# IBM Elastic Storage System 5000
# Version 6.0.1

## *Model 092 Hardware Guide*

SC28-3135-01

**Note**

Before using this guide and the product it supports, read the information in Chapter 1, “Notices,” on page 1.

This edition applies to version 6 release 0 modification 1 of the following product and to all subsequent releases and modifications until otherwise indicated in new editions:

- IBM Spectrum® Scale Data Management Edition for IBM ESS (product number 5765-DME)
- IBM Spectrum Scale Data Access Edition for IBM ESS (product number 5765-DAE)

IBM welcomes your comments; see the topic “How to submit your comments” on page xiii. When you send information to IBM, you grant IBM a nonexclusive right to use or distribute the information in any way it believes appropriate without incurring any obligation to you.

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# About this information

## Who should read this information

This information is intended for administrators of IBM Elastic Storage® System (ESS) that includes IBM Spectrum Scale RAID.

## IBM Elastic Storage System information units

IBM Elastic Storage System (ESS) 5000 documentation consists of the following information units.

| Information unit | Type of information | Intended users |
|---|---|---|
| Hardware Guide | This unit provides ESS 5000 information including system overview, installing, and troubleshooting. | System administrators and IBM support team |
| Quick Deployment Guide | This unit provides ESS 5000 information including the software stack, deploying, upgrading, and best practices. | System administrators, analysts, installers, planners, and programmers of IBM Spectrum Scale clusters who are very experienced with the operating systems on which each IBM Spectrum Scale cluster is based |
| Model 092 storage enclosures | This unit provides information including initial hardware installation and setup, and removal and installation of field-replaceable units (FRUs), customer-replaceable units (CRUs) for ESS 5000 Expansion – Model 092, 5147-092. | System administrators and IBM support team |
| Model 106 storage enclosures | This unit provides information including hardware installation and maintenance for ESS 5000 Expansion – Model 106. | System administrators and IBM support team |
| Problem Determination Guide | This unit provides ESS 5000 information including setting up call home, replacing servers, issues, maintenance procedures, and troubleshooting. | System administrators and IBM support team |
| Command Reference | This unit provides information about ESS commands and scripts. | System administrators and IBM support team |
| IBM Spectrum Scale RAID: Administration | This unit provides IBM Spectrum Scale RAID information including administering, monitoring, commands, and scripts. | • System administrators of IBM Spectrum Scale systems<br>• Application programmers who are experienced with IBM Spectrum Scale systems and familiar with the terminology and concepts in the XDSM standard |

## Related information

**Related information**

For information about:

- IBM Spectrum Scale, see:

  **http://www.ibm.com/support/knowledgecenter/STXKQY/ibmspectrumscale_welcome.html**
- mmvdisk command, see mmvdisk documentation.
- Mellanox OFED (MLNX_OFED v4.9-0.1.7.0) Release Notes, go to https://docs.mellanox.com/display/OFEDv490170/Release%20Notes

## Conventions used in this information

Table 1 on page xii describes the typographic conventions used in this information. UNIX file name conventions are used throughout this information.

*Table 1. Conventions*

| Convention | Usage |
|---|---|
| **bold** | Bold words or characters represent system elements that you must use literally, such as commands, flags, values, and selected menu options.<br>Depending on the context, **bold** typeface sometimes represents path names, directories, or file names. |
| **bold underlined** | bold underlined keywords are defaults. These take effect if you do not specify a different keyword. |
| **constant width** | Examples and information that the system displays appear in constant-width typeface.<br>Depending on the context, constant-width typeface sometimes represents path names, directories, or file names. |
| ***italic*** | *Italic* words or characters represent variable values that you must supply.<br>*Italics* are also used for information unit titles, for the first use of a glossary term, and for general emphasis in text. |
| **<*key*>** | Angle brackets (less-than and greater-than) enclose the name of a key on the keyboard. For example, <Enter> refers to the key on your terminal or workstation that is labeled with the word *Enter*. |
| **** | In command examples, a backslash indicates that the command or coding example continues on the next line. For example:<br>`mkcondition -r IBM.FileSystem -e "PercentTotUsed > 90" \`<br>`-E "PercentTotUsed < 85" -m p "FileSystem space used"` |
| **{*item*}** | Braces enclose a list from which you must choose an item in format and syntax descriptions. |
| **[*item*]** | Brackets enclose optional items in format and syntax descriptions. |
| **<Ctrl-*x*>** | The notation <Ctrl-*x*> indicates a control character sequence. For example, <Ctrl-c> means that you hold down the control key while pressing <c>. |
| ***item*...** | Ellipses indicate that you can repeat the preceding item one or more times. |

*Table 1. Conventions (continued)*

| Convention | Usage |
|---|---|
| \| | In *synopsis* statements, vertical lines separate a list of choices. In other words, a vertical line means *Or*.<br><br>In the left margin of the document, vertical lines indicate technical changes to the information. |

## How to submit your comments

To contact the IBM Spectrum Scale development organization, send your comments to the following email address:

`scale@us.ibm.com`

# Chapter 1. Notices

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## Homologation statement

This product may not be certified in your country for connection by any means whatsoever to interfaces of public telecommunications networks. Further certification may be required by law prior to making any such connection. Contact an IBM representative or reseller for any questions.

## Safety and environmental notices

Review all safety notices, environmental notices, and electronic emission notices before you install and use the product.

**Suitability for telecommunication environment**: This product is not intended to connect directly or indirectly by any means whatsoever to interfaces of public telecommunications networks.

To find the translated text for a caution or danger notice, complete the following steps.

1. Look for the identification number at the end of each caution notice or each danger notice. In the following examples, the numbers (C001) and (D002) are the identification numbers.

   **CAUTION:** A caution notice indicates the presence of a hazard that has the potential of causing moderate or minor personal injury. (C001)

   **DANGER:** A danger notice indicates the presence of a hazard that has the potential of causing death or serious personal injury. (D002)
2. Locate the *IBM Systems Safety Notices* with the user publications that were provided with your system hardware.
3. Find the matching identification number in the *IBM Systems Safety Notices*. Then, review the topics about the safety notices to ensure that you are in compliance.
4. (Optional) Read the multilingual safety instructions on the system website.
   a. Go to www.ibm.com/support
   b. Search for IBM Elastic Storage System 5000 Expansion – Model 092.
   c. Click the documentation link.

### Safety notices and labels

Review the safety notices and safety information labels before you use this product.

To view a PDF file, you need Adobe Acrobat Reader. You can download it at no charge from the Adobe website:

www.adobe.com/support/downloads/main.html

#### IBM Systems Safety Notices

This publication contains the safety notices for the IBM Systems products in English and other languages. Anyone who plans, installs, operates, or services the system must be familiar with and understand the safety notices. Read the related safety notices before you begin work.

**Note:** The *IBM System Safety Notices* document is organized into two sections. The danger and caution notices without labels are organized alphabetically by language in the "Danger and caution notices by language" section. The danger and caution notices that are accompanied with a label are organized by label reference number in the "Labels" section.

**Note:** You can find and download the current *IBM System Safety Notices* by searching for Publication number **G229-9054** in the IBM Publications Center.

The following notices and statements are used in IBM documents. They are listed in order of decreasing severity of potential hazards.

**Danger notice definition**
A special note that emphasizes a situation that is potentially lethal or extremely hazardous to people.

**Caution notice definition**
A special note that emphasizes a situation that is potentially hazardous to people because of some existing condition, or to a potentially dangerous situation that might develop because of some unsafe practice.

**Note:** In addition to these notices, labels might be attached to the product to warn of potential hazards.

### Finding translated notices

Each safety notice contains an identification number. You can use this identification number to check the safety notice in each language.

To find the translated text for a caution or danger notice:

1. In the product documentation, look for the identification number at the end of each caution notice or each danger notice. In the following examples, the numbers (D002) and (C001) are the identification numbers.

   **DANGER:** A danger notice indicates the presence of a hazard that has the potential of causing death or serious personal injury. (D002)

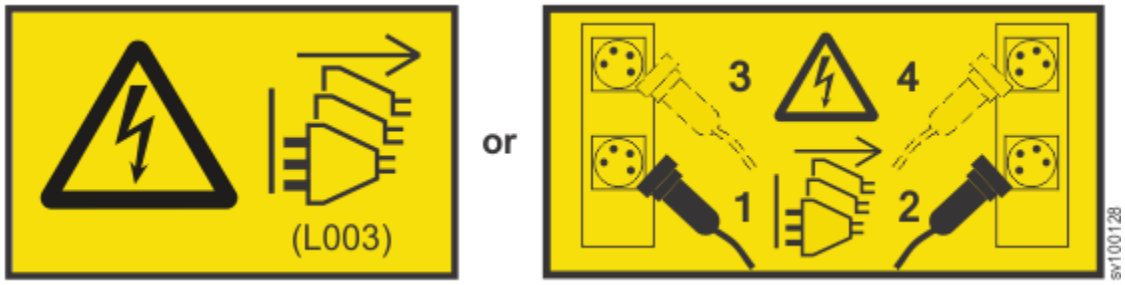
   **CAUTION:** A caution notice indicates the presence of a hazard that has the potential of causing moderate or minor personal injury. (C001)
2. After you download the *IBM System Safety Notices* document, open it.
3. Under the language, find the matching identification number. Review the topics about the safety notices to ensure that you are in compliance.

### Danger and caution notices

Before you install, service, or move a Model 092 expansion enclosure, always read and follow the safety notices and guidelines.

Use the reference numbers in parentheses at the end of each notice (for example, D005) to find the matching translated notice in *IBM Systems Safety Notices*.

**DANGER:** Multiple power cords. The product might be equipped with multiple power cords. To remove all hazardous voltages, disconnect all power cords. (L003)




**DANGER:**

Hazardous voltage present. Voltages present constitute a shock hazard, which can cause severe injury or death. (L004)

**DANGER:**


Hazardous energy present. Voltages with hazardous energy might cause heating when shorted with metal, which might result in splattered metal, burns, or both. (L005)

**DANGER:**

**Observe the following precautions when working on or around your IT rack system:**

- **Heavy equipment–personal injury or equipment damage might result if mishandled.**
- **Always lower the leveling pads on the rack cabinet.**
- **Always install stabilizer brackets on the rack cabinet.**
- **To avoid hazardous conditions due to uneven mechanical loading, always install the heaviest devices in the bottom of the rack cabinet. Always install servers and optional devices starting from the bottom of the rack cabinet.**
- **Rack-mounted devices are not to be used as shelves or work spaces. Do not place objects on top of rack-mounted devices.**

- **Each rack cabinet might have more than one power cord. Be sure to disconnect all power cords in the rack cabinet when directed to disconnect power during servicing.**
- **Connect all devices installed in a rack cabinet to power devices installed in the same rack cabinet. Do not plug a power cord from a device installed in one rack cabinet into a power device installed in a different rack cabinet.**
- **An electrical outlet that is not correctly wired could place hazardous voltage on the metal parts of the system or the devices that attach to the system. It is the responsibility of the customer to ensure that the outlet is correctly wired and grounded to prevent an electrical shock. (R001 part 1 of 2)**

**CAUTION:**

- Do not install a unit in a rack where the internal rack ambient temperatures will exceed the manufacturer's recommended ambient temperature for all your rack-mounted devices.
- Do not install a unit in a rack where the air flow is compromised. Ensure that air flow is not blocked or reduced on any side, front, or back of a unit used for air flow through the unit.
- Consideration should be given to the connection of the equipment to the supply circuit so that overloading of the circuits does not compromise the supply wiring or overcurrent protection. To provide the correct power connection to a rack, refer to the rating labels located on the equipment in the rack to determine the total power requirement of the supply circuit.
- (For sliding drawers) Do not pull out or install any drawer or feature if the rack stabilizer brackets are not attached to the rack. Do not pull out more than one drawer at a time. The rack might become unstable if you pull out more than one drawer at a time.
- (For fixed drawers) This drawer is a fixed drawer and must not be moved for servicing unless specified by the manufacturer. Attempting to move the drawer partially or completely out of the rack might cause the rack to become unstable or cause the drawer to fall out of the rack. (R001 part 2 of 2)

**CAUTION:** Removing components from the upper positions in the rack cabinet improves rack stability during a relocation. Follow these general guidelines whenever you relocate a populated rack cabinet within a room or building.

- Remove all disks from the attached enclosure before moving the rack.
- Reduce the weight of the rack cabinet by removing equipment starting at the top of the rack cabinet. When possible, restore the rack cabinet to the configuration of the rack cabinet as you received it. If this configuration is not known, you must observe the following precautions.
  - Remove all devices in the 32U position and above.
  - Ensure that the heaviest devices are installed in the bottom of the rack cabinet.
  - Ensure that there are no empty U-levels between devices installed in the rack cabinet below the 32U level.
- If the rack cabinet you are relocating is part of a suite of rack cabinets, detach the rack cabinet from the suite.
- If the rack cabinet you are relocating was supplied with removable outriggers they must be reinstalled before the cabinet is relocated.
- Inspect the route that you plan to take to eliminate potential hazards.
- Verify that the route that you choose can support the weight of the loaded rack cabinet. Refer to the documentation that comes with your rack cabinet for the weight of a loaded rack cabinet.
- Verify that all door openings are at least 760 x 230 mm (30 x 80 in.).
- Ensure that all devices, shelves, drawers, doors, and cables are secure.
- Ensure that the four leveling pads are raised to their highest position.
- Ensure that there is no stabilizer bracket installed on the rack cabinet during movement.
- Do not use a ramp inclined at more than 10 degrees.
- When the rack cabinet is in the new location, complete the following steps:
  - Lower the four leveling pads.
  - Install stabilizer brackets on the rack cabinet.
  - If you removed any devices from the rack cabinet, repopulate the rack cabinet from the lowest position to the highest position.
- If a long-distance relocation is required, restore the rack cabinet to the configuration of the rack cabinet as you received it. Pack the rack cabinet in the original packaging material, or equivalent. Also lower the leveling pads to raise the casters off the pallet and bolt the rack cabinet to the pallet. (R002)

**Warning:** In ESS application, the rack must NOT be moved with disk drives in the enclosures. One must remove and carefully label each disk drive and secure the disk drives whereby they will not be subjected to any damage or vibrational shock. Moving enclosures with disk drives in place may damage the enclosures and the installed disk drives resulting in loss of access and/or data stored in the installed system.

**DANGER:** Racks with a total weight of > 227 kg (500 lb.), Use Only Professional Movers! (R003)

**DANGER:** Do not transport the rack via fork truck unless it is properly packaged, secured on top of the supplied pallet. (R004)

**DANGER:**

**Main Protective Earth (Ground):**

**This symbol is marked on the frame of the rack.**

**The PROTECTIVE EARTHING CONDUCTORS should be terminated at that point. A recognized or certified closed loop connector (ring terminal) should be used and secured to the frame with a lock washer using a bolt or stud. The connector should be properly sized to be suitable for the bolt or stud, the locking washer, the rating for the conducting wire used, and the considered rating of the breaker. The intent is to ensure the frame is electrically bonded to the PROTECTIVE EARTHING CONDUCTORS. The hole that the bolt or stud goes into where the terminal conductor and the lock washer contact should be free of any non-conductive material to allow for metal to metal contact. All PROTECTIVE EARTHING CONDUCTORS should terminate at this main protective earthing terminal or at points marked with ⏚. (R010)**

**CAUTION:**


The weight of this part or unit is more than 55 kg (121.2 lb). It takes specially trained persons, a lifting device, or both to safely lift this part or unit. (C011)

**CAUTION:** To avoid personal injury, before lifting this unit, remove all appropriate subassemblies per instructions to reduce the system weight. (C012)

**CAUTION:** CAUTION regarding IBM provided VENDOR LIFT TOOL:

- Operation of LIFT TOOL by authorized personnel only
- LIFT TOOL intended for use to assist, lift, install, remove units (load) up into rack elevations. It is not to be used loaded transporting over major ramps nor as a replacement for such designated tools like pallet jacks, walkies, fork trucks and such related relocation practices. When this is not practicable, specially trained persons or services must be used (for instance, riggers or movers). Read and completely understand the contents of LIFT TOOL operator's manual before using.
- Read and completely understand the contents of LIFT TOOL operator's manual before using. Failure to read, understand, obey safety rules, and follow instructions may result in property damage and/or personal injury. If there are questions, contact the vendor's service and support. Local paper manual must remain with machine in provided storage sleeve area. Latest revision manual available on vendor's website.
- Test verify stabilizer brake function before each use. Do not over-force moving or rolling the LIFT TOOL with stabilizer brake engaged.
- Do not raise, lower or slide platform load shelf unless stabilizer (brake pedal jack) is fully engaged. Keep stabilizer brake engaged when not in use or motion.
- Do not move LIFT TOOL while platform is raised, except for minor positioning.
- Do not exceed rated load capacity. See LOAD CAPACITY CHART regarding maximum loads at center versus edge of extended platform.
- Only raise load if properly centered on platform. Do not place more than 200 lb (91 kg) on edge of sliding platform shelf also considering the load's center of mass/gravity (CoG).
- Do not corner load the platform tilt riser accessory option. Secure platform riser tilt option to main shelf in all four (4x) locations with provided hardware only, prior to use. Load objects are designed to slide on/off smooth platforms without appreciable force, so take care not to push or lean. Keep riser tilt option flat at all times except for final minor adjustment when needed.
- Do not stand under overhanging load.
- Do not use on uneven surface, incline or decline (major ramps).
- Do not stack loads. (C048, part 1 of 2)

- **Do not operate while under the influence of drugs or alcohol.**
- **Do not support ladder against LIFT TOOL.**
- **Tipping hazard. Do not push or lean against load with raised platform.**
- **Do not use as a personnel lifting platform or step. No riders.**
- **Do not stand on any part of lift. Not a step.**
- **Do not climb on mast.**
- **Do not operate a damaged or malfunctioning LIFT TOOL machine.**
- **Crush and pinch point hazard below platform. Only lower load in areas clear of personnel and obstructions. Keep hands and feet clear during operation.**
- **No Forks. Never lift or move bare LIFT TOOL MACHINE with pallet truck, jack or fork lift.**
- **Mast extends higher than platform. Be aware of ceiling height, cable trays, sprinklers, lights, and other overhead objects.**
- **Do not leave LIFT TOOL machine unattended with an elevated load.**
- **Watch and keep hands, fingers, and clothing clear when equipment is in motion.**
- **Turn Winch with hand power only. If winch handle cannot be cranked easily with one hand, it is probably over-loaded. Do not continue to turn winch past top or bottom of platform travel. Excessive unwinding will detach handle and damage cable. Always hold handle when lowering, unwinding. Always assure self that winch is holding load before releasing winch handle.**
- **A winch accident could cause serious injury. Not for moving humans. Make certain clicking sound is heard as the equipment is being raised. Be sure winch is locked in position before releasing handle. Read instruction page before operating this winch. Never allow winch to unwind freely. Freewheeling will cause uneven cable wrapping around winch drum, damage cable, and may cause serious injury. (C048, part 2 of 2)**

**CAUTION:** If the System slide rails are installed above EIA location 29U, the [ServerLIFT®] tool (or other qualified lift tool) must be used as a safety precaution for servicing. Position the lift tool platform slightly below the bottom of the System drawer to account for the slight downward flex when the drawer is extended out fully on its slides. Then gently raise the lift tool platform to stably contact the bottom of the drawer, minding not to over force it as it could put upward stress to the slide rails. A service-qualified ladder may have to be used to reach or properly work around the System at such heights. While using a ladder, do not lean on or against the system drawer or lift tool during service, and follow safe practices. (C051)

## Special caution and safety notices

This information describes special safety notices that apply to the system. These notices are in addition to the standard safety notices that are supplied; they address specific issues that are relevant to the equipment provided.

### General safety

When you service the Model 092 expansion enclosure, follow general safety guidelines.

Use the following general rules to ensure safety to yourself and others:

- Observe good housekeeping in the area where the devices are kept during and after maintenance.
- Follow the guidelines when lifting any heavy object:
  1. Ensure that you can stand safely without slipping.
  2. Distribute the weight of the object equally between your feet.
  3. Use a slow lifting force. Never move suddenly or twist when you attempt to lift.
  4. Lift by standing or by pushing up with your leg muscles; this action removes the strain from the muscles in your back. *Do not attempt to lift any objects that weigh more than 18 kg (40 lb) or objects that you think are too heavy for you.*

- Do not perform any action that causes a hazard or makes the equipment unsafe.
- Before you start the device, ensure that other personnel are not in a hazardous position.
- Place removed covers and other parts in a safe place, away from all personnel, while you are servicing the unit.
- Keep your tool case away from walk areas so that other people cannot trip over it.
- Do not wear loose clothing that can be trapped in the moving parts of a device. Ensure that your sleeves are fastened or rolled up above your elbows. If your hair is long, fasten it.
- Insert the ends of your necktie or scarf inside clothing or fasten it with a nonconducting clip, approximately 8 cm (3 in.) from the end.
- Do not wear jewelry, chains, metal-frame eyeglasses, or metal fasteners for your clothing.

  **Remember:** Metal objects are good electrical conductors.
- Wear safety glasses when you are hammering, drilling, soldering, cutting wire, attaching springs, using solvents, or working in any other conditions that might be hazardous to your eyes.
- After service, reinstall all safety shields, guards, labels, and ground wires. Replace any safety device that is worn or defective.
- Reinstall all covers correctly after you have finished servicing the unit.

**Inspecting the system for unsafe conditions**
Use caution when you are working in any potential safety hazardous situation that is not covered in the safety checks. If unsafe conditions are present, determine how serious the hazards are and whether you can continue before you correct the problem.

Before you start the safety inspection, make sure that the power is off, and that the power cord is disconnected.

Each device has the required safety items that are installed to protect users and support personnel from injury. Only those items are addressed.

**Important:** Good judgment must also be used to identify potential safety hazards due to the attachment of non-IBM features or options that are not covered by this inspection guide.

If any unsafe conditions are present, you must determine how serious the apparent hazard might be and whether you can continue without first correcting the problem. For example, consider the following conditions and their potential safety hazards:

**Electrical hazards (especially primary power)**
Primary voltage on the frame can cause serious or lethal electrical shock.

**Explosive hazards**
A damaged CRT face or a bulging capacitor can cause serious injury.

**Mechanical hazards**
Loose or missing items (for example, nuts and screws) can cause serious injury.

To inspect each node for unsafe conditions, use the following steps. If necessary, see any suitable safety publications.

1. Turn off the system and disconnect the power cord.
2. Check the frame for damage (loose, broken, or sharp edges).
3. Check the power cables by using the following steps:
   a) Ensure that the third-wire ground connector is in good condition. Use a meter to check that the third-wire ground continuity is 0.1 ohm or less between the external ground pin and the frame ground.
   b) Ensure that the power cord is the appropriate type, as specified in the parts listings.
   c) Ensure that the insulation is not worn or damaged.
4. Check for any obvious nonstandard changes, both inside and outside the unit. Use good judgment about the safety of any such changes.

5. Check inside the node for any obvious unsafe conditions, such as metal particles, contamination, water or other fluids, or marks of overheating, fire, or smoke damage.
6. Check for worn, damaged, or pinched cables.
7. Ensure that the voltage that is specified on the product-information label matches the specified voltage of the electrical power outlet. If necessary, verify the voltage.
8. Inspect the power-supply assemblies and check that the fasteners (screws or rivets) in the cover of the power-supply unit are not removed or disturbed.
9. Check the grounding of the network switch before you connect the system to the storage area network (SAN).

### *Checking external devices*

Ensure that you complete an external device check before you install or service the system.

To conduct an external device check, complete the following steps:

1. Verify that all external covers are present and are not damaged.
2. Ensure that all latches and hinges are in the correct operating condition.
3. Check for loose or broken feet when the system is not installed in a rack cabinet.
4. Check the power cords for damage.
5. Check the external signal cables for damage.
6. Check the cover for sharp edges, damage, or alterations that expose the internal parts of the device.
7. Check the bottom of the external cover for any loose or broken feet.
8. Correct any problems that you find.

### *Checking internal devices*

Ensure that you complete an internal device check before you install or service your system.

To conduct the internal device check, use the following steps.

