SUSE Linux Enterprise High Availability 12 SP5

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 fencing mechanism.

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Contents

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 (`192.168.1.1`) which allows clients to connect to the service no matter which physical node it is running on.
- 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).

After setup of the cluster with the bootstrap scripts, we will monitor the cluster with the graphical HA Web Console (Hawk), one of the cluster management tools included with SUSE® Linux Enterprise High Availability. As a basic test of whether failover of resources works, we will put one of the nodes into standby mode and check if the virtual IP address is migrated to the second node.

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, modify it according to your requirements.

2 System Requirements

This section informs you about the key system requirements for the scenario described in *Section 1, "Usage Scenario"*. If you want to adjust the cluster for use in a production environment, read the full list of *System Requirements and Recommendations* in *Book "Administration Guide", Chapter 2 "System Requirements and Recommendations"*.

HARDWARE REQUIREMENTS

Servers

Two servers with software as specified in *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 (to be preferred).
- A second communication channel in Corosync.
- Network fault tolerance on infrastructure layer (for example, hypervisor).

Node Fencing/STONITH

To avoid a “split brain” scenario, clusters need a node fencing mechanism. In a split brain scenario, cluster nodes are divided into two or more groups that do not know about each other (because of a hardware or software failure or because of a cut network connection). A fencing mechanism isolates the node in question (usually by resetting or powering off the node). This is also called STONITH (“Shoot the other node in the head”). A node fencing mechanism can be either a physical device (a power switch) or a mechanism like SBD (STONITH by disk) in combination with a watchdog. Using SBD requires shared storage.

On all nodes that will be part of the cluster the following software must be installed:

SOFTWARE REQUIREMENTS

- SUSE® Linux Enterprise Server 12 SP5 (with all available online updates)
- SUSE Linux Enterprise High Availability 12 SP5 (with all available online updates)

OTHER REQUIREMENTS AND RECOMMENDATIONS

Time Synchronization

Cluster nodes must synchronize to an NTP server outside the cluster. For more information, see https://documentation.suse.com/sles-12/html/SLES-all/cha-netz-xntp.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.
- 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.

All bootstrap scripts log to `/var/log/ha-cluster-bootstrap.log`. Check this file for any details of the bootstrap process. Any options set during the bootstrap process can be modified later with the YaST cluster module. See *Book "Administration Guide", Chapter 3 "Installing SUSE Linux Enterprise High Availability", Section 3.1 "Manual Installation"* 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

If NTP has not been configured to start at boot time, a message appears.

SSH

It creates SSH keys for passwordless login between cluster nodes.

Csync2

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

Corosync

It configures the cluster communication system.

SBD/Watchdog

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

Virtual Floating IP

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

Firewall

It opens the ports in the firewall that are needed for cluster communication.

Cluster Name

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

4 Installing SUSE Linux Enterprise Server and High Availability Extension

The packages for configuring and managing a cluster with SUSE Linux Enterprise High Availability are included in the `High Availability` installation pattern. This pattern is only available after SUSE Linux Enterprise High Availability has been installed as an extension to SUSE® Linux Enterprise Server.

For information on how to install extensions, see the Deployment Guide for SUSE Linux Enterprise Server 12 SP5 (https://documentation.suse.com/sles-12/html/SLES-all/cha-add-ons.html).

If the pattern is not installed yet, install it with the command **`zypper install -t pattern ha_sles`**. Alternatively, install the pattern with YaST. Proceed as follows:

PROCEDURE 1: INSTALLING THE HIGH AVAILABILITY PATTERN

1. Start YaST and select *Software* › *Software Management*.
2. Click the *Patterns* tab and activate the *High Availability* pattern in the pattern list.

3. Click *Accept* to start installing the packages.

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

   ### Note: Installing Software Packages on All Parties

   For an automated installation of SUSE Linux Enterprise Server 12 SP5 and SUSE Linux Enterprise High Availability 12 SP5, 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. Register the machines at SUSE Customer Center. Find more information in the Upgrade Guide for SUSE Linux Enterprise Server 12 SP5 (https://documentation.suse.com/sles-12/html/SLES-all/cha-update-offline.html#sec-update-registersystem).

5 Using SBD as Fencing Mechanism

If you have shared storage, for example, a SAN (Storage Area Network), you can use it to avoid split brain scenarios by configuring SBD as node fencing mechanism. SBD uses watchdog support and the `external/sbd` STONITH resource agent.

5.1 Requirements for SBD

During setup of the first node with **`ha-cluster-init`**, you can decide whether to use SBD. If yes, you need to enter the path to the shared storage device. By default, **`ha-cluster-init`** will automatically create a small partition on the device to be used for SBD.

To use SBD, the following requirements must be met:

- 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-abcedf12345`.
- The SBD device *must not* use host-based RAID, cLVM2, nor reside on a DRBD* instance.

