

IBM Elastic Storage System 5000  
6.1.0

*Hardware Guide*



**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 1 modification 0 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)

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## About this information

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### Who should read this information

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

### IBM Elastic Storage System information units

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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 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.	<ul style="list-style-type: none"><li>• System administrators of IBM Spectrum Scale systems</li><li>• Application programmers who are experienced with IBM Spectrum Scale systems and familiar with the terminology and concepts in the XD SM standard</li></ul>

## Related information

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### Related information

For information about:

- IBM Spectrum Scale, see:

[http://www.ibm.com/support/knowledgecenter/STXKQY/ibmspectrumscale\\_welcome.html](http://www.ibm.com/support/knowledgecenter/STXKQY/ibmspectrumscale_welcome.html)

- mmvdisk command, see mmvdisk documentation.
- Mellanox OFED (MLNX\_OFED v4.9-2.2.4.0) Release Notes, go to <https://docs.mellanox.com/display/MLNXOFEDv492240/Release%20Notes>
- DCS3700 storage enclosure, see:
  - *System Storage® DCS3700 Quick Start Guide*, GA32-0960-04:  
<https://www-01.ibm.com/support/docview.wss?uid=ssg1S7005178>
  - *IBM System Storage DCS3700 Storage Subsystem and DCS3700 Storage Subsystem with Performance Module Controllers: Installation, User's, and Maintenance Guide*, GA32-0959-07:  
<http://www.ibm.com/support/docview.wss?uid=ssg1S7004920>
- For information about the IBM Power Systems EXP24S I/O Drawer (FC 5887), see [IBM Knowledge Center](#) :  
[http://www.ibm.com/support/knowledgecenter/8247-22L/p8ham/p8ham\\_5887\\_kickoff.htm](http://www.ibm.com/support/knowledgecenter/8247-22L/p8ham/p8ham_5887_kickoff.htm)
- IBM Spectrum Scale call home, see [Understanding call home](#).
- Installing IBM Spectrum Scale and CES protocols with the installation toolkit, see [Installing IBM Spectrum Scale on Linux® nodes with the installation toolkit](#).
- Detailed information about the IBM Spectrum Scale installation toolkit, see [Using the installation toolkit to perform installation tasks: Explanations and examples](#).
- CES HDFS, see [Adding CES HDFS nodes into the centralized file system](#).
- Installation toolkit ESS support, see [ESS awareness with the installation toolkit](#).
- IBM POWER8® servers, see [IBM Knowledge Center](#):  
<http://www.ibm.com/support/knowledgecenter/POWER8/p8hdx/POWER8welcome.htm>
- Extreme Cluster/Cloud Administration Toolkit (xCAT), go to the [xCAT website](#) :  
<http://xcat.org/>
  - [xCAT 2.16.1 Release Notes®](#)

For the latest support information about IBM Spectrum Scale RAID, see the IBM Spectrum Scale RAID FAQ in [IBM Knowledge Center](#):

<http://www.ibm.com/support/knowledgecenter/SSYSP8/gnrfaq.html>

## Conventions used in this information

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

Table 1. Conventions

Convention	Usage
<b>bold</b>	<p>Bold words or characters represent system elements that you must use literally, such as commands, flags, values, and selected menu options.</p> <p>Depending on the context, <b>bold</b> typeface sometimes represents path names, directories, or file names.</p>
<b><u>bold underlined</u></b>	<u>bold underlined</u> keywords are defaults. These take effect if you do not specify a different keyword.
<b>constant width</b>	<p>Examples and information that the system displays appear in constant-width typeface.</p> <p>Depending on the context, constant-width typeface sometimes represents path names, directories, or file names.</p>
<i>italic</i>	<p><i>Italic</i> words or characters represent variable values that you must supply.</p> <p><i>Italics</i> are also used for information unit titles, for the first use of a glossary term, and for general emphasis in text.</p>
<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 <i>Enter</i> .
\	<p>In command examples, a backslash indicates that the command or coding example continues on the next line. For example:</p> <pre>mkcondition -r IBM.FileSystem -e "PercentTotUsed &gt; 90" \ -E "PercentTotUsed &lt; 85" -m p "FileSystem space used"</pre>
{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.
	<p>In <i>synopsis</i> statements, vertical lines separate a list of choices. In other words, a vertical line means <i>Or</i>.</p> <p>In the left margin of the document, vertical lines indicate technical changes to the information.</p>

## 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



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# Chapter 1. Notices

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## Homologation statement

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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

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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](http://www.ibm.com/support).
  - b. Search for IBM Elastic Storage System 5000.
  - 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](http://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 notices for the system**

Ensure that you are familiar with the danger notices for your system.

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:** When working on or around the system, observe the following precautions:

Electrical voltage and current from power, telephone, and communication cables are hazardous. To avoid a shock hazard: If IBM supplied the power cord(s), connect power to this unit only with the IBM provided power cord. Do not use the IBM provided power cord for any other product. Do not open or service any power supply assembly. Do not connect or disconnect any cables or perform installation, maintenance, or reconfiguration of this product during an electrical storm.



- The product might be equipped with multiple power cords. To remove all hazardous voltages, disconnect all power cords. For AC power, disconnect all power cords from their AC power source. For racks with a DC power distribution panel (PDP), disconnect the customer's DC power source to the PDP.
- When connecting power to the product ensure all power cables are properly connected. For racks with AC power, connect all power cords to a properly wired and grounded electrical outlet. Ensure that the outlet supplies proper voltage and phase rotation according to the system rating plate. For racks with a DC power distribution panel (PDP), connect the customer's DC power source to the PDP. Ensure that the proper polarity is used when attaching the DC power and DC power return wiring.



- Connect any equipment that will be attached to this product to properly wired outlets.
- When possible, use one hand only to connect or disconnect signal cables.
- Never turn on any equipment when there is evidence of fire, water, or structural damage.
- Do not attempt to switch on power to the machine until all possible unsafe conditions are corrected.
- When performing a machine inspection: Assume that an electrical safety hazard is present. Perform all continuity, grounding, and power checks specified during the subsystem installation procedures to ensure that the machine meets safety requirements. Do not attempt to switch power to the machine until all possible unsafe conditions are corrected. Before you open the device covers, unless instructed otherwise in the installation and configuration procedures: Disconnect the attached AC power cords, turn off the applicable circuit breakers located in the rack power distribution panel (PDP), and disconnect any telecommunications systems, networks, and modems.
- Connect and disconnect cables as described in the following procedures when installing, moving, or opening covers on this product or attached devices.

To disconnect:

1. Turn off everything (unless instructed otherwise).
2. For AC power, remove the power cords from the outlets.
3. For racks with a DC power distribution panel (PDP), turn off the circuit breakers located in the PDP and remove the power from the Customer's DC power source.
4. Remove the signal cables from the connectors.
5. Remove all cables from the devices.

To connect:

1. Turn off everything (unless instructed otherwise).
2. Attach all cables to the devices.
3. Attach the signal cables to the connectors.
4. For AC power, attach the power cords to the outlets.
5. For racks with a DC power distribution panel (PDP), restore the power from the Customer's DC power source and turn on the circuit breakers located in the PDP.
6. Turn on the devices.



- Sharp edges, corners and joints might be present in and around the system. Use care when handling equipment to avoid cuts, scrapes and pinching. (D005)



**DANGER:** Heavy equipment—personal injury or equipment damage might result if mishandled. (D006)



**DANGER:** Serious injury or death can occur if loaded lift tool falls over or if a heavy load falls off the lift tool. Always completely lower the lift tool load plate and properly secure the load on the lift tool before moving or using the lift tool to lift or move an object. (D010)



**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 notices for the system

Ensure that you understand the caution notices for the system.

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*.




**CAUTION:** The battery contains lithium. To avoid possible explosion, do not burn or charge the battery.

Do not: Throw or immerse into water, heat to more than 100°C (212°F), repair or disassemble. (C003)



**CAUTION:**

		
33.6-46.3 kg (74-102 lbs)	46.3-61.7 kg (102-136 lbs)	≥61.7-100 kg (136-220 lbs)

snc01053

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:**

High levels of acoustical noise are (or could be under certain circumstances) present.

Use approved hearing protection and/ or provide mitigation or limit exposure. (L018)



**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 (compliance ID RACK-001) or 22U (compliance ID RR001) 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 (compliance ID RACK-001) or 22U (compliance ID RR001) level, unless the received configuration specifically allowed it.
- 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 or in an earthquake environment bolt the rack to the floor.
  - 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)

## 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 IBM Elastic Storage System 5000, 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).
10. Contact technical support if there are any issues.

### ***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. Contact technical support if there are any issues.

### ***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

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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-Mitgliedsstaaten und 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、P F C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

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## 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 A.  
В жилых помещениях оно может создавать  
радиопомехи, для снижения которых необходимы  
дополнительные меры

russepi

## Taiwan Notice

警告使用者：

這是甲類的資訊產品，在居住的環境中使用時，可能會造成射頻干擾，在這種情況下，使用者會被要求採取某些適當的對策。

taitemi

### IBM Taiwan Contact Information:

台灣IBM 產品服務聯絡方式：  
台灣國際商業機器股份有限公司  
台北市松仁路7號3樓  
電話：0800-016-888

f2c00790

## 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](mailto:fccinfo@us.ibm.com)



## Chapter 2. System overview

IBM Elastic Storage System 5000 (ESS 5000) is a high-capacity storage system that uses the GPFS file system. It combines the IBM Elastic Storage System (5105) on the IBM POWER9 architecture with the IBM Spectrum Scale software, which provides the clustered file system.

ESS 5000 can be configured with the following hardware to create an enterprise-level solution:

- IBM Elastic Storage System data server node, protocol node, and ESS management server (5105-22E)
- Model 106 (5147-106) or Model 092 (5147-092) expansion enclosures
- 7965-S42 rack

### High-level architecture

IBM Spectrum Scale RAID is the most important component of the ESS 5000 software stack. IBM Spectrum Scale RAID is a software implementation of storage RAID technologies within IBM Spectrum Scale. It implements sophisticated data placement and error-correction algorithms to deliver high levels of storage reliability, availability, and performance. Standard GPFS file systems are created from the NSDs that are defined through IBM Spectrum Scale RAID.

The following figure illustrates the high-level software architecture of the ESS 5000 system:

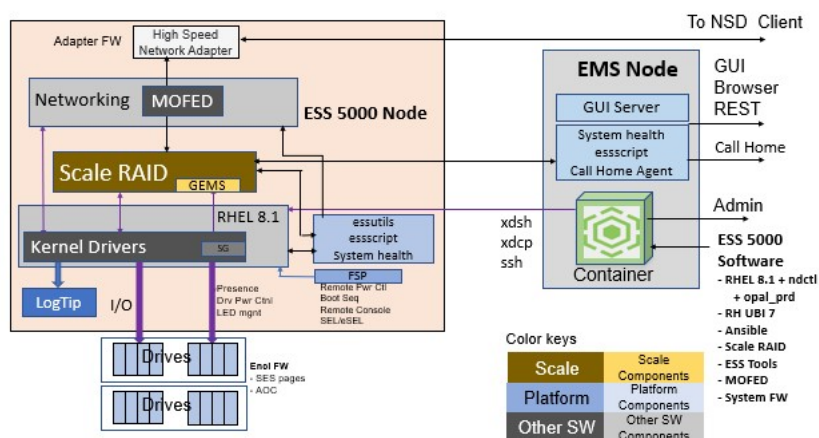


Figure 1. ESS 5000 high-level software architecture

For more information about the IBM Spectrum Scale RAID features, see *IBM Spectrum RAID Administration Guide* in *Elastic Storage Server Knowledge Center*.

An EMS node in an ESS 5000 cluster provides system management functions. ESS 5000 GUI runs on the EMS nodes and provides management and health monitoring capabilities. The EMS node also runs a container with Ansible® playbooks that can provide orchestration of complex tasks, such as cluster configuration, file system creation, and code update. The following figure shows high-level view of the system management topology:

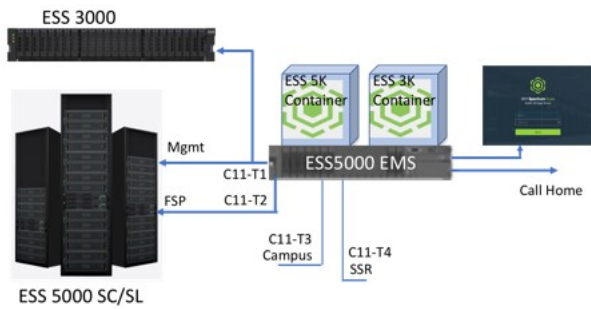


Figure 2. System management topology

The following figure lists the components of a management container:

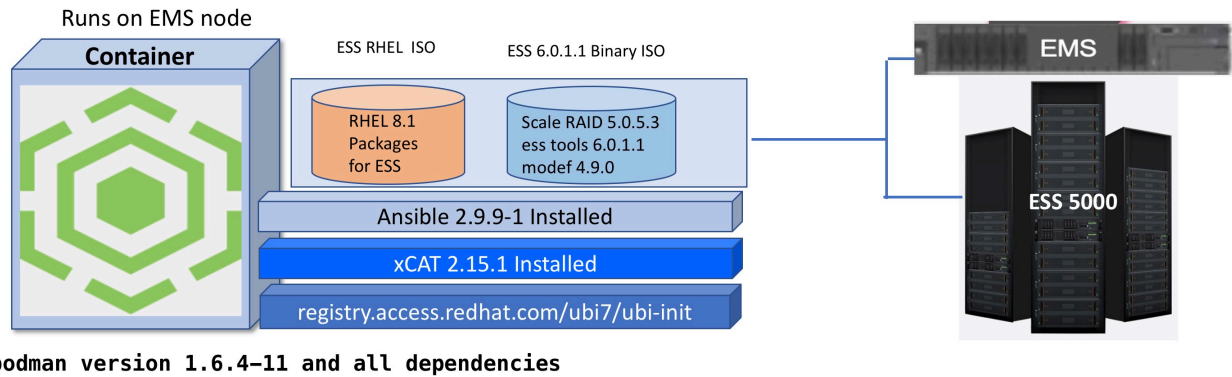


Figure 3. Components of a management container

## Servers

The following types of servers are used in the ESS 5000 system:

- ESS management server
- Protocol node
- Data server node

All these servers are based on the IBM POWER9 architecture. All these server types are having the same MTM (5105-22E).