1. Check for any non-IBM changes that were made to the device.
2. Check the condition of the inside of the device for any metal or other contaminants, or any indications of water, other fluid, fire, or smoke damage.
3. Check for any obvious mechanical problems, such as loose components.
4. Check any exposed cables and connectors for wear, cracks, or pinching.

### *Handling static-sensitive devices*

Ensure that you understand how to handle devices that are sensitive to static electricity.

**Attention:** Static electricity can damage electronic devices and your system. To avoid damage, keep static-sensitive devices in their static-protective bags until you are ready to install them.

To reduce the possibility of electrostatic discharge, observe the following precautions:

- Limit your movement. Movement can cause static electricity to build up around you.
- Handle the device carefully, holding it by its edges or frame.
- Do not touch solder joints, pins, or exposed printed circuitry.
- Do not leave the device where others can handle and possibly damage the device.
- While the device is still in its antistatic bag, touch it to an unpainted metal part of the system unit for at least 2 seconds. (This action removes static electricity from the package and from your body).
- Remove the device from its package and install it directly into your system, without putting it down. If it is necessary to put the device down, place it onto its static-protective bag. (If your device is an adapter, place it component-side up.) Do not place the device onto the cover of the system or onto a metal table.
- Take additional care when you handle devices during cold weather. Indoor humidity tends to decrease in cold weather, causing an increase in static electricity.

**Sound pressure**

**Attention:** Depending on local conditions, the sound pressure can exceed 85 dB(A) during service operations. In such cases, wear appropriate hearing protection.

### Environmental notices

This information contains all the required environmental notices for IBM Systems products in English and other languages.

The *IBM Systems Environmental Notices* includes statements on limitations, product information, product recycling and disposal, battery information, flat panel display, refrigeration and water-cooling systems, external power supplies, and safety data sheets.

## Electromagnetic compatibility notices

The following Class A statements apply to IBM products and their features unless designated as electromagnetic compatibility (EMC) Class B in the feature information.

When attaching a monitor to the equipment, you must use the designated monitor cable and any interference suppression devices that are supplied with the monitor.

### Canada Notice

CAN ICES-3 (A)/NMB-3(A)

### European Community and Morocco Notice

This product is in conformity with the protection requirements of Directive 2014/30/EU of the European Parliament and of the Council on the harmonization of the laws of the Member States relating to electromagnetic compatibility. IBM cannot accept responsibility for any failure to satisfy the protection requirements resulting from a non-recommended modification of the product, including the fitting of non-IBM option cards.

This product may cause interference if used in residential areas. Such use must be avoided unless the user takes special measures to reduce electromagnetic emissions to prevent interference to the reception of radio and television broadcasts.

**Warning:** This equipment is compliant with Class A of CISPR 32. In a residential environment this equipment may cause radio interference.

### Germany Notice

**Deutschsprachiger EU Hinweis: Hinweis für Geräte der Klasse A EU-Richtlinie zur Elektromagnetischen Verträglichkeit**

Dieses Produkt entspricht den Schutzanforderungen der EU-Richtlinie 2014/30/EU zur Angleichung der Rechtsvorschriften über die elektromagnetische Verträglichkeit in den EU-Mitgliedsstaatenund hält die Grenzwerte der EN 55032 Klasse A ein.

Um dieses sicherzustellen, sind die Geräte wie in den Handbüchern beschrieben zu installieren und zu betreiben. Des Weiteren dürfen auch nur von der IBM empfohlene Kabel angeschlossen werden. IBM übernimmt keine Verantwortung für die Einhaltung der Schutzanforderungen, wenn das Produkt ohne Zustimmung von IBM verändert bzw. wenn Erweiterungskomponenten von Fremdherstellern ohne Empfehlung von IBM gesteckt/eingebaut werden.

EN 55032 Klasse A Geräte müssen mit folgendem Warnhinweis versehen werden:
"Warnung: Dieses ist eine Einrichtung der Klasse A. Diese Einrichtung kann im Wohnbereich Funk-Störungen verursachen; in diesem Fall kann vom Betreiber verlangt werden, angemessene Maßnahmen zu ergreifen und dafür aufzukommen."

**Deutschland: Einhaltung des Gesetzes über die elektromagnetische Verträglichkeit von Geräten**
Dieses Produkt entspricht dem "Gesetz über die elektromagnetische Verträglichkeit von Geräten (EMVG)." Dies ist die Umsetzung der EU-Richtlinie 2014/30/EU in der Bundesrepublik Deutschland.

**Zulassungsbescheinigung laut dem Deutschen Gesetz über die elektromagnetische Verträglichkeit von Geräten (EMVG) (bzw. der EMC Richtlinie 2014/30/EU) für Geräte der Klasse A**

Dieses Gerät ist berechtigt, in Übereinstimmung mit dem Deutschen EMVG das EG-Konformitätszeichen - CE - zu führen.

Verantwortlich für die Einhaltung der EMV-Vorschriften ist der Hersteller:

International Business Machines Corp.
New Orchard Road
Armonk, New York 10504
Tel: 914-499-1900

Der verantwortliche Ansprechpartner des Herstellers in der EU ist:

IBM Deutschland GmbH
Technical Relations Europe, Abteilung M456
IBM-Allee 1, 71139 Ehningen, Germany
Tel: +49 800 225 5426
e-mail: Halloibm@de.ibm.com

Generelle Informationen:

**Das Gerät erfüllt die Schutzanforderungen nach EN 55024 und EN 55032 Klasse A.**

## Japan Electronics and Information Technology Industries Association (JEITA) Notice

（一社）電子情報技術産業協会　高調波電流抑制対策実施
要領に基づく定格入力電力値：Knowledge Centerの各製品の
仕様ページ参照

This statement applies to products less than or equal to 20 A per phase.

高調波電流規格 JIS C 61000-3-2 適合品

This statement applies to products greater than 20 A, single phase.

高調波電流規格 JIS C 61000-3-2 準用品

本装置は、「高圧又は特別高圧で受電する需要家の高調波抑制対策ガイドライン」対象機器（高調波発生機器）です。
- 回路分類：6（単相、ＰＦＣ回路付）
- 換算係数：0

This statement applies to products greater than 20 A per phase, three-phase.

高調波電流規格 JIS C 61000-3-2 準用品

本装置は、「高圧又は特別高圧で受電する需要家の高調波抑制対策ガイドライン」対象機器（高調波発生機器）です。
- 回路分類：５（３相、ＰＦＣ回路付）
- 換算係数：０

### Japan Voluntary Control Council for Interference (VCCI) Notice

この装置は、クラスA情報技術装置です。この装置を家庭環境で使用すると電磁妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

VCCI－A

### Korea Notice

이 기기는 업무용 환경에서 사용할 목적으로 적합성평가를 받은 기기로서 가정용 환경에서 사용하는 경우 전파간섭의 우려가 있습니다.

### People's Republic of China Notice

声 明

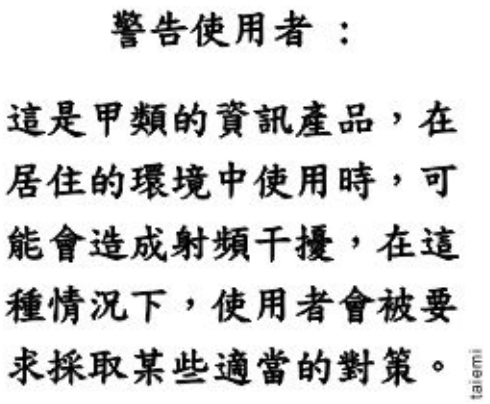
此为A级产品，在生活环境中，
该产品可能会造成无线电干扰。
在这种情况下，可能需要用户对其
干扰采取切实可行的措施。

### Russia Notice

ВНИМАНИЕ! Настоящее изделие относится к классу А.
В жилых помещениях оно может создавать
радиопомехи, для снижения которых необходимы
дополнительные меры

rusemi

## Taiwan Notice




**IBM Taiwan Contact Information:**


## United States Federal Communications Commission (FCC) Notice

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Properly shielded and grounded cables and connectors must be used in order to meet FCC emission limits. IBM is not responsible for any radio or television interference caused by using other than recommended cables and connectors, or by unauthorized changes or modifications to this equipment. Unauthorized changes or modifications could void the user's authority to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) this device might not cause harmful interference, and (2) this device must accept any interference received, including interference that might cause undesired operation.

Responsible Party:
International Business Machines Corporation
New Orchard Road
Armonk, NY 10504
Contact for FCC compliance information only: fccinfo@us.ibm.com

# Chapter 2. Weight considerations: Model 092 expansion enclosure

Before you install, move, or perform service on a Model 092 expansion enclosure, you must be prepared to handle the weight of the enclosure and its parts.

### Safety notices and considerations

**Important:** Always read and follow the safety notices and instructions before you install, move, or service the expansion enclosure and its parts. For more information, see "Danger and caution notices" on page 4.

- Do not exceed the specified maximum load of the rack where the enclosure is to be installed.
- Do not exceed any load limit of the building and flooring where the enclosure is to be installed.
- Always use a suitably rated mechanical lift or four persons when you are performing any of the following tasks:
  - Removing the expansion enclosure from its packing material
  - Lifting and installing the expansion enclosure in the rack for the first time
  - Reinstalling the expansion enclosure after you complete a service task (for example, replacing the enclosure FRU).
- At least three persons are required to move the enclosure while it is in the rack (if you are moving the enclosure off the rails). Even after the drives, power supply units, secondary expander modules, canisters, fans, and top cover are removed, the enclosure weighs approximately 43 kg (95 lbs).
- To maximize rack stability, always install the expansion enclosure in the lowest possible position in the rack.

### Weight of expansion enclosure parts

Table 2 on page 15 summarizes the weight and quantity of the parts (FRUs) that are shipped with the Model 092 expansion enclosure.

*Table 2. Weight of expansion enclosure parts*

| FRU description | Weight per unit | | Quantity shipped | Total weight | |
|---|---|---|---|---|---|
| | kg | lbs | | kg | lb |
| Enclosure FRU | 42.5 | 93.696 | 1 | 42.500 | 93.696 |
| Rail kit | 9.231 | 20.351 | 1 | 9.231 | 20.351 |
| Front fascia (4U front cover) | 0.303 | 0.668 | 1 | 0.303 | 0.668 |
| Display panel assembly | 0.020 | 0.044 | 1 | 0.020 | 0.044 |
| PSU fascia (1U cover) | 0.010 | 0.022 | 1 | 0.010 | 0.022 |
| Power supply unit (PSU) | 3.335 | 7.352 | 2 | 6.670 | 14.705 |
| Secondary expansion module | 0.826 | 1.821 | 2 | 1.652 | 3.642 |
| Fan module | 0.890 | 1.962 | 4 | 3.560 | 7.848 |
| Expansion canister | 1.588 | 3.501 | 2 | 3.176 | 7.002 |
| Cable management arm (lower and upper arms) | 1.373 | 3.027 | 1 | 1.373 | 3.027 |
| Top cover | 3.720 | 8.201 | 1 | 3.720 | 8.201 |

| Table 2. Weight of expansion enclosure parts (continued) | | | | | |
|---|---|---|---|---|---|
| **FRU description** | **Weight per unit** | | **Quantity shipped** | **Total weight** | |
| | **kg** | **lbs** | | **kg** | **lb** |
| Fan interface board | 0.118 | 0.260 | 1 | 0.236 | 0.260 |

### Weight of expansion enclosure SAS drives

The SAS drives are shipped in a separate package from the Model 092 expansion enclosure. The enclosure can support up to 92 SAS drives; however, the quantity varies depending on the number of drives ordered.

| Table 3. Weight of expansion enclosure drives | | |
|---|---|---|
| **FRU description** | **Approximate weight per unit** | |
| | **kg** | **lb** |
| 800 GB 2.5-inch SSD | 0.224 | 0.494 |
| 6 TB 3.5-inch HDD | 0.876 | 1.931 |
| 10 TB 3.5-inch HDD | 0.876 | 1.931 |
| 14 TB 3.5-inch HDD | 0.876 | 1.931 |
| 16 TB 3.5-inch HDD | 0.670 | 1.477 |

### Weight increases as FRUs are installed

As you install or replace FRUs, the overall weight of the expansion enclosure increases. For example, Table 4 on page 16 shows the weight progression as different combinations of FRUs are installed.

| Table 4. Enclosure weight as FRUs are installed | | | |
|---|---|---|---|
| **Enclosure assembly** | | **Approximate weight** | |
| **FRUs installed** | **FRUs not installed** | **kg** | **lb** |
| • Enclosure | • Secondary expansion modules<br>• Fascia (1U and 4U)<br>• PSUs<br>• Expansion canisters<br>• Fan modules<br>• Fan interface board<br>• Display assembly<br>• Drives<br>• Cover | 42.5 | 93.7 |

*Table 4. Enclosure weight as FRUs are installed (continued)*

| Enclosure assembly | | Approximate weight | |
|---|---|---|---|
| **FRUs installed** | **FRUs not installed** | **kg** | **lb** |
| • Enclosure<br>• Secondary expansion modules | • Fascia (1U and 4U)<br>• PSUs<br>• Expansion canisters<br>• Fan modules<br>• Fan interface board<br>• Display assembly<br>• Drives<br>• Cover | 44.3 | 97.7 |
| • Enclosure<br>• Secondary expansion modules<br>• Fascia (1U and 4U)<br>• PSUs<br>• Expansion canisters<br>• Fan modules<br>• Fan interface board<br>• Display assembly | • Drives<br>• Cover | 58 | 127.9 |
| **Note:** The following FRUs are installed when the enclosure is initially shipped.<br>• Enclosure<br>• Secondary expansion modules<br>• PSUs<br>• Expansion canisters<br>• Fan modules<br>• Fan interface board<br>• Display assembly<br>• Cover | • Fascia (1U and 4U)<br>• Drives | 61.5 | 135.4 |
| • Enclosure<br>• Secondary expansion modules<br>• Fascia (1U and 4U)<br>• PSUs<br>• Expansion canisters<br>• Fan modules<br>• Fan interface boards | • Cover | 78.6 | 173.3 |

Conversely, the overall weight of the expansion enclosure is reduced as you remove parts. However, even with parts removed, the Model 092 expansion enclosure is heavy. Depending on the number of parts that remain, you might need four persons or a mechanical lift to support the weight of the expansion enclosure.

# Chapter 3. System overview

IBM Elastic Storage System 5000 Expansion – Model 092 is an expansion enclosure. This Model 092 is a high capacity and density expansion enclosure, which is designed for use in cloud and enterprise environments. It holds up to 92 3.5-inch SAS disk drives in a 5U, 19-inch rack mount enclosure. The integral cable management arm (CMA) allows the enclosure to be withdrawn from the rack for servicing, while remaining connected and powered.

Figure 1 on page 19 shows the Model 092 expansion enclosure.


*Figure 1. Model 092 expansion enclosure*

## Model 092 expansion enclosure features

Model 092 expansion enclosure is an ESS 5000 SL series product.

The main features of the Model 092 expansion enclosure are as follows:

- Supports four HDD drives: 6 TB, 10 TB, 14 TB, and 16 TB

Figure 2 on page 20 shows the basic building block of the ESS 5000 with Model 092 expansion enclosure.

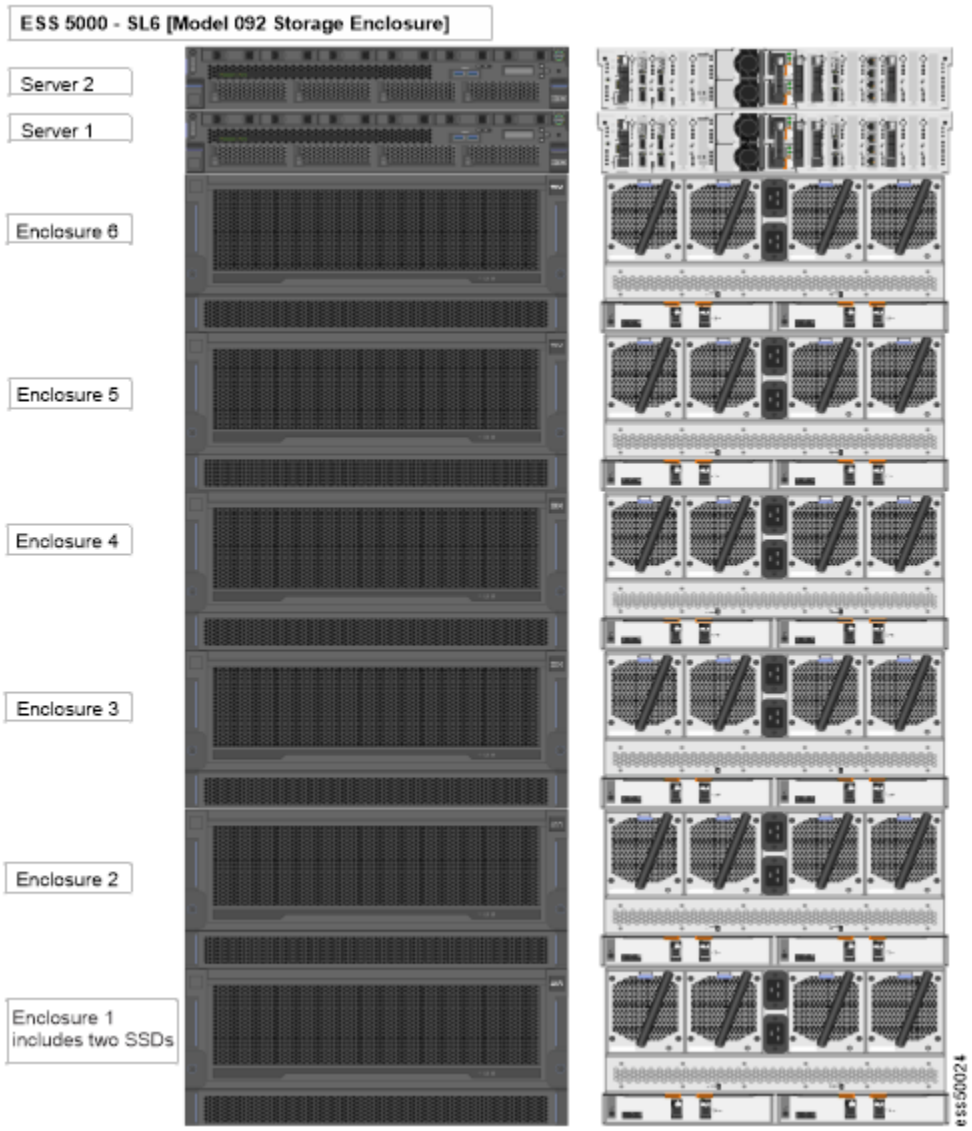



*Figure 2. ESS 5000 with Model 092 expansion enclosure*

Figure 3 on page 21 shows the rear view of a Model 092 expansion enclosure.

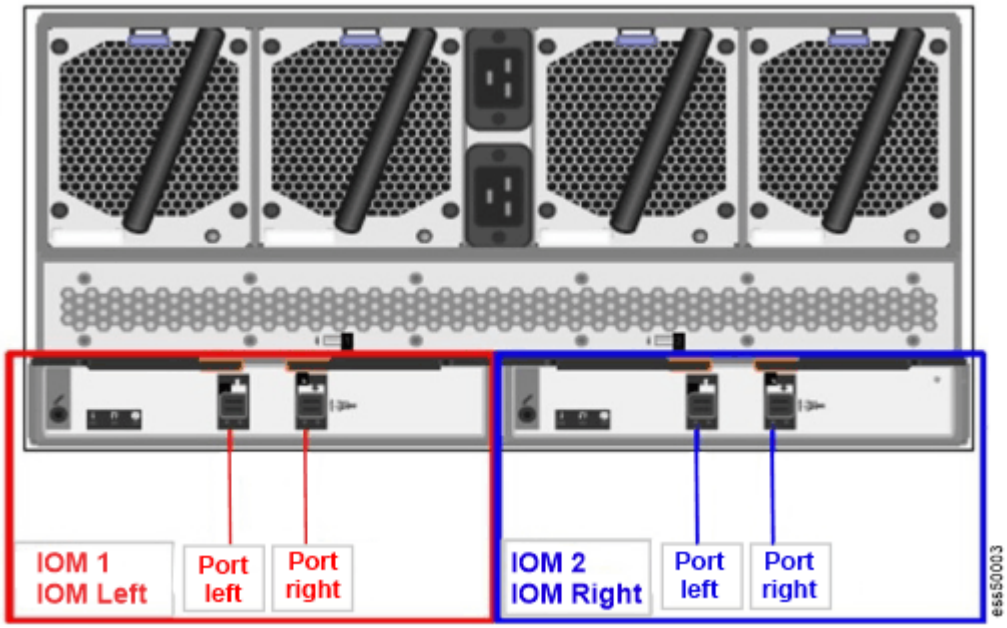



*Figure 3. Model 092 expansion enclosure rear view*

Figure 4 on page 21 shows the disk locations in the Model 092 expansion enclosure.

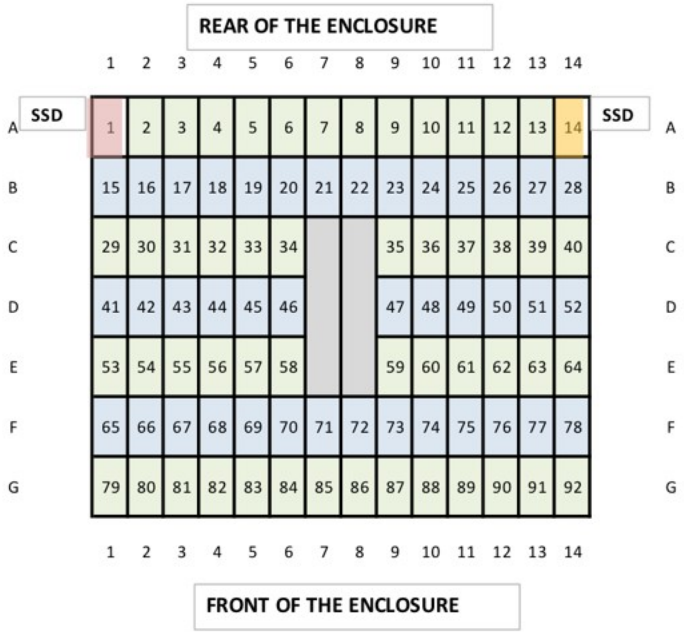



*Figure 4. Drive locations of Model 092 expansion enclosure*

# Chapter 4. Planning for hardware

Before the IBM Service Support Representative (SSR) installs the system hardware, the customer must provide a plan that explains where and how the hardware will be installed, configured, and connected. Ensure that the system's physical configuration records are easily accessible to be used as a reference as needed.

The customers have to work with the IBM technical team to plan for installation and deployment of IBM Elastic Storage System 5000 Expansion – Model 092.

## Planning for site preparation

This information is intended to help you prepare your physical site for the installation of a Model 092 expansion enclosure. Marketing and installation planning representatives are also available to help you plan your installation. Proper planning for your new system facilitates a smooth installation and a fast system startup.

The use of the terms, “server”, “processor”, “system” and “all models” in the following information refer to the IBM Elastic Storage System 5000 Expansion – Model 092.

### Site preparation and physical planning

For detailed guidelines about site preparation and physical planning, see the Site preparation and physical planning' document.

## Planning for hardware installation

Before the IBM SSR installs the system, you must plan the physical configuration and the initial data configuration.

Certain physical site specifications must be met before you can set up your system. This activity includes verifying that adequate space is available, and requirements for power, network, and environmental conditions are met.

**Important:** The IBM SSR refers to these system configuration details when they perform the system installation, so it is important that these records are complete and accurate.

1. Review all the guidelines in the Planning topics to understand where the system can be installed and identify all prerequisites, such as building structure, equipment rack, environmental controls, power supply, and accessibility.

   If there are dependencies identified, you need to resolve them before the IBM SSR installs your system hardware.
2. Use the Table 23 on page 73 to identify the rack locations where the IBM SSR will install each enclosure.

### Planning for racks

For detailed rack specification information on the 7965-S42 rack, see Planning for the 7965-S42 rack.

If you do not have a 7965-S42 rack and want to install the system into a non-IBM rack, see “Model 092 expansion enclosure requirements” on page 26. Ensure that the physical environment meets the specified requirements, such as rack space, power, and environmental conditions.

