

Installation and Setup Quick Start

This document guides you through the setup of a very basic two-node cluster, using the bootstrap scripts provided by the `ha-cluster-bootstrap` package. This includes the configuration of a virtual IP address as a cluster resource and the use of SBD on shared storage as a node fencing mechanism.

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1 Usage Scenario

The procedures in this document will lead to a minimal setup of a two-node cluster with the following properties:

- Two nodes: `alice` (IP: `192.168.1.1`) and `bob` (IP: `192.168.1.2`), connected to each other via network.
- A floating, virtual IP address (`192.168.2.1`) that allows clients to connect to the service no matter which node it is running on. This IP address is used to connect to the graphical management tool Hawk2.
- A shared storage device, used as SBD fencing mechanism. This avoids split-brain scenarios.
- Failover of resources from one node to the other if the active host breaks down (*active/passive* setup).

You can use the two-node cluster for testing purposes or as a minimal cluster configuration that you can extend later on. Before using the cluster in a production environment, see *Book "Administration Guide"* to modify the cluster according to your requirements.

2 System Requirements

This section informs you about the key system requirements for the scenario described in [Section 1](#). To adjust the cluster for use in a production environment, refer to the full list in *Book "Administration Guide", Chapter 2 "System Requirements and Recommendations"*.

2.1 Hardware Requirements

Servers

Two servers with software as specified in [Section 2.2, "Software Requirements"](#).

The servers can be bare metal or virtual machines. They do not require identical hardware (memory, disk space, etc.), but they must have the same architecture. Cross-platform clusters are not supported.


Communication Channels

At least two TCP/IP communication media per cluster node. The network equipment must support the communication means you want to use for cluster communication: multicast or unicast. The communication media should support a data rate of 100 Mbit/s or higher. For a supported cluster setup two or more redundant communication paths are required. This can be done via:

- Network Device Bonding (preferred).
- A second communication channel in Corosync.

Node fencing/STONITH

A node fencing (STONITH) device to avoid split-brain scenarios. This can be either a physical device (a power switch) or a mechanism like SBD (STONITH by disk) in combination with a watchdog. SBD can be used either with shared storage or in diskless mode. This document describes using SBD with shared storage. The following requirements must be met:

- A shared storage device. For information on setting up shared storage, see [Storage Administration Guide for SUSE Linux Enterprise Server \(https://documentation.suse.com/sles/html/SLES-all/book-storage.html\)](https://documentation.suse.com/sles/html/SLES-all/book-storage.html) . If you only need basic shared storage for testing purposes, see [Appendix A, Basic iSCSI Storage for SBD](#).
- The path to the shared storage device must be persistent and consistent across all nodes in the cluster. Use stable device names such as `/dev/disk/by-id/dm-uuid-part1-mpath-abcdef12345`.
- The SBD device *must not* use host-based RAID, LVM, or DRBD*.

For more information on STONITH, see *Book "Administration Guide", Chapter 12 "Fencing and STONITH"*. For more information on SBD, see *Book "Administration Guide", Chapter 13 "Storage Protection and SBD"*.

2.2 Software Requirements

All nodes that will be part of the cluster need at least the following modules and extensions:

- Base System Module 15 SP2
- Server Applications Module 15 SP2
- SUSE Linux Enterprise High Availability 15 SP2

2.3 Other Requirements and Recommendations

Time Synchronization

Cluster nodes must synchronize to an NTP server outside the cluster. Since SUSE Linux Enterprise High Availability 15, chrony is the default implementation of NTP. For more information, see the [Administration Guide for SUSE Linux Enterprise Server 15 SP2 \(https://documentation.suse.com/sles/15-SP2/html/SLES-all/cha-ntp.html\)](https://documentation.suse.com/sles/15-SP2/html/SLES-all/cha-ntp.html) ↗.

The cluster might not work properly if the nodes are not synchronized, or even if they are synchronized but have different timezones configured. In addition, log files and cluster reports are very hard to analyze without synchronization. If you use the bootstrap scripts, you will be warned if NTP is not configured yet.

Host Name and IP Address

- Use static IP addresses.
- Only the primary IP address is supported.
- List all cluster nodes in the `/etc/hosts` file with their fully qualified host name and short host name. It is essential that members of the cluster can find each other by name. If the names are not available, internal cluster communication will fail.