### ESS management server

The ESS management server (EMS) manages and deploys the data server nodes and hosts the graphical user interface (GUI). The specifications of the EMS server are as follows:

- 1x DD2.3 20 Small Cores, 190W/225W, 2.5GHz/2.9GHz
- 128 GB default memory, no NVDIMMs
- No HBAs
- The same NIC/fabric options as the NSD server
  - C9, C6, C12, C7
- 2x SFF HDD capacity 1.8 TB

The ESS 5000 EMS node can be used to manage both ESS 3000 and ESS 5000 systems as shown in the following figure:

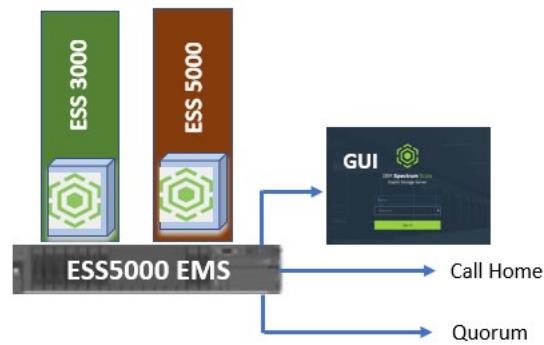


Figure 4. EMS in ESS 5000 environment

## Data server node

The specifications of the data server node are as follows:

- **Processor**
  - 2x DD2.3 20 Small Cores, 190W/225W, 2.5GHz/2.9GHz
- **Memory**
  - Total 32 DDR4 IS DIMM slots.
  - 6 RDIMM per socket: 32 GB (default), 64 GB, 128 GB @ 2400 MHz
  - 384 GB, 768 GB, 1.5 TB capacities @ 128 GB/s
  - 2 NVDIMM per socket, 16 GB per, @ 2400 MHz. Logtip only
  - 32 GB @ 42.6 GB/s interleaved per socket
  - 2x SFF HDD capacity 1.8 TB
- **Storage**
  - EJ1F Solstice +Fandango 8 SFF backplane
  - Mirrored SFF HDD, local boot only
  - NVMe not used
  - NVLink not used
- **PCIe slots**
  - 5x gen3 X8 HBA: Broadcom 9305-16e fc ESA5
    - C2, C6, C7, C8, C12
  - 3x gen4 x16 CX5
    - C3, C9, C4
  - 1x gen3 x4 Austin Ethernet management, C11
  - See I/O matrix for full list

## Protocol node

The ESS access methods are like the ones for accessing an IBM Spectrum Scale cluster. Depending on the required configuration, the ESS can be accessed as an IBM Spectrum Scale client, with a specific connector, or through dedicated protocol node servers. The specifications of the protocol node are as follows:

- 2x DD2.3 20 Small Cores, 190W/225W, 2.5GHz/2.9GHz
- Default and min 192 GB, no NVDIMMs
- Option for 1x DD3.2 proc with min 128 GB min memory

- 2x SFF HDD capacity 1.8 TB
- Up to seven network adapters

## ESS 5000 product line-up

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Based on the enclosure that is used in the ESS 5000 system, the following variants of ESS 5000 products are available:

- ESS 5000 SC series
- ESS 5000 SL series

### **ESS 5000 SC series**

The main features of the ESS 5000 SC series are as follows:

- Uses the 5147-106 enclosures.
- Uses up to six network adapters per ESS system.
  - 25G Ethernet, 100G Ethernet, 100G InfiniBand
- HDD options available are 10 TB, 14 TB, and 16 TB

The following figure shows the basic building block of the ESS 5000 system with Model 106 expansion enclosures:



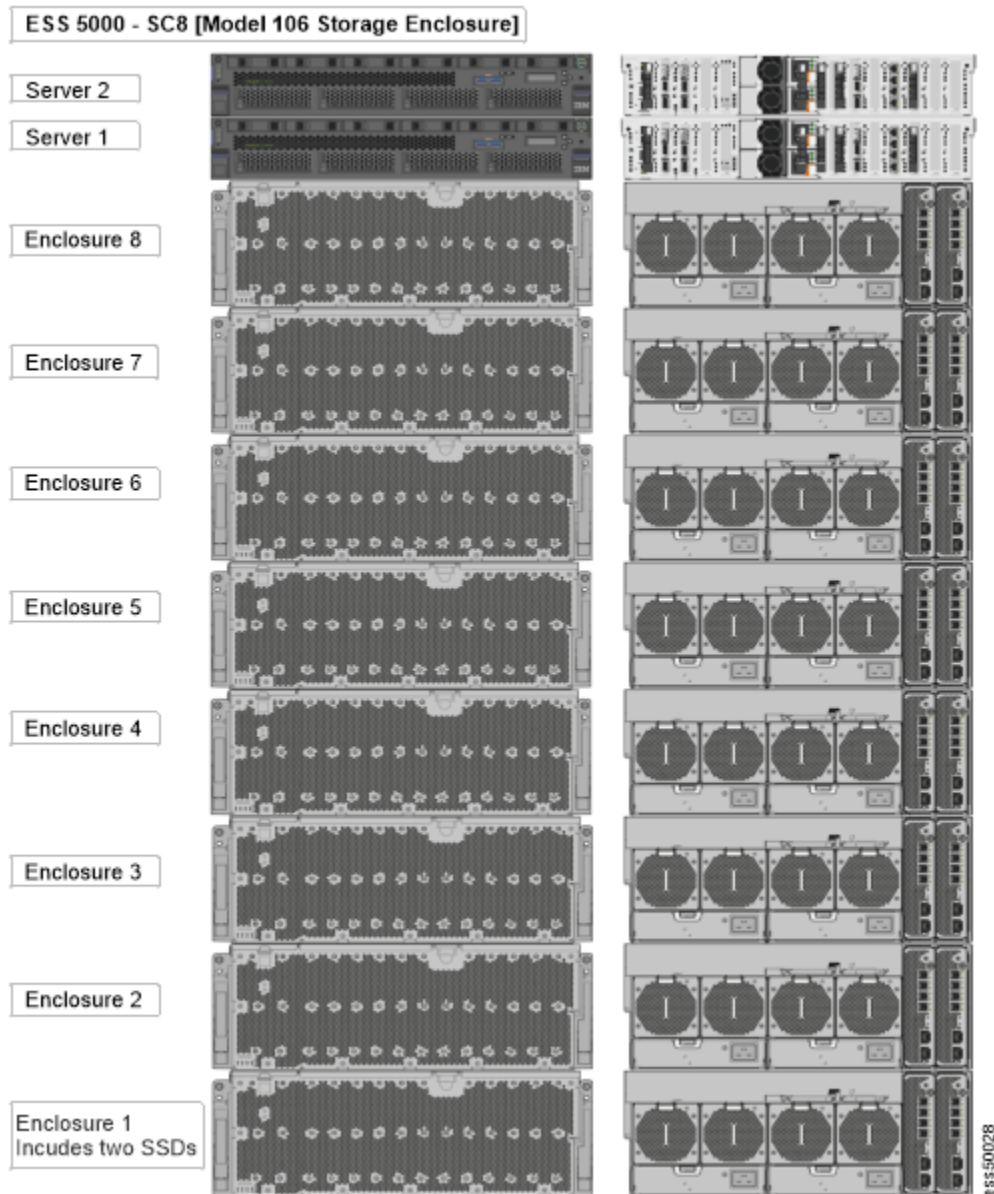


Figure 5. ESS 5000 system with Model 106 expansion enclosures

The following figure shows different configurations that are available under the raw capacity of ESS 5000 SC variants SC series:

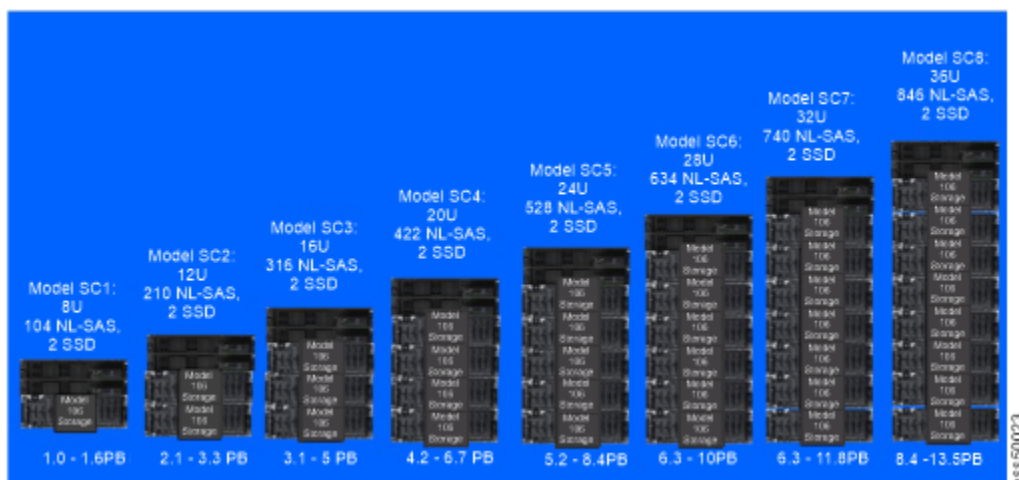


Figure 6. Raw capacity of ESS 5000 SC variants

## ESS 5000 SL series

The main features of the ESS 5000 SL series are as follows:

- Uses the 5147-092 enclosures.
- Uses up to six network adapters per ESS system.
  - 25G Ethernet, 100G Ethernet, 100G InfiniBand
- Four HDD options: 6 TB, 10 TB, 14 TB, and 16 TB

The following figure shows the basic building block of the ESS 5000 system with Model 092 expansion enclosures:

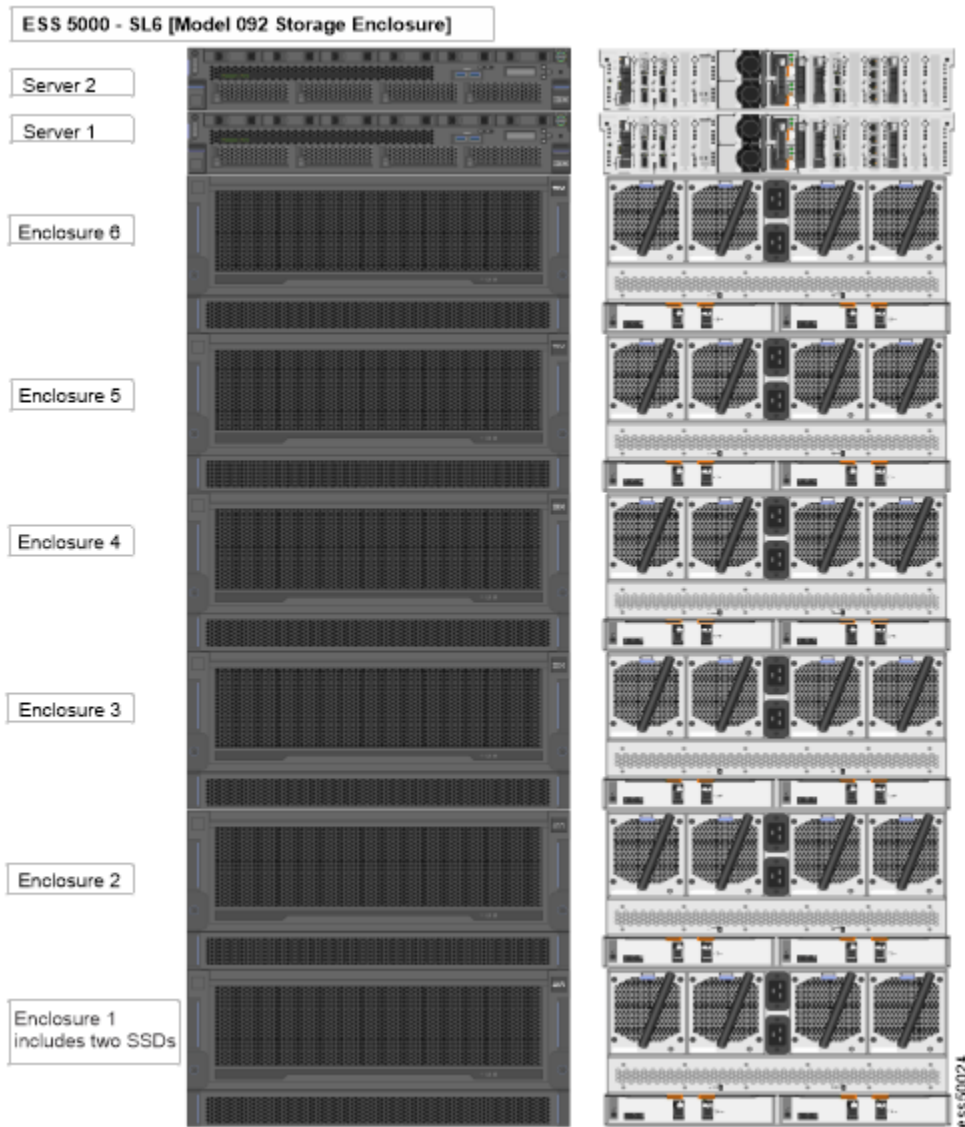


Figure 7. ESS 5000 with Model 092 expansion enclosures

The following figure shows the different configurations that are available under the ESS 5000 SL series and their raw capacities:

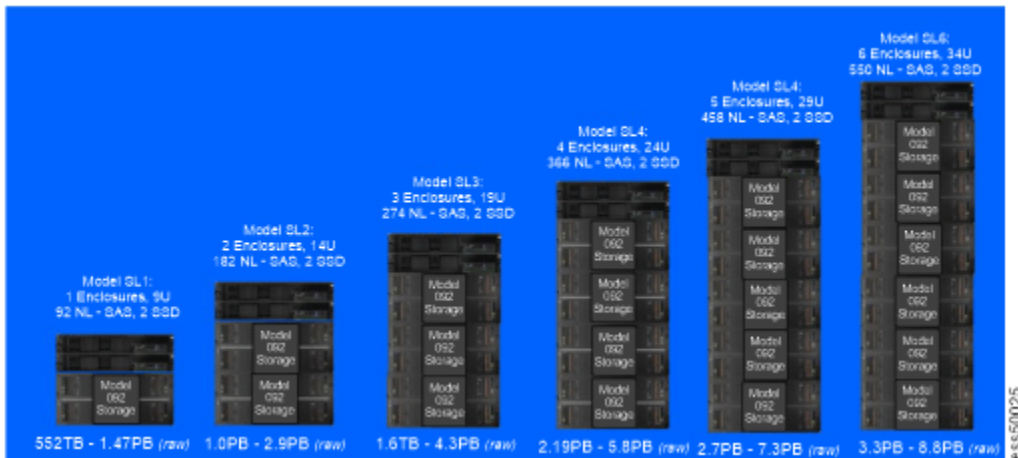


Figure 8. Raw capacity of ESS 5000 SL variants

# Enclosures

Enclosures are the storage expansion units that are mounted on the rack.

ESS 5000 system can have the following enclosures:

- IBM Elastic Storage System 5000 Expansion – Model 106 (5147-106): The ESS 5000 system with this type of expansion enclosure is known as the IBM ESS 5000 SC series.
- IBM Elastic Storage System 5000 Expansion – Model 092 (5147-092): The ESS 5000 system with this type of expansion enclosure is known as the IBM ESS 5000 SL series.

## IBM Elastic Storage System 5000 Expansion – Model 106 (5147-106)

The Model 106 has a 4U chassis. It holds up to 106 low profile (1-inch high) 3.5-inch form factor disk drive modules in a vertical orientation. Alternatively, disk slots can hold a low profile (5/8-inch high) 2.5-inch form factor disk with an adapter within the large form factor carrier.

The following figure shows the rear portion of the 5147-106 enclosure:

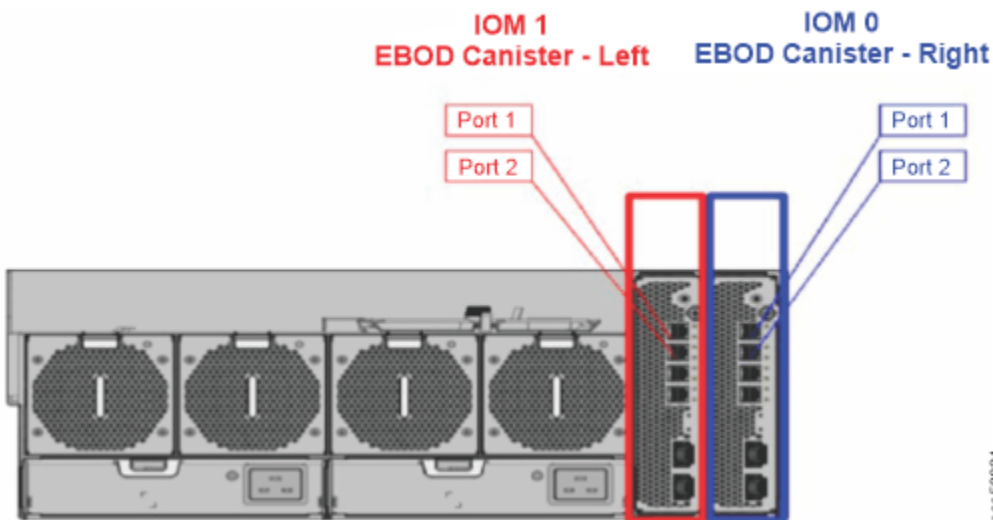


Figure 9. Model 106 expansion enclosure rear view

The following figure shows disk locations in the 5147-106 expansion enclosure:


4U106 Enclosure Drive Locations									
SSD	Disk 97	Disk 99	Disk 101	Disk 103	Disk 105	IOM Fan Module 4/5		IOM 0	
	Disk 98	Disk 100	Disk 102	Disk 104	Disk 106			IOM 1	
Enclosure Front	Disk 1	Disk 13	Disk 25	Disk 37	Disk 49	Disk 61	Disk 73	Disk 85	Fan Module 3
	Disk 2	Disk 14	Disk 26	Disk 38	Disk 50	Disk 62	Disk 74	Disk 86	
	Disk 3	Disk 15	Disk 27	Disk 39	Disk 51	Disk 63	Disk 75	Disk 87	
	Disk 4	Disk 16	Disk 28	Disk 40	Disk 52	Disk 64	Disk 76	Disk 88	Fan Module 2
	Disk 5	Disk 17	Disk 29	Disk 41	Disk 53	Disk 65	Disk 77	Disk 89	
	Disk 6	Disk 18	Disk 30	Disk 42	Disk 54	Disk 66	Disk 78	Disk 90	
	Disk 7	Disk 19	Disk 31	Disk 43	Disk 55	Disk 67	Disk 79	Disk 91	Fan Module 1
	Disk 8	Disk 20	Disk 32	Disk 44	Disk 56	Disk 68	Disk 80	Disk 92	
	Disk 9	Disk 21	Disk 33	Disk 45	Disk 57	Disk 69	Disk 81	Disk 93	
	Disk 10	Disk 22	Disk 34	Disk 46	Disk 58	Disk 70	Disk 82	Disk 94	Fan Module 0
	Disk 11	Disk 23	Disk 35	Disk 47	Disk 59	Disk 71	Disk 83	Disk 95	
	Disk 12	Disk 24	Disk 36	Disk 48	Disk 60	Disk 72	Disk 84	Disk 96	
Sideplane 0	Sideplane 1	Sideplane 2	Sideplane 3	Sideplane 4	Sideplane 5	Sideplane 6	Sideplane 7		

Figure 10. Model 106 expansion enclosure disk locations



## IBM Elastic Storage System 5000 Expansion – Model 092 (5147-092)

The Model 092 enclosure 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 following figure shows the rear portion of the 5147-092 enclosure:

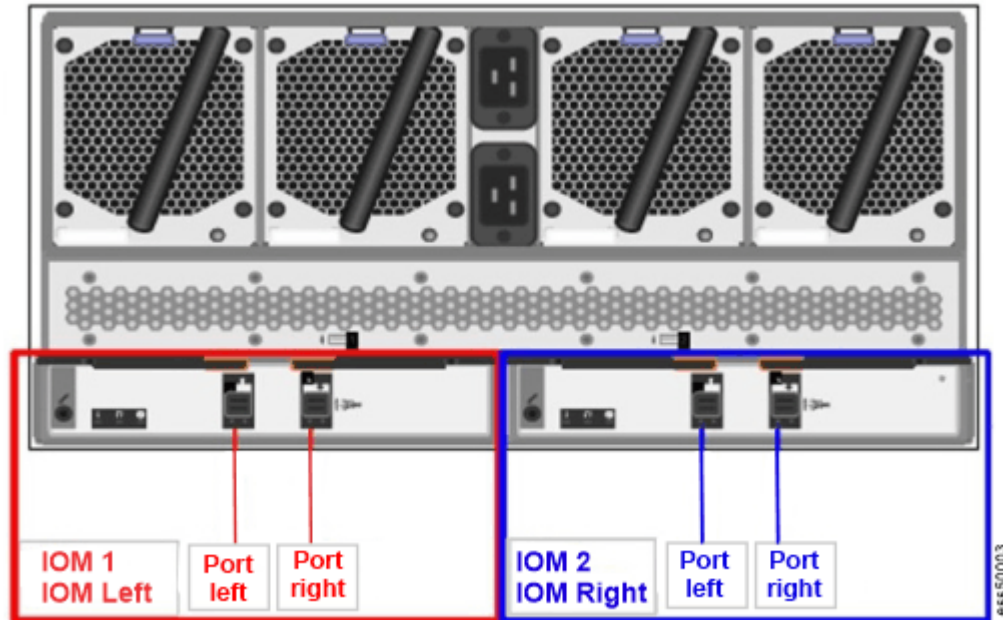


Figure 11. Model 092 expansion enclosure rear view

The following figure shows the disk locations in the Model 092 expansion enclosure:

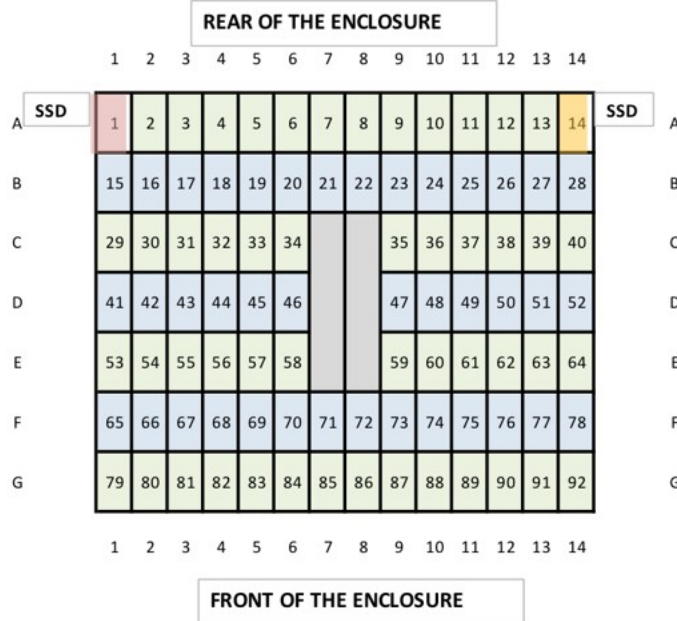


Figure 12. Model 092 expansion enclosure disk locations

## Network topology

An Elastic Storage Server network includes the following components:

- Management or provisioning network: The container requires the management or provisioning network for all deployment-related activities. This primarily evolves code updates, network, and cluster setup commands via Ansible.
- Clustering Network: This is a high-speed network based on InfiniBand (IB), or 10-Gigabit Ethernet, or 40-Gigabit Ethernet that is used by the IBM Spectrum Scale clients to access data on the Elastic Storage Server solution.
- External or campus management network: This network is used to remotely access and manage the EMS and HMC.
- Service or FSP network: The EMS requires this network to power control the POWER9 servers and to collect Call Home data.

Figure 13 on page 26 shows the ESS 5000 network topology of a mixed ESS 5000 cluster, which contains ESS 3000 and IBM POWER9 servers.