### Reviewing Model 092 expansion enclosure location guidelines

Consult these guidelines when you plan the location of Model 092 expansion enclosure and any existing Elastic Storage System in your environment, including any IBM Spectrum Scale client or protocol node.

Each ESS 5000 cluster consists of the following components:

- One or more ESS 5000 building blocks. Each building block is composed of two I/O server nodes. Each I/O server node requires 2U (standard rack units) space in a rack. The I/O server nodes are attached to up to six Model 092 expansion enclosures.
- One ESS Management Server (EMS) node. The EMS node requires 2U space in a rack. The EMS can support several ESS 5000 building blocks.

## Planning for power for Model 092 expansion enclosure

Each Model 092 expansion enclosure is provided power through two power supply units (PSU). Either of the power supply units can power the enclosure independently if there is a loss of input power to the other power supply in the enclosure.

Plan to connect the power cords of the power supplies on the left side of the enclosures (when viewed from the rear) to one power source, and connect the power cords of the power supplies on the right side of the enclosures to another power source.

**Attention:** The power cord is the main power disconnect. Ensure that the socket outlets are located near the equipment and are easily accessible.

Figure 5 on page 24 shows the front and the rear of a Model 092 expansion enclosure.

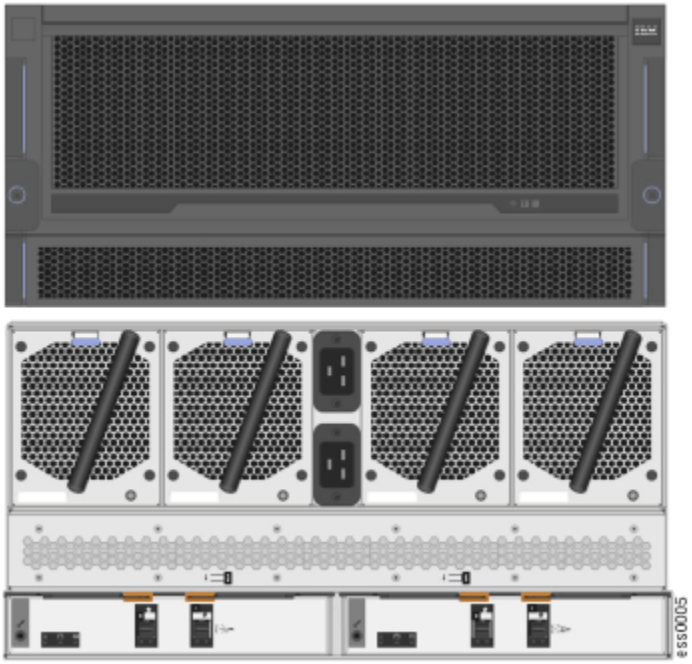



*Figure 5. Front and rear view of Model 092 expansion enclosure*

### Planning for cable connections to PDUs

Each Model 092 expansion enclosure must be connected to a pair of power outlets by selecting appropriate feature codes while ordering the system. The following table lists the feature codes of the power cords:

*Table 5. Power cord feature codes*

| Feature codes | Description |
|---|---|
| 6458 | Power Cord 4.3 m (14 ft), drawer to IBM PDU, (250V/10A) with C13/C14 connectors |
| 6671 | Power Cord 2.7 m (9 ft), drawer to IBM PDU (250V/10A) with C13/C14 connectors |

| Table 5. Power cord feature codes (continued) | |
|---|---|
| **Feature codes** | **Description** |
| 6672 | Power Cord 2 m (6.5 ft), drawer to IBM PDU (250V/10A) with C13/C14 connectors |
| 6665 | Power Cord 2.8 m (9.2 ft), drawer to IBM PDU (250V/10A) with C19/C20 connectors |

**Attention:** Ensure that sufficient power supply circuits are available to provide the total power requirements of the equipment that is connected to each power supply circuit.

## Physical installation planning

Before you set up your system environment, you must verify that the prerequisite conditions for the system are met.

This information applies to the supported hardware components. Answer the following questions before you start the installation process:

- Does your physical site meet the environment requirements for your system?
- Do you have adequate rack space for your hardware?

  The system requires two Electronic Industries Alliance (EIA) units for each Model 092 expansion enclosure.
- Do the power circuits you are planning to use have sufficient capacity and the correct sockets for your installation?
  - A clearly visible and accessible emergency power off switch is required.
  - For redundancy, two independent power circuits are required. One circuit connects to each power supply in each enclosure.
- Have you provided appropriate connectivity by preparing your environment?

### Operating environment

To use the system, you must meet the minimum hardware and software requirements and ensure that the other operating environment criteria are met.

#### Supported hosts

IBM Spectrum Scale needs to be installed on the host server before it is connected to ESS 5000. IBM Spectrum Scale provides the high-performance scale-out clustering capabilities. For a list of supported host type and OS, see the IBM Spectrum Scale Frequently Asked Questions.

#### User interfaces

The system provides the following user interfaces:

- The management GUI, which is a web-accessible graphical user interface (GUI) that supports flexible and rapid access to storage management information. The ESS 5000 GUI also provides a Directed Maintenance Procedure (DMP) for drive replacement.
- A command-line interface (CLI) that uses Secure Shell (SSH).

## Model 092 expansion enclosure requirements

Before you install a system, your physical environment must meet certain requirements. This includes verifying that adequate space is available and that requirements for power and environmental conditions are met.

### Safety notices

Use the following general safety information for all rack-mounted devices:

**DANGER:**

**Observe the following precautions when working on or around your IT rack system:**

- **Heavy equipment–personal injury or equipment damage might result if mishandled.**
- **Always lower the leveling pads on the rack cabinet.**
- **Always install stabilizer brackets on the rack cabinet.**
- **To avoid hazardous conditions due to uneven mechanical loading, always install the heaviest devices in the bottom of the rack cabinet. Always install servers and optional devices starting from the bottom of the rack cabinet.**
- **Rack-mounted devices are not to be used as shelves or work spaces. Do not place objects on top of rack-mounted devices.**

- **Each rack cabinet might have more than one power cord. Be sure to disconnect all power cords in the rack cabinet when directed to disconnect power during servicing.**
- **Connect all devices installed in a rack cabinet to power devices installed in the same rack cabinet. Do not plug a power cord from a device installed in one rack cabinet into a power device installed in a different rack cabinet.**
- **An electrical outlet that is not correctly wired could place hazardous voltage on the metal parts of the system or the devices that attach to the system. It is the responsibility of the customer to ensure that the outlet is correctly wired and grounded to prevent an electrical shock. (R001 part 1 of 2)**

**CAUTION:**

- Do not install a unit in a rack where the internal rack ambient temperatures will exceed the manufacturer's recommended ambient temperature for all your rack-mounted devices.
- Do not install a unit in a rack where the air flow is compromised. Ensure that air flow is not blocked or reduced on any side, front, or back of a unit used for air flow through the unit.
- Consideration should be given to the connection of the equipment to the supply circuit so that overloading of the circuits does not compromise the supply wiring or overcurrent protection. To provide the correct power connection to a rack, refer to the rating labels located on the equipment in the rack to determine the total power requirement of the supply circuit.
- (For sliding drawers) Do not pull out or install any drawer or feature if the rack stabilizer brackets are not attached to the rack. Do not pull out more than one drawer at a time. The rack might become unstable if you pull out more than one drawer at a time.
- (For fixed drawers) This drawer is a fixed drawer and must not be moved for servicing unless specified by the manufacturer. Attempting to move the drawer partially or completely out of the rack might cause the rack to become unstable or cause the drawer to fall out of the rack. (R001 part 2 of 2)

**Important:** In addition, remember:

- The rack design must support the total weight of the installed enclosures and incorporate stabilizing features suitable to prevent the rack from tipping or being pushed over during installation or normal use.
- The rack must not exceed the maximum enclosure operating ambient temperature of 32-degrees C, using any optical cable or discrete optical transceiver, including all Ethernet (100 Gb) cables and InfiniBand (100Gb EDR). However, when you are using the copper cable, the maximum ambient operating temperature can be 35-degrees C, including all Ethernet and InfiniBand cables.

  In particular, the rack front and rear doors must be at least 60% perforated to enable sufficient airflow through the enclosure. If there is less airflow, additional mechanisms are required to cool the enclosure. An appropriate IBM rack configuration would be the 7014-T42 IBM Rack Model T42, with standard rear door and feature code 6069 Front Door For 2.0 Meter Rack (High Perforation).
- The rack must have a safe electrical distribution system. It must provide overcurrent protection for the enclosure and must not be overloaded by the total number of enclosures installed. The electrical power consumption rating that is shown on the nameplate should be observed.
- The electrical distribution system must provide a reliable ground for each enclosure in the rack.

**Power requirements for each power supply (two per enclosure)**

Ensure that your environment meets the following power requirements:

To aid in power and cooling requirements planning, Table 6 on page 27 lists the rating of each power supply unit (PSU) by enclosure.

The power that is used by the system depends on various factors, including the number of enclosures and drives in the system and the ambient temperature.

*Table 6. Power specifications per power supply*

| Model and type | PSU | Input power requirements | Maximum input current | Maximum power output |
|---|---|---|---|---|
| 5147-092 expansion enclosure | 1200 W (2) | 200 V to 240 V single phase AC<br>at a frequency of 50 Hz or 60 Hz<br>IEC C20 standardized | 6.12 A (x2) | 1200 W |

The power and thermal measurements that are shown in Table 7 on page 28 were obtained in the specific operating environment.

| *Table 7. Power consumption examples per enclosure* | | | | | |
|---|---|---|---|---|---|
| **Model and type** | **PSU** | **Input power requirements** | **Maximum input current** | **Maximum power output (W)** | **Caloric value (BTU/hr)** |
| 5147-092 expansion enclosure with 92 HDDs in a primary enclosure. 2 SSDs and 90 HDDs in non-primary enclosures, 3.5-inch form factor SAS drive slots | 1200 W (2) | 180 V to 264 V single phase AC<br>at a frequency of 47 Hz to 63 Hz | 6.12 A<br>Requires a C20 power socket (C20 PDU) | 1200 | 4096 |

**Note:** These measurements are presented as an example. Measurements that are obtained in other operating environments might vary. Conduct your own testing to determine specific measurements for your environment.

Each Model 092 expansion enclosure contains two PSUs for redundancy. The total power consumption values represent the total power that is drawn by both PSUs.

### Environmental requirements

System airflow is from the front to the rear of each enclosure:

- Airflow passes between drive carriers and through each enclosure.
- The combined power and cooling module exhausts air from the rear of each canister.

Ensure that your environment falls within the ranges that are listed in Table 8 on page 28.

| *Table 8. Temperature requirements* | | | |
|---|---|---|---|
| **Environment** | **Ambient temperature** | **Altitude** | **Relative humidity** |
| Operating | 5°C to 32°C[1]<br>(41°F to 90°F) | 0 - 3048 m[2, 3]<br>(0 - 10000 ft) | 8% to 80% non-condensing |
| Non-operating | 1°C to 50°C<br>(34°F to 122°F) | -305 to 12192 m<br>(-1000 to 40000 ft) | 8% to 80% non-condensing |
| Storage | 1°C to 60°C<br>(34°F to 140°F) | | 5% to 80% non-condensing |
| Shipping | -40°C to 60°C<br>(-40°F to 140°F) | | 5% to 100% condensing, but not precipitating |

**Note:**

- – Max Ambient Temperature Environment = 32C / 950 m
  - Max Altitude Environment = 25C / 3,050 m
  - Decrease the maximum air temperature by 1 degree C per 300 m above 950 m.
- The maximum ambient operating temperature when using an optical cable or discrete optical transceiver is 32C, which includes all Ethernet (100Gb) cables and InfiniBand (100Gb EDR) that are

greater than or equal to 3 meter in length. The maximum ambient operating temperature when using only copper cable is 35C, which includes all Ethernet and InfiniBand cables less than 3 meter in length.

### Dimensions and weight requirements for rack installation

Ensure that space is available in a standard 19-in. rack that is capable of supporting the enclosure. The rack rail kit supports racks with threaded round and square rail mounting holes. The following table lists the dimensions and weights of the enclosures:

*Table 9. Physical characteristics of the enclosures*

| Enclosure | Height | Width | Depth | Maximum weight | |
|---|---|---|---|---|---|
| | | | | Drive ready (without drive modules) | Fully configured (with drive modules) |
| IBM Elastic Storage System 5000 Expansion – Model 092 with 92 drive slots | 87 mm (3.46 in.) | 483 mm (19.0 in.) | 850 mm (33.5 in.) | 44.85 kg (98.87 lb) | 49.65 kg (109.46 lb) |

**Important:** To avoid potential equipment damage during transport and subsequent loss of data, see Procedure: Transporting a 5U 92-drive expansion enclosure. The procedure describes what to do for the following situations:

- When you are powering off an 5U expansion enclosure because you intend to transport it to another location.
- When you intend to move a rack that contains an 5U expansion enclosure.

The procedure describes how to remove each drive from the 5U enclosure and transport the enclosure. Removing the drives prevents damage to the drives and makes the lighter enclosure easier to move.

CAUTION:


**The weight of this part or unit is between 32 and 55 kg (70.5 and 121.2 lb). It takes three persons to safely lift this part or unit. (C010)**

The following table shows the rack space requirements for a Model 092 expansion enclosure:

*Table 10. Rack space requirements for the Model 092 expansion enclosure*

| Minimum rail length | Maximum rail depth |
|---|---|
| 670 mm (26.38 in.) | 870 mm (34.25 in.) |

### Service clearance for Model 092 expansion enclosure

The service clearance area is the area around the rack which is needed for the authorized service representatives to service the enclosure as shown in the sample illustration in Figure 6 on page 30.

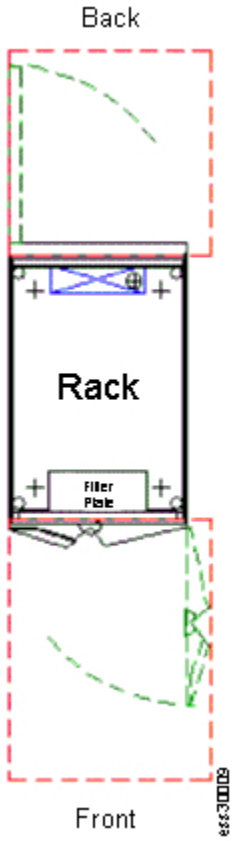



*Figure 6. Sample illustration to show space around the rack*

For a Model 092 expansion enclosure, use the recommended measurements that are given in Table 11 on page 30.

*Table 11. Service clearance requirements*

| **Front**[1] | **Back** |
|---|---|
| 1200 mm (47 in.) | 1000 mm (39 in.) |
| [1]Storage racks require larger service clearances in the front of the rack. | |

For more information on the layout of the room, see *Computer room layout*

See Site preparation and physical planning section to help you prepare your physical site for the installation of a Model 092 expansion enclosure.

### Additional space requirements

Ensure that these additional space requirements, as shown in Table 12 on page 30, are available around the enclosures.

*Table 12. Clearances*

| Location | Additional space requirements | Reason |
|---|---|---|
| Left and right sides | 50 mm (2 in.) | Cooling air flow |
| Back | Minimum: 100 mm (4 in.) | Cable exit |

### Supported drives Model 092 expansion enclosure

Table 13 on page 31 provides drive specifications for your system.

*Table 13. Drive specifications*

| Model and type | 3.5-inch drives |
|---|---|
| IBM Elastic Storage System 5000 Expansion – Model 092 with 92 3.5-inch drive slots | 92 SAS drives (6 TB, 10 TB, 14 TB, 16 TB) |

### Acoustical noise emissions

Table 14 on page 31 provides the acoustical specifications for the Model 092 expansion enclosure. The noise emission level that is stated is the declared (upper limit) sound power level, in decibels, for a random sample of enclosures. All measurements are made in accordance with ISO 7779 and reported in conformance with ISO 9296.

*Table 14. Acoustical noise emissions*

| Enclosure type | Drive configuration | Acoustical output per enclosure | |
|---|---|---|---|
| | | Idling | Operating |
| Expansion enclosure | 90 LFF drives | 6.1 bels | 6.1 bels |
| | 2 SFF drives | 6.2 bels | 6.2 bels |

Table 15 on page 31 provides acoustical specifications for the Model 092 expansion enclosures in accordance with ISO 9296(1,2,3).

**Important:** Hearing conservation program (HCP) procedures are required for field service personnel servicing a Model 092 expansion enclosure.

*Table 15. Declared noise emissions for Model 092 expansion enclosure*

| Model and type | Declared A-Weighted Sound Power Level, $L_{WAd}$ (B) | | Declared A-Weighted Sound Pressure Level, $L_{pAm}$ (dB) | |
|---|---|---|---|---|
| | Operating | Idling | Operating | Idling |
| Fully configured Model 092 expansion enclosure | 8.5 | 8.5 | 85 | 85 |

| *Table 15. Declared noise emissions for Model 092 expansion enclosure (continued)* | | | | |
|---|---|---|---|---|
| **Model and type** | **Declared A-Weighted Sound Power Level, $L_{WAd}$ (B)** | | **Declared A-Weighted Sound Pressure Level, $L_{pAm}$ (dB)** | |
| | **Operating** | **Idling** | **Operating** | **Idling** |

**Notes:**

1. Declared level $L_{WAd}$ is the upper-limit A-weighted sound power level. Declared level $L_{pAm}$ is the mean A-weighted sound pressure level measured at the 1-meter bystander positions.
2. All measurements are made in conformance with ISO 7779 and declared in conformance with ISO 9296.
3. "B" and "dB" are abbreviations for bels and decibels, respectively. 1 B = 10 dB.

**Important:** Government regulations (such as those prescribed by OSHA or European Community Directives) may govern noise level exposure in the workplace and may apply to you and your server installation. This system is available with an optional acoustical door feature that can help reduce the noise emitted from this system. The actual sound pressure levels in your installation depend upon a variety of factors, including the number of racks in the installation; the size, materials, and configuration of the room where you designate the racks to be installed; the noise levels from other equipment; the room ambient temperature, and employees' location in relation to the equipment. Further, compliance with such government regulations also depends upon a variety of additional factors, including the duration of employees' exposure and whether employees wear hearing protection. IBM recommends that you consult with qualified experts in this field to determine whether you are in compliance with the applicable regulations.

### Shock and vibration specifications

Table 16 on page 32 provides the shock testing results for each Model 092 expansion enclosure.

*Table 16. Shock testing results*

| Shock categories | Test level | Performance |
|---|---|---|
| Operational | 5 g 10 ms 1/2 Sine | <=25 g 10 ms |
| Non-operational | 30 g 10 ms 1/2 Sine | <=75 g 11 ms |

Table 17 on page 32 provides the vibration testing results for Model 092 expansion enclosure.

*Table 17. Vibration testing results*

| Vibration categories | Test level | Performance |
|---|---|---|
| Operational | 0.21 grms 5-500 Hz Random | Throughput loss <=10% FCAL <= 0.68 grms |
| Non-operational | 1.04 grms 2-200 Hz Random | <=3.12 grms |
| Shipping | 0.3 g 2-200 Hz Sine | <=5 g |
| Rotational vibration | Normal operation performance measurements in enclosure with no external vibration. | Throughput loss for all drives of the same type within performance profile. |

### IP address allocation and usage

As you plan your installation, you must consider IP address requirements and service access for the system.

ESS 5000 uses 100GbE/100Gb EDR network for cluster communication and data transport. For IP port usage requirement, see IBM Spectrum Scale Knowledge Center. For more information about the management network and the IP address requirements, see *ESS 5000 Quick Deployment Guide*.

Model 092 does not require IP address for management and service in the ESS 5000 application. All management and service tasks are done via ESS 5000 I/O server node. For more information about the management IP requirement and service ports, see *ESS 5000 Quick Deployment Guide*.

## Planning for high availability

IBM Spectrum Scale can provide rack level redundancy and stretched cluster using file system data replication. AFM-DR can be used for site-level disaster recovery. For more details, see IBM Spectrum Scale Knowledge Center.

## Storage configuration planning

Model 092 expansion enclosure provides optimal configuration of IBM Spectrum Scale RAID. For further customization, see *IBM Spectrum Scale RAID Administration guide*.

## Planning the network and storage network

Plan to provide the network infrastructure and the storage network infrastructure that your system requires.

You need to use only supported switches, cables, and other network components. See the IBM support website for specific firmware levels and the latest supported hardware.

Model 092 expansion enclosure is directly attached to the I/O server nodes in ESS 5000 application and the enclosure does not require and a switch or other infrastructure. For more information about the network attachment requirements, see the *ESS 5000 Quick Deployment Guide*.

## Planning for cables

### Connections for Model 092 expansion enclosure

The I/O server nodes of the ESS 5000 building block are preinstalled with LSI 9305-16 12 Gbps host bus adapter (HBA) (feature code ESA5). The SAS adapters are connected to the Model 092 expansion enclosure via a mini SAS HD active optical cable (AOC) (feature code AJGB).

Each expansion enclosure contains two I/O modules (IOM) that provide the switching functions between the drives and the cable that is connected in the ports by using multiple SAS expanders. Figure 7 on page 34 shows IOM ports.

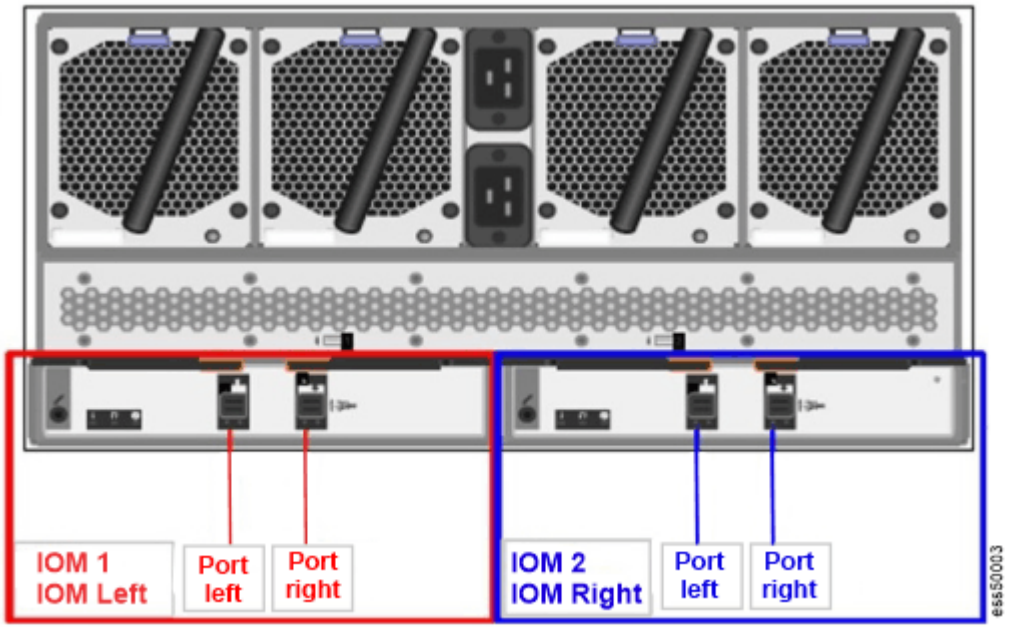



*Figure 7. Model 092 expansion enclosure IOM ports*

Up to seven Model 092 expansion enclosures can be attached to an ESS 5000 building block. Figure 8 on page 35 shows the front (left) and rear (right) view of the I/O server nodes and Model 092 expansion enclosures.