SSH

All cluster nodes must be able to access each other via SSH. Tools like `crm report` (for troubleshooting) and Hawk2's *History Explorer* require passwordless SSH access between the nodes, otherwise they can only collect data from the current node.

If you use the bootstrap scripts for setting up the cluster, the SSH keys will automatically be created and copied.

3 Overview of the Bootstrap Scripts

All commands from the `ha-cluster-bootstrap` package execute bootstrap scripts that require only a minimum of time and manual intervention.

- With `ha-cluster-init`, define the basic parameters needed for cluster communication. This leaves you with a running one-node cluster.
- With `ha-cluster-join`, add more nodes to your cluster.
- With `ha-cluster-remove`, remove nodes from your cluster.

The options set by the bootstrap scripts might not be the same as the Pacemaker default settings. You can check which settings the bootstrap scripts changed in `/var/log/ha-cluster-bootstrap.log`. Any options set during the bootstrap process can be modified later with the YaST cluster module. See *Book "Administration Guide", Chapter 4 "Using the YaST Cluster Module"* for details. Each script comes with a man page covering the range of functions, the script's options, and an overview of the files the script can create and modify.

The bootstrap script `ha-cluster-init` checks and configures the following components:

NTP

Checks if NTP is configured to start at boot time. If not, a message appears.

SSH

Creates SSH keys for passwordless login between cluster nodes.

Csync2

Configures Csync2 to replicate configuration files across all nodes in a cluster.

Corosync

Configures the cluster communication system.

SBD/Watchdog

Checks if a watchdog exists and asks you whether to configure SBD as node fencing mechanism.

Virtual Floating IP

Asks you whether to configure a virtual IP address for cluster administration with Hawk2.

Firewall

Opens the ports in the firewall that are needed for cluster communication.

Cluster Name

Defines a name for the cluster, by default `hacluster`. This is optional and mostly useful for Geo clusters. Usually, the cluster name reflects the geographical location and makes it easier to distinguish a site inside a Geo cluster.

QDevice/QNetd

Asks you whether to configure QDevice/QNetd to participate in quorum decisions. We recommend using QDevice and QNetd for clusters with an even number of nodes, and especially for two-node clusters.

This configuration is not covered here, but you can set it up later as described in *Book "Administration Guide", Chapter 14 "QDevice and QNetd"*.

4 Installing the High Availability Packages

The packages for configuring and managing a cluster are included in the High Availability installation pattern. This pattern is only available after the SUSE Linux Enterprise High Availability is installed.

You can register to the SUSE Customer Center and install SUSE Linux Enterprise High Availability while installing SUSE Linux Enterprise Server, or after installation. For more information, see the [Deployment Guide \(https://documentation.suse.com/sles/html/SLES-all/cha-register-sle.html\)](https://documentation.suse.com/sles/html/SLES-all/cha-register-sle.html) for SUSE Linux Enterprise Server.

PROCEDURE 1: INSTALLING THE HIGH AVAILABILITY PATTERN

1. Install the High Availability pattern from the command line:

```
# zypper install -t pattern ha_sles
```

2. Install the High Availability pattern on *all* machines that will be part of your cluster.



Note: Installing software packages on all nodes

For an automated installation of SUSE Linux Enterprise Server 15 SP2 and SUSE Linux Enterprise High Availability 15 SP2, use AutoYaST to clone existing nodes. For more information, see *Book “Administration Guide”, Chapter 3 “Installing SUSE Linux Enterprise High Availability”, Section 3.2 “Mass Installation and Deployment with AutoYaST”*.

5 Using SBD for Node Fencing

Before you can configure SBD with the bootstrap script, you must enable a watchdog on each node. SUSE Linux Enterprise Server ships with several kernel modules that provide hardware-specific watchdog drivers. SUSE Linux Enterprise High Availability uses the SBD daemon as the software component that “feeds” the watchdog.

The following procedure uses the softdog watchdog.



Important: Softdog Limitations

The softdog driver assumes that at least one CPU is still running. If all CPUs are stuck, the code in the softdog driver that should reboot the system will never be executed. In contrast, hardware watchdogs keep working even if all CPUs are stuck.

Before using the cluster in a production environment, we highly recommend replacing the `softdog` module with the hardware module that best fits your hardware.

However, if no watchdog matches your hardware, `softdog` can be used as kernel watchdog module.