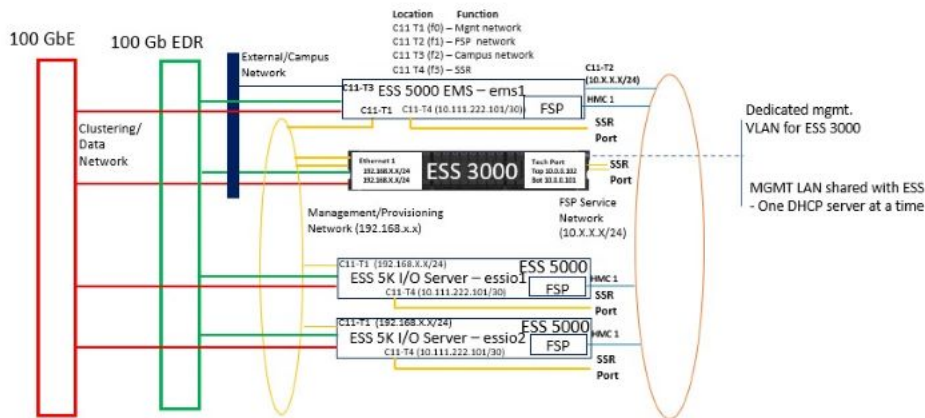


Figure 13. ESS 5000 network topology

**Note:** Although connecting EMS to the clustering network is optional, if there is only one building block, the EMS helps to keep the quorum in a data server node outage. Also, the high-speed network can be used to gather data used by a GUI software.

## Data server nodes

Figure 14 on page 26 shows the data server node P2P cabling.

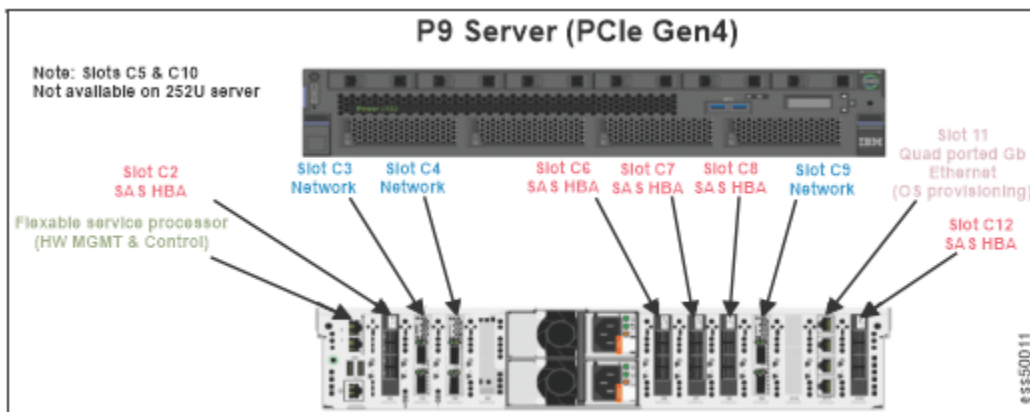


Figure 14. data server node P2P cabling

## Protocol node

Figure 15 on page 27 shows the protocol node P2P cabling.

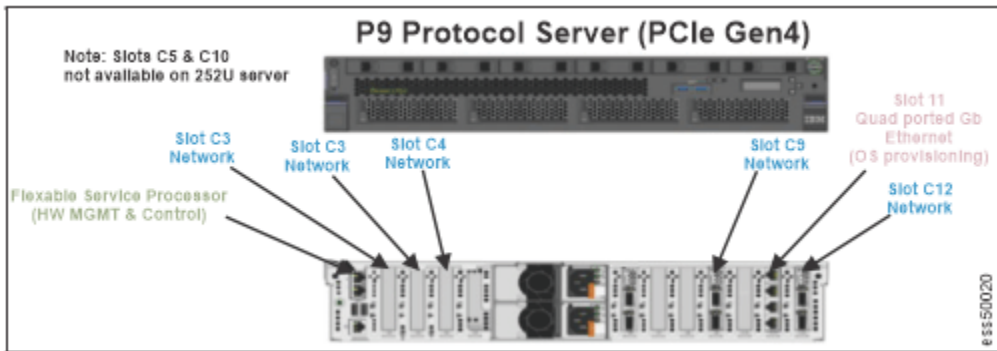


Figure 15. Protocol node P2P cabling

## ESS management server

Figure 16 on page 27 shows the EMS server P2P cabling.

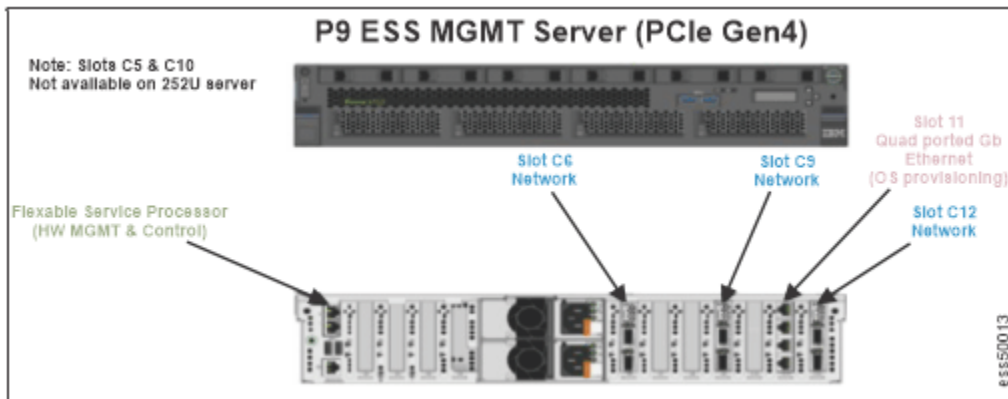


Figure 16. EMS server P2P cabling

## SAS HBA port schema

Figure 17 on page 27 shows the SAS HBA port schema.

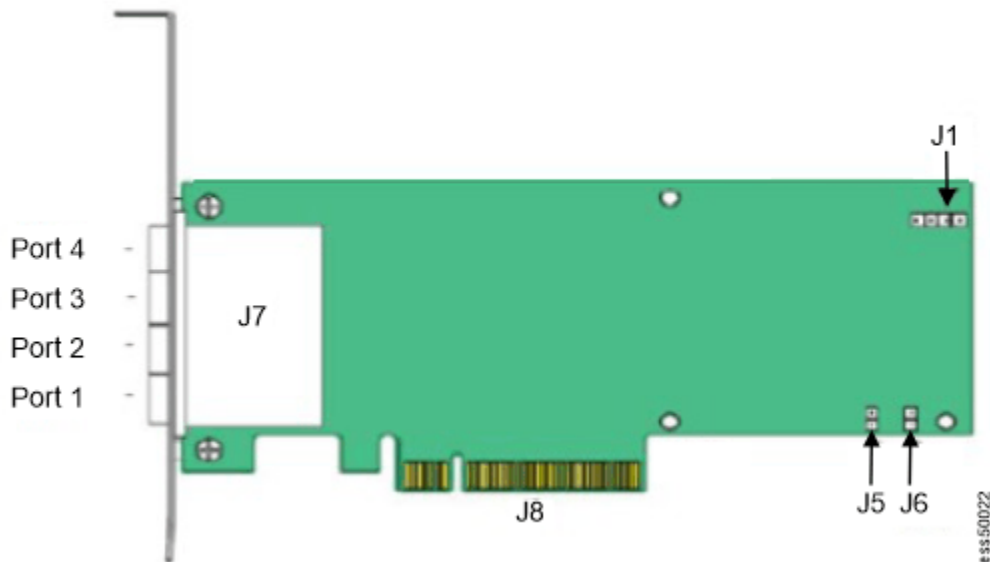


Figure 17. SAS HBA port schema

## Operating system and software levels

---

The supported software levels are as follows:

- Linux embedded Red Hat® Enterprise Linux 8.1
- IBM Spectrum Scale 5.0.5.1
- IBM Elastic Storage System 5000 6.0.1

## Reliability, availability, and serviceability features

---

The major reliability, availability, and serviceability (RAS) features are as follows:

- Disk Hospital
- Call home
- Concurrent maintenance
  - No server adapters, uses failover
  - HDD/SSD
  - Redundant cooling
  - Redundant power supply
    - 1+1 1400W PS, 200 - 240 VAC
  - JBOD drives and select components
  - Enclosure only with enclosure protection

## Warranty information

---

See the [Warranty Information PDF](#) for details of the warranty.



## Chapter 3. Installing

An IBM Service Support Representative (SSR) must install and configure the ESS 5000 system by following the plan that you provide to them.

### Network

The following figure illustrates ESS 5000 network connections and shows an optional ESS 3000 server:

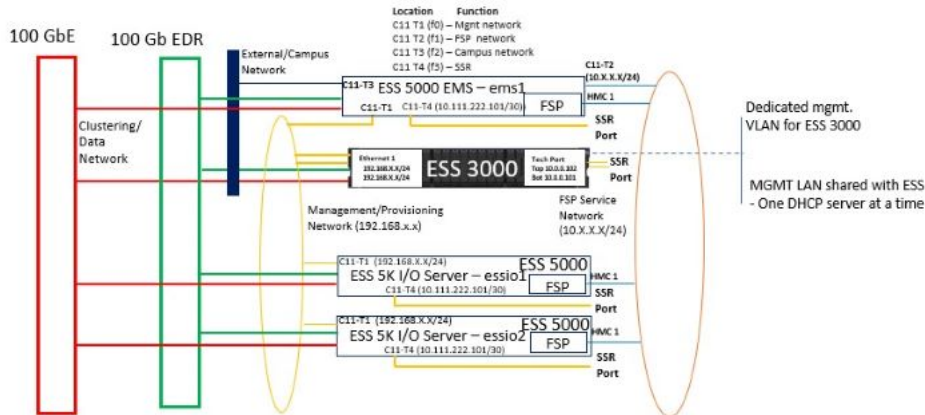


Figure 18. ESS 5000 network

### Starting system state

- ESS 5000 comes from manufacturing CSC tested with the latest GA code. All hardware is validated as 'clean' before it leaves CSC. CSC cleans up the system (tear down the file system, cluster, SSH keys, and so on), and perform an SSR test (**essutils** simulation) before shipping.
- The system can be ordered racked or rackless. The racked system configuration is as follows:
  - ESS 5000 management server (EMS) (5105-22E)
  - Two or more ESS 5000 (5105-22E) protocol nodes (optional)
  - One or more ESS 5000 building blocks (5105-22E)
    - Building block consists of two ESS 5000 data server nodes and one or more storage enclosures.
    - Solution offerings are SC (Model 106) and SL (Model 092) series
  - 1 Gb management switch (required) – preconfigured with the proper VLANs
  - High-speed switch (100 Gb Ethernet or 100 Gb InfiniBand) – The customer may choose to use own supported switch and not purchase from IBM.
  - Ethernet cables run
  - Power cables run
- Root passwords are set to expire – the default password is 'ibmesscluster'.
- HMC1 FSP IP address is cleared.
- Default SSR port (C11-T4) IP address is 10.111.222.101 per node.
- The ASMI and IPMI passwords are set to the server serial number.

## Installation prerequisites (SSR task)

---

Customers must fill the “Installation worksheet” on page 51 for the SSR to start installation. This process must be done by using the Technical Delivery Assessment (TDA) process. The installation worksheet describes the IP addresses that the SSR sets on each node.

The SSR might need the following things for the ESS 5000 installation:

- Ethernet cable
- USB-C (or USB-A) to Ethernet dongle (This connector is required if your laptop does not have an Ethernet port.)
- Serial cable for POWER9™ servers (the serial cable is also used for the management switch.)
- USB-C (or USB-A) to Serial dongle

If available, power on the high-speed switch(es) and connect the Ethernet or InfiniBand cables to the adapters that are installed within the POWER9 servers. This step must be done before the customer can deploy the cluster but is not required for code 20. The low-speed Ethernet cables must be run to the proper locations on both switch and server sides before code 20 can begin (If the system came racked with the management switch this step is done in manufacturing).

The goal is to install the hardware and perform a full code 20. After performing the code 20, SSR should provide the following information to the customer or LBS. Fill information such as installation notes in the “Installation worksheet” on page 51.

## Installation steps (SSR task)

---

This section is a high-level overview of the tasks that an IBM service support representative (SSR) performs to complete code 20.

### SSR objectives

#### Note:

- Ping tests are performed in this flow to verify that the management or FSP IP addresses were properly set up and the switch is configured correctly. Typically, you ping to or from the EMS at the end of the flow to verify these addresses.
- When the default /24 (255.255.255.0) netmask option is provided, most commands take the */mask* format.

If you need an alternative mask, that is 255.255.255.252, you must use /30. For a complete list of masks, see [Subnet Mask Cheat Sheet](#).

1. Log in by using the SSR ID (essserv1) and run the specified **essutils** command options on each server in the following order:
  - a. One or more ESS 5000 building blocks
  - b. Two or more ESS 5000 protocol nodes
  - c. An ESS 5000 management server (EMS)

**Note:** This is the order to be followed for a new customer. If you are adding a building block or protocol node(s) the sequence is adjusted slightly.
2. Set the root password to `ibmesscluster` from within **essutils**. This password is set to expire from manufacturing but must be set to run the **essutils** SSR task options.
3. Perform all specified hardware validation options. You will run a subset of the commands for the EMS and protocol nodes, if available. The data server nodes have more checks because they are connected via SAS to the storage enclosures.