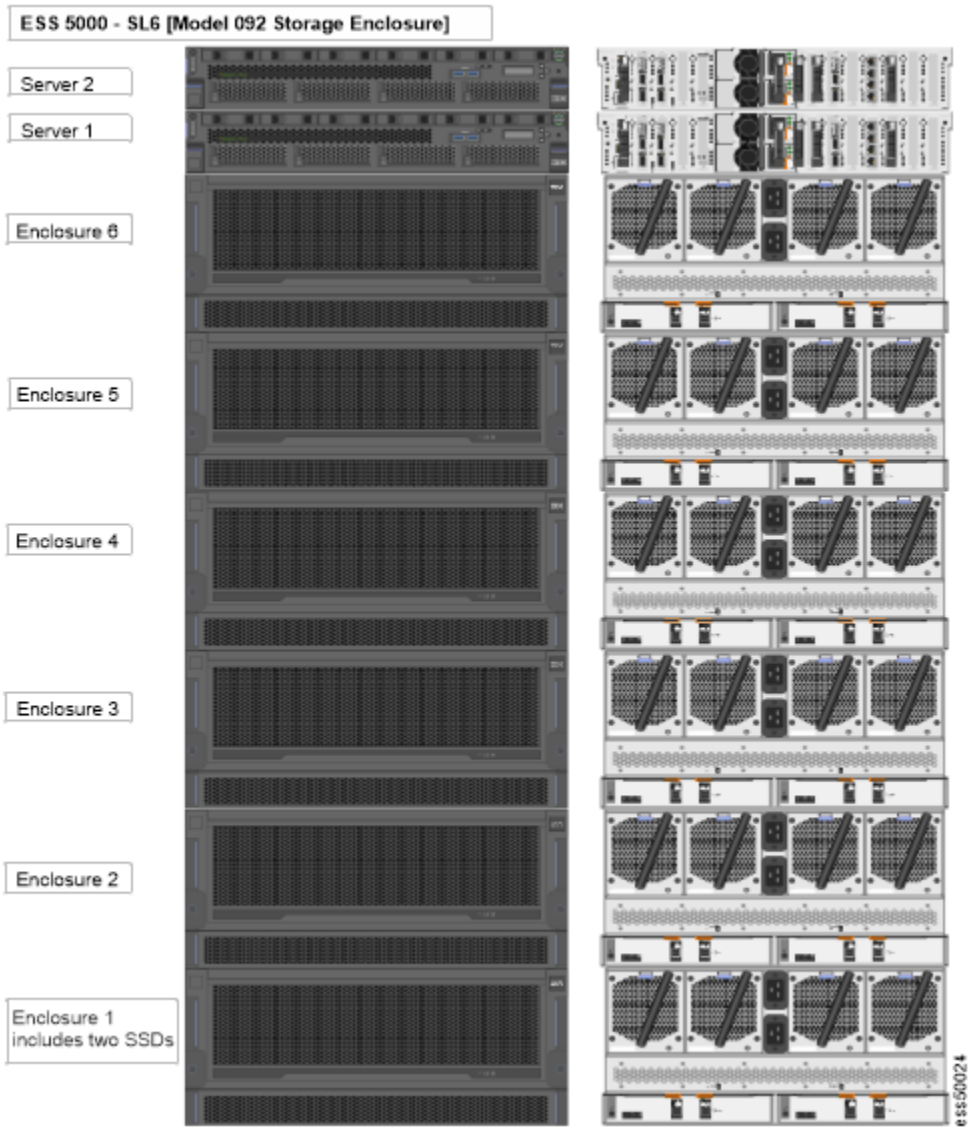



*Figure 8. Front and rear view of I/O servers and Model 092 expansion enclosures*

Figure 9 on page 35 shows each I/O server node that is preinstalled with five 12 Gbps SAS host bus adapters in slots C2, C6, C7, C8, and C12.

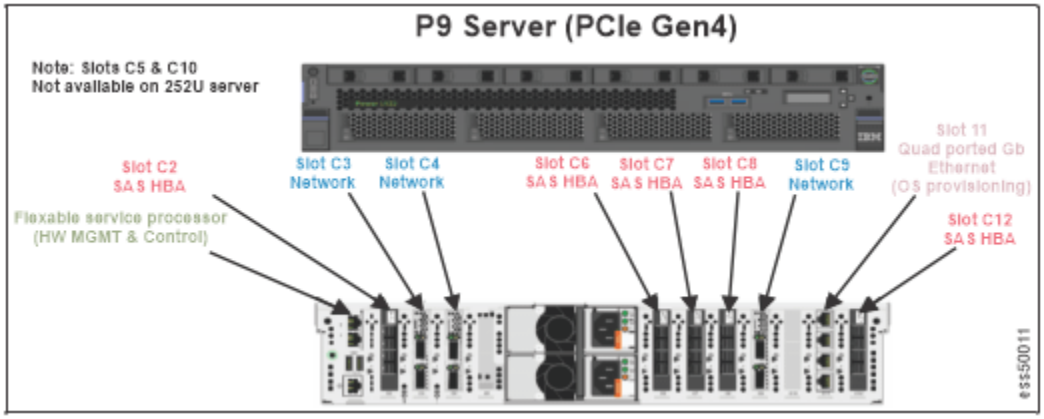



*Figure 9. SAS host bus adapters*

Figure 10 on page 36 shows port location of SAS host bus adapters.

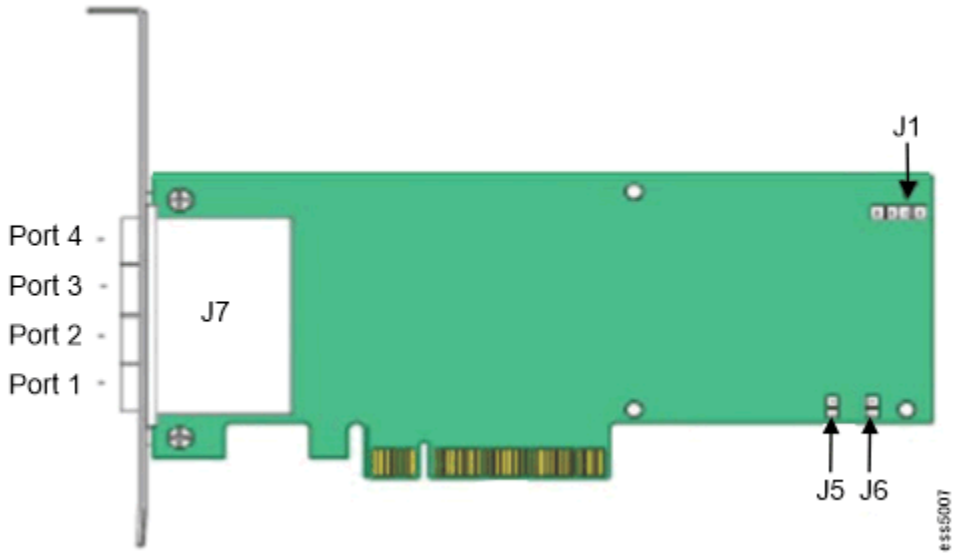
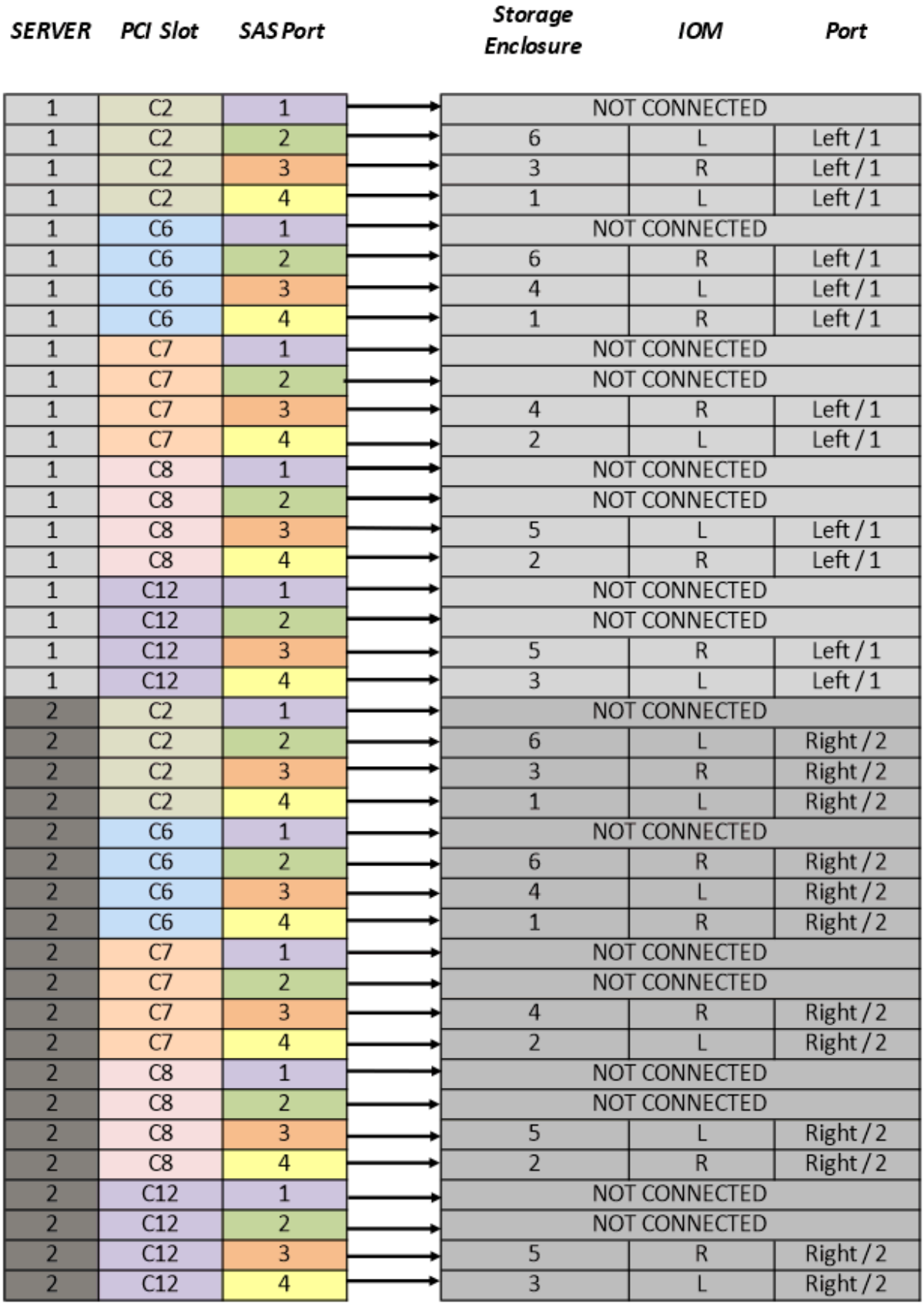



*Figure 10. Location of SAS host bus adapters*

Figure 11 on page 37 shows cable connectivity from I/O server nodes to the Model 092 expansion enclosure.

***SL1 --> SL6***



| SERVER | PCI Slot | SAS Port | Storage Enclosure | IOM | Port |
|---|---|---|---|---|---|
| 1 | C2 | 1 | NOT CONNECTED | | |
| 1 | C2 | 2 | 6 | L | Left / 1 |
| 1 | C2 | 3 | 3 | R | Left / 1 |
| 1 | C2 | 4 | 1 | L | Left / 1 |
| 1 | C6 | 1 | NOT CONNECTED | | |
| 1 | C6 | 2 | 6 | R | Left / 1 |
| 1 | C6 | 3 | 4 | L | Left / 1 |
| 1 | C6 | 4 | 1 | R | Left / 1 |
| 1 | C7 | 1 | NOT CONNECTED | | |
| 1 | C7 | 2 | NOT CONNECTED | | |
| 1 | C7 | 3 | 4 | R | Left / 1 |
| 1 | C7 | 4 | 2 | L | Left / 1 |
| 1 | C8 | 1 | NOT CONNECTED | | |
| 1 | C8 | 2 | NOT CONNECTED | | |
| 1 | C8 | 3 | 5 | L | Left / 1 |
| 1 | C8 | 4 | 2 | R | Left / 1 |
| 1 | C12 | 1 | NOT CONNECTED | | |
| 1 | C12 | 2 | NOT CONNECTED | | |
| 1 | C12 | 3 | 5 | R | Left / 1 |
| 1 | C12 | 4 | 3 | L | Left / 1 |
| 2 | C2 | 1 | NOT CONNECTED | | |
| 2 | C2 | 2 | 6 | L | Right / 2 |
| 2 | C2 | 3 | 3 | R | Right / 2 |
| 2 | C2 | 4 | 1 | L | Right / 2 |
| 2 | C6 | 1 | NOT CONNECTED | | |
| 2 | C6 | 2 | 6 | R | Right / 2 |
| 2 | C6 | 3 | 4 | L | Right / 2 |
| 2 | C6 | 4 | 1 | R | Right / 2 |
| 2 | C7 | 1 | NOT CONNECTED | | |
| 2 | C7 | 2 | NOT CONNECTED | | |
| 2 | C7 | 3 | 4 | R | Right / 2 |
| 2 | C7 | 4 | 2 | L | Right / 2 |
| 2 | C8 | 1 | NOT CONNECTED | | |
| 2 | C8 | 2 | NOT CONNECTED | | |
| 2 | C8 | 3 | 5 | L | Right / 2 |
| 2 | C8 | 4 | 2 | R | Right / 2 |
| 2 | C12 | 1 | NOT CONNECTED | | |
| 2 | C12 | 2 | NOT CONNECTED | | |
| 2 | C12 | 3 | 5 | R | Right / 2 |
| 2 | C12 | 4 | 3 | L | Right / 2 |

*Figure 11. Cable connectivity from I/O servers*

## Supported environment

Refer to the IBM support website for up-to-date information about the supported environment for your system.

Environmental topics can include updates about the following items:

- Host attachments
- Physical disk storage systems
- Host bus adapters
- Switches
- Firmware levels
- Other support hardware

# Chapter 5. Installing Model 092 expansion enclosure

Before you start the installation process, review the procedures; ensure you follow them in the order they are presented.

1. Read and understand the safety and weight information about the Model 092 expansion enclosure.
2. Review the installation checklist.
3. Remove the parts from the shipping container.
4. Remove parts to reduce the weight of the enclosure.
5. Install the enclosure in the rack by using the provided support rails.
6. Install the fascia.
7. Install the drives.
8. Install the cable management arm.
9. Connect the Model 092 expansion enclosures to the system.

The tools and the number of persons that are required are as follows:

- Three or more persons or a lifting device to support the enclosure
- Box cutter
- Screw driver
- Two 16 A power distribution units (PDU) IEC 60320 J and power cables

## Checklist: Unpacking and installing Model 092 expansion enclosure

Before you unpack and install the Model 092 expansion enclosure, ensure that you review and follow the installation checklist and the safety notices.

**CAUTION:**


The weight of this part or unit is more than 55 kg (121.2 lb). It takes specially trained persons, a lifting device, or both to safely lift this part or unit. (C011)

**CAUTION:** To avoid personal injury, before lifting this unit, remove all appropriate subassemblies per instructions to reduce the system weight. (C012)

**Important:** Before you unpack, move, install, or service the Model 092 expansion enclosure and its parts, always complete the following tasks:

- Read and follow the safety notices and instructions. For more information, see “Danger and caution notices” on page 4.
- Read and follow the guidelines that are described in Chapter 2, “Weight considerations: Model 092 expansion enclosure,” on page 15.
- Ensure that a suitably rated mechanical lift is available to support the weight of the expansion enclosure as it inserted into the rack for installation.

The Model 092 expansion enclosure and most parts are shipped together in one large box. A tray on the top of the enclosure contains the front fascia (1U and 4U pieces), the cable management arm (CMA), and the slide rail kit; you must install these parts. Figure 12 on page 40 shows how the enclosure is packaged for shipment.

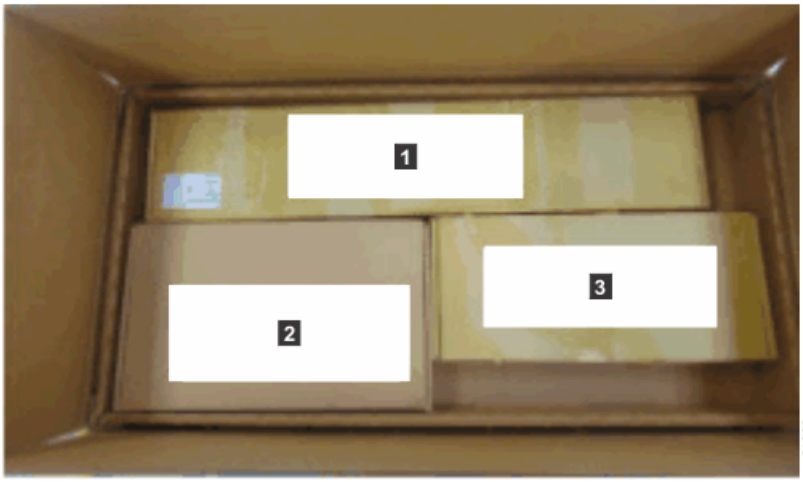



*Figure 12. Tray containing expansion enclosure parts*

1 Slide rail kit
2 Cable management arm
3 Fascia

Other parts, such as the cover, secondary expander modules, and fans, are installed in the enclosure. However, due to weight considerations, you must remove some parts and then reinstall them as part of the initial installation process.

**Note:** Drives are not included in installation package for the enclosure; they are provided in a separate package.

1. Remove the cardboard tray that contains the slide rails, cable management arm, and fascia from cardboard box in which the expansion enclosure was shipped.
2. Remove the foam end pieces from the top of the Model 092 expansion enclosure.
3. Cut the corners of the shipping box and fold them down to uncover the sides and faces of the expansion enclosure, as shown in Figure 13 on page 40.

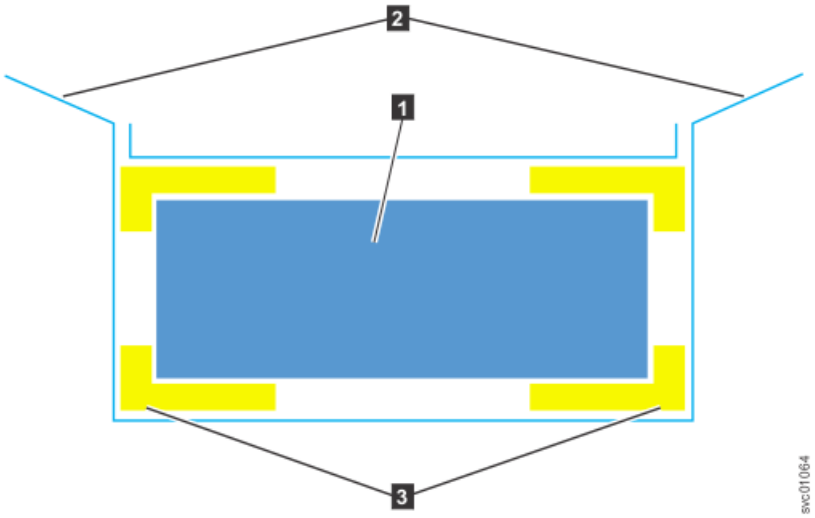



*Figure 13. Packaging materials*

1 Enclosure
2 Top of shipping box, folded back.
3 Foam protectors

4. Remove the top cover. For more information, see “Removing the top cover” on page 44.

5. With two or more persons, push the expansion enclosure sideways onto an adjacent flatbed lift. Keep the remaining foam block protectors attached to the enclosure.
6. Remove the support rail kit from the box in which it was shipped (1, as shown in Figure 12 on page 40).
7. Separate the inner section of the support rails and attach them to each side of the expansion enclosure. For more information, see steps "3" on page 45 through "5" on page 46 in "Installing or replacing the support rails (IBM SSR task)" on page 45.
8. Attach the remaining sections of the support rails to the rack. For more information, see step "6" on page 46 in "Installing or replacing the support rails (IBM SSR task)" on page 45.
9. Move the mechanical lift to the front of the rack. Align the inner section of the rails with the mid-section of the rails that are extending from the rack.
10. On each side, push the inner section and middle section of the rails together until they click and will no longer separate. For more information, see step "1" on page 56 in "Installing or replacing a Model 092 expansion enclosure in a rack " on page 55.
11. Remove the 4U fascia and the 1U fascia from the boxes in which they were shipped, as shown in Figure 14 on page 41.


*Figure 14. Packaging for fascia*

1 4U fascia (front)
2 1U fascia (power supply units)

12. Attach the 4U fascia and the 1U fascia to the front of the enclosure. For more information, see "Installing or replacing the fascia" on page 48.
13. Install the drives. For more information, see "Installing or replacing a drive" on page 49.
14. Replace the top cover. For more information, see "Installing or replacing the top cover" on page 54.
15. Lower the mechanical lift so that you can remove the remaining foam blocks away from the expansion enclosure.
16. Slide the latch on the side of each rail and push the expansion enclosure securely into the rack. For more information, see steps "4" on page 56 through "6" on page 56 in "Installing or replacing a Model 092 expansion enclosure in a rack " on page 55.
17. Remove the cable management arm assembly from its packaging (2 in Figure 12 on page 40).
18. Attach the cable management arm. For more information, see "Installing or replacing the cable management arms" on page 56.
19. Connect the SAS cables. For more information, see "Removing and installing a SAS cable" on page 60.
20. Connect the power cables.

# External parts of the Model 092 expansion enclosure

You must become familiar with the external components of the Model 092 expansion enclosure.

### Components on the front of the enclosure

Figure 15 on page 42 shows the front of the Model 092 expansion enclosure. In the figure, all parts are installed in the enclosure.

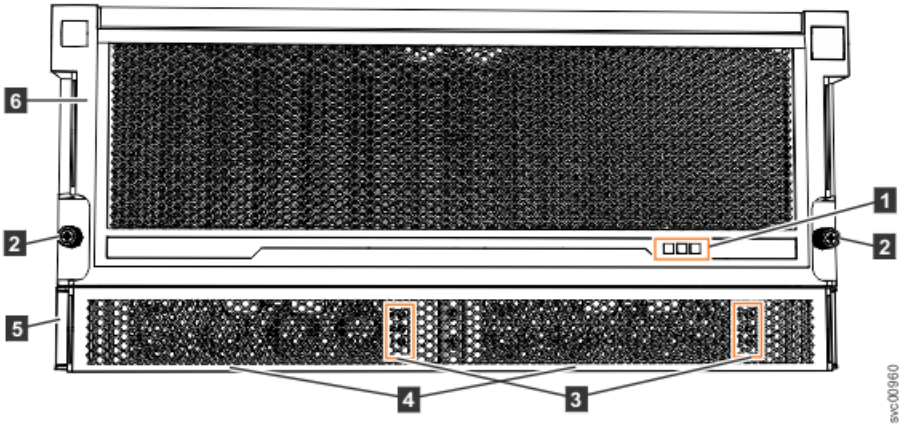



*Figure 15. Features on the front of the Model 092 expansion enclosure*

1. Display panel indicators
2. Rack retention thumb screws
3. Power supply unit indicators
4. Power supply units (PSUs)
5. PSU fascia (1U)
6. Front fascia (4U)

However, as Figure 16 on page 42 shows, the 4U fascia and the 1U fascia are packaged separately. You must attach them to the front of the Model 092 expansion enclosure as part of the initial installation process.

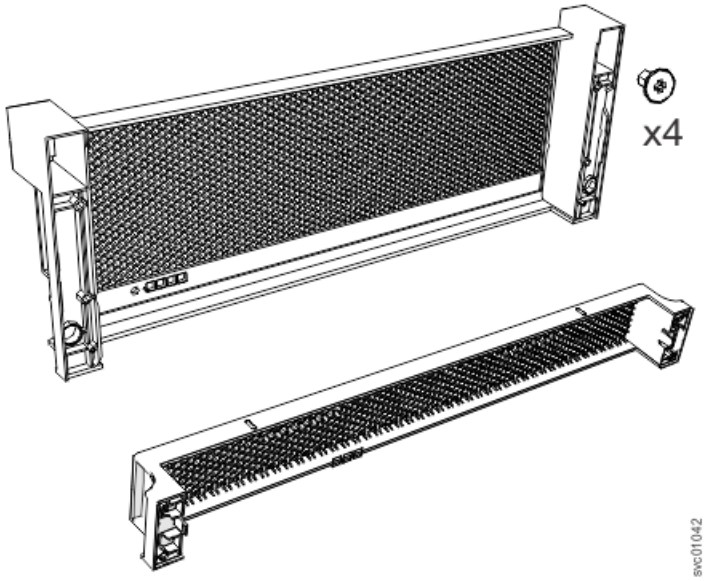



*Figure 16. Front fascia of the Model 092 expansion enclosure*

### Components on the rear of the enclosure

Figure 17 on page 43 shows the components on the rear of the Model 092 expansion enclosure. Four fan modules and two expansion enclosures are accessible from the back of the enclosure.

