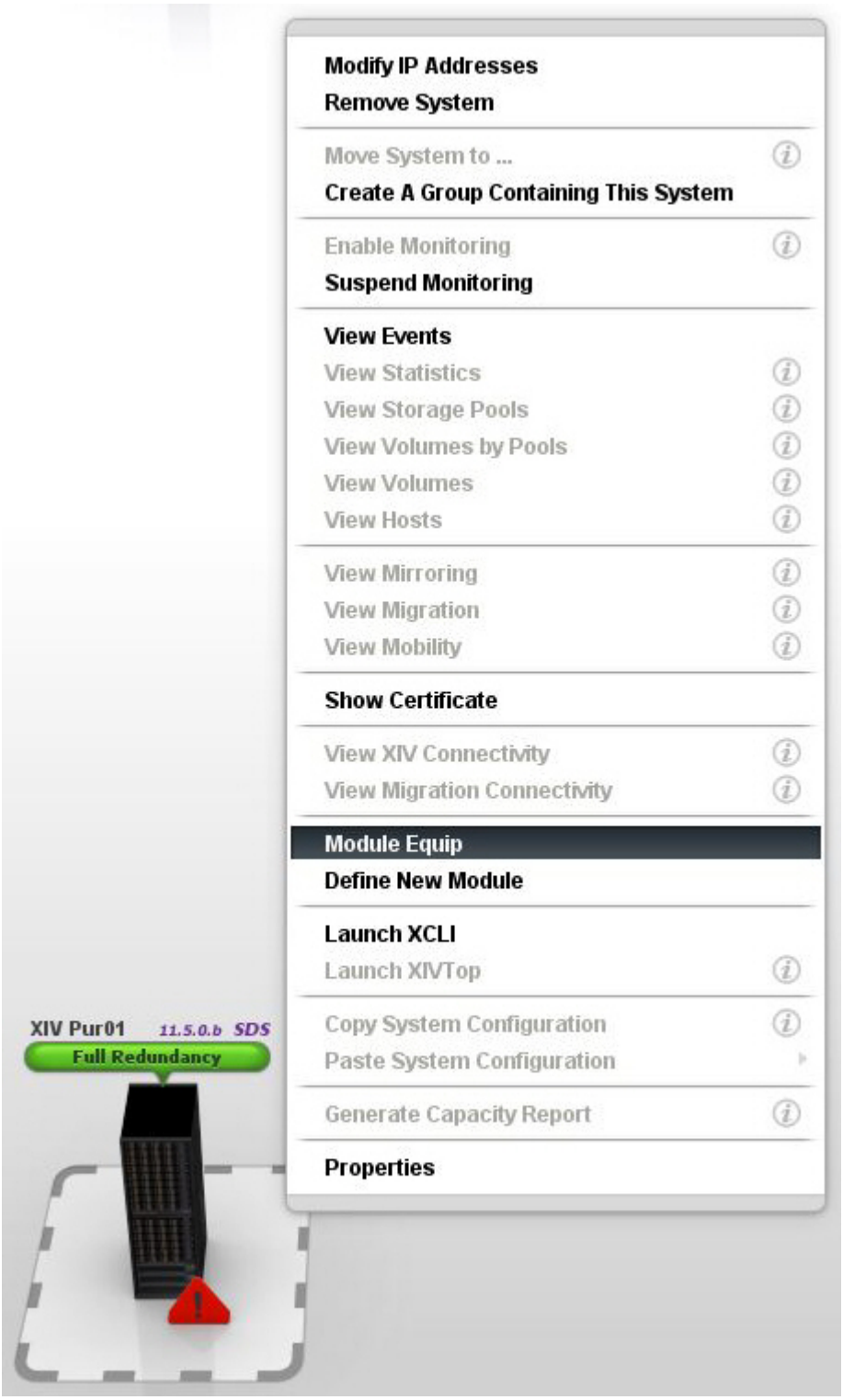


Figure 66. XIV GUI – Module Equip option

Note: The **Module Equip** GUI option is needed only in cases when the equip operation was not done from the CLI. Otherwise, upon any new module deployment from the GUI (see "Adding a new module from the XIV GUI" on page 61), the equip operation is done automatically.

When equipping a module from the GUI, you are prompted to enter the IP address of the interconnect network through which the new module should communicate and exchange data with the other modules.

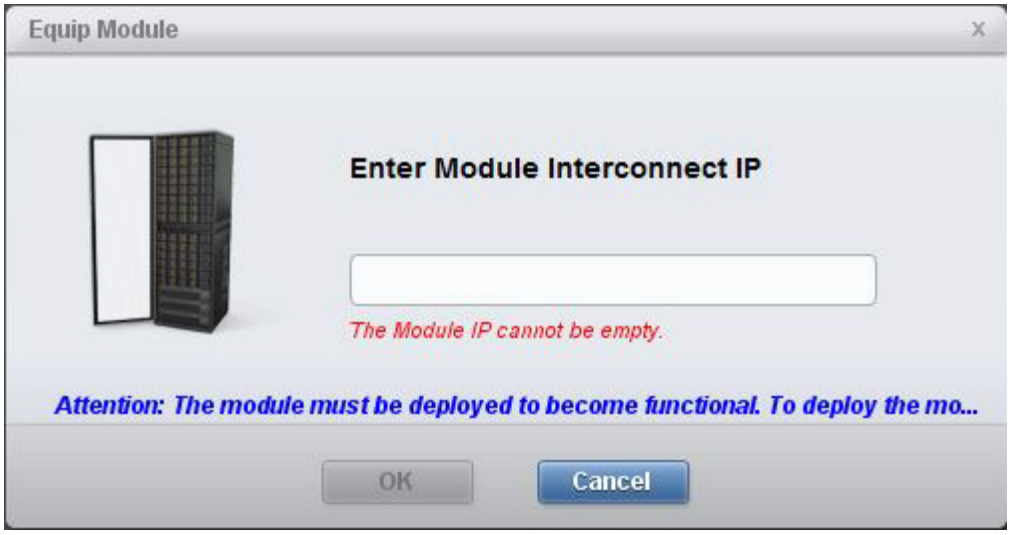


Figure 67. XIV GUI – Equip Module dialog box

Replacing a module

If you are using a Spectrum Accelerate system that comprises at least 4 modules (ESXi hosts that operate with the Spectrum Accelerate virtual appliance), you can replace a module by first phasing it out and then by adding a new module.