4. Set HMC1 and OS management IP address. On the EMS, you also need to set the FSP interface on the OS. For more information about the interface and the IP address, see [“Installation worksheet” on page 51](#).
5. Perform ping test from the EMS to the data server nodes and the protocol nodes. This ping test is performed to check whether connections to the management (C11-T1) and FSP interfaces (HMC1) are working properly.
6. Document issues on the customer worksheet for use by the customer or LBS.
7. Each **essutils** command option displays a red or green system output. For any red system output, try to debug the issue by using the system output, and rerun the command. For more information about the **essutils** command error debug, see *IBM Elastic Storage System 5000: Problem Determination Guide*.

If you have any general issues when you run the **essutils** flow, see [Chapter 4, “Troubleshooting \(SSR tasks\),” on page 45](#).

## Installation flow

Connect USB to Ethernet dongle to your laptop, if no direct Ethernet connection is available.

When the SSR connects a laptop to each server, an IP address will automatically be assigned (10.111.222.102). The ping tests to SSR port [“Checking data server nodes” on page 32](#) and [“Checking ESS management server and protocol nodes” on page 42](#) fail, set the following static IP address manually and try again:

- IP address: 10.111.222.102
- Netmask: 255.255.255.252

## Node combination rules

---

The node combination rules are as follows:

- If you are installing only an EMS and/or protocol node, skip to [“Checking ESS management server and protocol nodes” on page 42](#).
- If you are adding additional building blocks to an existing configuration, run only the flow [“Checking data server nodes” on page 32](#). Request the customer to provide a node already on the management network that can be used to test ping.
- If you are adding additional protocol nodes to an existing configuration, run only the flow [“Checking ESS management server and protocol nodes” on page 42](#). Request the customer to provide a node already on the management network that can be used to test ping.

## Mixing ESS 3000, ESS 5000, and/or legacy ESS

IBM service support representatives (SSRs) must follow the following sequence of steps when they are installing multiple solutions at one time:

1. Always start with WCII. WCII document has a table that shows what to do based on what the order is whether they are racked or unracked. The WCII shows how to rack any Power-based nodes.
2. Use the *IBM Elastic Storage System 5000: Hardware Installation Guide* to do the following steps:
  - a) Complete the installation on Power nodes (including EMS), and then perform the installation procedure on the ESS 5000 nodes.
  - b) After the racking is complete, start with the building block at the bottom, run the **essutils** tool on each node, and set the management IP address and the HMC1 port.  
Continue with any additional building blocks.
  - c) Check and configure the POWER9 protocol nodes and EMS, if applicable.

- d) After the EMS is checked and IP addresses (Management, FSP IP, HMC1 port) is set, perform ping tests from the EMS to all other Power nodes. If adding a building block this step is not applicable.
3. Use the instructions in the *Elastic Storage System 3000 installation (SSR task)* in the *IBM Elastic Storage System 3000: Hardware Planning and Installation Guide* to check the nodes by using the **essutils** tool, starting with the node that is at the bottom of the rack.

If the EMS is already a part of an existing ESS setup and only ESS 3000 nodes are being added, then perform a ping test from each canister to the EMS.

If the solution consists of only ESS 3000 and (POWER8 or POWER9) EMS with no protocol nodes and there is no ESS 5000, then follow the flow below in the guide to check the EMS first (POWER8 or POWER9) and then ESS 3000 canisters with a ping test back to EMS. If you are adding additional ESS 3000 systems, ESS 5000 systems, and/or POWER9 protocol nodes, then skip the EMS check. Check the nodes by using the **essutils** sequence and perform a ping test from each back to the EMS.

## Checking data server nodes

---

Start the bottom-most build-block in the rack. Starting with data server node 1, which is the bottom data server node in the building block. Then, you will be instructed to check the top node in the building block. Repeat the steps in this procedure for additional data server nodes and building blocks (non-EMS or protocol).

1. Connect the Ethernet cable to C11-T4 (bottom port) of the 1/10 Gb network card. When the Ethernet cable is connected your laptop should automatically obtain a DHCP IP address from the server, which is 10.111.222.102.

**Note:** This card has four ports that are positioned vertically. The top port is connected to the management switch VLAN.

2. Ping the port to ensure whether it is active 10.111.222.101.

**Note:** If you do not get a response, debug the problem to find the reason. First, try to set manually the following static IP on your laptop:

- IP address: 10.111.222.102
- Netmask: 255.255.255.252

3. Use PuTTY, or any alternative terminal, to connect the server by using the SSH client and the following details:

- IP: 10.111.222.101
- Username: essserv1
- Password: Use the server serial number. The password must contain 7 digits – all CAPS.

For example, `ssh essserv1@10.111.222.101`.

An example of how to set an IP in PuTTY for SSH is shown in the following figure. For more information, see [How do I connect using SSH \(Putty\)?](#)

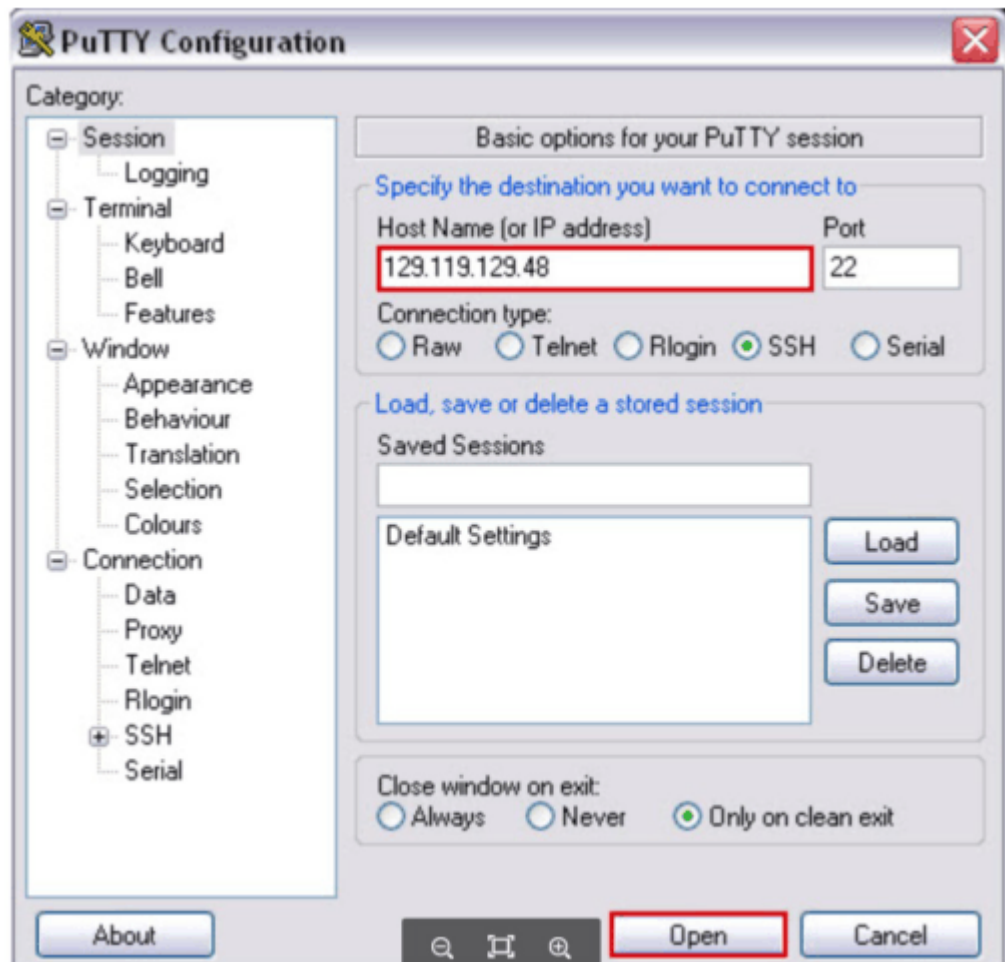


Figure 19. PuTTY configuration example

4. When you log in, press Enter to start the **essutils** tool.

A sample output is as follows:

```
[root@ci145f05zems06 ~]# ssh essserv1@10.10.0.2
essserv1@10.10.0.2's password:
Last failed login: Sat Apr 25 18:17:21 EDT 2020 from 10.10.0.1 on ssh:notty
There was 1 failed login attempt since the last successful login.
('[[INFO]: ESS log directory: '.', '...', '/var/log/ess/esslog_202004251818', '...', 'created.')]
Press Enter to continue...
```

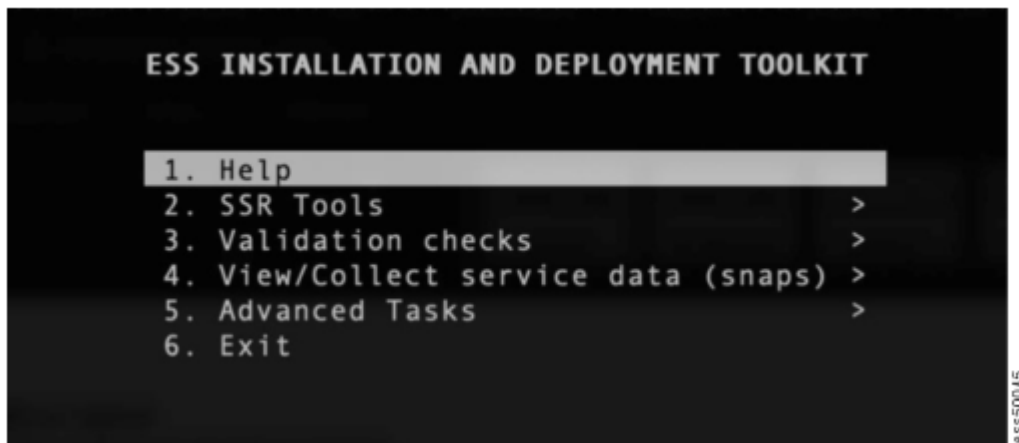
#### Note:

The IP shown in this output is an example. It will be 10.111.222.101 on a real system.

If **essutils** crashes when you logged in, it indicates that the `xterm` value is incorrect. You must log in as a root and run the following command:

```
echo "export XTERM=xterm-256color" >> /home/essserv1/.bash_profile
```

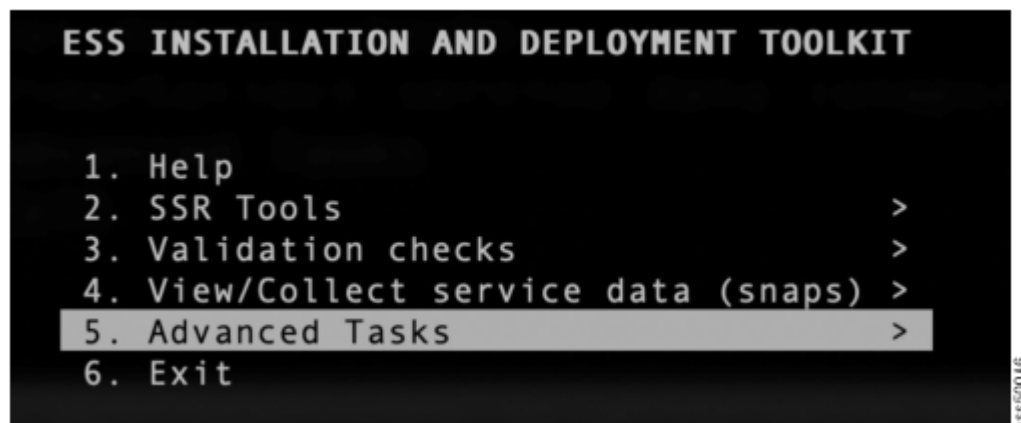
Log out and log in again as **essserv1**. It is a best practice to always use Ethernet (when possible) over a serial connection. For more information see, [Chapter 4, “Troubleshooting \(SSR tasks\),”](#) on page 45.



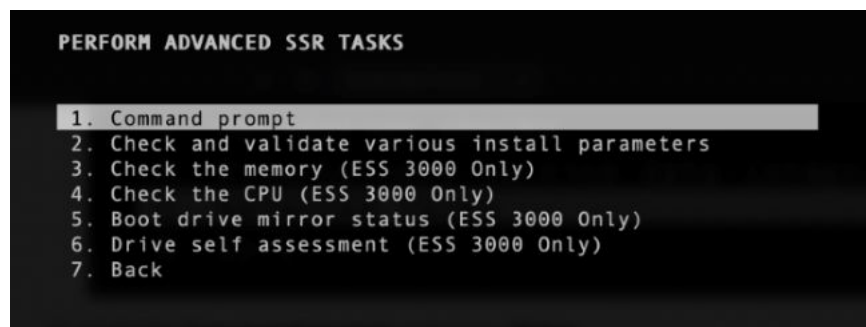
**Note:** Enlarge the PuTTY window to minimum 80 x 24, otherwise **essutils** might not work correctly.

5. Set the root password, by performing the following steps:

- a) In the **ESS installation and deployment toolkit** screen, highlight **Advanced Tasks** as shown in the following figure and then press Enter:



- b) Highlight **Command prompt** and press Enter.



- c) Type the command **passwd** and press Enter.
- d) In the prompt message that appears, change the password to **ibmesscluster** and then press Enter. When you are asked to enter the new password, **ibmesscluster**, again, enter it and then press Enter to accept the change.

```
Running: /bin/bash -r

[root@c145f08zn01 essserv1]# passwd
Changing password for user root.
New password:
Retype new password:
passwd: all authentication tokens updated successfully.
[root@c145f08zn01 essserv1]#
```

e) Type the command `exit` and press Enter. The **essutils Advanced SSR tasks** screen appears again.

f) Highlight **Back** and then press Enter.

g) Highlight **SSR Tools** and then press Enter.