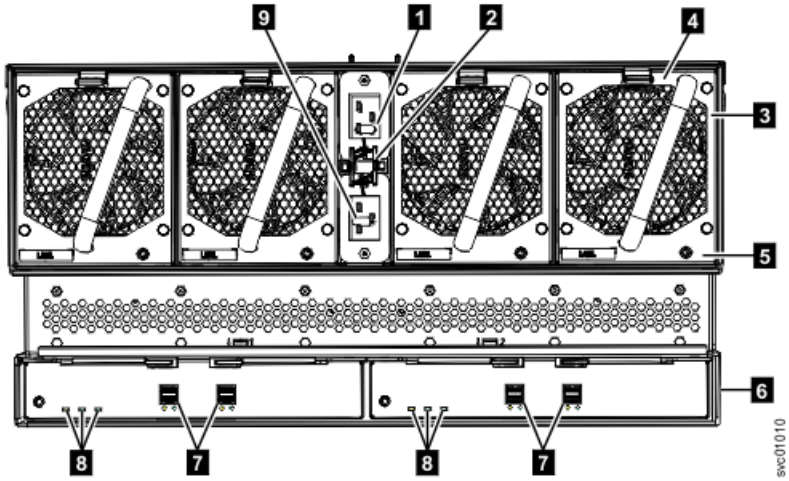



*Figure 17. Features on the rear of the Model 092 expansion enclosure*

1 Power cable connector for PSU 2
2 Power cable retention clamps
3 Fan module
4 Fan release latch
5 Fan fault indicator
6 Expansion canister
7 SAS ports and indicators
8 Expansion canister indicators
9 Power cable connector for PSU 1

### Support rails

Figure 18 on page 43 shows the support rails for the expansion enclosure. The support rails are packaged separately from the expansion enclosure.

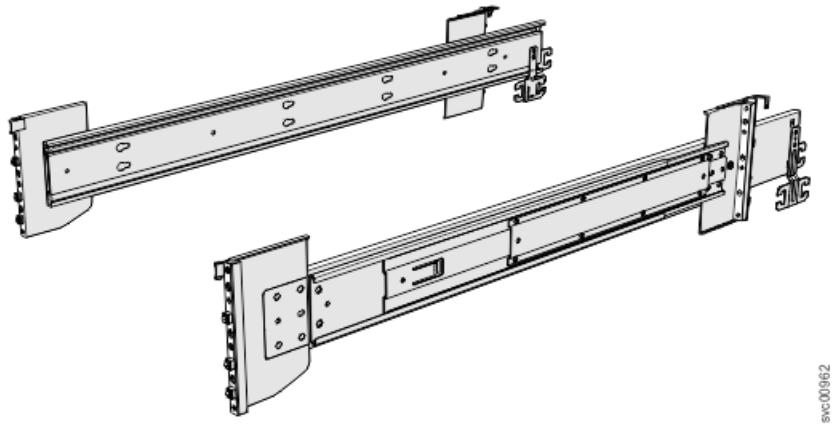



*Figure 18. Support rails*

### Cable management arm

The cable management arm (CMA), which consists of an upper and lower assembly, are packaged separately from the expansion enclosure. As Figure 19 on page 44 shows, each CMA assembly is attached to the rear end of the support rails.

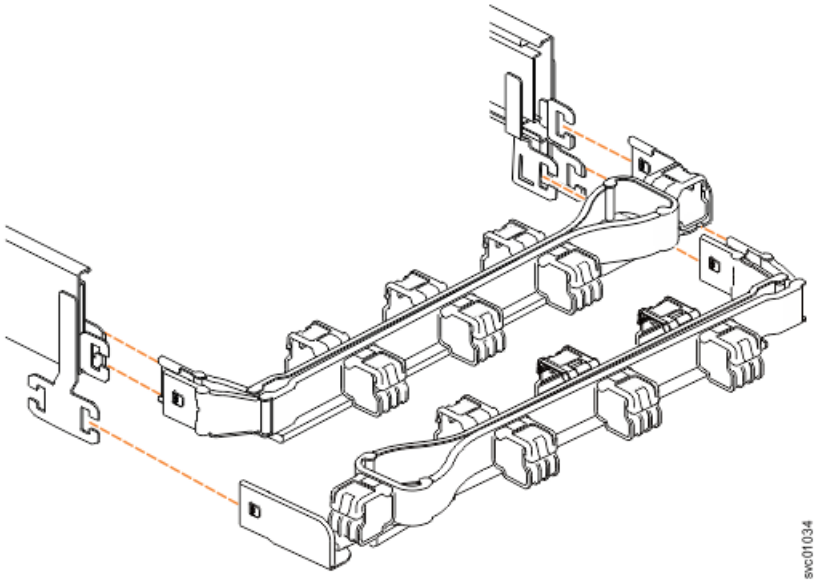



*Figure 19. CMA assemblies*

## Removing the top cover

To complete some service tasks, you might need to remove the top cover from a Model 092 expansion enclosure.

**Important:** You can remove the cover without powering off the expansion enclosure. However, to maintain operating temperature, replace the cover within 15 minutes of its removal. When the cover is removed, the reduction in airflow through the enclosure might cause the enclosure or its components to shut down to protect from overheating.

1. Slide the release latch (1) in the direction that is shown in Figure 20 on page 44.

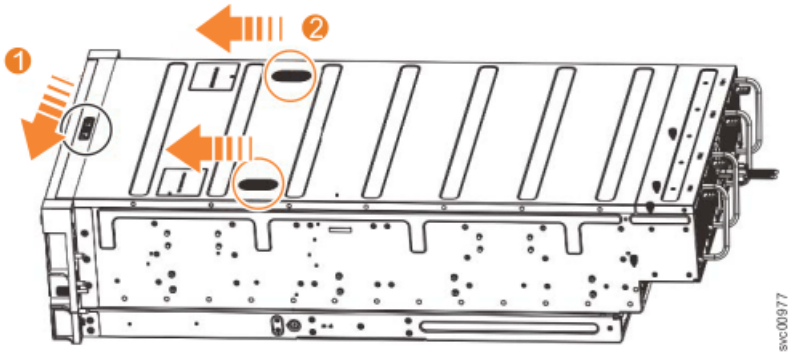



*Figure 20. Releasing the Model 092 enclosure cover*

2. Slide the cover toward the front of the expansion enclosure (2), as shown in Figure 20 on page 44.
3. Carefully lift the cover up, as shown in Figure 21 on page 45.

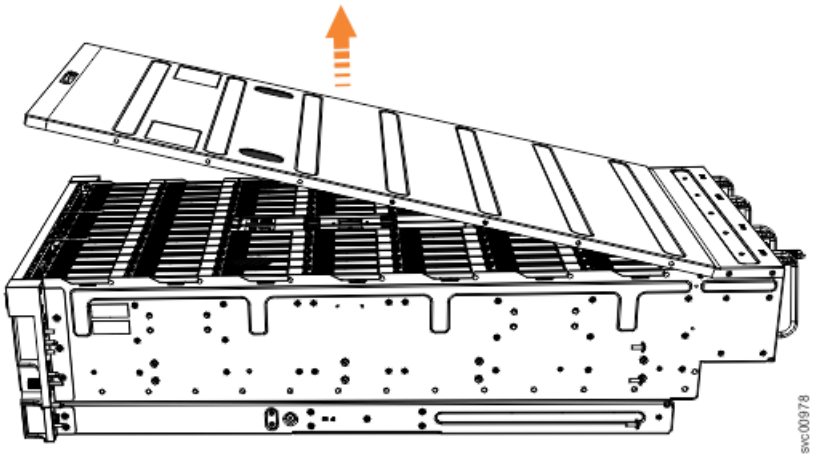



*Figure 21. Removing the Model 092 enclosure cover*

4. Place the cover in a safe location.

## Installing or replacing the support rails (IBM SSR task)

You must install the support rails before you can install a Model 092 expansion enclosure in a rack.

1. Locate the hardware that is used to install the rails, including the M4xL6 and M5xL13 screws. Set the support rails aside for use later in the installation process.

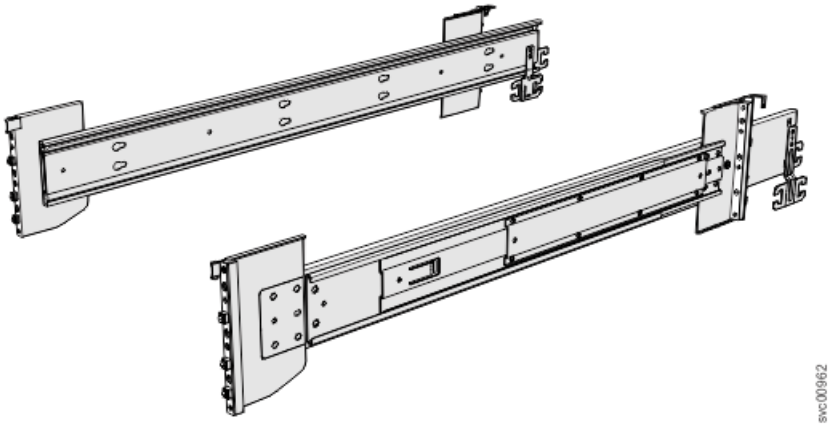



*Figure 22. Support rails*

2. Select an available 5U space in your rack to install the expansion enclosure.

   **Important notes:**

   - When you select a rack location, ensure that the enclosure and its parts are easily accessible. Allow enough space for the lid to be easily removed and for internal components, such as drives and secondary expansion modules, to be serviced.
   - When all components and drives are installed, the expansion enclosure is heavy. Install the support rails and enclosure at the lowest available position. Do not install the rails and the enclosure in the 32U position and above in the rack when you relocate the rack. After the rack is installed, you can install devices in the 32U position and above.

3. Remove the inner member of the rail. Push the tab (a) and slide the middle rail member back, as shown in Figure 23 on page 46.

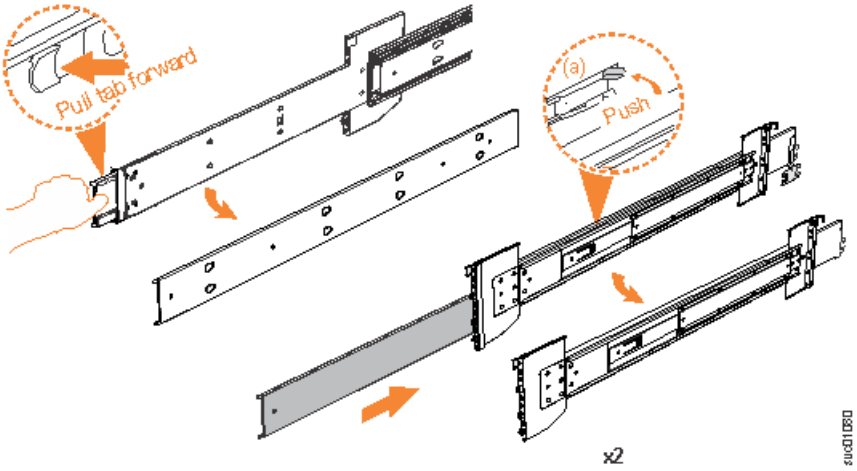



*Figure 23. Detaching the inner rail section*

4. Use four M4 screws to attach the inner rail to the side of the enclosure. Figure 24 on page 46 shows the screw locations.

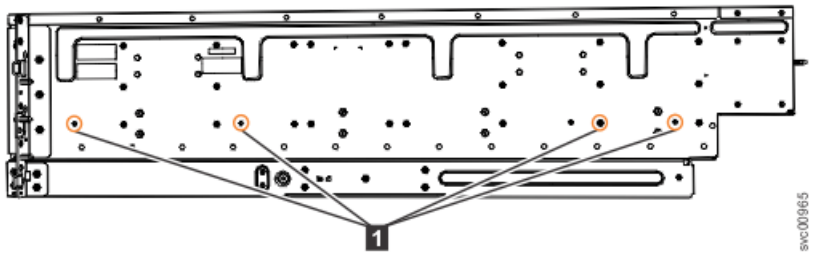



*Figure 24. Screw locations to attach the inner rail to the enclosure*

5. Install the inner section of the rail onto each side of the expansion enclosure, as shown in Figure 25 on page 46.

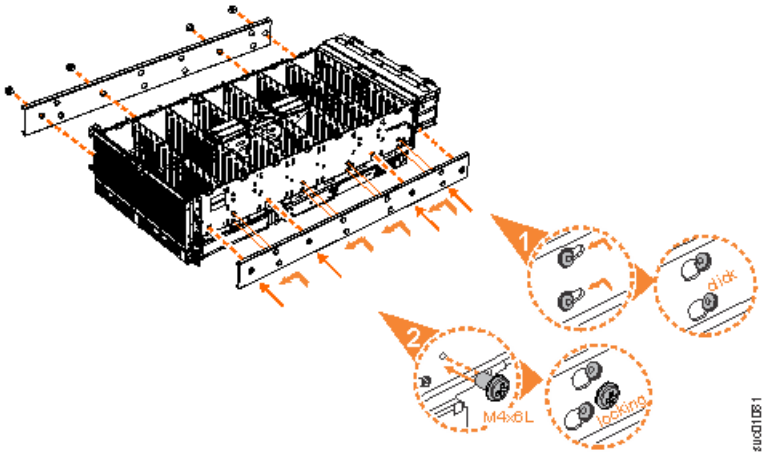



*Figure 25. Attaching the inner rail section to the enclosure*

6. Use the M5 screws to install the outer rail member and bracket assembly to the rack, as shown in Figure 26 on page 47.

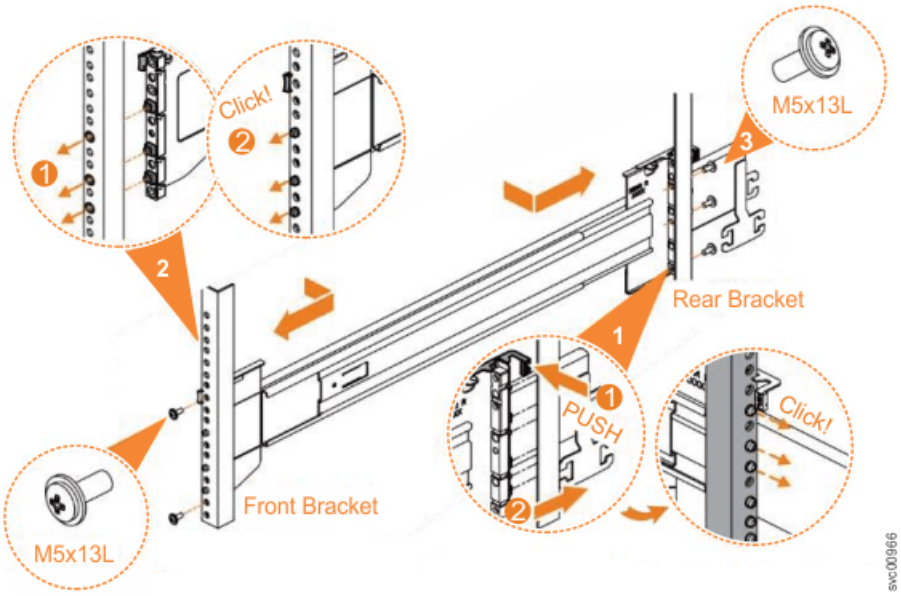



*Figure 26. Installing the rail assembly to the rack frame*

For example, Figure 27 on page 47 shows the front of the rail that is attached to the frame.

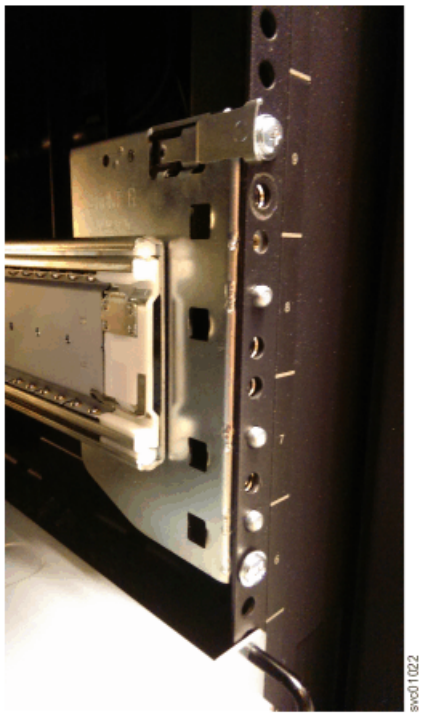



*Figure 27. Example of the required rack space*

7. Repeat steps “5” on page 46 through “6” on page 46 to install the opposite rail.
8. Install the expansion enclosure in the rack. For more information, see “Installing or replacing a Model 092 expansion enclosure in a rack ” on page 55.

## Installing or replacing the fascia

During the initial installation process or after you perform service, you can install the fascia components on the front of a Model 092 expansion enclosure.

The 4U fascia covers the display panel of the expansion enclosure. It is attached to the enclosure by four screws. The bottom 1U fascia covers both of the power supply units (PSUs) on the enclosure. As Figure 28 on page 48 shows, the fascias are independent; you can remove or replace one without having to remove or replace the other.

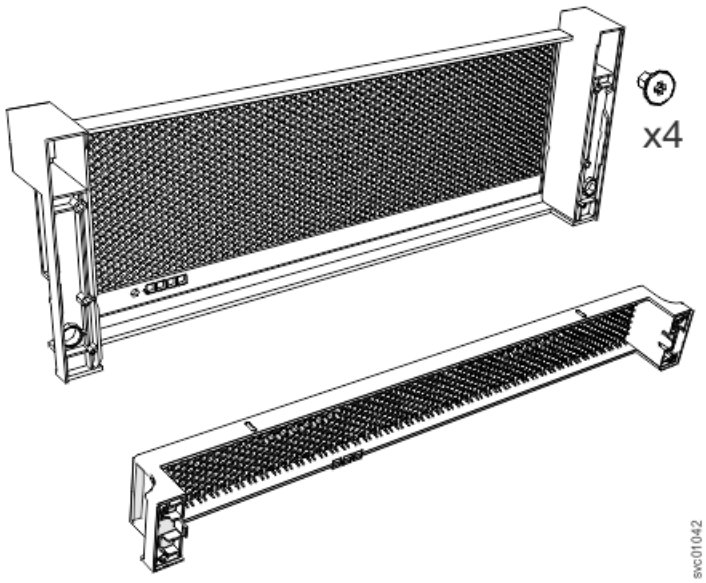



*Figure 28. Fascia components on the expansion enclosure*

**Note:** When the expansion enclosure is shipped, the 4U fascia and the 1U fascia are not installed. You must install them as part of the initial installation process.

**Attach the front (4U) fascia**

1. Align the front 4U fascia with the enclosure so that the thumbscrews go through the holes on each side. As Figure 29 on page 49 shows, this action aligns the screw holes on the back of the fascia with the screw holes on the front flange of the enclosure.
2. Replace the four screws to reattach the 4U fascia. Secure the screws from the back of the flange and into the rear of the fascia. Each side of the 4U fascia contains two screws.

**Attach the bottom (1U) fascia**

3. Reattach the bottom 1U fascia that covers the power supply units (PSUs). Align the fascia with the enclosure and gently push it until it clicks into place on the chassis, as shown in Figure 29 on page 49.

   Align the tab on each side of the 1U fascia with the corresponding slots on the enclosure flange. Pins on each flange must also align with a hole in each side of the 1U fascia.

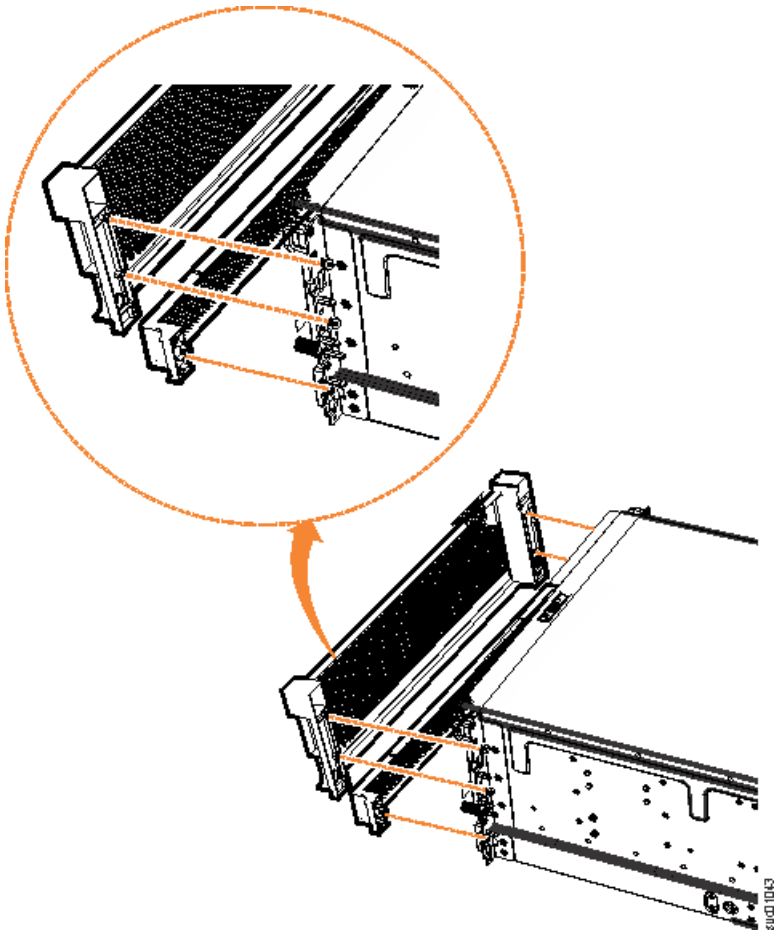


*Figure 29. Replace fascia components on the expansion enclosure*

## Installing or replacing a drive

Use the following procedure to install a drive for the first time or to replace a faulty drive in a Model 092 expansion enclosure with a new one received from FRU stock. You can also use this procedure.

**Important:**

- You can replace a drive assembly without powering off the expansion enclosure. However, to maintain operating temperature, do not keep the cover off an operational enclosure for more than 15 minutes. The reduction in airflow through the enclosure might cause the enclosure or its components to shut down to protect from overheating.
- If failed disks are in the replaceable status, they can be replaced by using corresponding directed maintenance procedure. Select **Replace Broken Disks** from the **Actions** menu in the **Monitoring** > **Hardware** window. You can also replace the disks from the **Monitoring** > **Events** and **Storage** > **Physical Disks**, and some other GUI pages.
- Disk maintenance can also be performed by using the **`mmvdisk pdisk replace`** command with the `--prepare` option to inform IBM Spectrum Scale to locate the disk, suspend it, and allow it to be removed. Locate and remove the failed disk, and replace it with a new disk.
- After the disk is reinserted, the **`mmvdisk pdisk replace`** command integrates it into the ESS recovery group.

The Model 092 expansion enclosure supports 92 drives. Figure 30 on page 50 shows an example of a drive assembly.

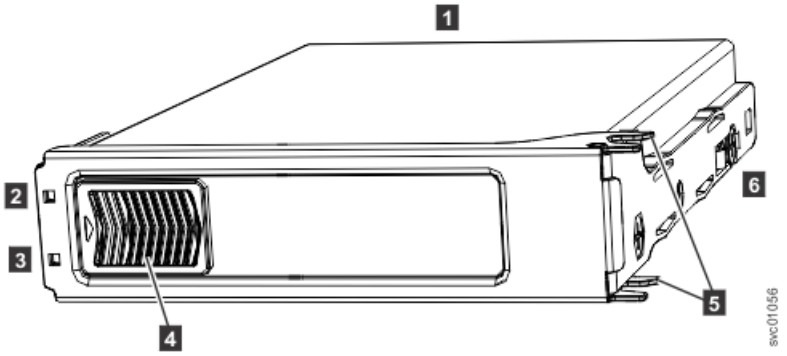



*Figure 30. Drive assembly*

1 Disk drive
2 Online indicator
3 Fault indicator
4 Release latch
5 Drive latch toes
6 Drive carrier

1. Read all of the available safety information.
2. Remove the cover. For more information, see “Removing the top cover” on page 44.
3. Locate the empty drive slot to receive the new drive or that contains the faulty drive that you want to replace.