For details of how to set up shared storage, refer to the Storage Administration Guide for SUSE Linux Enterprise Server 12 SP5 (https://documentation.suse.com/sles-12/html/SLES-all/stor-admin.html).

5.2 Setting Up Softdog Watchdog and SBD

In SUSE Linux Enterprise Server, watchdog support in the kernel is enabled by default: It 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, it is highly recommended to replace the `softdog` module with the respective hardware module that best fits your hardware.

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

1. Create a persistent, shared storage as described in *Section 5.1, "Requirements for SBD"*.
2. Enable the softdog watchdog:

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

3. Test if the softdog module is loaded correctly:

   ```
   # lsmod | egrep "(wd|dog)"
   softdog                16384  1
   ```

4. On `bob`, initialize the SBD partition:

   ```
   # sbd -d /dev/SBDDEVICE create
   ```

5. Start SBD to listen on the SBD device:

   ```
   # sbd -d /dev/SBDDEVICE watch
   ```

6. On `alice`, send a test message:

   ```
   # sbd -d /dev/SBDDEVICE message bob test
   ```

7. On `bob`, check the status with **`systemctl`** and you should see the received message:

```
# systemctl status sbd
[...]
info: Received command test from alice on disk SBDDEVICE
```

8. Stop watching the SBD device on `bob` with:

```
# systemctl stop sbd
```

Testing the SBD fencing mechanism for proper function in case of a split brain situation is highly recommended. Such a test can be done by blocking the Corosync cluster communication.

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 2: SETTING UP THE FIRST NODE (`alice`) WITH **`ha-cluster-init`**

1. Log in as `root` to the physical or virtual machine you want to use as cluster node.

2. Start the bootstrap script by executing:

```
# 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 if you want to create a Geo cluster later on, as it simplifies the identification of a site. If you run the command without the `--name` option, the default name is `hacluster`.
If you need unicast instead of multicast (the default) for your cluster communication, use the option `-u`. After installation, find the value `udpu` in the file `/etc/corosync/corosync.conf`. If **`ha-cluster-init`** detects a node running on Amazon Web Services (AWS), the script will use unicast automatically as default for cluster communication.
The scripts 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. Enter a multicast address. The script proposes a random address that you can use as default. Of course, your particular network needs to support this multicast address.

   c. Enter a multicast port. The script proposes `5405` as default.

4. Finally, the script will start the Pacemaker service to bring the one-node cluster online and enable Hawk2. The URL to use for Hawk2 is displayed on the screen.

5. Set up SBD as 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, see *Section 5, "Using SBD as Fencing Mechanism"*. The path must be consistent across all nodes in the cluster.

6. Configure a virtual IP address for cluster administration with Hawk2. (We will use this virtual IP resource for testing successful failover later on).

   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: `192.168.1.1`
   Instead of logging in to an individual cluster node with Hawk2, you can connect to the virtual IP address.

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

PROCEDURE 3: 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 IP address or host name of any cluster node running the Hawk Web service. Alternatively, enter the address of the virtual IP address that you configured in *Step 6* of *Procedure 2, “Setting Up the First Node (`alice`) with* **`ha-cluster-init`**”:

```
https://HAWKSERVER: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 has been created during the bootstrap procedure (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*. After login, the Hawk2 Web interface shows the Status screen by default, displaying the current cluster status at a glance:

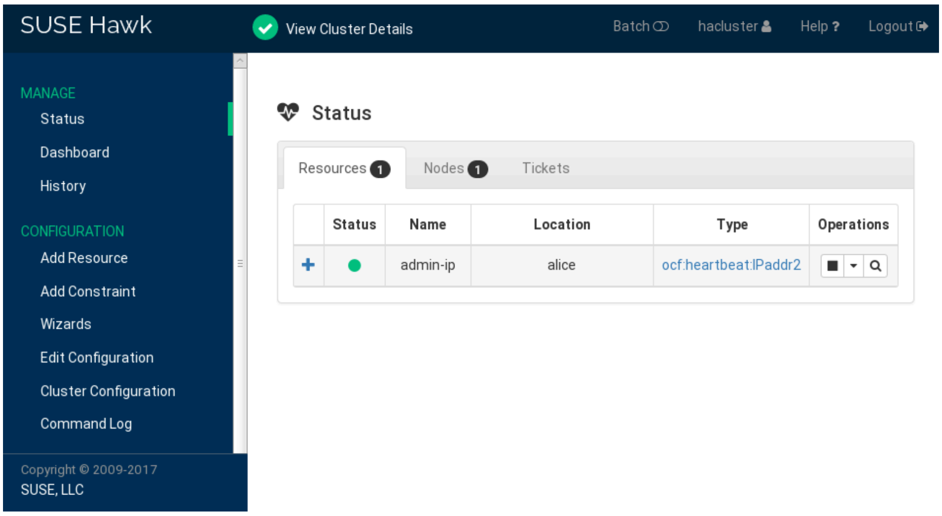

FIGURE 1: STATUS OF THE ONE-NODE CLUSTER IN HAWK2

7 Adding the Second Node

If you have a one-node cluster up and running, add the second cluster node with the `ha-cluster-join` bootstrap script, as described in *Procedure 4*. The script only needs access to an existing cluster node and will complete the basic setup on the current machine automatically. For details, refer to the `ha-cluster-join` man page.