The following menu is displayed:

```

CHECK SYSTEM HARDWARE AND SOFTWARE

1. Help
2. ESS Legacy (p8)      >
3. ESS 3000 SSR checks  >
4. ESS 5000 SSR checks  >
5. Back

```

h) Highlight the **ESS 5000 SSR checks** option and press Enter.

The following menu is displayed:

```

SSR Checks for ESS 5000 nodes

1. Quick storage configuration check
2. Check enclosure cabling and paths to disks
3. Check disks for IO operations
4. Check for servicable event
5. Gather servicable event ID details
6. Erase servicable event ID
7. Set FSP ipmi IP address (HMC1 port)
8. Set FSP ipmi static state and netmask (HMC1 port)
9. Check FSP interface (HMC1 port)
10. Assign IP address to Management Interface (C11-T0)
11. Assign IP address to FSP Interface (EMS ONLY C11-T1)
12. Check management interface (C11-T0)
13. Check FSP interface (EMS ONLY C11-T1)
14. Ping tests
15. Back

```

6. Highlight the **Quick Storage Configuration check** option and then press Enter.



```

Running: /opt/ibm/ess/tools/bin/essstoragequickcheck -N localhost

2020-04-25T18:32:34.395094 Start of storage quick configuration check
2020-04-25T18:32:35.902730 xCAT objects not found for the nodelist localhost
2020-04-25T18:32:35.902981 nodelist: localhost

localhost: IO Server/Canister Type: 5105-22E, Serial: 789888BA
localhost: Valid SAS Adapter Configuration. Number of Adapter(s) found 5
localhost: Slots of SAS Adapter found C7, C8, C12, C6, C2
localhost: Valid Network Adapter Configuration. Number of Adapter(s) found: 3
localhost: Slots of Network Adapter found C9, C4, C3
localhost: Enclosure 5147-092 found 2
localhost: Disk HUH721010AL4200 found 180
localhost: SSD ST800FM0183 found 2
localhost: Total disk found 180, expected 180
localhost: Total ssd found 2, expected 2

2020-04-25T18:33:23.424178 End of storage quick configuration check
[PASS] essstoragequickcheck passed successfully
Press Enter to continue...

```

If the output summary that appears at the end of the screen displays ERROR, see either the *IBM Elastic Storage System 5000: Problem Determination Guide* or the WCII or both to debug the issue.

**Note:** Incorrect adapters or disk placement is usually the issue. Unsupported hardware or missing paths to some disks could also cause an error.

7. Press Enter to continue.
8. Highlight the **Check enclosure cabling and paths to disks** option and then press Enter.

```

Running: /opt/ibm/ess/tools/bin/essfindmissingdisks -N localhost

2020-05-09T19:46:58.780826 Start find missing disk paths
2020-05-09T19:46:58.962528 xCAT objects not found for the nodelist localhost
2020-05-09T19:46:58.962760 nodelist: localhost
2020-05-09T19:46:58.962836 May take long time to complete search of all drive paths

2020-05-09T19:46:59.131326 Checking missing disk paths from node localhost
localhost: GNR server: name c145f08zn01-hs.gpfs.net arch ppc64le model 5105-22E serial 789888BA
localhost: Enclosure 789A36B sees 92 disks (2 SSDs, 90 HDDs)
localhost: Enclosure 789A39W sees 92 disks (0 SSDs, 92 HDDs)
localhost: GNR server disk topology: ESS5K SL2 5-HBA (match: 100/100)
localhost: GNR configuration: 2 enclosures, 2 SSDs, 0 empty slots, 184 disks total, 2 NVRAM partitions
localhost: ERROR: Location 789A36B-8 appears only on the sg197 path
localhost: ERROR: Location 789A39W-6 appears only on the sg7 path
localhost: ERROR: Location 789A39W-8 appears only on the sg7 path
[ERROR] essfindmissingdisks detected error in system. Please review output carefully.
Press Enter to continue...

```

If the output summary that appears at the end of the screen displays ERROR, see either the *IBM Elastic Storage System 5000: Problem Determination Guide* or the WCII or both to debug the issue.

**Note:** Incorrect enclosure cabling, bad disks, or the enclosures in a bad state and should be power cycled can cause an error.

9. Press Enter to continue.
  10. Highlight the **Check disks for IO operations** option and then press Enter.
- A message stating the risks appears.



### SSR Checks for ESS 5000 nodes

1. Quick storage configuration check
2. Check enclosure cabling and paths to disks
3. Check disks for IO operations
4. Check for servicable event
5. Gather servicable event ID details
6. Erase servicable event ID
7. Set FSP ipmi IP address (HMC1 port)
8. Set FSP ipmi static state and netmask (HMC1 port)
9. Check FSP interface (HMC1 port)
10. Assign IP address to Management Interface (C11-T0)
11. Assign IP address to FSP Interface (EMS ONLY C11-T1)
12. Check management interface (C11-T0)
13. Check
14. Ping t
15. Back

This task may change state of the system and/or modify existing data. Type 'Yes' and press Enter to continue.

Response: Yes

a) Type Yes and press Enter to begin the test.

**Note:** This command deletes the data from the disks. If you see a message regarding existing disk descriptors found, exit the command and **essutils** immediately and call IBM Service. Do not type 'Yes' to continue.

When the test is completed, the test summary that indicates PASS or ERROR appears at the bottom of the screen. If the output summary that appears at the end of the screen displays ERROR or if any disks display I/O errors above the given threshold value, see *IBM Elastic Storage System 5000: Problem Determination Guide* or the WCII or both.

**Note:** One or more disks require replacement might be a possible cause of an error.

This operation might take time depending on the size and the number of disks. The number of enclosures is also a major factor. The time that is spent for each disk is reduced for SSRs to speed up the overall test time (5 seconds per disk operation).

11. Press Enter to continue.

12. Highlight the **Check for servicable event** option and then press Enter.

```
Running: /usr/sbin/opal-elog-parse -s
```

ID	Date	Time	SRC	Creator	Event Severity
890000CC	2020-04-25	21:02:49	BC8A1A39	Hostboot	Predictive Error
890000CD	2020-04-25	21:02:49	BC8A1A39	Hostboot	Predictive Error
890000CE	2020-04-25	21:02:49	BC8A1A39	Hostboot	Predictive Error
890000CF	2020-04-25	21:02:50	BC8A1A39	Hostboot	Predictive Error

Press Enter to continue...

Write down the **ID** field for each issue. This field ID is required to retrieve more information in the next step.

13. Press Enter to continue.

14. If applicable, highlight the **Gather servicable event ID details** option and then press c to edit the field.

**Important:** Do not press Enter. Always press c to customize and do the following steps:

- a) Type the ID for which you want additional information.
- b) Press Ctrl+G keys to save.
- c) Press Enter to check the information.

```
SSR Checks for ESS 5000 nodes

1. Quick storage configuration check
2. Check enclosure cabling and paths to disks
3. Check disks for IO operations
4. Check for servicable event
5. Gather servicable event ID details
6. Erase servicable event ID
7. Set FSP ipmi IP address (HMC1 port)
8. Set FSP ipmi static state and netmask (HMC1 port)
9. Check FSP interface (HMC1 port)
10. Assign IP address to Management Interface (C11-T0)
11. Assign IP address to FSP Interface (EMS ONLY C11-T1)

/usr/sbin/opal-elog-parse -d 890001F4

Change command option(s) below. Press Ctrl+G to return.
Modelist/Group:-d 890001F4
Prefix:
Suffix:
cmd options:

/usr/sbin/opal-elog-parse -d 890001F4
Press 'c' to customize command and change the event target. Hit Ctrl+G to save.
```

**Note:** When saved, the changes are displayed at the bottom of the screen as shown in the following figure:

```
/usr/sbin/opal-elog-parse -d 890000CC
Press 'c' to customize command and change the event target. Hit Ctrl+G to save.
```

A sample output is as follows:

```

Running: /usr/sbin/opal-elog-parse -d 890000CC

ERROR parse_opal_event_log: Truncated error log, expected section EH not found
-----
|                                     Private Header                                     |
|-----|
| Section Version      : 1 (PH) |
| Sub-section type     : 0x0    |
| Section Length       : 0x30   |
| Component ID         : 1a00   |
| Created at           : 2020-04-25 | 21:02:49 |
| Committed at         : 2020-04-25 | 21:02:49 |
| Created by           : Hostboot |
| Creator Sub Id       : 0x0 (0), 0x0 (0) |
| Platform Log Id      : 0x890000cc |
| Entry ID             : 0x890000cc |
| Section Count        : 18     |
|-----|
|                                     User Header                                     |
|-----|
| Section Version      : 1 (UH) |
| Sub-section type     : 0x0    |
| Section Length       : 0x18   |
| Component ID         : d900   |
| Subsystem            : Hostboot |
| Event Scope          : Single platform |
| Event Severity       : Predictive Error |
| Event Type           : Not applicable. |
| Action Flags         : Report to Operating System |
|                     : Service Action Required |
|                     : Call Home |
|-----|

```

d) Press **Enter** to continue.

15. If applicable, highlight the **Erase servicable event ID** option if you need to clear any resolved serviceable events and then press c to edit the field.

**Important:** Do not press **Enter**. Always press c to customize and do the following steps:

- a) Type the ID for which you want more information.
- b) Press Ctrl+G keys to save.
- c) Press Enter to clear the event.

16. Highlight the **Set FSP ipmi IP address (HMC1 port)** option to set the HMC1 IP address on the server and then press c to edit the field. The port is connected to FSP VLAN.

**Important:** Do not press Enter. Always press c to customize and do the following steps:

- a) Type an IP that you want to set in the **cmd options** field.

A sample output is as follows:

```

SSR Checks for ESS 5000 nodes

1. Quick storage configuration check
2. Check enclosure cabling and paths to disks
3. Check disks for IO operations
4. Check for servicable event
5. Gather servicable event ID details
6. Erase servicable event ID
7. Set FSP ipmi IP address (HMC1 port)
8. Set FSP ipmi static state and netmask (HMC1 port)
9. Check FSP interface (HMC1 port)
10. Assign IP address to Management Interface (C11-T0)
11. Assign IP address to FSP Interface (EMS ONLY C11-T1)

/bin/ipmitool lan set 1 ipaddr

Change command option(s) below. Press Ctrl+G to return.
Nodelist/Group:
Prefix:
Suffix:
cmd options:ipaddr 10.0.0.50

/bin/ipmitool lan set 1 ipaddr
Set the FSP (HMC port1) ipmi IP address. Press 'c' set ip in cmd options. Hit Ctrl+G to save

```

- b) Press Ctrl+G keys to save.
- c) Press Enter to set the IP.

**Note:** This is the FSP IP (HMC1) that the customer provided for this server on the worksheet. A default address is recommended on the 10.0.0.0/24 (netmask 255.255.255.0) subnet.

- 17. Highlight the **Set FSP ipmi static state and netmask (HMC1 port)** option to set the netmask and the HMC1 port to static. Press Enter if you want a netmask of 255.255.255.0 (/24).
  - a) If you want to change the netmask, press c to edit the field.
  - b) Type the new netmask that you want to set.
  - c) Press Ctrl+G keys to save.
  - d) Press Enter to set.
- 18. Highlight the **Check FSP interface (HMC1 port)** option and then press Enter. This option verifies that the HMC1 IP, static state, and netmask are correctly configured based on your inputs.

```

Running: /bin/ipmitool lan print 1

Set in Progress           : Set Complete
IP Address Source         : Static Address
IP Address                : 172.16.0.118
Subnet Mask               : 255.255.0.0
MAC Address               : 98:be:94:7c:ff:16
Default Gateway IP        : 0.0.0.0
Cipher Suite Priv Max     : Not Available
Bad Password Threshold    : Not Available
Press Enter to continue...

```

**Note:** If anything is not correct, go back to the associated commands and retry.

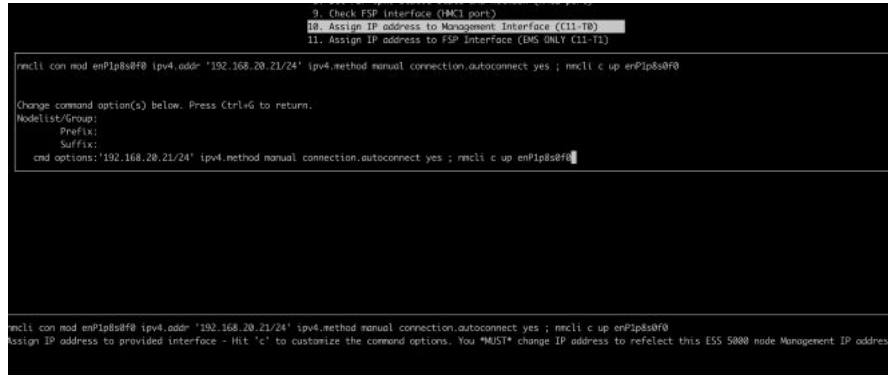
Press Enter to continue.