   **Note:** When a drive is faulty, the amber fault indicator is lit (3 in Figure 30 on page 50). Do not replace a drive unless the drive fault indicator is on or you are instructed to do so by a fix procedure.

   A label on the enclosure cover (Figure 31 on page 51) shows the drive locations in the enclosure. The drive slots are numbered 1-14 from left to right and A-G from the back to the front of the enclosure.

   **Note:** In an ESS building block, only the primary enclosure has two SSDs. See Figure 31 on page 51 where SSDs are placed at locations 1 and 14. All other non-primary enclosures have only HDDs at all locations.

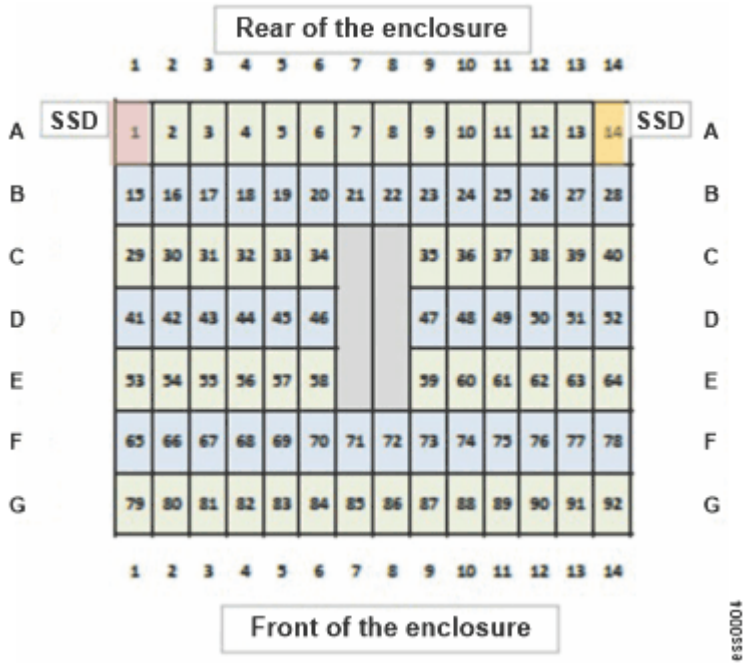



*Figure 31. Drive locations in a Model 092 expansion enclosure*

The drive slots must be populated sequentially, starting from the back-left corner position (slot 1, grid A1). Sequentially install the drive in the slots from left to right and back row to front. Always complete a full row before you install drives in the next row.

For example, in Figure 32 on page 51, the drives are installed correctly. Drives are installed in slots 1 -14 of row A and the installation continues in slot 15 in row B.

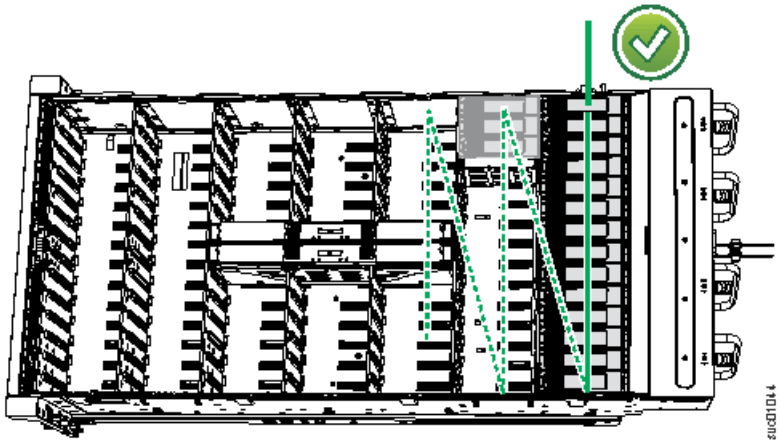


*Figure 32. Correct drive installation*

In the first Model 092 expansion enclosure slots, 1 and 14 contain SSDs for the LogTip backup. For more information about the LogTip backup, see IBM Spectrum Scale RAID guide.

In Figure 33 on page 52, the drives are not installed correctly. Slot 1 (A1) does not contain a drive. In addition, drives are installed in row B even though row A contains empty drive slots.

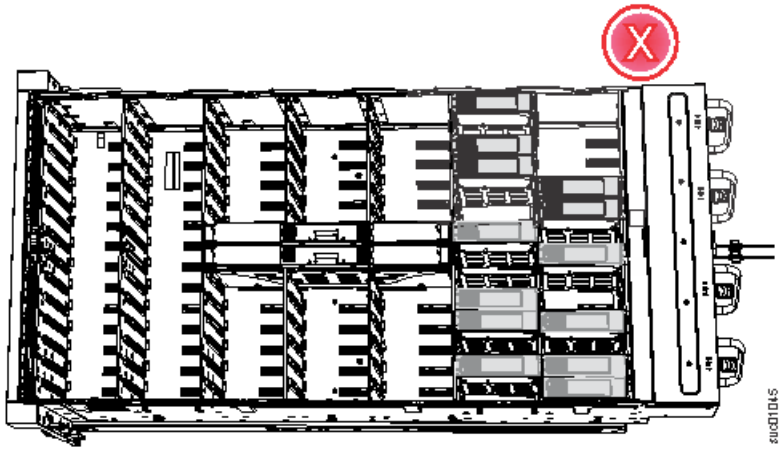


*Figure 33. Incorrect drive installation*

4. Touch the static-protective package that contains the drive to any unpainted metal surface on the enclosure. Wear an anti-static wrist strap to remove the drive from the package.
5. Ensure that the drive handle (1 in Figure 34 on page 53) of the drive assembly is in the open (unlocked) position.
6. Align the drive carrier into the appropriate drive slot.

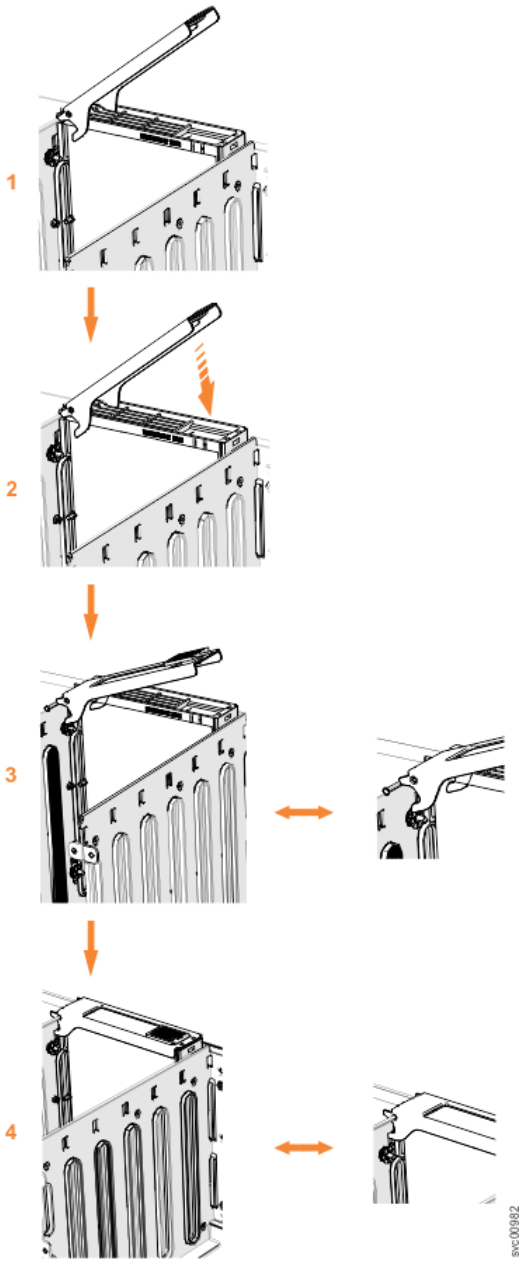



*Figure 34. Replace the drive*

7. Gently push the drive down until it stops, and the bottom of the latch is aligned with the top of the partition. Ensure that the handle is not open more than 45 degrees from the drive carrier. (2 in Figure 34 on page 53).
8. Rotate the handle down to lock the drive assembly into the chassis (3 in Figure 34 on page 53).
9. Ensure the toe on the bottom of the latch is fully engaged with the partition in the chassis.
10. Ensure that the top toe of the latch is also fully engaged (4 in Figure 34 on page 53).
11. Repeat steps "4" on page 52 through "10" on page 53 for each drive you are replacing.
12. Replace the cover. For more information, see "Installing or replacing the top cover" on page 54.
13. Slide the expansion enclosure back into the rack. For more information, see "Installing or replacing a Model 092 expansion enclosure in a rack " on page 55.

## Installing or replacing the top cover

You can replace the top cover on a Model 092 expansion enclosure during the installation process or after you complete a service task.

**Important:** You can install the cover while the expansion enclosure is powered on. To maintain operating temperature, replace the cover within 15 minutes of completing other service tasks. When the cover is removed, the reduction in airflow through the enclosure might cause the enclosure or its components to shut down to protect from overheating.

To install or replace the top cover on the Model 092 expansion enclosure, complete the following steps:

1. Carefully lower the cover and ensure that it is aligned correctly with the back of the enclosure, as shown in Figure 35 on page 54.

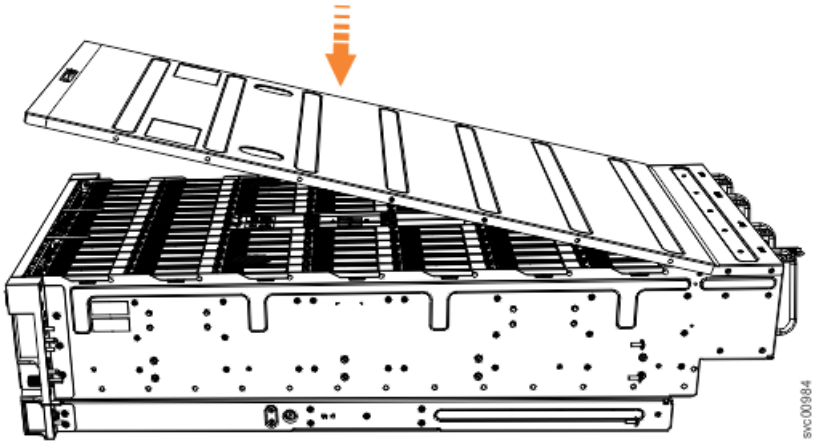



*Figure 35. Aligning the top cover*

2. Push the cover release lever to the side (2) as shown in Figure 36 on page 54.
3. Slide the cover towards the back of the enclosure (3) back until it stops, as shown in Figure 36 on page 54.

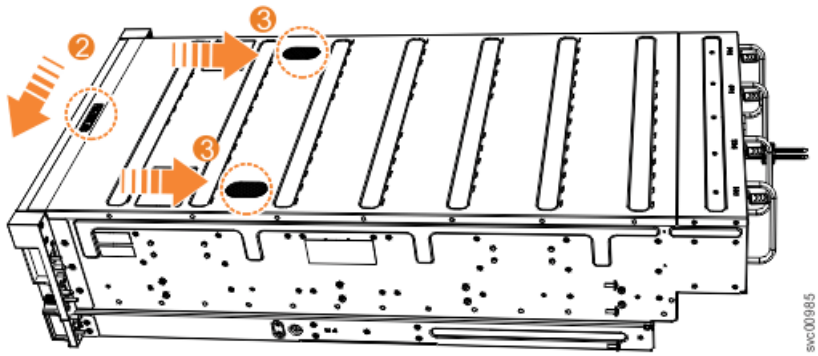



*Figure 36. Replacing the top cover*

4. Verify that the cover correctly engages the cover release latch and all of the inset tabs on the expansion enclosure.
5. Lock the cover into position by sliding the release lever 4, as shown in Figure 37 on page 55

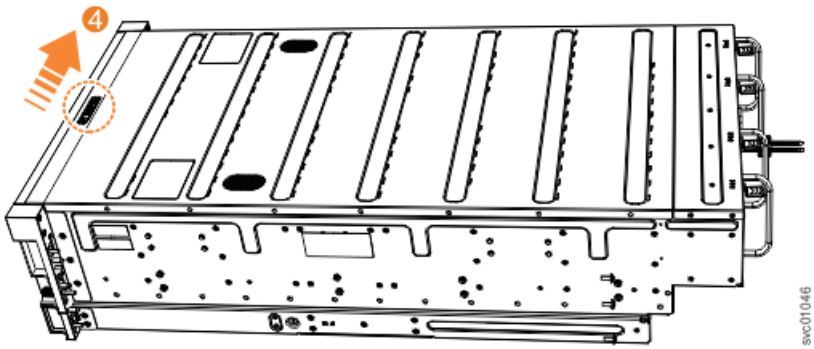



*Figure 37. Locking the top cover*

## Installing or replacing a Model 092 expansion enclosure in a rack

Use the following procedure to place an expansion enclosure in a rack during the installation process. To complete some service tasks, you might also need to slide the enclosure back in to the rack.

**Important:** The Model 092 expansion enclosure is heavy. Before you install the expansion enclosure in the rack for the first time or replace it in the rack to complete a service task, review and implement the following tasks:

- Always use a suitably rated mechanical lift or four persons to raise the enclosure to install it in the rack. Even after the drives, power supply units, secondary expander modules, canisters, fans, and top cover are removed, the enclosure weighs approximately 43 kg (95 lbs).
- Install the expansion enclosure in the lowest position in the rack. Figure 38 on page 55 shows an example.

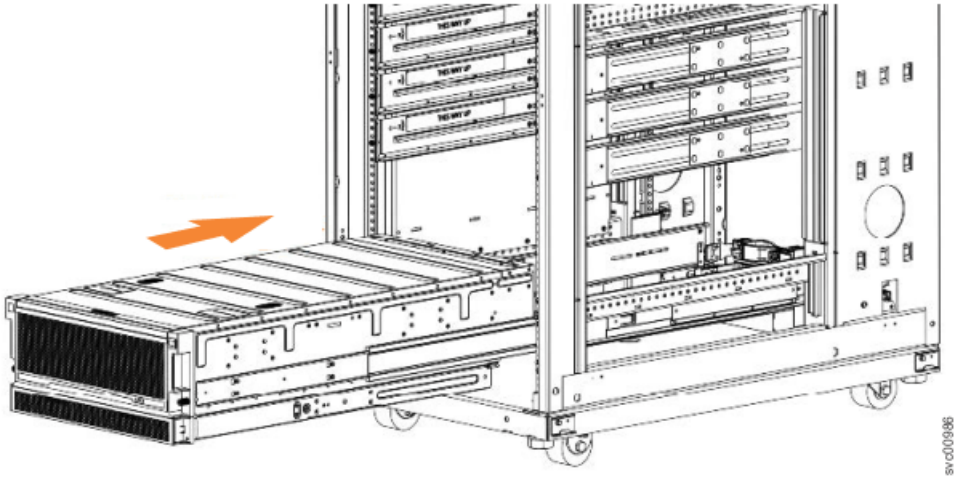



*Figure 38. Example installation of the enclosure in the rack*

- Ensure that the drives are easily accessible. Avoid installing the Model 092 expansion enclosure in the 32U position above in the rack, when you relocate the rack. After the rack is installed, you can install devices in the U32 position and above.

If you are reinstalling the expansion enclosure in the rack after you performed a service task (for example, replacing the enclosure), you must also perform the following tasks:

- Reinstall all of the following parts:
  - Cover
  - Drives
  - Fan modules
  - Power supply units and 1U fascia

  - Secondary expander modules
  - Expansion canisters (and SAS cables)
- Reconnect both power cables to the expansion enclosure.

1. Fully extend the left and right drawer sections from the rack to lock the rails in the extended position (1 in Figure 39 on page 56).

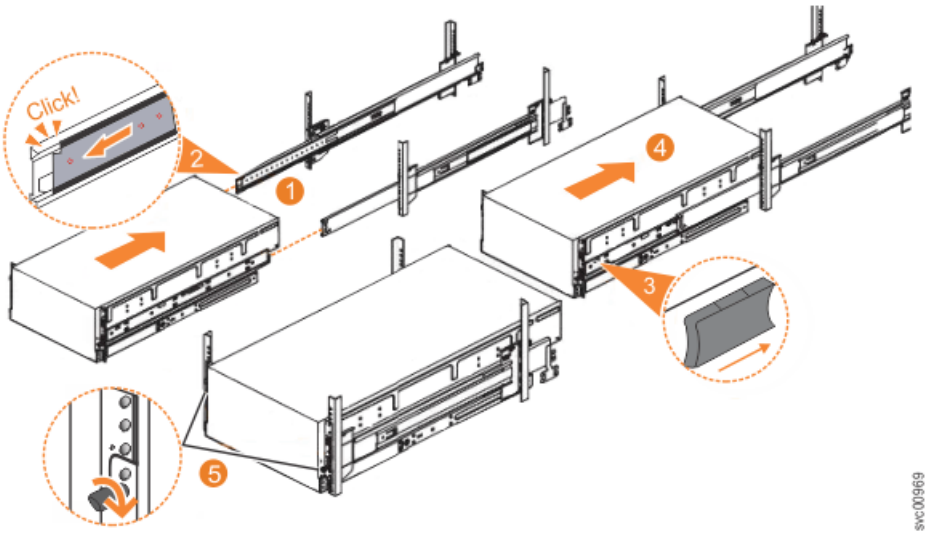



*Figure 39. Replacing the Model 092 enclosure in the rack*

2. Ensure that the ball bearing retainer clicks into place inside the front of the left and right drawer sections (2 in Figure 39 on page 56).

**Reinstalling parts into the enclosure**

3. Replace the top cover. For more information, see "Installing or replacing the top cover" on page 54.

**Sliding the enclosure into the rack**

4. Locate the left and right blue release tabs near the front of the enclosure. Press both release tabs forward to unlock the drawer mechanism (3 in Figure 39 on page 56).
5. Push the enclosure firmly into the rack (4 in Figure 39 on page 56).
6. Tighten the locking thumb screws (5 in Figure 39 on page 56) to secure the enclosure in the rack.
7. Reconnect power to the expansion enclosure.

## Installing or replacing the cable management arms

Use these procedures to install the cable management arm (CMA) for the Model 092 expansion enclosure. You can also use these procedures to replace a faulty CMA assembly.

As part of the initial installation of the Model 092 expansion enclosure, you must attach the CMA. You might also need to replace a faulty CMA with a CMA from the FRU stock.

The cable management arm (CMA) consists of an upper arm 1 and a lower arm 2 assembly, as indicated in the Figure 40 on page 57.

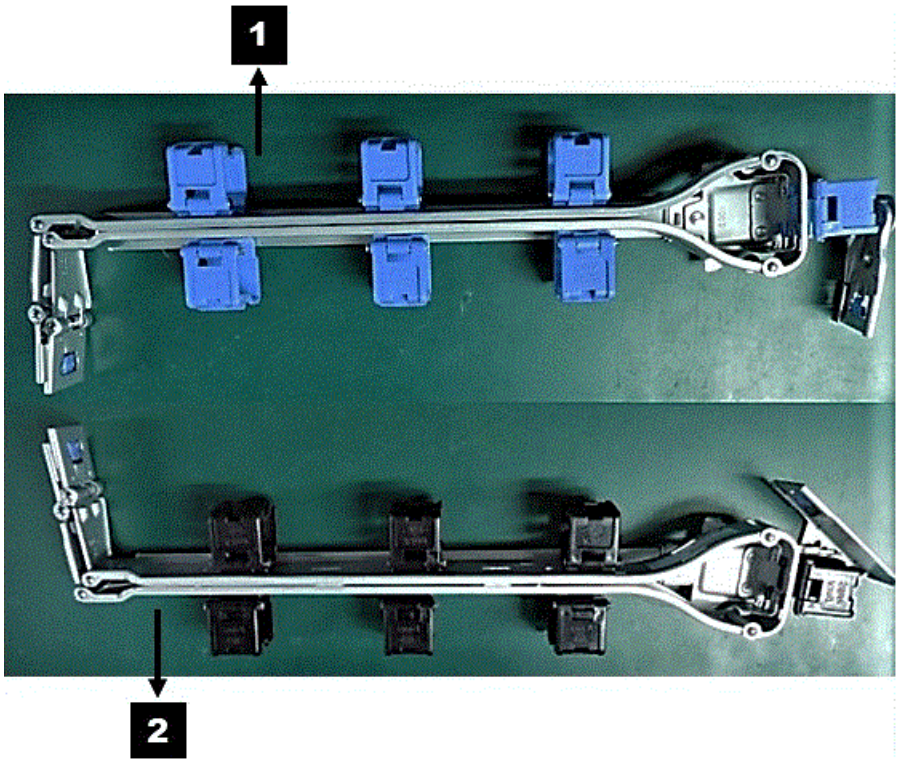



*Figure 40. Upper and lower cable management arms*

As Figure 41 on page 57 shows, the support rail connectors of each CMA assembly are installed on the rail hooks at the end of the support rails.

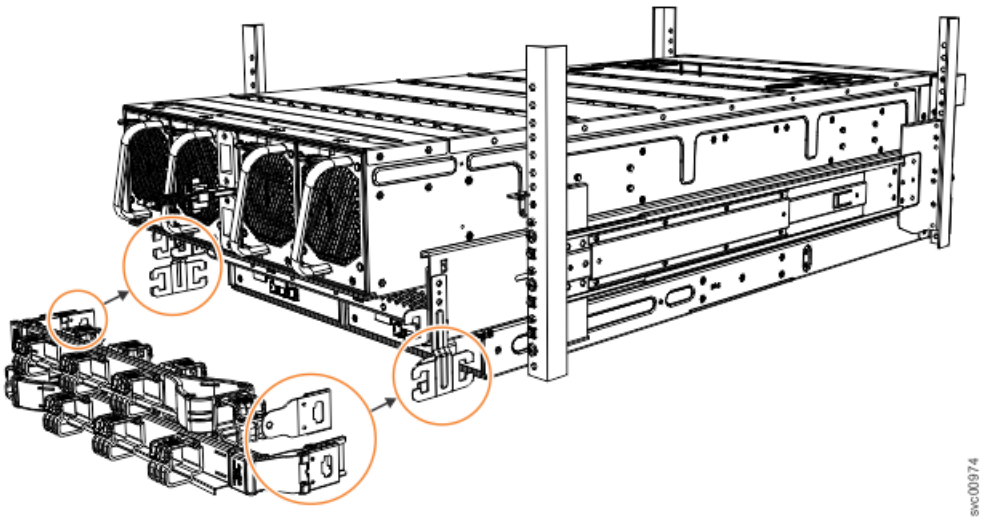



*Figure 41. Upper and lower cable management arms*

1. Remove the loop straps from the upper and lower CMA assemblies. The straps are used only for shipping.

**Installing the upper CMA assembly**

Figure 42 on page 58 shows the connectors on the upper CMA assembly.

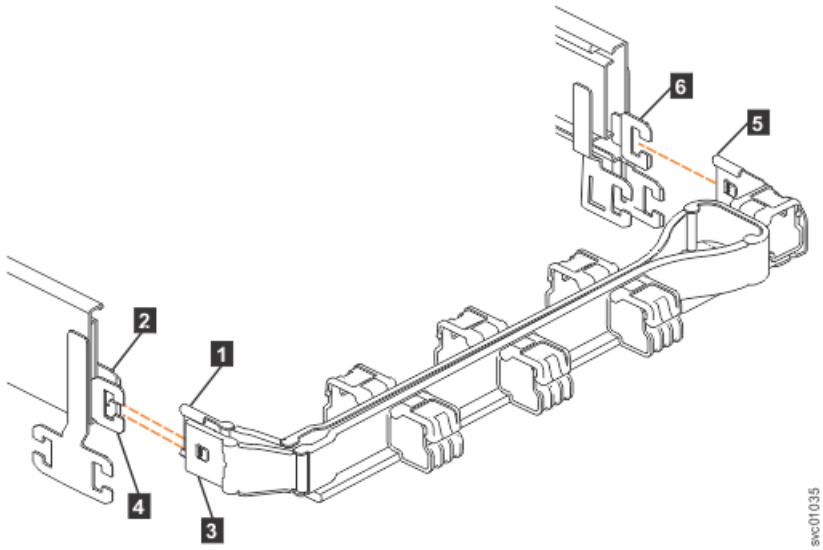



*Figure 42. Connectors for the cable management arm*

1 Inner connector on upper CMA
2 Connector base on inner rail member
3 Outer connector on upper CMA
4 Connector base on outer rail member
5 Support rail connector on upper CMA
6 Connector base on outer rail member

2. Install the inner connector of the upper CMA assembly (1) to the inner member of the left support rail (2), as shown in Figure 43 on page 58.