If you are using a Spectrum Accelerate system that comprises only 3 modules, phasing out a module leaves the system with only 2 functional modules, which is below the required minimum. You can avoid such situation by first adding a module to the three-module system, and only then phase out the module that you want to replace.

Attention:

- Before starting the following procedure, ensure the system has not detected a **MEDIUM_ERROR_NOT_RECOVERED** event that relates to a media error that was detected on one of the disks. This can be verified by running the **event_list code=MEDIUM_ERROR_NOT_RECOVERED** CLI command, which displays any instances that have been detected. In case the event occurred, stop the replacement and contact IBM Support.
- The deployed version of Spectrum Accelerate on a phased-in module must not be newer than the version of the Spectrum Accelerate system to which the module is phased in. Use either the same Spectrum Accelerate version or an earlier Spectrum Accelerate version on the phased-in module.
- The configuration of a phased-in module must be the same as the configuration of the existing Spectrum Accelerate modules. For more information, see "Required VMware ESXi host machines" on page 7. If the hard disks (HDDs) of the newly added module have greater capacity than the capacity of the existing system HDDs (indicated by the **DISK_LARGER_THAN_SYSTEM_DISK_SIZE** event), the HDDs of the newly added module can be utilized only up to the capacity of the existing system HDDs.

Perform the following steps to replace a module:

1. Phase out the module, if it is not in Failed state already.
2. Wait until the Spectrum Accelerate system is in full data redundancy.
3. Add a new module as described in "Adding modules" on page 57. For the **Module ID** parameter, use the same ID number of the replaced module.

For information about the module phase-out and phase-in operations, see "Phase-out, equip, test, and phase-in principles" on page 91 and "Phasing out and phasing in modules and disks" on page 82.

Using service LED to identify a failed disk

Use vendor specific tools to retrieve the physical location of a failed or phased-out disk.

Important:

- This information is intended for VMware administrators who are familiar with ESXi terms, ESXi configuration, and the Spectrum Accelerate CLI commands.
- To carry out hardware component maintenance operations, you must log in as a user with the role of **Storage Administrator** or **Operations Administrator** (roles defined in the Spectrum Accelerate system).

Certain hardware vendors provide ESXi packages containing additional information about the hardware. Specifically, these packages may contain bay information per disk which Spectrum Accelerate can use to:

- Sort the disks according to their physical location
- Return the location output to the deployment server

- Inject the physical location information to the Spectrum Accelerate modules when deploying them. The information is added to a separate column in the disk list.

In addition to the ESXi package, the supported hardware must have a compatible vSphere Installation Bundle (VIB) installed. If the VIB is unsupported or is not installed, the system is unable to retrieve information about the component's physical location.

The currently supported hardware and the required VIBs are listed in the table below.

Hardware	Required VIB
LSI controllers	MegaCLI For download and installation instructions, refer to http://de.community.dell.com/techcenter/support-services/w/wiki/909.how-to-install-megacli-on-esxi-5-x

When you are notified about a disk failure in a Spectrum Accelerate module or when a disk is phased-out, issue the following command:

```
component_identify
```

In the command parameters you must indicate either the component ID or the disk device serial number. The respective disk in the enclosure will start blinking.

Alternatively, in the XIV Storage Management GUI, right-click on the module that includes the failed disk, and select **Start / Stop Blinking** (see Figure 62 on page 82). The **Start / Stop Blinking** dialog is opened.

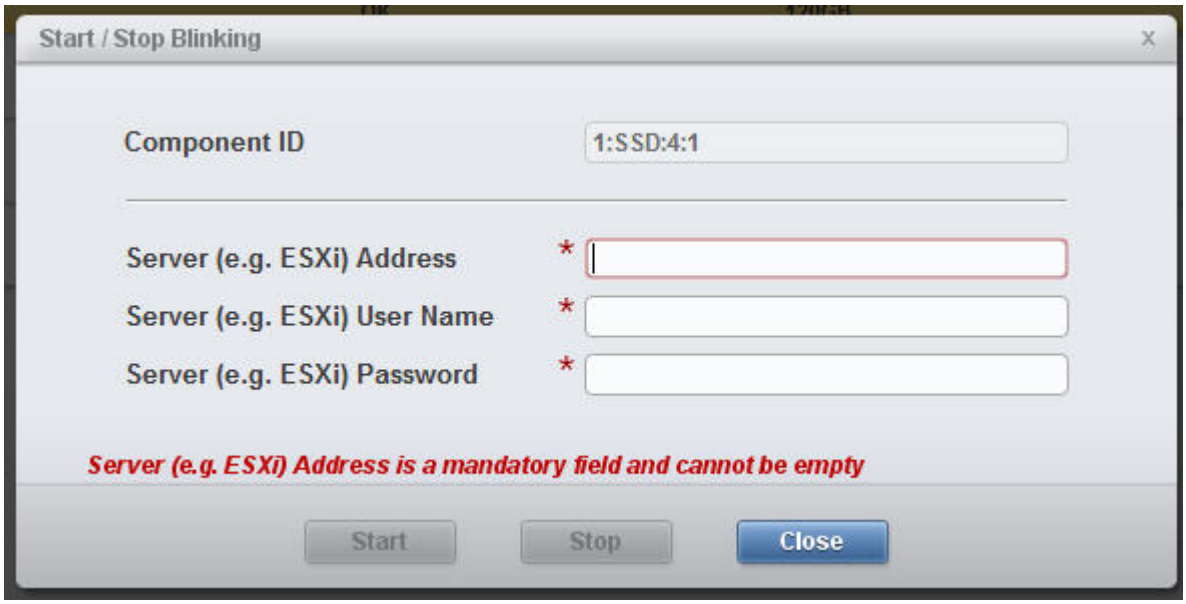


Figure 68. XIV GUI – Start / Stop Blinking dialog

- **Server (e.g. ESXi) Address** – IP address of the ESXi server management

- **Server (e.g. ESXi) User Name** – Username that is used to authenticate to the ESXi server management
- **Server (e.g. ESXi) Password** – Password that is used to authenticate to the ESXi server management

Important: The username and password are securely passed from the server. They are not stored in the system and are erased immediately after the operation is completed.

Replacing a disk

The following table provides guidance for replacing individual disks of any Spectrum Accelerate module (ESXi host that operates with the Spectrum Accelerate virtual appliance).