PROCEDURE 2: ENABLING THE SOFTDOG WATCHDOG FOR SBD

1. On each node, enable the softdog watchdog:

```
# echo softdog > /etc/modules-load.d/watchdog.conf
# systemctl restart systemd-modules-load
```

2. Test if the softdog module is loaded correctly:

```
# lsmod | grep dog
softdog          16384  1
```

6 Setting Up the First Node

Set up the first node with the `ha-cluster-init` script. This requires only a minimum of time and manual intervention.

PROCEDURE 3: SETTING UP THE FIRST NODE (alice) WITH `ha-cluster-init`

1. Log in as `root` to the physical or virtual machine to use as cluster node.
2. Start the bootstrap script:

```
# ha-cluster-init --name CLUSTERNAME
```

Replace the `CLUSTERNAME` placeholder with a meaningful name, like the geographical location of your cluster (for example, `amsterdam`). This is especially helpful to create a Geo cluster later on, as it simplifies the identification of a site.

If you need to use multicast instead of unicast (the default) for your cluster communication, use the option `--multicast` (or `-U`).

The script checks for NTP configuration and a hardware watchdog service. It generates the public and private SSH keys used for SSH access and Csync2 synchronization and starts the respective services.

3. Configure the cluster communication layer (Corosync):
 - a. Enter a network address to bind to. By default, the script will propose the network address of `eth0`. Alternatively, enter a different network address, for example the address of `bond0`.
 - b. Accept the proposed port (`5405`) or enter a different one.
4. Set up SBD as the node fencing mechanism:
 - a. Confirm with `y` that you want to use SBD.
 - b. Enter a persistent path to the partition of your block device that you want to use for SBD. The path must be consistent across all nodes in the cluster.
The script creates a small partition on the device to be used for SBD.
5. Configure a virtual IP address for cluster administration with Hawk2:
 - a. Confirm with `y` that you want to configure a virtual IP address.
 - b. Enter an unused IP address that you want to use as administration IP for Hawk2:
`192.168.2.1`
Instead of logging in to an individual cluster node with Hawk2, you can connect to the virtual IP address.
6. Choose whether to configure QDevice and QNetd. For the minimal setup described in this document, decline with `n` for now. You can set up QDevice and QNetd later, as described in Book “Administration Guide”, Chapter 14 “QDevice and QNetd”.

Finally, the script will start the cluster services to bring the cluster online and enable Hawk2. The URL to use for Hawk2 is displayed on the screen.

You now have a running one-node cluster. To view its status, proceed as follows:

PROCEDURE 4: LOGGING IN TO THE HAWK2 WEB INTERFACE

1. On any machine, start a Web browser and make sure that JavaScript and cookies are enabled.
2. As URL, enter the virtual IP address that you configured with the bootstrap script:

```
https://192.168.2.1:7630/
```



Note: Certificate Warning

If a certificate warning appears when you try to access the URL for the first time, a self-signed certificate is in use. Self-signed certificates are not considered trustworthy by default.

Ask your cluster operator for the certificate details to verify the certificate.

To proceed anyway, you can add an exception in the browser to bypass the warning.

3. On the Hawk2 login screen, enter the *Username* and *Password* of the user that was created by the bootstrap script (user `hacluster`, password `linux`).



Important: Secure Password

Replace the default password with a secure one as soon as possible:

```
# passwd hacluster
```