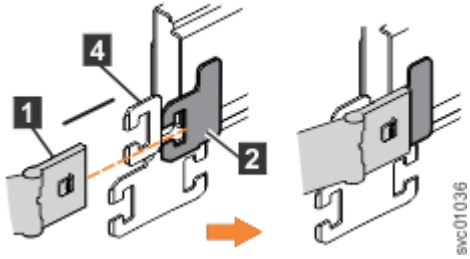



*Figure 43. Install the inner connector of the upper CMA to the inner member of the support rail*

3. Install the outer connector of the upper CMA assembly (3) to the outer member of the left support rail (4), as shown in Figure 44 on page 58.

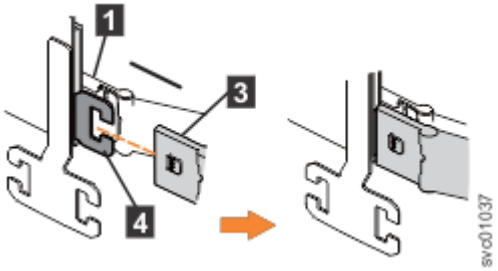



*Figure 44. Install the outer connector of the upper CMA to the outer member of the support rail*

4. Attach the support rail connector on the upper CMA assembly (5) to the connector base on the right support rail (6), as shown in Figure 45 on page 59.

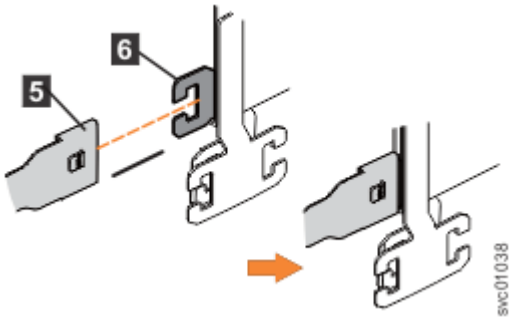



*Figure 45. Attach the support rail connector of the upper CMA to the right support rail*

Ensure the cable management arm connector attaches securely to the hooks on the rails.

**Installing the lower CMA assembly**

**Note:** The procedure for attaching the lower CMA assembly is the same as the procedure to attach the upper CMA assembly. However, the connector locations are reversed. For comparison, Figure 46 on page 59 shows the upper and lower CMA assemblies as they are aligned to the support rails. The support rail connector of the upper CMA attaches to the right rail. The support rail connector of the lower CMA 11 attaches to the left rail.

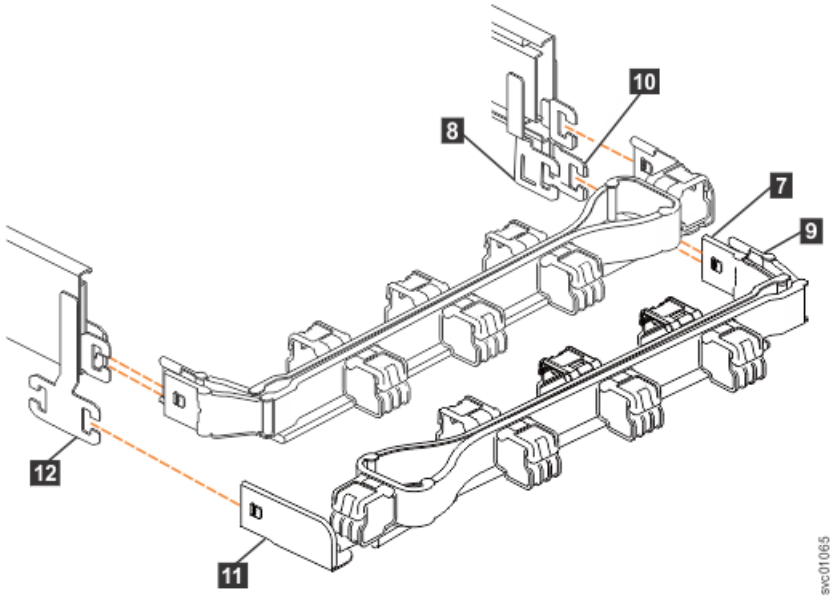



*Figure 46. Comparing the location of the components of the CMA assemblies*

7 Inner connector on lower CMA
8 Connector base on inner rail member
9 Outer connector on lower CMA
10 Connector base on outer rail member
11 Support rail connector the lower CMA
12 Connector base on outer rail member

5. Install the inner connector of the lower CMA assembly (7) to the inner member of the right support rail (8), as shown in Figure 46 on page 59).
6. Install the outer connector of the lower CMA assembly (9) to the outer member of the right support rail 10, as shown in Figure 46 on page 59.
7. Attach the support rail connector on the lower CMA assembly (11) to the connector on the left support rail (12), as shown in Figure 46 on page 59.

   Ensure that the lower CMA assembly is securely attached to the hooks on the end of the support rails.

8. Route the cables and power cords on the CMA. Route the SAS cables through the lower CMA with black brackets. If needed, secure them with cable ties or hook-and-loop fasteners.

   **Notes:**

   - Use the cable straps that are provided on the rear of the system to retain the cables and prevent them from sagging.
   - Allow slack in all of the cables to avoid tension in the cables as the CMA moves.

9. Reconnect the power cords and other cables, as needed.

## Removing and installing a SAS cable

Use the following procedures to attach SAS cables to the Model 092 expansion enclosure during the initial installation process. You can also remove a faulty SAS cable and replace it with a new one received from FRU stock.

Be careful when you are replacing the hardware components that are located in the back of the system. Do not inadvertently disturb or remove any cables that you are not instructed to remove.

If you replace more than one cable, record which two ports, canisters, and enclosures each cable connects, so you can match the connections with the replacement cables. The system cannot operate if the SAS cabling to the expansion enclosure is incorrect.

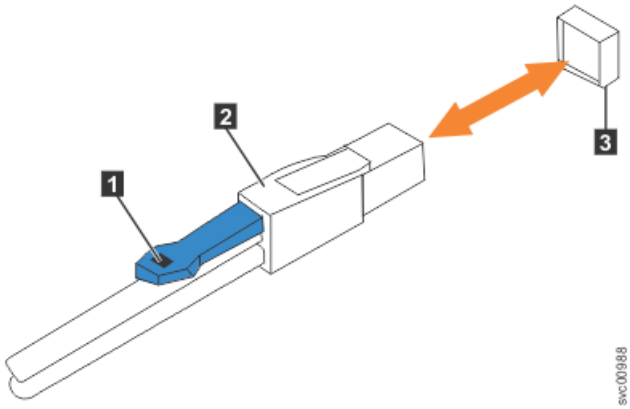
When the Model 092 expansion enclosure is installed in the rack, the expansion canisters are upside down. The input cable connects to the right port on the expansion canister. The output cable connects to the left port on the canister.

**Removing a SAS cable**

1. Locate the connector at the end of the SAS cable that is to be removed from the expansion enclosure.
2. Grasp the connector by its blue tag. Pull the tag.
3. Release the connector and slide it out of the SAS port.
4. Repeat steps “2” on page 60 and “3” on page 60 on the other end of the SAS cable.

**Replacing a SAS cable**

5. Ensure that the SAS connector is oriented correctly, as shown in Figure 47 on page 60. The blue tab must face towards the top of the enclosure canister.




1 Blue pull tab
2 SAS cable
3 SAS port

*Figure 47. Correct orientation for SAS cable connectors*

6. Insert the SAS cable into the SAS port until you hear or feel a click. When the cable is successfully inserted, you cannot disconnect the cable without pulling on the blue tag.

**Connecting to an I/O server node**

7. Connect the SAS cable to the SAS port with blue tab **above** the connector (that is, facing towards the top of the node).

   You hear or feel a click when the cable is successfully inserted. You cannot disconnect the cable without pulling on the blue tag.
8. The SAS cables should be routed through the lower CMA with black brackets. Route the SAS cables through the cable management arms, as shown in Figure 48 on page 61.

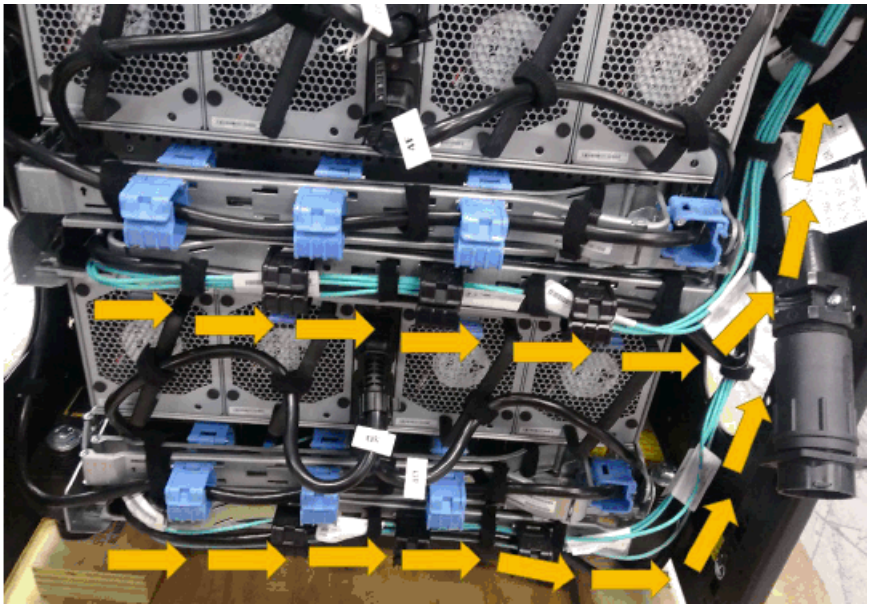


*Figure 48. Example of SAS cables routed through the cable management arms*

9. When both ends of a SAS cable are correctly connected, the green link-LED next to the connected SAS ports are lit.

   For example, Figure 49 on page 61 shows the LEDs of expansion canister 1 on a Model 092 expansion enclosure. The SAS cable is successfully inserted in to right port; left port does not contain a SAS cable.

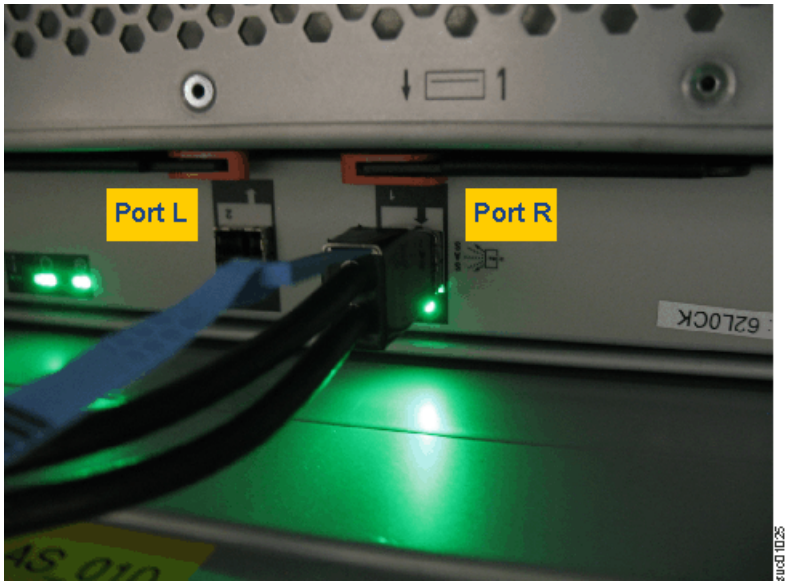



*Figure 49. SAS cable correctly inserted into the SAS port*

## Connecting the Model 092 expansion enclosures

After you install the Model 092 expansion enclosures into the rack, you must connect them to each system that will use them.

**Note:** When you insert SAS cables, ensure that the connector is oriented correctly to the node and the expansion enclosure.

- The blue pull tab must be above the connector (in Figure 50 on page 62).

*Figure 50. SAS cable connector orientation*

- Insert the connector gently until it clicks into place. If you feel resistance, the connector is probably oriented the wrong way. Do not force it.
- When inserted correctly, the connector can be removed only by pulling the tab.

**Attention:**

- No cable can be connected between a port on a left canister and a port on a right canister of the expansion enclosures.
- Ensure that cables are installed in an orderly way to reduce the risk of cable damage when replaceable units are removed or inserted.
- SAS cables must be routed through the cable management arms to reduce the risk of disconnecting the nodes from their storage arrays. This step also helps to protect the SAS cables from getting damaged if you slide the node or enclosure out of the rack while they are attached.

## Powering on the Model 092 expansion enclosure

Use the following procedure to provide power to the Model 092 expansion enclosure as part of the initial installation process or after a service procedure.

**Important:** Before you connect the power cables to the rear of the enclosure, always check that the expansion enclosure is secured in the rack. If needed, tighten the thumbscrews on the front of the enclosure (2 in Figure 51 on page 62) to ensure that the enclosure drawer does not roll open.

The Model 092 expansion enclosure has two power supply units (PSUs) that are accessible from the front of the enclosure (4 in Figure 51 on page 62). As the figure also shows, the PSUs are covered by the 1U fascia (5).

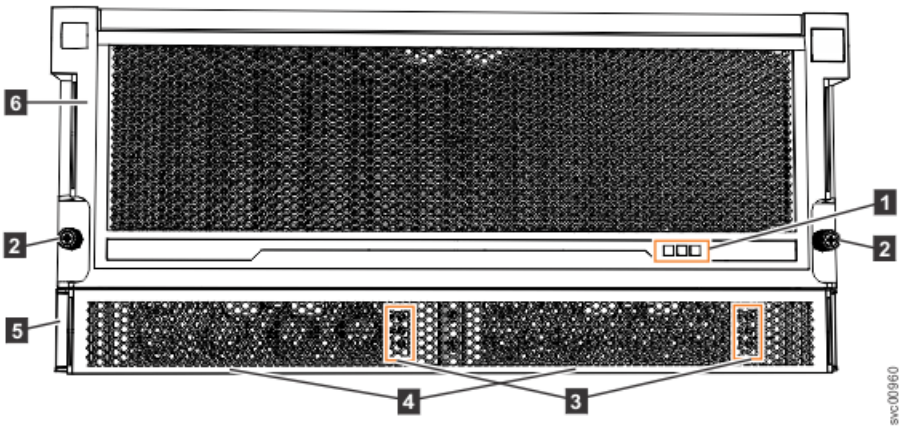



*Figure 51. Features on the front of the Model 092 expansion enclosure*

1 Display panel LEDs
2 Rack retention thumb screws

3 Power supply unit LEDs
4 Power supply units (PSUs)
5 PSU fascia (1U)
6 Front fascia (4U)

Each PSU has a power supply connector and power cable, which are accessible from the back of the enclosure. Power is provided by plugging a C19-C20 power cable into each power supply unit and, if necessary, turning on the power source. The expansion enclosure does not have a power button.

1. Connect the C19-C20 power cables to the power connectors on the rear of the expansion enclosure.

   The enclosure automatically powers on and begins its Power On Self-Tests (POST).
2. Secure the power cables in the cable retainer at each power connector on the rear of the enclosure, as shown in Figure 52 on page 63. Also, ensure that each cable is installed along one of the cable management arms. The cable management arms also support the SAS cables.

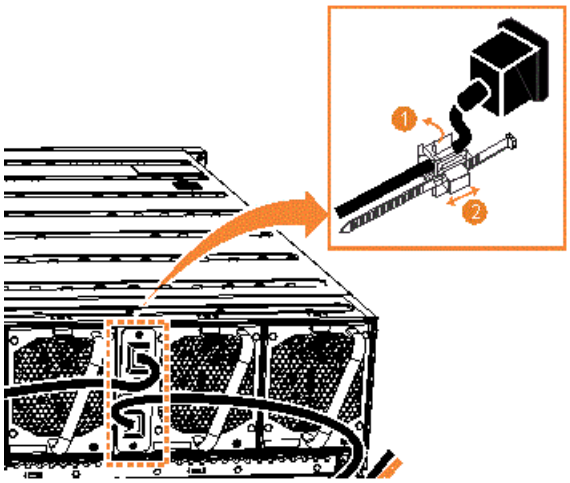



*Figure 52. Secure power cables*

**Important:** Always secure each power cable with a cable retainer and ensure that the cable is installed along one of the cable management arms. When secured, the power and SAS cables stay connected when you slide the expansion enclosure out of the rack to perform service tasks.


*Figure 53. Power and SAS cable connections on the back of the enclosure*

3. Verify that the expansion enclosure and its components are operating as expected.

   On the back of the expansion enclosure, all four fans and the expansion canister indicators (3 and 8 in Figure 54 on page 64) become active when the power is connected.

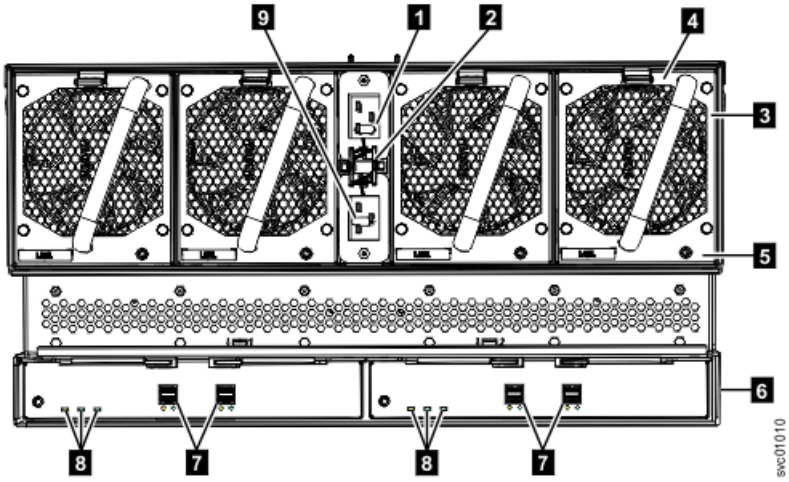



*Figure 54. Features on the rear of the Model 092 expansion enclosure*

1 Power cable connector for PSU 2
2 Power cable retention clamps
3 Fan module
4 Fan release latch
5 Fan fault indicator
6 Expansion canister
7 SAS ports and indicators
8 Expansion canister indicators
9 Power cable connector for PSU 1

4. Verify that both I/O server nodes of the building block recognize expansion enclosure and installed disks.
   a. In both I/O server nodes of the building block, start **`essutils`** in the I/O server node and select **SSR Tools -> Check** the enclosure cabling and paths to disks.
   b. Review the output and take any corrective action needed.

## Powering off the Model 092 expansion enclosure

Before you power off an expansion enclosure, review the following procedure.

When you power off an expansion enclosure, the drives in that enclosure are no longer available to the declustered array. The missing drive might exceed the enclosure failure protection that results in to resignation of the corresponding recovery group. For more information about removing power from an expansion enclosure, see *IBM Spectrum Scale RAID: Administration* guide.

**Important:** To avoid potential equipment damage during transport and subsequent loss of data, see "Transporting a Model 092 expansion enclosure" on page 65. The procedure describes what to do for the following situations:

- When you are powering off a Model 092 expansion enclosure because you intend to transport it to another location.
- When you intend to move a rack that contains a Model 092 expansion enclosure.

The procedure describes how to remove each drive from the Model 092 enclosure and transport the enclosure. Removing the drives prevents damage to the drives and makes the lighter enclosure easier to move.

1. Stop all I/O to the system from all clients that access the file system, which is defined on the recovery group that is created in the expansion enclosure.
2. Unmount any associated file systems.

3. Wait 5 minutes for all write data to be flushed to the drives.
4. Stop IBM Spectrum Scale RAID in both I/O servers of the building block.
5. To remove all power from the enclosure, unplug both power cords from the rear of the expansion enclosure.

## Transporting a Model 092 expansion enclosure

To transport an expansion enclosure or an entire rack that contains one or more of these Model 092 enclosures, follow these steps to protect against drive damage:

1. Safely power down the Model 092 enclosure by referring to "Powering off the Model 092 expansion enclosure" on page 64. Do not remove rack power until systems are safely powered down.
2. Transfer all of the drives in the Model 092 enclosure into their original packaging or equivalent packaging for safe transportation.

   The original packaging consists of an anti-static bag for each drive, an inner carton with protective, padded slots for 20 drives, and an outer carton to hold three inner cartons of drives.
3. Disconnect only the cables necessary for the equipment move.
4. Remove the Model 092 enclosure from the rack. See in the Servicing chapter.

   **Note:** An IBM intranet connection is required to access this website.
5. Return all components, except the drives, to the Model 092 enclosure for shipping.

   Do not return the drives to the Model 092 enclosure until the enclosure is at its new location and is not to be moved again.

## Model 092 expansion enclosure LEDs and indicators

The enclosure has several sets of LEDs that provide information about the overall status of the enclosure, power, drives, fans, canisters, and SAS connections. An expansion enclosure has sets of LEDs on the front and rear of the enclosure. Inside of the expansion enclosure, LEDs also indicate the status of the drives and each secondary expander module.

### LEDs on the front of the expansion enclosure

As Figure 55 on page 65 shows, the front of the expansion enclosure contains LEDs for the display panel (1) and for each of the power supply units (3).

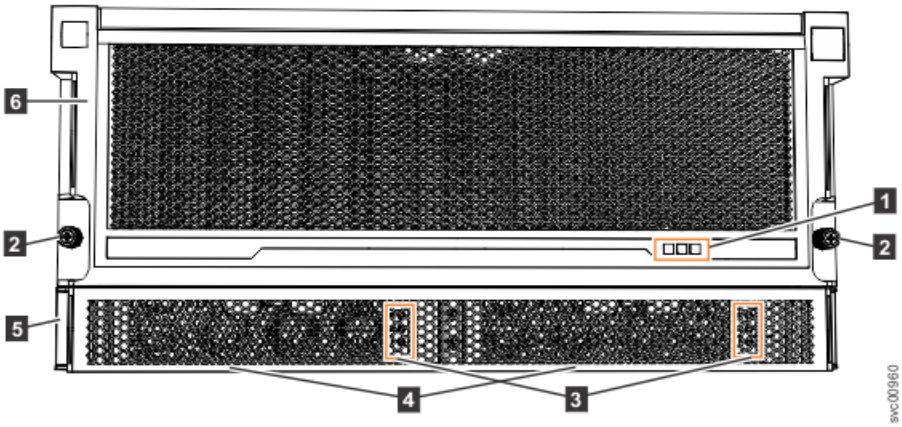



*Figure 55. LEDs on the front of the expansion enclosure*

1 Display panel LEDs
2 Rack retention thumb screws
3 Power supply unit LEDs
4 Power supply units (PSUs)

5 PSU fascia (1U)
6 Front fascia (4U)

The display panel (1) contains three LEDs that describe the operational status of the expansion enclosure. Table 18 on page 66 describes the function and meaning of the LEDs on the front display panel.

*Table 18. Display panel LEDs*

| Function | Color | Status | Description |
|---|---|---|---|
| Power | Green | On | The expansion enclosure power is on; this LED is controlled by the expansion enclosure. |
| | | Off | The expansion enclosure power is off. |
| Identify | Blue | On | Identifies the expansion enclosure; this LED is controlled by the system. Use the management GUI or service interface to identify an enclosure. |
| | | Off | The expansion enclosure is operating normally. |
| Enclosure fault | Amber | On | The expansion enclosure is coming up or a fault is detected against a component within the enclosure. |
| | | Off | No faults are detected. |

The expansion enclosure contains two PSUs (4 in Figure 55 on page 65) that are accessible from the front of the enclosure. Each PSU has its own a set of LEDs, as shown in Figure 56 on page 66.