Important:

- This information is intended for VMware administrators who are familiar with ESXi terms, ESXi configuration, and the Spectrum Accelerate CLI commands.
- You must have **Operations Admin** permissions (user account that is defined on the Spectrum Accelerate system) to carry out hardware component maintenance operations.
- Before replacing a disk for the first time, see "Phase-out, equip, test, and phase-in principles" on page 91.

Attention:

- Ensure the system has not detected a **MEDIUM_ERROR_NOT_RECOVERED** event that relates to a media error that was detected on one of the disks. This can be verified by running the **event_list code=MEDIUM_ERROR_NOT_RECOVERED** CLI command, which displays any instances that have been detected. In case the event occurred, stop the replacement and contact IBM Support.
- During the procedure, **do not turn off** the Spectrum Accelerate virtual machine, nor its guest operating system.

Table 32. Steps for replacing a disk

Step	CLI command or procedure	Expected result
Record the disk identifier	Check the disk unique identifier in the XIV GUI (see Figure 18 on page 45) or in vSphere Client (see Figure 8 on page 27).	Unique identifier of the disk is recorded in order to ensure that the correct disk is replaced and to avoid disk misplacement.
Phase out one disk	**component_phaseout component=<module number>:<disk number>**	Data redistribution starts. Note that if the disk is in Failed state, the system starts the phase-out process automatically and this step can be skipped.
Check the redistribution progress	**monitor_redist**	Redistribution progress is shown

Table 32. Steps for replacing a disk (continued)

Step	CLI command or procedure	Expected result
Check the status	**state_list**	Redistribution progress is shown
Wait for redistribution to finish		Full data redundancy. If full data redundancy is not achieved, contact the IBM Support Center.
Display the disk list	**disk_list**	Disk is in Failed state; write down the disk ID number (for example: 5000c5007de82b13)
Force service on disk	**component_service_force_ok component=<module number>:<disk number>**	Disk is removed from the required component list
Use service LED to physically identify the disk in the enclosure	**component_identify [component=1:disk|ssd:<module number>:<disk number>] [serial=Serial] [state=<on|off>] server_address=IP address of the ESX server server_username=ESX server administrator's user name server_password=ESX server administrator's password** (see also "Using service LED to identify a failed disk" on page 96)	The respective disk in the enclosure starts blinking.
Physically remove the disk		The system continues operating without the disk
Physically install a new disk (must be of identical capacity)		
Use vSphere to locate the new disk identifier in the disk list		Visually compare the old identifier list in vSphere client with the new list and find the newly added identifier. Use its details in the next step, as values for the parameters in the **component_attach** command.

Table 32. Steps for replacing a disk (continued)

Step	CLI command or procedure	Expected result
Detach the old disk/SSD and attach the new one directly to the Spectrum Accelerate virtual machine	**component_attach module=ComponentId device_identifier=NaaIdentifier server_address=IP address of the ESX server server_username=ESX server administrator's user name server_password=String [management_server_address=IPAddress] [management_server_username=String] [management_server_password=ESX server administrator's password] [component_type=[SSD|disk]]**	The old disk/SSD is detached, and the new one is attached directly to the Spectrum Accelerate virtual machine at the specified server. If management server credentials are supplied, the management server is updated accordingly. The LED associated with the newly attached disk/SSD turns off. You can also complete this operation from the XIV GUI (see "Attaching disks or SSDs").
Run disk test	**component_test component=<module number>:<disk number>**	Disk is in Ready state after the test completion; the test might take a few minutes to complete
Phase in the disk	**component_phasein component=<module number>:<disk number>**	Disk is phased in
Check disk status	**disk_list**	Disk state is OK
Check event	**event_list**	Related events are shown

Attaching disks or SSDs

If you are logged in as a user with the role of **Operations Administrator** (a role defined in the Spectrum Accelerate system), you can attach a newly replaced disk or SSD exclusively and directly to a Spectrum Accelerate Virtual Machine.

To detach an old disk or SSD and attach a newly replaced one exclusively and directly to a Spectrum Accelerate Virtual Machine, issue the **component_attach** command (see "Replacing a disk" on page 98 for the full syntax). The command also turns off the LED associated with the attached disk/SSD (see "Using service LED to identify a failed disk" on page 96).

Alternatively, in the XIV Storage Management GUI, right-click on the failed disk/SSD to display the available options, as shown in Figure 62 on page 82.

Select **Attach Disk/SSD** and define the following parameters in the **Attach Disk/SSD** dialog box:

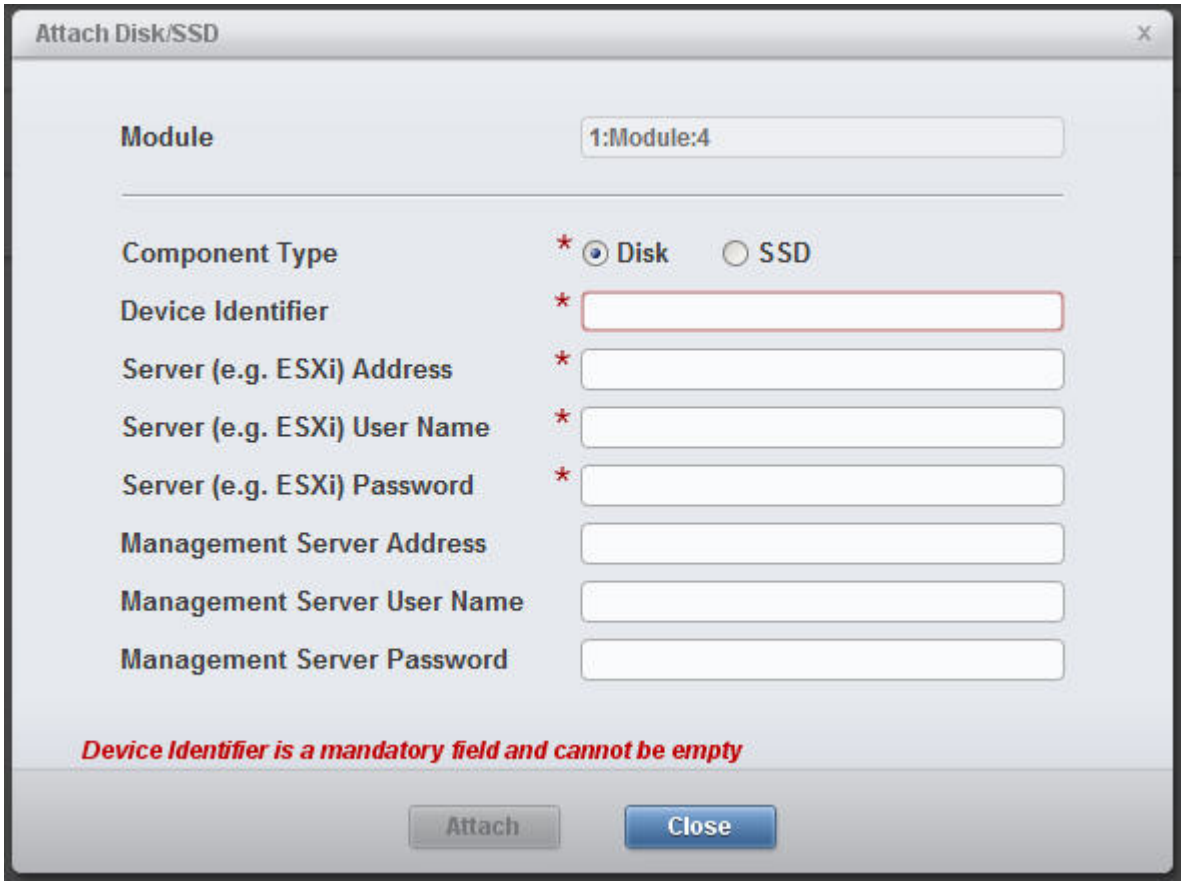


Figure 69. XIV GUI – Parameters for attaching a failed disk/SSD component

- **Component Type** – Select **Disk** or **SSD** depending on the component you're adding
- **Device Identifier** – The disk/SSD identifier as reported by the hypervisor (for example: `5000c50057d9cc27`)
- **Server (e.g. ESXi) Address** – IP address of the ESXi server management
- **Server (e.g. ESXi) User Name** – Username that is used to authenticate to the ESXi server management
- **Server (e.g. ESXi) Password** – Password that is used to authenticate to the ESXi server management
- **Management Server Address** – The IP address of the management server
- **Management Server User Name** – Username that is used to authenticate to the management server
- **Management Server Password** – Password that is used to authenticate to the management server

On successful completion, the hypervisor treats the disk as owned and controlled directly by the Spectrum Accelerate virtual machine. If management server credentials are supplied (e.g. vCenter) the management server will be updated with the information about the newly attached disk/SSD.

Waiting for data rebuilding

Whenever the IBM Spectrum Accelerate system detects a failed disk or module, or whenever a maintenance operation is performed, data redundancy might be temporarily compromised.

To prevent situations in which only one copy of data exists, always wait until the completion of data rebuilding **before** performing any manual test operation (see "Phase-out, equip, test, and phase-in principles" on page 91).

Chapter 8. Troubleshooting

If you encounter any problem during or after the deployment procedure, make sure that all requirements were met prior to the deployment, and that the deployment steps were carried out as specified in this guide.

The following sections provide miscellaneous troubleshooting information:

Handling emergency shutdown

Accidental power loss, or improper system shutdown, might result in data loss.

In case of power loss, immediate shutdown of the Spectrum Accelerate storage system is required. The continuous backup power must allow a graceful shutdown procedure that might take 30 seconds or more, depending on the specific scale of your Spectrum Accelerate deployment.

The minimum time period needed for a graceful shutdown of a specific Spectrum Accelerate deployment is provided by the optional diagnostics process that runs (if enabled) at the end of the deployment process (see Chapter 4, "Deployment," on page 25).

In a graceful shutdown, the Spectrum Accelerate system saves all the modified user data, cache data, and metadata to its disks and then shuts itself down.

Although the shutdown operation can be invoked manually from the GUI, an immediate automated showdown procedure is recommended for cases of unpredictable power loss. The ability to manually invoke the shutdown operation should be restricted to avoid an accidental shutdown (see "Restricting the manual shutdown" on page 104).

To automatically shut down the Spectrum Accelerate system in case of an unplanned power loss, use the system shutdown API (RESTful API), or set the following CLI command:

```
shutdown emergency=yes
```

Alternatively, an emergency shutdown of the ESXi hosts is also possible, by using VMware Tools. The ESXi host can be configured to issue a graceful shutdown to VMs when they are being shut down, in response to UPS events with certain hardware.

When the Spectrum Accelerate system identifies that a single VM is being shut down, it performs an emergency power shutdown. For the instructions on configuring the VM shutdown in the vSphere Web Client, see “Configuring the emergency shutdown in the vSphere Web Client” on page 107.

If your currently deployed UPS unit does not support a Smart Card, this UPS unit is unable to send the power loss event to ESXi to trigger the emergency shutdown. In this case, ensure data safety as described in “Emergency shutdown with non-Smart UPS units” on page 109

Restricting the manual shutdown

The manual shutdown should be restricted in order to avoid an accidental shutdown of the Spectrum Accelerate virtual machines.

About this task

Although the shutdown operation can be invoked manually from the VMware (Web) Client GUI, this ability should be restricted in order to avoid an accidental shutdown.

Procedure

The following procedure describes how to prevent all users from completing the manual shutdown, including the shutdown from a CLI command.

1. Create a new role for Spectrum Accelerate with the privilege to perform any operation, except powering off (**Power Off**) or suspending (**Suspend**) the virtual machine.