4. Click *Log In*. The Hawk2 Web interface shows the Status screen by default:

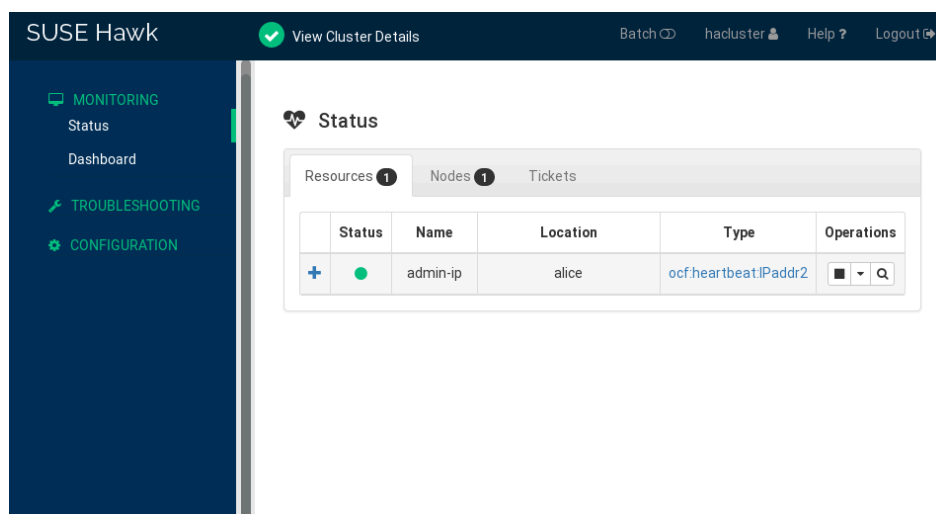


FIGURE 1: STATUS OF THE ONE-NODE CLUSTER IN HAWK2

7 Adding the Second Node

Add a second node to the cluster with the `ha-cluster-join` bootstrap script. The script only needs access to an existing cluster node and will complete the basic setup on the current machine automatically.

For more information, see the `ha-cluster-join` man page.

PROCEDURE 5: ADDING THE SECOND NODE (bob) WITH `ha-cluster-join`

1. Log in as `root` to the physical or virtual machine you want to add to the cluster.
2. Start the bootstrap script:

```
# ha-cluster-join
```

If NTP has not been configured to start at boot time, a message appears. The script also checks for a hardware watchdog device. You are warned if none is present.

3. If you decide to continue anyway, you will be prompted for the IP address of an existing node. Enter the IP address of the first node (`alice`, `192.168.1.1`).
4. If you have not already configured passwordless SSH access between both machines, you will be prompted for the `root` password of the existing node.
After logging in to the specified node, the script will copy the Corosync configuration, configure SSH and Csync2, bring the current machine online as new cluster node, and start the service needed for Hawk2.

Check the cluster status in Hawk2. Under *Status* > *Nodes* you should see two nodes with a green status:

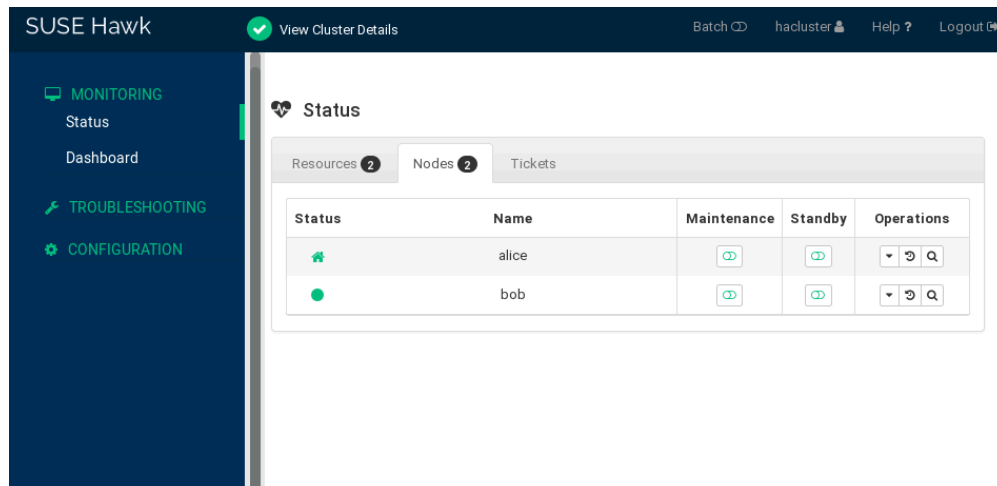


FIGURE 2: STATUS OF THE TWO-NODE CLUSTER

8 Testing the Cluster

The following tests can help you identify issues with the cluster setup. However, a realistic test involves specific use cases and scenarios. Before using the cluster in a production environment, test it thoroughly according to your use cases.

- The command **`sbd -d DEVICE_NAME list`** lists all of the nodes that are visible to SBD. For the setup described in this document, the output should show both alice and bob.
- [Section 8.1, “Testing Resource Failover”](#) is a simple test to check if the cluster moves the virtual IP address to the other node if the node that currently runs the resource is set to standby.
- [Section 8.2, “Testing with the `crm cluster crash_test` command”](#) simulates cluster failures and reports the results.