19. Highlight the **Assign IP address to Management Interface (C11-T1)** option and then press c to edit the field.

**Important:** Do not press Enter. Always press c to customize and do the following steps:

- a) Type an IP and a netmask that you want to set in the **cmd options** field.

The management interface is enP1p8s0f0. This interface is the same on all POWER9 nodes.



```
mcli con mod enP1p8s0f0 ipv4.addr '192.168.20.21/24' ipv4.method manual connection.autocconnect yes ; mcli c up enP1p8s0f0

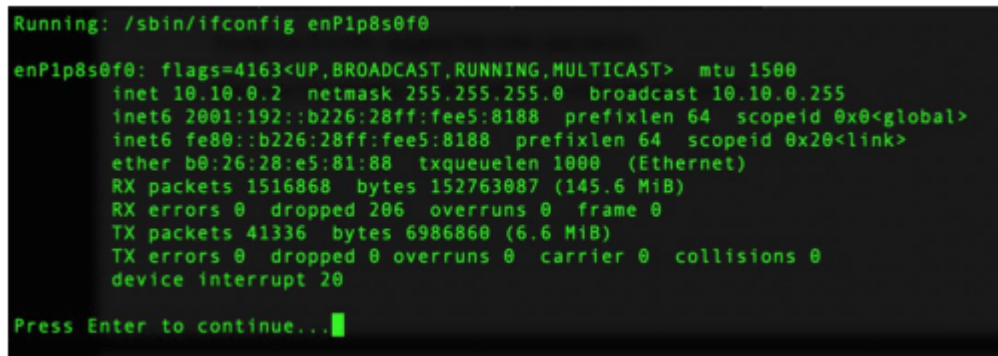
Change command option(s) below. Press Ctrl+G to return.
Modelist/Group:
Prefix:
Suffix:
cmd options: '192.168.20.21/24' ipv4.method manual connection.autocconnect yes ; mcli c up enP1p8s0f0

mcli con mod enP1p8s0f0 ipv4.addr '192.168.20.21/24' ipv4.method manual connection.autocconnect yes ; mcli c up enP1p8s0f0
Assign IP address to provided interface - Hit 'c' to customize the command options. You *MUST* change IP address to reflect this ESS 5000 node Management IP address.
```

**Note:** This is the management interface IP that the customer provided for this server in the “Installation worksheet” on page 51. A default address is recommended on the 192.168.45.0/24 (netmask 255.255.255.0) subnet. The netmask must be in the (/<mask>) format. For example, '/24' for 255.255.255.0.

- b) Press Ctrl+G keys to save.
- c) Press Enter to set the IP.

20. Highlight and click the **Check management interface (C11-T1)** option. Verify that the IP is set correctly and then press Enter.



```
Running: /sbin/ifconfig enP1p8s0f0

enP1p8s0f0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
inet 10.10.0.2 netmask 255.255.255.0 broadcast 10.10.0.255
inet6 2001:192::b226:28ff:fee5:8188 prefixlen 64 scopeid 0x0<global>
inet6 fe80::b226:28ff:fee5:8188 prefixlen 64 scopeid 0x20<link>
ether b0:26:28:e5:81:88 txqueuelen 1000 (Ethernet)
RX packets 1516868 bytes 152763087 (145.6 MiB)
RX errors 0 dropped 206 overruns 0 frame 0
TX packets 41336 bytes 6986860 (6.6 MiB)
TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0
device interrupt 20

Press Enter to continue...
```

The management interface must be enP1p8s0f0.

21. Highlight **Back** and then press Enter to exit.

**Note:**

You must type the exit command, which stops the DHCP server on the node. You are now logged out of the system.

If you are adding only a building-block, perform a ping test to the EMS before you exit from the **essutils** tool. Consult the customer on what the IP of the EMS is so you can perform this test. If you cannot ping to the EMS, attempt to ping between the data server nodes on the newly deployed building-block. To perform a ping test, see “Checking ESS management server and protocol nodes” on page 42.

22. Disconnect the laptop from C11-T4.

**Note:** You need to run all these steps for each additional data server node and/or building-blocks.

## Checking ESS management server and protocol nodes

---

By using the following steps, you can check the ESS protocol nodes and the ESS management server (EMS). Ensure that the EMS is the final node that you check in an order (if applicable). If an EMS is not in the order, skip any ping tests that are specified.

The following hardware checks are the same for the protocol nodes and the EMS because both are not attached to external storage:

Quick storage configuration check

- If you are adding only a protocol node, when the hardware check-out is complete perform the ping test from the protocol node to the existing EMS. Request the customer to provide the EMS IP address.
- If an EMS is in the order, the EMS is always checked last and a ping test is performed from the EMS.
- When you configure the IP addresses for the protocol node, set the following items:
  - C11-T1 – Management VLAN
  - HMC1 port – FSP VLAN
- When you configure the IP addresses for the EMS node, set the following items:
  - C11-T1 – Management VLAN
  - HMC1 port – FSP VLAN
  - C11-T2 – FSP VLAN

**Note:** Always see the Installation worksheet to know what the IP addresses need to be set by using **essutils**.

**Remember:** Use the same SSR port as the data server nodes for p9 EMS or p9 protocol nodes.

Connect point-to-point to C11-T4 (bottom port).

- IP address: 10.111.222.101
- User ID: essserv1
- Password: <Serial number of server>

You can use the same commands that you use to check a data server node except two command options:

**Check enclosure cabling and paths to disks** and **Check disks for IO operations**. You will not run these options because the EMS nor protocol nodes contain any SAS adapter or external storage like the data server nodes. However, when you run **essutils**, perform the following steps:

**Note:** For more information, see Checking data server nodes.

- Set root password to **ibmesscluster**
- Quick storage configuration check
- Check for servicable event
- Gather servicable event ID details (if required)
- Erase servicable event ID (if required)
- Set FSP ipmi IP address (HMC1 port)
- Set FSP ipmi static state and netmask (HMC1 port)
- Check FSP interface (HMC1 port)
- Assign IP address to Management Interface (C11-T1)
- Assign IP address to FSP Interface (EMS ONLY C11-T2)
- Check management interface (C11-T1)
- Check FSP interface (EMS ONLY C11-T2)
- Ping tests
  1. Assign IP addresses.

- a) Set the following three IP addresses of the EMS (On the protocol node you will only set two IP addresses – the same as the data server nodes.). One for C11-T1 (management interface) and HMC1 (FSP connection).

- FSP ipmi IP (HMC1 port)

essutils: **Set FSP ipmi IP address.**

essutils: **Set FSP ipmi static state and netmask.**

- Management interface (enP1p8s0f0)

essutils: **Assign IP address to Management Interface (C11-T0).**

- FSP interface (enP1p8s0f1)

essutils: **Assign IP address to FSP interface (EMS ONLY C11-T1).**

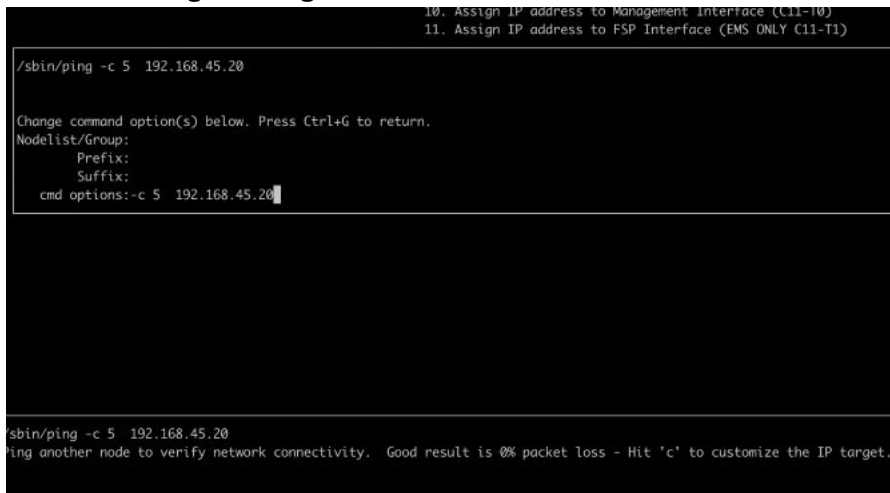
- b) To verify that the IPs were set correct run the following options in **essutils**:

- **Check FSP interface (HMC1 port).**
- **Check management interface (C11-T0).**
- **Check FSP interface (EMS ONLY C11-T1).**

2. Do a ping test from the EMS to the management interface of the first data server node and then the HMC1 port. After the first data server node ping test is complete, do the same ping test for the second data server node. Finally, perform the same ping tests to any protocol nodes (if applicable).

- a) Highlight the **Ping tests** option (do not click).

- b) Press c to change the target IP address.



```
10. Assign IP address to Management Interface (C11-T0)
11. Assign IP address to FSP Interface (EMS ONLY C11-T1)

/sbin/ping -c 5 192.168.45.20

Change command option(s) below. Press Ctrl+G to return.
NodeList/Group:
Prefix:
Suffix:
cmd options:-c 5 192.168.45.20

/sbin/ping -c 5 192.168.45.20
ping another node to verify network connectivity. Good result is 0% packet loss - Hit 'c' to customize the IP target.
```

- c) Change the current IP address with a target IP (usually one of the data server node or protocol nodes management IP addresses).

- d) Press Ctrl + G keys to save.

The test tries five pings to the target node. A successful result means 0% packet loss.



```
Running: /sbin/ping -c 5 10.10.0.12

PING 10.10.0.12 (10.10.0.12) 56(84) bytes of data.
64 bytes from 10.10.0.12: icmp_seq=1 ttl=64 time=0.200 ms
64 bytes from 10.10.0.12: icmp_seq=2 ttl=64 time=0.098 ms
64 bytes from 10.10.0.12: icmp_seq=3 ttl=64 time=0.103 ms
64 bytes from 10.10.0.12: icmp_seq=4 ttl=64 time=0.090 ms
64 bytes from 10.10.0.12: icmp_seq=5 ttl=64 time=0.084 ms

--- 10.10.0.12 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 154ms
rtt min/avg/max/mdev = 0.084/0.115/0.200/0.043 ms
Press Enter to continue...
```

- e) Change the target IP to one of the HMC1 IP address of data server nodes.
  - f) Press Enter to run the command.
  - g) Repeat this process for each node that is being deployed (data server nodes, protocol nodes).
- If the ping is not successful, check the cabling and switch. You might need to log in as root to confirm whether the IP address was set correctly. For more information, see *IBM Elastic Storage System 5000: Problem Determination Guide*.
3. Press Enter to continue.
  4. Do the following final steps:
    - a) Disconnect your laptop from EMS.
    - b) Ensure that no server or enclosure warning LEDs are on. If required, take the appropriate actions.
- If all hardware is clean and IP addresses ping test is successful, Code 20 is completed.



## Chapter 4. Troubleshooting (SSR tasks)

This section will help you to troubleshoot issues that are faced while configuring EMS and Elastic Storage System 5000.

**Note:** Ensure that you have gone through the topic and also followed the steps given in the topic.

### EMS issues

#### EMS Boot issues

When booting up the node, if you face any issue while pinging the FSP interface (C11-T4 IP 110.111.222.101) 5 minutes after pressing the white button, perform the following checks:

- Verify if the Ethernet cable on both the ends has a solid green light.
- Check if your laptop is set to IP 10.111.222.102 and netmask 255.255.255.252.
- Verify that you are plugged into the correct port – C11-T4 on the EMS.

If the issues still persist, shut down the node (hold the white button until blinking again) and perform the following steps:

1. Connect the laptop point-to-point over serial connection, connecting the USB to RJ45 console cable between the auxiliary laptop and the serial port of the server with active ASMI session from the previous section.

**Note:**

- The USB to RJ45 console cable shown in the following figure works for Linux and Windows laptops.
- Identify the right console cable when using an Apple laptop.

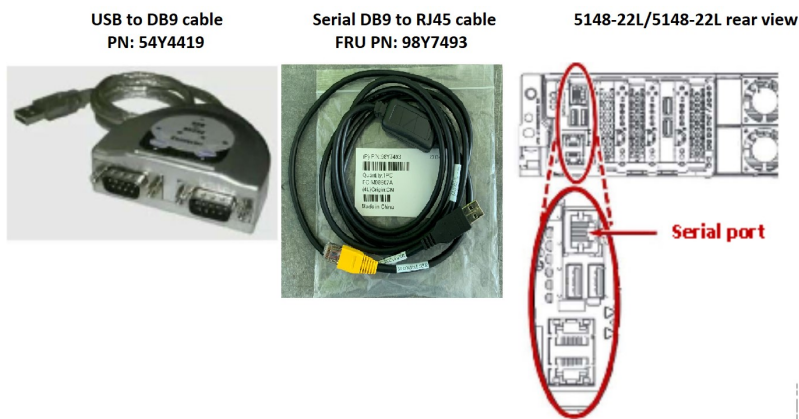


Figure 20. Connecting a laptop to the serial port in the EMS node

2. Open a terminal emulator program such as PuTTY or minicom. Set the following settings for communications using the serial connection:

```
19200 baud rate
Data bits of 8
Parity of None
Stop bits of 1
```

3. For the serial terminal to show an FSP login screen, press any key on the keyboard. Log in using the ASMI credentials:
  - username: **admin**
  - password: *Serial number of server*

4. Manually power on the server by pressing the power button on the front.
  - After powering on the server, the terminal emulator (for example, PuTTY) will display messages during the system boot.