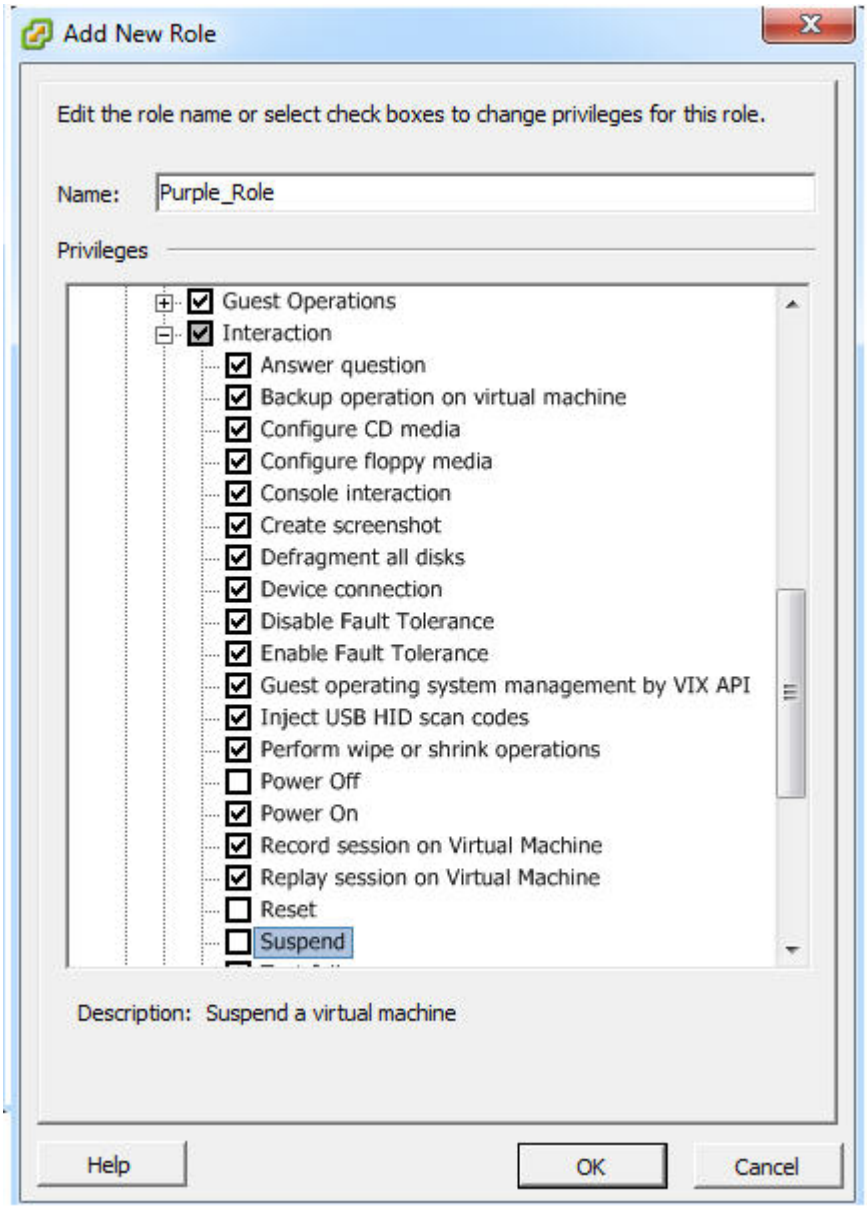


Figure 70. vSphere Web Client – Add New Role dialog box

2. Add a new permission to each Spectrum Accelerate virtual machine.

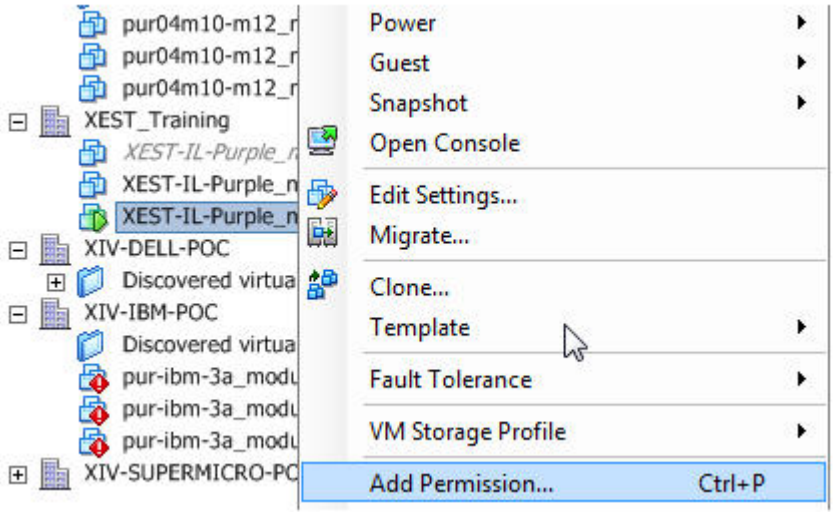


Figure 71. vSphere Web Client – Adding a new permission

3. Assign the newly created role to every user.

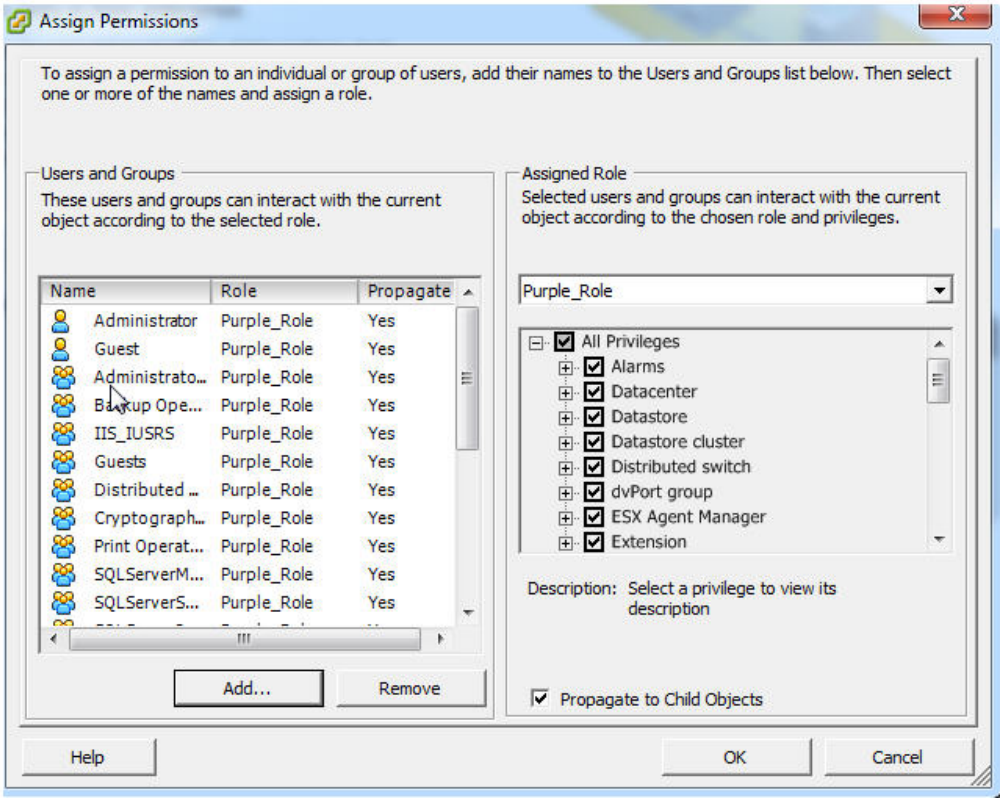


Figure 72. vSphere Web Client – Assigning a role to users

4. Verify that the newly created role includes the virtual machine.

Figure 73. vSphere Web Client – Assigning a role to users

5. Make sure that the virtual machine's **Power** options are disabled.

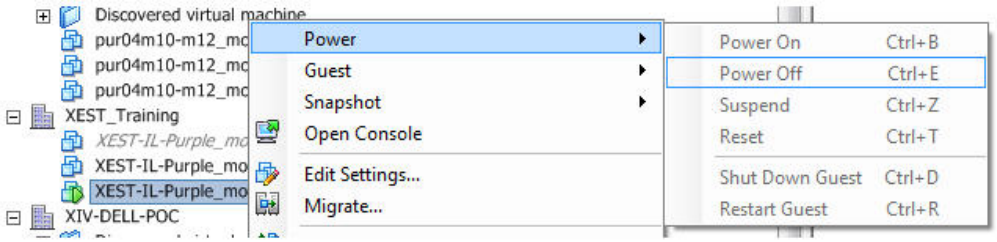


Figure 74. vSphere Web Client – User's power permissions

Configuring the emergency shutdown in the vSphere Web Client

Configure the Spectrum Accelerate virtual machines running on an ESXi host to shut down after a delay. This way, the virtual machines have enough time to save data when the host is powered off.

About this task

Various UPS units detect an imminent power shutdown and carry out a set of predefined operations. They may invoke the ESXi shutdown procedure, which then shuts down the Spectrum Accelerate virtual machines (VMs) through the embedded VM tools. The following procedure describes how to configure the Spectrum Accelerate VMs residing on an ESXi host to shut down after a delay. This way, the virtual machines have enough time to save data when the host is powered off. When the Spectrum Accelerate system identifies that a single VM is shut down, it phases that module out. Then, when the system identifies that multiple VMs are being shut down, it performs an emergency power shutdown. As a result, Spectrum Accelerate is able to survive a single module failure.

Procedure

The following procedure describes how to configure the Spectrum Accelerate VMs residing on an ESXi host to shut down after a delay.