8.1 Testing Resource Failover

As a quick test, the following procedure checks on resource failovers:

PROCEDURE 6: TESTING RESOURCE FAILOVER

1. Open a terminal and ping `192.168.2.1`, your virtual IP address:

```
# ping 192.168.2.1
```

2. Log in to Hawk2.
3. Under *Status > Resources*, check which node the virtual IP address (resource `admin_addr`) is running on. This procedure assumes the resource is running on `alice`.
4. Put `alice` into *Standby* mode:

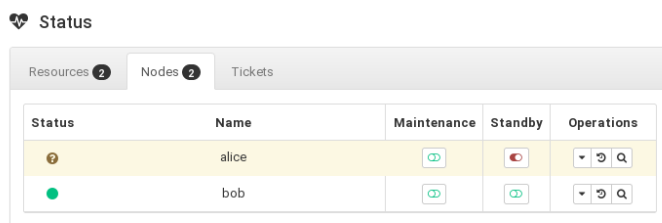


FIGURE 3: NODE `alice` IN STANDBY MODE

5. Click *Status > Resources*. The resource `admin_addr` has been migrated to `bob`.

During the migration, you should see an uninterrupted flow of pings to the virtual IP address. This shows that the cluster setup and the floating IP work correctly. Cancel the `ping` command with `Ctrl-C`.

8.2 Testing with the `crm cluster crash_test` command

The command `crm cluster crash_test` triggers cluster failures to find problems. Before you use your cluster in production, it is recommended to use this command to make sure everything works as expected.

The command supports the following checks:

`--split-brain-iptables`

Simulates a split-brain scenario by blocking the Corosync port. Checks whether one node can be fenced as expected.

--kill-sbd / --kill-corosync / --kill-pacemakerd

Kills the daemons for SBD, Corosync, and Pacemaker. After running one of these tests, you can find a report in the directory /var/lib/krmsh/crash_test/. The report includes a test case description, action logging, and an explanation of possible results.

--fence-node NODE

Fences a specific node passed from the command line.

For more information, see crm cluster crash_test --help.

EXAMPLE 1: TESTING THE CLUSTER: NODE FENCING

```
# crm_mon -l
Stack: corosync
Current DC: alice (version ...) - partition with quorum
Last updated: Fri Mar 03 14:40:21 2020
Last change: Fri Mar 03 14:35:07 2020 by root via cibadmin on alice

2 nodes configured
1 resource configured

Online: [ alice bob ]
Active resources:

    stonith-sbd    (stonith:external/sbd): Started alice

# crm cluster crash_test --fence-node bob

=====
Testcase:          Fence node bob
Fence action:      reboot
Fence timeout:     60

!!! WARNING WARNING WARNING !!!
THIS CASE MAY LEAD TO NODE BE FENCED.
TYPE Yes TO CONTINUE, OTHER INPUTS WILL CANCEL THIS CASE [Yes/No](No): Yes
INFO: Trying to fence node "bob"
INFO: Waiting 60s for node "bob" reboot...
INFO: Node "bob" will be fenced by "alice"!
INFO: Node "bob" was successfully fenced by "alice"
```

To watch bob change status during the test, log in to Hawk2 and navigate to *Status > Nodes*.

9 Next Steps

The bootstrap scripts provide a quick way to set up a basic High Availability cluster that can be used for testing purposes. However, to expand this cluster into a functioning High Availability cluster that can be used in production environments, more steps are recommended.

RECOMMENDED STEPS TO COMPLETE THE HIGH AVAILABILITY CLUSTER SETUP

Adding more nodes

Add more nodes to the cluster using one of the following methods:

- For individual nodes, use the `crm cluster join` script as described in [Section 7, “Adding the Second Node”](#).
- For mass installation of multiple nodes, use AutoYaST as described in *Book “Administration Guide”, Chapter 3 “Installing SUSE Linux Enterprise High Availability”, Section 3.2 “Mass Installation and Deployment with AutoYaST”*.

A regular cluster can contain up to 32 nodes. With the `pacemaker_remote` service, High Availability clusters can be extended to include additional nodes beyond this limit. See *Article “Pacemaker Remote Quick Start”* for more details.



Configuring QDevice

If the cluster has an even number of nodes, configure QDevice and QNetd to participate in quorum decisions. QDevice provides a configurable number of votes, allowing a cluster to sustain more node failures than the standard quorum rules allow. For details, see *Book “Administration Guide”, Chapter 14 “QDevice and QNetd”*.

Enabling a hardware watchdog

Before using the cluster in a production environment, replace the `softdog` module with the hardware module that best fits your hardware. For details, see *Book “Administration Guide”, Chapter 13 “Storage Protection and SBD”, Section 13.6 “Setting Up the Watchdog”*.