If there is no output, press the **Up Arrow** key and the **Down Arrow** key a few times to make the terminal respond.
  - After the terminal starts showing output as the system boots, pay close attention to detect when the system reaches the **petitboot** menu (it takes a few minutes before it discovers the disks):
    - System pauses the boot process for a few seconds when it gets the **petitboot** menu.
    - Immediately press the **Up Arrow** key and/or the **Down Arrow** key a few times while in the **petitboot** menu.
    - Boot process stops indefinitely and the user will be able to interact with the **petitboot** menu and choose a boot option.
5. In the **petitboot** menu, press the **Up Arrow** key and/or the **Down Arrow** key to select the **redhat** boot option:
  - Do not select the Rescue option.
  - If several **redhat** boot options (besides the **Rescue** option) are shown, select the newest available.
  - Press **Enter** and the server will start to boot the OS. You should see the output going across the screen and come to a login.
6. Log in using the SSR credentials:
  - username: **essserv1**
  - password: **<serial number of server>**

**Note:** You must set the terminal variable correctly before attempting to run any commands. Within PuTTY do the following:

```
export TERM=xterm
```

Continue with the rest of the flow (using **essutils**) to check the EMS and set the management IP address.

If there is an issue with the boot process, you will need to call the technical support.

## EMS login issues

**Note:** The default password is **ibmesscluster** and must be changed after the first login. Customers should be advised to change the password once the SSR task is complete.

If you face issues logging in with username: **essserv1** and password: **<serial number of server>**, perform the following steps:

- Log in as a root user:
  - username: **root**
  - password: **ibmesscluster**

**Note:** You should only log in as root when you cannot log in as **essserv1** and it is an emergency. The root password is set to expire so you will be prompted to change immediately.

- Run **essutils** manually by typing **essutils** and press **Enter**.

## Network switch issues

---

If you have any issues that are related to the management or high-speed switches, see [ESS – Switch Update and Configuration Guide](#).

**Note:** An IBM intranet connection is required to open this document.

Some important chapters in this document are as follows:

- How to manually set up VLANs on the management switch
- Default passwords and help locating
- Resetting switches back to factory defaults
- Best practice settings
- Changing passwords
- Upgrading switch firmware and recommended levels

## SSR port login issues

---

The workaround given in this topic apply to POWER9 EMS or POWER9 protocol nodes only.

By default, you will be given a DHCP IP when connected to C11-T4 of each node. This IP will automatically assign the following IP to your laptop:

- IP address: 10.111.222.102
- Netmask: 255.255.255.252

If the ping test fails to the SSR port (10.111.222.101), attempt to set the IP address statically. If a ping still does not work, the system might be shipped with an old default SSR IP address.

- IP address: 10.0.0.100
- Netmask: 255.255.255.0

Try to set that IP address and attempt ping. If the ping test still does not work (Ensure that the system is also booted up – apply power and press the front white button. Wait minimum 5 minutes though it could be up to 20 minutes to boot a data server.) call IBM service.

## Assigning the management IP address

---

This section covers the issues that you might encounter while you assign the management IP address by using the **essutils** tool. This task requires knowledge of the Linux command line and the Vi editor.

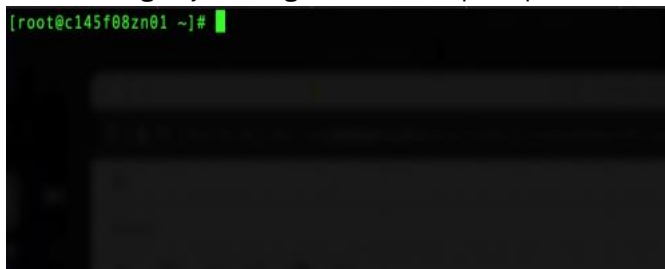
When you see an *interface name*, the interface name is **enP1p8s0f0** for ESS 5000.

If you need to modify the FSP interface (EMS only), use the device name for the EMS as **enP1p8s0f1**.

1. Log in the ESS 5000 or the EMS as a root user.

The default password is **ibmesscluster**. You can be prompted to set the expired password. If you are prompted, set the password to **ibmesscluster** again. (You will be asked to enter the password two times and then press Enter.)

After the login, you are greeted with a prompt.



2. Go to the networks scripts directory and press Enter.

```
cd /etc/sysconfig/network-scripts
```

Example:

```
[root@cl145f08zn01 ~]# cd /etc/sysconfig/network-scripts/  
[root@cl145f08zn01 network-scripts]#
```

3. Open the `ifcfg-` file and press Enter.

```
vi ifcfg-interface name
```

```
[root@cl145f08zn01 network-scripts]# vi ifcfg-enP1p8s0f0
```

A sample output is as follows:

```
DEVICE=enP1p8s0f0  
IPADDR=10.10.0.2  
NETMASK=255.255.255.0  
BOOTPROTO=static  
ONBOOT=yes  
HWADDR=b0:26:28:e5:81:88  
TYPE=Ethernet  
NAME=enP1p8s0f0
```

4. Edit the `ifcfg-` file.

Press 'i' on the keyboard to enter the insert mode. You can see **Insert** at the bottom of the screen.

```
-- INSERT --
```

5. Modify the IP address and netmask.

- a. Based on the information, ensure that you add or modify the **IPADDR** and **NETMASK** lines with the correct information.
- b. Use the keyboard arrows to navigate the file and add the necessary information.

Example:

```
IPADDR=IP ADDRESS  
NETMASK=NETMASK
```

It does not matter where you add these lines in this file.

6. Save the file.
7. Press escape on the keyboard and type **:wq!**.

Example:

```
:wq!
```

8. Bring down and up the interface.

```
ifdown interface name  
ifup interface name
```

Example:

```
ifdown enP1p8s0f0 down
```

ifup **enP1p8s0f0** up

9. Check that the IP address was set.

```
ifconfig interface name
```

Example:

```
ifconfig enP1p8s0f0
```

## Troubleshooting serial console issues

---

To successfully run commands over a serial console, use the following information.

1. If essutils crashes over a serial console, log in as a root and issue the following command:

```
vi /opt/ibm/ess/tools/bin/essutils
```

- a) Locate the following lines in the essutils file:

```
curses.curs_set
```

- b) Comment out these lines. The file contains approximately four instances of this text that you need to comment out.

```
# curses.curs_set
```

- c) Save the file and log in as essserv1.

2. If the essutils tool opens but the window is not large enough, do the following steps:

- a) Ensure that the xterm terminal window is minimum 80x24 or larger.

- b) If the window is still not large, log in as a root and issue the following command:

```
vi /home/essserv1/.profile
```

- c) To enlarge the window, add the following lines before the sudo line:

```
# stty rows 40 cols 130  
# stty erase '^?'
```

- d) Save the file and log in as essserv1.

3. If you cannot delete entries in the essutils file, repeat step 2 and try to delete the entries. If the entries are still not deleted, press Ctrl+D to delete the characters in the essutils window.

4. If the essruntask ping test wrapper fails, log in as a root and run the ping test manually. Older versions of the code use a ping test wrapper that is called essruntask.

```
# ping -c 5 target ip address
```

5. If you cannot set the management or FSP (EMS) IP address, do the following steps:

- a) To set the IP address manually, modify the ifcfg file in /etc/sysconfig/network-scripts manually.

- b) To reload the network service.

```
# systemctl restart network
```

- c) To verify that the IP addresses are set, issue the **ifconfig** command.



## Appendix A. Planning worksheets (customer task)

Customers are responsible for completing the system planning worksheets. Planning worksheets can help you identify important information that is needed when the system is installed and configured.

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

### Installation worksheet

**Note:** The worksheet has default IPs filled out in case they were not provided by the customer during the TDA process. Before setting any default IPs, the customer must confirm that they are not currently in use by the associated networks.

Customers must fill in the following values so that the SSR is able perform the required networking tasks. If there are more than one ESS 5000 nodes are being installed, you need to add the corresponding rows. Customers can download and fill the required information in this [worksheet](#).

Recommendations:

- Keep all management interfaces on 192.168.x.x/24 (netmask 255.255.255.0).
- Keep all FSP (HMC1) interfaces on 10.0.0.x/24 (netmask 255.255.255.0).

**Note:** The EMS has an additional FSP connection at C11-T2, which is visible to the operating system.

**Important:** All IP addresses must be on the same subnet. For example,

- All management interfaces on 192.168.x.x/24
- All FSP interfaces on 10.0.0.x/24

#### ESS 5000 building block

##### Data server node management interfaces

Building blocks	IP address	Netmask
Building block #1		
Data server node 1 management interface (bottom node in the building block)	192.168.45.21	255.255.255.0
Data server node 2 management interface (top node in the building block)	192.168.45.22	255.255.255.0
Building block #2		
Data server node 1 management interface (bottom node in the building block)	192.168.45.23	255.255.255.0
Data server node 2 management interface (top node in the building block)	192.168.45.24	255.255.255.0

**Note:** For additional building blocks, add more rows.

##### Data server node FSP interfaces

Building blocks	IP address	Netmask
Building block #1		
Data server node 1 FSP (HMC1 port) interface (bottom node in the building block)	10.0.0.101	255.255.255.0

Building blocks	IP address	Netmask
Data server node 2 FSP (HMC1 port) interface (bottom node in the building block)	10.0.0.102	255.255.255.0
Building block #2		
Data server node 1 FSP (HMC1 port) interface (bottom node in the building block)	10.0.0.103	255.255.255.0
Data server node 2 FSP (HMC1 port) interface (bottom node in the building block)	10.0.0.104	255.255.255.0

**Note:** For additional building blocks, add more rows.

### ESS 5000 POWER9 protocol nodes

Interfaces	IP address	Netmask
Management interfaces		
Protocol node 1 management Interface (bottom-most)	192.168.45.40	255.255.255.0
Protocol node 2 management Interface (top)	192.168.45.41	255.255.255.0
FSP interfaces		
Protocol node 1 FSP (HMC1 port) interface	10.0.0.105	255.255.255.0
Protocol node 2 FSP (HMC1 port) interface	10.0.0.106	255.255.255.0

**Note:** For additional POWER9 protocol nodes, add more rows.

### ESS 3000

Interfaces	IP address	Netmask
Management interface node 1		
ESS 3000 canister 1 management interface (top)	192.168.45.30	255.255.255.0
ESS 3000 canister 2 management interface (bottom)	192.168.45.31	255.255.255.0
Management interface node 2		
ESS 3000 canister 1 management interface (top)		
ESS 3000 canister 2 management interface (bottom)		

**Note:** For additional building blocks, add more rows.

### EMS POWER9

Interfaces	IP address	Netmask
EMS management interface (C11-T1)	192.168.45.20	255.255.255.0



Interfaces	IP address	Netmask
EMS FSP (C11-T2) interface	10.0.0.1	255.255.255.0
EMS FSP (HMC1 port) interface	10.0.0.100	255.255.255.0

**Note:** Write down any vital information that you encountered during the procedure. This information should be shared with the customer or LBS.

## Call home worksheet

This worksheet contains the steps and prerequisites to set up hardware and software call home.

### Prerequisites

From version 3.3, IBM Electronic Service Agent (ESA) connects to the new IBM server environment that simplifies connectivity and provides enhanced security. This server environment is fully NIST SP800-131A compliant by supporting TLS 1.2 protocol, SHA-256 or stronger hashing functions, and at least 2048-bit strength RSA keys. All ESA transactions to the new environment route through a single hosting environment with only a few IP addresses that are required for outbound connections.

1. Ensure that the 5024 port is open for the incoming traffic on the ESS Management Server (EMS) node.
2. Ensure that firewall allows connections from the EMS node to the IP addresses and ports in the following table:

Domain name	Port	Protocol	IP address
esupport.ibm.com	443	TCP and UDP	129.42.56.189
			129.42.54.189
			129.42.60.189
			2620:0:6c2:200:129.42.60.189
			2620:0:6c1:200:129.42.54.189
			2620:0:6c0:200:129.42.56.189

**Note:** It is recommended to open 129.42.0.0/18.

esupport.ibm.com works for the Call Home uploads as a proxy by forwarding data to ECuRep. Therefore, allowing any direct connections to ECuRep IPs is not required.

3. (Optional) If client internet does not allow direct access to the internet, set up a proxy.

If the proxy requires authentication, set a user ID and a password, and share it with the IBM service personnel.

User ID	Password



---

## Appendix B. 5105 22E: Reference information

For detailed information about 5105 22E, see [PDF files for 5105 22E](#).



## 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 \(www.ibm.com/support/knowledgecenter\)](http://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 \(www.ibm.com/able\)](http://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](http://www.ibm.com/software/globalization/terminology) (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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