1. In the vSphere Web Client, navigate to the host where the virtual machine is located.
2. Select **Manage > Settings**.
3. Under **Virtual Machines**, select **VM Startup/Shutdown** and click **Edit**.

Figure 75. vSphere Web Client – VM Startup/Shutdown dialog box

The **Edit VM Startup and Shutdown** dialog box opens.

4. Select **Automatically start and stop the virtual machines with the system**.
5. Configure the default shutdown behavior for all virtual machines on the host.

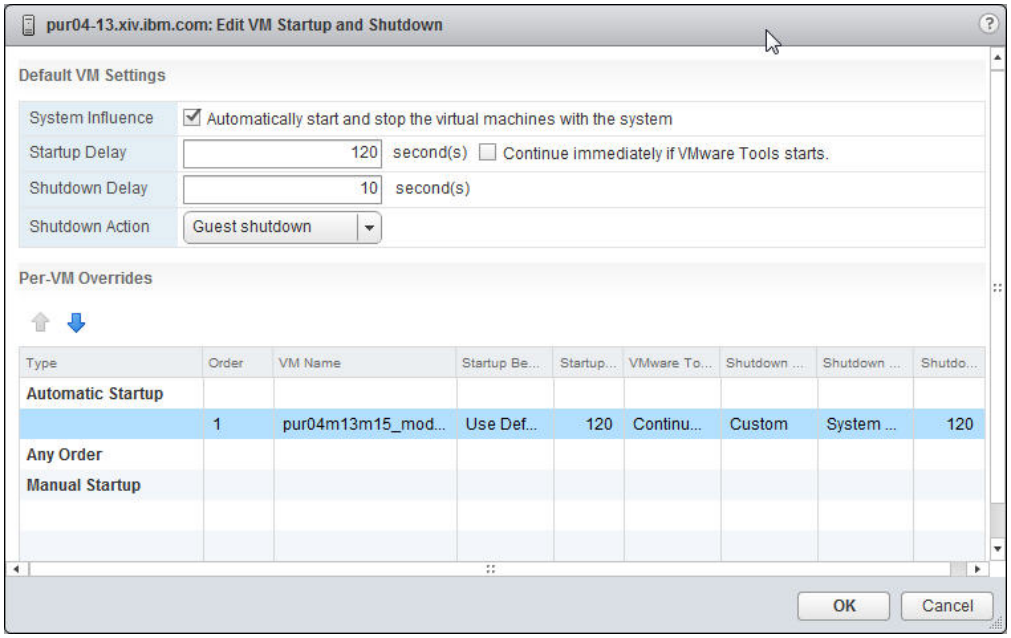


Figure 76. vSphere Web Client – The Edit VM Startup/Shutdown dialog box

Table 33. Shutdown settings for the Spectrum Accelerate virtual machines

Parameter	Recommended setting
Shutdown delay	The value of this parameter depends on the specific UPS unit operating in your deployment. The delay must be sufficient for the virtual machine to save data, and the remaining resources must allow the UPS unit to complete the shutdown.
Shutdown action	Select **Guest shutdown**.

6. If necessary, in the **Per-VM Overrides** pane use the up arrow to move the virtual machine up to the Automatic Startup category.
7. Perform this procedure on every ESXi of the cluster.

Emergency shutdown with non-Smart UPS units

This topic outlines a possible design for implementing the emergency shutdown, if your currently deployed UPS unit does not support a Smart Card and is unable to send the power loss event to the ESXi server.

About this task

If your currently deployed UPS unit does not support a Smart Card, set up a power monitoring environment.

Design outline

Establish two power channels to Spectrum Accelerate nodes and interconnect switches. One channel (Power-1) should directly connect to an AC power output. The other channel (Power-2) should be supplied through the UPS unit, to make sure that the emergency shutdown of the Spectrum Accelerate virtual machines is completed if the datacenter power generator is down.