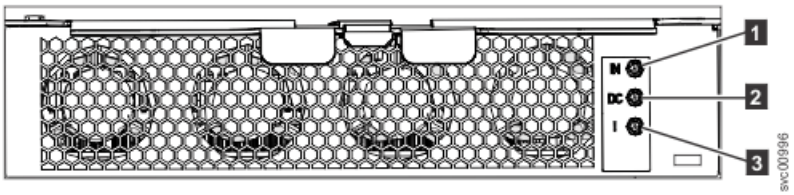



*Figure 56. LEDs on the front of a power supply unit*

1 Input power
2 DC power
3 Fault indicator

Table 19 on page 66 explains the function and status that is indicated by each of the LEDs. The power cords for each PSU are accessible from the rear of the expansion enclosure (1), as shown in Figure 59 on page 68.

*Table 19. Power supply unit LEDs*

| Function | Color | Status | Description |
|---|---|---|---|
| 1 Input power | Green | On | The input voltage is within specification. |
| | | Off | No power input detected. |
| 2 DC power | Green | On | DC power outputs are within specification. |
| | | Off | DC power is not available. |
| 3 Fault | Amber | On | A fault is detected in the PSU. |
| | | Off | No faults are detected. |

### LEDs of drives and secondary expansion modules

Each of the drives and secondary expansion modules within the expansion enclosure has two LED indicators.

Figure 57 on page 67 shows the components of a drive assembly. Each drive has an online indicator (2) and fault indicator (3).

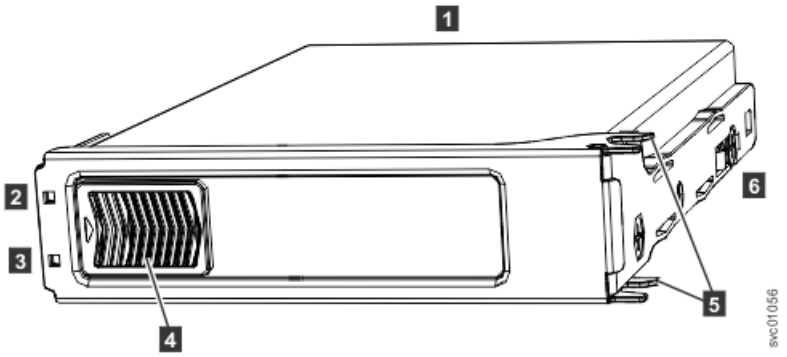



*Figure 57. LEDs on a drive assembly*

Table 20 on page 67 describes the meaning of the LEDs on each drive.

*Table 20. LED indicators on drives*

| Function | Color | Status | Description |
|---|---|---|---|
| 2 Activity | Green | On | The drive is ready to be used. |
| | | Flashing | The drive is operating, and I/O is occurring. |
| | | Off | The drive is not installed, or an installed drive is not ready to be used. |
| 3 Fault | Amber | On | A fault occurred on the drive. The LED is turned off when the drive is removed and replaced. |
| | | Flash | The drive is being identified, a fault might or might not be detected. |
| | | Off | The installed drive is operating normally. |

Figure 58 on page 67 shows the LEDs on a secondary expansion module.

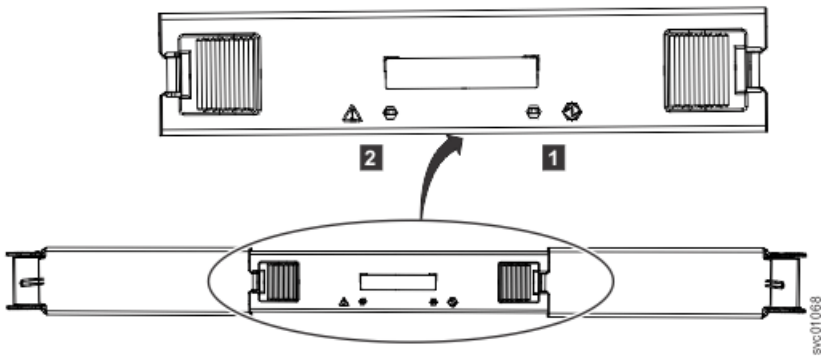



*Figure 58. LEDs on a secondary expansion module*

1 Online indicator
2 Fault indicator

Table 21 on page 68 describes the meaning of the LEDs on each secondary expansion module.

| Table 21. LED indicators on secondary expansion modules | | | |
|---|---|---|---|
| **Function** | **Color** | **Status** | **Description** |
| 1 Power | Green | On | The secondary expansion module is receiving power. |
| | | Flashing | Not used. |
| | | Off | The secondary expansion module is not receiving power. |
| 2 Fault | Amber | On | Not used. |
| | | Flash | The secondary expansion module is being identified. |
| | | Off | The secondary expansion module is operating normally. |

### LEDs on the rear of the expansion enclosure

Figure 59 on page 68 shows the rear view of a Model 092 expansion enclosure. LEDs on the rear of the enclosure provide information about each fan module, each expansion canister, and SAS links.

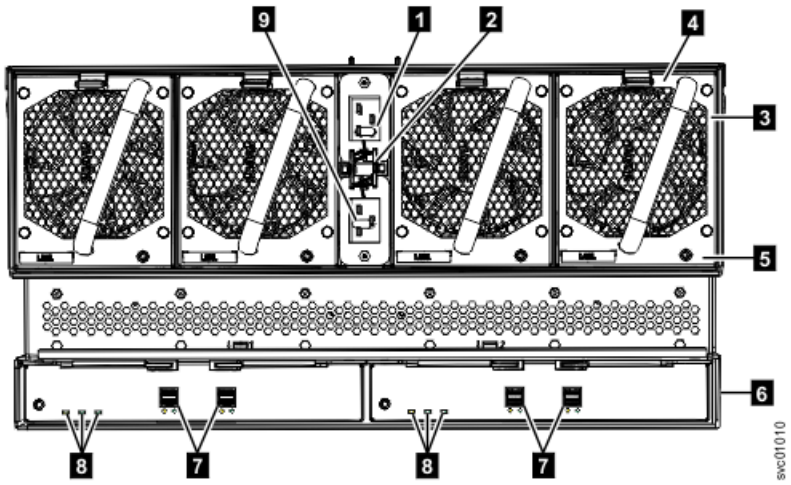



*Figure 59. LEDs on the back of the expansion enclosure*

The expansion enclosure has four fans. Each fan has one LED; for example, Figure 59 on page 68 shows the location of the LED (5) for fan number four. When a fan is operating normally, the LED is not lit. If a fault is detected, the amber LED is lit.

As Figure 59 on page 68 also shows, the expansion enclosure contains two expansion canisters. Each expansion canister contains its own set of LEDs, as shown in Figure 60 on page 68. The LEDs provide status information about the expansion canister itself and the SAS connections.

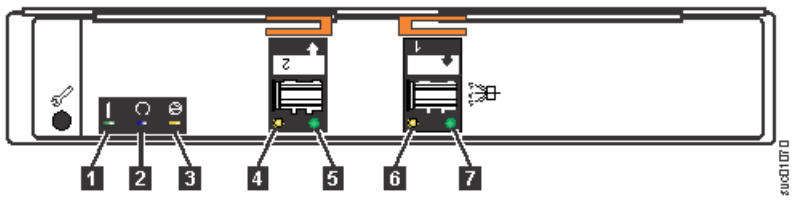



*Figure 60. LEDs on the back of the expansion canister*

1 Canister fault
2 Canister status
3 Canister power

4 and 6 SAS link fault
5 and 7 SAS link operational
8 Canister release handles

Table 22 on page 69 describes the values and meaning of each LED.

*Table 22. Expansion canister and SAS port LEDs*

| Name | Color | State | Meaning |
|---|---|---|---|
| 1 Canister fault | Amber | Off | Normal operation. |
| | | On | A fault was detected. |
| | | Flashing | The expansion canister is being identified. A fault might or might not be detected. |
| 2 Canister status | Green | Off | Canister is off. |
| | | On | Normal operation. |
| | | Flashing | A vital product data (VPD) error occurred. |
| 3 Canister power | Green | Off | Canister is off. |
| | | On | Canister is receiving power. |
| 4 and 6 SAS link fault | Amber | Off | No faults are detected. All four phys have a link connection. |
| | | On | Several error conditions are possible:<br>• Only 1, 2, or 3 phys are connected, but not all 4.<br>• The phys are not operating at the same speed.<br>• All phys are not connected to the same remote port. One or more of the connected lanes are attached to a different address. |
| 5 and 7 SAS link operational | Green | Off | No link connection on any lane. The connection is down. |
| | | On | The SAS link is active. At least one of the four lanes is connected. |

# Chapter 6. Servicing

Service information is intended for IBM authorized service personnel only. Consult the terms of your warranty to determine the extent to which you can attempt to accomplish any IBM ESS 5000 system maintenance.

IBM service support representatives and lab-based services personnel can access service information through the following link:

Servicing (service personnel only)

**Note:** An IBM intranet connection is required.

# Chapter 7. Planning worksheets (customer task)

Customers are responsible for completing the system planning worksheets.

The customer then provides the worksheets to the IBM SSR when they install and configure the system.

## Completing the hardware location chart

Planning for the physical location of the system hardware includes documenting the rack locations of the enclosures and other devices. To determine the rack location, review the requirements and specification of each device.

The hardware location chart represents the rack into which the enclosures are installed. Each row of the chart represents one Electronic Industries Alliance (EIA) 19-inch wide by 1.75-inch tall rack space or unit, each of which is commonly referred to as *1U* of the rack. As you design your rack for your system, use Table 23 on page 73 to record the physical configuration of the enclosures and other devices in your system.

*Table 23. Hardware locations of enclosures and other devices*

| Rack unit | Component |
|---|---|
| EIA 42 | |
| EIA 41 | |
| EIA 40 | |
| EIA 39 | |
| EIA 38 | |
| EIA 37 | |
| EIA 36 | |
| EIA 35 | |
| EIA 34 | |
| EIA 33 | |
| EIA 32 | |
| EIA 31 | |
| EIA 30 | |
| EIA 29 | |
| EIA 28 | |
| EIA 27 | |
| EIA 26 | |
| EIA 25 | |
| EIA 24 | |
| EIA 23 | |
| EIA 22 | |
| EIA 21 | |
| EIA 20 | |
| EIA 19 | |

| *Table 23. Hardware locations of enclosures and other devices (continued)* | |
|---|---|
| **Rack unit** | **Component** |
| EIA 18 | |
| EIA 17 | |
| EIA 16 | |
| EIA 15 | |
| EIA 14 | |
| EIA 13 | |
| EIA 12 | |
| EIA 11 | |
| EIA 10 | |
| EIA 9 | |
| EIA 8 | |
| EIA 7 | |
| EIA 6 | |
| EIA 5 | |
| EIA 4 | |
| EIA 3 | |
| EIA 2 | |
| EIA 1 | |

Table 24 on page 74 lists the rack requirements for a Model 092 expansion enclosure.

| *Table 24. Enclosure models and rack requirements* | | | |
|---|---|---|---|
| **Device** | **Machine type and model** | **Number of EIA units required** | **Notes** |
| Model 092 expansion enclosure | 5147-092 | 5 | 92 3.5-inch drive slots; dual power supplies |

# Accessibility features for the system

Accessibility features help users who have a disability, such as restricted mobility or limited vision, to use information technology products successfully.

## Accessibility features

The following list includes the major accessibility features in IBM Spectrum Scale RAID:

- Keyboard-only operation
- Interfaces that are commonly used by screen readers
- Keys that are discernible by touch but do not activate just by touching them
- Industry-standard devices for ports and connectors
- The attachment of alternative input and output devices

IBM Knowledge Center, and its related publications, are accessibility-enabled. The accessibility features are described in IBM Knowledge Center (www.ibm.com/support/knowledgecenter).

## Keyboard navigation

This product uses standard Microsoft Windows navigation keys.

## IBM and accessibility

See the IBM Human Ability and Accessibility Center (www.ibm.com/able) for more information about the commitment that IBM has to accessibility.

# Glossary

This glossary provides terms and definitions for the IBM Elastic Storage System solution.

The following cross-references are used in this glossary:

- *See* refers you from a non-preferred term to the preferred term or from an abbreviation to the spelled-out form.
- *See also* refers you to a related or contrasting term.

For other terms and definitions, see the IBM Terminology website (opens in new window):

http://www.ibm.com/software/globalization/terminology

**B**

**building block**
A pair of servers with shared disk enclosures attached.

**BOOTP**
See *Bootstrap Protocol (BOOTP)*.

**Bootstrap Protocol (BOOTP)**
A computer networking protocol that is used in IP networks to automatically assign an IP address to network devices from a configuration server.

**C**

**CEC**
See *central processor complex (CPC)*.

**central electronic complex (CEC)**
See *central processor complex (CPC)*.

**central processor complex (CPC)**
A physical collection of hardware that consists of channels, timers, main storage, and one or more central processors.

**cluster**
A loosely-coupled collection of independent systems, or *nodes*, organized into a network for the purpose of sharing resources and communicating with each other. See also *GPFS cluster*.

**cluster manager**
The node that monitors node status using disk leases, detects failures, drives recovery, and selects file system managers. The cluster manager is the node with the lowest node number among the quorum nodes that are operating at a particular time.

**compute node**
A node with a mounted GPFS file system that is used specifically to run a customer job. ESS disks are not directly visible from and are not managed by this type of node.

**CPC**
See *central processor complex (CPC)*.

**D**

**DA**
See *declustered array (DA)*.

**datagram**
A basic transfer unit associated with a packet-switched network.

**DCM**
See *drawer control module (DCM)*.

**declustered array (DA)**
A disjoint subset of the pdisks in a recovery group.

**dependent fileset**
A fileset that shares the inode space of an existing independent fileset.

**DFM**
See *direct FSP management (DFM)*.

**DHCP**
See *Dynamic Host Configuration Protocol (DHCP)*.

**direct FSP management (DFM)**
The ability of the xCAT software to communicate directly with the Power Systems server's service processor without the use of the HMC for management.

**drawer control module (DCM)**
Essentially, a SAS expander on a storage enclosure drawer.

**Dynamic Host Configuration Protocol (DHCP)**
A standardized network protocol that is used on IP networks to dynamically distribute such network configuration parameters as IP addresses for interfaces and services.

**E**

**Elastic Storage System (ESS)**
A high-performance, GPFS NSD solution made up of one or more building blocks. The ESS software runs on ESS nodes - management server nodes and I/O server nodes.

**ESS Management Server (EMS)**
An xCAT server is required to discover the I/O server nodes (working with the HMC), provision the operating system (OS) on the I/O server nodes, and deploy the ESS software on the management node and I/O server nodes. One management server is required for each ESS system composed of one or more building blocks.

**encryption key**
A mathematical value that allows components to verify that they are in communication with the expected server. Encryption keys are based on a public or private key pair that is created during the installation process. See also *file encryption key (FEK)*, *master encryption key (MEK)*.

**ESS**
See *Elastic Storage System (ESS)*.

**environmental service module (ESM)**
Essentially, a SAS expander that attaches to the storage enclosure drives. In the case of multiple drawers in a storage enclosure, the ESM attaches to drawer control modules.

**ESM**
See *environmental service module (ESM)*.

**Extreme Cluster/Cloud Administration Toolkit (xCAT)**
Scalable, open-source cluster management software. The management infrastructure of ESS is deployed by xCAT.

**F**

**failback**
Cluster recovery from failover following repair. See also *failover*.

**failover**
(1) The assumption of file system duties by another node when a node fails. (2) The process of transferring all control of the ESS to a single cluster in the ESS when the other clusters in the ESS fails. See also *cluster*. (3) The routing of all transactions to a second controller when the first controller fails. See also *cluster*.

**failure group**
A collection of disks that share common access paths or adapter connection, and could all become unavailable through a single hardware failure.

**FEK**
See *file encryption key (FEK)*.

**file encryption key (FEK)**
A key used to encrypt sectors of an individual file. See also *encryption key*.

**file system**
The methods and data structures used to control how data is stored and retrieved.

**file system descriptor**
A data structure containing key information about a file system. This information includes the disks assigned to the file system (*stripe group*), the current state of the file system, and pointers to key files such as quota files and log files.

**file system descriptor quorum**
The number of disks needed in order to write the file system descriptor correctly.

**file system manager**
The provider of services for all the nodes using a single file system. A file system manager processes changes to the state or description of the file system, controls the regions of disks that are allocated to each node, and controls token management and quota management.

**fileset**
A hierarchical grouping of files managed as a unit for balancing workload across a cluster. See also *dependent fileset*, *independent fileset*.

**fileset snapshot**
A snapshot of an independent fileset plus all dependent filesets.

**flexible service processor (FSP)**
Firmware that provides diagnosis, initialization, configuration, runtime error detection, and correction. Connects to the HMC.

**FQDN**
See *fully-qualified domain name (FQDN)*.

**FSP**
See *flexible service processor (FSP)*.

**fully-qualified domain name (FQDN)**
The complete domain name for a specific computer, or host, on the Internet. The FQDN consists of two parts: the hostname and the domain name.

**G**

**GPFS cluster**
A cluster of nodes defined as being available for use by GPFS file systems.

**GPFS portability layer**
The interface module that each installation must build for its specific hardware platform and Linux distribution.

**GPFS Storage Server (GSS)**
A high-performance, GPFS NSD solution made up of one or more building blocks that runs on System x servers.

**GSS**
See *GPFS Storage Server (GSS)*.

**H**

**Hardware Management Console (HMC)**
Standard interface for configuring and operating partitioned (LPAR) and SMP systems.

**HMC**
See *Hardware Management Console (HMC)*.

**I**

**IBM Security Key Lifecycle Manager (ISKLM)**
For GPFS encryption, the ISKLM is used as an RKM server to store MEKs.

**independent fileset**
A fileset that has its own inode space.

**indirect block**
A block that contains pointers to other blocks.

**inode**
The internal structure that describes the individual files in the file system. There is one inode for each file.

**inode space**
A collection of inode number ranges reserved for an independent fileset, which enables more efficient per-fileset functions.

**Internet Protocol (IP)**
The primary communication protocol for relaying datagrams across network boundaries. Its routing function enables internetworking and essentially establishes the Internet.

**I/O server node**
An ESS node that is attached to the ESS storage enclosures. It is the NSD server for the GPFS cluster.

**IP**
See *Internet Protocol (IP)*.

**IP over InfiniBand (IPoIB)**
Provides an IP network emulation layer on top of InfiniBand RDMA networks, which allows existing applications to run over InfiniBand networks unmodified.

**IPoIB**
See *IP over InfiniBand (IPoIB)*.

**ISKLM**
See *IBM Security Key Lifecycle Manager (ISKLM)*.

**J**

**JBOD array**
The total collection of disks and enclosures over which a recovery group pair is defined.

**K**

**kernel**
The part of an operating system that contains programs for such tasks as input/output, management and control of hardware, and the scheduling of user tasks.

**L**

**LACP**
See *Link Aggregation Control Protocol (LACP)*.

**Link Aggregation Control Protocol (LACP)**
Provides a way to control the bundling of several physical ports together to form a single logical channel.

**logical partition (LPAR)**
A subset of a server's hardware resources virtualized as a separate computer, each with its own operating system. See also *node*.

**LPAR**
See *logical partition (LPAR)*.

**M**

**management network**
A network that is primarily responsible for booting and installing the designated server and compute nodes from the management server.

**management server (MS)**
An ESS node that hosts the ESS GUI and xCAT and is not connected to storage. It must be part of a GPFS cluster. From a system management perspective, it is the central coordinator of the cluster. It also serves as a client node in an ESS building block.

**master encryption key (MEK)**
A key that is used to encrypt other keys. See also *encryption key*.

**maximum transmission unit (MTU)**
The largest packet or frame, specified in octets (eight-bit bytes), that can be sent in a packet- or frame-based network, such as the Internet. The TCP uses the MTU to determine the maximum size of each packet in any transmission.

**MEK**
See *master encryption key (MEK)*.

**metadata**
A data structure that contains access information about file data. Such structures include inodes, indirect blocks, and directories. These data structures are not accessible to user applications.

**MS**
See *management server (MS)*.

**MTU**
See *maximum transmission unit (MTU)*.

**N**

**Network File System (NFS)**
A protocol (developed by Sun Microsystems, Incorporated) that allows any host in a network to gain access to another host or netgroup and their file directories.

**Network Shared Disk (NSD)**
A component for cluster-wide disk naming and access.

**NSD volume ID**
A unique 16-digit hexadecimal number that is used to identify and access all NSDs.

**node**
An individual operating-system image within a cluster. Depending on the way in which the computer system is partitioned, it can contain one or more nodes. In a Power Systems environment, synonymous with *logical partition*.

**node descriptor**
A definition that indicates how ESS uses a node. Possible functions include: manager node, client node, quorum node, and non-quorum node.

**node number**
A number that is generated and maintained by ESS as the cluster is created, and as nodes are added to or deleted from the cluster.

**node quorum**
The minimum number of nodes that must be running in order for the daemon to start.

**node quorum with tiebreaker disks**
A form of quorum that allows ESS to run with as little as one quorum node available, as long as there is access to a majority of the quorum disks.

**non-quorum node**
A node in a cluster that is not counted for the purposes of quorum determination.

**O**

**OFED**
See *OpenFabrics Enterprise Distribution (OFED)*.

**OpenFabrics Enterprise Distribution (OFED)**
An open-source software stack includes software drivers, core kernel code, middleware, and user-level interfaces.

**P**

**pdisk**
A physical disk.

**PortFast**
A Cisco network function that can be configured to resolve any problems that could be caused by the amount of time STP takes to transition ports to the Forwarding state.

**R**

**RAID**
See *redundant array of independent disks (RAID)*.

**RDMA**
See *remote direct memory access (RDMA)*.

**redundant array of independent disks (RAID)**
A collection of two or more disk physical drives that present to the host an image of one or more logical disk drives. In the event of a single physical device failure, the data can be read or regenerated from the other disk drives in the array due to data redundancy.

**recovery**
The process of restoring access to file system data when a failure has occurred. Recovery can involve reconstructing data or providing alternative routing through a different server.

**recovery group (RG)**
A collection of disks that is set up by ESS, in which each disk is connected physically to two servers: a primary server and a backup server.

**remote direct memory access (RDMA)**
A direct memory access from the memory of one computer into that of another without involving either one's operating system. This permits high-throughput, low-latency networking, which is especially useful in massively-parallel computer clusters.

**RGD**
See *recovery group data (RGD)*.

**remote key management server (RKM server)**
A server that is used to store master encryption keys.

**RG**
See *recovery group (RG)*.

**recovery group data (RGD)**
Data that is associated with a recovery group.

**RKM server**
See *remote key management server (RKM server)*.

**S**

**SAS**
See *Serial Attached SCSI (SAS)*.

**secure shell (SSH)**
A cryptographic (encrypted) network protocol for initiating text-based shell sessions securely on remote computers.

**Serial Attached SCSI (SAS)**
A point-to-point serial protocol that moves data to and from such computer storage devices as hard drives and tape drives.

**service network**
A private network that is dedicated to managing POWER8® servers. Provides Ethernet-based connectivity among the FSP, CPC, HMC, and management server.

**SMP**
See *symmetric multiprocessing (SMP)*.

**Spanning Tree Protocol (STP)**
A network protocol that ensures a loop-free topology for any bridged Ethernet local-area network. The basic function of STP is to prevent bridge loops and the broadcast radiation that results from them.

**SSH**
See *secure shell (SSH)*.

**STP**
See *Spanning Tree Protocol (STP)*.

**symmetric multiprocessing (SMP)**
A computer architecture that provides fast performance by making multiple processors available to complete individual processes simultaneously.

**T**

**TCP**
See *Transmission Control Protocol (TCP)*.

**Transmission Control Protocol (TCP)**
A core protocol of the Internet Protocol Suite that provides reliable, ordered, and error-checked delivery of a stream of octets between applications running on hosts communicating over an IP network.

**V**

**VCD**
See *vdisk configuration data (VCD)*.

**vdisk**
A virtual disk.

**vdisk configuration data (VCD)**
Configuration data that is associated with a virtual disk.

**X**

**xCAT**
See *Extreme Cluster/Cloud Administration Toolkit*.

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