The bootstrap scripts take care of changing the configuration specific to a two-node cluster, for example, SBD and Corosync.

PROCEDURE 4: ADDING THE SECOND NODE (bob) WITH `ha-cluster-join`

1. Log in as `root` to the physical or virtual machine supposed to join the cluster.

2. Start the bootstrap script by executing:

```
# 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 (which is important in case you want to configure SBD) and warns you 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 a passwordless SSH access between both machines, you will also 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, and will bring the current machine online as new cluster node. Apart from that, it will start the service needed for Hawk2.

Check the cluster status in Hawk2. Under *Status* › *Nodes* you should see two nodes with a green status (see *Figure 2, "Status of the Two-Node Cluster"*).

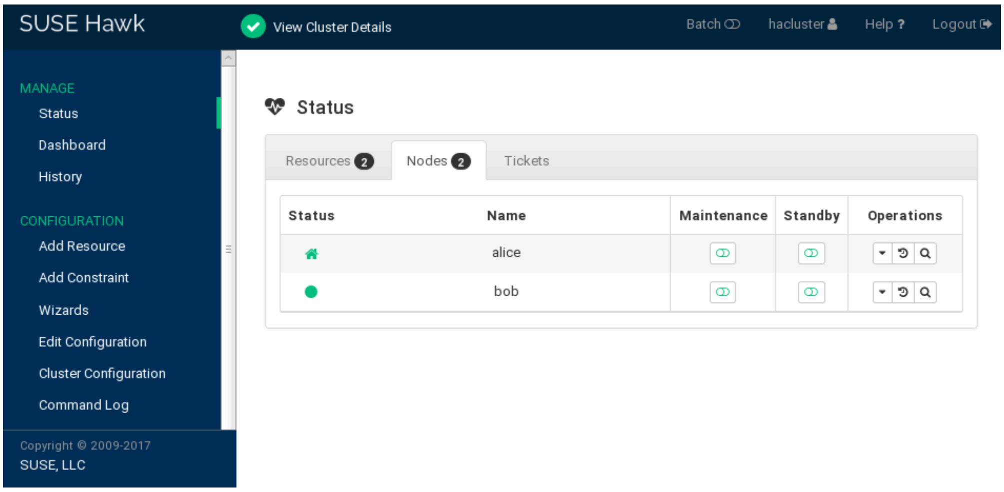

FIGURE 2: STATUS OF THE TWO-NODE CLUSTER

8 Testing the Cluster

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`.

However, a realistic test involves specific use cases and scenarios, including testing of your fencing mechanism to avoid a split brain situation. If you have not set up your fencing mechanism correctly, the cluster will not work properly.

Before using the cluster in a production environment, test it thoroughly according to your use cases or by using the **`crm cluster crash_test`** command.

8.1 Testing Resource Failover

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

PROCEDURE 5: TESTING RESOURCE FAILOVER

1. Open a terminal and ping `192.168.1.1`, your virtual IP address:

```
# ping 192.168.1.1
```

2. Log in to your cluster as described in *Procedure 3, “Logging In to the Hawk2 Web Interface”*.

3. In Hawk2 *Status* › *Resources*, check which node the virtual IP address (resource `admin_addr`) is running on. We assume the resource is running on `alice`.

4. Put `alice` into *Standby* mode (see *Figure 3, “Node `alice` in Standby Mode”*).

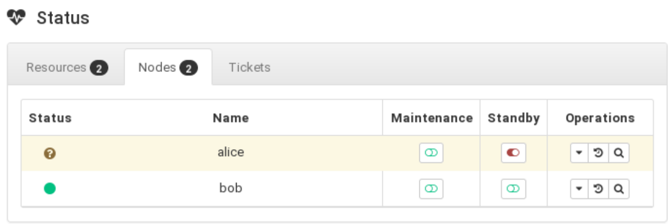

FIGURE 3: NODE `alice` IN STANDBY MODE

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/crmsh/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 -1
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 For More Information

Find more documentation for this product at https://documentation.suse.com/sle-ha-12. The documentation also includes a comprehensive *Administration Guide* for SUSE Linux Enterprise High Availability. Refer to it for further configuration and administration tasks.

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