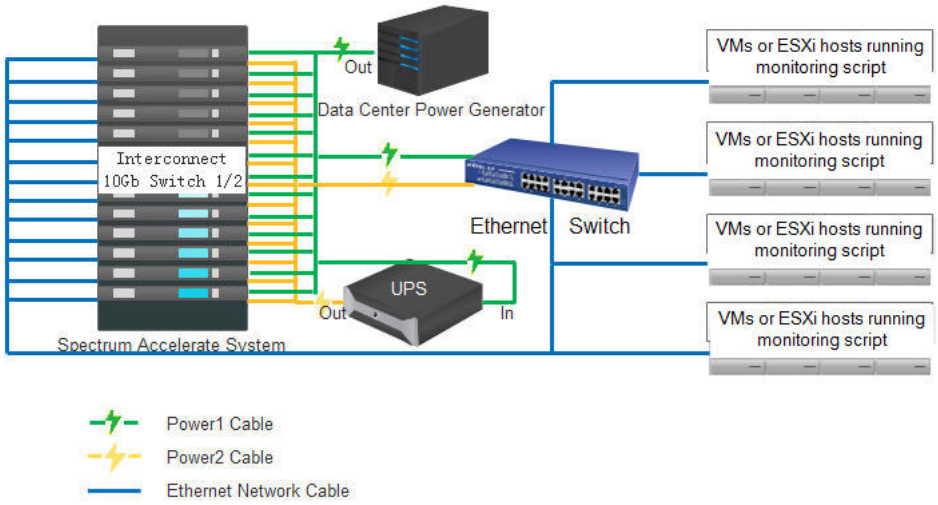


Figure 77. Power supply monitoring architecture with a non-Smart UPS unit

Write a script that does the following:

- Detects the power loss at the AC power output. To retrieve the power status of an ESXi server, use the excli **`hardware ipmi sel list`** command (described at https://pubs.vmware.com/vsphere-51/index.jsp?topic=%2Fcom.vmware.vcli.ref.doc%2Fesxcli_hardware.html)
- Instructs the Spectrum Accelerate to complete the emergency shutdown by invoking the **Power Off** option on the vSphere Web Client. Alternatively, the script can instruct the Spectrum Accelerate to complete the emergency shutdown by issuing the XIV CLI command **`shutdown emergency=yes`** using the Spectrum Accelerate XCLI tools package.

The script can run on a virtual machine on an ESXi host, or on the ESXi host itself. It is recommended to run the script on multiple hosts for redundancy.

The monitoring script must be running at all times. After the power is restored, the script must be re-launched.

The script must be resilient to failures of individual ESXi servers and to network communication problems.

Collecting support logs

When needed, you can collect all relevant support logs, system configuration, and recent events that might be needed for IBM Support.

In the XIV GUI, use the **Collect Support Logs** to collect and save all diagnosis information in single compressed TAR file (`*.tar`), and then to automatically upload it to the IBM Support FTP site.