10 For More Information

More documentation for this product is available at <https://documentation.suse.com/sle-ha/15-SP2> . For further configuration and administration tasks, see the comprehensive [Administration Guide](https://documentation.suse.com/sle-ha/15-SP2/html/SLE-HA-all/book-sleha-guide.html) (<https://documentation.suse.com/sle-ha/15-SP2/html/SLE-HA-all/book-sleha-guide.html>) .

A Basic iSCSI Storage for SBD

REQUIREMENTS

- A SUSE Linux Enterprise Server virtual machine to act as the iSCSI target. This VM is not part of the cluster.
- Two virtual storage devices on the VM: a 20 GB device for the system, and a 1 GB device for SBD.
- Two SUSE Linux Enterprise Server nodes that have not been added to a High Availability cluster yet.

First, set up an iSCSI target on the virtual machine:

PROCEDURE A..1: CONFIGURING AN ISCSI TARGET

1. Install the package `yast2-iscsi-lio-server`:

```
# zypper install yast2-iscsi-lio-server
```

2. Start the `iscsi-lio-server` module in YaST:

```
# yast2 iscsi-lio-server
```

3. In the *Service* tab, under *After reboot*, select *Start on boot*.
4. Activate *Open Port in Firewall*.
5. In the *Global* tab, activate *Discovery Authentication*.
6. Under *Authentication by Targets*, enter a *Username* and *Password*.
7. Under *Authentication by Initiators*, enter a *Mutual Username* and *Mutual Password*. This password must be different from the *Authentication by Targets* password.
8. In the *Targets* tab, select *Add*.
9. Change the *Target* name by replacing `.com.example.`.
10. The *IP Address* of this server should be filled automatically. If not, add the IP address now.
11. Select *Add*.
12. In the *LUN Details* window, enter the *LUN Path* to the 1 GB storage device (for example, `/dev/vbd`).

13. Select *Ok*.
14. Select *Next*.
15. Select *Finish* to close YaST.
16. To check the target setup, switch to the target CLI:

```
# targetcli
```

Show the configuration:

```
/> ls
```

Next, set up iSCSI initiators on the nodes. Repeat this procedure on both nodes:

PROCEDURE A..2: CONFIGURING AN ISCSI INITIATOR

1. Install the required packages:

```
# zypper install open-iscsi yast2-iscsi-client
```

2. Start the `iscsid` service:

```
# systemctl start iscsid
```

3. Open the `iscsi-client` module in YaST:

```
# yast2 iscsi-client
```

4. In the *Discovered Targets* tab, select *Discovery*.
5. Enter the IP address of the iSCSI target.
6. Clear *No Discovery Authentication*.
7. Under *Authentication by Initiator*, enter the initiator *Username* and *Password*.
8. Under *Authentication by Targets*, enter the target *Username* and *Password*.
9. Select *Next*.
10. After YaST discovers the iSCSI target, select *Connect*.
11. Under *Startup*, select *onboot*.
12. Select *Next*.

13. Select *Ok* to close YaST.

14. Check the iSCSI initiator:

```
# ls SCSI
[0:0:1:0] cd/dvd QEMU QEMU DVD-ROM 2.5+ /dev/sr0
[2:0:0:0] disk LIO-ORG IBLOCK 4.0 /dev/sda
```

Look for a line with IBLOCK. In this example, the iSCSI device is /dev/sda.

15. Check the status of the iscsid service:

```
# systemctl status iscsid
```

You can find the stable device name in /dev/disk/by-id/. Usually, an iSCSI device starts with scsi-SLIO-ORG_IBLOCK.

If you have multiple disks, you can run the command **lsblk -o name,serial** to confirm which stable device name corresponds to which short name (for example, /dev/sda).

When you configure the cluster, specify the stable device name using one of these methods:

- When you run **crm cluster init**, enter the stable device name when prompted.
- Before running **crm cluster init**, add the stable device name to /etc/sysconfig/sbd:

```
SBD_DEVICE=/dev/disk/by-id/scsi-SLIO-ORG_IBLOCK_DEVICE_ID_STRING
```

When you run **crm cluster init**, answer n for this question:

```
SBD is already configured to use /dev/disk/by-id/scsi-SLIO-ORG_IBLOCK_... -
overwrite (y/n)?
```

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