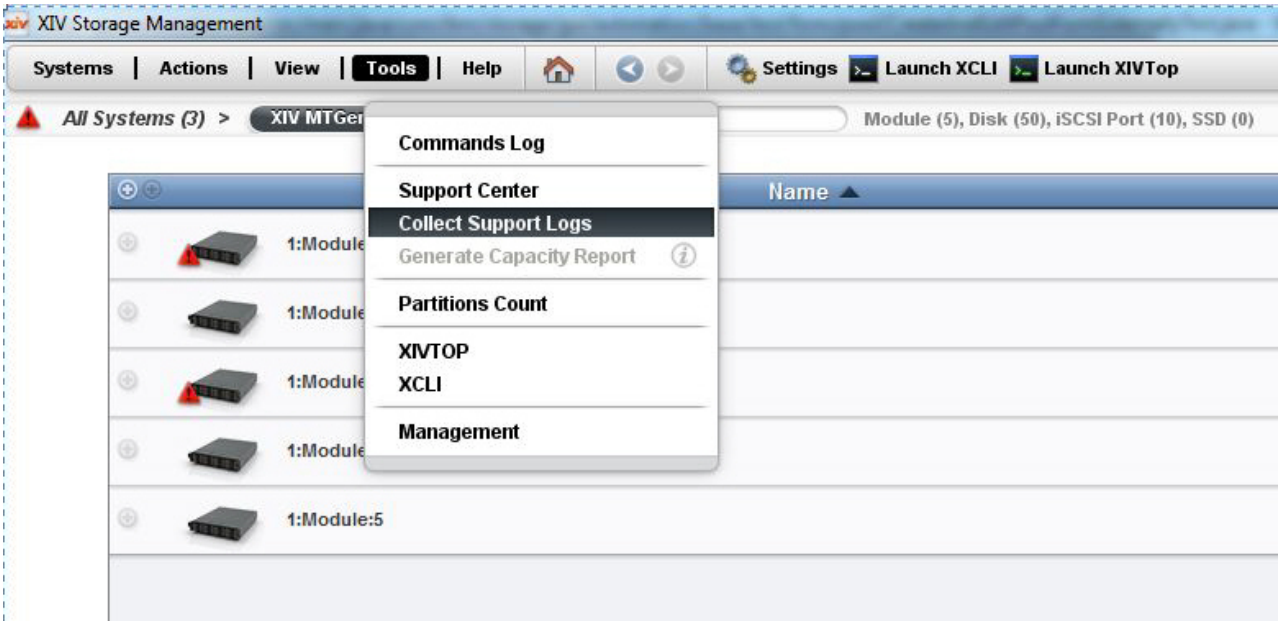


Figure 78. XIV GUI – Collect Support Logs option

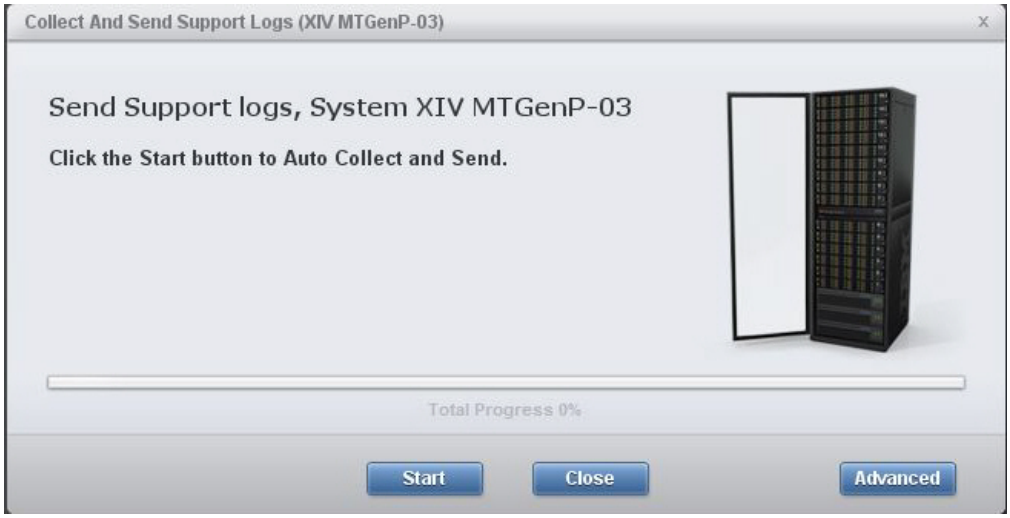


Figure 79. XIV GUI – Collect and Send Support Logs wizard

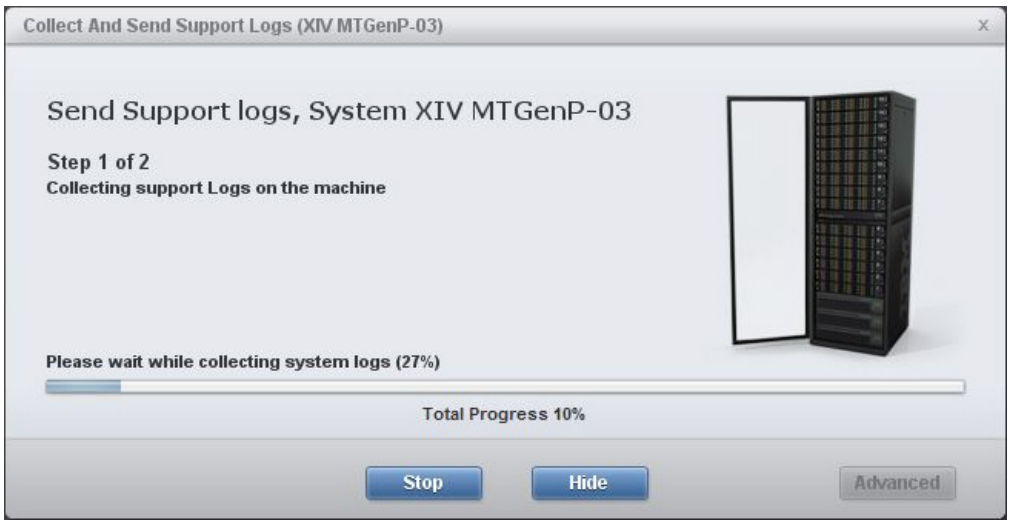


Figure 80. XIV GUI – Collect and Send Support Logs wizard – Collecting logs

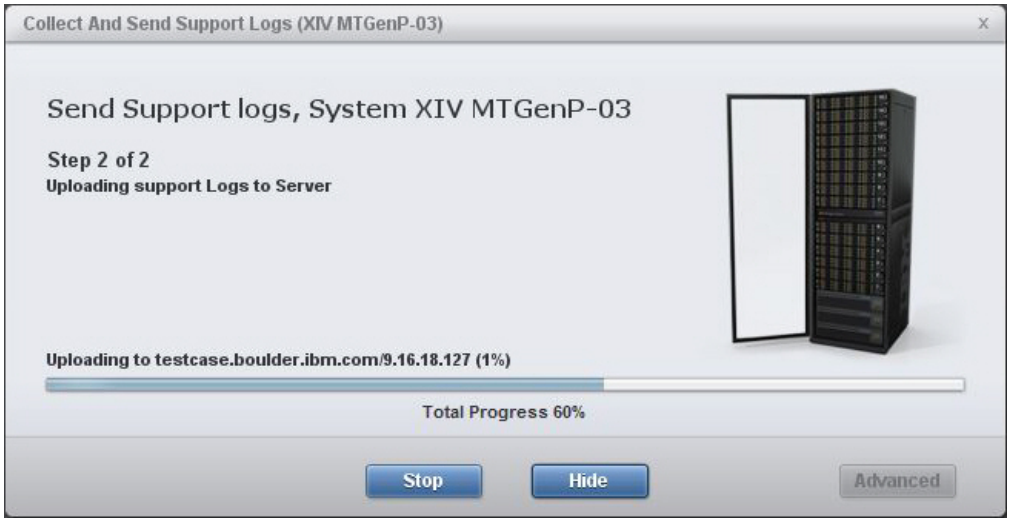


Figure 81. XIV GUI – Collect and Send Support Logs wizard – Uploading logs

Checking the end-to-end MTU setting

As specified in the configuration requirements section, the interconnect network for IBM Spectrum Accelerate must be configured with an end-to-end MTU setting of 9000 bytes (Jumbo frame).

To check the MTU setting on a Linux host, use the following command:

```
ping <IP address> -M do -s 8972
```

To check the MTU setting on a Windows host, use the following command:

```
ping <IP address> -f -l 9000
```

Retrieving your IBM Customer Number (ICN)

Your IBM Customer Number (ICN) is required for associating your IBM Spectrum Accelerate deployment with your customer license, and entitles you to support calls and code upgrades.

The ICN is entered into the system manually as part of the initial Spectrum Accelerate deployment (see "Step 2: Creating and editing the XML configuration file" on page 30 and "Deploying from the XIV GUI" on page 38).

To retrieve your ICN after your Spectrum Accelerate system is up and running, use the following CLI command:

```
vpd_config_get name=customer.icn
```

Handling the SSD reading failure

This topic describes what to do if an ESXi server fails to complete the read check on a newly replaced SSD.

In some cases, the ESXi server might fail to complete the read check of a newly replaced SSD. As a result, the SSD deployment fails as well.

To resolve this:

- Reboot the ESXi server.
- Create a datastore on the newly replaced SSD to make sure that it is writable.
- If successful, delete the datastore and complete the SSD deployment.

Self-assist options for IBM Spectrum Accelerate

IBM Support provides several online self-service tools for Spectrum Accelerate users.

You can try using the following tools to find information and resolve issues without having to contact IBM Support:

- Technical forum (developer.ibm.com/answers) – Allows you to ask questions online and get answers from IBM experts or other users. The issue of interest can also be searched for in older discussions.
- Knowledge Base articles (ibm.co/1FFwm6v) – Technical troubleshooting documents for known issues that highlight the error observed by users and help fix or mitigate the issue.
- Security alerts (ibm.biz/BdXxj6) – Bulletins that list new security vulnerabilities, their impact on the product, and how to address the vulnerability.
- IBM Redbooks (redbooks.ibm.com) – Technical documents where IBM experts share their expertise and best practices for using IBM Spectrum Accelerate.
- YouTube channel (ibm.biz/BdXxj7) – A dedicated YouTube channel for IBM Spectrum Accelerate support, including introductory and how-to videos. Subscribe to this channel to be notified about newly added videos.

The above resources are constantly being indexed by web search engines such as Google (google.com).

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